

# SOAP 54<sup>th</sup> ANNUAL MEETING

**Maternal and Neonatal  
Healthcare Inequities:**  
How We Can Do Better  
for Our Patients

**May 11-15, 2022**  
Hilton Chicago Hotel  
Chicago, Illinois

## SYLLABUS



American Society of  
**Anesthesiologists**<sup>™</sup>

**SOAP**   
*Society for Obstetric  
Anesthesia and Perinatology*

Jointly provided by the  
American Society of  
Anesthesiologists and the  
Society for Obstetric Anesthesia  
and Perinatology



## SYLLABUS

### SOAP 54<sup>th</sup> Annual Meeting

*Maternal and Neonatal Healthcare Inequities:  
How We Can Do Better for Our Patients*

---

Welcome .....	3
Planning Committees .....	4
Faculty .....	5
Program Information.....	17
Session Descriptions .....	20
Program Agenda .....	23
Speaker Disclosures .....	49
Program Materials .....	50

### Click to Go!

Wednesday, May 11

Thursday, May 12

Friday, May 13

Saturday, May 14

Sunday, May 15

# Welcome!

On behalf of the SOAP Board of Directors and the 2021-2022 Annual Meeting and Live Events Committee, we are delighted to see you in Chicago for the SOAP 54th Annual Meeting.

The meeting theme is “Maternal and Neonatal Healthcare Inequities: How We Can Do Better for our Patients.” We are thrilled to feature themed lectures and panels to explore this topic.

Pre-meeting workshops resume this year on Wednesday, May 11, and feature hands-on sessions, including an all-day Point of Care Ultrasound course, a workshop featuring guidance on communicating more effectively and equitably with obstetric patients, and a workshop on using technology to enhance education for our learners. Please join us Wednesday night at the Hilton Chicago for our opening reception where we are excited to reunite our community.

On Thursday, May 12, we open our meeting with a special address by Dr. Ann Borders, a Maternal Fetal Medicine Specialist, who will provide insights on how to implement actions to address disparities in maternal health and improve maternal outcomes. This will be followed by a themed panel where experts will discuss maternal mortality with data from both the United Kingdom and local maternal mortality review committees as well as the implicit bias that may contribute to disparities in care. The best research of the meeting will be highlighted in the **Best Paper Competition**. Finally, Dr. William Grobman will be featured in our **Society for Maternal-Fetal Medicine Session, “What’s New in Obstetrics?”** elucidating targets for creating equitable care for our patients.

The beloved **Gertie Marx Research Competition** will take the main stage on Friday, May 13, followed by oral research presentations and the annual **Fred Hehre Lecture**, given by honoree Dr. Robert Gaiser. Following these sessions, we will begin our **Sol Shnider Clinical Track**, which features high yield and relevant reviews of clinical topics, including point of care ultrasound for the parturient, preeclampsia, post-dural puncture headache, and common cardiac disorders on the labor and delivery floor.

Saturday, May 14, is packed with amazing sessions including a continuation of the **Sol Shnider Clinical Track** with information about care for patients with substance use disorder, how to improve diversity and inclusion in the workplace, postpartum hemorrhage update, and obesity in the parturient. This year, the beloved and engaging **Best Case Reports Session** is led by Dr. Emily Sharpe, with

distinguished panelists Drs. Katie Arendt, Brenda Bucklin, and Richard Wissler. **The SOAP Mentoring Academy** “couch session,” led by Drs. Feyce Peralta and Grace Shih, will be hosted during the lunch hour. We invite you to grab some food on your own and head to this informational gathering to network with peers and see how SOAP Mentors can help you achieve your career goals. Following lunch, Dr. Randall Clark, President of the American Society of Anesthesiologists, will provide us an update on the work of the ASA. Dr. Michaela Farber will be the featured speaker of the day, presenting the annual memorial **Gerard W. Ostheimer Lecture**, which examines the most meaningful and impactful research from 2021. The general session will conclude with the presentation of the **Distinguished Service Award** and honoring our other yearly award recipients, including the winners of the Gertie Marx and Best Paper Competitions, Teacher of the Year Awards, Research in Education, Frederick P. Zuspan Award, Patient Safety Award, and the Diversity and Inclusivity Award. Following these presentations, we invite our newly formed **Special Interest Groups (SIGs)** to meet in the expo hall. This is a perfect time for interested attendees to engage with these groups. Afterwards, please come and support our fellow and resident members as they discuss the challenging cases they encountered this year in the **Fellow and Resident Case Presentation Session**.

We end our meeting Sunday, May 15, with a collaborative **panel with the American Society of Regional Anesthesia** focusing on how to address pain in all parturients, followed by the final session of the **Sol Shnider Clinical Track** considering current techniques to care for critically ill pregnant patients with placenta accrete spectrum, requiring ECMO, and how to address neurologic injury in the peripartum period.

We are so pleased you can join us for these amazing sessions and the opportunity to network with peers.

---

Sincerely,  
**Heather C. Nixon, MD**  
Chair, Annual Meeting and Live Events Committee

**Edward (Ted) Yaghmour, MD, FAFSA**  
President

# Thank You Planning Committees

## ANNUAL MEETING AND LIVE EVENTS

### Heather C. Nixon, MD

Chair, Annual Meeting and Live Events Committee

### Rebecca D. Minehart, MD, MEd

Vice Chair, Annual Meeting and Live Events Committee

### David Gambling, MB, BS, FRCPC

### Thomas T. Klumpner, MD

### Amy Lee, MD

### Pervez Sultan, MD

### Brandon Togioka, MD

*With special thanks to members of the following subcommittees who volunteered their time and expertise to the planning of the 54th Annual Meeting.*

Locations and Logistics Subcommittee  
(Chair: Samir Patel, MD)

Platforms and Technology Subcommittee (Chair: Thomas T. Klumpner, MD)

Annual Curricular Planning Subcommittee (Chair: Rebecca D. Minehart, MD, MEd)

CME Subcommittee (Chair: Robert R. Gaiser, MD, FASA)

Sponsors and Industry Subcommittee (Chair: Brandon Togioka, MD)

Inter Society Planning Subcommittee (Chair: Pervez Sultan, MD, MBChB)

## RESEARCH COMMITTEE

### Philip E. Hess, MD

Chair, Research Committee

### Cynthia A. Wong, MD

Vice Chair, Research Committee

### David Arnolds, MD

### Jake Beilin, MD

### Anthony Chau, MD

### Grace Lim, MD, MS

### Carolyn Weiniger, MD

## ABSTRACT REVIEWERS

*Special thanks are due to **Ruth Landau, MD**, chair of the Abstract Review Subcommittee, and the dedication of these volunteers who reviewed hundreds of abstracts to help in creating the educational program.*

### David Arnolds, MD

### Jake Beilin, MD

### Shobana Bharadwaj, MD

### Anthony Chau, MD

### Holly Ende, MD

### Kristen Fardelmann, MD

### Michael Froelich, MD

### Ronald B. George, MD, FRCPC

### Liliana Goelkel-Garcia, MD

### Ashraf Habib, MBBCh, MHSc, FRCA

### Ling-Qun Hu, MD

### Unyime Ituk, MD

### Bedru Jemal, MD

### Vesela Kovacheva, MD

### Fatoumata Kromah, MD

### Elizabeth Lange, MD

### Amy Lee, MD

### Lisa Leffert, MD

### Grace Lim, MD, MS

### John Markley, MD

### Jessian Munoz, MD

### Olutoyosi Ogunkua, MD

### Arvind Palanisamy, MD

### Greg Palleschi, MD

### Feyce Peralta, MD

### Erik Romanelli, MD

### Scott Segal, MD

### Yunus Shah, MD

### Emily Sharpe, MD

### Shashank Shettar, MD

### Pervez Sultan, MD

### Caitlin Sutton, MD

### Brandon Togioka, MD

### Paloma Toledo, MD, MPH

### Aliki Tympa-Grigoriadou, MD

### Rana Umair, MD

### Carolyn Weiniger, MD

### Adam Wendling, MD

### Richard Wissler, MD

### Cynthia A. Wong, MD

### Mary Yurashevich, MD

# Faculty

**Safir Abbas, BS**

University of Texas Medical Branch  
of Galveston  
Houston, Texas

**Samantha Abel, MD, MS**

Department of Anesthesiology,  
Perioperative and Pain Medicine,  
Brigham & Women's Hospital,  
Harvard Medical School  
Boston, Massachusetts

**Gillian Abir, MBChB, FRCA**

Stanford University School of  
Medicine  
Palo Alto, California

**Pedro Acevedo-Rodriguez, MD, JD**

Yale University  
San Juan, Puerto Rico

**Patrick Ahern, MD**

University of Texas Southwestern  
Dallas, Texas

**Meredith Albrecht, MD**

Medical College of Wisconsin –  
Froedtert Birth Center  
Milwaukee, Wisconsin

**Marah Alian, BS**

University of New England, College  
of Osteopathic Medicine  
Bedford, Maine

**Shirley Andrade Santos, PhD, MD,  
EDAIC, TSA**

Mount Sinai Hospital/Hospital das  
Clínicas da Universidade de São  
Paulo  
Toronto, Ontario, Canada

**Ioannis (Yanni) Angelidis, MD,  
MSPH**

University of Chicago, Pritzker  
school of Medicine, Department  
of Anesthesiology and Critical  
Care, Section of Obstetric  
Anesthesiology  
Chicago, Illinois

**Jessica Ansari, MD**

Stanford University  
Stanford, California

**Kelechi Anyaehie, MD, MPH**

UT Southwestern Medical Center  
Frisco, Texas

**Katie Arendt, MD**

Mayo Clinic  
Rochester, Minnesota

**David Arnolds, MD**

University of Michigan  
Ann Arbor, MI

**Cristian Arzola, MD**

Mount Sinai Hospital-University of  
Toronto  
Toronto, Ontario, Canada

**Muhammed Waseem Athar, MD**

University of Arkansas for Medical  
Sciences  
Little Rock, Arkansas

**Thomas Avritt, MD**

University of Kentucky  
Lexington, Kentucky

**Kate Balbi, DO**

Cedars-Sinai Medical Center  
Santa Monica, California

**Mrinalini Balki, MD**

Department of Anesthesiology  
and Pain Medicine, Mount Sinai  
Hospital, University of Toronto  
Toronto, Ontario, Canada

**Michael Balot, DO**

Mount Sinai West & Morningside  
New York, New York

**Michael Balot, DO**

Mount Sinai Hospital Icahn School  
of Medicine  
New York, New York

**Jennifer Banayan, MD**

Northwestern University  
Skokie, Illinois

**Elvera Baron, MD, PhD, FASA, FASE**

Louis Stokes Cleveland VA Medical  
Center  
Cleveland, Ohio

**Juliana Barrera Ramirez, MD, MSc**

Department of Anesthesia &  
Perioperative Medicine. Western  
University  
London, Ontario, Canada

**Brian Bateman, MD**

Stanford University  
Stanford, California

**Colin Beals-Reid, MD**

Yale University School of Medicine  
Milford, Connecticut

**Kevin Beitz, DO**

Medical College of Wisconsin  
Wauwatosa, Wisconsin

**Amnon Berger, MD, PhD**

Beth Israel Deaconess Medical  
Center  
Westwood, Massachusetts

**Terry James Biel, MD MBA**

Oregon Health & Science University  
Portland, Oregon

**Eve Bishop, MD**

Massachusetts General Hospital  
Boston, Massachusetts

**Lauren Blake, MD**

University of North Carolina at  
Chapel Hill  
Chapel Hill, North Carolina

**Carolina Blotte, MD**

Boston University Medical Center  
Boston, Massachusetts

**Ann Borders, MD, MSc, MPH**

Ian Bernard Horowitz Chair of  
Obstetrics  
Maternal Fetal Medicine,  
NorthShore University  
HealthSystem, Evanston Hospital  
Clinical Associate Professor,  
University of Chicago, Pritzker  
School of Medicine  
Executive Director and Obstetric  
Lead, Illinois Perinatal Quality  
Collaborative  
Evanston, Illinois

**Alexa Borja**

Baylor University  
Troup, Texas

**Benjamin Brakke, DO**

Mayo Clinic  
Rochester, Minnesota

**Taylor Branstool, MD**

The Ohio State University Wexner  
Medical Center  
Columbus, Ohio

**Kaitlyn Brennan, MD**

Vanderbilt University Medical  
Center  
Nashville, Tennessee

**Alexander Brown, MD**

Henry Ford Hospital  
Southfield, Michigan

**Kendra Brown, MD**

McGovern Medical School at  
UTHealth  
Houston, Texas

**Joe Bryant-Huppert, MD**

New York Presbyterian - Weill  
Cornell Medicine  
New York, New York

**Brenda Bucklin, MD**

University of Colorado School of  
Medicine  
Aurora, Colorado

**Hannah Burcham, MD**

University of Texas at  
Southwestern Medical Center  
Dallas, Texas

**Caley Butler**

Columbia University Vagelos  
College of Physicians and  
Surgeons  
Greensboro, North Carolina

**Ahmed Butt**

The University of Texas Medical  
Branch  
Galveston, Texas

**Alexander Butwick, MBBS, FRCA,  
MS**

Stanford University  
Stanford, California

**Tim Cai, MD**

Metrohealth Medical Center  
Cleveland, Ohio

**Elliott Callahan, MD**

University of California, San  
Francisco  
San Francisco, California

**Jean Marie Carabuena, MD**

Brigham and Women's Hospital  
Needham, Massachusetts

**Alexandra Carlson, BS**

Texas A&M Health Science Center  
College of Medicine  
Temple, Texas

**Brendan Carvalho, MBBCh, FRCA,  
MDCH**

Stanford University  
Stanford, California

**Jose C. Carvalho, MD, PhD**

Department of Anesthesiology  
and Pain Medicine, Mount Sinai  
Hospital, University of Toronto  
Toronto, Ontario, Canada

**Radhika Chalasani, MD**

The Ohio State University - Wexner  
Medical Center  
Delaware, Ohio

**Laurie Chalifoux, MD**

Anesthesia Practice Consultants  
Ada, Michigan

**CeCe Cheng, MD**

UT Health Science Center at San  
Antonio  
San Antonio, Texas

**Christopher Ching, MD**

Ochsner Medical Center  
New Orleans, Louisiana

**Jennifer Choi, DO**

Cleveland Clinic  
Cleveland, Ohio

**Anna Cholewa, MD**

Froedtert & The Medical College of  
Wisconsin  
West Bend, Wisconsin

**Dhruv Choudhry, MD**

Ochsner Health  
New Orleans, Louisiana

**Bhakti Chourasia, MD**

University of Florida College of  
Medicine  
Jacksonville, Florida

**Kathryn Clark, MB, BCh, BAO**

Mayo Clinic  
Rochester, Minnesota

**Randall Clark, MD, FASA**

American Society of  
Anesthesiologists  
Schaumburg, Illinois

**Lisa Corbett, MD, CPE**

Oregon Health Sciences University  
West Linn, Oregon

**Daniel Couper, Medical Student**  
Medical University of South  
Carolina  
Charleston, South Carolina

**Eve Cremers, DO**  
San Antonio Uniformed Services  
Health Education Consortium  
San Antonio, Texas

**Casey Cuccio, DO**  
UCONN Anesthesiology Residency  
Program  
Glastonbury, Connecticut

**Candice Cuppini, MD**  
The University of Chicago  
Chicago, Illinois

**Patricia Dalby, MD**  
University of Pittsburgh School of  
Medicine  
Pittsburgh, Pennsylvania

**Jaime Daly, MD**  
University of Colorado, Anschutz  
Golden, Colorado

**James Damron, MD**  
Vanderbilt University Medical  
Center  
Nashville, Tennessee

**Preshita Date, MD**  
Montefiore Medical Center  
Bronx, New York

**Kathryn Davis, MD**  
Johns Hopkins University, School  
of Medicine  
New Haven, Connecticut

**Rudolph Davis, MD, MPH**  
Stanford University  
Belmont, California

**Andrew Davis-Sandfoss, MD**  
McGaw Medical Center of  
Northwestern University  
Cincinnati, Ohio

**Sanjana Dayananda, BS**  
Department of Anesthesiology &  
Perioperative Medicine, University  
of Pittsburgh School of Medicine  
Franklin, Michigan

**Gabriela Dellapiana, MD**  
Cedars-Sinai Medical Center  
Los Angeles, California

**Erin Dengler, MD, MBA**  
University of North Carolina  
Durham, North Carolina

**Mary Dierks, MD**  
University of Chicago  
Chicago, Illinois

**Drew Michael Donnell, MD**  
The Ohio State University  
Columbus, Ohio

**Weijia Du**  
Shanghai First Maternity and Infant  
Hospital, Tongji University School  
of Medicine  
Shanghai, China

**Adam Dunmore, MD**  
University of Pittsburgh Medical  
Center  
Pittsburgh, Pennsylvania

**Ghislaine Echevarria, MD, MS**  
Mount Sinai West & Morningside  
New York, New York

**Jamal Egbaria, Resident**  
UAB Department of Anesthesiology  
Birmingham, Alabama

**Mohamed Eissa, MBBCh, MD**  
The University of Ottawa  
Ottawa, Ontario, Canada

**Nour El Hage Chehade, MD**  
Cleveland Clinic  
Cleveland, Ohio

**Omar El Masri, MD, MA, BS**  
Ochsner Health  
New Orleans, Louisiana

**Chris Elton, MD**  
University Hospital of Leicester  
Leicester, United Kingdom

**Liliane Ernst, MD**  
University of Tennessee Medical  
Center  
Knoxville, Tennessee

**Danielle Esnard, MD**  
Ochsner Medical Center  
New Orleans, Louisiana

**Morgane Factor, MD**  
Stony Brook Medicine  
Woodbury, New York

**Michaela Farber, MD, MS**  
Brigham & Women's Hospital  
Boston, Massachusetts

**Kristen Fardelmann, MD**  
Yale University  
Woodbridge, Connecticut

**Kelly Fedoruk, MD, FRCPC**  
Stanford University  
Stanford, California

**Sara Feldman, MD**  
Department of Anesthesiology,  
Duke University  
Durham, North Carolina

**Julia Fernandes Casellato, MD**  
Department of Anesthesiology  
and Pain Medicine, Mount Sinai  
Hospital, University of Toronto  
Toronto, Ontario, Canada

**Robert Ffrench O'Carroll, MBBCh  
BAO, MSc, FCAI**  
National Maternity Hospital, Dublin,  
Ireland  
Dublin, Ireland

**Cedar Fowler, MD PHD MPH**  
Stanford University  
Stanford, California

**Gabriel Fregoso, MD**

Massachusetts General Hospital-  
Anesthesia, Critical Care and Pain  
Medicine  
Boston, Massachusetts

**Nathan Fritts, MD**

Dartmouth-Hitchcock Medical  
Center  
White River Junction, Vermont

**Robert Gaiser, MD**

Yale School of Medicine  
Branford, Connecticut

**Andrew Gallagher, MD**

University of Vermont Larner  
College of Medicine  
Burlington, Vermont

**Jose Gallardo Vega, MD**

LSU HSC New Orleans  
Kenner, Louisiana

**Hilary Gallin, MD, MBA**

Massachusetts General Hospital  
Boston, Massachusetts

**Jacqueline Galvan, MD**

University of Illinois Chicago  
Chicago, Illinois

**Angelique Garay, DNAP, CRNA,  
ACNP-BC**

Yale New Haven Hospital  
Milford, Connecticut

**Ian Gaston, MD**

McGaw Medical Center of  
Northwestern University  
Chicago, Illinois

**Yen-Yen Gee, MD**

University of Chicago  
Chicago, Illinois

**Ronald George, MD, FRCPC**

University of California San  
Francisco  
San Francisco, California

**Joanna Ghobrial, DO**

UCONN Anesthesiology Residency  
Program  
New Hyde Park, New York

**Edward Gill, MBChB, MSc**

Barts Health NHS Trust  
London, England

**Andrea Girnius, MD**

University of Cincinnati  
Cincinnati, Ohio

**Lana Glantz, MD**

Maimonides Medical Center  
Brooklyn, New York

**Regine Goh, MD**

University of California, San Diego  
San Diego, California

**Ashlee Gourdine, MD**

University of Maryland School of  
Medicine  
Baltimore, Maryland

**Rachel Gray, MD**

Albany Medical Center  
Albany, New York

**Leon Grinman, DO**

Thomas Jefferson University  
Hospital  
Philadelphia, Pennsylvania

**William Grobman, MD**

The Ohio State University, Wexner  
Medical Center  
Columbus, Ohio

**David Grossman, MD**

West Jersey Anesthesia  
Associates/Virtua Hospital  
Panama City Beach, Florida

**Thomas Gruffi, MD**

Mount Sinai West & Morningside  
New York, New York

**Jean Guglielminotti, MD, PHD**

Department of Anesthesiology,  
Columbia University Vagelos  
College of Physicians and  
Surgeons  
New York, New York

**Carter Guice, MD**

Ochsner Clinic Foundation  
New Orleans, Louisiana

**David Gutman, MD, MBA**

Medical University of South  
Carolina  
Charleston, South Carolina

**Ashraf Habib, MD**

Duke University Medical Center  
Durham, North Carolina

**Kathryn Hackett, MD**

Department of Anesthesiology,  
Perioperative and Pain Medicine,  
Brigham & Women's Hospital,  
Harvard Medical School  
Boston, Massachusetts

**John Hale, MD**

Brigham and Women's Hospital  
Boston, Massachusetts

**Jakayla Harrell, MD**

Ochsner Clinic Foundation  
Kenner, Louisiana

**Michael Hart, MD**

University of North Carolina  
Holly Springs, North Carolina

**Christy Henderson, MD**

Vanderbilt University Medical  
Center  
Nashville, Tennessee

**Katherine Herbert, MD**

Medical University of South  
Carolina  
Charleston, South Carolina

**Phil Hess, MD**

Beth Israel Deaconess Medical Center  
Boston, Massachusetts

**Leigh Hickerson, MD**

Dartmouth-Hitchcock Medical Center  
Lebanon, New Hampshire

**Nicole Higgins, MD**

Northwestern University Feinberg School of Medicine  
Burr Ridge, Illinois

**Brianna Hildreth**

Department of Anesthesiology & Perioperative Medicine, University of Pittsburgh School of Medicine  
Pittsburgh, Pennsylvania

**Dorene Hinton**

Medical College of Wisconsin  
West Allis, Wisconsin

**Jennifer Hoayek, MD**

The University of Texas Health Science Center in Houston  
Houston, Texas

**Courtney Hood, MD**

SAUSHEC  
San Antonio, Texas

**Benjamin Houseman, MD, PhD, FASA**

Memorial Hospital System  
Department of Anesthesiology, Envision Physician Services  
Department of Anesthesiology  
Boca Raton, Florida

**Pamela Huang, MD**

University of California, San Francisco  
San Francisco, California

**Alexander Hunter, DO**

Geisinger Medical Center  
Danville, Pennsylvania

**Rodwan Husein, MBChB**

Barts Health and The London School of Anaesthesia  
London, United Kingdom

**Mohammed Hussain, DO**

University of Texas Medical Branch at Galveston  
Houston, Texas

**Benjamin Hyers, MD**

Icahn School of Medicine at Mount Sinai  
New York, New York

**Laura Ibidunni, MD**

Vanderbilt University Medical Center  
Nashville, Tennessee

**Mohammed Idris, MD**

Beth Israel Deaconess Medical Center  
Boston, Massachusetts

**Adem Idrizi, BS**

SUNY Downstate Health Sciences University  
Brooklyn, New York

**Unyime Ituk, MD**

University of Iowa Hospitals & Clinics  
Iowa City, Iowa

**Giselle Jaconia, MD**

New York Presbyterian - Columbia University  
Leonia, New Jersey

**Asantha Jayaweera, MB BS BSc (Hons) MRCS (Eng) FRCA**

Queen Charlotte's and Chelsea Hospital, London  
London, United Kingdom

**Rochelle Johns, MD**

HHC Lincoln  
Bronx, New York

**William Jones, MD**

Baylor College of Medicine  
Houston, Texas

**Nikhil Kamath, MD**

University of Arkansas for Medical Sciences  
Little Rock, Arkansas

**Bradley Kaminski, MD**

University of Toronto, Department of Anesthesiology and Pain Medicine  
Toronto, Ontario, Canada

**Anuradha Kanaparthi, BS**

College of Medicine, Northeast Ohio Medical University  
Dublin, Ohio

**Dan Katz, MD**

Icahn School of Medicine at Mount Sinai  
River Edge, New Jersey

**Julia Katz**

Zucker School of Medicine at Hofstra/Northwell  
Lawrence, New York

**Teshi Kaushik, MD**

Emory University  
Decatur, Georgia

**Rhiannon Kelsh-Lasher, MD**

Albany Medical Center  
Niskayuna, New York

**Eleanor Kenny, MD**

McGaw Northwestern Feinberg School of Medicine  
Chicago, Illinois

**Attila Kett, MD, MBA, FASA**

Saint Peter's University Hospital  
Atlantic Highlands, New Jersey

**Shradha Khadge, MD**

Cedars-Sinai Medical Center  
West Hollywood, California

**Fouzia Khalid, MBBS**

University of Washington  
Kirkland, Washington

**Taimoor Khan, MD**

Memorial Healthcare System  
Pembroke Pines, Florida

**Mickael Khouzami, MD**

Mount Sinai Hospital Icahn School  
of Medicine  
New York, New York

**Alexandra Kiers, MD**

Henry Ford Hospital  
Detroit, Michigan

**Stephanie Kierstead, MD**

University of Colorado  
Denver, Colorado

**Cecilia Kim, DO**

Maimonides Medical Center  
Brooklyn, New York

**Jenny Kim, MD**

Vanderbilt University Medical  
Center  
Nashville, Tennessee

**Michael Kim, MD**

New York Presbyterian - Columbia  
University Campus  
New York, New York

**Tom Klumpner, MD**

University of Michigan  
Ann Arbor, Michigan

**Andrew Kolomensky, MD**

Ochsner Clinic Foundation  
New Orleans, Louisiana

**Hiroaki Kondo, MD**

Division of Obstetric Anesthesia,  
Center for Perinatal Care, Child  
Health and Development, Kitasato  
University Hospital  
Sagamihara City, Kanagawa, Japan

**Jessica Kruse, MD**

Northwestern University  
Chicago, Illinois

**Alexandre Lacombe, MD, FRCPC**

Department of Anesthesia, Jewish  
General Hospital, McGill University  
Toronto, Ontario, Canada

**Ruth Landau, MD**

Columbia University  
New York, New York

**James Lane, MA**

University of Texas Medical Branch  
of Galveston  
Galveston, Texas

**Kristine Lane, BS**

University of Texas Medical Branch  
John Sealy School of Medicine  
Galveston, Texas

**Brittini Lanoux, MD**

LSUHSC New Orleans  
Metairie, Louisiana

**Taylor Leathers, MD**

The University of Kansas Medical  
Center  
Kansas City, Missouri

**Allison Lee, MD, MS**

Columbia University  
New York, New York

**Amy Lee, MD**

Baylor College of Medicine  
Houston, Texas

**Heewon Lee, MD**

Emory University  
Decatur, Georgia

**Won Lee, MD**

University of California - San  
Francisco  
South San Francisco, California

**Roy Lei, MD**

The University of Texas Health  
Science Center in Houston -  
McGovern Medical School  
Houston, Texas

**Brandon Leighton, MD**

Brooke Army Medical Center  
San Antonio, Texas

**Neva Lemoine, MD**

McGovern Medical School at UT  
Health  
Houston, Texas

**Ashley Lewis, MD**

Medical College of Wisconsin  
Milwaukee, Wisconsin

**Allen Li, MD**

The University of Western Ontario  
London, Ontario, Canada

**Maytinee Lilaonitkul, MBBS BSc**

University of California San  
Francisco  
San Francisco, California

**Grace Lim, MD, MSc**

Department of Anesthesiology &  
Perioperative Medicine, University  
of Pittsburgh School of Medicine  
Pittsburgh, Pennsylvania

**Sherry Liou, MD**

UCSF  
San Francisco, California

**Mingchun Liu, MD**

Washington University School of  
Medicine  
St. Louis, Missouri

**Nathaniel Liu, DO**

Hospital of University of PA  
Philadelphia, Pennsylvania

**Carmen Lopez, MD**

Northwestern University McGaw  
Medical Center  
Chicago, Illinois

**Keyin Michelle Lu, MD**

University of Texas Medical Branch  
at Galveston  
Houston, Texas

**Marshal Lu, MD**

Montefiore Medical Center  
Forest Hills, New York

**Jennifer Lucero, MD**

University of California, Los  
Angeles  
Los Angeles, California

**Katie Luepke, PharmD, BCPS**

Heron Therapeutics  
Atlanta, Georgia

**Mario Lumbreras-Marquez, MBBS,  
MMSc**

Department of Anesthesiology,  
Perioperative and Pain Medicine,  
Brigham & Women's Hospital,  
Harvard Medical School  
Boston, Massachusetts

**Mutasim Makeen, MB, BS**

University Of Pittsburgh  
Pittsburgh, Pennsylvania

**Jayne Manigrasso, MD**

Oregon Health and Science  
Univeristy  
Portland, Oregon

**Renjith Maracheril, DO**

Maimonides Medical Center  
Brooklyn, New York

**Eva Martinez, MD**

University of Illinois at Chicago  
Chicago, Illinois

**Leslie Matthews, MD, PharmD**

The Ohio State University  
Columbus, Ohio

**Yusuke Mazda, MD, PhD**

Saitama Medical Center, Saitama  
Medical University  
Kawagoe, Saitama, Japan

**Michael McGinnis, MD**

Rush University Medical Center  
Chicago, Illinois

**Christine McKenzie, MD**

University of North Carolina  
Chapel Hill, North Carolina

**Emily McQuaid-Hanson, MD**

Providence Anesthesiology  
Spokane, Washington

**Marie-Louise Meng, MD**

Duke University Medical Center  
Durham, North Carolina

**Jessica Merrill, MD**

University of Arkansas for Medical  
Science  
Little Rock, Arkansas

**Mercades Meuli, DO**

University of California San Diego  
San Diego, California

**Jill Mhyre, MD**

University of Arkansas for Medical  
Sciences  
Little Rock, Arkansas

**Rebecca Minehart, MD**

Massachusetts General Hospital/  
Harvard Medical School  
Newton, Massachusetts

**Mehwish Mirza, MD**

Montefiore Medical Center  
Yonkers, New York

**Anna Moldysz, MD**

Beth Israel Deaconess Medical  
Center/Harvard Medical School  
Boston, Massachusetts

**David Monks, MBChB, FRCA, MSc**

Washington University School of  
Medicine  
Saint Louis, Missouri

**Allison Mootz, MD**

University of Texas Southwestern  
Medical Center & Parkland  
Memorial Hospital  
Dallas, Texas

**Juan Morales, MD**

Mount Sinai Hospital - University of  
Toronto  
Toronto, Ontario, Canada

**Brendan Morgan, MD**

Dalhousie University  
Halifax, Nova Scotia, Canada

**Jessian Munoz, MD PhD MPH**

University of Texas Health San  
Antonio  
San Antonio, Texas

**Natalie Nakles, MD**

University of Pittsburgh  
Pittsburgh, Pennsylvania

**Emily Naoum, MD**

Massachusetts General Hospital  
Boston, Massachusetts

**Emily Nasser, MD**

University of California Los  
Angeles  
Los Angeles, California

**Elmari Neethling, MD**

University of Toronto  
Toronto, Ontario, Canada

**David Newhouse**

University of Pittsburgh School of  
Medicine  
Pittsburgh, Pennsylvania

**Lauren Newhouse, MD**

University of Illinois Hospital  
Chicago, Illinois

**Sofia Nicolls, BSc, Hon Med Sci  
candidate**

Dalhousie University, Faculty of  
Science  
Halifax, Nova Scotia, Canada

**Kaila Nicolson, MD**

Ochsner Medical Center  
New Orleans, Louisiana

**Hokuto Nishioka, MD**

University of Illinois Hospital  
Chicago, Illinois

**Shohei Noguchi, MD**

Saitama Medical Center, Saitama  
Medical University  
Kawagoe, Saitama, Japan

**Leziga Obiyo, MD, MPH**

Stanford University  
Chicago, Illinois

**James O'Carroll, MBBS, FRCA**

Stanford University  
Palo Alto, California

**Hisako Okada, MD, PhD**

Juntendo University Urayasu  
Hospital  
Chiba, Tokyo, Japan

**Chikezie Okeagu, MD**

Louisiana State University Health  
Sciences Center  
New Orleans, Louisiana

**Yuliana Olivero, Anesthesiologist**

General Hospital of Mexico  
Mexico City, Distrito Federal,  
Mexico

**Clemens Ortner, MD**

Stanford School of Medicine  
San Carlos, California

**Monique Osigbeme, MD**

Vanderbilt University Medical  
Center  
Nashville, Tennessee

**Adeeb Oweidat, MD**

Cleveland Clinic  
Cleveland, Ohio

**Elizabeth Ozery, MD**

Stanford University  
San Francisco, California

**Arvind Palanisamy, MD, FRCA**

Washington University School of  
Medicine  
Chesterfield, Missouri

**Craig Palmer, MD**

University of Arizona College of  
Medicine  
Tucson, Arizona

**Bo-Chih Pan, MD**

Medical College of Wisconsin  
Milwaukee, Wisconsin

**Perman Pandal, MBBS**

Department of Anesthesiology,  
Perioperative and Pain Medicine,  
Stanford University  
San Ramon, California

**Ludovic Pao, MD**

The University of Texas at  
Southwestern Medical Center  
Dallas, Texas

**Brian Paoletti, MD**

Vanderbilt University Medical  
Center  
Nashville, Tennessee

**John Parker, DO**

Case Western Reserve University -  
MetroHealth  
South Euclid, Ohio

**Bhavidip Patel, FCAI**

Rotunda Hospital Dublin  
Dublin, Ireland

**Shyam Patel, DO**

Brooke Army Medical Center  
Fort Sam Houston, Texas

**Samuel Pettigrew, MD**

University of Tennessee Medical  
Center Knoxville  
Knoxville, Tennessee

**Alex Pham, MD**

Department of Anesthesiology,  
LSUHSC - New Orleans  
Slidell, Louisiana

**Trung Pham, MD**

Duke University Hospital  
Moore, Oklahoma

**Natalia Portela, MD**

Department of Anesthesiology  
and Pain Medicine, Mount Sinai  
Hospital, University of Toronto  
Toronto, Ontario, Canada

**Borislava Pujic, MD, PhD**

Clinical Center Vojvodina, Clinic  
for Anesthesia, Intensive Care and  
Pain Therapy  
Novi Sad, Vojvodina, Serbia

**Jake Rachiele, MD**

Columbia University Medical  
Center  
New York, New York

**Wesley Rajaleelan, MBBS MD DA**

University of Ottawa  
Ottawa, Ontario, Canada

**Mauricio Ramos Lozano**

University of Texas Medical Branch  
at Galveston  
San Benito, Texas

**Sapna Ravindranath, MD**

Indiana University Hospital  
Indianapolis, Indiana

**Joseph Reno, MD**

University of Washington  
Seattle, Washington

**Michael Richter, MD**

University of Minnesota  
St. Paul, Minnesota

**Carolina Rincón, MD, MSc**

Hospital Universitario San Ignacio  
Bogota, Distrito Capital de Bogota,  
Colombia

**Pauline Ripchik, MD**

Northwestern University, Feinberg  
School of Medicine  
Chicago, Illinois

**Mary Roberts, MD**

University of Cincinnati  
Cincinnati, Ohio

**Aubri Robinson**

University of Minnesota Rochester  
Rochester, Minnesota

**Jasmine Robinson, MD**

Tufts Medical Center  
Dedham, Massachusetts

**Tobias Robinson, MD**

University of Vermont Medical  
Center  
Burlington, Vermont

**Erik Romanelli, MD, MPH**

Montefiore Medical Center  
New York, New York

**John Rouck, MD**

New York Presbyterian - Columbia  
University Campus  
New York, New York

**Angus Royal, MBBS, FRCA**

BC Women's Hospital, University of  
British Columbia  
Vancouver, British Columbia,  
Canada

**Samantha Rubright, MD**

Duke University Medical Center  
Durham, North Carolina

**Susanne Rupert, MD**

University of Minnesota  
Minneapolis, Minnesota

**Joe Salloum, MD**

Cleveland Clinic Foundation  
Strongsville, Ohio

**Migdalia Saloum, MD**

US Anesthesia Partners North  
Texas - Arlington Division  
Southlake, Texas

**Leilani Sampang, MD**

Loyola University Health System  
Oak Park, Illinois

**Alexander Samworth, MD**

McGaw Medical Center of  
Northwestern University  
Chicago, Illinois

**Shirley Santos, PhD, MD, EDAIC,  
TSA**

Mount Sinai Hospital/Hospital das  
Clínicas da Universidade de São  
Paulo  
Toronto, Ontario, Canada

**Elie Sarraf, MD**

Penn State Health Milton S.  
Hershey Medical Center  
Hershey, Pennsylvania

**Luc Saulnier, BA (Hons) MA**

BC Women's Hospital  
Vancouver, British Columbia,  
Canada

**Katelyn Scharf, MD**

University of Maryland School of  
Medicine  
Baltimore, Maryland

**Robert Schroell, MD**

The Ohio State Wexner Medical  
Center  
Columbus, Ohio

**Julie Seavello, MD MPH**

Island Hospital  
Mill Creek, Washington

**Katie Seligman, MD**

University of British Columbia  
Vancouver, British Columbia,  
Canada

**Maitri Shah, MD**

University of Arkansas for Medical  
Science  
Little Rock, Arkansas

**Charles Shaller, Resident**

Maimonides Medical Center  
Brooklyn, New York

**Soniya Sharma, MD, MSc, FRCPC**

Stanford University  
Stanford, California

**Shanthi Shaver, MD MPH**

Augusta University Medical Center  
Augusta, Georgia

**Meredith Shaw, MD**

LSUHSC Anesthesiology - New  
Orleans  
New Orleans, Louisiana

**Jessica Sheeran, MD**

University of Virginia  
Charlottesville, Virginia

**Maria Sheikh, MD, MPH**

Columbia University Irving Medical  
Center  
New York, New York

**Alice Sherman-Brown, MD**

UC Irvine Medical Center  
Tustin, California

**Priyanka Shetty, DO**

University of Connecticut  
Hartford, Connecticut

**Joo Hyun Shin, MD**

UT Southwestern Medical Center  
Irving, Texas

**Phillip Sholes, MD**

University of North Carolina  
Chapel Hill, North Carolina

**Karim Shuaib, MD**

Stony Brook University Hospital  
Port Jefferson Station, New York

**Matthew Sikora, DO**

Cedars Sinai Medical Center  
West Hollywood, California

**Richard Smiley, MD, PhD**

Columbia University Vagelos  
College of Physicians and  
Surgeons  
New York, New York

**C. Tyler Smith, MD**

University of Pittsburgh,  
Anesthesiology & Perioperative  
Medicine  
Pittsburgh, Pennsylvania

**Kathleen Smith, MD**

University of North Carolina  
Chapel Hill, North Carolina

**Margaret Smith, MD**

University of Chicago  
Chicago, Illinois

**Samantha Smith, DNAP, CRNA**

NewYork-Presbyterian, Weill  
Cornell Medical Center  
New York, New York

**Olaide Sode**

UT Southwestern Medical Center  
Dallas, Texas

**Samantha Sohnen, MD**

Dartmouth-Hitchcock Medical  
Center  
Lebanon, New Hampshire

**Laura Sorabella, MD**

Vanderbilt University Medical  
Center  
Brentwood, Tennessee

**Claire Spradling, MD**

Vanderbilt University Medical  
Center  
Nashville, Tennessee

**Ellen Stallings, MD**

Vanderbilt University Medical  
Center  
Nashville, Tennessee

**Mellany Stanislaus, MD**

The Johns Hopkins Hospital  
Baltimore, Maryland

**Grace Steel, MD**

Baylor Scott & White Medical  
Center  
Temple, Texas

**Alyssa Streff, MD**

Vanderbilt University Medical  
Center  
Nashville, Tennessee

**Simone Sukhdeo, MA, PhD**

Rutgers Robert Wood Johnson  
Medical School  
Piscataway, New Jersey

**Kyle Sullivan, MD**

University of Texas Health Science  
Center at San Antonio  
San Antonio, Texas

**Pirianthini Suntharalingam, MD**

Dartmouth-Hitchcock Medical  
Center  
Lebanon, New Hampshire

**Caitlin Sutton, MD**

Texas Children's Hospital  
Houston, Texas

**Anna Swenson, MD**

University of Minnesota  
Golden Valley, Minnesota

**Brian Taussig, MD**

Icahn School of Medicine at Mount  
Sinai  
New York, New York

**Benjamin Ten Eyck, MD**

The University of Texas Medical  
Branch at Galveston  
Phoenix, Arizona

**Kokila Thenuwara, MD**

University of Iowa  
Iowa City, Iowa

**Caroline Thomas, MD**

Northwestern Medicine  
Chicago, Illinois

**Dean Thorsen, DO, PhD**

Kaiser Permanente  
Vallejo, California

**Christian Tilley, MD**

NewYork-Presbyterian/Weill  
Cornell Medicine  
New York, New York

**Paloma Toledo, MD**

Northwestern University Feinberg  
School of Medicine  
Chicago, Illinois

**R. Jeanne Tong, MD**

New York Medical College/  
Westchester Medical Center  
White Plains, New York

**Bryna Torre, MD**

University of Pittsburgh Medical  
Center  
Pittsburgh, Pennsylvania

**Abigail Torres, BS**

Texas A&M Health Science Center  
College of Medicine  
Temple, Texas

**Mikayla Troughton, MD**

University of Arkansas for Medical Sciences  
Little Rock, Arkansas

**William Turner, MSci (hons) BMBS (hons) FRCA**

Department of Anaesthesia and Pain Management, Mount Sinai Hospital, University of Toronto  
Surbiton, United Kingdom

**Ekaterina Upryamova, MD**

Moscow Regional Scientific Research Institute of Obstetrics and Gynecology  
Moskva, Russia

**Beth VadnerWielen, MD**

Beth Israel Deaconess Medical Center  
Boston, Massachusetts

**Oscar van den Bosch, MD**

Department of Anesthesiology and Pain Medicine, Mount Sinai Hospital, University of Toronto  
Toronto, Ontario, Canada

**Anu Vasudevan, MD**

Geisinger Commonwealth School of Medicine  
Danville, Pennsylvania

**Ivan Velickovic, MD**

SUNY Downstate Health Sciences University  
Tenafly, New Jersey

**Shibinath Velutha Mannil, MD**

Montefiore Medical Center  
Bronx, New York

**Olivia Vetter, MD**

University of Illinois at Chicago  
Chicago, Illinois

**Diego Villela-Franyutti, MD**

Department of Anesthesiology, Perioperative and Pain Medicine, Brigham & Women's Hospital, Harvard Medical School, Boston, Massachusetts, United States  
Boston, Massachusetts

**Ashley Vincent, BA**

Rutgers Robert Wood Johnson Medical School  
Guttenberg, New Jersey

**Patrice Vinsard, Fellow**

Mayo Clinic Rochester  
Rochester, Minnesota

**Tracey Vogel, MD**

Allegheny Health Network  
Pittsburgh, Pennsylvania

**Mai-Anh Vu, MD**

University of Texas Medical Branch at Galveston  
Galveston, Texas

**Bryan Wakefield, MD**

University of North Carolina  
Chapel Hill, North Carolina

**Damon Wallace, MD**

University of North Carolina  
Durham, North Carolina

**Emily Walsh, BS**

Northwestern University School of Medicine  
Chicago, Illinois

**Anne Wanaselja, MD**

University of Pittsburgh Medical Center  
Pittsburgh, Pennsylvania

**Trent Weatherley, BSA**

University of Texas Medical Branch at Galveston  
Friendswood, Texas

**Carolyn Weiniger, MB ChB**

Tel Aviv Sourasky Medical Center  
Tel Aviv, Israel

**Lawrence Weinstein, MD**

University of California, San Diego  
San Diego, California

**Cassie Wernke, D.O.**

The Ohio State University Wexner Medical Center  
Grandview Heights, Ohio

**Danielle White, MD**

McGovern Medical School  
Houston, Texas

**Graham White, MBChB FRCA**

NHS Greater Glasgow and Clyde  
Glasgow, Scotland

**Jason White, MD**

Weill Cornell Medicine  
New York, New York

**Robert White, MD**

Weill Cornell Medicine  
New York, New York

**Jatturong Wichianson, MD**

Cedars Sinai Medical Center  
Los Angeles, California

**Alyson Win, BS**

Texas A&M Health Science Center  
College of Medicine  
Temple, Texas

**Richard Wissler, MD**

University of Rochester  
Pittsford, New York

**Melanie Wood, MD**

Yale School of Medicine  
Hamden, Connecticut

**Tianna Xia, DO**

The Ohio State University Wexner  
Medical Center  
Dublin, Ohio

**Eduardo Yamaguchi, MD**

BC Women's Hospital - Vancouver,  
BC  
Vancouver, British Columbia,  
Canada

**Waquas Yaqoob, MD**

University of Connecticut Health  
Center  
Kew Gardens, New York

**Alla Yarmosh, MD, MCR**

Stanford University  
Redwood City, California

**Jessica Yeh, MBBS**

University of Arkansas for Medical  
Sciences  
Little Rock, Arkansas

**Jordan Yokley, MD**

SAUSHEC  
San Antonio, Texas

**Jin Yoo, BS**

Rutgers Robert Wood Johnson  
Medical School  
New Brunswick, New Jersey

**Hadley Young, MD**

Baylor Scott & White Medical  
Center  
Temple, Texas

**Mary Yurashevich, MD, MPH**

Duke University Department of  
Anesthesiology  
Durham, North Carolina

**Sonal Zambare, MD**

Baylor College of Medicine  
Pearland, Texas

**Nicole Zanolli, BA**

Duke University School of Medicine  
Wauwatosa, Wisconsin

**Bosi Zhang, MD**

Northwell  
Farmingdale, New York

**Amy Zheng, MD**

University of Maryland School of  
Medicine  
Baltimore, Maryland

**Jie Zhou, MD, MS, MBA**

Brigham and Women's Hospital,  
Harvard Medical School  
Boston, Massachusetts

**Mario Zuniga Palma, MPH**

University of Texas Medical Branch  
Galveston, Texas

# Program Information

## ACCME Accreditation and Designation Statements

This activity has been planned and implemented in accordance with the accreditation requirements and policies of the Accreditation Council for Continuing Medical Education (ACCME) through the joint providership of the American Society of Anesthesiologists and the Society for Obstetric Anesthesia and Perinatology. The American Society of Anesthesiologists is accredited by the ACCME to provide continuing medical education for physicians.

The American Society of Anesthesiologists designates this live activity for a maximum of 26.50 *AMA PRA Category 1 Credits*<sup>™</sup>. Physicians should claim only the credit commensurate with the extent of their participation in the activity.

## Optional Workshops

8:00 am – 12:00 pm Simulation: How to Have a Difficult Conversation with your Patient

The American Society of Anesthesiologists designates this live activity for a maximum of 4.0 *AMA PRA Category 1 Credits*<sup>™</sup>. Physicians should claim only the credit commensurate with the extent of their participation in the activity.

8:00 am – 5:00 pm POCUS Workshop

The American Society of Anesthesiologists designates this live activity for a maximum of 8.0 *AMA PRA Category 1 Credits*<sup>™</sup>. Physicians should claim only the credit commensurate with the extent of their participation in the activity.

8:00 am – 5:00 pm POCUS Workshop Online Activity

The American Society of Anesthesiologists designates this enduring material activity for a maximum of 7.0 *AMA PRA Category 1 Credits*<sup>™</sup>. Physicians should claim only the credit commensurate with the extent of their participation in the activity.

1:00 pm – 5:00 pm Education: Teaching in Alternative Environments (AR/VR/Serious Games)

The American Society of Anesthesiologists designates this live activity for a maximum of 4.0 *AMA PRA Category 1 Credits*<sup>™</sup>. Physicians should claim only the credit commensurate with the extent of their participation in the activity.



Maintenance of Certification in Anesthesiology Program<sup>®</sup> and MOCA<sup>®</sup> are registered certification marks of The American Board of Anesthesiology<sup>®</sup>

The Maintenance of Certification in Anesthesiology Program<sup>®</sup> logo are registered trademarks of the American Board of Anesthesiology. MOCA 2.0<sup>®</sup> is a trademark of The American Board of Anesthesiology<sup>®</sup>.

This activity offers up to 26.50 CME credits, of which 2.50 credits contribute to the Patient Safety CME component of the American Board of Anesthesiology's redesigned Maintenance of Certification in Anesthesiology<sup>®</sup> (MOCA<sup>®</sup>) program, known as MOCA 2.0<sup>®</sup>. Please consult the ABA website, [www.theABA.org](http://www.theABA.org), for a list of all MOCA 2.0 requirements.

## **About This Meeting**

Studies continue to document disparity in maternal and neonatal healthcare in the United States and other developed countries. The specialty of obstetric anesthesiology is in a unique position to positively impact maternal and neonatal healthcare. The purpose of this educational activity is to inform individuals of the various healthcare disparities in obstetric anesthesia, and how to mitigate the impacts of structural and implicit biases of care within their practice. Individuals who attend this educational activity will understand the scientific, environmental and systemic basis of these disparities, and new advancement and methods to improve the care of the parturient. By emphasizing the scientific basis of these new advancements, individuals will practice evidence-based medicine with the outcomes of improved patient safety and of patient experience without inherent biases.

## **Target Audience**

This meeting is intended for Anesthesiologists, Anesthesiologists Assistants, CRNAs, Nurses, Resident/Fellows, and Medical Students interested in the recent advances in obstetric anesthesia and the application of these advances to their practice.

## **Mission of the SOAP Annual Meeting and Live Events Committee**

The mission of the AMLE Committee is to provide anesthesiologists, obstetricians, and other physicians and members of related allied health specialties with the knowledge that will reinforce past learning as well as disseminate new concepts, practices, and skills involving anesthesia and analgesia for the pregnant patient.

## **Participation in the SOAP 54th Annual Meeting**

Attendance is open to all health practitioners, provided that they have registered for the meeting. CME credit will only be offered to those with an MD, DO or equivalent.

## **Educational Format**

CME activities may include the following formats: plenary sessions, debates, lectures, poster discussions, oral abstracts, problem-based learning, and skill-set workshops.

## **Annual Meeting Objectives**

At the completion of this conference the participants should be able to:

1. Improve the care of the parturient through better understanding of the physiology of pregnancy and the impact of maternal disease with the goal of implementation of safe and effective care.
2. Impact positively maternal mortality in the United States through actions that address disparities of care and improve understanding of biases in patient care
3. Utilize an evidence-based approach when caring for the pregnant patient in the development of an analgesic plan that optimizes both analgesia and patient safety
4. Implement practices in the anesthetic management of the parturient undergoing cesarean section that will enhance recovery and provide postpartum analgesia using minimal opioids.
5. Develop specific measures that increase safety in the Labor Suite that emphasizes team-based care with clear communication.
6. Incorporate recommendations in the management of the pregnant patient who requires analgesia/anesthesia and who has a relative contraindication to neuraxial analgesia/anesthesia.

### **Special Needs Statement**

The American Society of Anesthesiologists and the Society for Obstetric Anesthesia and Perinatology are committed to making its activities accessible to all individuals and fully comply with the legal requirements of the Americans with Disabilities Act and the rules and regulations thereof. If you are in need of an accommodation, please do not hesitate to submit a description of your needs in writing to [membership@soap.org](mailto:membership@soap.org).

### **Disclosure Policy**

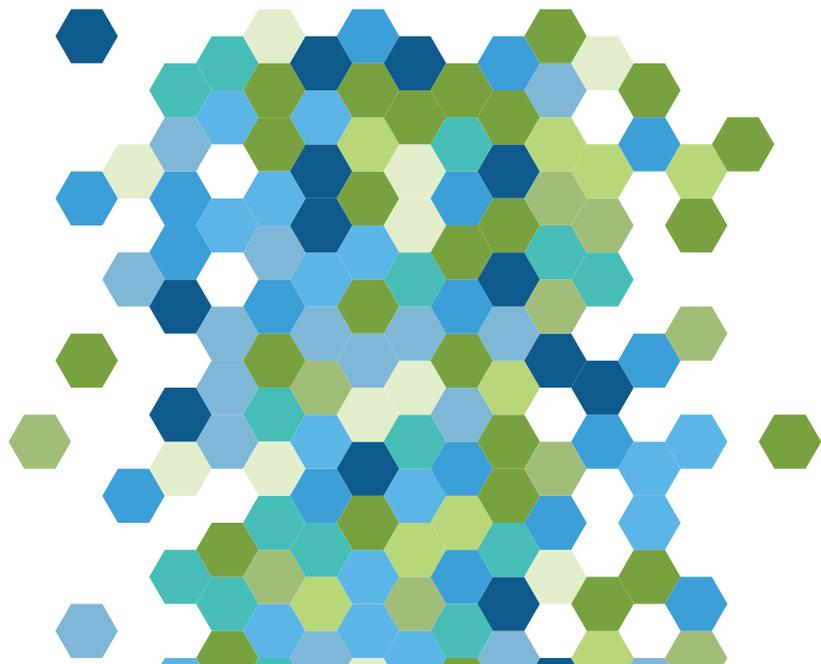
The American Society of Anesthesiologists remains strongly committed to providing the best available evidence-based clinical information to participants of this educational activity and requires an open disclosure of any potential conflict of interest identified by our faculty members. It is not the intent of the American Society of Anesthesiologists to eliminate all situations of potential conflict of interest, but rather to enable those who are working with the American Society of Anesthesiologists to recognize situations that may be subject to question by others. All disclosed conflicts of interest are reviewed by the educational activity course director/chair to ensure that such situations are properly evaluated and, if necessary, resolved. The American Society of Anesthesiologists educational standards pertaining to conflict of interest are intended to maintain the professional autonomy of the clinical experts inherent in promoting a balanced presentation of science. Through our review process, all American Society of Anesthesiologists CME activities are ensured of independent, objective, scientifically balanced presentations of information. Disclosure of any or no relationships will be made available for all educational activities.

### **How to Receive CME Credit**

To receive credit, participants must access the ASA Education Center, review the meeting information, and complete the evaluation. Further instructions will be emailed to each participant immediately prior to and after the activity.

### **Disclaimer Statement**

The information provided at this accredited activity is for continuing education purposes only and is not meant to substitute for the independent medical judgment of a healthcare provider relative to diagnostic and treatment options of a specific patient's medical condition.



# SESSION DESCRIPTIONS

## Pre-Meeting Workshops

### **Simulation Workshop: “How to Have a Difficult Conversation with your Patient”**

This workshop will feature interactive role play to demonstrate and practice techniques for engaging with patients and establishing rapport. Attendees will learn to demonstrate empathy and be able to uncover patients’ perspectives, learn how to explain risks and benefits to patients and discuss alternative approaches to care, and learn how to approach shared decision-making.

### **POCUS Workshop**

This in-depth, hands-on training session will include a focus on knobology, FATE views, various M-mode features (including M mode in pos 2 and pos 3), methods to assess MAPSE/TAPSA, lung ultrasound, parasternal long axis view, and more. The workshop will conclude with certification test and scenario training, discussion and evaluation.

### **Education Workshop: “Teaching in Alternative Environments (AR/VR/Serious Games)”**

This workshop will explore new and emerging teaching environments, including augmented reality, virtual reality, and screen-based gaming. Participants will learn about each modality as well as develop an action plan to integrate new technologies into their own programs. The workshop will conclude with workstations aimed at demonstrating what the new technology can do, including time with virtual reality headsets. Each participant will have an opportunity to have a hands-on experience with each teaching modality.

## Sessions

### **Best Case Reports – So You Did What?**

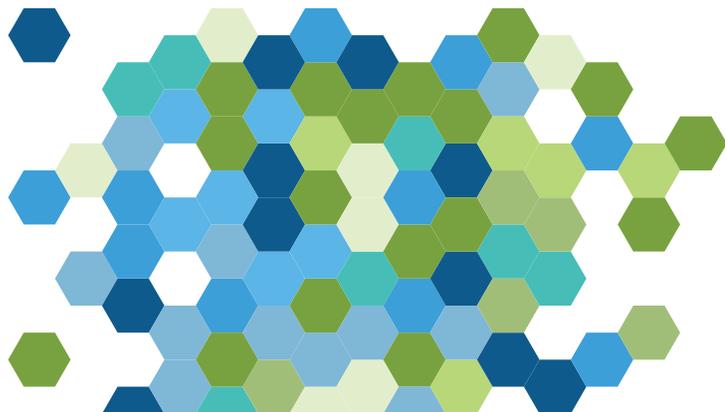
This live presentation highlights some of the most well-written and interesting case reports submitted to the Annual Meeting. Cases were selected to represent a wide range of topics from various institutions and are sure to foster lively discussions among the panelists. There will be author and audience participation, via virtual chat function, to encourage interactive discussion. This engaging session will be moderated by Dr. Emily Sharpe, and will feature panelists Dr. Katie Arendt, Dr. Brenda Bucklin, and Dr. Richard Wissler.

### **Best Paper Competition**

This curated session includes presentations from the top rated and most impactful research abstracts submitted this year. Presenters compete for the title of SOAP Annual Meeting Best Paper via presentations and a question-and-answer session. This competition will be moderated by Dr. Cynthia Wong, a distinguished researcher in the obstetric anesthesiology field.

### **Resident/Fellow Case Presentations**

These moderated sessions, scheduled for Saturday, are designed to highlight educationally valuable case reports submitted and presented by obstetric anesthesiology fellows and residents across the country. There will be opportunities to participate and ask questions regarding some of the most challenging clinical scenarios our presenters have encountered.



### **Faculty Case Presentations**

This Sunday session will feature some of the most challenging and captivating case presentations of difficult clinical situations. You are sure to learn as our faculty presenters describe how they approached the care of these unique parturients.

### **Research Poster Sessions**

These moderated sessions, scheduled for Thursday and Friday, showcase the state-of-the-art research being conducted in obstetric anesthesia.

### **Oral Presentations**

Oral presentations of diverse, high-quality and hand-selected peer-reviewed scientific research related to obstetric anesthesia will be presented, followed by a moderated question-and-answer session led by Dr. Ron George.

### **Gertie Marx Research Competition**

Named in memory of obstetric anesthesia pioneer Gertie Marx, this research competition highlights the best quality research performed by our trainees (medical students, residents and fellows). Five presenters will compete in this judged competition, moderated by Dr. Ashraf Habib.

### **Fred Hehre Lecture**

This session offers reflections from a renowned member of the obstetric anesthesia community, which bring insights into scope of practice changes over time and focuses on what matters most to the art and science of obstetric anesthesia practice. This year's Fred Hehre lecturer will be obstetric anesthesia legend Dr. Robert Gaiser.

### **Gerard W. Ostheimer Lecture**

Always a highlight and one of the most highly anticipated sessions of the meeting, the Gerard W. Ostheimer lecture is a review of important, relevant, and practice-changing literature related to obstetric anesthesia, obstetrics, perinatology, and allied medical disciplines that was published in the preceding calendar year (2021). This digestible synthesis of the literature analyzes the clinical impact of published works and latest evidence-based advances in the field of obstetric anesthesia. This year's Ostheimer lecturer will be Dr. Michaela Farber.

### **SOAP Distinguished Service Award Presentation & Awards Ceremony**

Join us as we honor Dr. Craig Palmer, 2022 recipient of SOAP's highest honor, the 2022 Distinguished Service Award. Dr. Palmer will be introduced by Dr. Michael Paesch. This session will also include Dr. Ted Yagmour, SOAP President, announcing recipients of the Gertie Marx and Best Paper Competitions, Teacher of the Year Awards, Research in Education, Frederick P. Zuspan Award, Patient Safety Award, and the Diversity and Inclusivity Award. Don't miss it!

### **Keynote – "Illinois Perinatal Quality Collaborative (ILPQC) – Birth Equity Initiative"**

This presentation by Dr. Ann Borders, the Executive Director and Obstetrics Lead for the Illinois Perinatal Quality Collaborative, will cover the work of the ILPQC, which is a nationally recognized statewide network of hospital teams, perinatal clinicians, patients, public health leaders, and policymakers committed to improving healthcare and outcomes for mothers and babies across Illinois.

### **Panel – Addressing Maternal Mortality: Key Factors for Change**

This joint panel of Obstetric Anaesthetists' Association and SOAP representatives will discuss maternal mortality, with data from both the United Kingdom and local maternal mortality review committees, as well as the implicit bias that may contribute to disparities in care. The session will be moderated by Dr. Allison Lee and including panelists Dr. Chris Elton (OAA), Dr. Caitlin Sutton, and Dr. Paloma Toledo.

### **Panel – SNAP Talks – Getting the Right Resources to the Patient**

Dr. Dave Arnolds, Dr. Thomas Klumpner, and Dr. Rebecca Minehart will review the various available resources in obstetric anesthesiology, how to access these resources in critical moments, and appropriately deploying these resources in various patient settings. This session will be moderated by Dr. Vibha Mahendra.

### **Panel – SOAP Centers of Excellence: How to Provide Quality Care for All Parturients**

In this session, panelists Dr. Dave Berman, Dr. Davida Grossman, and Dr. Jill Mhyre will discuss how the Centers of Excellence standards can be implemented in practices to provide quality care for parturients. This session will be moderated by Dr. Brendan Carvalho, Chair of the SOAP Centers of Excellence Subcommittee.

### **SMFM Session – Tackling Maternal Inequities in U.S. Obstetric Care**

Dr. William Grobman, Immediate Past President of the Society for Maternal-Fetal Medicine, will present data on current inequities in maternal care in the United States and highlight how obstetric anesthesiologists can play a role to improve care.

### **ASRA/SOAP Panel - Post Cesarean Delivery Pain Management: What Do We Know and How do We Do It?**

This joint panel moderated by Dr. Pervez Sultan will feature Dr. Beth A. VanderWielen and Dr. Unyime Ituk, representing ASRA, and Dr. Ruth Landau and Dr. Ashraf Habib, representing SOAP, as they provide thoughtful discussion surrounding severe post cesarean pain management. This session will cover the role of peripheral nerve blocks (transversus abdominis plane blocks, quadratus lumborum block, Ilioinguinal and Iliohypogastric blocks, and wound infiltration techniques) for cesarean delivery analgesia, how to perform these blocks with tips and tricks from the experts. Pain management strategies in challenging situations including chronic opioid users, history of severe postoperative pain, and anticipated cesarean hysterectomy will also be discussed with potential pharmacological strategies to consider.

### **ASA Update**

SOAP is honored to host Dr. Randall Clark, President, American Society of Anesthesiologists, for an update on the work of the ASA. SOAP President Dr. Ted Yagmour will provide the introduction.

### **Kybele Ukrainian Update**

Like most of the world, SOAP has been closely tracking the tragic events unfolding in Ukraine. Through our partnership with Kybele, we are honored to host a briefing from Dr. Oleg Turkot, who co-founded Kybele's initiative in Ukraine and currently serves as the co-leader of the project to coordinate medical response teams and advocate for donations and essential medical supplies.

### **Clinical Track**

#### **Sol Shnider Clinic Track – Session #1**

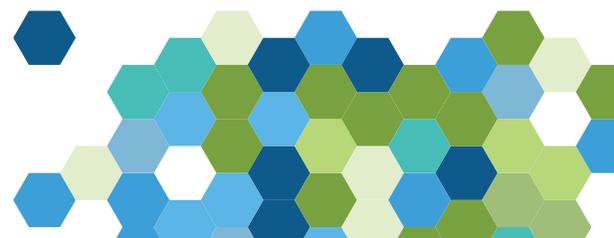
The Sol Shnider clinical track session #1 will cover clinically relevant reviews and updates for important topics such as “Update on POCUS” by Dr. Laurie Chalifoux, “Preeclampsia: What Are We Doing Now?” by Dr. Emily McQuaid, “Update on PDPH” by Dr. Robert White, and “Management of Common Cardiac Disorders on L&D” by Dr. Marie-Louise Meng. This session will be moderated by Dr. Greg Palleschi.

#### **Sol Shnider Clinic Track – Session #2**

The Sol Shnider clinical track session #2 will cover clinically relevant reviews and updates for important topics including “Parturient with Substance Use Disorder” by Dr. Katie Seligman, “Diversity & Inclusivity in the Workplace” by Dr. Jen Lucero, “What’s New in PPH” by Dr. Jaime Daly, and “Obesity in the Parturient” by Dr. Kathleen Smith. This session will be moderated by Dr. Nakia Hunter.

#### **Sol Snider Clinical Track – Session #3**

The Sol Shnider clinical track session #3 will cover clinically relevant reviews and updates for important topics including “PAS New and Cutting Edge” by Dr. Nicole Higgins, “ECMO in the Parturient” by Dr. Emily Naoum, and “Neurological Deficits” by Dr. Amy Lee. The session will be moderated by Dr. Naida Cole.





# SOAP 2022 Program Schedule

## WEDNESDAY, MAY 11

*\*all times are listed in Central Time*

### Optional Workshops

8:00am – 12:00pm    Simulation Workshop  
*Williford C – 3<sup>rd</sup> floor*  
“How to Have a Difficult Conversation with your Patient”  
Speakers:    Kokila Thenuwara, MD  
                  Gill Abir, MD  
                  Rebecca Minehart, MD  
                  Daniel Katz, MD  
                  Tracey Vogel, MD  
                  Sonal Zambare, MD  
                  Meredith Albrecht, MD  
                  Sapna Ravindranath, MD  
                  Allison Lee, MD

Course Description: This interactive session will feature role play to demonstrate techniques for engaging with patients and establishing rapport. Attendees will learn to demonstrate empathy and be able to uncover the patients’ perspectives, learn how to explain risks and benefits to patients and discuss alternative approaches to care, and learn how to approach shared decision-making.

Learning Objectives:

1. Demonstrate techniques for engaging with, and establishing a rapport with patient
2. Demonstrate empathy and be able to uncover patient’s perspectives
3. Demonstrate ability to explain risks and benefits to patients and discuss alternative approaches to care
4. Demonstrates shared decision-making

## Wednesday, May 11 - Continued

8:00am – 5:00pm POCUS Workshop  
*Williford AB – 3<sup>rd</sup> floor*  
Speakers: Laurie Chalifoux, MD  
Maria Sheikh, MD  
Muhammed Waseem Athar, MD  
Clemens Ortner, MD  
Elmari Neethling, MD  
Cristian Arzola, MD  
Elie Sarraf, MD  
Jean Marie Carabuena, MD  
Jennifer Banayan, MD  
Hopkuto Nishioka, MD  
Jacqueline Galvan, MD  
Anu Vasudevan, MD  
Ian Gaston, MD  
Kaitlyn Brennan, MD

Course Description: *Includes registration for FATE (Focused Assessed Transthoracic Echocardiography) pre-course requirement.*

This hands-on training session will include knobology, FATE views, M-mode in pos 2 and pos 3, MAPSE/TAPSA, lung ultrasound, parasternal long axis view, and more. We will conclude with certification test and scenario training, discussion and evaluation.

1:00pm – 5:00pm Education Workshop  
*Williford C – 3<sup>rd</sup> floor*  
“Teaching in Alternative Environments (AR/VR/Serious Games)”  
Speakers: Elvera Baron, MD  
Allison Lee, MD  
Benjamin Hyers, MD

Course Description:

This workshop will explore all of the new and emerging teaching environments including augmented reality, virtual reality, and screen-based gaming. Participants will learn about each modality as well as develop an action plan to integrate new technologies into their own programs. The workshop will conclude with workstations aimed at demonstrating what the new technology can do. Each participant will have an opportunity to have a hands-on experience with each modality.

Learning Objectives:

1. Describe the various AR/VR/screen-based modalities available to the academic anesthesiologists, including evidence to support these technologies.
2. Compare and discuss the benefits and drawbacks of AR/VR/screen-based gaming after first-hand experience with each modality.
3. Identify barriers and successful methods for the development of AR/VR/screen-based gaming training content.
4. Construct a plan to integrate mixed reality technology into a specific training program.

6:00pm - 8:00pm **Welcome Reception**  
*720 Lounge (Lobby level)*





## THURSDAY, MAY 12

*\*all times are listed in Central Time*

*All meetings are in International North Ballroom unless otherwise noted.*

- 6:30am Registration Opens
- 7:00am – 9:00am Continental Breakfast in Expo Hall  
*International South Ballroom*
- 7:45am – 8:00am Opening Remarks  
Heather Nixon, MD & Samir Patel, MD
- 8:00am – 9:00am Opening Keynote  
“Illinois Perinatal Quality Collaborative (ILPQC) - Birth Equity Initiative”  
Speaker: Ann Borders, MD
- 9:00am – 10:00am Addressing Maternal Mortality: Key Factors for Change  
Moderator: Allison Lee, MD  
Panelists:
  - Chris Elton, MD – OAA
  - Caitlin Sutton, MD
  - Paloma Toledo, MD
- 10:00am- 10:30am Break in Expo Hall  
*International South Ballroom*
- 10:30am – 11:15am SNAP Talks – Getting the Right Resources to the Patient  
Moderator: Vibha Mahendra, MD  
Panelists: Thomas Klumpner, MD  
Dave Arnolds, MD  
Rebecca Minehart, MD
- 11:15am – 12:00pm LUNCH ON YOUR OWN  
  
Sponsored Lunch – Pacira (No CME)  
“Hot Block to Know as a Foundation of your ERAC Platform”  
*Pre-registration required; seating is limited*
- 12:00pm – 1:00pm Best Paper Competition  
Moderator: Cynthia Wong, MD  
Judges: Arvind Palanisamy, MD  
Paloma Toledo, MD  
Jill Mhyre, MD  
Brian Bateman, MD  
Brendan Carvalho, MD  
Phil Hess, MD

## Thursday, May 12 - Continued

1. An innovative approach to optimize Programmed Intermittent Epidural Bolus (PIEB) delivery for labour analgesia – *Ronald George, MD*
2. In vitro optimization of oxytocin-induced myometrial contractility by propranolol: Potential applications in induction of labor and treatment of postpartum hemorrhage – *Mrinalini Balki, MD*
3. The Compensatory Reserve Index in Obstetrical Patients Undergoing Cesarean Section to Identify Postpartum Hemorrhage – *Stephanie Kierstead, MD*
4. Oxytocin at elective cesarean delivery: a dose-finding study in people with twin pregnancy – *Jose Carvalho, MD*
5. Plasmatic catecholamines after neuraxial labor analgesia: a randomized controlled trial comparing epidural versus combined spinal-epidural – *Shirley Santos, MD*
6. State-level indicators of structural racism and severe adverse maternal outcomes during childbirth – *Jean Guglielminotti, MD*

1:00pm – 1:45pm SOAP Centers of Excellence: How to Provide Quality Care for All Parturients  
Moderator: Brendan Carvalho, MD  
Panelists: Jill Mhyre, MD  
Dave Berman, MD  
Davida Grossman, MD

1:45pm – 2:00pm **BREAK in Expo Hall**  
*International South Ballroom*

2:00pm – 3:00pm SMFM Session: Tackling Maternal Inequities in U.S. Obstetric Care  
Introduction: Ted Yagmour, MD, FASA  
Speaker: William Grobman, MD, MBA, Society for Maternal-Fetal Medicine

3:00pm – 5:00pm Research Posters Session #1  
*Third Floor Breakout Rooms*

### Concurrent Breakout Room #1 – Analgesia

*Waldorf – 3<sup>rd</sup> floor*

Moderators: Bryan Mahoney, MD & Carlo Pancaro, MD

1. Comparison of Uniport Versus Multiport Wire-reinforced Catheters for Labor Analgesia During Programmed Intermittent Epidural Boluses: A Randomized Controlled Clinical Trial – *Weijia Du, MD*
2. Color Flow Doppler in Spinal Ultrasound: A Novel Technique for Assessment of Epidural Catheter Position – *Oscar van den Bosch, MD*
3. Feasibility of surface electromyography and electrodermal activity for assessment of neuraxial blockade – *Ana Sjaus, MD*
4. Labor Epidural Failure Rate using CompuFlo Epidural System Assistance for Placement – *Trent Weatherly, MD*
5. Complications with CompuFlo Device Assisted Epidural Placement – *Trent Weatherley, MD*
6. Using CompuFlo to streamline and troubleshoot epidural placement – *Keyin Lu, MD*
7. Laboring Epidural Analgesia with Compu-Flo: Analyzing Correlation of Ligamentum Flavum and Epidural Pressures with Epidural Success – *Mai-Anh Vu, MD*
8. The Effect of an Electronic “Nudge” to Encourage Physician Charting of Replacement Neuraxial Catheters in Obstetric Patients – *Kelly Carlson Fedoruk, MD*
9. Conversion of labor analgesia for intrapartum cesarean delivery: dural puncture epidural vs combined spinal epidural vs epidural – *Kathryn Clark, MD*
10. Implementation of a Countdown Timer to Standardize Patient Assessment Times during Neuraxial Labor Analgesia – *James Damron, MD*
11. Fetal Bradycardia in the Peri-Neuraxial Period: Identifying Parturients at Risk for Cesarean Delivery: A Retrospective Study – *Ian Gaston, MD*

## Thursday, May 12 - Continued

### Concurrent Breakout Room #2 – Postpartum Hemorrhage

Joliet – 3<sup>rd</sup> floor

Moderators: Rachel Kacmar, MD & Jamie Murphy, MD

1. Inpatient Nifedipine Use Prior to Delivery is associated with Increased Risk of Uterine Atony and Use of Secondary Uterotonics: A Retrospective Cohort Study – *Amnon Berger, MD*
2. Evaluation of physician automatic alert-activated anesthesiology interventions for postpartum hemorrhage after vaginal delivery: a prospective pilot study – *Diego Villela-Franyutti, MD*
3. Incorporating a Postpartum Hemorrhage Bundle on the Labor and Delivery Unit: A State-Wide Survey of Anesthesiologists – *Kathryn Hackett, MD*
4. Should BMI bear more weight on ACOG guidelines? – *Marah Alian, MD*
5. Variation in postpartum hemorrhage prevalence based on hospital of delivery in California – *Rudolph Davis, MD*
6. Indication and utilization of fibrinogen replacement therapy in postpartum hemorrhage: a single-center retrospective descriptive study – *Hisako Okada, MD*
7. Evidence-Based Oxytocin Use for Cesarean Delivery: A Quality Improvement Project – *Elliott Callahan, MD*
8. Calculated allowable blood loss and transfusion among women with PPH during cesarean delivery: a retrospective cohort – *Carmen Lopez, MD*
9. Phenylephrine Use Alters Shock Index Reliability With Postpartum Hemorrhage During Cesarean Delivery – *Emery McCrorey, MD*
10. Simulation for Postpartum Hemorrhage Management: An Organizational Strategy Reconfigured to Include Professional Wellness – *Samantha Smith, DNAP, CRNA*

### Concurrent Breakout Room #3 – POCUS

PDR#2 – 3<sup>rd</sup> floor

Moderators: Elizabeth Lange, MD

1. Is pregnancy a risk factor for developing postoperative nausea and vomiting? – *Anuradha Kanaparthi, MD*
2. Optic Nerve Sheath Diameter and Ophthalmic Artery Doppler in Pregnant Patients as Point-of-Care Ultrasound for Anesthesiologists – *Eduardo Yamaguchi, MD*
3. Use of Artificial Intelligence in Cardiac Point-of-Care Ultrasound: Education Amongst Obstetric Anesthesiologists – *Sara Feldman, MD*
4. Gastric emptying of water versus carbohydrate drink in early labor with epidural analgesia – A Randomized Controlled Trial – *Mohammed Idris, MD*
5. Translating the probe: education of residents in lung ultrasound – *Alice Sherman-Brown, MD*
6. Point-of-Care Ultrasonography (POCUS) in Obstetric Anesthesia Fellowship Training: A Survey of North American Programs – *Juliana Barrera Ramirez, MD*
7. Gastric Ultrasound in Parturients Presenting for Scheduled Cesarean Delivery – *Michael Balot, MD*
8. Antenatal Anesthesia Consultation for Spinal Fusion: Please Bring Your Smartphone! – *Ghislaine Echevarria, MD*
9. Strain Echocardiography During Active Labor Pilot Study – *Piranthini Suntharalingam, MD*
10. Feasibility of focused cardiac ultrasound performed by novices during Cesarean delivery – *Maria Sheikh, MD*
11. Focused cardiac ultrasound in parturients with congenital and acquired heart disease: a case series – *Maria Sheikh, MD*

### Concurrent Breakout Room #4 – Morbidity

Astoria – 3<sup>rd</sup> floor

Moderators: Jie Zhou, MD & Shamantha Reddy, MD

1. Comparative performance of obstetric comorbidity scores within categories of race and ethnicity: an external validation study – *Joe Bryant-Huppert, MD*
2. Retrospective Data Analysis for Pulmonary Hypertension in Pregnancy in a County Hospital System – *Sonal Zambare, MD*
3. Venovenous Extracorporeal Membrane Oxygenation Treatment Parameter Differences in Obstetric Patients – *Brianna Hildreth, MD*
4. Hospital Readmissions after Postpartum Emergency Department Visit – *Alexander Butwick, MD*

## Thursday, May 12 - Continued

5. Quality standards in obstetric anesthesia - adherence to key indicators for quality improvement in obstetric units in the United Kingdom – *James O’Carroll, MD*
6. State-level nurse workforce diversity and severe adverse maternal outcomes during childbirth – *Jean Guglielminotti, MD*
7. Decision Analysis for Evaluating Antepartum Risk Prediction of Pre-eclampsia: Minimum Test Tradeoff – *Mellany Stanislaus, MD*
8. Assessing the Adequacy of Our Labor and Delivery Anesthesia Staffing Model – *Samantha Abel, MD*
9. Factors Associated with Delayed Administration of Gentamicin in Patients with Suspected Chorioamnionitis – *John Hale, MD*
10. Optimal baseline mean arterial pressure for the management of spinal hypotension in women undergoing elective cesarean delivery: a case-control study analysis – *Brendan Carvalho, MD*
11. Impact of nitrous oxide on parturient recall of neuraxial analgesia risks – *Benjamin Brakke, MD*

### Concurrent Breakout Room #5 - Hematologic/Uterotonics/Bleeding

*Marquette – 3<sup>rd</sup> floor*

Moderator: Mohamed Tiouririne, MD

1. Factor XI Deficiency: A Retrospective Review – *Michael Balot, MD*
2. Factor XI Deficient Parturient Management for Neuraxial Anesthesia: Narrative review – *Kate Balbi, MD*
3. Measured vs calculated blood loss at cesarean delivery: correlation and practical use – *Graham White, MD*
4. The effect of a standardized checklist and multidisciplinary care team on outcomes for planned hysterectomy at time of cesarean delivery: a single center retrospective study – *Michael Hofkamp, MD*
5. Anemia in Pregnancy and Social Determinants of Health: An Institutional Retrospective Cohort Study – *Ioannis Angelidis, MD*
6. Low-dose oxytocin protocol made no difference in quantitative blood loss in elective Caesarean sections; a single-center, retrospective cohort study – *Courtney Hood, MD*
7. Cost savings and Prevention of Uterotonics Wastage- A Quality Improvement Project – *Shibinath Velutha Mannil, MD*
8. When Enough is Enough: A retrospective study of oxytocin delivery before and after implementation of the “Rules of Three” dosing algorithm – *Kathryn Hackett, MD*
9. Automated alert system of second-line uterotonic drug administration – *Gillian Abir, MD*
10. Implementation and feasibility of a uterine tone communication and documentation tool for cesarean delivery embedded in the anesthesia information management system – *Jessica Ansari, MD*
11. Trends in blood product usage and cost in obstetrical anesthesia: a single site study – *Soniya Sharma, MD*

### Concurrent Breakout Room #6 – Fetus/Neonatal Outcomes

*Williford B – 3<sup>rd</sup> floor*

Moderators: Laurent Bollag, MD & Carolyn Weininger, MD

1. Sex-dependent metabolic programming of the offspring after induced birth with oxytocin – *Arvind Palanisamy, MD*
2. Intrapartum epidural fentanyl dose, meconium opioid concentration and short-term neonatal outcomes – *Ruth Landau, MD*
3. Association of chronic maternal opioid use, fetal exposure and short-term adverse neonatal outcomes – *Ruth Landau, MD*
4. Pregnancy Outcomes Associated Sugammadex Reversal of Neuromuscular Blockade in Pregnant Patients Undergoing Non-Obstetric Surgery During Pregnancy – *Grace Lim, MD*
5. A comparison of fetal outcomes between with and without the use of sugammadex in pregnant patients undergoing non-obstetric surgery: A multicenter retrospective study – *Shohie Noguchi, MD*
6. Incidence of maternal and fetal/neonatal outcomes in morbidly obese parturients undergoing spinal anesthesia for elective cesarean delivery at term – *Ling-Tianna Xia, DO*
7. Fetal Surgery During the COVID-19 Pandemic: A Decision Support Algorithm for Managing Ethical and Clinical Conundrums – *Caitlin Sutton, MD*
8. Comparison of maternal arterial blood gas differences between oxytocin antagonist atosiban and beta-agonist terbutaline in fetal surgeries for correction of myelomeningocele - prospective cohort study – *Shirley Santos, MD*
9. Breastfeeding after Anesthesia: Giving the Greenlight – *Amy Bingham, MD*
10. Readability, content, quality, and accuracy assessment of cannabis and pregnancy patient education materials – *Matthew Sikora, MD*
11. Racial and Ethnic disparities in Obstetric Anesthesia: Scoping Review – *Won Lee, MD*

## Thursday, May 12 - Continued

### Concurrent Breakout Room #7 – Labor Analgesia

*Williford C – 3<sup>rd</sup> floor*

Moderators: Emily McQuaid, MD & Hans Sviggum, MD

1. A Retrospective Cohort Study Comparing Catheter Replacement Rates with Programmed Intermittent Epidural Bolus and Continuous Epidural Infusion – *Brendan Morgan, MD*
2. A Trial to Determine the Optimal Bupivacaine Dose for Initiation of Labor Epidural Pain Relief – *Diego Villela-Franyutti, MD*
3. Timing of labor epidural analgesia placement among primigravida non-White and non-English speaking patients: A retrospective cohort study – *Mario Lumbreras-Marquez, MD*
4. Mindful Meditation for Epidural Catheter Placement During Labor: A Single-Center Randomized Controlled Trial – *Mario Lumbreras-Marquez, MD*
5. Communication, education, and beliefs about epidurals among Spanish-speaking parturients; a pilot cross-sectional study – *Elizabeth Ozery, MD*
6. A comparison of neuraxial labor analgesia utilization rates before and during the COVID-19 pandemic: a single center retrospective study – *Michael Hofkamp, MD*
7. The Effect of Chorioamnionitis on Achieved Labor Analgesia – *Jakayla Harrell, MD*
8. Case failure rate of Spinal Anesthesia and Combined Spinal-Epidurals in the super morbidly obese obstetric patient population – *Safir Abbas, MD*
9. A patient-centered, algorithm-based management of epidural analgesia for labour and delivery: A prospective observational cohort study – *Natalia Portela, MD*
10. Evaluation of Distal Epidural Catheter Pressure Generation: An in-vitro study – *William Turner, MD*

5:00pm

Dinner On Your Own



# MISSION

To advance and advocate for the health of pregnant women and their babies through research, education, and best practices in obstetric anesthesia care

Safe and equitable care  
for women and newborns  
everywhere

# VISION

# CORE VALUES

Care  
Excellence  
Professionalism  
Respect  
Diversity  
Inclusivity



## FRIDAY, MAY 13

*\*all times are listed in Central Time*

*All meetings are in International North Ballroom unless otherwise noted.*

6:30am Registration Opens

7:00am – 9:00am Continental Breakfast in Expo Hall  
International South Ballroom

7:45am – 8:00am Opening Remarks  
Rebecca Minehart, MD; Brandon Togioka, MD

8:00am – 10:00am Research Posters Session #2  
Third Floor Breakout Rooms

### Concurrent Breakout Room #1 – Abnormal Placenta & Coagulation

Waldorf – 3<sup>rd</sup> floor

Moderators: Jennifer Banayan, MD & Jeanette Bauchat, MD

1. An Obstetric-specific Surgical Apgar Score (ObSAS) predicts maternal morbidity from cesarean hysterectomy for Placenta Accreta Spectrum (PAS) – *Jessian Munoz, MD*
2. Patient-Centered Outcomes Associated with Delayed Hysterectomy in Severe Placenta Accreta Spectrum – *Laura Sorabella, MD*
3. Strong Linear Correlation Between Functional Fibrinogen by Thromboelastography 6s and Fibrinogen Level by Clauss Method in Pregnant Women – *Anna Moldysz, MD*
4. Normal Thromboelastography 6s Values During Third Trimester of Pregnancy – *Anna Moldysz, MD*
5. Variability in Preparation for Placenta Accreta Spectrum Surgery – *Phil Hess, MD*
6. When To Cross: A single center retrospective study of transfusion stewardship for patients with placenta accreta spectrum disorder – *Jessica Kruse, MD*
7. Obtaining a Reference Range for Rotational Thromboelastometry (ROTEM) in the Obstetric Population at Northwestern Memorial Hospital (NMH). A Prospective Single-Center Study – *Pauline Ripchik, MD*
8. Intraoperative red blood cell transfusion: A systematic review and meta-analysis in patients with placenta accreta spectrum – *Alex Butwick, MD*
9. Anesthetic Techniques During the Development of a Novel Surgical Approach To Placenta Accreta Spectrum Disorder: A Case Series – *Mercades Meuli, MD*
10. Utilizing Rotational Thromboelastography to Evaluate Coagulation Status in COVID-19 Positive Parturients – *Samantha Abel, MD*
11. Racial/Ethnic Differences on Baseline Coagulation Parameters using Point of Care Viscoelastic Testing for Obstetric Patients – *Jin Yoo, MD*

### Concurrent Breakout Room #2 – Cesarean Delivery

Joliet – 3<sup>rd</sup> floor

Moderators: Alex Butwick, MD & Jennifer Dominguez, MD

1. Administration of intravenous adjuvants during cesarean delivery: retrospective cohort study comparing intrapartum versus non-intrapartum cesarean deliveries – *Michael Kim, MD*
2. Reduction of General Anesthesia Rate by Improving Multidisciplinary Communication Before Unscheduled Cesarean Sections – *Andrea Girmius, MD*

## Friday, May 13 - Continued

3. Rates of General Anesthesia for Cesarean Delivery in Women Identifying a Non-English Language as Their Primary Language: A Quality Improvement Project – *Monique Osigbeme, MD*
4. Racial Disparities in Pain after Cesarean: Implementation of a Plan-Do-Study-Act (PDSA) Improvement Process – *Joseph Reno, MD*
5. General anesthesia for cesarean delivery in African Americans: The needle has not moved – *Daniel Couper, MD*
6. Inequities in Cesarean Delivery during the COVID-19 Pandemic – *Trung Pham, MD*
7. General anesthesia at time of emergent cesarean delivery and adverse neonatal outcomes – *Savannah Dellapiana, MD*
8. Relationship Between Maternal Satisfaction and Quality of Recovery After Cesarean Delivery: A Mixed-Methods, Prospective, Observational Study – *Robert Ffrench-O'Carroll, MD*
9. A Retrospective Study: Factors Associated with Conversion of Neuraxial Anesthesia to General Anesthesia for Cesarean Delivery – *Nikhil Kamath, MD*
10. The effect of encouraging a combined spinal epidural technique for cesarean delivery: a single center retrospective study – *Alexa Borja, MD*
11. General anesthesia and systemic anesthetic adjunct medication administration rates at a level 4 maternity care center from 2019-2021: a single center retrospective study – *Hadley Young, MD*
12. Choice of anesthetic technique for dilation and curettage for pregnancy loss in first and second trimesters: a single center retrospective study – *Alexandria L. Carlson, BS*

### Concurrent Breakout Room #3 – Obesity

*PDR#2 – 3<sup>rd</sup> floor*

Moderators: Jake Beilin, MD & Carlos Delgado, MD

1. Anesthetic Management of Patients with Class 3 Obesity Undergoing Elective Cesarean Delivery – *Oscar van den Bosch, MD*
2. Labor Epidural Anesthesia Neuraxial Outcomes in Super Morbidly Obese Patients as compared to General Population – *Ahmed Butt, MD*
3. Impact of Super Morbid Obesity on Duration of Admission in Patients Undergoing Cesarean Section – *Trent Weatherley, MD*
4. Comparing the Comorbidities in Super Obese Patients Who Received Labor Anesthesia Who Had Vaginal Deliveries vs Cesarean Deliveries – *Mauricio Ramos Lozano, MD*
5. Epidural Depth Required in Super Morbidly Obese Patients as Compared to General Population – *Mauricio Ramos Lozano, MD*
6. General Anesthesia in Super Obese Parturients for Labor and Delivery, a Retrospective Study of a Single Institution – *Kristine Lane, MD*
7. Complications and Outcomes for Emergent vs. Nonemergent Cesarean Delivery in Super Morbidly Obese Patients – *Mario Zuniga Palma, MD*
8. Labor Anesthesia and Delivery Modalities in Super Obese Patients Receiving Anesthesia – *James Lane, MD*
9. Hemodynamics of Cesarean Section in Super Obese Patients Comparing Phenylephrine and Estimated Blood Loss – *James Lane, MD*
10. Improving Nursing Compliance with Ventilatory Checks after Neuraxial Morphine Administration – *Erin Dengler, MD*
11. Nursing requirements post-implementation of Society for Obstetric Anesthesia & Perinatology (SOAP) guidelines for prevention and detection of respiratory depression with neuraxial morphine use – *CeCe Cheng, MD*

### Concurrent Breakout Room #4 – Postpartum Headache, Depression, and Skilled Nursing Care

*Astoria – 3<sup>rd</sup> floor*

Moderators: Shubhangi Singh, MD

1. Accidental Dural Puncture Management and Outcomes Following Obstetric Anesthesia at an Academic Medical Center – *Caley Butler, MD*
2. Association between headache and childbirth in a chronic pain population: A cross-sectional study including 1018 patients – *Jessica Ansari, MD*
3. Prevalence and Management Guidelines for Parturients with Idiopathic Intracranial Hypertension at an Academic Institution – *Mikayla Troughton, MD*
4. Persistent Intracranial Hypotension Headache after Unintentional Dural Puncture in Obstetric

## Friday, May 13 - Continued

- Patients: A Prospective Cohort Study – *Anne Wanaselja, MD*
5. Virtual Reality Biofeedback for Postpartum Anxiety and Depression – *Grace Lim, MD*
  6. Long-term Complications of Unintentional Dural Puncture During Labor Epidural Analgesia: A Case-Control Study – *Alexandre Lacombe, MD*
  7. Incidence of post-dural puncture headache during labor analgesia in two time matched retrospective cohorts – A quality study – *Wesley Rajaleelan, MD*
  8. Clinical characteristics and biomarkers associated with perinatal depression and persistent pain in parturients undergoing cesarean delivery – *Mary Yurashevich, MD*
  9. Ketamine to prevent postpartum depression after planned cesarean delivery under neuraxial anesthesia. A randomized feasibility pilot-study of intravenous and subcutaneous administration – *David Monks, MD*
  10. The Futility of Cosyntropin in the Management of Post-Dural Puncture Headache: a Propensity-Matched Retrospective Analysis – *Mingchun Liu, MD*
  11. Development of an Institutional Protocol for Collaborative Care of Pregnant Patients Undergoing Electroconvulsive Therapy – *Mingchun Liu, MD*

### Concurrent Breakout Room #5 – Cesarean Delivery (general anesthesia)

*Marquette – 3<sup>rd</sup> floor*

Moderators: Richard Month, MD & Mark Zakowski, MD

1. Comparison of umbilical pH between subjects who had cesarean deliveries under general and regional anesthesia for the indication of fetal heart rate abnormalities: a single center retrospective study – *Grace Steel, MD*
2. The effect of a dedicated video laryngoscope in the labor and delivery suite on airway management for cesarean deliveries performed under general anesthesia: a single center retrospective study – *Alyson, Win, BS*
3. Quality Assurance Methods to Reduce General Anesthesia Rates in Cesarean Delivery – *Christopher Smith, MD*
4. Patient-reported outcome measures to assess postpartum fatigue: a systematic review using COSMIN guidelines – *Perman Pandal, MD*
5. Quality of recovery in Hispanic versus non-Hispanic patients following vaginal delivery – *Perman Pandal, MD*
6. Impact of an interdisciplinary process to increase utilization of neuraxial anesthesia for cesarean delivery: A retrospective database analysis – *Carolyn Weiniger, MD*
7. Retrospective database study to investigate the effect of phenylephrine infusion versus vasopressor boluses during cesarean delivery on neonatal acidosis – *Carolyn Weiniger, MD*
8. Adult Attachment Style as a predictor of increased pain after cesarean delivery: a prospective observational study – *Allen Li, MD*
9. Anesthesia Management for Intrapartum Cesarean Delivery: A Retrospective Comparison Between Extended Epidural and New Spinal Anesthesia – *Allison Mootz, MD*
10. Guideline concurrence of timing of sodium citrate administration prior to general anesthesia for cesarean delivery: A retrospective analysis – *Caroline Thomas, MD*

### Concurrent Breakout Room #6 – COVID Education/Global Health

*Williford B – 3<sup>rd</sup> floor*

Moderator: Arvind Palianisamy, MD

1. COVID Peripartum Management – *Michael McGinnis, MD*
2. Obstetric services in the UK during the Covid-19 pandemic: a national survey of standards of care – *James O'Carroll, MD*
3. COVID-19 and the Impact on Pregnancy Outcomes – *Julia Katz, MD*
4. #OBAnes: a characterization and analysis of Twitter conversations during the onset of the COVID-19 pandemic – *Aubri Robinson, MD*
5. Development of a milestone-based competency list for obstetric anesthesia residency training through Delphi expert consensus – *Maytinee Lilaonitkul, MD*
6. Social Media Presence of Obstetric Anesthesiology Fellowship Programs – *Thomas Gruffi, MD*
7. Anesthesia resident preferences regarding learning to perform neuraxial procedures in obstetrics – a qualitative phenomenological approach – *Giselle Jaconia, MD*
8. Serious gaming to learn how to perform general anesthesia for cesarean delivery: a randomized

## Friday, May 13 - Continued

- controlled trial comparing two debriefing methods – *Allison Lee, MD*
9. Inpatient Postpartum Recovery of Nulliparous women following Elective Cesarean Delivery and Spontaneous Vaginal Delivery in Japanese – *Yusuke Mazda, MD*
  10. Time Series Analysis of Racial Disparities in Postpartum Care during the COVID-19 Pandemic: A Real-World Data Study – *Jie Zhou, MD*
  11. The Influence of a Kybele Teaching Program on the use of regional anesthesia for labor and cesarean delivery, during COVID-19 pandemic, in Tuzla, Bosnai and Herzegovina – *Ivan Velickovic, MD*
  12. Generation of Obstetric Anesthesia Entrustable Professional Activities through a Delphi methodology in Colombia – *Carolina Rincón, MD*

### Concurrent Breakout Room #7 – Post Cesarean Pain & Recovery

*Williford C – 3<sup>rd</sup> floor*

Moderators: Erin Ciampa, MD & David Gambling, MD

1. Quality of recovery after unplanned and planned cesarean deliveries – an application of ObsQoR-10 tool – *Andrea Gomez, MD*
2. Development and validation of a Turkish version of Obstetric Quality of Recovery-10 (ObsQoR-10-Turkish) – *James O'Carroll, MD*
3. A systematic review of patient-reported outcome measures for maternal postpartum depression using the Consensus-based Standards for the selection of health Measurement Instruments (COSMIN) checklist – *James O'Carroll, MD*
4. Continuous Wound Infusions Added to a Multimodal Analgesia Regimen for Cesarean Delivery: A Quality Improvement Practice Change Evaluation – *Cedar Fowler, MD*
5. Implementation of a Standardized Post-cesarean Analgesia Protocol for Patients on Chronic Buprenorphine Associated with Decreased Pain Scores and Opioid Consumption – *Jenny Kim, MD*
6. Effect of Dexamethasone as an Adjuvant Analgesic for Quadratus Lumborum Block Following Cesarean Delivery: A Retrospective Review – *Adem Idrizi, MD*
7. Incidence of oral hydromorphone use after elective cesarean delivery under spinal anesthesia: a clinical audit – *Luc Saulnier, MA*
8. Interim Safety and Efficacy of HTX-011 Administered Postpartum to Women Undergoing a Planned Caesarean Section – *Katie Luepke, MD*
9. Patient and staff satisfaction and confidence in a continuous wearable monitor to detect respiratory depression following neuraxial opioid use for postoperative pain relief after cesarean section – *Attila Kett, MD*
10. Acute Postpartum Pain and Anxiety Influence Long-term Postpartum Pain, Maternal-Infant Attachment and Parenting Self-Efficacy – *Mutasim Makeen, MD*
11. Quantitative Sensory Correlates of Pain in Pregnant Women with Opioid Use Disorder – *Bryna Torre, MD*
12. The effect of epidural administration of a small dose (0.75 mg) of morphine on postpartum pain relief after vaginal delivery: A randomized, single-blind study – *Hiroki Kondo, MD*

10:00am – 10:15am **BREAK in Expo Hall**  
*International South Ballroom*

10:15am – 11:25am **Gertie Marx Research Competition**

Moderator: Ashraf Habib, MD

Judges: Ruth Landau, MD  
Anton Chau, MD  
Feyce Peralta, MD  
Michaela Farber, MD  
Jake Beilin, MD

- Ketorolac Inhibits Platelet Function After Cesarean Delivery – *Anna Moldysz, MD*
- Spontaneous and oxytocin-induced contractility after exposure to intravenous anesthetic agents: an in-vitro study in human myometrium – *Natalia Portela, MD*
- A multicenter evaluation of quality of recovery following cesarean delivery – *James O'Carroll, MD*
- Fetal Delivery During Maternal Mechanical Ventilation for Severe COVID-19: The Relationship of Maternal PaO<sub>2</sub>, PaCO<sub>2</sub>, and Acid-Base Status on Neonatal Outcomes – *Katelyn Scharf, MD*
- Changes in sensory block level during a programmed intermittent epidural bolus regimen for labor analgesia: a prospective observational cohort study – *Julia Casellato, MD*

## Friday, May 13 - Continued

11:30am – 12:30pm LUNCH ON YOUR OWN

Sponsored Lunch – Rivanna (No CME)  
“Zoie was told an epidural would be impossible”  
Case Study and Q&A Presented by Stephen Garber, MD  
*Pre-registration required; seating is limited*

Sponsored Lunch – The Fortune Law Firm (no CME)  
Mythbusters: Myths Doctors Believe Regarding Taxes, Lawsuits, and Estate Planning that  
put your Life and Practice at Risk  
*Pre-registration required; seating is limited*

12:30pm – 1:00pm BREAK in Expo Hall  
*International South Ballroom*

1:00pm – 1:45pm Oral Presentations  
Moderator: Ron George, MD, FRCPC

1. Acute Pain After Vaginal Delivery and Subsequent Persistent Opioid Use – *Grace Lim, MD*
2. Obstetric pain management for women with opioid use disorder: A longitudinal, Qualitative mixed-methods Evaluation of patients and provider perspectives (The QUEST Study) – *Sanjana Dayananda, MD*
3. Need of packed red blood transfusion before and after the inclusion of intraoperative continuous non-invasive hemoglobin monitoring technology in a real-life setting in a developing country – *Yuliana Olivero, MD*
4. Multimodal Analgesia Use After Cesarean Delivery Under General Anesthesia – *Nicole Zanolli, MD*
5. Is there an association of labor neuraxial analgesia with autism spectrum disorder in children? A systematic review and meta-analysis – *Mario Lumbreras-Marquez, MD*

1:45pm – 2:50pm Fred Hehre Lecture  
Intro: Lisa Leffert, MD  
Speaker: Robert Gaiser, MD

2:50pm – 3:00pm BREAK

3:00pm – 5:00pm Sol Shnider Clinical Track #1  
Moderator: Greg Palleschi, MD

- Update on POCUS – *Laurie Chalifoux, MD*
- Management of Common Cardiac Disorders on Labor & Delivery – *Marie-Louise Meng, MD*
- Preeclampsia: What Are we Doing Now? – *Emily McQuaid, MD*
- Update on PDPH – *Robert White, MD*

6:00pm – 7:00pm SOAP “Meet Up” Reception with cash bar  
*Normandie Lounge*

7:00pm [Dinner on your Own](#)



## Experience

Deliver a beneficial year-round experience for members that provides a safe environment for the exchange of knowledge, best practices, successes and challenges

### Supporting Efforts

- Provide a content-rich Annual Meeting
- Ensure members receive year-round value and engagement from their memberships
- Deliver impactful educational opportunities and learning resources
- Advance obstetric anesthesia research
- Communicate with members in effective and beneficial ways

## Community

Build a diverse, inclusive, engaged membership community that reflects the values and purposes of SOAP

### Supporting Efforts

- Ensure a welcoming and inclusive society
- Build strong, mutually beneficial strategic partnerships
- Advocate for our patients and profession; establish best practices
- Elevate the next generation of professionals

## Infrastructure

Develop an infrastructure that provides effective operations and aligns our governance model with the changing needs of our organization and environment

### Supporting Efforts

- Provide meaningful opportunities for members to engage
- Develop a cohesive and inclusive leadership team
- Ensure financial sustainability and growth
- Operate efficiently, transparently and consistently
- Solidify SOAP's brand and focus



## SATURDAY, MAY 14

*\*all times are listed in Central Time*

*All meetings are in International North Ballroom unless otherwise noted.*

7:00am Registration Opens

7:00am – 9:00am Continental Breakfast in Expo Hall  
*International South Ballroom*

7:50am – 8:00am Opening Remarks  
Amy Lee, MD; Brandon Togioka, MD

8:00am – 10:00am Sol Shnider Clinical Track #2  
Moderator: Nakia Hunter, MD

- Parturient with Substance Abuse Disorder – *Katie Seligman, MD*
- Diversity & Inclusivity in the Workplace – *Jen Lucero, MD*
- What's New in Postpartum Hemorrhage – *Jaime Daly, MD*
- Obesity in the Parturient – *Kathleen Smith, MD*

10:00am – 10:15am BREAK in Expo Hall  
*International South Ballroom*

10:15am – 11:30am Best Case Reports – So You Did What?  
Moderator: Emily Sharpe, MD  
Panelist: Brenda Bucklin, MD  
Richard Wissler, MD  
Katie Arendt, MD

1. Sustained Vasovagal Response Requiring Transvenous Pacing after Bakri balloon placement: A Case Report – *Won Lee, MD*
2. Reaction(R) Time prolongation on TEG in Parturients with Antiphospholipid Syndrome after discontinuation of Heparin – *Mohammed Idris, MD*
3. Cardiovascular Collapse, Multi-Chamber Intracardiac Thrombosis, and Disseminated Intravascular Coagulation Following Dilatation & Evacuation in a Post-partum Cardiomyopathy Patient – *Hilary Gallin, MD*
4. Cushing's Syndrome in Pregnancy: A Diagnostic Dilemma – *Caroline Thomas, MD*
5. Medically Challenging Case: Intracranial hemorrhage in a pregnant patient with HELLP syndrome – *Mohammed Hussain, MD*
6. Severe Factor XI Deficiency in a Jehovah's Witness Parturient – *Shradha Khadge, MD*
7. Lymphangiomyomatosis (LAM) Complicated by Bilateral Pneumothorax in Pregnancy: A Case Report – *Michael Kim, MD*
8. Neurocovid in the Peripartum Period – *Monique Osigbeme, MD*
9. Anesthetic Management for Cesarean Delivery of a Parturient with COVID-19 Infection while on Extracorporeal Membrane Oxygen Support – *Samantha Rubright, MD*
10. Preterm delivery in a patient with spontaneous hemoperitoneum in pregnancy and concurrent placenta accreta – *Emily Nasser, MD*

11:30am – 12:30pm LUNCH ON YOUR OWN

Sponsored Lunch – Legally Mine  
“Keys to Lawsuit Prevention, License Protection and Tax Savings”  
*For U.S. practicing physicians only.*  
*Pre-registration required; seating is limited*

Couch Session: SOAP Mentorship Academy  
Feyce Peralta, MD; Grace Shih, MD

12:30pm – 1:00pm

ASA Update

12:30pm – 12:40pm Acknowledgments & Intro:

Ted Yaghmour, MD, FASA, President, SOAP

12:40pm – 1:00pm Speaker: Randall Clark, MD, FASA, President, ASA

1:00pm – 2:00pm

Gerard W. Ostheimer Lecture

Intro: Grace Lim, MD, M.S.

Speaker: Michaela Farber, MD, M.S.

2:00pm- 2:15pm

SOAP Distinguished Service Award

Intro: Michael Paesch, MD

Recipient: Craig Palmer, MD

2:15pm – 2:30pm

SOAP Awards Ceremony

Ted Yaghmour, MD, FASA

2:30pm – 3:30pm

BREAK in Expo Hall

Special Interest Groups (SIGs) Meet Up

*International South Ballroom*

3:30pm - 6:30pm

Resident/Fellow Case Presentations

*Third Floor Breakout Rooms*

Concurrent Breakout Room #1

*Waldorf – 3<sup>rd</sup> floor*

Moderators: Liane Germond, MD & Amy Lee, MD

Nakiyah Knibbs, MD

Corrine Weinstein, MD

1. Sustained Vasovagal Response Requiring Transvenous Pacing after Bakri balloon placement: A Case Report – *Won Lee, MD*
2. Reaction(R) Time prolongation on TEG in Parturients with Antiphospholipid Syndrome after discontinuation of Heparin – *Mohammed Idris, MD*
3. Cardiovascular Collapse, Multi-Chamber Intracardiac Thrombosis, and Disseminated Intravascular Coagulation Following Dilatation & Evacuation in a Post-partum Cardiomyopathy Patient – *Hilary Gallin, MD*
4. Cushing's Syndrome in Pregnancy: A Diagnostic Dilemma – *Caroline Thomas, MD*
5. Ruling out an epidural arteriovenous malformation in a parturient with Hereditary Hemorrhagic Telangiectasia – *Jayne Manigrasso, MD*
6. Serial ocular ultrasound as a surrogate of fundoscopic examination in a parturient with suspected elevated intracranial pressure. – *Adeeb Oweidat, MD*
7. Intracranial Abscess in a Primigravida: An Interdisciplinary Approach – *Lauren Blake, MD*
8. Medically Challenging Case: Intracranial hemorrhage in a pregnant patient with HELLP syndrome – *Mohammed Hussain, MD*

## Saturday, May 14 - Continued

9. Pregnancy-associated Complement-mediated Thrombotic Microangiopathy: diagnostic dilemma – *Kate Balbi, MD*
10. The High-Risk Hemorrhage Cesarean Section That Wasn't: Advanced Planning Meets Great Luck – *Kathryn Davis, MD*
11. Management And Cesarean Delivery Of A Parturient With Refractory AF-RVR And Severe Peripartum Cardiomyopathy – *Tilman Chambers, MD*
12. Severe Factor XI Deficiency in a Jehovah's Witness Parturient – *Shradha Khadge, MD*
13. Lymphangiomyomatosis (LAM) Complicated by Bilateral Pneumothorax in Pregnancy: A Case Report – *Michael Kim, MD*
14. Delayed Postpartum Hemorrhage in a Parturient with Glanzmann Thrombasthenia – *Brian Taussig, MD*
15. Neurocovid in the Peripartum Period – *Monique Osigbeme, MD*
16. Successful Antepartum De-labelling of Local Anesthetic Allergy in a Parturient with a Self-Reported Allergy to Amide and Ester Local Anesthetics – *Eduardo Yamaguchi, MD*
17. Acute right middle cerebral artery stroke and bilateral carotid artery dissection in a one-week postpartum patient with SARS CoV-2 infection – *Katelyn Scharf, MD*
18. Early extra-corporeal membrane oxygenation cannulation for COVID-19 positive parturients – *Maitri Shah, MD*
19. Bicuspid aortic valve with Aortopathy during pregnancy: coming soon to your L&D suite – *Matthew Sikora, MD*
20. Transfusion Exclusion with Dwindling Perfusion: Management of Postpartum Hemorrhage and Severe Anemia in a Jehovah's Witness Patient – *Samantha Sohnen, MD*
21. Moyamoya Disease in Pregnancy – *Cassie Wernke, MD*
22. Placental Reninoma: an Atypical Case of Hypertension During Pregnancy – *Bosi Zhang, MD*
23. Refractory hypothermia following neuraxial opiate administration in the peripartum population – *Yun Xia, MD*
24. The Golden Hour: Intraoperative Preparation and Management for Neonatal Congenital Erythropoietic Porphyria – *Elliott Callahan, MD*
25. Differential Diagnosis and Management of Seizures During Cesarean Section – *Casey Cuccio, MD*

### Concurrent Breakout Room #2

*Joliet – 3<sup>rd</sup> floor*

Moderators: Arthur Calimarian, MD & Holly Ende, MD  
Christopher "Tyler" Smith, MD & Jessica Ansari, MD  
Constandionos Papagerorgiou, MD

1. Primary Mediastinal B cell lymphoma (PMBL) - Timing of Treatment and Contraception Counseling During Pregnancy – *Dhruv Choudhry, MD*
2. Anesthetic Management for Cesarean Delivery of a Parturient with COVID-19 Infection while on Extracorporeal Membrane Oxygen Support – *Samantha Rubright, MD*
3. Atrial Fibrillation as Maternal Presentation of Mirror Syndrome – *Alexander Samworth, MD*
4. Thrombotic Thrombocytopenic Purpura in a Parturient Leading to Life Threatening Thrombocytopenia and Fetal Demise – *Amnon Berger, MD*
5. Management of a Parturient with Russell Silver Syndrome, Cerebral Palsy, and HELLP Syndrome – *Amy Zheng, MD*
6. General Anesthesia for a Cesarean in patient with Anterior Mediastinal Mass – *Nathaniel Liu, MD*
7. Anesthetic Management of a Parturient with Fibrosing Mediastinitis – *Monique Osigbeme, MD*
8. Symptomatic Hemothorax Caused by a Ruptured Pulmonary Arteriovenous Malformation in Pregnancy – *James Damron, MD*
9. Hypertriglyceridemia-Induced Acute Pancreatitis During Pregnancy: A Case Report – *Jamal Egbaria, MD*
10. Emergency Anesthetic Management for a Concurrent Subdural Hematoma Evacuation and C-Section in a Pregnant Trauma Patient – *Ellen Stallings, MD*
11. Management Of A Parturient With Congenital Fiber Type Disproportion Myopathy – *Shibinath Velutha Mannil, MD*
12. Hereditary Angioedema in a Parturient who Presents for Induction of Labor – *Ioannis Angelidis, MD*
13. The Texas Heartbeat Act: Affecting the parturient one beat at a time – *Kendra Brown, MD*
14. Severe Hyponatremia in Preeclampsia – *Ashlee Gourdine, MD*
15. Anesthetic Planning for Delivery for a Patient with Titin-Truncating Variant Mutation Complicated by Complex Arrhythmia – *Kiana Nguyen, MD*

## Saturday, May 14 - Continued

16. Management Of Refractory Thrombocytopenia In A Parturient With Twin Gestation, Asymptomatic SARS-CoV-2 And Mild Pre-eclampsia – *Tilman Chambers, MD*
17. Anesthetic Considerations in a Parturient with Neurofibromatosis Type 1: A Case Report – *Candice Cuppini, MD*
18. Shoulder pain as an early sign of uterine rupture – *Preshita Date, MD*
19. Undiagnosed Dilated Cardiomyopathy Complicating Severe Pre-Eclampsia – *Mickael Khouzami, MD*
20. Consideration for Spinal Anesthesia in a Thrombocytopenic Patient – *Ashley Lewis, MD*
21. Anesthetic Management for Cesarean Section in Morbidly Obese Parturient with History of Multiple Sclerosis & Scoliosis Surgery – *Renjith Maracheril, MD*
22. Delivery of Mother and Child with Osteogenesis Imperfecta – *Allison Mullins, MD*
23. Mast Cell Activation Syndrome and Analgesic Management in the Parturient – *Kaila Nicolson, MD*
24. Anesthetic Management of Postpartum Patient with Huntington's Disease – *Ludovic Pao, MD*
25. Anesthetic management of term parturient with congenital hypofibrinogenemia for repeat cesarean delivery – *Maitri Shah, MD*

### Concurrent Breakout Room #3

*PDR#2 – 3<sup>rd</sup> floor*

Moderators: Adrienne Ray, MD & Amy Cassidy, MD  
Brittany Raymond, MD & Jane Huffnagle, MD  
David Gutman, MD & Dave Monks, MD

1. Surgical abortion during the second trimester in a patient with plasminogen activator inhibitor type 1 deficiency – *Joanna Ghobrial, MD*
2. Persistent Inadequate Analgesia as Identifier of Uterine Window In Nulliparous Parturient: A Case Report – *Eleanor Kenny, MD*
3. Blood Return in an Epidural Catheter, Followed by Disseminated Intravascular Coagulation: A Case Report – *Eleanor Kenny, MD*
4. Near Fatal Asthmatic Exacerbation in Pregnancy – *Marshal Lu, MD*
5. Awake fiberoptic intubation and tracheostomy for a parturient with submandibular abscess – *Jessica Yeh, MD*
6. Chloroprocaine Epidural Analgesia in Local Anesthetic Resistance – *Kevin Beitz, MD*
7. Cesarean delivery in a patient with severe aortic stenosis secondary to bicuspid aortic valve in need of concomitant aortic valve replacement – *Kendra Brown, MD*
8. To cannulate or not– that is the question: a multidisciplinary team approach to prophylactic ECMO cannulation in a morbidly obese patient with cardiomyopathy – *Joe Bryant-Huppert, MD*
9. Family Member Mishaps on Labor and Delivery: How Close is Too Close? – *Jose Gallardo Vega, MD*
10. Neuraxial Anesthesia in a Patient with a Chronic Epidural Cerebrospinal Fluid Collection – *Hilary Gallin, MD*
11. Management of a 62 Year Old Parturient with Severe Preeclampsia – *Lana Glantz, MD*
12. Successful Labor Neuraxial Analgesia in Parturient with Suspected Bernard-Soulier Syndrome – *William Hart, MD*
13. Pregnancy and COVID 19: Cesarean Delivery on ECMO – *Dorene Hinton, MD*
14. Awake Craniotomies In Pregnancy: To Use Dexmedetomidine Or Not To Use Dexmedetomidine – *Pamela Huang, MD*
15. Not All Maternal Seizures are Eclamptic: A Case of Acute Maternal Water Intoxication – *Stephanie Kierstead, MD*
16. Perioperative management of a parturient with untreated bilateral pheochromocytomas. – *Dean Thorsen, MD*
17. Sudden Onset of Severe Headache with Emesis in Postpartum Woman with Corrected Chiari I Malformation – *Alyssa Streff, MD*
18. Delivery Considerations for the Parturient with Conjoined Twins and Postnatal Palliative Care – *Alyssa Streff, MD*
19. Delivery Planning in a Parturient with End Stage Systemic Sclerosis: When a General Anesthesia is Not an Option – *Pedro Acevedo-Rodriguez, MD*
20. Pregnancy complicated by Subdural Hematomas: A case report – *Rochelle Johns, MD*
21. Penicillin Infusion Through Epidural Catheter: A Case of Wrong Drug Administration – *Brittini Lanoux, MD*
22. Considerations for Surgery in Cirrhotic Patients with Subacute Hepatic Decompensation During Pregnancy – *Leilani Sampang, MD*
23. A super morbid obese patient with Wolff-Parkinson-White Syndrome and supraventricular tachycardia in

## Saturday, May 14 - Continued

- need of a cesarean delivery – *Kendra Brown, MD*
24. Hemorrhagic Shock in an Obstetric Patient Secondary to Ruptured Couvelaire Uterus Resulting in Emergent Cesarean Hysterectomy with Massive Transfusion Protocol – *Radhika Chalasani, MD*
  25. Consideration for Early ECMO Cannulation in the Pregnant Patient with Severe COVID Disease: A Case Report – *Erin Dengler, MD*

### Concurrent Breakout Room #4

*Astoria – 3<sup>rd</sup> floor*

Moderators: Adrienne Ray, MD & Tracey Vogel, MD  
John Kowalczyk, MD  
Cristina Wood, MD & Joshua Hamburger, MD

1. Severe Fetal Brain Damage as a Complication of Acute Maternal Hypoxemia in Covid-19 – *Eve Bishop, MD*
2. Labor Epidural in a Parturient with a Lumboperitoneal Shunt – *Carolina Blotte, MD*
3. Acute Systolic Dysfunction During Emergent Cesarean Delivery – *Andrew Davis-Sandfoss, MD*
4. Can chronic aortic dissection and preeclampsia coexist? – *Jennifer Hoayek, MD*
5. Combined Spinal Epidural for an Intrauterine Term Therapeutic Fetal Paracentesis in a Multiparous Parturient with Substance Use Disorder – *Lauren Newhouse, MD*
6. Disc Herniation During Labor Requiring Emergent Surgery – *Alex Pham, MD*
7. Pregnant patient with intracranial hypertension secondary to brain abscesses undergoing an emergency cesarean section: A Case Report – *Carolina Rincón, MD*
8. Coronary Artery Embolus-Induced Peripartum Myocardial Infarction in Parturient with Fontan Physiology – *Damon Wallace, MD*
9. Anesthetic management of a high risk primigravida patient with brugada syndrome – *Tim Cai, MD*
10. Post Partum Transfusion-Related Acute Lung Injury and atypical Hemolytic Uremic Syndrome – *Omar El Masri, MD*
11. Labor analgesia in a patient with reported lidocaine allergy – *Andrew Kolomensky, MD*
12. Syrix and Symptomatic COVID in Pregnancy – *Robert Schroell, MD*
13. Anesthetic Management of a Parturient with a Syringo-pleural Shunt – *Karim Shuaib, MD*
14. Local Anesthetic Systemic Toxicity after Transverses Abdominis Plane Block in the Parturient: Early Recognition and Treatment – *Christian Tilley, MD*
15. Undiagnosed Mitral Stenosis Presenting with Arrhythmia and Pulmonary Edema in Peripartum Care: A Case Report – *Joe Bryant-Huppert, MD*
16. Spontaneous liver rupture in parturient in the absence of preeclampsia or HELLP syndrome – *Andrew Gallagher, MD*
17. Cardio-obstetric management of mitral cleft with LVOT obstruction in a rural center – *Leigh Hickerson, MD*
18. Neuraxial Anesthesia Affected by a Sacral Tarlov Cyst – *Ashlee Gourdine, MD*
19. To get pregnant or not to get pregnant: Post-Fontan parturient – *Jennifer Hoayek, MD*
20. Managing Labor in the Cardiac Intensive Care Unit; a Patient with Congenital Ebstein Anomaly – *Benjamin Hyers, MD*
21. Anesthetic Management of a parturient with Moya Moya Syndrome and Sickle cell Disease – *Morgane Factor, MD Teshi Kaushik, MD*
22. Massive Obstetric Hemorrhage Complicated by Submassive Pulmonary Embolism: A Massive Case Report – *Roy Lei, MD*
23. Stranger Things: COVID Vaccine Induced ITP in a Parturient – *Meredith Shaw, MD*
24. Coagulation Assessment and Anesthetic Concerns after Plasmapheresis in a Parturient with Familial Hyperlipidemia Type III and Preeclampsia – *Priyanka Shetty, MD*
25. Ketamine Dart in an Acutely Psychotic, COVID+ Patient in Preterm Labor – *Melanie Wood, MD*

## Saturday, May 14 - Continued

### Concurrent Breakout Room #5

Marquette – 3<sup>rd</sup> floor

Moderators: Colleen Yen, MD & Thomas Gruffi, MD  
Carolina Rincón, MD & Andrew Chalupka, MD  
Preet Singh, MD

1. A Post-Partum Acute Type A Aortic Dissection without Known Connective Tissue Disease – *Regine Goh, MD*
2. Surgical Consequences of Intraoperative Nausea and Vomiting during Cesarean Section – *Rachel Gray, MD*
3. Interdisciplinary Management of a Parturient with Spinal Cord Stimulator and Intrathecal Pump for CRPS During Labor and Delivery – *Leon Grinman, MD*
4. Allergic Contact Dermatitis to Mastisol Adhesive Used for Labor Epidural Dressing: A Case Report – *Mingchun Liu, MD*
5. Previously Undiagnosed Methemoglobinemia in a Parturient with Pre-eclampsia Presenting with Dyspnea – *Leslie Matthews, MD*
6. A Case of Autoimmune Hepatitis and Cesarean Delivery – *Mercades Meuli, MD*
7. A Case of Placental Abruption Complicated by Maternal Fontan Physiology – *Mercades Meuli, MD*
8. Delayed diagnosis of disseminated intravascular coagulation after vaginal delivery due to laboratory systems issue – a case report and root cause analysis – *Leziga Obiyo, MD*
9. Anesthetic Management in a Parturient with Uterine Rupture – *Olaide Sode, MD*
10. Delayed neurological sequelae due to retained epidural catheter fragment – *Ronghua Tong, MD*
11. Cesarean Section in a COVID Positive Patient for Non-Reassuring BPP – *Colin Beals-Reid, MD*
12. Local Anesthetic Systemic Toxicity after Transverses Abdominis Plane Block in the Parturient: Early Recognition and Treatment – *Joe Bryant-Huppert, MD*
13. Successful use of Combined Spinal Epidural Anesthesia (CSEA) for Cesarean Section in Patient with Severe Mitral Regurgitation/Stenosis and Severe Pulmonary Hypertension – *Alexander Hunter, MD*
14. Cesarean delivery in a parturient with severe mitral regurgitation from Libman-Sacks endocarditis and recurrent deep vein thromboses – *Neva Lemoine, MD*
15. Combined Spinal Epidural Anesthesia for Labor Analgesia in a patient with Mast Cell Activation Disorder – *John Rouck, MD*
16. Anesthetic Management and ECMO Cannulation for Cesarean Delivery in Patient with Compressive Anterior Mediastinal Tumor – *Hannah Burcham, MD*
17. Venous Air Embolism during a Cesarean Delivery in the Parturient – *Waquas Yaqoob, MD*
18. Separating from the Pack: Preeclampsia-Induced Liver Dysfunction – *Drew Michael Donnell, MD*
19. General Anesthesia for Cesarean Delivery in Two Critically Ill Parturients with COVID-19 – *Bradley Kaminski, MD*
20. Radiographic Image Suggesting Broken Epidural Catheter: A case report – *Eleanor Kenny, MD*
21. Anesthetic Management of a Parturient with Congenital Factor VII Deficiency – *Victoria Nguyen, MD*
22. A Case of Placental Abruption and Takotsubo Cardiomyopathy After Epidermoid Tumor Resection – *Shanthi Shaver, MD*
23. Robotic Adrenalectomy for the Treatment of Pheochromocytoma in a Parturient – *Olivia Vetter, MD*
24. Anesthetic management of the morbidly obese, anticoagulated parturient with a spinal cord stimulator – *Marshal Lu, MD*
25. Postpartum Myonecrosis in a Patient with VLCAD - The Epidural Blame Game Continues... – *Marshal Lu, MD*

### Concurrent Breakout Room #6

Williford B – 3<sup>rd</sup> floor

Moderators: Erin Haggerty, MD & Libby Ellinas, MD  
Emily Dinges, MD  
Chantal Pyram, MD

1. Use Of Thromboelastography To Aid In Clinical Decision-making For Epidural Catheter Placement In A Patient With Von Willebrand Disease Type 2 – *Benjamin Houseman, MD*
2. Use of Protamine to Reverse Therapeutic Heparin Infusion in a Patient with Postoperative Hemorrhage After Cesarean Delivery – *Richard Smiley, MD*
3. Awake Fiberoptic in Spanish-Speaking Parturient for Submandibular Abscess – *Christy Henderson, MD*
4. Transfusion Management in Immunoglobulin A Deficient Parturients with Post-Partum Hemorrhage – *Bo-Chih Pan, MD*
5. Caesarean Delivery in a Parturient with Autoimmune Hepatitis and Cirrhosis – *Jake Rachiele, MD*
6. Labor Anesthesia in Marfan Syndrome, An Interesting Case – *Tobias Robinson, MD*

## Saturday, May 14 - Continued

7. When an AFE isn't just an Amniotic Fluid Embolism: AFE and Massive Pulmonary Embolism during Cesarean Delivery – *Mohammed Idris, MD*
8. Management of Anesthesia and Anticoagulation in a Parturient with COVID Pneumonia, Thrombophilia and Heparin-Induced Thrombocytopenia – *Mehwish Mirza, MD*
9. Urgent Cesarean Section for Parturient with Acute Decompensated Heart Failure – *Kyle Sullivan, MD*
10. General anesthesia for cesarean delivery in parturients with clinically-significant intracranial lesions: a case series – *Patrick Ahern, MD*
11. Chronic Pulmonary Embolus and Pulmonary Hypertension in a Primigravida with Protein S Deficiency – *Danielle Esnard, MD*
12. Neuraxial anesthesia in patient with preeclampsia with severe features and possible ventriculoperitoneal shunt malfunction – *Gabriel Fregoso, MD*
13. Management of a Parturient with Lumbar Schwannoma – *Lana Glantz, MD*
14. Hydatidiform Molar Pregnancy with Co-existent Normal Fetus – *Jakayla Harrell, MD*
15. When recurrent T-cell lymphoma goes undiagnosed in a parturient – *Jennifer Hoayek, MD*
16. Neuraxial Anesthetic Management for Tubal Ligation After Inadvertent Dural Puncture and Severe Post Dural Puncture Headache – *Eva Martinez, MD*
17. Primary Pulmonary Hypertension in a Late Second Trimester Parturient Presenting with Hemoptysis and Dyspnea: A Role for Point of Care Ultrasound (PoCUS)? – *Phillip Sholes, MD*
18. Anesthetic Management for Resection of a Rare, Large, Metastatic Brain Mass during Multiple Gestation Pregnancy – *James Damron, MD*
19. Pregnancy complicated by Spina Bifida and Edwards Syndrome: A Case Report and Review of the Literature – *Rochelle Johns, MD*
20. High Neuraxial Blockade in Unrecognized Intrathecal/Subdural Catheter during Emergency Caesarean Section – *Charles Shaller, MD*
21. Subdural hematoma and pneumocephalus after obstetric epidural anesthesia – *Christopher Ching, MD*
22. Successful Labor Epidural Placement in a Parturient with a Spinal Cord Stimulator – *Samuel Pettigrew, MD*
23. Dwyer instrumentation for scoliosis, a challenge for Neuraxial Anesthesia – *Mickael Khouzami, MD*
24. The use of 2-chloroprocaine for labor analgesia in a patient with lidocaine allergy – *Mickael Khouzami, MD*
25. Minimizing Maternal and Fetal Morbidity in the Setting of Rapidly Evolving Placenta Percreta: A Multidisciplinary Approach – *Jatturong Wichianson, MD*

### Concurrent Breakout Room #7

*Williford C – 3<sup>rd</sup> floor*

Moderators: Ana Lisa Ramirez-Chapman, MD  
Ruba Elmaoued, MD & Paulina Cardenas, MD  
Meredith Albrecht, MD & Andrea Girnius, MD

1. Anesthesia Management in a Parturient with Unresectable Astrocytoma and Opioid Use Disorder – *Brian Paoletti, MD*
2. Double intracranial trouble: Delayed diagnosis of postpartum intracranial hypotension after intrathecal catheter placement obscured by intracranial hemorrhage in the setting of pre-eclampsia – *Samuel Pettigrew, MD*
3. Uterine incarceration in the third trimester complicated by bilateral hydronephrosis and inferior vena cava compression leading to severe tricuspid regurgitation necessitating delivery – *Trung Pham, MD*
4. A Case of a High-Risk Parturient on Therapeutic Fondaparinux – *Pauline Ripchik, MD*
5. Cesarean Delivery in the Setting of Severe COVID-19 Pneumonia Requiring ECMO: A Case Study of Two Patients – *Joo Hyun Shin, MD*
6. Severe Delusional Disorder in a Parturient With History of Fetal Demise After Home Birth – *Terry Biel, MD*
7. Post-Partum Headache in Parturient with Difficult Epidural Placement, Preeclampsia, and COVID Positive – *Jennifer Choi, MD*
8. Subdural Hematoma After Accidental Dural Puncture – *Anna Cholewa, MD*
9. Neuraxial anesthesia in a patient with a history of Chiari malformation type-1 (CM1) – *Yen-Yen Gee, MD*
10. Cesarean Delivery of Patient with Peripartum Cardiomyopathy and Pulmonary Hypertension – *Carter Guice, MD*
11. Delayed Hysterectomy After Cesarean Delivery for Placenta Accreta Spectrum: A Case Report and Update on the Literature – *Courtney Hood, MD*
12. Anesthetic Management of a Parturient with History of Cardiac Stents – *Rhiannon Lasher, MD*
13. Anesthetic Considerations for Severe COVID-19 in the Peripartum Period – *Taylor Leathers, MD*
14. Management of Postpartum Hemorrhage in Patient with ITP and superimposed HELLP – *Sherry Liou, MD*

## Saturday, May 14 - Continued

15. The Outlier: A Case of Postpartum Piriformis Muscle Spasm – *Chikezie Okeagu, MD*
16. Massive obstetric hemorrhage from an unanticipated uterine rupture – *Elizabeth Ozery, MD*
17. Stuck between a rock and a hard place: anesthetic management of patient with a life threatening pregnancy complication, congenital hearing loss, and morbid obesity – *Jasmine Robinson, MD*
18. Second Trimester Uterine Rupture in a Parturient with Class 3b Placenta Accreta Spectrum – *Ashlee Gourdine, MD*
19. A Case of Symptomatic COVID in Pregnancy and Pre-Term Delivery – *Laura Ibidunni, MD*
20. Anesthetic Management of Cesarean Section in a Critically Ill COVID-19 Obstetrical Patient: Case Report – *Juliana Barrera Ramirez, MD*
21. Management of Von Willebrand Disease in an Intrapartum Patient – *Cecilia Kim, MD*
22. Anesthetic considerations in a parturient with preeclampsia and recent myocardial infarction presenting for Cesarean section – *Joe Salloum, MD*
23. Are Uterine Fibroids a Risk Factor for Placenta Accreta Spectrum Disorder? – *Ashley Vincent, MD*

7:00pm – 9:00pm     **Residents & Fellows Reception**  
*Ace Bounce (offsite venue)*





## SUNDAY, MAY 15

*\*all times are listed in Central Time*

*All meetings are in International North Ballroom unless otherwise noted.*

- 7:00am Registration Opens
- 7:00am – 9:00am Continental Breakfast  
International South Ballroom
- 8:00am – 8:10am Kybele Ukrainian Update  
Oleg Turkot, MD
- 8:10am – 8:15am Opening Remarks  
Klaus Kjaer, MD
- 8:15am - 9:45am ASRA/SOAP Panel  
“Post Cesarean Delivery Pain Management: What do we know and how do we do it?”  
Moderator: Pervez Sultan, MD  
Speakers: Beth A. VanderWielen, MD – ASRA  
Unyime Ituk, MD – ASRA  
Ruth Landau, MD – SOAP  
Ashraf Habib, MD – SOAP
- 9:45am – 10:00am BREAK in EXPO Hall  
International South Ballroom
- 10:00am – 11:30am Sol Shnider Clinical Track #3  
Moderator: Naida Cole, MD
- PAS New and Cutting Edge – *Nicole Higgins, MD*
  - ECMO in the Parturient – *Emily Naoum, MD*
  - Neurological Deficits – *Amy Lee, MD*
- 12:00pm Registration Desk Closes
- 11:30am – 1:00pm Faculty Case Presentations  
Third Floor Breakout Rooms
- Concurrent Breakout Room #1 – Cardiac  
Waldorf – 3<sup>rd</sup> floor  
Moderator: Chad Dean, MD
1. Anesthetic Management of an Obstetric Patient with Severe Right Ventricular Outflow Tract Obstruction after Truncus Arteriosus Repair Undergoing an Elective Cesarean Section – *Nour El Hage Chehade, MD*
  2. Anesthetic Management of A Parturient with a History of Ross Procedure Complicated by Pulmonary Valve Stenosis Undergoing Elective Cesarean-Section – *Nour El Hage Chehade, MD*

## Saturday, May 14 - Continued

3. Management of Labor Induction in a Parturient with Symptomatic Pericardial Effusion – *Jessica Sheeran, MD*
4. Delivery Management of a Parturient with Newly Diagnosed Double Chambered Right Ventricle – *James Damron, MD*
5. Case Series of Two Types of Successful Deliveries in Parturients With Shone's Complex Syndrome – *David Gutman, MD*
6. Cardiovascular complications following severe COVID-19 infection during pregnancy: A case report – *Sonal Zambare, MD*
7. Anesthetic Management of Ebstein's Anomaly in the Advanced Maternal Age Parturient – *Alexander Brown, MD*
8. Anesthetic Management of a Parturient with Pulmonary Hypertension for Cesarean Delivery – *Lawrence Weinstein, MD*
9. Severe Mitral Regurgitation Complicates Risk of Pulmonary Edema in Severe Preeclampsia – *Simone Sukhdeo, MD*
10. Use of Transthoracic Echocardiography (TTE) for Intraoperative Monitoring during a Cesarean Section for a Patient with Unicuspid Aortic Valve – *Mohamed Eissa, MD*

### Concurrent Breakout Room #2 – Heme Preeclampsia

Joliet – 3<sup>rd</sup> floor

Moderator: Matthew Hire, MD & Alice O'Brien, MD

1. The Influence of Private Genetic Testing on the Peripartum Workup of Thrombocytopenia and Selection of Neuraxial Anesthesia for Cesarean Delivery – *Angus Royal, MD*
2. Management of Blood Transfusion in Parturients with Sickle Cell Disease – *Mary Dierks, MD*
3. Paroxysmal nocturnal hemoglobinuria and pregnancy- two case reports – *Borislava Pujic, MD*
4. Labor Epidural Placement in a COVID-Positive Patient with Profound Thrombocytopenia – *Thomas Avritt, MD*
5. Using INTEM for Transfusion Guidance in a Parturient with Severe Factor XI Deficiency – *Jessica Sheeran, MD*
6. Subcapsular Hematoma Rupture in Pregnancy – *Jakalya Harrell, MD*
7. Posterior Reversible Encephalopathy Syndrome (PRES) and Pre-Eclampsia/Eclampsia: Anesthetic Implications and Management – *Andrea Trent, MD*
8. Post-Delivery Epidural Removal with Platelet Count of Thirty Two Thousand – *David Gutman, MD*
9. Acute and Profound Immune Thrombocytopenia in Pregnancy: Are we Sure a Routine Platelet Count Isn't Necessary? – *David Gutman, MD*

### Concurrent Breakout Room #3 – Neuraxial Labor Analgesia

PDR#2 – 3<sup>rd</sup> floor

Moderator: Emory McCrorey, MD

1. A Case of Total Neuraxial Anesthesia after Epidural Bolus for an Emergency Cesarean Section – *Eve Cremers, MD*
2. A Case of Unexplained Persistent Unilateral Block Following Epidural Anesthesia – *Bhakti Chourasia, MD*
3. Epidural Abscess after Labor Epidural Analgesia – *Jason White, MD*
4. When In Doubt, Pull It Out – *Danielle White, MD*
5. Platelet transfusion prior to neuraxial placement for term parturient on dual antiplatelet therapy – *Jessica Merrill, MD*
6. Facial itching to facial blisters: reactivation of herpes simplex virus after neuraxial opioids – *Katherine Herbert, MD*
7. Anesthetic management of an incarcerated gravid uterus on a knee chest position; A case report and a narrative review of literature of anesthetic management of incarcerated uterus from 1971 to 2021 – *Wesley Rajaleelan, MD*
8. Noisy Breathing in the Labor Suite – *Patricia Dalby, MD*

### Concurrent Breakout Room #4 – Cesarean Delivery

Astoria – 3<sup>rd</sup> floor

Moderator: Erica Johnson, MD

1. 3-D printing and holograms to facilitate EXIT airway management planning – *Ronald George, MD*
2. Intraoperative Diagnosis and Management of Euglycemic Diabetic Ketoacidosis During Emergent Cesarean Delivery – *Kelechi Anyaehie, MD*
3. Anesthetic Considerations During Prolonged Fetal Extraction; A Case Report – *Michael Richter, MD*
4. Hypertriglyceridemia-Induced Acute Pancreatitis in Pregnancy – *Erik Romanelli, MD*
5. Acute Pancreatitis in Second Trimester Leading to IUFD and Multi-Organ Dysfunction – *Erik Romanelli, MD*
6. Volume Management of a Critically Ill Pregnancy Patient with Chronic Renal Disease – *Kate Petty, MD*
7. Intraoperative Cesarean Section During Robotic Inguinal Hernia Repair – *Migdalia Saloum, MD*
8. Anesthetic management of pregnancy termination in a high-risk patient with genetic peripartum cardiomyopathy – *Alla Yarmosh, MD*
9. Anesthesia and the Decompensated Obstetric Patient – *Brandon Leighton, MD*
10. ECMO Cannulation and Emergent Cesarean for a COVID Positive Mother – *Shyam Patel, MD*
11. Tailored Gentle Section For Best Maternal Bonding and Surgical Experience using a Multitude of Accommodations – *Nour El Hage Chehade, MD*

### Concurrent Breakout Room #5 – PAS Postpartum Hemorrhage

Marquette – 3<sup>rd</sup> floor

Moderators: Rachel Waldinger, MD & Kristen Vanderhoef, MD

1. Cesarean Section in a Parturient with Placenta Accreta Complicated by Uterine Torsion and Incarceration – *David Gutman, MD*
2. Bronchoscopy and Laser Resection at 8 Months of Pregnancy for Proximal Subglottic Tracheal Stenosis – *David Gutman, MD*
3. Cesarean Section in a Parturient with Profound Tracheal Stenosis and Placenta Increta – *David Gutman, MD*
4. Anesthetic Management and Use of Point-of-Care Ultrasound in a Parturient with Symptomatic Goiter – *Maria Sheikh, MD*
5. Anesthetic Management of a Parturient with Pathologic Uterine Ring – *Maria Sheikh, MD*
6. Delayed postpartum hemorrhage requiring massive transfusion including prothrombin complex concentrate – *Bryan Wakefield, MD*
7. Management of Ornithine Transcarbamylase Deficiency in a Parturient with Placenta Accreta – *Jessica Sheeran, MD*
8. Fluoroscopy Free Intraaortic Balloon Occlusion in a Patient with Morbidly Adherent Placenta Accreta in Planned Cesarean Hysterectomy – *Bhavdip Vallavadas Patel, MD*
9. Two Parturients with Placenta Previa and Placenta Accreta Spectrum (PAS) Undiagnosed by Ultrasound – *Susanne Rupert, MD*
10. Peri-Partum Veno-Arterio-Venous Extracorporeal Membrane Oxygenation as A Rescue Therapy for Cardiogenic Shock and Acute Respiratory Distress Syndrome – *Angelique Garay, MD*
11. Preterm delivery in a patient with spontaneous hemoperitoneum in pregnancy and concurrent placenta accreta – *Emily Nasser, MD*

### Concurrent Breakout Room #6 – Post Dural Puncture Headache/Neuro

Williford B – 3<sup>rd</sup> floor

Moderator: Michael Holland, MD

1. Arachnoiditis after Inadvertent Dural Puncture Requiring Epidural Blood Patch – *Jason White, MD*
2. Management of a Parturient with Vein of Galen Malformation – *Kristen Fardelmann, MD*
3. Unusual Reoccurrence of Postdural Puncture Headache and Subdural Hematoma After a Labor Epidural – *Taimoor Khan, MD*
4. The Benefit of Neuraxial Ultrasound-Guided Mapping for Epidural Blood Patch Placement and Treatment of Lumbosacral Radiculitis Following Repeat Epidural Blood Patch – *Nour El Hage Chehade, MD*
5. Successful Epidural Placement and Vaginal Delivery In a Case of Arnold-Chiari Malformation type 1 and Ehler Danlos Syndrome with the Assistance of Point of Care Ultrasound and Epidural Needle Stopper – *Nour El Hage Chehade, MD*

6. To Patch or Not To Patch? – *Lisa Corbett, MD*
7. Delayed treatment of accident dural puncture in the setting of parturients with hypertensive disorders – perfect storm for PRES – *Katherine Herbert, MD*
8. Neuraxial Labor Analgesia With Transverse Myelitis – *Fouzia Khalid, MD*
9. Hemorrhagic Stroke in Pregnancy: A Case Report – *Edward Gill, MD*

Concurrent Breakout Room #7 – Rare Diseases

*Williford C – 3<sup>rd</sup> floor*

Moderators: Sarah Nizamuddin, MD & Kelechi Brenda Anyaehie, MD

1. Case Report: Anesthesia and Peripartum Management of Alpha Gal Syndrome In Pregnancy – *Adam Dunmore, MD*
2. A Case Report of Cesarean Section for a Parturient with Cantú Syndrome – *Mary Roberts, MD*
3. Combined Spinal-Epidural Anesthesia for Cesarean Delivery of a Parturient with VACTERL Association – *Lawrence Weinstein, MD*
4. Intellectual disability, sexual abuse and scoliosis: coordinated cesarean section care for a patient with 22q11 deletion syndrome – *Anna Swenson, MD*
5. Cesarean Delivery in a Patient with Blue Rubber Bleb Nevus Syndrome – *Alexandra Kiers, MD*
6. Cesarean Section of a Patient With Fibrodysplasia Ossificans Progressiva – *Heewon Lee, MD*
7. Interdisciplinary management of a medically complex parturient with sarcoidosis and splenomegaly – *Margaret Smith, MD*
8. Case report: Peri-partum challenges in a parturient with systemic sclerosis & COVID-19 infection – *Sonal Zambare, MD*
9. Total Parenteral Nutrition in Pregnancy: A Case Report – *Rodwan Husein, MD*

1:00pm

ADJOURN

# Speaker Disclosures

The following speakers and/or planning committee members have indicated that they have relationships with ineligible companies to disclose.

Name	Type of Relationship	Ineligible Company
Brendan Carvalho	Stock Option	Flat Medical
Brendan Carvalho	Consultant	Stryker Corporation
Lisa Corbett	Fiduciary Officer	Kybele, Inc.
Robert Gaiser	Travel	American Board of Anesthesiology
Ron George	Employment	Canadian Journal of Anesthesia
Ron George	Consultant	Octapharma USA, Inc.
Jean Guglielminotti	Grant/Contract	National Institute on Minority Health and Health Disparities
Ashraf Habib	Grant/Contract	Haisco USA
Ashraf Habib	Grant/Contract	Heron Therapeutics, Inc.
Ashraf Habib	Grant/Contract	Pacira Pharmaceuticals Incorporated
Ashraf Habib	Consultant	Trevena
Ashraf Habib	Consultant	Vertex Pharmaceuticals
Thomas Klumpner	Grant/Contract	Medical School, University of Michigan
Vesela Kovacheva	Consultant	Avania
Ruth Landau	Consultant	Pacira Pharmaceuticals Incorporated
Elizabeth Lange	Consultant	Octapharma USA, Inc.
Marie-Louise Meng	Employment	Duke University
Jill Mhyre	Gift	Wolters Kluwer Health, Inc.
Cesar Padilla	Other Intellectual Property	Author of "Method of Treating Obstetric Conditions Using the Maternal Critical Care Model" via Cleveland Clinic Grant Back License of the method
Brandon Togioka	Grant/Contract	B. Braun Medical
Brandon Togioka	Grant/Contract	Georgia-Pacific
Brandon Togioka	Grant/Contract	Merck
Cynthia Wong	Other (royalties)	Elsevier
Mark Zakowski	Other business ownership	Quantum Birthing LLC

All relevant financial relationships for this activity have been mitigated.

All other planners, faculty, and staff have reported no relevant financial relationships with ineligible companies to disclose.

# Program Material

## Thursday, May 12, 2022

---

### Opening Keynote "Illinois Perinatal Quality Collaborative (ILPQC) - Birth Equity Initiative"

Introduction: TBD

Speaker: Ann Borders, MD

### Addressing Maternal Mortality: Key Factors for Change

Moderator: Allison Lee, MD

Panelists: Chris Elton, MD; Caitlin Sutton, MD; Paloma Toledo, MD

### SNAP Talks – Getting the Right Resources to the Patient

Moderator: Vibha Mahendra, MD

Panelists: Thomas Klumpner, MD; Dave Arnolds, MD; Rebecca Minehart, MD

### Best Paper Competition

Moderator: Cynthia Wong, MD

Judges: Arvind Palanisamy, MD; Paloma Toledo, MD; Jill Mhyre, MD;  
Brian Bateman, MD; Brendan Carvalho, MD; Philip E. Hess, MD

### SOAP Centers of Excellence: How to Provide Quality Care for All Parturients

Moderator: Brendan Carvalho, MD

Panelists: Jill Mhyre, MD; Dave Berman, MD; Davida Grossman, MD

### SMFM Session: Tackling Maternal Inequities in U.S. Obstetric Care

Introduction: Edward Yaghmour, MD, FASA

Speaker: William Grobman, MD, MBA

### Research Posters Sessions

Room 1 – Analgesia

Room 2 – Postpartum Hemorrhage

Room 3 – POCUS

Room 4 – Morbidity

Room 5 – Hematologic/Uterotonics/Bleeding

Room 6 – Fetus/Neonatal Outcomes

Room 7 – Labor Analgesia

Make the connection.

Matching Intentional Communication Strategies to Opportunities where Disparities Exist

Caitlin Setzer, MD  
Obstetrical, Pediatric Anesthesiologist  
Chief, Maternal-Fetal Anesthesia Division  
SOAP AM 2022 - Chicago, Illinois

What do we know?

- Disparities exist.
- Approximately three in five pregnancy-related deaths are preventable.
- Contributing factors can be organized by community, system, health facility, patient, and provider levels.

Petersen E, MMWR 2019.



Four Intentional Connection Strategies

1. Use cross-cultural education as a framework for inquiry.
2. Participate in implicit bias training.
3. Communicate in ways that meet patients' language, cultural, and health literacy needs.
4. Engage in best practices for shared decision-making.

Unequal Treatment, Institute of Medicine Report, 2003.  
AIM Reduction of Peripartum Racial/Ethnic Disparities Patient Safety Bundle, 2016.

Ask yourself...

---

Are similarly situated patients being treated similarly?

If not... is there a morally compelling reason?  
 (Race, ethnicity, sexual orientation, gender, insurance status are *not* morally compelling reasons.)




Strategy 1: Use cross-cultural education as a framework for inquiry.



Cultural Competence

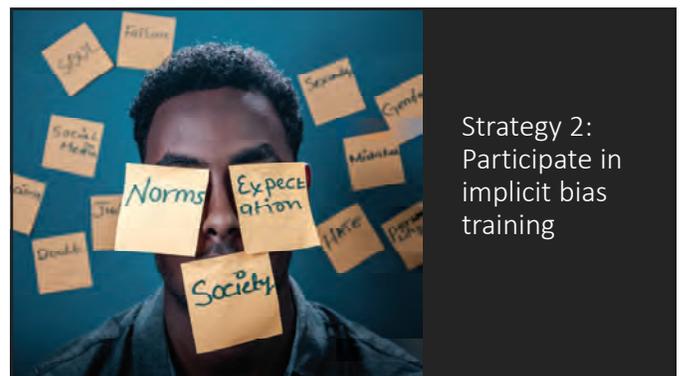
The ability to understand and respect different attitudes and customs that vary across cultures



Expanding from cultural competence to cultural humility

- Early cultural competence training aimed to alleviate barriers to care for marginalized groups
- Attempts to define cultural norms may inadvertently reinforce stereotypes
- Cultural competence is a helpful starting point

Unequal Treatment, Institute of Medicine Report, 2003;  
 Gregg, Acad Med 2006;  
 Lexas HIM, Health Serv Insights 2002;  
 Betancourt, Acad Med 2006.



### What is implicit bias?

- Implicit bias: negative attitudes towards and beliefs about members of a group (eg, racial-ethnic, disability, sexual orientation) that are **spontaneously and automatically activated**
- Explicit bias: **deliberate** negative attitudes toward and beliefs about members of a group

Green T, Obstet Gynecol 2017  
Butler M, AHRQ Comparative Effectiveness Rev 2015

### Who is calling for implicit bias training?

- California's Dignity in Pregnancy and Childbirth Act mandates implicit bias training for perinatal health care workers
- Black Maternal Health Momnibus Act would fund implicit bias training in medical and nursing schools
- National Partnership for Maternal Safety calls for implicit bias training as part of a strategy to combat racial-ethnic disparities

Maina I, Soc Sci Med 2019  
AIM Reduction of Peripartum Racial/Ethnic Disparities Patient Safety Bundle, 2016

### Is implicit bias training enough?

- Most studies evaluating implicit bias training look at physician attitudes rather than clinical outcomes
- Effect of implicit bias on real-world clinical outcomes are mixed
- Health-care providers' implicit prejudice is consistently associated with reports of lower quality patient-provider communication

Photo of an Asian American woman in a power chair. She is wearing a blue shirt with a geometric pattern with orange, black, white, and yellow lines and cubes. She is wearing a mask over her nose attached to a gray tube and bright red lip color. She is smiling at the camera.  
Photo credit: Eddie Hernandez Photography

Maina IW, Soc Sci Med 2018  
Cooper LA, Am J Public Health 2012  
Lanzetta K, Sem Perinatol 2017  
Cooper-Patrick L, J Am Med Assoc 1999  
Butler M, AHRQ Comparative Effectiveness Rev 2016

### For more information...

Implicit Association Test  
Project Implicit, www.projectimplicit.net ©2011

**Traumatic Birth and PTSD**

- 20-43% of women who give birth meet some dx criteria for PTSD. Prevalence of PTSD related to childbirth is 4% in all women and 18% in high-risk women.
- Rates of PTSD are higher in people with ACEs; ACEs are higher in racial/ethnic and sexual minority individuals & those with lower education/income.

Yildiz J Affective Disorders 2017  
Liu, Min Clin Health J 2013.  
Hall, JOGNN 2021.  
Giampino MC Pub Health 2020.

**Strategy 3:  
Meet patients' communication needs**

**When should I use an interpreter?**

---

When caring for one of the 25 million Americans who have limited English proficiency (LEP)

US Census Bureau 2010

**Why not just use an ad hoc interpreter?**

---

- Unfamiliarity with medical terminology can lead to errors and misunderstanding
- Family members may have personal agendas
- No guarantee of confidentiality

Karlner L, Health Serv Res 2007.  
Flores G, Ann Emerg Med 2012.  
Flores G, Med Care Res Rev 2009.  
Lindholm M, J Gen Intern Med 2013.  
Rutow P, J Clin Oncol 2013.

Ad hoc interpreters increase the risk of...

- Medical errors
- Longer hospital stays
- Readmission
- Unnecessary testing
- Poor adherence

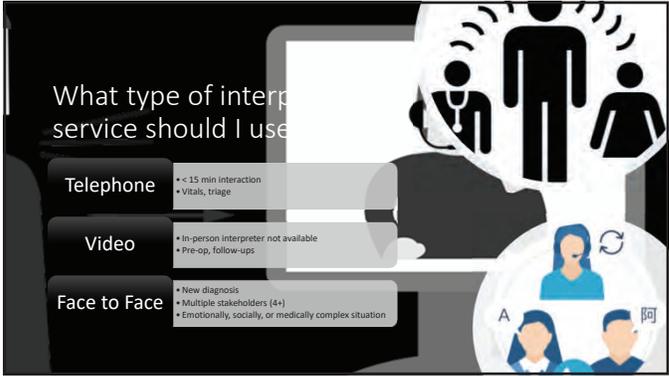
Increases disparities for patients with limited English proficiency



Sagebi A. Am Emerg Med 2011.  
Wagner E. Health Serv Res 2007.  
Forsell G. Am Emerg Med 2012.  
Flores G. Med Care Res Rev 2005.  
Lindholm M. J Gen Intern Med 2012.  
Rutow P. J Clin Oncol 2011.  
AIM Reduction of Peripartum Racial/Ethnic Disparities Patient Safety Bundle 2014

### What type of interpretation service should I use?

- Telephone**
  - < 15 min interaction
  - Vitals, triage
- Video**
  - In-person interpreter not available
  - Pre-op, follow-ups
- Face to Face**
  - New diagnosis
  - Multiple stakeholders (4+)
  - Emotionally, socially, or medically complex situation



### Dialogue Tips

- Speak directly to the patient.
- Keep statements short.
- Ask only one question at a time.
- Avoid medical jargon, acronyms, and idiomatic expressions.
- Use the “teach back” technique.



Texas Children's Hospital

### Neuraxial Labor Analgesia

- Disparities in pain assessment and use of neuraxial labor analgesia exist.
- A language-concordant educational program about labor analgesia is feasible and reduces misconceptions regarding epidural analgesia.



Rishi, Am J Obstet Gynecol 2004.  
Hoffman, Proc Natl Acad Sci USA 2016.  
Glinone, Anesth 2007.  
Tolosa, Anesth Analg 2012.  
Rappaport, Anesth 2010.

For more information...



Best practices for working with interpreters  
Disparities Solutions Center, Institute for Health Policy,  
MGH 2012.



Strategy 4:  
Engage in shared  
decision- making

What is Shared Decision Making?



Information

Preferences

Choice





euro  
anaes  
thesia  
2022

M  
MIL  
AN

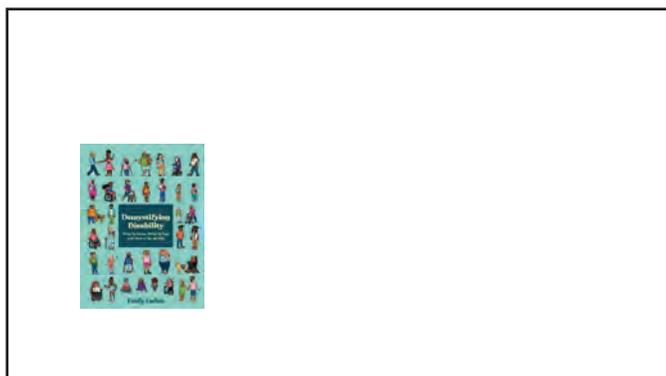
04 + 06  
JUNE

**Register  
for #EA22!**

Join us in person in Milan or from the comfort of your own home and attend Europe's biggest congress on anaesthesiology and intensive care. Access the full scientific programme and register at: [euroanaesthesia2022.org](http://euroanaesthesia2022.org)

## Sample Language

- “What should I know about you, your experiences, your preferences, that would help me take care of you in a way that would make you more comfortable?”
- “Hi, I’m Dr. Sutton, your anesthesiologist. My pronouns are she/her, and you can call me Caitlin. How should I refer to you? Who is here with you today?”



## Build Back Better Act

- Includes every eligible provision of the Black Maternal Health Momnibus Act
- Permanently expands postpartum Medicaid coverage to 1 year
- Provides \$175 million in funding for local entities to address social determinants of maternal health like housing, nutrition, and environmental conditions – including a minimum of \$75 million exclusively for community-based organizations working to promote maternal health equity.
- Provides \$295 million to grow and diversify the perinatal health workforce, including nurses, midwives, physicians, doulas, and maternal mental and behavioral health professionals – including \$50 million specifically for doulas.
- Provides \$100 million for maternal mental health equity grant programs.
- Provides \$85 million to address the impacts of climate change-related maternal and infant health risks through health professional schools.
- Provides \$50 million to advance maternal health research at Minority-Serving Institutions like Historically Black Colleges and Universities, Tribal Colleges and Universities, Hispanic-Serving Institutions, and AAUPIs.
- Provides \$50 million to promote representative community engagement in Maternal Mortality Review Committees.
- Provides \$210 million to strengthen federal maternal health programs like the CDC's Surveillance for Emerging Threats to Mothers and Babies program, Enhancing Review and Surveillance to Eliminate Maternal Mortality (ERASE MW), Pregnancy Risk Assessment Monitoring System (PRAMS), Perinatal Quality Collaboratives, and the National Institute of Child Health and Human Development (NICHD).
- Provides \$60 million to expand access to maternal health equity digital tools.
- Provides \$50 million for bias trainings among health care professionals.

## Lost Mothers:

Maternal mortality, racial/ethnic disparities,  
and systems-based approaches for  
improving peripartum care

Paloma Toledo, MD, MPH



1

## Disclosure Information

I have no financial relationships to disclose

2

## Overview

- Maternal mortality
- Process for developing maternal mortality review committee recommendations
- Racial/ethnic disparities in maternal mortality
- Strategies to reduce healthcare disparities

3

The position of woman in any  
civilization is an index of the  
advancement of that civilization.

The position of woman is gauged  
best by the care given her at the birth  
of her child

H.W. Haggard 1929

4

## Maternal health continuum



Illinois Maternal Morbidity and Mortality Report.  
Illinois Department of Public Health Oct 2018

5

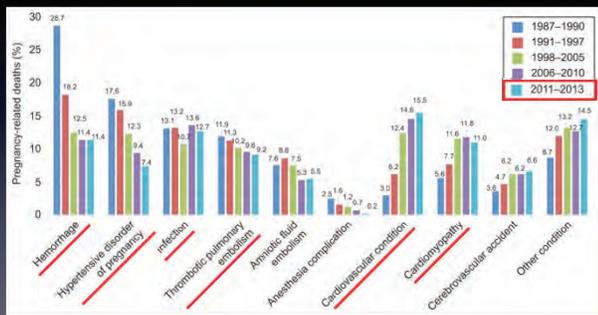
 **DEADLY  
DELIVERIES**



<https://www.usatoday.com/deadly-deliveries/interactive/how-hospitals-are-failing-new-moms-in-graphics>

6

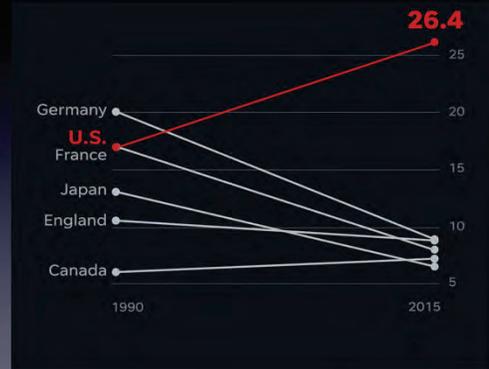
## Pregnancy-Related Mortality United States (2011–2013)



Creanga A. *Obstet Gynecol* 2017;130: 366–73

7

## Maternal deaths per 100,000 births



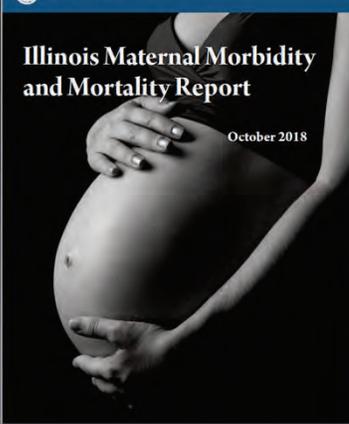
Lancet 2016; 388: 1775-1812

8



## Illinois Maternal Morbidity and Mortality Report

October 2018



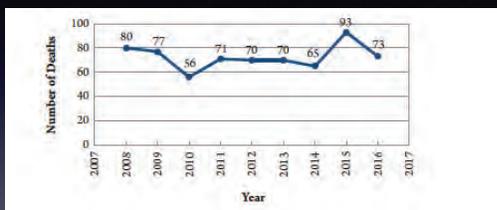
9

### Maternal Mortality Review Committee

- Robert Abrams, MD, Maternal-Fetal Medicine Specialist, Southern Illinois University
- Katherine Aantman, MD, Family Medicine Physician, Gibson Area Hospital
- Jennifer Banayan, MD, Cardiac and Obstetric Anesthesiologist, University of Chicago
- Deborah Boyle, FACOG/MD, BSN, Maternal-Fetal Medicine Specialist, University of Chicago
- Jean Briller, MD, FACC, FAHA, Cardiologist, University of Illinois at Chicago
- Stacie Geller, MPH, PhD, Researcher, University of Illinois at Chicago
- Robert Geisser, Forensic Medicine, Illinois Coroners and Medical Examiners Association
- Robin L. James, MD, Obstetrician, Rush University
- Abby Koch, MA, Researcher, University of Illinois at Chicago
- Olga Lazala, PhD, APN, CNS/CNM, RNC-OB, Certified Nurse Midwife, Advocate Health and University of Illinois at Chicago
- Kathryn Lindley, MD, FACC, Cardiologist, Washington University
- Jerome Lowe, MD, Pathologist, Rush University
- Gary Loy, MD, Maternal-Fetal Medicine Specialist, Rush University
- Kevin Madison, MD, Maternal-Fetal Medicine Specialist, Advocate Good Shepherd Hospital
- Lisa Mautner, MD, MPH, MS, Director of Research, Alliance Chicago
- Paula Melrose, DO, Maternal-Fetal Medicine Specialist, Loyola University Medical Center
- Frank Nagorka, JD, EMT-P, Emergency Medicine and Law Specialist, Attorney at Law
- Heather Nixon, MD, Obstetric Anesthesiologist, University of Illinois at Chicago
- Bridle Osting, AM, MPP, Infant Mortality Reduction Coordinator, EverThrive Illinois
- Beth Plankert, MD, MPH, Obstetrician and Gynecologist, Northshore University Health System
- Donald Reese, MD, Family Medicine Physician, Gibson Area Hospital
- Barbara Scavone, MD, Obstetric Anesthesiologist, University of Chicago
- Shelby Scott, MS, RN-BC, C-FPM, APN, Perinatal Advance Practice Nurse, University of Illinois
- Lee Smith, Family Case Manager, Mt. Sinai Community Institute
- Michael Socol, MD, Maternal-Fetal Medicine Specialist, Northwestern University
- Patrick Thornton, CNM, PhD, Certified Nurse Midwife, University of Illinois at Chicago
- Pakima Tolaks, MD, MPH, Anesthesiologist, Northwestern University

10

## Pregnancy-Associated Deaths in Illinois 2008-2016



11

## Vision and Purpose of MMRC

### Vision

To eliminate preventable pregnancy-associated deaths in Illinois

### Purpose

MMRC reviews maternal deaths that are potentially related to pregnancy

Determine contributing factors to maternal mortality and identify potential interventions to prevent future deaths

12

## Timing of death

### Maternal mortality (CDC)

Death of a pregnant woman, or death within 1 year of end of pregnancy

### Maternal mortality (WHO)

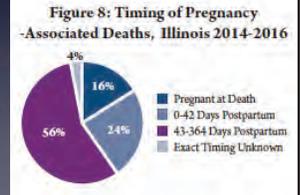
Death of a pregnant woman, or death within 42 days of end of pregnancy

13

## Timing of pregnancy-associated deaths in Illinois

### Maternal mortality (CDC)

Death of a pregnant woman, or death within 1 year of end of pregnancy



14

## Process for Reviewing Maternal Deaths in IL MMRC

### Maternal Deaths Identified

Medical, police records assembled

### Chart Abstracted

Key events of pregnancy/postpartum period chronicled

### Case reviewed by MMRC at in person meeting

Maternal Mortality Review Information Application (MMRIA) form completed

15

16

17

## Process for Reviewing Maternal Deaths in IL MMRC

### 1. What was the cause of death?

### 2. Was the death pregnancy-related?

**Pregnancy-related:** The death resulted from a pregnancy complication, a chain of events initiated by the pregnancy, or an underlying condition exacerbated by the pregnancy

**Pregnancy-associated:** The death was not related to pregnancy

18

## Process for Reviewing Maternal Deaths in IL MMRC

### 3. Was the death potentially preventable?

Was there at least some chance that the death could have been prevented by one or more changes to the patient, family, provider, facility, system, or community factors

If preventable what was the chance of altering the outcome: Good, some, none, or can not determine

19

## Process for Reviewing Maternal Deaths in IL MMRC

### 4. What were the factors that contributed to this death?

CONTRIBUTING FACTORS WORKSHEET	
What were the factors that contributed to the death? Multiple contributing factors may be present at each level.	
CONTRIBUTING FACTOR LEVEL	CONTRIBUTING FACTOR AND DESCRIPTION OF ISSUE
PATIENT/FAMILY	
PROVIDER	
FACILITY	
SYSTEM	
COMMUNITY	

20

CONTRIBUTING FACTOR DESCRIPTIONS	
<b>DELAY OR FAILURE TO SEEK CARE</b> The woman was delayed in seeking or did not access care, insurance, or follow-up services (e.g. missed appointment, adherence to care).	<b>TOBACCO USE</b> Woman's use of tobacco directly compromised the woman's health (e.g. long term smoking led to underlying chronic lung disease).
<b>ADHERENCE TO MEDICAL RECOMMENDATIONS</b> The woman did not follow medical advice (e.g. refused treatment for diabetes or other reasons or left the hospital against medical advice).	<b>OBSTETRIC DISEASE</b> Presence of one or more significant pre-existing medical conditions (e.g. chronic cardiovascular disease, or diabetes).
<b>KNOWLEDGE - LACK OF UNDERSTANDING</b> ADVERSE EFFECT OF EVENT OR OF TREATMENT ON FOLLOW-UP The woman did not receive adequate education or lacked knowledge or understanding regarding the significance of a health condition (e.g. diabetes), or did not understand the importance of continuing care or follow-up care (e.g. missed appointment or did not follow-up for a health condition) or did not understand the need for appropriate care (e.g. missed appointment for postpartum follow-up or did not follow-up for postpartum follow-up).	<b>CLINICAL SKILL/QUALITY OF CARE</b> Personnel were not appropriately skilled for the situation or did not provide timely, appropriate care (e.g. error in the progression or administration of the medicine, chronic condition management, or other clinical care).
<b>CLINICAL PREVENTION OR LACK OF PREVENTION</b> Screening tests that any of these factors was either a barrier to care due to lack of understanding or due to refusal of therapy (e.g. biopsy, or breast screening).	<b>INADEQUATE COMMUNITY OUTREACH/EDUCATION</b> Lack of coordination between healthcare system and other outside agencies/organizations in the geographic/ethnic area that work with maternal and child health issues.
<b>ENVIRONMENTAL FACTORS</b> Factors related to residence or location (e.g. access to a facility, access to a minor vehicle, accident).	<b>INADEQUATE LAW ENFORCEMENT RESPONSE</b> Law enforcement response was not in a timely manner or was not appropriate or through to court.
<b>DOMESTIC VIOLENCE AND INTIMATE PARTNER VIOLENCE (IPV)</b> Physical or emotional abuse or other forms of partner violence that prevented the woman from seeking care, or from following medical advice, or from following medical advice.	<b>LACK OF REFERRAL OR CONSULTATION</b> Referrals were not obtained or did not provide care related to pregnancy were not made.
<b>MENTAL HEALTH CONDITIONS</b> The woman had a diagnosis of a psychiatric disorder. This includes postpartum depression.	<b>FAILURE TO SCREEN/ASSESS/ASSESSMENT OF RISK</b> Factors placing the woman at risk for a poor clinical outcome (pregnancy, and the woman was not screened/assessed for risk).
<b>SUBSTANCE USE DISORDER - ALCOHOL, ILICIT/ PRESCRIPTION DRUGS</b> Substance use disorder is characterized by recurrent use of alcohol and/or drugs causing clinically significant impairment, health problems or disability. The substance use disorder is characterized by recurrent use of alcohol and/or drugs causing clinically significant impairment, health problems or disability. The substance use disorder is characterized by recurrent use of alcohol and/or drugs causing clinically significant impairment, health problems or disability.	<b>LEGAL</b> Legal considerations that impeded outcomes.
<b>INTEGRITY OF RECORDS</b> Woman's record "on the record" or as a humanable object is lost or fragmented or temporary circumstances with family or friends.	<b>LACK OF STANDARDIZATION OF PRACTICES/PROCESSES</b> The facility lacked best practice or infrastructure (e.g. standardization of care, or lack of standard practice or process).
<b>SOCIAL SUPPORT/ISOLATION - LACK OF FAMILY/FRIEND SUPPORT SYSTEM</b> Lack of support from family, partner, or friends was lacking, inadequate, or not available (e.g. domestic violence, no one to help on in minor emergencies, etc.).	
<b>INADEQUATE OR UNAVAILABLE EQUIPMENT</b> Equipment was missing, outdated, or not functional. (e.g. absence of blood, drug, etc.).	

21

## Process for Reviewing Maternal Deaths in IL MMRC

### 5. Did obesity, mental health, or substance use contribute to the death?

### 6. What are the recommendations to prevent future deaths?

### 7. Were the records complete enough to enable decisions?

22

## IL MMRC recommendations

- 25 recommendations
- Organized recommendations by whom should implement the recommendation:
  - Hospitals
  - Health care providers
  - Insurers
  - State of Illinois
  - Recommendations for women and their families

23

### Recommendations for Hospitals

There are many opportunities for preventing maternal mortality through the improvement of hospital practices. The Committees felt that poor communication and care coordination within and between hospitals led to poor outcomes for pregnant and postpartum women. In addition, there were unclear policies and practices for identifying and treating pregnant and postpartum women, especially for substance use, depression, and domestic violence, in addition to identifying and treating well-established complications that may occur in pregnancy or in the postpartum period. While many hospitals are conducting routine screenings and assessments on pregnant and postpartum women, many still are not. The Committees stressed the importance of coordinating consultations and supporting patients who need further specialized care by connecting them directly to the specialty or additional care they need, therefore, reducing a barrier to seeking treatment.

#### Specifically, the Committees recommended:

1. Hospitals should implement best practices and review updated guidelines and techniques for risk assessment/screening and subsequent consultation and referral practices to improve outcomes for pregnant and postpartum women. This should include peer review, interdisciplinary morbidity and mortality reviews, patient safety bundles, and screening tools for mental health, substance use, and violence. Hospital quality improvement efforts should include use of the patient safety bundle for the "Reduction of Perinatal Racial/Ethnic Disparities".
2. Hospitals should have clear policies for emergency departments to identify pregnant and postpartum women (up to one year post-pregnancy), and seek consultation from an obstetrical provider for all pregnant or postpartum women with specific triggers indicative of pregnancy or postpartum complications.
3. Birthing hospitals should ensure that women are connected with a primary care or obstetrical provider and scheduled for a postpartum visit prior to hospital discharge.
4. Hospitals should require that medical providers and emergency department staff utilize both the Prescription Monitoring Program database and internal medical records to check for past opioid prescriptions and/or patterns of drug seeking behavior in pregnant and postpartum patients. When there is evidence of frequent opioid use, hospitals should develop standardized protocols to facilitate a successful referral for pain management and/or

24

# Racial/ethnic disparities in maternal mortality

25

# Disparities definitions

Agency for Healthcare Research and Quality

Difference or gap between two groups

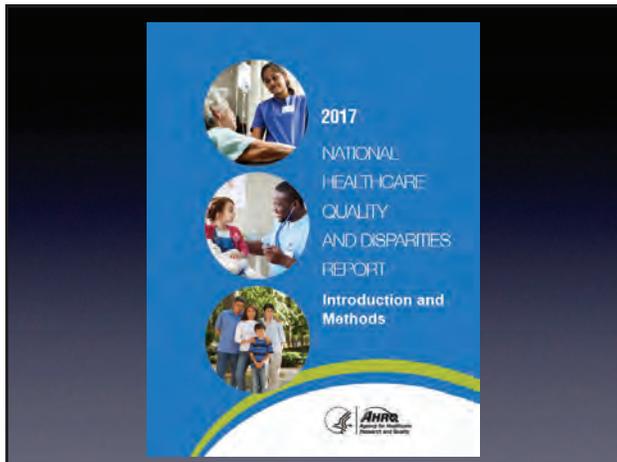
Institute of Medicine

Differences not related to *need, preferences, or appropriateness* of the intervention

World Health Organization

Differences, not only *unnecessary and unavoidable*, but *unfair and unjust*

26



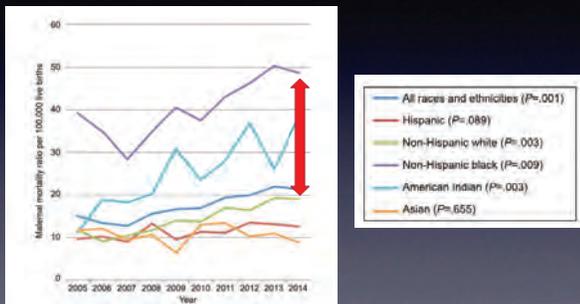
27

Table 12.4. Disparities that are changing over time

Group	Disparities (baseline)	Disparities (newest)
65+ compared with 18-44	Cancer deaths per 100,000 population per year Deaths per 1,000 adult hospital admissions with acute myocardial infarction Prostate cancer deaths per 100,000 male population per year	
Black compared with White	Hospital admissions for congestive heart failure per 100,000 population Incidence of end-stage renal disease due to diabetes per 100,000 population Long-stay nursing home residents who were diagnosed for pneumococcal pneumonia	Maternal deaths per 100,000 live births Hypertension management of adolescent girls per 100,000 women age 40 and over
Asian compared with White	Hospital patients with pneumonia who received pneumococcal screening or vaccination Hospital patients with heart failure discharged home with written instructions Hospital patients with pneumonia who received influenza screening or vaccination	Children 0-40 to for whom a health provider gave advice about using car safety seats
American Indian/ Alaska Native compared with White	Incidence of end-stage renal disease due to diabetes per 100,000 population Infant deaths per 1,000 live births, birth weight <1,500 grams Patients who received surgical resection of colon cancer that included at least 12 lymph nodes pathologically examined	Adults age 60 and over who ever received a colonoscopy, sigmoidoscopy, or proctoscopy People with difficulty contacting their usual source of care over the telephone
Hispanic compared with Non-Hispanic White	Hospital admissions for congestive heart failure per 100,000 population Hospital patients with pneumonia who received pneumococcal screening or vaccination Hospital patients with pneumonia who received influenza screening or vaccination	
Poor compared with High Income	Hospital admissions for asthma per 100,000 population (0-17, 18-64, 65 and over) Hospital admissions for long-term complications of diabetes per 100,000 population age 16+ Patients who received surgical resection of colon cancer that included at least 12 lymph nodes pathologically examined	Adults age 60 and over who ever received a colonoscopy, sigmoidoscopy, or proctoscopy Adults who did not have problems seeing a specialist they needed to see in the last year People without a usual source of care who indicated a financial or insurance reason for not having a provider of care

28

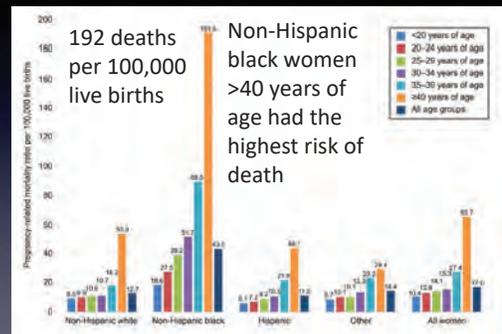
# Trends in US maternal mortality, by race, 2005-2014



Obstet Gynecol 2018; 131: 707-12

29

# Pregnancy-Related Mortality United States (2011-2013)



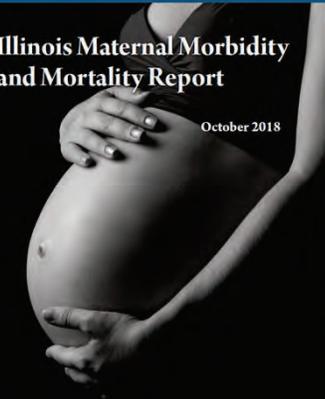
Creanga A. Obstet Gynecol 2017;130: 366-73

30

State of Illinois  
Illinois Department of Public Health

## Illinois Maternal Morbidity and Mortality Report

October 2018

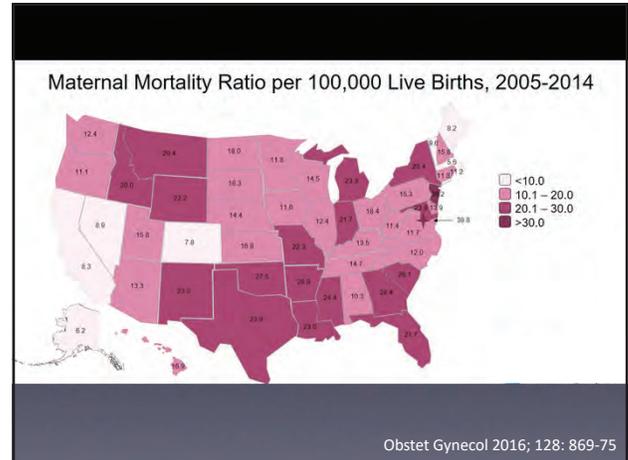


Compared to non-Hispanic white women:

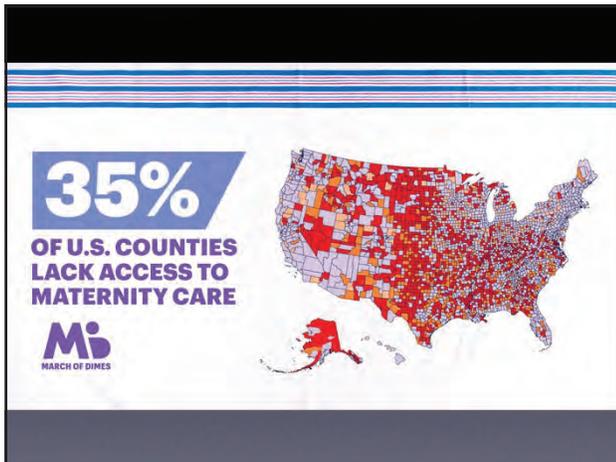
- Black women were **seven times** more likely to die
- Hispanic women were **twice** as likely to die

Illinois Maternal Morbidity and Mortality Report.  
Illinois Department of Public Health Oct 2018

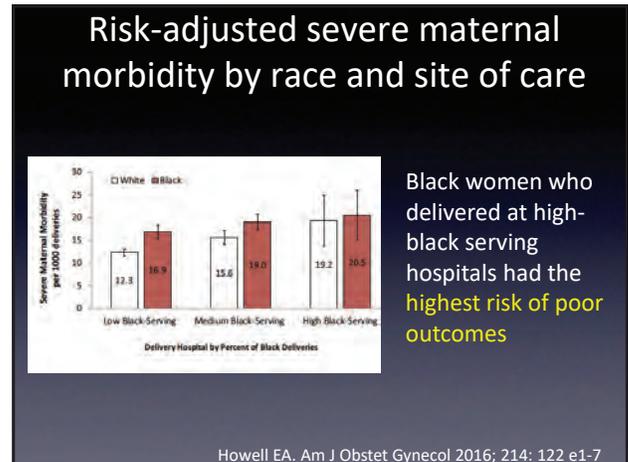
31



32



33



34

## Deconstructing racial/ethnic disparities

35

### Maternal Mortality Case Example - Jasmine

"Jasmine" was a Black woman in her 20s. Throughout the end of her pregnancy, she had frequent pain in her side, and pain and numbness in her foot and calf. During her pregnancy, Jasmine visited hospital emergency departments eight times for various reasons, including pain. She delivered a healthy full-term baby, but experienced severe leg pain during her hospital stay. She was discharged from the hospital with instructions to return for a MRI if pain continued. Jasmine went to the emergency department twice in the week following the birth of her child. First she was admitted to the hospital for pain management, and discharged the next day with instructions to use ice packs and pain medications. Three days later, she went back to the emergency department due to continued leg swelling and back pain. Her examination was limited due to her pain level and not all leg veins were thoroughly examined for blood clots. She was discharged and told to follow up with her primary care physician. During each of these visits, she was screened for drug use and repeatedly had negative tests. One week later, Jasmine collapsed at home and was transported to the hospital in cardiac arrest. Jasmine died of a pulmonary embolism 18 days after giving birth, which was the result of an undetected blood clot travelling to her lungs. Her death was associated with inactivity, obesity, and deep venous thrombosis, which was not identified at previous hospital visits.

**What can we learn from Jasmine's Death?**

Despite complaints of leg pain and swelling during multiple hospital visits, Jasmine was not thoroughly screened for blood clotting issues, and her condition was misdiagnosed as back pain. There was a lack of care coordination between facilities, and Jasmine's pain was not taken seriously. Providers appear to have misinterpreted her pain as "drug-seeking" behavior, showing how implicit bias or prejudice can affect the care a woman receives. If providers had recognized her leg pain as a blood clot issue, Jasmine's life might have been saved.

Illinois Maternal Morbidity and Mortality Report. Illinois Department of Public Health Oct 2018

36

**Racial and Ethnic Disparities in Neuraxial Labor Analgesia**  
 Paloma Toledo, MD, MPH,† Jinglu Sun, BA,\* William A. Grobman, MD, MBA,†† Cynthia A. Wong, MD,\*  
 Joe Feinglass, PhD,†§ and Romana Hasnain-Wynia, PhD,†§

**A qualitative analysis of parturients' perspectives on neuraxial labor analgesia**

**Primary Spoken Language and Neuraxial Labor Analgesia Use Among Hispanic Medicaid Recipients**  
 Paloma Toledo, MD, MPH, Stanley T. Ezsakul, MD, MS, William A. Grobman, MD, MBA,  
 Joe Feinglass, PhD, and Romana Hasnain-Wynia, PhD

**Readability, Content, and Quality Assessment of Web-Based Patient Education Materials Addressing Neuraxial Labor Analgesia**  
 Samir K. Patel, MD,\* Elisa J. Gordon, PhD, MPH,† Cynthia A. Wong, MD,\*  
 William A. Grobman, MD, MBA,† Haley Goucher, MD,\* and Paloma Toledo, MD, MPH,†

37

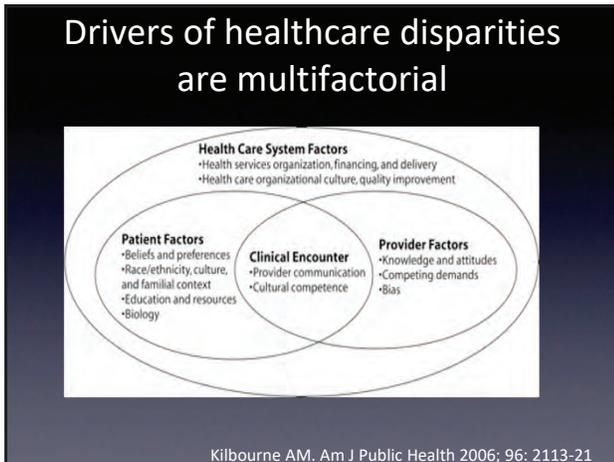
NIH Research Portfolio Online Reporting Tools (RePORT)

Project Information  
 1903M001162B-01A1

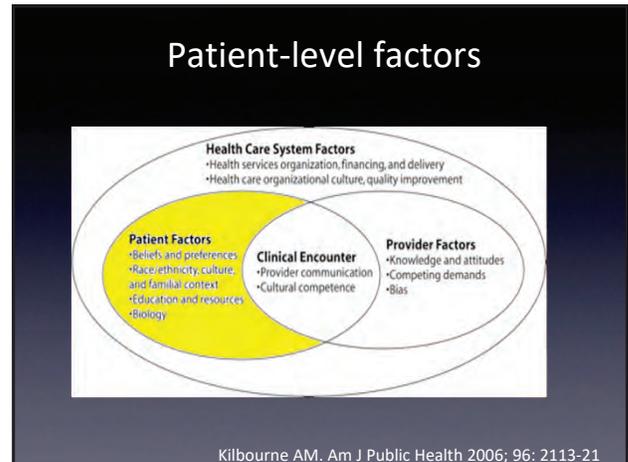
Project Number: 1903M001162B-01A1  
 Title: UNDERSTANDING THE DISPARITIES IN POSTPARTUM HEMORRHAGE AND HEMORRHAGE OUTCOMES  
 Principal Investigator: Awardee Organization: TOLEDO, PALOMA NORTHWESTERN UNIVERSITY AT CHICAGO

**Abstract Text:**  
 PROJECT SUMMARY: Childbirth is the most common reason for hospital admission in the United States (US). Not only has overall maternal morbidity and mortality been increasing, but significant and continuing racial and ethnic disparities have been demonstrated for both. Postpartum hemorrhage (PPH), one of the leading causes of maternal morbidity and mortality in the US, is more common among minority women, who also experience worse PPH-related outcomes than non-minority white women. Yet, it is unknown whether minority women are more likely to have severe PPH due to differences in underlying risk factors or whether PPH is recognized and/or managed differently for minority women. Understanding which factors are contributing to the disparity has significant implications with regard to developing effective and sustainable solutions. Previous studies that have explored racial/ethnic disparities in PPH outcomes have used state or national datasets, which lack granular, patient-level factors, as well as information on provider management of PPH. Northwestern University's Perinatal Women's Hospital delivers approximately 12,000 women annually and the population is racially/ethnically diverse. A standardized form, available in the electronic health record (EHR), is completed for all women who experience a PPH, thus providing detailed patient-level information. The form also includes critical provider- and system-level information allowing for a highly-detailed investigation of the sources of racial/ethnic disparities. We propose to use these data from 2007-2017 to achieve the following aims: (1) Evaluate whether risk factors for PPH differ by race/ethnicity; (2) Identify racial/ethnic differences in PPH management (e.g. medications administered, blood transfused, surgical interventions used) and the timing of those interventions (e.g. time from PPH recognition to administration of additional uterotonic, time to transfusion); and (3) Develop a PPH prediction score that accounts for risk factors and patient race/ethnicity. This study will fill an important gap in the knowledge and understanding of patient-, provider-, and systems-level contributors to PPH and its related outcomes. Such findings are fundamental to the development of effective and sustainable solutions to reduce the observed disparities in PPH outcomes. This project will meet the mission of the National Institute of Minority Health and Health Disparities by furthering our understanding of contributors to disparities in PPH outcomes.

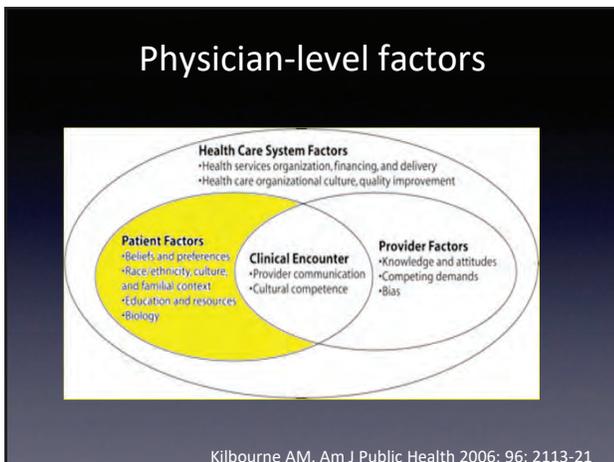
38



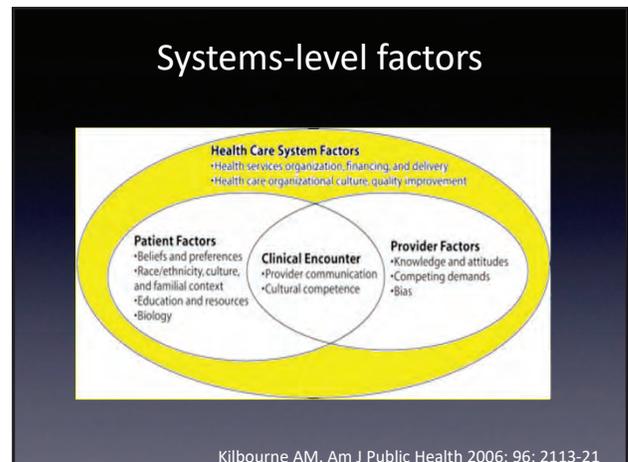
39



40



41

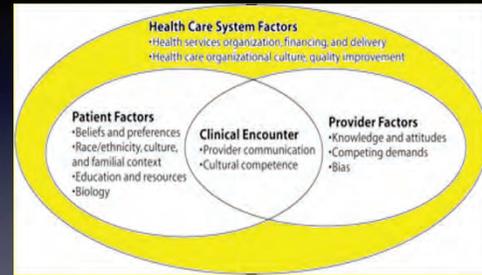


42

# Strategies to reduce healthcare disparities

43

# Creating systems level awareness and change

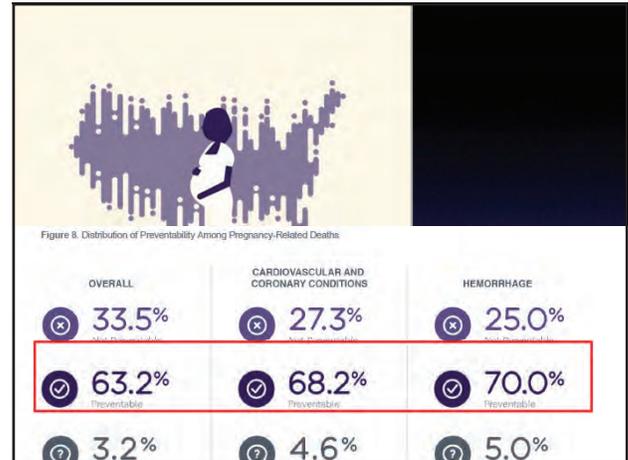


Kilbourne AM. Am J Public Health 2006; 96: 2113-21

44

# Implementing best-practice bundles

45



46

# Impact of safety bundle implementation, maternal mortality in California 1999-2013



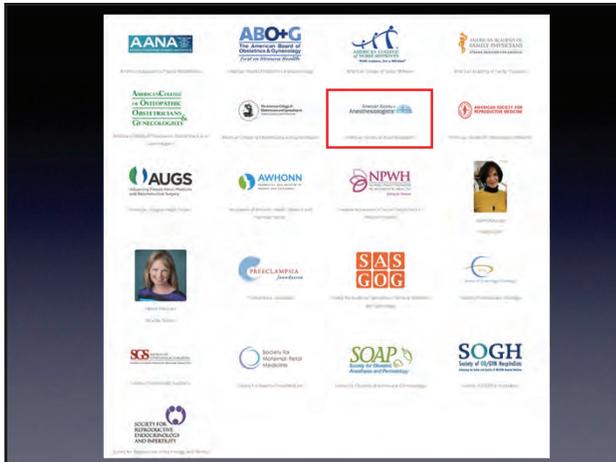
47

**COUNCIL ON PATIENT SAFETY IN WOMEN'S HEALTH CARE**  
 safe health care for every woman

Navigation: About Us | Patient Safety Bundles and Tools | Safety Action Series | National Improvement Challenge | AIM Program

Video Content: CONTINUALLY IMPROVING PATIENT SAFETY IN WOMEN'S HEALTH CARE THROUGH MULTIDISCIPLINARY COLLABORATION THAT DRIVES CULTURE CHANGE

48

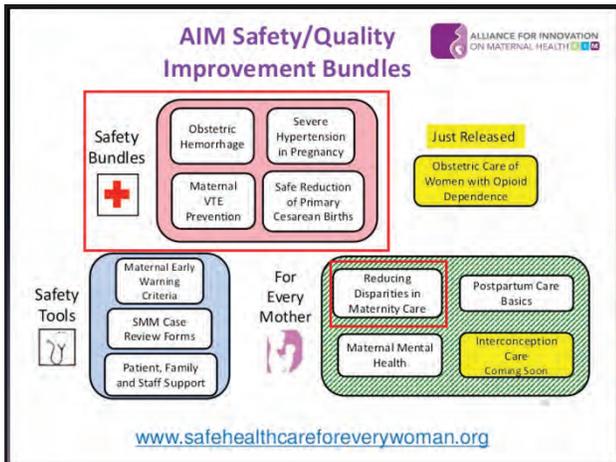


49

## Patient Safety Bundle

- Readiness
- Recognition
- Response
- Reporting and systems learning

50



51

### Consensus Statement

## Reduction of Peripartum Racial and Ethnic Disparities

#### A Conceptual Framework and Maternal Safety Consensus Bundle

*Elizabeth A. Howell, MD, MPP, Haywood Brown, MD, Jessica Bramley, CNM, PhD, Allison S. Bryant, MD, MPH, Aaron B. Caughey, MD, PhD, Andria M. Cornell, MSPH, Jacqueline H. Grant, MD, MPH, Kimberly D. Gregory, MD, MPH, Susan M. Gullo, RN, MS, Katy B. Kochimannil, PhD, MPA, Jill M. Mhyre, MD, Paloma Toledo, MD, MPH, Robyn D'Orta, MA, RN, Martha Nigh, MPH, and William A. Grobman, MD, MBA*

Howell EA, Toledo P. *Obstet Gynecol* 2018; 131: 770-82

52

## Definitions

- Readiness: Protocols and kits
- Recognition: Identifying patients
- Response: Standards for managing and treating
- Reporting/systems learning: Use of huddles and debriefs to learn from cases

53

### COUNCIL ON PATIENT SAFETY IN WOMEN'S HEALTH CARE

Safe health care for every woman

#### READINESS

Every health system

- Establish systems to accurately document self-identified race, ethnicity, and primary language. ✓
- Provide system-wide staff education and training on how to ask demographic intake questions. ✓
- Ensure that patients understand why race, ethnicity, and language data are being collected. ✓
- Ensure that race, ethnicity, and language data are accessible in the electronic medical record. ✓
- Evaluate non-English language proficiency (e.g. Spanish proficiency) for providers who communicate with patients in languages other than English. ✓
- Educate all staff (e.g., inpatient, outpatient, community-based) on interpreter services available within the healthcare system. ✓
- Provide staff-wide education on:
  - Peripartum racial and ethnic disparities and their root causes. ✓
  - Best practices for shared decision making. ✓
- Engage diverse patient, family, and community advocates who can represent important community partnerships on quality and safety leadership teams. ✓

PATIENT SAFETY BUNDLE

**Reduction of Peripartum Racial/Ethnic Disparities**

54

**COUNCIL ON PATIENT SAFETY  
IN WOMEN'S HEALTH CARE**  
safe health care for every woman

**PATIENT SAFETY BUNDLE**

**Reduction of Peripartum Racial/Ethnic Disparities**

**RECOGNITION**

Every patient, family, and staff member

- Provide staff-wide education on implicit bias.
- Provide convenient access to health records without delay (paper or electronic), at minimal to no fee to the maternal patient, in a clear and simple format that summarizes information most pertinent to perinatal care and wellness.
- Establish a mechanism for patients, families and staff to report inequitable care and episodes of miscommunication or disrespect.

55

**COUNCIL ON PATIENT SAFETY  
IN WOMEN'S HEALTH CARE**  
safe health care for every woman

**PATIENT SAFETY BUNDLE**

**Reduction of Peripartum Racial/Ethnic Disparities**

**RESPONSE**

Every clinical encounter

- Engage in best practices for shared decision making.
- Ensure a timely and tailored response to each report of inequity or disrespect.
- Address reproductive life plan and contraceptive options not only during or immediately after pregnancy, but at regular intervals throughout a women's reproductive life.
- Establish discharge navigation and coordination systems post childbirth to ensure that women have appropriate follow-up care and understand when it is necessary to return to their health care provider.
- Provide discharge instructions that include information about what danger or warning signs to look out for, who to call, and where to go, if they have a question or concern.
- Design discharge materials that meet patients' health literacy, language, and cultural needs.

56

**COUNCIL ON PATIENT SAFETY  
IN WOMEN'S HEALTH CARE**  
safe health care for every woman

**PATIENT SAFETY BUNDLE**

**Reduction of Peripartum Racial/Ethnic Disparities**

**REPORTING & SYSTEMS LEARNING**

Every clinical unit

- Build a culture of equity, including systems for reporting, response, and learning similar to ongoing efforts in safety culture.
- Develop a disparities dashboard that monitors process and outcome metrics stratified by race and ethnicity, with regular dissemination of the stratified performance data to staff and leadership.
- Implement quality improvement projects that target disparities in healthcare access, treatment, and outcomes.
- Consider the role of race, ethnicity, language, poverty, literacy, and other social determinants of health, including racism at the interpersonal and system-level when conducting multidisciplinary reviews of severe maternal morbidity, mortality, and other clinically important metrics.
- Add as a checkbox on the review sheet: Did race/ethnicity (i.e., implicit bias), language barrier, or specific social determinants of health contribute to the morbidity (yes/no/yes/No)? And if so, are there system changes that could be implemented that could alter the outcome?

57

**IL PQC**  
Illinois Perinatal Quality Collaborative

**Vision**

A statewide perinatal quality collaborative that involves all perinatal stakeholders; utilizes data-driven, evidence-based practices; improves perinatal quality resulting in improved birth outcomes, improved health for women and infants, and decreased costs; builds on Illinois' existing state-mandated Regionalized Perinatal System, and operates with long-term sustainable funding.

58

**Birth Equity (BE)**  
What will we focus on?

**IL PQC**  
Illinois Perinatal Quality Collaborative

Address Social Determinants of Health → Review race/ethnicity medical record and quality data → Promote patient-centered approach to engage patients and communities → Develop respectful care and bias education for providers, nurses, and staff

**BE AIM:** By December 2023, more than 75% of Illinois birthing hospitals will be participating in the Birth Equity Initiative and more than 75% of participating hospitals will have all key strategies in place

**IL PQC**  
Illinois Perinatal Quality Collaborative

59

**IL PQC**  
Illinois Perinatal Quality Collaborative

**1. Addressing social determinants of health**

- Mapping social determinants of health community resources and services
- Screening all patients for social determinants of health needs during prenatal care and at the delivery admission and linking to resources/ services
- Incorporating social determinants of health and discrimination factors in hospital maternal morbidity reviews

**IL PQC**  
Illinois Perinatal Quality Collaborative

60

### 2. Utilize race/ethnicity medical record & quality data




- Implement processes and protocols for **improving the collection and accuracy of patient-reported race/ethnicity data**
- Review **maternal health quality data stratified by race, ethnicity, and Medicaid status** to identify disparities and address opportunities for improvement

61

### 3. Engage patients, support partners, & communities




- Take steps to engage **patients and/or community members** to provide input on quality improvement efforts
- Implementing a strategy for **sharing respectful care practices** with patients and delivery staff
- Implement a Patient Reported Experience Measure (PREM) **patient survey to obtain feedback**
- Providing **postpartum safety patient education** on urgent maternal warning signs, how to communicate with providers and importance of early follow up

62

### 4. Engage and educate providers, nurses & staff




- Educating providers, nurses, and staff on the importance of **listening to patients, providing respectful care and addressing implicit bias**
- Implementing strategies for **addressing diversity in health care team hiring**




63

# Structural solutions

64

### Structural solutions: Delivery facility

Level*	Definition	Capability	Obstetric Providers	Anesthesiology Providers
Birth Center	Low-risk, peripartum care	Term, singleton, vertex presentation	Certified midwives, certified nurse-midwives, certified professional	None
Level I	Manage uncomplicated pregnancies and anticipate complications until patient can be transferred			
Level II	Can manage high-risk antepartum and postpartum conditions		MFM available as needed	available for consultation
Level III	More complex maternal and fetal conditions and complications	Advanced imaging ICU	Obstetrician available 24/7 MFM available 24/7	Available 24/7 OB Anesthesiologist in charge of OB anesthesia services
Level IV	Most complex, critically ill maternal and fetal conditions	ICU Perinatal system leadership	Obstetrician available 24/7 MFM available 24/7	Avail 24/7 OB Anesthesiologist in charge of OB Anesthesia Services

\*Each level assumes the capabilities of all levels below it



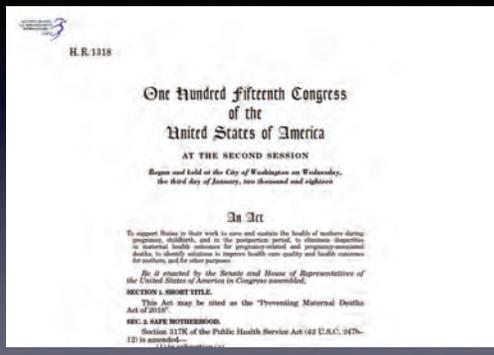
Am J Obstet Gynecol 2015;212:259-71

65

# Policy solutions

66

## Policy solutions: Establishing and supporting Maternal Mortality Review Committees



67

68

69

70

## Summary

- Racial/ethnic disparities exist and are worsening in the United States
- Disparities are multifactorial and arise at the patient-, provider-, and systems-level
- Solutions include:
  - Implementing patient safety initiatives
  - Implementing structural solutions
  - Creating systems to understand disparities and address root causes

71

## Funding



Evergreen Foundation International Grant (PI: Toledo)



AHRQ T32 (PI: Holl)



AHRQ F32 and AHRQ R03 (PI: Toledo)  
Robert Wood Johnson Foundation Harold Amos Faculty Development Award (PI: Toledo)



NIMHD R03 (PI: Toledo)



Anesthesia Patient Safety Foundation (PI: Toledo)

72



**Automating a Maternal Early Warning System**

**Tom Klumpner, MD**  
 Clinical Assistant Professor  
 Anesthesiology and Obstetrics and Gynecology  
 Assistant Director, Informatics and Systems Improvement

1

**Disclosures**

- Dr. Kevin Tremper is a founder and equity holder in AlertWatch™, the medical software company with which we co-developed the surveillance system described in this presentation.
- I led this co-development project. I have no financial ties to AlertWatch™.
- Some of the work presented here was supported by: University of Michigan Precision Health Investigators Award

Department of Anesthesiology



2

**Maternal Early Warning Criteria**

**Table 1. The Maternal Early Warning Criteria**

Systolic BP (mm Hg)	<90 or >160
Diastolic BP (mm Hg)	>100
Heart rate (beats per min)	<50 or >120
Respiratory rate (breaths per min)	<10 or >30
Oxygen saturation on room air, at sea level, %	<95
Oliguria, mL/hr for ≥2 hours	<35
Maternal agitation, confusion, or unresponsiveness; Patient with preeclampsia reporting a non-remitting headache or shortness of breath	

Mlynes J, et al. The Maternal Early Warning Criteria: A Proposal From the National Partnership for Maternal Safety. Obstet Gynecol 2014;124:762-6



Department of Anesthesiology



3

**MiEOWS**

**MiEOWS (Michigan Early Obstetric Warning System)**

**GOALS:** Early recognition, shared responsibility, collaboration

**Contact OB and Anesthesia and Team Leader**  
 (Check / Team Leader may facilitate)

**Rate Type of Communication on clinical urgency**

**RED Triggers Require Phone Call**  
 Paging may be appropriate for Black Triggers

FHT STRIP	Cat. 3 or Concerning Cat. 2
O <sub>2</sub> Sat	<95%
BP systolic	<90    >160
BP diastolic	<50    >110
Pulse	<50    >120
Resp. Rate	<10    >34
Temp	<36.0    >38.0
Urine Output	<30cc/hr for over 2 hrs
Pain Level*	≥4

**EBL** Cumulative EBL ≥700 with Vaginal Delivery  
 Additional Postop or Postpartum EBL ≥ 500cc

**EBL ≥ 500cc at Vaginal Delivery or ≥ 2,000cc at Cesarean Delivery**

\*Patients with abnormal V/S or EBL may NOT be discharged to next level unless cleared by Anesthesiology and Obstetrics teams

**OB NOTIFICATION ALGORITHM:**

1. Designated Staff Contact (Anesthesia Backup)
  - OB in OR: (248) 646-2244
  - OB in OR: (248) 646-2244
  - OB in OR: (248) 646-2244
2. OB in OR: (248) 646-2244
3. OB in OR: (248) 646-2244
4. OB in OR: (248) 646-2244

**ANESTHESIA NOTIFICATION ALGORITHM:**

1. Designated Staff Contact (OB Backup) - (248) 646-2244
2. OB in OR: (248) 646-2244
3. OB in OR: (248) 646-2244
4. OB in OR: (248) 646-2244

**TEAM LEADERS:**

- OB: (248) 646-2244
- OB: (248) 646-2244
- OB: (248) 646-2244
- OB: (248) 646-2244

Department of Anesthesiology

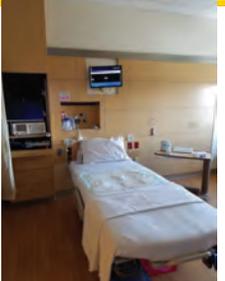


4

**The Problem**

2015: A near-miss severe postpartum hemorrhage

- Healthy patient. Labor room delivery.
- Systolic blood pressure = 60s for at least 30 minutes.
- Several providers in room for delivery.
- Notification of anesthesiology service occurred when patient arrived unconscious in OR.



Department of Anesthesiology



5

**The Problem**

**Barriers to Activate MiEOWS**

Cognitive bias leading to errors in judgement	She wants to bond with her newborn. The increase in heart rate is probably nothing.
Hesitation to escalate care	I don't want the doctors to bother the patient. I don't want to interrupt the bonding experience.
Logistical difficulties with notification	You have to log in to a computer, find the paging website and know who to page.

Department of Anesthesiology



6

A Solution?

Department of Anesthesiology

M MICHIGAN MEDICINE UNIVERSITY OF MICHIGAN

7

A Solution?

- Automated pages triggered by vitals from the bedside monitor
  - “Can’t you just program the monitors to send a page whenever the vitals criteria are met?”



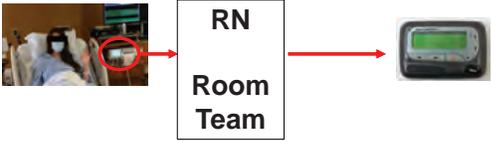
CNN.com

Department of Anesthesiology

M MICHIGAN MEDICINE UNIVERSITY OF MICHIGAN

8

Automated Maternal Early Warning Systems – The U of M Experience

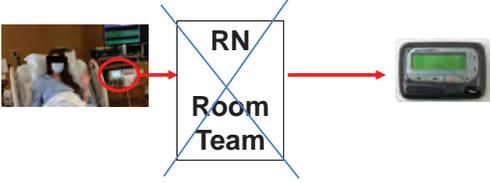


Department of Anesthesiology

M MICHIGAN MEDICINE UNIVERSITY OF MICHIGAN

9

Automated Maternal Early Warning Systems – The U of M Experience



Department of Anesthesiology

M MICHIGAN MEDICINE UNIVERSITY OF MICHIGAN

10

Automated Maternal Early Warning Systems – The U of M Experience



Department of Anesthesiology

M MICHIGAN MEDICINE UNIVERSITY OF MICHIGAN

11

Automated Maternal Early Warning Systems – The U of M Experience



Department of Anesthesiology

M MICHIGAN MEDICINE UNIVERSITY OF MICHIGAN

12

### Automated Maternal Early Warning Systems – The U of M Experience

1 page every 9.6 minutes

Department of Anesthesiology

13

### Automated Maternal Early Warning Systems – The U of M Experience

What Happened?

Department of Anesthesiology

14

### Automated Maternal Early Warning Systems – The U of M Experience

Possible explanations:

- Vital sign abnormalities are not uncommon during labor.

Department of Anesthesiology

15

### Automated Maternal Early Warning Systems – The U of M Experience

Distribution of Extreme Vital Signs and Complete Blood Count Values of Healthy Parturients: A Retrospective Database Analysis and Review of the Literature

Table 3. Distribution of Extreme Values of Systolic, Diastolic, and Mean Arterial Blood Pressures in Low-Risk Population

Vital Parameter	n	Mean ± SD (Range)	Percentiles			
			5%	95%	99.5%	
Systolic blood pressure (mm Hg)	High	25,187	125.2 ± 1	133, 142	158, 147	159, 153
	Low	25,179	104.94 ± 1	90, 122	83, 126	76, 130
Diastolic blood pressure (mm Hg)	High	25,187	81.2 ± 0.2	85, 87	88, 87	89, 87
	Low	25,168	59.71 ± 1	47, 74	43, 77	38, 80
MAP (calculated for extreme diastolic)	High	25,080	61.8 ± 0.28	78, 76, 87	74, 113, 88	
	Low	25,108	46.87 ± 0.25	33, 33, 36	34, 67	

Possible explanations:

- Vital sign abnormalities are not uncommon during labor.

Department of Anesthesiology

16

### Automated Maternal Early Warning Systems – The U of M Experience

National Partnership for Maternal Safety Recommended Maternal Early Warning Criteria Are Associated With Maternal Morbidity

David E. Arnolds, MD, PhD,\* Aaron Smith, BA,† Jennifer M. Banayyan, MD,\* Roxanne Holt, MD,‡ and Barbara M. Scavone, MD\*‡

Possible explanations:

- Vital sign abnormalities are not uncommon during labor.

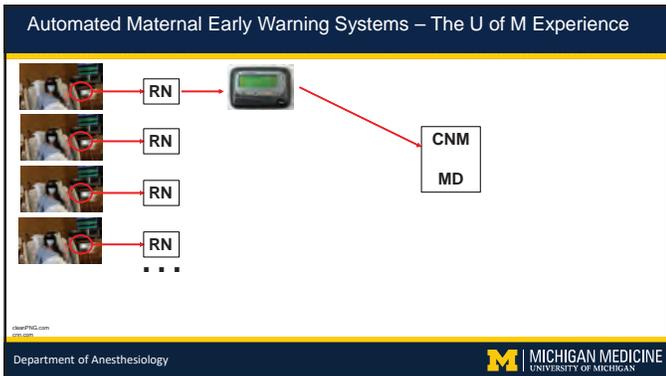
Department of Anesthesiology

17

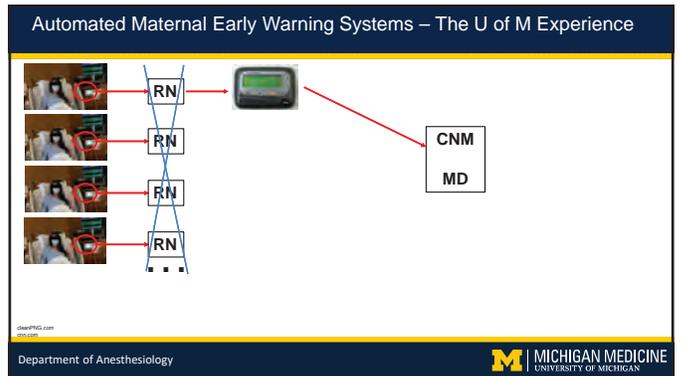
### Automated Maternal Early Warning Systems – The U of M Experience

Department of Anesthesiology

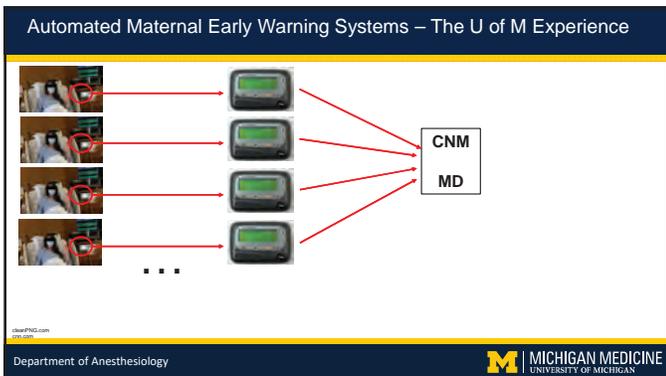
18



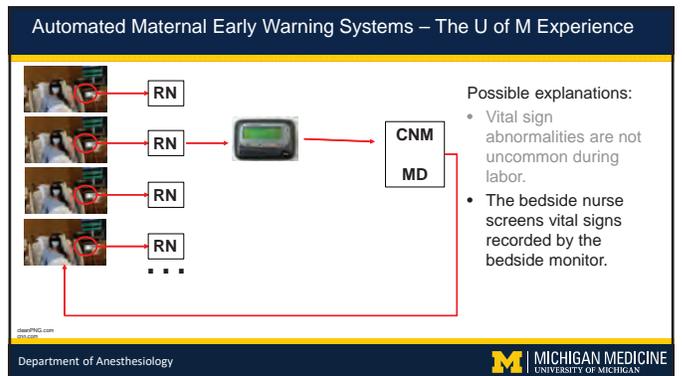
19



20



21



22

### Automated Maternal Early Warning Systems – The U of M Experience

**Value of a modified early obstetric warning system (MEOWS) in managing maternal complications in the peripartum period: an ethnographic study**

MacIntosh N, et al. Value of a modified early obstetric warning system (MEOWS) in managing maternal complications in the peripartum period: an ethnographic study. *BMJ Qual Saf* 2014;23:26-34. doi:10.1136/bmjqs-2013-007781

“We had a woman that was showing signs that something was slightly out but it was a very grey thing. She was a bit out of breath. We thought, “Oh well, she is a very large lady anyway, she’s got crutches, she can’t walk properly. That’s why she’s a bit puffed out.” But that’s not what she was like all the time. She went into cardiac arrest.” (Westward, Midwife OU, 7)

Possible explanations:

- Vital sign abnormalities are not uncommon during labor.
- The bedside nurse screens vital signs recorded by the bedside monitor.

Department of Anesthesiology | MICHIGAN MEDICINE UNIVERSITY OF MICHIGAN

23

### Automated Maternal Early Warning Systems – The U of M Experience

Possible explanations:

- Vital sign abnormalities are not uncommon during labor.
- The bedside nurse screens vital signs recorded by the bedside monitor.
- Paging for artifactual vital signs.

Department of Anesthesiology | MICHIGAN MEDICINE UNIVERSITY OF MICHIGAN

24

### Automated Paging Using Computer Software

Department of Anesthesiology

25

### Automated Maternal Early Warning Systems – The U of M Experience

Department of Anesthesiology

26

### Automated Maternal Early Warning Systems – The U of M Experience

Department of Anesthesiology

27

### Automated Maternal Early Warning Systems – The U of M Experience

Department of Anesthesiology

28

### Automated Maternal Early Warning Systems – The U of M Experience

Department of Anesthesiology

29

### Automated Maternal Early Warning Systems – The U of M Experience

Department of Anesthesiology

30



### Automated Maternal Early Warning Systems – The U of M Experience

#### Use of a Novel Electronic Maternal Surveillance System and the Maternal Early Warning Criteria to Detect Severe Postpartum Hemorrhage



Thomas T. Klumpner, MD,\* Joana A. Kourtanis, MD,\* Sean R. Neve, MD,† Justin Ortmann, BS,\* Melissa E. Bauer, DO,\* Aissa Carver, MD,\* Anne Marie Patti, MSN, RN, CNM,‡ Roger Smith, MD,§ Gracela Mertz, PhD,¶ and Kevin R. Tempel, PhD, MD\*

There were 10 severely morbid hemorrhages identified by automated pages, but not identified by our subset of the MEWC. Six of these cases were identified by an automated page for anemia, 2 cases by an automated page for tachycardia, 1 case by a page for systolic hypotension, and the last case by a page for high shock index. Review of electronic recordings from these bedside monitors confirmed that vital signs meeting the system's paging criteria were registered by the bedside monitor, but not recorded in the patient's medical record by the nurse. In 3 of the 4

Klumpner, T., et al. Use of a Novel Electronic Maternal Surveillance System and the Maternal Early Warning Criteria to Detect Severe Postpartum Hemorrhage. Anesthesia & Analgesia; September 2020 - Volume 131 - Issue 3 - p 807-865

Department of Anesthesiology



37

### Automated Maternal Early Warning Systems – The U of M Experience

#### Use of a Novel Electronic Maternal Surveillance System and the Maternal Early Warning Criteria to Detect Severe Postpartum Hemorrhage



There were 10 severely morbid hemorrhages identified by automated pages, but not identified by our

**"Also, there have been instances when I didn't think a vital sign value was significant, but have been met by an MD (OB or anesthesiology) in the room who felt the VS change was important (when it actually was important, but I hadn't put it together yet that it mattered)."**

high shock index. Review of electronic recordings from these bedside monitors confirmed that vital signs meeting the system's paging criteria were registered by the bedside monitor, but not recorded in the patient's medical record by the nurse. In 3 of the 4

Klumpner, T., et al. User Perceptions of an Electronic Maternal Alerting System. AA Pract. 2020;14(11):e01308

Department of Anesthesiology



38

### Automated Maternal Early Warning Systems – The U of M Experience

Context Matters

Department of Anesthesiology



39

### Automated Maternal Early Warning Systems – The U of M Experience

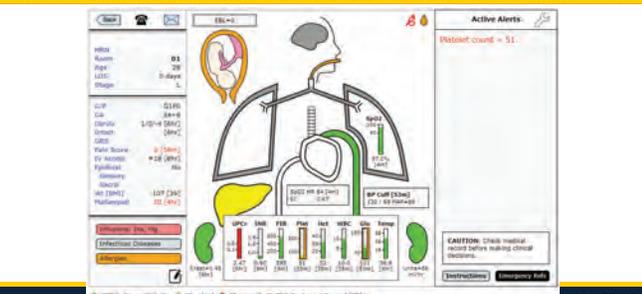


Department of Anesthesiology



40

### Automated Maternal Early Warning Systems – The U of M Experience



Department of Anesthesiology



41

### Automated Maternal Early Warning Systems – The U of M Experience

#### User Perceptions of an Electronic Maternal Alerting System



Thomas T. Klumpner, MD,\* Joana A. Kourtanis, MD,\* Melissa E. Bauer, DO,§ Aissa Carver, MD,† Anne Marie Patti, MSN, RN, CNM,‡ Roger Smith, MD,§ Gracela Mertz, PhD,¶ and Kevin R. Tempel, PhD, MD\*

**"Should we continue to use AlertWatch OB on Labor and Delivery?"**

Yes  80%

No  20%

0.0% 20.0% 40.0% 60.0% 80.0% 100.0%  
Percentage of Respondents

Modified from: Klumpner, T., et al. User Perceptions of an Electronic Maternal Alerting System. AA Pract. 2020;14(11):e01308

Department of Anesthesiology



42

### Automated Maternal Early Warning Systems – The U of M Experience

#### User Perceptions of an Electronic Maternal Alerting System

Thomas T. Klumpner, MD,\*† Joanna A. Klumpner, MD,\*† Melissa E. Baine, DO,§ Alaska Carver, MD,\*†  
 Anne Marie Pihl, MSN, RN, CNM,§ Roger Smith, MD,† Graciela Mierz, PhD,‡  
 and Kevin K. Tremont, PhD, MD\*

"Should we continue to use AlertWatch OB on Labor and Delivery?"

Even so, a PPV of 5.1% suggests there may be room for improvement.

Department of Anesthesiology

43

### Automated Maternal Early Warning Systems – The Future?

Vital signs data

Patient-specific risk factors

Early treatments for PPH

Department of Anesthesiology

44

### The Future?

Department of Anesthesiology

45

### Automated Maternal Early Warning Systems – The Future?

Vital signs data

Patient-specific risk factors

Early treatments for PPH

Better Computer Algorithms

Department of Anesthesiology

46

### Automated Maternal Early Warning Systems – The Future?

#### Machine Learning and Statistical Models to Predict Postpartum Hemorrhage

Karrik K. Venkatesh, MD, PhD, Robert A. Strawn, MD, Chad A. Grouten, MD, MBA, R. Philip Heine, MD, Nancy C. Chaudhry, MD, Jeffrey S. A. Strigens, MD, David M. Stamillo, MD, MS, Katherine M. Almond, MD, MPH, and J. Eric Jelencik, MD, MBA

**AUROC = 0.93**

Department of Anesthesiology

47

### Automated Maternal Early Warning Systems – The Future?

#### External Validation of Postpartum Hemorrhage Prediction Models Using Electronic Health Record Data

Sean R Meyer, MSc, Carlos Hyeon Joo, Karrik K Venkatesh, J. Eric Jelencik, Thomas T. Klumpner, Karanpreet Singh

**AUROC = 0.93 0.57**

Department of Anesthesiology

48

### Automated Maternal Early Warning Systems – The Future?

**Prediction of obstetrical and fetal complications using automated electronic health record data**

Gabriel J. Fournier, MD, Emma Solorza, BS, Alejandro Schöler, PhD, Harold NDA, MS From Malmacia, MS, Colchester, VT, USA

Model	Recall	Sensitivity	Specificity	PPV	NBC
Gradient boosted	5.27 (99%)	89.8	3.7	1.9	65.7
Logistic regression	0.14 (99%)	88.8	1.5	1.5	64.8
Support vector	4.1	49.6	86.8	5.5	78.1
Logistic regression	6.1	52.9	84.5	4.9	70.9
Gradient boosted	5.2	45.8	81.5	6.9	74.5
Logistic regression	5.2	44.8	89.4	6.3	71.8
Gradient boosted	7.5	27.8	96.1	8.9	83.2
Logistic regression	7.5	31.4	95.5	9.9	71.2

- Machine Learning algorithms to predict obstetric or fetal morbidity
- Data on admission
- 35 predictors
  - Demographics
  - Obstetric Diagnoses
  - Comorbidities
  - Vitals
- AUROC = 0.79**

Escobar, G. et al. Prediction of obstetrical and fetal complications using automated electronic health record data. American Journal of Obstetrics and Gynecology, Volume 224, Issue 2, 2021, Pages 137-147

49

### Automated Maternal Early Warning Systems – The Future?

**Prediction of obstetrical and fetal complications using automated electronic health record data**

Gabriel J. Fournier, MD, Emma Solorza, BS, Alejandro Schöler, PhD, Harold NDA, MS From Malmacia, MS, Colchester, VT, USA

Model	Recall	Sensitivity	Specificity	PPV	NBC
Gradient boosted	5.27 (99%)	89.8	3.7	1.9	65.7
Logistic regression	0.14 (99%)	88.8	1.5	1.5	64.8
Support vector	4.1	49.6	86.8	5.5	78.1
Logistic regression	6.1	52.9	84.5	4.9	70.9
Gradient boosted	5.2	45.8	81.5	6.9	74.5
Logistic regression	5.2	44.8	89.4	6.3	71.8
Gradient boosted	7.5	27.8	96.1	8.9	83.2
Logistic regression	7.5	31.4	95.5	9.9	71.2

"Only 0.1% of alerts were issued in the postpartum period and none were true positives."

- Machine Learning algorithms to predict obstetric or fetal morbidity or mortality
- Data on admission
- 35 predictors
  - Demographics
  - Obstetric Diagnoses
  - Comorbidities
  - Vitals
- AUROC = 0.79**

Escobar, G. et al. Prediction of obstetrical and fetal complications using automated electronic health record data. American Journal of Obstetrics and Gynecology, Volume 224, Issue 2, 2021, Pages 137-147

50

### Automated Maternal Early Warning Systems – The Future?

**Comprehensive pregnancy monitoring with a network of wireless, soft, and flexible sensors in high- and low-resource health settings**

Ryu, D. et al. Comprehensive pregnancy monitoring with a network of wireless, soft, and flexible sensors in high- and low-resource health settings. PNAS 2021; 118: 6210-6218

51

### Automated Maternal Early Warning Systems – The Future?

Caution

52

### Automated Maternal Early Warning Systems – Caution

"Trust me, if there is any doubt about whether or not I need anesthesiology and/or OB in the room, I will call pronto. Just like the MIEOWS thing was a giant waste of time and money, so is this."

"The nurse is the eyes/ears at the bedside, not the machine/computer"

Klumppner, T. et al. User Perceptions of an Electronic Maternal Alerting System. A A Pract. 2020; 14(11):401308

53

### Automated Maternal Early Warning Systems – Caution

- Possible Drawbacks:
  - Loss of vigilance due to over-reliance on system

Therapeutic.com

54

### Automated Maternal Early Warning

- Possible Drawbacks:**
  - Loss of vigilance due to over-reliance on system
  - Increasing complexity creates blind spots

Modified from: Klumpner, T. et al. Use of a novel electronic maternal surveillance system to generate automated alerts on the labor and delivery unit. BMC Anesthesiol. 2018; 18: 78.

Department of Anesthesiology

55

### Automated Maternal Early Warning

- Possible Drawbacks:**
  - Loss of vigilance due to over-reliance on system
  - Increasing complexity creates blind spots
    - Systolic BP = 65mmHg -> wait up to 30 minutes to notify.

Modified from: Klumpner, T. et al. Use of a novel electronic maternal surveillance system to generate automated alerts on the labor and delivery unit. BMC Anesthesiol. 2018; 18: 78.

Department of Anesthesiology

56

### Automated Maternal Early Warning Systems – Caution

- Possible Drawbacks:**
  - Loss of vigilance due to over-reliance on system
  - Increasing complexity creates blind spots
  - Alarm fatigue

"I have turned my personal pager off during the call nights so as to not be unnecessarily interrupted."

Modified from: Klumpner, T. et al. User Perceptions of an Electronic Maternal Alerting System. A A Pract. 2020;14(11):d01308

Department of Anesthesiology

57

### Conclusions

- Notifications for every abnormal vital sign registered by a bedside monitor will result in alarm fatigue.
- Bedside nurse confirmation of vital sign abnormalities may be a useful method to reduce unnecessary notifications.
- Some important vitals data may be missed if only nurse validated vitals are used.
- Identifying better electronic predictors of maternal morbidity is an evolving area of study.

Department of Anesthesiology

58

### Thank you

Department of Anesthesiology

59

# Getting the Right Resources to the Patient: Maternal Levels of Care

David Arnolds, MD PhD  
 SOAP Annual Meeting 2022  
 University of Michigan Department of Anesthesia  
 @David\_Arnolds



## Disclosures

- I have no relevant financial disclosures related to this presentation
- In the past I have received honoraria from Dannemiller, Inc for educational material related to labor analgesia



“Levels of care” historically have been oriented towards anticipated neonatal needs



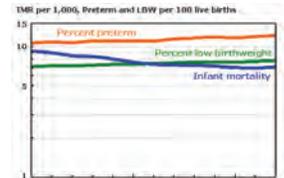
## Perinatal regionalization works for babies

State	Level 1 (NICU)	Level 2 (NICU)	Level 3 (NICU)	Level 4 (NICU)	Level 5 (NICU)	Level 6 (NICU)	Level 7 (NICU)	Level 8 (NICU)	Level 9 (NICU)	Level 10 (NICU)
Alabama	1	1	1	1	1	1	1	1	1	1
Alaska	1	1	1	1	1	1	1	1	1	1
Arizona	1	1	1	1	1	1	1	1	1	1
Arkansas	1	1	1	1	1	1	1	1	1	1
California	1	1	1	1	1	1	1	1	1	1
Colorado	1	1	1	1	1	1	1	1	1	1
Connecticut	1	1	1	1	1	1	1	1	1	1
Delaware	1	1	1	1	1	1	1	1	1	1
District of Columbia	1	1	1	1	1	1	1	1	1	1
Florida	1	1	1	1	1	1	1	1	1	1
Georgia	1	1	1	1	1	1	1	1	1	1
Hawaii	1	1	1	1	1	1	1	1	1	1
Idaho	1	1	1	1	1	1	1	1	1	1
Illinois	1	1	1	1	1	1	1	1	1	1
Indiana	1	1	1	1	1	1	1	1	1	1
Iowa	1	1	1	1	1	1	1	1	1	1
Kansas	1	1	1	1	1	1	1	1	1	1
Kentucky	1	1	1	1	1	1	1	1	1	1
Louisiana	1	1	1	1	1	1	1	1	1	1
Maine	1	1	1	1	1	1	1	1	1	1
Maryland	1	1	1	1	1	1	1	1	1	1
Massachusetts	1	1	1	1	1	1	1	1	1	1
Michigan	1	1	1	1	1	1	1	1	1	1
Minnesota	1	1	1	1	1	1	1	1	1	1
Mississippi	1	1	1	1	1	1	1	1	1	1
Missouri	1	1	1	1	1	1	1	1	1	1
Montana	1	1	1	1	1	1	1	1	1	1
Nebraska	1	1	1	1	1	1	1	1	1	1
Nevada	1	1	1	1	1	1	1	1	1	1
New Hampshire	1	1	1	1	1	1	1	1	1	1
New Jersey	1	1	1	1	1	1	1	1	1	1
New Mexico	1	1	1	1	1	1	1	1	1	1
New York	1	1	1	1	1	1	1	1	1	1
North Carolina	1	1	1	1	1	1	1	1	1	1
North Dakota	1	1	1	1	1	1	1	1	1	1
Ohio	1	1	1	1	1	1	1	1	1	1
Oklahoma	1	1	1	1	1	1	1	1	1	1
Oregon	1	1	1	1	1	1	1	1	1	1
Pennsylvania	1	1	1	1	1	1	1	1	1	1
Rhode Island	1	1	1	1	1	1	1	1	1	1
South Carolina	1	1	1	1	1	1	1	1	1	1
South Dakota	1	1	1	1	1	1	1	1	1	1
Tennessee	1	1	1	1	1	1	1	1	1	1
Texas	1	1	1	1	1	1	1	1	1	1
Utah	1	1	1	1	1	1	1	1	1	1
Vermont	1	1	1	1	1	1	1	1	1	1
Virginia	1	1	1	1	1	1	1	1	1	1
Washington	1	1	1	1	1	1	1	1	1	1
West Virginia	1	1	1	1	1	1	1	1	1	1
Wisconsin	1	1	1	1	1	1	1	1	1	1
Wyoming	1	1	1	1	1	1	1	1	1	1

VLBW infants have a mortality benefit if delivered at a hospital of the appropriate level of care



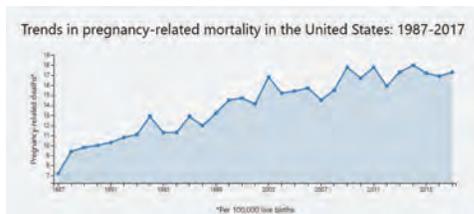
Lasswell et al JAMA 2010



NCHS Analyses of Recent Trends in Infant Mortality



## But What about Moms ?



CDC Pregnancy Mortality Surveillance System



## If Americans Love Moms, Why Do We Let Them Die?



By Nicholas Kristof

July 29, 2017

Hospitals know how to protect mothers. **They just aren't doing it.**

Alison Young USA TODAY

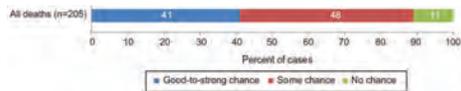
Published 6:00 AM EDT, Jul. 29, 2017 | Updated 11:08 AM EDT Mon., Jul. 31, 2017



## Maternal mortality is preventable

### Pregnancy-Related Mortality in California Causes, Characteristics, and Improvement Opportunities

Elisbeth K. Main, MD, MSc, Christy L. McCain, MD, Christine H. Morone, PhD, Susan Hubby, MD, and Elizabeth S. Lewin, MD



Main et al, Obstetrics & Gynecology 2015



## The maternal safety movement

### PATIENT SAFETY BUNDLES

#### OBSTETRICS

#### Putting the "M" back in

Mary E. D'Almeida, MD, Christine A. Brennan, MD, F. Gary Cunningham, MD, Thomas J. Coates, MD, Gary H. V. Hankins, MD, John C. Hinkle, MD, E. Stephen R. Martin, DCO, M. Katherine Mullan, MD, J. Louise R. Ross, MD, George A. Savelle, MD, Leslie American Journal of Obstetrics & Gynecology



The American College of Obstetrics and Gynecology



Society for Maternal-Fetal Medicine

care for Women with Opioid Use Disorder

maternal mortality

Prevention of Primary Cesarean Birth

Retention in Pregnancy

Interventions in Obstetrical Care

Discharge Transition

#### OBSTETRIC CARE

#### CONSENSUS

#### Levels of Maternal Care

#### The National Action for

Barbara M. Scavone, MD,† and Elisbeth K. Main, MD† July 2015 • Volume 121 • Number 1

Care for Pregnant and Postpartum People with Substance Use Disorder



## Maternal levels of care: matching maternal medical needs with appropriate facilities

### Maternal Levels of Care are designed to:

- Reduce maternal morbidity and mortality
- Provide risk-appropriate care
- Facilitate consultation and transfer of care when appropriate

### Maternal Levels of Care are NOT designed to:

- Close low delivery volume hospitals
- Advocate transfer of all patients to high acuity centers

Obstetric Care Consensus: Levels of Maternal Care. *Obstetrics & Gynecology* 2019



Level of Care	Appropriate patients	Key Capabilities	Health Care Providers
<b>Accredited birth center</b>	Low risk patients with uncomplicated singleton term vertex pregnancies	Consultation, collaboration, or referral system for both maternal and neonatal needs.	
<b>Level I (Basic Care)</b>	Low-moderate risk patients	<ul style="list-style-type: none"> <li>- Emergency C/S</li> <li>- Readily available limited diagnostics and imaging</li> </ul>	<ul style="list-style-type: none"> <li>- Readily available providers</li> </ul>
<b>Level II (Specialty Care)</b>	Moderate-high risk patients	<ul style="list-style-type: none"> <li>- Readily available CT/MRI/TTE, standard OB U/S</li> </ul>	<ul style="list-style-type: none"> <li>- Readily available <b>OB-GYN</b></li> <li>- Readily available <b>anesthesiologist</b></li> <li>- <b>MFM, IM/FM, general surgery</b> readily available</li> </ul>

Obstetric Care Consensus: Levels of Maternal Care. *Obstetrics & Gynecology* 2019



	Appropriate patients	Key Capabilities	Health Care Providers
<b>Level III (Subspecialty Care)</b>	Complex maternal medical conditions, obstetric complications, and fetal conditions	<ul style="list-style-type: none"> <li>- All blood in-house</li> <li>- All imaging with interpretation</li> <li>- <b>IR</b> readily available, <b>ICU onsite</b></li> <li>- Accept transfers and educate</li> </ul>	<ul style="list-style-type: none"> <li>- <b>Physically present</b> OB/GYN and anesthesiologist</li> <li>- <b>Director</b> of OB anesthesia with <b>fellowship training</b></li> <li>- RNs comfortable with critical illness</li> <li>- All medical sub-specialists</li> </ul>
<b>Level IV (Regional Perinatal Health Care Centers)</b>	Complex and critically ill pregnant patients	<ul style="list-style-type: none"> <li>- <b>ICU for obstetric patients</b> with primary or co-management by <b>MFM</b></li> <li>- Perinatal leadership</li> </ul>	<ul style="list-style-type: none"> <li>- <b>OB-fellowship trained</b> anesthesiologist at all times</li> <li>- Readily available <b>neurosurgery, cardiac, or transplant surgery</b></li> </ul>

Obstetric Care Consensus: Levels of Maternal Care. *Obstetrics & Gynecology* 2019



### What is the appropriate minimum level of care?

**Level I**

- Twins
- TOLAC
- Previa, complex C/S

**Level II**

- Poorly controlled asthma

**Level III**

- Accreta Spectrum
- Moderate Cardiac Disease
- Severe Cardiac Disease

**Level IV**

- Requires organ transplant

Obstetric Care Consensus: Levels of Maternal Care. *Obstetrics & Gynecology* 2019



## Experience matters: comorbidities

**TABLE 2**  
Adjusted risk ratios for severe maternal morbidity by patient risk status at low- and high-acuity hospitals

Patient comorbidity risk	Hospital, adjusted risk ratio (95% confidence interval)	
	Low acuity	High acuity
Low	Reference	Reference
Intermediate	1.53 (1.33–1.77)	1.57 (1.49–1.65)
High	9.55 (6.83–13.35)	6.50 (5.95–7.09)

Log binary regression models adjusted for patient primary insurer, quartile of the median income of the patient's residence zip code, urban-rural designation of the patient's county of residence, hospital ownership, hospital teaching status, and the number of deliveries per hospital. All probability values for the adjusted odds ratios listed in the table are <.001.

Clapp et al. Hospital acuity and maternal morbidity. *Am J Obstet Gynecol* 2018.

Clapp et al, AJOG 2018



## Experience matters: Peripartum hysterectomy

Table 2. Unadjusted Operative and Perioperative Complications Associated With Peripartum Hysterectomy Stratified by Hospital Volume

	Low Volume	Intermediate Volume	High Volume	P
Patients	715 (33.4)	867 (39.3)	627 (28.4)	
Hospitals	221 (69.3)	73 (22.8)	26 (8.1)	
Perioperative surgical complications				
Reoperation	46 (6.4)	38 (4.4)	20 (3.2)	.02
Transfusion	409 (57.2)	405 (46.7)	283 (45.3)	<.001
Intensive care use	322 (45.0)	343 (39.6)	172 (27.4)	<.001
Perioperative death	13 (1.8)	8 (0.9)	3 (0.5)	.02

Wright et al, *Obstetrics & Gynecology* 2010



## Do we already appropriately match patients and facilities?

Maternal Risk Level	Hospital Level of Care				Total <sup>a</sup>	Delivered at an Inappropriately Low-Level Center <sup>a</sup>
	IV	III	II	I		
Risk appropriate for level IV	1,157 (31.6) <sup>†</sup>	1,297 (35.5) <sup>‡</sup>	864 (23.6) <sup>§</sup>	340 (9.3) <sup>¶</sup>	3,658 (0.4)	2,501 (68.4)
Risk appropriate for level III or IV	4,372 (26.8) <sup>†</sup>	5,779 (35.4) <sup>‡</sup>	4,462 (27.3) <sup>§</sup>	1,717 (10.5) <sup>¶</sup>	16,330 (1.9)	6,179 (37.8)
Risk appropriate for level II or above	23,394 (22.0) <sup>†</sup>	37,738 (35.5) <sup>‡</sup>	33,540 (31.5) <sup>§</sup>	11,716 (11.0) <sup>¶</sup>	106,388 (12.6)	11,716 (11.0)
Risk appropriate for level I or above	122,186 (17.0) <sup>†</sup>	259,950 (36.2) <sup>‡</sup>	246,819 (34.3) <sup>§</sup>	90,214 (12.5) <sup>¶</sup>	719,169 (85.1)	N/A
Total <sup>a</sup>	151,109 (17.9)	304,764 (36.0)	285,685 (33.8)	103,987 (12.3)	845,545	20,396 (2.4)

Easter et al, *Obstetrics & Gynecology* 2019



## Summary and next steps

- **Maternal levels of care:**
  - Incorporate maternal needs into regionalized networks
  - Are supported by evidence
  - Have not been effectively informally implemented
- **Advocate for your patients**
- **Know your institutional and regional resources**
- **Be active within your network**
  - Teaching and resources are an essential part of the regionalized approach

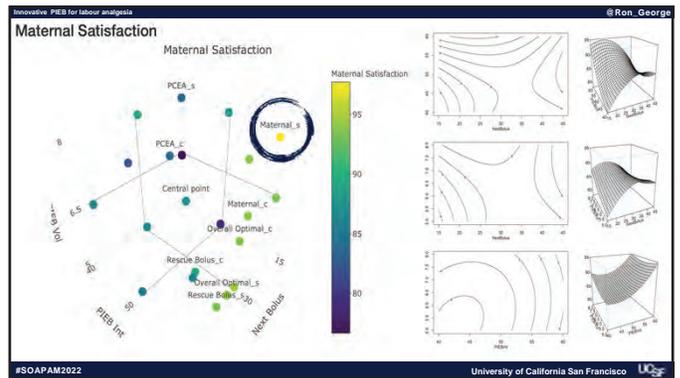
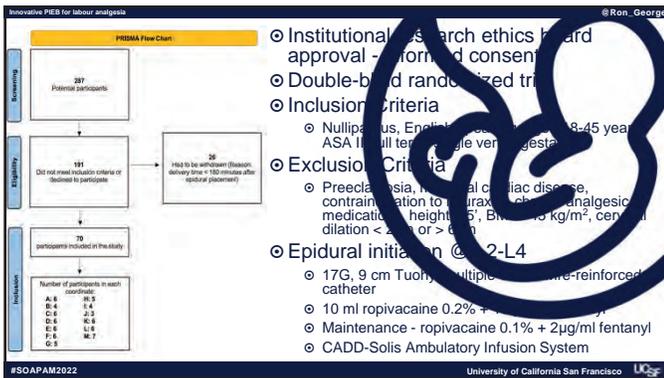
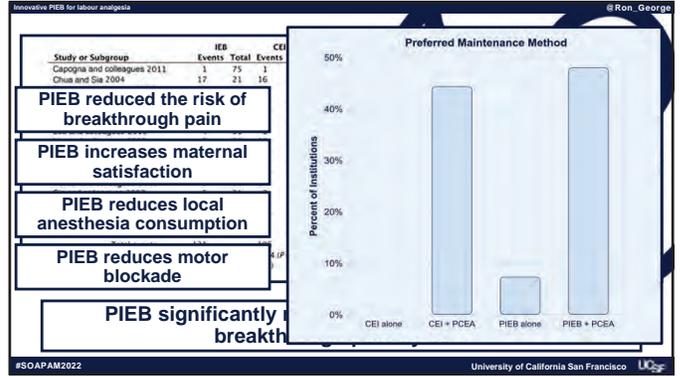
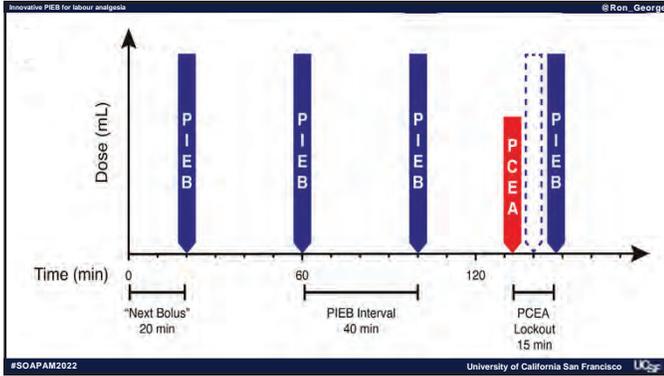


The Participating States & Success Stories



Learn More





Innovative PIEB for labour analgesia © Ron. George

	Next Bolus (min)	PIEB Interval (min)	PIEB Volume (mL)	Satisfaction (0-100)	Clinician Bolus (0-1)	PCEA Ratio (0-1)
Maternal Satisfaction	27	60	6.7	94	0.39	0.76

#SOAPAM2022 University of California San Francisco UCsf

Innovative PIEB for labour analgesia © Ron. George

### An innovative approach to optimize Programmed Intermittent Epidural Bolus (PIEB) delivery for labour analgesia

Ronald B. George MD FRCP, Allana Munro BSc Pharm MD FRCP, Pantelis Andreou, PhD

	Next Bolus (min)	PIEB Interval (min)	PIEB Volume (mL)	Satisfaction (0-100)	Clinician Bolus (0-1)	PCEA Ratio (0-1)
Maternal Satisfaction	27	60	6.7	94	0.39	0.76
Clinician Bolus	15	15	1.1	80	0.41	0.80
PCEA Ratio	22	42	3.4	84	0.41	0.80
Common Optimal	29	60	6.2	94	0.39	0.78

• Double-blind randomized trial

• Inclusion Criteria

- Nulliparous, English-speaking, aged 18-45 years, ASA II, full term, single vertex gestation

• Exclusion Criteria

- Preeclampsia, maternal cardiac disease, contraindication to neuraxial, chronic analgesic medications, height < 5', BMI > 45 kg/m<sup>2</sup>, cervical dilation < 2cm or > 6cm

• Epidural @ L2-L4

- 17G, 9 cm Tuohy, multiple-orifice wire-reinforced catheter
- 10 ml ropivacaine 0.2% + 10 µg/ml fentanyl
- Maintenance - ropivacaine 0.1% + 2µg/ml fentanyl
- CADD-Solis Ambulatory Infusion System

**Optimal PIEB**

- PIEB Interval = 60 minutes
- PIEB Volume = 6.2 mL
- NEXT Bolus = 29 minutes
- Maternal Satisfaction = 94%
- PCEA Ratio = 0.78
- Rescue Bolus = 0.28

#SOAPAM2022 University of California San Francisco UCsf

*In vitro* optimization of oxytocin-induced myometrial contractility by propranolol  
 - Potential applications in induction of labor and treatment of postpartum hemorrhage  
 Jayalakshmi Caliaparamal; Lauren Miller; Stella Wang; Ella Huszti; John Kingdom; Mrinalini Balki

**Background**

- o Current rates of labor induction and augmentation with oxytocin are high
  - Labor is induced in 20 - 40% and augmented in 37 - 75% deliveries
  - High-dose/prolonged exposure to oxytocin during labor leads to oxytocin receptor desensitization
- o CD for "failure to progress" is very common in clinical practice
- o Rates of primary PPH are thus rising worldwide in tandem with high CD rates
- o Prolonged labor is stressful, leading to maternal fever and tachycardia
  - Indicates high circulating catecholamines
- o There is a need to investigate novel methods to enhance oxytocin-induced myometrial contractions



**Propranolol to augment myometrial contractility**



**Objective**

- To investigate the effect of propranolol on myometrial contractions induced by:
- 1) low-dose oxytocin by simulating labor induction
  - 2) high-dose oxytocin by simulating labor augmentation (oxytocin-desensitized myometrium) to examine its potential role for prevention of postpartum hemorrhage.

**Hypothesis**

Pre-treatment or co-treatment with propranolol would augment oxytocin-induced myometrial contractions

**Methods**

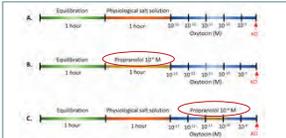
In-vitro study



Elective C-section



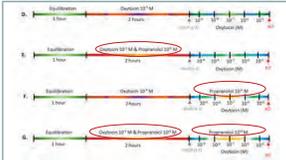
**Labor Induction Model (low-dose oxytocin)**



Myometrial contractions with increasing oxytocin concentrations recorded for:

- o Amplitude (g)
- o Frequency (contractions/10 min)

**Labor Augmentation Model (high-dose oxytocin)**



**Primary outcome**

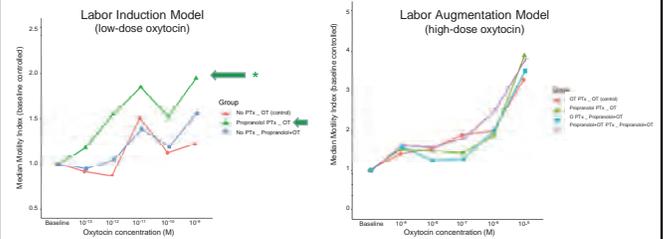
- o Motility index (amp x freq)

**Analysis**

- o Multivariable Linear regression model with GEE
- o Outcomes expressed as % change from baseline (equilibration)
- o Sample size 28/ group
- o  $\alpha$  0.05, power 80%

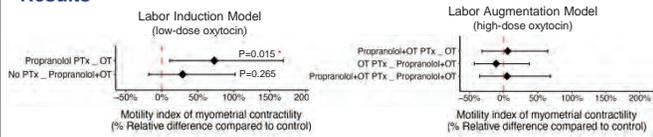
**Results**

**Motility Index during oxytocin dose response period**



- o 222 experiments in samples from 51 patients
- o Propranolol pretreatment significantly improved Motility Index induced by low-dose oxytocin compared to control
- o No change in contractility when propranolol administered in oxytocin desensitized myometrium

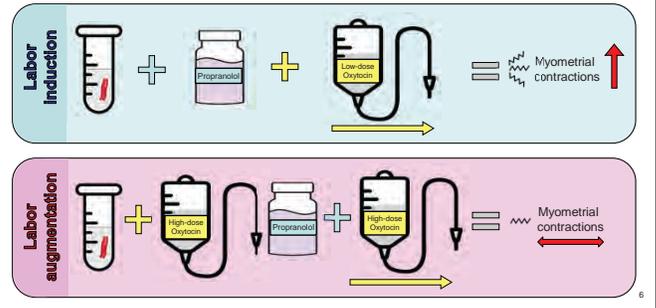
## Results



## Conclusion

- o Propranolol pretreatment improves myometrial contractility with low-dose oxytocin administration (modeling labor induction)
  - Merits further investigation to reduce the rate of CD for failed labor
- o Propranolol does not improve contractions in oxytocin-desensitized myometrium
  - Likely no role in PPH prevention after labor augmentation
- o Further biomolecular studies are required to understand the pathways involved and clinical studies are needed to validate these findings.

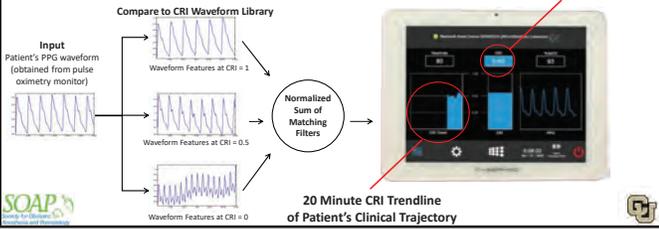
*In vitro* optimization of oxytocin-induced myometrial contractility by propranolol  
 - Potential applications in induction of labor and treatment of postpartum hemorrhage



## THE COMPENSATORY RESERVE INDEX IN PATIENTS UNDERGOING CESAREAN DELIVERY

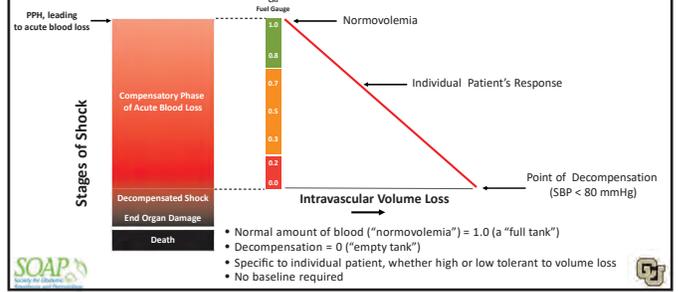
Marina L Reppucci, Jonathan Seth Rogerson, Kaci Pickett, Stephanie Kierstead, Margo M Nolan, Steven L Moulton, Cristina L Wood  
Obstetric Anesthesiology Fellow  
University of Colorado, SOM

The compensatory reserve index (CRI) uses a computer algorithm to measure small alterations in the photoplethysmogram (PPG) waveform generated by a pulse oximeter



## What is the Compensatory Reserve Index?

CRI Provides Continuous, Non-Invasive, Real Time Insight on Central Volume Status on a 0-1 Scale



## Study Description

Prospective observational study: Non-emergent cesarean deliveries at the University of Colorado between February 2020 and May 2021.

### Hypothesis:

- CRI will detect compensatory changes in women who experience PPH during a CD

67 patients enrolled; 51 patients with complete data

- 38 in the non-PPH group (74.5%) and 13 in the PPH group (25.5%)
- 49 patients with scheduled CD, 2 patients (1 in each group) were laboring and proceeded to CD
- 1 hysterectomy for PAS
- Inclusion: Pregnant, age 18 or greater
- Exclusion: Refusal, vaginal delivery, incarcerated
- Anesthesia team blinded from CRI data



## Results

Table 1. Overall Demographics of Study Population

Demographics	PPH (n=13)	Non-PPH (n=38)	Overall (n=51)	p-value
Race				
White	7 (53.8%)	23 (60.5%)	30 (58.8%)	
Asian	4 (30.8%)	2 (5.3%)	6 (11.8%)	
American/Black	0 (0.0%)	1 (2.6%)	1 (2.0%)	
Other	2 (15.4%)	12 (31.6%)	14 (27.5%)	
Maternal Age at Delivery	30.69 (1.44)	32.27 (0.71)	32.28 (0.94)	0.87
AMA	4 (30.8%)	13 (34.2%)	17 (33.3%)	1.00
Operational Age	37.68 (1.41)	35.41 (1.7)	37.23 (1.5)	0.05
Prior Delivery	11 (84.6%)	31 (81.6%)	42 (82.4%)	1.00
Prior SCD	3 (23.1%)	10 (26.3%)	13 (25.5%)	1.00
Prior C-Section	9 (69.2%)	24 (63.2%)	33 (64.7%)	0.75
Risk Factors				
Obesity	7 (53.8%)	27 (71.0%)	34 (66.7%)	0.26
Hypertension	5 (38.5%)	6 (16.2%)	11 (21.6%)	0.126
Diabetes	2 (15.4%)	8 (21.0%)	10 (20.0%)	1.00
Anemia	0 (0.0%)	4 (10.5%)	4 (7.8%)	0.561
Gravid Multiparity	2 (15.4%)	3 (7.9%)	5 (9.8%)	0.636
Uterine Anomaly	1 (7.7%)	6 (16.2%)	7 (13.7%)	0.679
Multiple Gestation	1 (7.7%)	5 (13.2%)	6 (11.8%)	1.000
Fetal Movement	5 (38.5%)	2 (5.3%)	7 (13.7%)	0.051
History of PPH	2 (15.4%)	1 (2.6%)	3 (5.9%)	0.342
Abnormal Placenta	1 (7.7%)	0 (0.0%)	1 (2.0%)	0.260
Pre-eclampsia	1 (7.7%)	4 (10.5%)	5 (9.8%)	0.696
Non-Severe	1 (7.7%)	4 (10.5%)	5 (9.8%)	
Severe	1 (7.7%)	0 (0.0%)	1 (2.0%)	

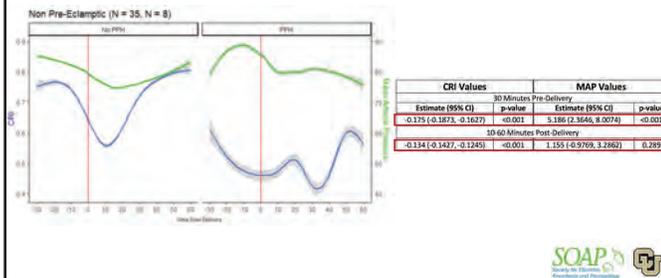
Table 2. Delivery Data

	PPH (n=13)	Non-PPH (n=38)	Overall (n=51)	p-value
General Anesthesia	3 (23.1%)	1 (2.6%)	4 (7.8%)	0.049
Type of Neuraxial Block				
Spinal	2 (15.4%)	9 (23.7%)	11 (21.6%)	
Epidural	1 (7.7%)	1 (2.6%)	2 (4.0%)	
Both	8 (61.9%)	26 (68.2%)	34 (66.4%)	0.784
Level of Neuraxial Block				
T2/3	2 (15.4%)	7 (18.4%)	9 (17.6%)	
T4/5	6 (46.2%)	21 (55.3%)	27 (52.8%)	
T6/7	2 (15.4%)	3 (7.9%)	5 (9.8%)	
Blood Loss (mL)	2149.85 (2970.21)	595.158 (160.52)	991.45 (1613.89)	<0.001
Phenylephrine (mcg/kg)	1620.77 (998.32)	1756.49 (423.72)	1763.50 (615.49)	0.47
Phenylephrine (mcg/kg)	37.6 (1.9)	27.0 (1.7)	NA	0.094

\*Analysis without hysterectomy case  
Blood Loss (mL): 1329.0 (261.9) vs 595.2 (160.5); p<0.001  
Phenylephrine (mcg/kg): 34.8 (1.7) vs 27.0 (1.7); p=0.184



## Results



## Key Points

- CRI can detect compensatory changes in women undergoing non-emergent CD who experience PPH, despite normal MAPs
- Low CRI baseline values may predict women at risk of PPH prior to delivery
- Further studies are needed to determine:
  - why these patients start at lower CRI values prior to delivery
  - how the change in CRI values can be utilized to guide resuscitation during PPH

SOAP

## Oxytocin at elective cesarean delivery: a dose-finding study in people with twin pregnancy

E Peska, M Balki, W Pfeifer, C Maxwell, XY Ye, K Downey, [JCA Carvalho](#)

Department of Anesthesiology and Pain Medicine  
Mount Sinai Hospital, University of Toronto

## Introduction

- Twin pregnancy is associated with higher risk of uterine atony and postpartum hemorrhage.
  - increase fetal weight (60% compared to singleton) leads to myometrial stretch
    - may increase oxytocin receptor expression
    - similar number of oxytocin receptors, gap junctions and cytokines
  - uterine contractions:
    - increased frequency, decreased duration; similar integral of force
    - decreased synchrony

- The optimal dose of oxytocin at elective CD in people with twin pregnancy is unknown.

### Research question:

- What is the bolus dose of oxytocin required to initiate adequate uterine contraction in 90% of people (ED90) with twin pregnancy undergoing elective cesarean delivery?

### Hypothesis:

- We hypothesized that the ED90 of oxytocin would be greater than 0.5 IU but less than 5 IU.

## Methods

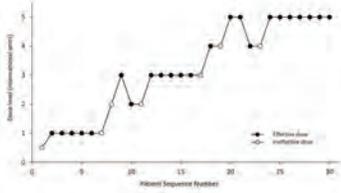
- Inclusion criteria
  - twin gestation;  $\geq 36$  weeks gestation
  - elective cesarean delivery under spinal anesthesia
- Exclusion criteria
  - allergy or hypersensitivity to oxytocin
  - conversion to general anesthesia
  - conditions predisposing to uterine atony and PPH other than multiple pregnancy
- Anesthetic technique
  - routine monitoring
  - co-loading with lactated Ringer's 10 mL/kg max 1000 mL
  - spinal anesthesia with bupivacaine/fentanyl/morphine
  - prophylactic nor-epinephrine bolus 6 mcg aiming at SBP 90-100% baseline
  - left uterine displacement

## Intervention

- Oxytocin bolus at delivery of the second twin, injected over 1 minute
- Pre-defined doses of oxytocin: 0.5; 1; 2; 3; 4; and 5 IU (diluted to 10mL NS)
- Biased coin up-down design
  - 1<sup>st</sup> patient received 0.5 IU. Thereafter, dose determined by the response of the previous patient
    - failure: dose increased
    - success: dose decreased with a probability of 1/9, otherwise same dose
- Uterine tone assessed at 2 minutes after injection of oxytocin
  - satisfactory vs unsatisfactory
- Maintenance of oxytocin 4.8 IU/h; additional uterotonics used as necessary
- Primary outcome: satisfactory uterine tone at 2 minutes
- ED90 (95% CI): isotonic regression and truncated Dixon and Mood method

## Results

30 patients recruited



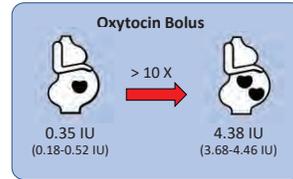
Estimated ED90 of oxytocin

Isotonic Regression  
4.38 IU (95% CI 3.68-4.86 IU)

Dixon-Mood  
3.41 IU (95% CI 2.83 - 3.98 IU)

23 pts initial success: 7 received additional uterotonic (4 intraop; 3 PACU)  
16 pts (53%) received no additional uterotonics at any time

## ED90 of oxytocin bolus at elective cesarean delivery in people with twin pregnancy



### Recommendations:

- Bolus dose 5 IU over 1 minute
- Maintenance > 4.8 IU/h or additional uterotonics (future studies)



**Plasmatic catecholamines after neuraxial labor analgesia: a randomized controlled trial comparing epidural versus combined spinal-epidural**

Shirley Andrade Santos\* MD PhD; Hermann dos Santos Fernandes MD PhD; Fernando Souza Nani MD; Andreza Gonzaga Bartilotti MD; Rossana Pulcineli Vieira Francisco MD PhD; Maria José Carvalho Carmona MD PhD; Fernando Bliacheriene MD PhD; Joaquim Edson Vieira MD PhD

Hospital das Clínicas – Universidade de São Paulo, São Paulo, Brazil

**Background**

- Combined spinal-epidural (CSE) analgesia has been associated with more fetal heart rate (FHR) abnormalities compared than epidural (EP)
- Quick and effective pain relief with CSE → decreasing levels of maternal plasmatic catecholamines → uterine hyperactivity → fetal heart rate abnormalities
- Previous studies: 80-90s
- Studies comparing neuraxial techniques not currently performed (doses and drugs)
- **Objective:** compare the decrease of plasmatic catecholamine levels between CSE and EP after neuraxial labor analgesia

**Methods**

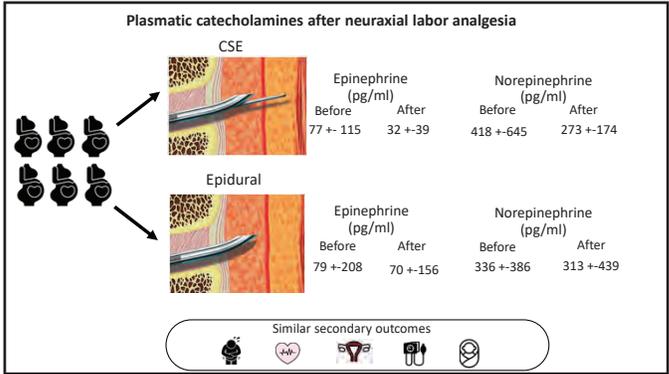
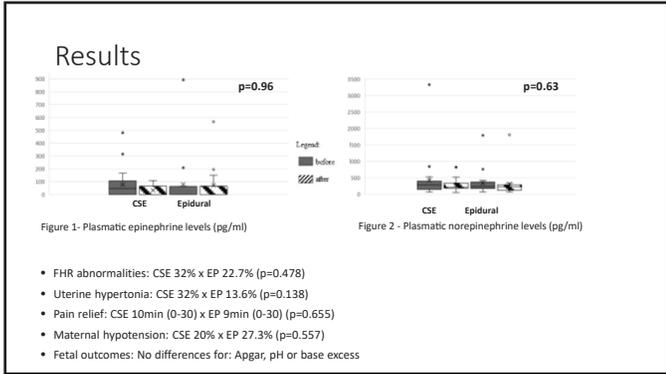
- Randomized clinical trial: 47 laboring patients
- Research Ethics board approval, patient’s written informed consent and ClinicalTrials registration
- Groups:
  - 1- CSE (n=25):
    - Hyperbaric bupivacaine 0.5% - 0.5 mL
    - Sufentanil 0.0005% - 1 mL
    - Morphine 0.02% - 0.3 mL
  - 2- EP (n=22):
    - Bupivacaine 0.5% + Epinephrine 5 mcg/mL - 2.5 mL
    - Sufentanil 0.0005% - 4 mL
    - NaCl 0.9% - 3.5 mL
- Maintenance:
  - Bupivacaine 0.0625% + Epinephrine 0.625 mcg/mL + Fentanyl 2mcg/mL: 10 mL/h

**Methods**

- Primary outcome:
  - Difference between catecholamine levels before and after analgesia
  - Samples: moment of analgesia requested and 20 minutes after
- Secondary outcomes:
  - Occurrence of FHR abnormalities
  - Uterine hypertonia
  - Hypotension
  - Pain relief – baseline and 20 minutes after
  - Fetal outcomes

• Sample size: 50 parturients (25 per group)

Shneider SM, Abboud TK, Artal R, Henriksen EH, Stefani SJ, Levinson G. Maternal catecholamines decrease during labor after lumbar epidural anesthesia. Am J Obstet Gynecol. 1983;147(1):13-5.  
 Cascio M, Pygon B, Bennett C, Ramanathan S. Labour analgesia with intrathecal fentanyl decreases maternal stress. Can J Anaesth. 1997 Jun;44(6):605-9. doi: 10.1007/BF03015443. PMID: 9187779.



**Abstract #: BP – 1**  
**Best Paper Competition**

**An innovative approach to optimize Programmed Intermittent Epidural Bolus (PIEB) delivery for labour analgesia**

**Presenting Author:** Ronald B. George, MD FRCPC

**Presenting Author's Institution:** UCSF - San Francisco, California

**Co-Authors:** Allana Munro, MD FRCPC - Dalhousie University, IWK Health

**Introduction**

Three key parameters need to be programmed on a Programmed Intermittent Epidural Bolus (PIEB) pump for labour analgesia; Next bolus (PIEBn), bolus interval (PIEBi) and bolus volume (PIEBv). We hypothesized a mathematical modelling tool, Response Surface Methodology (RSM)<sup>1</sup>, could evaluate multiple PIEB pump settings simultaneously. The objective of this study was to use RSM to best estimate PIEB settings to optimize primary outcome measures: maternal satisfaction, need for a clinician administered rescue bolus, and the ratio of Patient Controlled Epidural Analgesia (PCEA) boluses (delivered/requested).

**Methods**

With institutional ethics approval, a double-blind randomized trial was completed in the birth unit of a tertiary care centre. Nulliparous, English-speaking ASA Status II patients aged 18-45 years, at full term, with single gestation in vertex presentation and in spontaneous labour, between 2-6 cm cervical dilatation were eligible for inclusion. Those with comorbidities, contraindication to neuraxial analgesia, using chronic analgesics, less < 152 cm or BMI > 45 kg/m<sup>2</sup> were excluded. With consent, labour analgesia was initiated via the epidural catheter using 10 ml ropivacaine 0.2% with 10 ug/ml fentanyl solution and PCEA. After two unsuccessful PCEA attempts, a manual rescue bolus or an epidural pump bolus could be provided. All were randomly assigned to predetermined PIEB settings (Figure 1A & 1B). Clinical outcomes were gathered from the epidural pump and anesthesia and nursing electronic medical records. RSM identified coordinates for the three pump settings that represented a stationary point optimized for the three outcomes: PCEA ratio (a ratio closest to 0.1), rescue bolus (optimal is zero) and maternal satisfaction (Visual Analog Scale, 0-100, optimal response is  $\geq 90$ ).

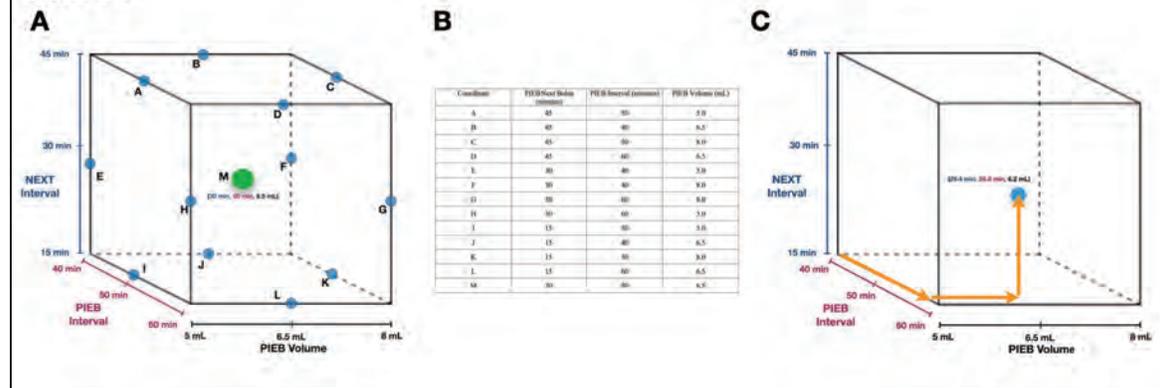
**Results**

Modelling calculations estimated 70 participants would estimate the optimal response for each outcome. Of 287 potential participants, 191 did not meet inclusion criteria and 26 were withdrawn, leaving 70 patients for study inclusion. Using RSM, the suggested PIEB settings when identifying a stationary point while trying to simultaneously optimize the primary study outcomes were: PIEBn = 29.4 minutes, PIEBi = 59.8 minutes, and PIEBv = 6.2 mL (Figure 1C). These values were associated with the optimized outcomes of Maternal Satisfaction 94%, PCEA ratio 0.78, and Need for Rescue Bolus 0.28.

**Discussion**

Our study recommends a PIEBi of approximately 60 minutes matching results presented previously.<sup>2,3</sup> The PIEBv in our study is slightly lower than reported in the literature,<sup>2</sup> however this study considered patient satisfaction, an outcome not previously examined. Future studies could use RSM methodology to target alternate obstetric populations with comorbid disease and multiparity.

**Figure 1**



Abstract #: BP – 2  
Best Paper Competition

**In vitro optimization of oxytocin-induced myometrial contractility by propranolol - Potential applications in induction of labor and treatment of postpartum hemorrhage.**

**Presenting Author:** Mrinalini Balki, MD

**Presenting Author's Institution:** Department of Anesthesiology and Pain Medicine, Mount Sinai Hospital, University of Toronto - Toronto, Ontario

**Co-Authors:** Jayalakshmi Caliaperumal, PhD - 1. Department of Anesthesia and Pain Management, Mount Sinai Hospital, University of Toronto. 2. Ingram School of Nursing, McGill University.

Ella Huszti, PhD - Biostatistics Research Unit, UHN

John Kingdom, MD - Department of Obstetrics and Gynaecology

Lauren Miller, B.Sc, M.Sc - Mount Sinai Hospital, Saba University School of Medicine

Stella Wang, M.Sc - Biostatistics Research Unit

**Introduction:** The rates of cesarean deliveries (CD) and postpartum hemorrhage (PPH) due to failed labor continue to rise worldwide.[1] Oxytocin (OT) is used to induce and augment labor; it is also used to reduce the risk of PPH.[2] However, continual exposure to OT during labor can result in OT receptor desensitization and downregulation, further resulting in poor responsiveness in many women.[1] It is proposed that propranolol (P), when administered with OT, can shorten the period between induction and active labor, with improvements in uterine contractility [3,4]. This study aims to determine: 1) the effect of P on myometrial contractions induced by low-dose (LD) OT by simulating labor induction (LI) and 2) the effect of P on contractions induced by high-dose (HD) OT in OT-desensitized myometrium for prevention of PPH.

**Methods:** This *in-vitro* study was conducted utilizing myometrial samples from women undergoing CDs. Each dissected myometrial strip was subjected to any one of the groups (Gr) in LI or PPH models (fig1). The LI model consisted of 3 Grs (A[control], B, C) with each undergoing either no pretreatment (pretx) (Gr A and Gr C) or P ( $10^{-6}$ M) pretx (Gr B) for 1h prior to dose response (DR) to LD OT from  $10^{-13}$ M to  $10^{-9}$ M. The PPH model consisted of 4 Grs (D [control], E, F, G), each undergoing a pretx with OT ( $10^{-5}$ M) for 2h to induce desensitization with addition of P( $10^{-6}$ M) in Grs E and G. Each Gr underwent DR with HD OT from  $10^{-9}$ M to  $10^{-5}$ M, with addition of P ( $10^{-6}$ M) during DR in Gr F and G. Myometrial contraction amplitude (g) and frequency (number of contractions in 10min) were recorded using an isometric force transducer. Primary outcome was motility index (MI; Amp x Freq). A multivariable linear regression model, applying generalized estimated equation to adjust for the type of drug and patient group, was used to analyze the data during DR relative to baseline.

**Results:** Sixty-two women were recruited, and 225 successful experiments ( $n=32/Gr$ ) were conducted. In the LI model, Gr B showed a significantly higher MI of contractions than Gr A (est mean diff [EMD] 72.98%,  $p=0.015$ ), while MI between Gr C and Gr A was not significantly different (EMD 29.05 %,  $p=0.27$ ). The MI in the PPH model did not show any significant group differences (EMD Gr D vs E, 5.76%,  $p=0.803$ ; Gr D vs Gr F, -10.95%,  $p=0.605$ ; Gr D vs Gr G, 4.98%,  $p=0.844$ ).

**Conclusion:** *In vitro* P pretx improved the OT induced contractility in the LI model, however, it did not affect contractions in the PPH model. Propranolol administration during early labor can facilitate OT induced contractility, thus reducing the risk of failed labor. Clinical correlation of these findings is required.

[Figure Propranolol SOAP Caliaperumal.pdf](#)

**Abstract #: BP – 3**  
**Best Paper Competition**

**The Compensatory Reserve Index in Obstetrical Patients Undergoing Cesarean Section to Identify Postpartum Hemorrhage**

**Presenting Author:** Stephanie M. Kierstead, MD  
**Presenting Author's Institution:** University of Colorado  
**Co-Authors:** Steven Moulton, MD - Children's Hospital Colorado  
Margo Nolan, BA - Children's Hospital Colorado  
Kaci Pickett, MS - UC Anschutz  
Marina L. Reppucci, MD - Children's Hospital Colorado  
Jonathan Seth Rogerson, DO - University of Utah  
Cristina Wood, MD - University of Colorado

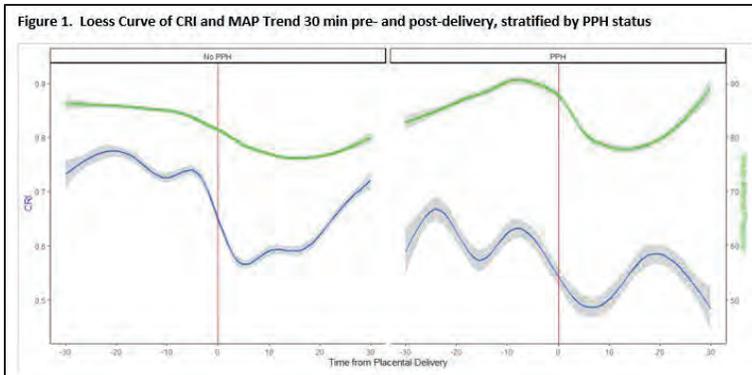
**Introduction:** Postpartum hemorrhage (PPH) is a significant cause of maternal mortality in the U.S. and the leading cause worldwide. Optimal outcomes require timely recognition and treatment, where minutes matter. Unfortunately, traditional vital signs such as heart rate (HR) and blood pressure (BP) are relatively stable until late in the setting of acute blood loss, which can lead to delayed recognition of hemorrhage. The Compensatory Reserve Index (CRI) is a statistically unbiased, real-time measure of an individual's compensatory reserve. It estimates how near or far a patient is from normovolemia (CRI=1) to hemodynamic decompensation (CRI=0). We sought to determine if CRI can detect compensatory changes in women who experience PPH compared to those who do not.

**Methods:** Parturients undergoing cesarean delivery were enrolled during a six-month period. A noninvasive CRI monitor was applied to collect continuous CRI values throughout the intraoperative and immediate post-partum periods. Demographic, obstetrical history, and delivery information were collected. Patients were stratified based on blood loss into PPH versus non-PPH groups. PPH was defined as a quantitative blood loss greater than 1000 mL. Function-on-scalar (FoS) regression was used to compare trends in CRI over time within a 30-minute window before and after delivery between groups (PPH vs. no). FoS regression was adjusted for high-risk pregnancy as an indication for cesarean delivery, preeclampsia, and administration of tranexamic acid or uterotonics during the surgery.

**Results:** Fifty-one patients were enrolled in the study. The mean (standard deviation) age at delivery was 32.4 (5.0) years. Thirteen (24.5%) patients experienced PPH. Women who experienced PPH had a slightly lower gestational age (37.6 vs 38.0,  $p=0.05$ ), and no differences in rates of prior cesarean deliveries. There was a greater proportion of patients with pre-eclampsia among the women who experienced PPH, but this was not statistically significant ( $p=0.060$ ). Women who experienced PPH had, on average, a lower starting CRI value [-0.067, 95% CI (-0.075, -0.060),  $p< 0.001$ ] which persisted throughout the case, than those who did not experience PPH. This remained significant even when adjusting for pre-eclampsia, high-risk pregnancy, and medications administered (Figure 1). In addition, the CRI values nadired prior to the noninvasive mean arterial blood pressure by approximately five minutes in those who experience PPH.

**Conclusions:** CRI has the potential to serve as an early notification tool regarding low volume status and increased PPH risk during cesarean delivery. Further studies are needed to elucidate the etiology of this relationship, CRI may assist in planning and preparation for a potential PPH before traditional vital sign change.

Figure 1. Loess Curve of CRI and MAP Trend 30 min pre- and post-delivery, stratified by PPH status



**Abstract # BP – 4**  
**Best Paper Competition**

**Oxytocin at elective cesarean delivery: a dose-finding study in people with twin pregnancy**

**Presenting Author:** Jose C A. Carvalho, MD, PhD

**Presenting Author's Institution:** Department of Anesthesiology and Pain Medicine, Mount Sinai Hospital, University of Toronto, Ontario

**Co-Authors:** Mrinalini Balki, MD - Department of Anesthesiology and Pain Medicine, Mount Sinai Hospital, University of Toronto

Kristi Downey, MSc - Department of Anesthesiology and Pain Medicine, Mount Sinai Hospital, University of Toronto

Cynthia Maxwell, MD - Department of Obstetrics and Gynaecology, Mount Sinai Hospital, University of Toronto

Emil Peska, MD, FANZCA - Department of Anesthesiology and Pain Medicine, Mount Sinai Hospital, University of Toronto

Wesla Pfeifer, MD - Department of Anesthesiology and Pain Medicine, Mount Sinai Hospital, University of Toronto

**Background:** Multiple pregnancy is associated with higher risk of uterine atony, postpartum hemorrhage, blood transfusion, hysterectomy and death (1-3). Oxytocin administration after delivery reduces blood loss. The ED90 of oxytocin at elective cesarean deliveries in people with singleton pregnancies has been shown to be 0.35 IU (95% CI 0.18-0.52 IU) (4). The optimal dose of oxytocin in people with twin pregnancy is unknown. We sought to determine the bolus dose of oxytocin required to initiate adequate uterine tone in 90% of people (ED90) with twin pregnancy undergoing elective cesarean delivery. Our hypothesis was that the dose of oxytocin would be >0.5 IU but < 5 IU.

**Methods:** A double-blind dose-finding study using the biased coin up-down method was undertaken in people with twin pregnancy  $\geq$  36 weeks gestational age undergoing elective cesarean delivery under neuraxial anesthesia. Those with additional risk factors for PPH, apart from twin pregnancy, were excluded. Oxytocin was administered as an intravenous bolus over one minute upon delivery of the second fetus. The first patient received 0.5 IU and subsequent oxytocin doses were administered according to a sequential allocation scheme. The actual doses administered were 0.5, 1, 2, 3, 4, 5 IU of oxytocin. The primary outcome was satisfactory uterine tone at two minutes after administration of the oxytocin bolus, as assessed by the operating obstetrician. Secondary outcomes included need for rescue uterotonic drugs, adverse effects, and estimated blood loss. The ED90 was estimated using the Dixon-Mood and the isotonic regression methods.

**Results:** Thirty patients were included in study. The patients' response to the allocated doses of oxytocin are presented in Figure 1. The estimated ED90 of oxytocin was 4.38 IU (95% CI 3.68-4.86 IU) and 3.41 IU (95% CI 2.83 – 3.98 IU) by the isotonic regression and Dixon-Mood methods respectively. Seven patients had inadequate tone at the 2-minute evaluation point and required rescue uterotonic drugs. The median (IQR) estimated blood loss was 1031 ml (732-1462 ml) calculated by the change in 24-hour hematocrit. Incidence of hypotension after oxytocin administration was 27%, nausea 30%, vomiting 17%.

**Discussion:** Our results demonstrated that people with twin pregnancy require a much higher dose of oxytocin than those with singleton pregnancies. We recommended people with twin pregnancies should receive an initial 5 IU bolus over at least one minute when undergoing elective cesarean delivery under neuraxial anesthesia.

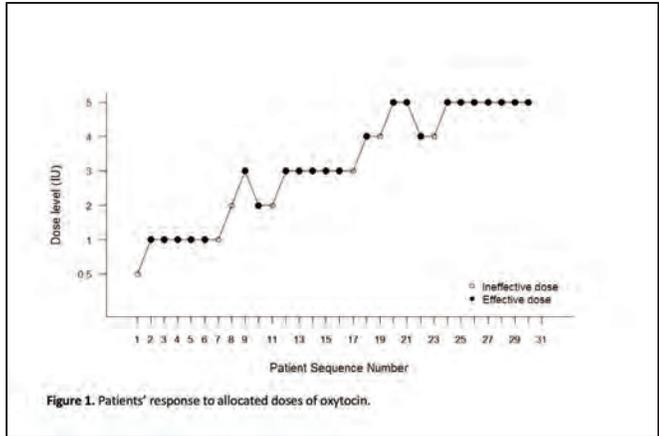


Figure 1. Patients' response to allocated doses of oxytocin.

Abstract #: BP – 5  
Best Paper Competition

Plasmatic catecholamines after neuraxial labor analgesia: a randomized controlled trial comparing epidural versus combined spinal-epidural

**Presenting Author:** Shirley Andrade Santos, PhD, MD, EDAIC, TSA

**Presenting Author's Institution:** Mount Sinai Hospital/Hospital das Clínicas da Universidade de São Paulo, Ontario

**Co-Authors:** Fernando Bliacheriene, n/a - Hospital das Clínicas da Universidade de São Paulo

Hermann dos Santos Fernandes, n/a - Hospital das Clínicas da Universidade de São Paulo

Joaquim Edson Vieira, n/a - Hospital das Clínicas da Universidade de São Paulo

Andreza Gonzaga Bartilotti, n/a - Hospital das Clínicas da Universidade de São Paulo

Rossana Pulcineli Vieira Francisco, n/a - Hospital das Clínicas da Universidade de São Paulo

Fernando Souza Nani, n/a - Hospital das Clínicas da Universidade de São Paulo

**Background:** Combined spinal-epidural (CSE) analgesia has been associated with changes in fetal heart rate (FHR) compared than epidural (EP)(1). One hypothesis is that the quick and effective pain relief with CSE can cause an imbalance in the levels of maternal plasmatic catecholamines, leading to some degree of uterine hyperactivity. This theory is frequently described. However, studies date from the 70-80s(2, 3) and there are no studies comparing neuraxial techniques. This study aimed to compare the decrease of plasmatic catecholamine levels between CSE and EP after labor analgesia.

**Methods:** Randomized clinical trial with 47 laboring patients. Patients were divided in two groups: CSE receiving 0.5% hyperbaric Bupivacaine 2.5 mg + 0.0005% Sufentanil 5 mcg + 0.02% Morphine 60mcg; EP group receiving 10ml of Bupivacaine 0.125% with Epinephrine 1.25mcg/ml + Sufentanil 20mcg. Analgesia was maintained in both groups with continuous infusion of Bupivacaine 0.0625%, Epinephrine 0.0625mcg/ml + Fentanyl 2mcg/ml. The primary outcome was the difference between catecholamine measurements before and after analgesia. The secondary outcomes were the occurrence of FHR abnormalities, uterine hypertonia, hypotension, pain scores and fetal outcomes. **Results:** For spinal-epidural group, the median decreasing of plasmatic epinephrine was 0 pg/ml [(-)480 - (+)41] and for norepinephrine was -21 pg/ml [(-)2507 - (+)94]. For epidural group, the median decreasing for epinephrine was 0 pg/ml [(-)326 - (+)15] and for norepinephrine was -5 pg/ml [(-)190 - (+)76]. There were no differences between groups ( $p=0.96$  and  $p=0.63$  for epinephrine and norepinephrine, respectively). There were no difference for secondary outcomes.

**Conclusions:** This study focused on to assess the proposed mechanism of catecholamine imbalance leading to fetal bradycardia and uterine hypertonia after CSE for labor analgesia. However, there were no statistically significant differences between groups, which denotes that, with low doses of opioids and local anesthetic, whether intrathecal or epidural, the catecholamine imbalance and its consequences for the maternal-fetal binomial may not occur, or they have minor clinical impact.

[Figure.pdf](#)

**Abstract #: BP – 6**  
**Best Paper Competition**

**State-level indicators of structural racism and severe adverse maternal outcomes during childbirth.**

**Presenting Author:** Jean R. Guglielminotti, MD, PHD

**Presenting Author's Institution:** Department of Anesthesiology, Columbia University Vagelos College of Physicians and Surgeons - New York, New York

**Background:** Compared to White mothers, Black mothers are 3 times more likely to experience serious complications during childbirth (1). Structural racism is suggested to contribute to these disparities, independent of socioeconomic determinants of health (e.g., poverty). Structural racism refers to a system where public policies, institutional practices, cultural representations, and other norms work to perpetuate racial group inequities (2). It can be assessed using Black-to-White ratios in domains reflecting the exclusion of the Black population from resources (e.g., employment), or their unfair judiciary treatment (e.g., imprisonment) (3). However, research assessing the impact of structural racism on severe adverse maternal outcomes (SAMO) is scant, and limited to New York State (4, 5). This study aims to assess the association between state-level indicators of structural racism and SAMO during childbirth.

**Methods:** Data came from the US Natality file 2017-2018, the Area Health Resource File, and the Sentencing Project. Black and White mothers who gave birth in a hospital in their residence state were analyzed. The outcome was the composite of SAMO, including eclampsia, blood transfusion, hysterectomy, and ICU admission. The exposures were state-level Black-to-White ratios for: 1) lower education level (less than high-school diploma), 2) unemployment, and 3) prison incarceration. A higher ratio value indicates more structural racism. Because of a high proportion of missing values, ratios for political participation (e.g., persons not registered to vote) were not assessed. Adjusted odds ratios (aORs) and 95% confidence intervals (CIs) of SAMO associated with each ratio were estimated for Black and for White mothers using multilevel models adjusting for patient, hospital, and state characteristics. The proportion of potentially preventable SAMO cases was estimated.

**Results:** Of the 4,804,488 birth certificates analyzed, 23% were for Black mothers. SAMO incidence rates were 1.06% (95% CI: 1.04, 1.08) for Black mothers and 0.73% (95% CI: 0.72, 0.74) for White mothers. Black-to-White ratios for unemployment and for incarceration were associated with significantly increased risk of SAMO for Black mothers and, to a lesser extent, for White mothers (Table). There was no significant association between the lower education level ratio and SAMO for both Black and White mothers. Reducing SAMO rate in states with high and medium levels of structural racism indicators to the rate observed in states with low level could prevent 34% of SAMO cases for Black mothers and 20% for White mothers.

**Conclusions:** State-level structural racism indicators for unemployment and incarceration are associated with a significantly increased risk of SAMO, underscoring the need to address structural racism in maternal care.

[02 SOAP 2022 RACISM TABLE V1.pdf](#)

# SOAP Centers of Excellence for Anesthesia Care of Obstetric Patients

A Panel of Experts



1

## SOAP COE Discussion Panelists



**David J. Berman M.D.**  
Assistant Professor, Assistant Program Director, Residency Program  
Johns Hopkins University School of Medicine



**Davida Grossman, MD**  
Anesthesiologist, West New Jersey Anesthesia Associates  
Former Director of Obstetric Anesthesia, Virtua Voorhees Hospital



**Jill Mhyre M.D.**  
The Dots S Thompson Professor & Chairperson  
University of Arkansas for Medical Sciences



**Brendan Carvalho MBBCh, FRCA, MDCH**  
Professor, Chief of Obstetric Anesthesia Division  
Stanford University School of Medicine

2

This is going to be different...

Participate with your phone or laptop

We want this to be interactive

Web address will be at the top of the slides



3

## Where are you coming from?



4



SOCIETY FOR OBSTETRIC ANESTHESIA AND PERINATOLOGY  
**CENTER of EXCELLENCE**

- Recognize programs that demonstrate excellence
- Set a benchmark for optimal care
- Surrogate quality metric for institutions
- Promote sub-specialty of obstetric anesthesia

[https://www.soap.org/centers-of-excellence\\_program](https://www.soap.org/centers-of-excellence_program)  
Anesth Analg. 2019;128(5):844-846



5

## 2018/2019 Center of Excellence Designees

- Stanford University
- Northwestern University Feinberg School of Medicine
- Columbia University
- University of New Mexico
- Colorado Fetal Care Center, Children's Hospital Colorado
- North Shore University Hospital
- Johns Hopkins Hospital
- Saddleback Memorial Medical Center
- Albany Medical Center
- University of North Carolina, Chapel Hill
- New York Presbyterian - Weill Cornell
- Tufts Medical Center
- Icahn School of Medicine at Mount Sinai
- Beth Israel Deaconess Medical Center
- Overlook Medical Center
- University of Minnesota
- Sparrow Hospital
- Ochsner Hospital
- NYU School of Medicine
- University of California San Francisco
- Wake Forest University Health Sciences
- Juntendo University Hospital
- Massachusetts General Hospital
- Mount Sinai West
- Magee-Womens Hospital of UPMC
- University of Washington
- Sharp Mary Birch Hospital for Women and Newborns
- Washington University School of Medicine
- Victoria Hospital
- Brigham and Women's Hospital
- Zuckerberg San Francisco General Hospital and Trauma Center
- Texas Children's Hospital - Pavilion for Women
- Mercy Hospital St. Louis
- Hospital e Maternidade Santa Joana
- Regional One Health
- Cedars-Sinai Medical Center
- Washington Hospital Center
- Penn Medicine Princeton Health
- Duke University

6

## 2019/2020 Center of Excellence Designees

- University of Michigan - Michigan Medicine
- Kaiser Permanente - Roseville Women & Children's Hospital
- University of Maryland Medical Center
- Virtua Voorhees Hospital - West Jersey Anesthesia Associates
- UAMS College of Medicine
- Vanderbilt University
- Missouri Baptist Medical Center
- BC Women's Hospital
- Hospital of the University of Pennsylvania
- Hackensack University Medical Center
- Froedtert Hospital Birth Center - The Froedtert & the Medical College of Wisconsin
- Mayo Clinic
- Miller Women's and Children's Hospital
- University of Utah



7

## 2020/2021 Center of Excellence Designees

- Clínica Universitaria Bolivariana (Pontifical Bolivarian University)
- George Washington School of Medicine
- Hamad Medical Corporation
- Hoag Memorial Hospital Presbyterian
- Loma Linda University
- Long Island Jewish Medical Center
- Minneapolis Anesthesia Partners
- National Center for Child Health and Development
- Ohio State Univ. Wexner Medical Center
- Sidra Medical & Research Center
- Stony Brook University
- Sutter Medical Center
- UC Davis Medical Center
- University of Alabama at Birmingham
- University of Chicago
- Virginia Commonwealth University Health System
- Yale New Haven Hospital - York Street Campus



8

## 2021/2022 Center of Excellence Designees

- Al Wakra Hospital, Hamad Medical Corporation
- Baptist Medical Center Jacksonville
- Baptist Medical Center South
- Baylor College of Medicine
- Clements University Hospital at UT Southwestern
- Elmhurst Mount Sinai Icahn School of Medicine
- Kitasato University Hospital
- Memorial Hermann Hospital - Texas Medical Center
- Parkland Health
- Pro Matre Paulista - Grupo Santa Joana
- University of Colorado
- University of Texas Medical Branch - Galveston
- Westchester Medical Center



9

## SOAP Centers of Excellence for Anesthesia Care of Obstetric Patients Designation



**83 institutions**

- USA (72) and worldwide (11)
- Academic and private/community
- Deliveries/year: <1,000 to >15,000



10

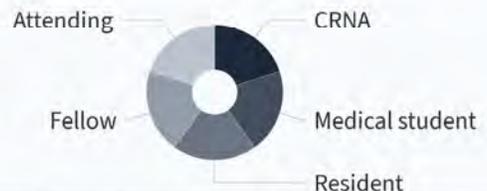
Are you currently part of a SOAP COE institution?

Yes No Unclear Lunchtime?

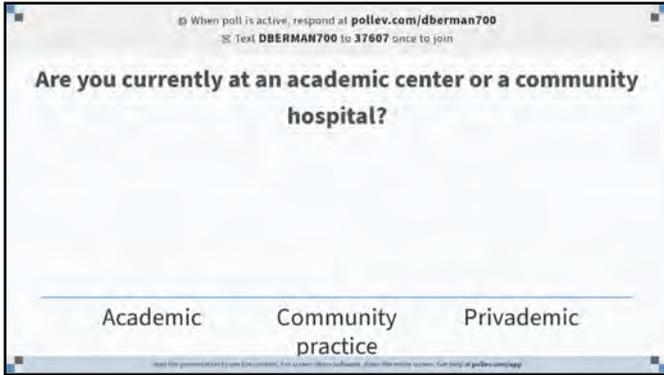
11

What is your role in your institution?

CRNA A Medical student B Resident C Fellow D Attending E



12



13

### SOAP COE for Anesthesia Care of Obstetric Patients Metrics and Criteria

- Metrics:**
  - General Anesthesia for Cesarean Delivery
  - Labor epidural block replacement rate
  - "Wet tap" rate
- Domains:**
  - Personnel and Staffing
  - Equipment, Protocols, Policies
  - Cesarean Delivery Management
  - Labor Analgesia
  - Recommendations and Guidelines Implementation
  - Quality Assurance and Patient Follow-up
- Requirements:**
  - All 'essential' criteria (highlighted with \*)
  - Majority of other criteria

[https://www.soap.org/centers-of-excellence\\_program](https://www.soap.org/centers-of-excellence_program)  
Anesth Analg. 2019;128(5):844-846

14

### SOAP COE for Anesthesia Care of Obstetric Patients Logistics

- Annual Application Cycle:** Open in August
- Certificate:** Valid for 4 years
- Cost** (Application \$500; Certification \$2000)
- Information:** SOAP website, talks/webinars, consultations
- SOAP COE Committee:** 1 chair and 13 members
- Rigorous review process**

[https://www.soap.org/centers-of-excellence\\_program](https://www.soap.org/centers-of-excellence_program)  
bcarvalho@stanford.edu

15

### SOAP COE for Anesthesia Care of Obstetric Patients Benefits

[https://www.soap.org/centers-of-excellence\\_program](https://www.soap.org/centers-of-excellence_program)

16

### Community Practice Applications for COE Designation: How-To and Hidden Benefits

- How to analyze your current practice to determine whether it's worthwhile to attempt to obtain designation.
- How to obtain "buy-in" from your practice, your obstetricians, your nurses, your pharmacy, and your hospital administration and why it's absolutely necessary to have this.
- Division of labor for the application process and the implementation of changes.
- Benefits of applying, whether you do or don't receive the designation

17

### Is it Worthwhile to Apply?

**West Jersey Anesthesia Associates - Private Practice Group** established in 1972

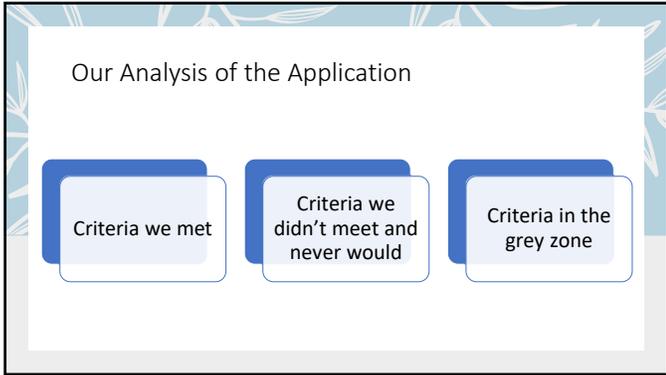
- 23 anesthesiologists
- 45 nurse anesthetists

Providing anesthesia services at 2 (of 4) Virtua hospitals, 2 surgicenters, a fertility center and two physician offices

**Virtua Voorhees Hospital**

- 587 bed community hospital
- Greater than 5600 deliveries annually
- 16 L&D rooms and 4 L&D ORs
- Level III NICU

18



19

### It Takes a Village...

How to obtain "buy-in" from:

- Your colleagues
- Your hospital administration
- Your obstetricians
- Your nurses
- Your pharmacy

And why it's absolutely necessary to have this

20

### Email to Administration

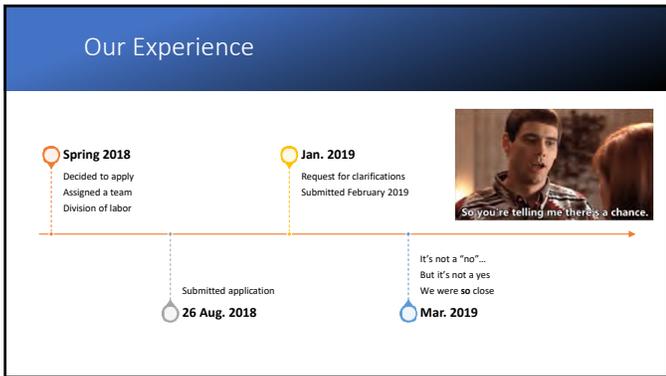
- *SOAP is THE well-respected authority on Obstetric Anesthesia practice.*
- *Will attract both patients and OB/GYN practices to our hospital.*
- *Patients are hospital shopping and comparing. Other hospitals in our area will be getting this designation. If we want to compete, we want to get it too.*
- *Similarly, obstetric groups considering coming to work at Virtua Voorhees want to know that they will have the support of excellent anesthesia services.*
- *Obtaining this certification will help us gain a recognition that will help us shine and help us compete in the marketplace.*
- *If we are not successful, we will obtain the feedback necessary to succeed the following year.*
- *In either case, we win.*

21

### Stakeholders

- In order to be a Center of Excellence in Obstetric Anesthesia, you must be a **whole center that is excellent**, not only an obstetric anesthesia department that is excellent. It takes the expertise of all these groups to apply, which displays the ways in which your center is excellent.
- Lots of colleagues
  - Nursing
  - Pharmacy
  - OB team
  - Hospital administration

22



23

### Things to Work On

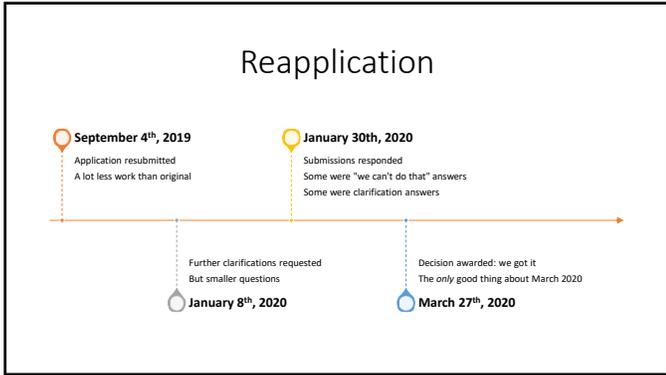
Phenylephrine drip & BP management protocol

- Pharmacy had to buy & stock syringes
- Had to buy syringe pumps for ORs
- Education of MDs and CRNAs a process

Change to Flex-Tip Catheters

- Financial challenge
- Culture change
- Required buy-in from financial backers

24



25

## Benefits of Applying

The Process Has Its Own Rewards



**PRACTICE IMPROVEMENT**



**LEADERSHIP AND  
RELATIONSHIP BUILDING**



**GOODWILL, GIVING  
BACK, PUBLIC RELATIONS**

26

## Summary

<b>Decision to apply</b>	Willing to put in a thorough and complete application? Meet many of the criteria?
<b>Build your team</b>	Not just anesthesiologists Not just physicians
<b>Delegate key tasks</b>	Can't climb this mountain solo
<b>Celebrate!</b>	Doing great work? Celebrate it! Nothing wrong with a bit of self-promotion

27



WHAT FOLLOWS WILL BE A  
DISCUSSION OF KEY METRICS



WILL BRIEFLY DISCUSS DATA  
SURROUNDING THESE GUIDELINES

## The Metrics

28

## SOAP COE for Anesthesia Care of Obstetric Patients

### Metrics

**General Anesthesia for Cesarean Delivery**

- < 5% overall
- Ongoing quality assurance review

**Labor epidural block replacement rate**

- Ideally 3-6%
- Ongoing quality assurance review

**"Wet tap" rate**

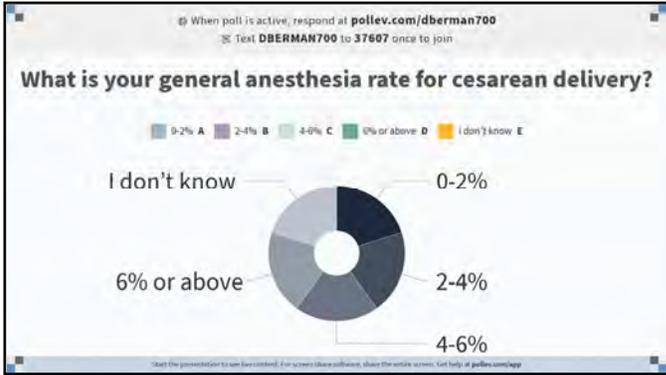
- < 2%
- Ongoing quality assurance review



SOCIETY FOR OBSTETRIC  
ANESTHESIOLOGY AND PAIN MEDICINE  
**CENTER of  
EXCELLENCE**  
for Anesthesia and Pain Management

[https://www.soap.org/centers-of-excellence\\_program](https://www.soap.org/centers-of-excellence_program)  
Anesth Analg. 2019;128(5):844-846

29



30

## General Anesthesia for Cesarean Delivery

### Obstetric Anesthesia Workforce Survey 2011

	>1500 births	500-1499 births	<500 births
Elective	3%	4%	3%
Emergent	19%	15%	14%

Traynor. Anesth Analg 2016;122:1939-46

### NACOR 2010-2015

	General Anesthesia	Neuraxial Anesthesia
Overall (N=205,671)	94.2%	5.8%
Emergent (N=15,282)	85.4%	14.6%

Juang. Anesth Analg 2017;124:1914-17

31

## Anesthesia-Related Maternal Mortality

Year of Death	Case Fatality Rates General Anesthetics*	Case Fatality Rates Regional Anesthetics*	Risk Ratios
1979-1984	20.0	8.6	2.3
1985-1990	32.3	1.9	16.7
1991-1996	16.8	2.5	6.7

Hawkins. Clin Obstet Gynecol 2003;46:679-87

### Avoidable General Anesthesia

- Retrospective study of NY State data
- 5.6% in 2003-2004 → 4.8% in 2013-2014
- Avoidable GA associated with: Anesthesia complications (aOR 1.6), SSI (aOR 1.7), VTE (aOR 1.9)

Guglielminotti. Anesthesiology 2019; 130:912-22

32

### Obstetric vs. Generalist Anesthesiologists

Single center retrospective study 2013-2017: Cobb. Anesthesiology 2019;130:237-46.

↓ Use of general anesthesia for cesarean delivery (aOR 0.71)

### Dedicated Obstetric Anesthesia Team

Single center interrupted time series: Ikeda. BMC Health Serv Res 2020;20:421.

Launch of obstetric anesthesia team in 2015

↓ Use of general anesthesia for cesarean delivery

33

When poll is active, respond at [polev.com/dberman700](https://www.polev.com/dberman700)

Text **DBERMAN700** to **37607** once to join

## What is your epidural replacement rate?

- 0-1%
- 1-3%
- 3-5%
- More than 5%
- I don't know

Real time presentation is not recorded. Your screen may disappear. Please close the screen. See text of poll for details.

34

### Active Management of Labor Epidural Analgesia Is the Key to Successful Conversion of Epidural Analgesia to Cesarean Delivery Anesthesia

Melissa E. Bauer, DO,\* and Jill M. Mhyre, MD†  
Anesth Analg 2016;123:1074-6

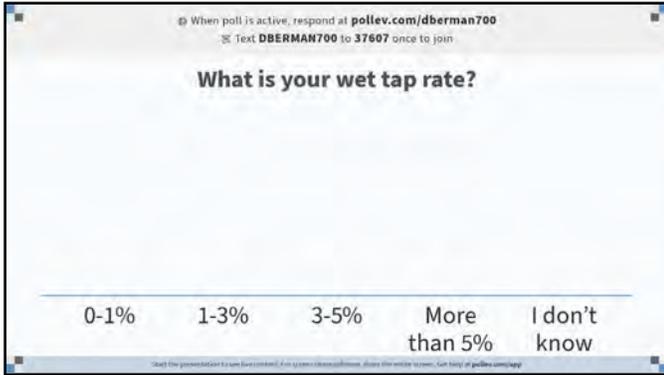
35

## Epidural Replacement Rate

Single center retrospective studies:

	Location	Years	N	Replacements
Paech. IJOA 1998;7:5-11	King Edward Memorial, Perth Australia	1989-1994	10,995	4.7%
Eappen. IJOA 1998;7:220-5	Brigham & Women's	1995	4,240	13.1%
Pan. IJOA 2004;13:227-33	Wake Forest University	2000-2002	19,259	5.6%
Sng. IJOA 2018;3:28-36	KK Women's & Childrens, Singapore	2012-2013	10,170	0.85%

36



37

**Unintended Dural Puncture Rate**  
 Meta-analysis of 16 RCT, 10 cohorts, 13 case series: **1.5%**  
Choi. CJA 2003;50:460-9

**PDPH**  
 US Nationwide Inpatient Sample 2006-2015: **0.3%**  
 • 29.8 per 10,000 (95% CI 29.3 to 30.2)  
Guglielminotti IJOA 2021;45:90-8.

**PDPH**  
 Truven MarketScan Commercial Claims & Encounters 2008-2015: **0.58%**  
Delgado. Anesth Analg 2020;131:850-6.

38

**Unintended Dural Puncture Rate**

**Single center retrospective studies:**

	Location	Years	N	Dural Punctures
Pan. IJOA 2004;13:227-33	Wake Forest University	2000-2002	19,259	1.63%
Van de Velde IJOA 2008;17:329-35	University Hospitals Leuven, Belgium.	1997-2006	17,198	0.5%
Peralta. Anesth Analg 2015;121:451-6	Northwestern University	2004-2013	~97,735	0.53%
Orbach-Zinger. Anesth Analg 2016;123:972-6	Rabin Medical Center, Beilinson Hospital, Israel	2004-2013	46,668	0.4%
Costa. CIA 2019;66:1464-71	Stony Brook Medical Center	2006-2015	32,655	0.9%

39

**COE for Anesthesia Care of Obstetric Patients**

**Personnel and Staffing**

- Leadership: Physician, obstetric anesthesia fellowship or equivalent
- Core staffing with obstetric anesthesia training
- Ongoing staffing education
- Adequate supervision
- In-house (24/7), dedicated coverage
- Ability to mobilize backup

40

**COE for Anesthesia Care of Obstetric Patients**  
 Equipment, Protocols and Policies

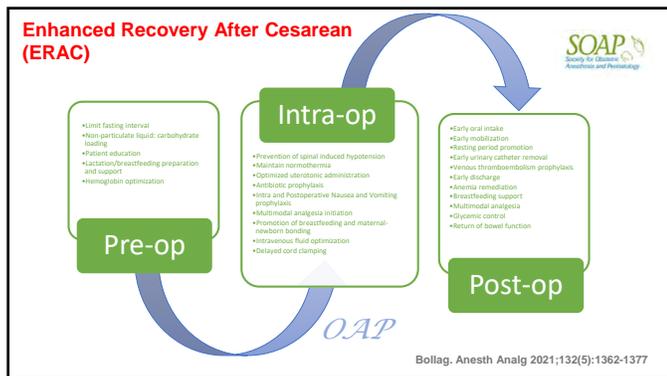
- Hemorrhage: Risk stratification, massive transfusion protocol, rapid-infusers, IV access options, POC devices, QA, toolkits/recommendations
- Airway management, emergencies (LAST, MH, cognitive aids)
- Emergency response, simulation program
- Daily multidisciplinary rounds, triage
- Institutional resources
- Ultrasound/TTE
- Community and interprofessional education
- Promote diversity, equity and inclusion

41

**COE for Anesthesia Care of Obstetric Patients**  
 Cesarean Delivery Management

ERAC protocol, standardized care	Multimodal analgesia protocols, minimize opioid usage	Pencil-point ≤25-gauge needle	Temperature management
Antibiotic prophylaxis	Spinal hypotension	Nausea and vomiting prophylaxis and treatment	Postpartum monitoring

42



43



44

### Light ( $\leq 0.1\%$ Bupivacaine) vs. Heavy ( $> 0.1\%$ )

Sultan. Can J Anaesth. 2013;60(9):840-54

**Meta-analysis:** ↓ **Assisted vaginal delivery**

↓ Second stage duration, ↓ Motor blockade, ↑ Ambulation

No difference with analgesia

### Low dose epidural vs. Non-epidural analgesia

Wang. Anesth Analg. 2017;124(5):1571-1580  
Anim-Somuah. Cochrane 2018, Issue 5, Art. No.: CD000331

**Meta-analysis:**

No difference assisted vaginal or cesarean delivery or duration of labor

**Second Stage of Labor:** 400 patients

Epidural 0.08% ropivacaine + 0.4 mcg/mL sufentanil vs. Saline

Second Stage Duration: 52 min vs. 51 min

Spontaneous vaginal delivery: 97% vs. 99%

Shen. Obstet Gynecol 2017;130:1097-103

45

### PIEB/AMB vs. CEI

Cochrane Library  
Cochrane Database of Systematic Reviews

- Meta-Analysis; 12 studies (1121 women)
- ↓ Breakthrough pain (33% → 20%; RR 0.60)
- ↓ Local anesthetic use (MD -1.1 mg/h)
- 5/7 studies ↑ maternal satisfaction
- Instrumental delivery (12% vs. 9%; RR 0.75; 95%CI 0.5-1.1)
- Duration of labor (MD -10 min; 95%CI -27 to 6)
- No difference cesarean delivery

Sng. Cochrane Database of Systematic Reviews 2018, Issue 5. Art. No.: CD011344

46

- ### COE for Anesthesia Care of Obstetric Patients Recommendations and Guidelines Implementation
- ASA Practice Guidelines for Obstetric Anesthesia
  - SOAP Consensus Statement Cardiac Arrest in Pregnancy
  - SOAP Consensus Statement on Neuraxial Anesthesia in Obstetric Patients Receiving Thromboprophylaxis
  - SOAP Interdisciplinary Consensus Statement on Neuraxial Procedures in Obstetric Patients With Thrombocytopenia (NEW)
  - Key aspects of all National Partnership Maternal Safety Bundles

47

- ### COE for Anesthesia Care of Obstetric Patients Quality Assurance and Patient Follow-up
- Anesthesiologist serves as multidisciplinary clinical policy and committees
  - Structured follow-up all patients who received analgesia/anesthesia**
  - Evaluate complications
  - Evaluate and treat post-dural puncture headache
  - Collect patient feedback
  - Root cause analysis or equivalent
  - Educate nurses, obstetricians and allied professionals

48



49



**Reapplying?**  
**New Metrics and Criteria**

- Labor epidural block replacement rates
- Clarified coverage, supervision, staff education/meetings
- Describe your hemorrhage quality assurance review process, toolkit implementation, abnormal placentation staffing/location
- Ultrasound and echocardiography
- Community and/or interprofessional education
- Efforts to promote diversity, equity and inclusion of your workforce.
- Opioid use disorders, and/or chronic pain management
- Non-neuraxial labor analgesia options

50



**Q&A**

[https://www.soap.org/centers-of-excellence\\_program](https://www.soap.org/centers-of-excellence_program)

51

**Please submit questions for our leadership panel.**

Top

Start the presentation to see live content. For screen share software, share the entire screen. Get help at [polls.com/help](https://polls.com/help)

52

## Social drivers of health and the mitigation of obstetric health disparities

William A. Grobman, MD, MBA  
 Professor  
 Department Of Obstetrics and Gynecology  
 The Ohio State University

## Objectives

- Describe disparities in pregnancy care and outcomes
  - Focus on racial/ethnic disparities, and the intersection with other socioeconomic factors
- Examine framework for understanding the origin of these disparities
- Discuss approaches for obtaining optimal and equitable outcomes for all people at all times

## Obstetric disparities: overview

- Racial/ethnic disparities exist in:
  - Obstetric care
  - Adverse pregnancy outcomes (e.g., GDM, HDP)
  - Maternal morbidity and mortality
  - Perinatal morbidity and mortality
- Disparities not only have been persistent but in some cases increasing

## Obstetric disparities in care

	Non-Hispanic Black	Hispanic	Asian
>1 hour between complete dilation and pushing	↓	↓	↑
<1 vaginal exam per 3 hours in the first stage	↑	↑	↑
General anesthesia at CS	↑	↔	↔

Grobman et al. Obstet Gynecol 2015

### Primary Spoken Language and Neuraxial Labor Analgesia Use Among Hispanic Medicaid Recipients

Paloma Toledo, MD, MPH, Stanley T. Eosakil, MD, MS, William A. Grobman, MD, MBA, Joe Feinglass, PhD, and Romana Hasnain-Wynia, PhD

Neuraxial analgesia among Hispanic individuals who used Spanish as primary spoken language

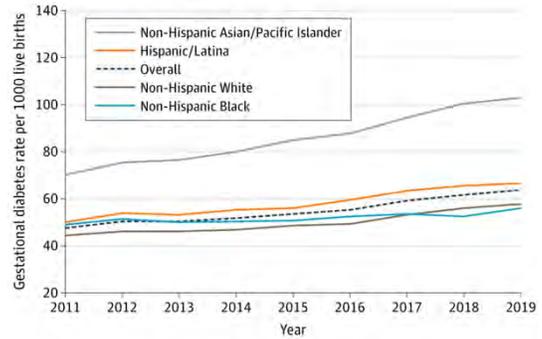
### Racial Disparities in Postpartum Pain Management

Nevert Badreddin, MD, MS, William A. Grobman, MD, MBA, and Lynn M. Yee, MD, MPH

	Non-Hispanic Black	Hispanic
Pain score 5 or more	▲	▲
Inpatient MME/d	▼	▼
Opioid prescription at DC	▼	▼

### Disparities in GDM

A Overall and by race and ethnicity



Shah et al, JAMA 2021

### GDM and obstetric morbidity

Figure 4. Maternal Outcomes and Association Between Race and Ethnicity Among Pregnant Individuals With Gestational Diabetes, US Natality Files, 2014-2020

Maternal outcomes*	No./total	Frequency, No./2000 live births (95% CI)	Adjusted risk ratio (95% CI)†
<b>Caesarean delivery (n = 1560511)</b>			
American Indian	6862/19256	356.6 (249.9-563.4)	0.98 (0.96-0.99)
Asian/Pacific Islander	71548/195953	376.1 (373.1-377.4)	0.91 (0.92-0.94)
Black	88346/185571	476.0 (473.8-478.3)	1.13 (1.12-1.14)
Hispanic/Latina	168012/415413	404.4 (402.9-405.9)	1.07 (1.07-1.07)
White	296916/744518	398.9 (397.8-400.1)	1 (reference)
Overall	633750/1560511	406.1 (405.3-406.8)	
<b>Preeclampsia or gestational hypertension (n = 1560822)</b>			
American Indian	3120/19263	162.0 (156.8-167.2)	1.24 (1.20-1.29)
Asian/Pacific Islander	13887/195982	70.9 (69.7-72.0)	0.58 (0.57-0.59)
Black	30122/185620	162.8 (160.6-164.9)	1.22 (1.20-1.23)
Hispanic/Latina	48084/115477	115.7 (114.8-116.7)	0.88 (0.87-0.89)
White	98680/744475	132.4 (131.6-133.3)	1 (reference)
Overall	159900/1560822	124.2 (123.7-124.7)	
<b>Intensive care unit admission (n = 1559845)</b>			
American Indian	47/19247	2.4 (1.7-3.1)	1.39 (1.04-1.85)
Asian/Pacific Islander	411/195809	2.0 (1.8-2.2)	1.29 (1.15-1.44)
Black	581/185463	3.1 (2.8-3.3)	1.58 (1.48-1.75)
Hispanic/Latina	890/415126	2.1 (2.0-2.2)	1.19 (1.09-1.31)
White	12707/44380	1.7 (1.6-1.8)	1 (reference)
Overall	3208/1559445	2.0 (1.9-2.1)	
<b>Preterm birth &lt;37 wk (n = 1560604)</b>			
American Indian	2288/19237	114.4 (110.1-119.1)	1.10 (1.06-1.13)
Asian/Pacific Islander	19032/195954	97.1 (95.8-98.4)	1.02 (1.01-1.04)
Black	29012/185608	156.8 (154.6-157.9)	1.40 (1.39-1.42)
Hispanic/Latina	49734/415420	119.7 (118.7-120.7)	1.18 (1.17-1.19)
White	75127/44380	101.7 (101.0-102.4)	1 (reference)
Overall	175713/1560604	112.5 (112.0-113.0)	

Venkatesh et al, JAMA 2022

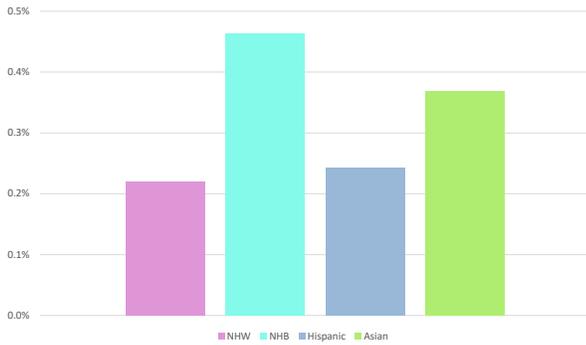
### Disparities in maternal morbidity

Table 2. Associations Between Race and Ethnicity and Adverse Maternal Outcomes

Outcome	Non-Hispanic White	Non-Hispanic Black	Hispanic	Asian
<b>Severe postpartum hemorrhage*</b>				
n (%)	805 (1.6)	702 (3.0)	827 (3.1)	130 (2.2)
Unadjusted OR (95% CI)	1.00 (reference)	<b>1.89 (1.70-2.09)</b>	1.94 (1.76-2.14)	1.38 (1.15-1.67)
Adjusted OR (95% CI)†	1.00 (reference)	<b>1.87 (1.65-2.12)</b>	2.07 (1.83-2.36)	1.49 (1.21-1.84)
Adjusted OR (95% CI)‡	1.00 (reference)	<b>1.71 (1.49-1.96)</b>	1.51 (1.31-1.74)	1.54 (1.24-1.91)
<b>Peripartum infection*</b>				
n (%)	2,119 (4.1)	1,169 (4.9)	1,744 (6.4)	374 (6.2)
Unadjusted OR (95% CI)	1.00 (reference)	<b>1.21 (1.13-1.31)</b>	1.61 (1.51-1.72)	1.57 (1.40-1.75)
Adjusted OR (95% CI)†	1.00 (reference)	1.13 (1.03-1.23)	<b>1.69 (1.56-1.85)</b>	1.59 (1.41-1.79)
Adjusted OR (95% CI)‡	1.00 (reference)	<b>1.25 (1.14-1.38)</b>	1.45 (1.32-1.59)	1.62 (1.43-1.84)

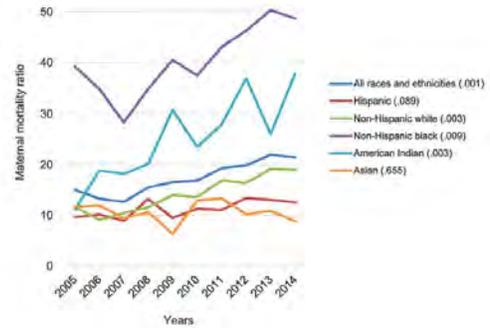
Grobman et al, Obstet Gynecol 2015

## Disparities in SMM

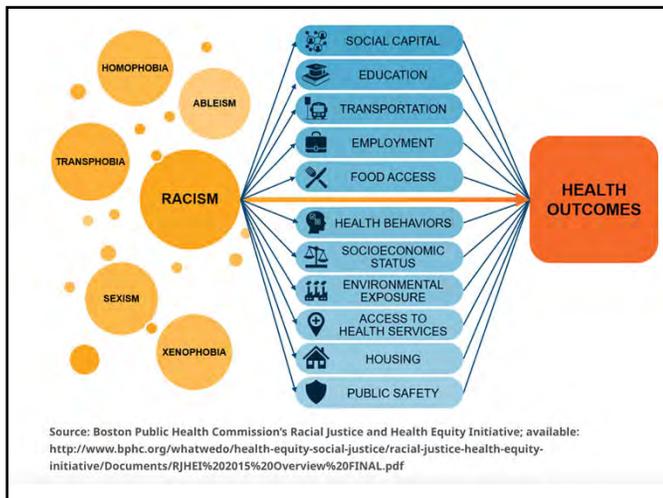


Grobman et al, 2014

## Maternal mortality (per 100,000)

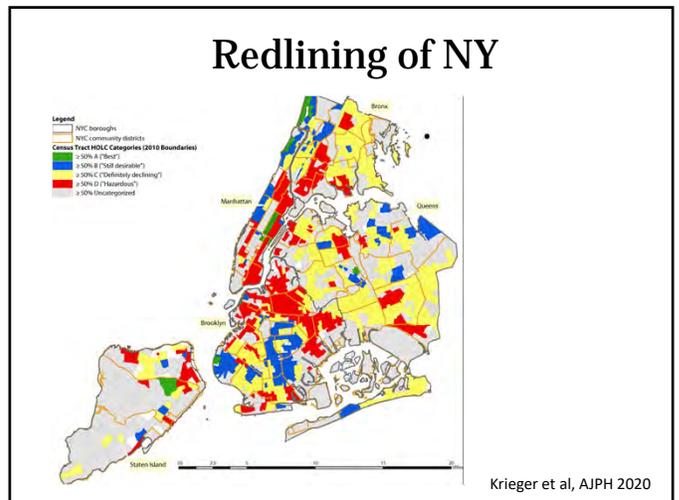
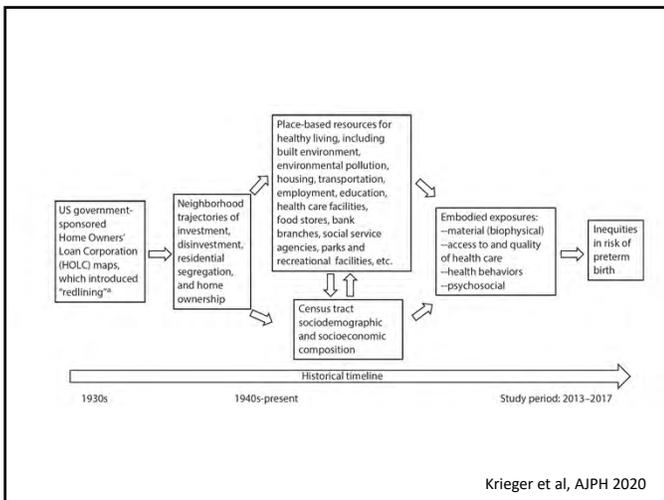
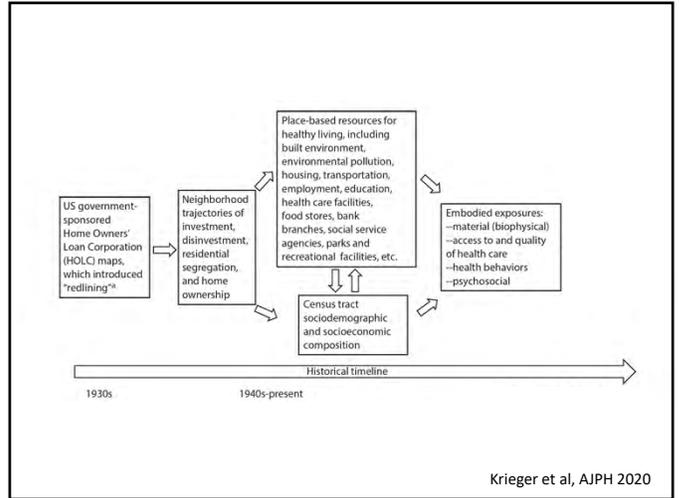
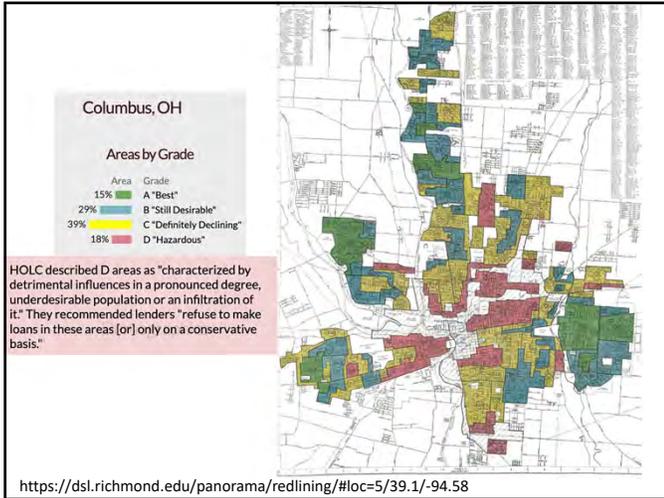


Obstetrics and Gynecology, 2016

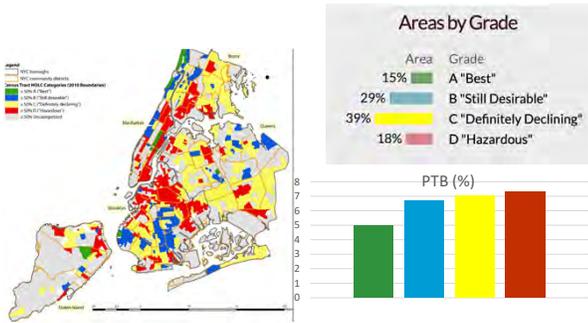


## Redlining

- Housing shortage in the 1930's
- Federal Housing Administration created
  - Underwrote insurance for mortgages
  - Safety of underwriting based on perceived neighborhood "risk"
  - Risk based upon racial make-up of the neighborhood, not actual financial risk
  - Highest risk neighborhoods color coded in red



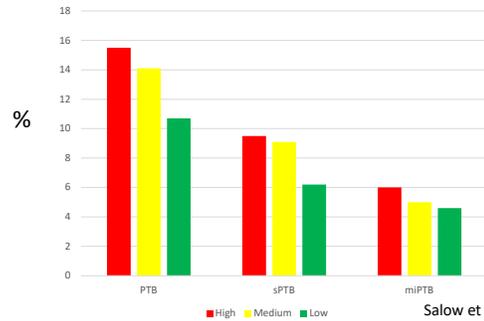
## PTB in 2013-2017



Krieger et al, AJPH 2020

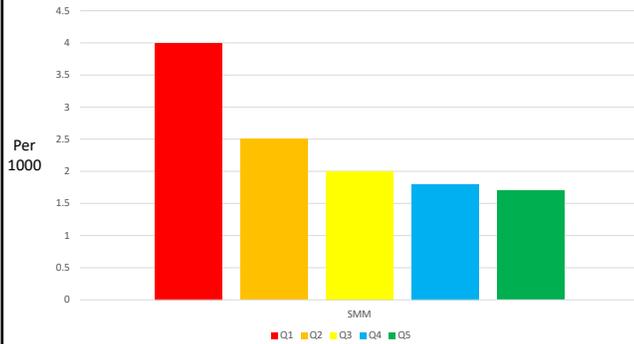
## Neighborhood segregation and PTB

- Black pregnant people in Chicago
- Gi\* statistic used to quantify degree of segregation



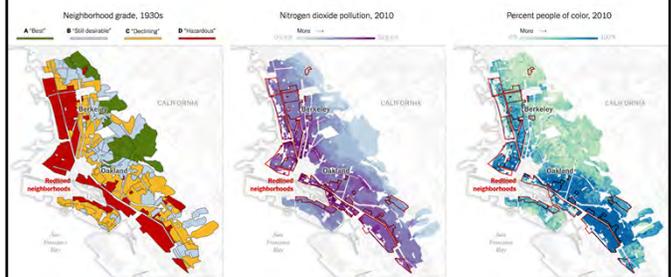
Salow et al, AJOG 2014

## Index of concentration at the extremes and severe maternal morbidity



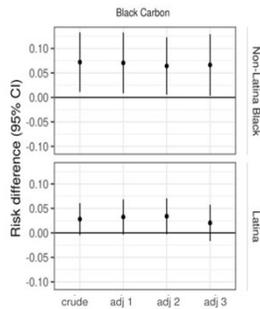
Janevic et al, Health Aff 2020

## Redlining and present-day pollution



Source: Environmental Science & Technology Letters. By The New York Times

## Pollution and preterm birth



Ridell et al, IJE 2021

## Built environment and physical activity during pregnancy

- NuMoM2b study
  - 10,038 nulliparous individuals
  - Address during pregnancy geocoded
    - Walkability index
    - Number of gyms and parks within 3 km
  - Self-reported physical activity

Neighborhood Characteristic	6 to <14 weeks	16 to <22 weeks	V22 to <30 weeks
	RR (95% CI)	RR (95% CI)	RR (95% CI)
Walkability index score, per 3 units	1.03 (1.00, 1.07) <sup>c</sup>	1.04 (1.00, 1.08) <sup>c</sup>	<b>1.04 (1.00, 1.08)</b>
Number of gyms, per doubling in value <sup>b</sup>	<b>1.07 (1.04, 1.10)</b>	<b>1.08 (1.05, 1.11)</b>	<b>1.10 (1.07, 1.13)</b>
Number of parks, per doubling in value <sup>b</sup>	<b>1.04 (1.00, 1.08)<sup>c</sup></b>	<b>1.05 (1.01, 1.09)</b>	<b>1.08 (1.03, 1.12)</b>

Kershaw et al, J Phys Act Health 2021

## Built environment and gestational weight gain

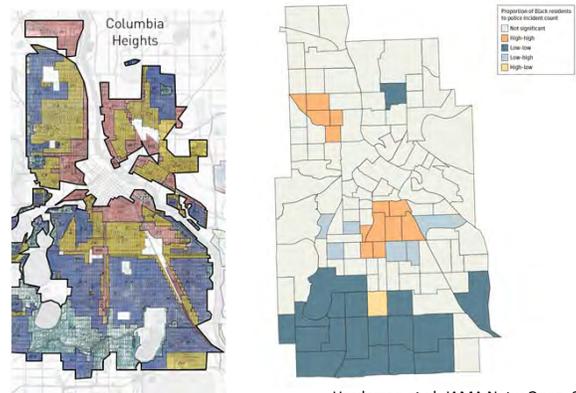
	Gestational weight gain	
	Excessive <sup>a</sup> aOR (95% CI)	Inadequate <sup>a</sup> aOR (95% CI)
Walkability score, per 3 units	0.94 (0.89–0.98)	0.92 (0.86–0.99)
Gyms count, per doubling in value <sup>b</sup>	0.93 (0.89–0.96)	0.91 (0.86–0.96)
Parks count, per doubling in value <sup>b</sup>	0.94 (0.90–0.98)	0.91 (0.86–0.97)
Grocery store count, per doubling in value <sup>b</sup>	0.94 (0.91–0.97)	0.96 (0.92–1.00) <sup>c</sup>
Grocery stores as fraction of all major food outlets (per 10% change)	0.96 (0.93–0.99)	1.01 (0.96–1.05)

Inadequate and excessive GWG are associated with adverse pregnancy outcomes

- HDP
- GDM
- SGA/LGA
- PTB

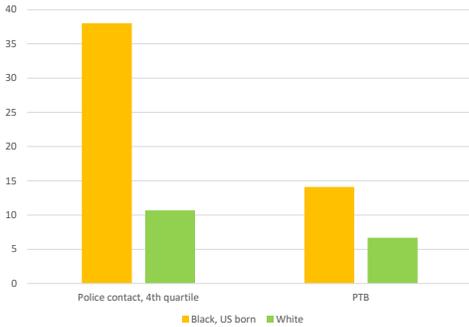
Grobman et al, AJP 2021

## Association of PTB with police contact



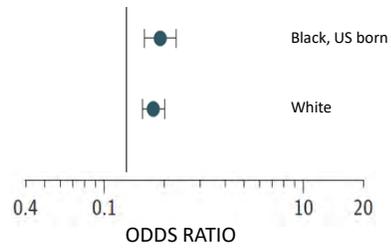
Hardeman et al, JAMA Netw Open, 2021

## Association of PTB with police contact



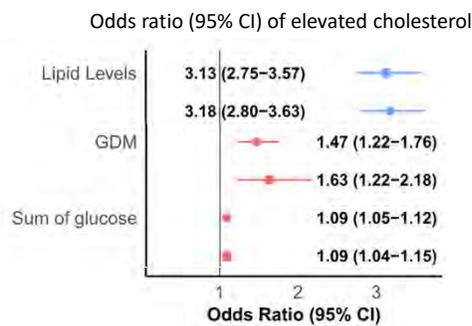
Hardeman et al, JAMA Netw Open, 2021

## Association of PTB with police contact in the 4<sup>th</sup> quartile



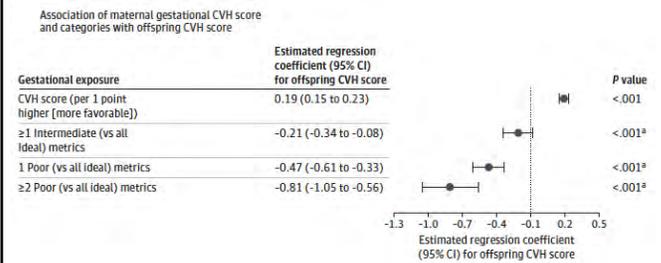
Hardeman et al, JAMA Netw Open, 2021

## Pregnancy CVH is related to lifetime CVH



Lowe et al, Diabetes Res Clin Prac 2022

## Maternal CVH is related to child CVH



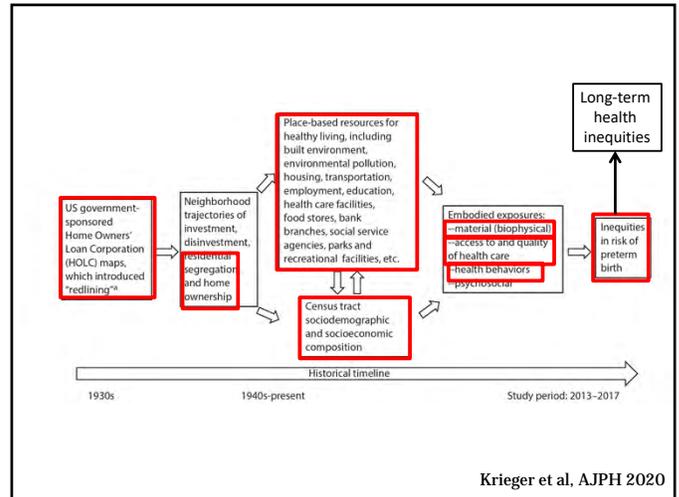
Perak et al, JAMA 2021

## Weathering from stress and telomeres

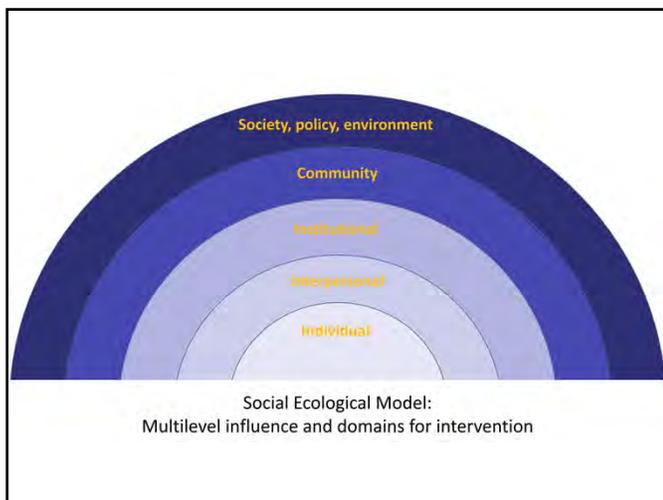
TABLE 2. Statistical models assessing the impact of maternal Adverse Childhood Experience questionnaire (ACE) score on infant telomere length<sup>a</sup>

Variable	Model 1: Main Effects <sup>b</sup>		Model 2: Adjusted Model <sup>b</sup>	
	$\beta$	p	B	p
Age	-1.757	<0.0001	-1.143	<0.0001
Age-squared	0.744	<0.0001	0.738	<0.0001
ACE score	-0.031	0.033	-0.039	0.021
PNMS score			0.027	0.30
Sex			-0.052	0.39
Race			-0.041	0.43
Socioeconomic status index			-0.014	0.45
Maternal depression			0.004	0.96

Drury et al, Am J Psychiatry 2020



Krieger et al, AJPH 2020



## Toward equitable and optimal outcomes

### • Centrality of community voices

#### Equity Strategy



Use your data to understand what race or ethnicity is most affected

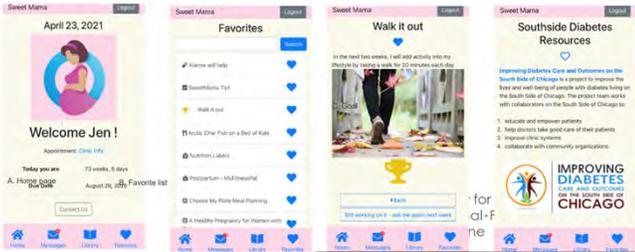
Listen. Engage. Include

- In the community
- In the organization



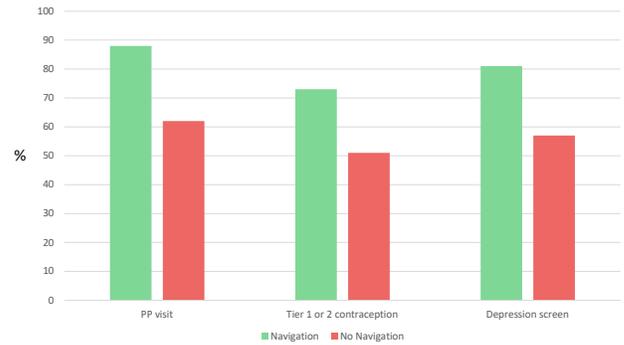
Build what you see & hear for interventions and for system level change

## Tailored SDOH-oriented tools



Yee et al, J Diabetes Sci Tech 2021

## Postpartum Navigation



Yee et al, Obstet Gynecol 2017



## Reduction of Peripartum Racial and Ethnic Disparities: A Conceptual Framework and Maternal Safety Consensus Bundle

Elizabeth A. Howell, Haywood Brown, Jessica Brumley, Allison S. Bryant, Aaron B. Caughey, Andria M. Cornell, Jacqueline H. Grant, Kimberly D. Gregory, Susan M. Gullo, Katy B. Kozhimannil, Jill M. Mhyre, Paloma Toledo, Robyn D'Orta, Martha Ngho, and William A. Grobman

Obstet Gynecol 2018



### READINESS

#### Every health system

- Establish systems to accurately document self-identified race, ethnicity, and primary language.
- Provide system-wide staff education and training on how to ask demographic intake questions.
- Ensure that patients understand why race, ethnicity, and language data are being collected.
- Ensure that race, ethnicity, and language data are accessible in the electronic medical record.
- Evaluate non-English language proficiency (e.g. Spanish proficiency) for providers who communicate with patients in languages other than English.
- Educate all staff (e.g., inpatient, outpatient, community-based) on interpreter services available within the healthcare system.
- Provide staff-wide education on:
  - Peripartum racial and ethnic disparities and their root causes.
  - Best practices for shared decision making.
- Engage diverse patient, family, and community advocates who can represent important community partnerships on quality and safety leadership teams.

PATIENT SAFETY BUNDLE

Reduction of Peripartum Racial/Ethnic Disparities



**COUNCIL ON PATIENT SAFETY  
IN WOMEN'S HEALTH CARE**  
safe health care for every woman

**RECOGNITION**

Every patient, family, and staff member

- Provide staff-wide education on implicit bias.
- Provide convenient access to health records without delay (paper or electronic), at minimal to no fee to the maternal patient, in a clear and simple format that summarizes information most pertinent to perinatal care and wellness.
- Establish a mechanism for patients, families and staff to report inequitable care and episodes of miscommunication or disrespect.

**PATIENT SAFETY BUNDLE**  
**Reduction of Peripartum Racial/Ethnic Disparities**



**COUNCIL ON PATIENT SAFETY  
IN WOMEN'S HEALTH CARE**  
safe health care for every woman

**RESPONSE**

Every clinical encounter

- Engage in best practices for shared decision making.
- Ensure a timely and tailored response to each report of inequity or disrespect.
- Address reproductive life plan and contraceptive options not only during or immediately after pregnancy, but at regular intervals throughout a women's reproductive life.
- Establish discharge navigation and coordination systems post childbirth to ensure that women have appropriate follow-up care and understand when it is necessary to return to their health care provider.
- Provide discharge instructions that include information about what danger or warning signs to look out for, who to call, and where to go if they have a question or concern.
- Design discharge materials that meet patients' health literacy, language, and cultural needs.

**PATIENT SAFETY BUNDLE**  
**Reduction of Peripartum Racial/Ethnic Disparities**



**COUNCIL ON PATIENT SAFETY  
IN WOMEN'S HEALTH CARE**  
safe health care for every woman

**REPORTING & SYSTEMS LEARNING**

Every clinical unit

- Build a culture of equity, including systems for reporting, response, and learning similar to ongoing efforts in safety culture.
- Develop a disparities dashboard that monitors process and outcome metrics stratified by race and ethnicity, with regular dissemination of the stratified performance data to staff and leadership.
- Implement quality improvement projects that target disparities in healthcare access, treatment, and outcomes.
- Consider the role of race, ethnicity, language, poverty, literacy, and other social determinants of health, including racism at the interpersonal and system-level when conducting multidisciplinary reviews of severe maternal morbidity, mortality, and other clinically important metrics.
- Add as a checkbox on the review sheet: Did race/ethnicity (i.e. implicit bias), language barriers, or specific social determinants of health contribute to the morbidity (yes/no/maybe)? And if so, are there system changes that could be implemented that could alter the outcome?

**PATIENT SAFETY BUNDLE**  
**Reduction of Peripartum Racial/Ethnic Disparities**

**Developing Tools to Report Racism in Maternal Health for the CDC Maternal Mortality Review Information Application (MMRIA): Findings from the MMRIA Racism & Discrimination Working Group**

Rachel R. Hardeman<sup>1</sup> · Anna Kheyfets<sup>2</sup> · Allison Bryant Mantha<sup>3</sup> · Andria Cornell<sup>4</sup> · Joia Crear-Perry<sup>5</sup> · Cornelia Graves<sup>6</sup> · William Grobman<sup>7</sup> · Sascha James-Contereili<sup>8,9</sup> · Camara Jones<sup>10</sup> · Breana Lipscomb<sup>11</sup> · Carla Ortique<sup>12</sup> · Alison Stuebe<sup>13</sup> · Kaprice Welsh<sup>14,15</sup> · Elizabeth A. Howell<sup>2,16</sup>

**DEFINITIONS**

- **Structural racism**—The systems of power based on historical injustices and contemporary social factors that systematically disadvantage people of color and advantage white people.
- **Interpersonal racism**—Discriminatory interactions between individuals based on differential assumptions about the abilities, motives, and intentions of others and resulting in differential actions toward others based on their race.
- **Discrimination**—Treating someone less or more favorably based on the group, class or category they belong to resulting from biases, prejudices, and stereotyping.

**FRAMEWORK FOR ACTION**

- (1) Valuing all individuals and populations equally (e.g., hospital-wide mandate on person-centered communication).
- (2) Recognizing and rectifying historical injustices (e.g., re-examination of drug testing policies).
- (3) Providing resources according to need (e.g., travel voucher funding).

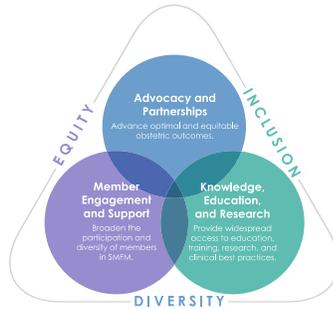
## Diversity, Equity, and Inclusion at SMFM



### 2022 – 2024 Strategic Map

**VISION:** SMFM is dedicated to the advancement of optimal and equitable perinatal outcomes for all people who desire or experience pregnancy.

**MISSION:** SMFM supports the clinical practice of maternal-fetal medicine by providing education, promoting research, and engaging in advocacy to optimize equitable perinatal outcomes for all people who desire or experience pregnancy.



## Diversity, Equity, and Inclusion at SMFM

### 2022 Publications [SMFM.org/publications](https://www.smfm.org/publications)

- SMFM Special Statement: Commitment to Excellence in Obstetrical Care, Research, and Education for People with Diverse Sexual and Gender Identities (*AJOG*, April 2022)
- SMFM Special Statement: Race in Maternal-Fetal Medicine Research - Dispelling Myths and Taking an Accurate, Antiracist Approach (*AJOG*, April 2022)

### 2022 Annual Meeting Events [SMFM.org/2022](https://www.smfm.org/2022)

- President's Workshop on Social Determinants of Health
- First-Ever Anti-Racism Special Interest Group
- Expert Roundtable: Optimizing Reproductive Health Experiences and Outcomes for Transgender and Gender Expansive Individuals
- Bridging the Gender and Racial Equity Gap: Critical Conversations on Promotion and Productivity
- Understanding Intersections: Care for Transgender and Gender Diverse Patient Populations

## Diversity, Equity, and Inclusion at SMFM

### Programs

- Emerging Leaders Program
- Member Spotlight on Website & in Monthly Newsletter
- Mentorship in DEI Annual Award

### Upcoming Online Course [bit.ly/jointQIcourse](https://bit.ly/jointQIcourse)

- Using Quality Improvement and Safety Science to Eliminate Perinatal Racial and Ethnic Health Inequities (May 13, 2022)

## Diversity, Equity, and Inclusion at SMFM

### Governance

- Hired a Director of DEI in 2021
- Reworked the process for committee appointments
  - Term Limits

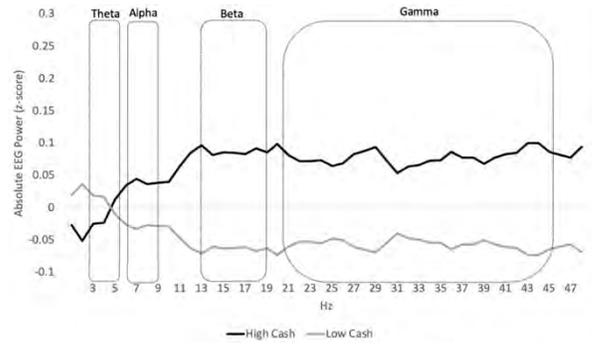
### Advocacy

- Equity checklist
- Support for the MOMnibus Act

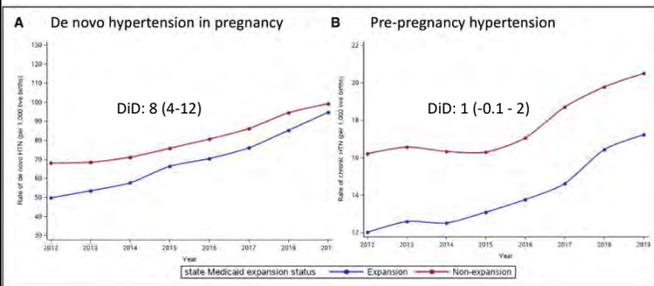
## MOMNIBUS

- Social Determinants for Moms Act
- Kira Johnson Act
- Protecting Moms Who Served Act
- Perinatal Workforce Act
- Data to Save Moms Act
- Moms Matter Act
- Justice for Incarcerated Moms Act
- Tech to Save Moms Act
- Impact to Save Moms Act
- Maternal Health Pandemic Response Act
- Protecting Moms and Babies Against Climate Change Act
- Maternal Vaccination Act

## Baby's First Years study

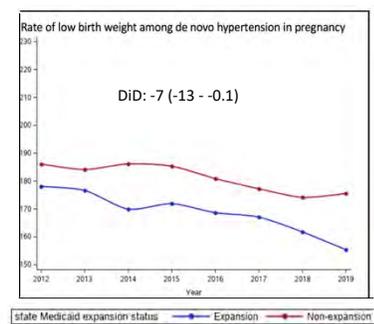


## Medicaid expansion and HDP



Everitt, Circ Cardiovasc Qual Outcomes 2022

## Medicaid expansion and HDP



Everitt, Circ Cardiovasc Qual Outcomes 2022

**The ills of today do not cloud the horizon of tomorrow, but act as a spur to greater effort.**

**-W. Mayo, 1926**

**Do not let the fear of not being able to do a big great thing dissuade you from trying to do many small good things.**

**-Fireman on NPR, 2022**

Abstract #: TH-RPS1 – Room 1 Analgesia – 01

**Comparison of Uniport Versus Multiport Wire-reinforced Catheters for Labor Analgesia During Programmed Intermittent Epidural Boluses: A Randomized Controlled Clinical Trial**

**Presenting Author:** Weijia Du, n/a

**Presenting Author's Institution:** Shanghai First Maternity and Infant Hospital, Tongji University School of Medicine, Shanghai

**Background:** High-rate delivery of programmed intermittent epidural bolus (PIEB) increases the delivery pressure and improves analgesic efficacy over low-rate bolus administration. To achieve high rate PIEB, high-flow epidural catheter is recommended. In this study, we aimed to compare the analgesic outcomes between the uniport catheters and the multiport catheters at high delivery rate during PIEB.

**Methods:** 182 parturients were randomized to receive either the uniport catheters or the multiport catheters. Epidural analgesia was initiated and maintained with a solution of 0.1% ropivacaine with 0.3µg/mL of sufentanil. The PIEB volume was 10mL and administered every 45 minutes at a delivery rate of 480mL/h after test dose. All pumps were programmed with an 8mL patient-controlled epidural (PCEA) bolus and a 10-minute lockout interval configured between PCEA or PIEB/PCEA boluses. The primary outcome was the percentage of participants with adequate analgesia 20 minutes after the initial epidural bolus. Secondary outcomes were sacral blockade 20 minutes after the initial epidural bolus, time to adequate analgesia, requests and numbers of patient-controlled epidural (PCEA) boluses, and ropivacaine consumption.

**Results:** The percentage of parturients with adequate analgesia 20 minutes after initial bolus was higher with the uniport catheters than with the multiport catheters [71.8% vs. 56.0%,  $P = .032$ , odd ratios 0.500, 95% confidence interval (CI), 0.264-0.947]. The median times (interquartile range) to adequate analgesia were 12 (8-30) minutes with the uniport catheters and 20 (10-47) minutes with the multiport catheters (hazard ratio = 1.672; 95% CI, 1.193–2.343;  $P = 0.003$ , Fig). S<sub>2</sub> sensory blockade levels were more frequently observed in the uniport catheter group at 20 minutes ( $P < .05$ ). The percentage of parturients who required PCEA and the number of PCEA boluses, as well as the hourly consumption of ropivacaine were lower with the uniport catheters compared to the multiport catheters (all  $P < .05$ ). There were no differences in the incidence of unilateral block, side effects and maternal satisfaction between the two groups.

**Conclusions:** Uniport catheters combined with 480 mL/h delivery rate used for epidural labor analgesia with PIEB improved analgesic efficacy compared to multiport catheters.

[Fig \(soap\).pdf](#)

**Abstract #: TH-RPS1 – Room 1 Analgesia - 02**

### **Color Flow Doppler in Spinal Ultrasound: A Novel Technique for Assessment of Epidural Catheter Position**

**Presenting Author:** Oscar van den Bosch, MD

**Presenting Author's Institution:** Department of Anesthesiology and Pain Medicine, Mount Sinai Hospital, University of Toronto

**Co-Authors:** Cristian Arzola, MD, MSc - Department of Anesthesiology and Pain Medicine, Mount Sinai Hospital, University of Toronto

Jose C A. Carvalho, MD, PhD - Department of Anesthesiology and Pain Medicine, Mount Sinai Hospital, University of Toronto

Kristi Downey, MSc - Department of Anesthesiology and Pain Medicine, Mount Sinai Hospital, University of Toronto

Yehoshua Gleicher, MD, MSc - Department of Anesthesiology and Pain Medicine, Mount Sinai Hospital, University of Toronto

Naveed Siddiqui, MD, MSc - Department of Anesthesiology and Pain Medicine, Mount Sinai Hospital, University of Toronto

**Background:** Ultrasound is increasingly used to facilitate placement of an epidural catheter for the management of labor pain, but little is known about its potential to ascertain the actual position of the catheter in the epidural space. Recent studies have proposed color flow Doppler as a way to confirm the position of the epidural catheter in the epidural space, however with limited success (1,2). Therefore, further optimization of the technique is warranted. Our aim was to use color flow Doppler ultrasound to visualize flow distal to the epidural catheter tip in patients undergoing epidural analgesia for childbirth.

**Methods:** In this prospective observational cohort study, we recruited patients who delivered vaginally under epidural analgesia. Using a 5-2 MHz curvilinear transducer in a longitudinal paramedian oblique view, the posterior complex and the anterior complex were visualized at the interspace of epidural insertion, two interspaces above and two interspaces below. Both a left and right paramedian oblique view were used. The color flow Doppler function was used to visualize flow within the epidural space upon injection of 1 mL aliquots of normal saline. An assessment was considered positive when turbulent flow was detected in the anterior and/or posterior complex at a specific interspace.

**Results:** We present the interim results of this ongoing study (12 out of 40 patients). At the time of the Doppler assessment, the average length of the catheter in the epidural space was 4.8 cm (range: 3.5 - 5.5 cm). Flow in the epidural space was visualized in all patients (Figure 1). Flow was visualized only at the interspace coinciding with the epidural insertion in most patients (8/12, 67%), only at the interspace above the insertion site in one case (1/12, 8.3%) and at both the interspace coinciding with the insertion site and one interspace above in the remaining cases (4/12, 33%). Flow was never visualized in interspaces caudad to the insertion site. Flow was visualized only either on the left or on the right paramedian view in most patients (7/12, 58%), whereas it was visualized bilaterally in the remaining cases (5/12, 42%). All patients had experienced successful analgesia with symmetric sensory blocks.

**Conclusions:** Color flow Doppler ultrasound is a feasible, fast and reliable tool to visualize flow distal to the epidural catheter in the obstetric population. This technique has the potential to confirm the position of epidural catheter after placement. Furthermore, our preliminary results suggest that epidural catheters mostly remain at the interspace of insertion. Future work is warranted to correlate the specific findings with relevant clinical outcomes.

[vandenBosch-Doppler.pdf](#)

**Abstract #: TH-RPS1 – Room 1 Analgesia - 03**

## **Feasibility of surface electromyography and electrodermal activity for assessment of neuraxial blockade**

**Presenting Author:** Sofia Nicolls, BSc, Hon Med Sci candidate

**Presenting Author's Institution:** Dalhousie University, Faculty of Science - Halifax, Nova Scotia

**Co-Authors:** Ana S Jaus, MD FRCPC - Dalhousie University, Faculty of Medicine, Department of Anesthesiology, Pain Management and Perioperative Medicine

### **Introduction**

Direct clinical testing of sensory and motor function is currently the only technique to assess neuraxial anesthesia. Despite increasing availability of wearable sensors that detect a range of biological signals, there are no known automatic methods for measuring and monitoring the level of neuraxial blockade.

Surface electromyography (sEMG) detects muscle contractions.[1] Electrodermal activity (EDA) measures changes in skin conductance due to sweat gland activity in order to indirectly detect sympathetic tone, stress and pain.[2] These technologies may have the capability to provide information for automatic assessment of block. However, optimal sensor placement, feasibility of recording and the impact on parturients' experience are unknown.

### **Objective**

To determine the feasibility and acceptability of sEMG and EDA bio signals in obstetrical setting.

### **Methods**

With local ethics approval, five healthy patients undergoing elective cesarian delivery under standardised spinal anesthetic consented to wear sEMG and EDA sensors (five sensors and a neutral).

The sensors were placed on patients' feet, and the trapezius, tibialis ant., lumbar paraspinal, and rectus abd. muscles.

Maximum voluntary contractions (MVC), EDA, and clinical data were collected at three timepoints. Patients gave feedback at discharge from recovery. Signals were recorded using BITalino Core BT and analyzed using OpenSignals<sup>®</sup> evolution (Plux, Portugal, EU).

### **Results**

No sensor related skin irritation, discomfort, restricted movement or impaired ability to bond with the newborn was reported. 4/5 women agreed that they would wear sensors as a routine part of the process (one was neutral).

Of the 75 planned wireless signal recordings, 58 (77%) were completed. Reasons for failure were sensor detachment (3), a computer failure (11), and emesis (3). Recordings had sufficient signal quality to allow feature extraction and detailed analysis.

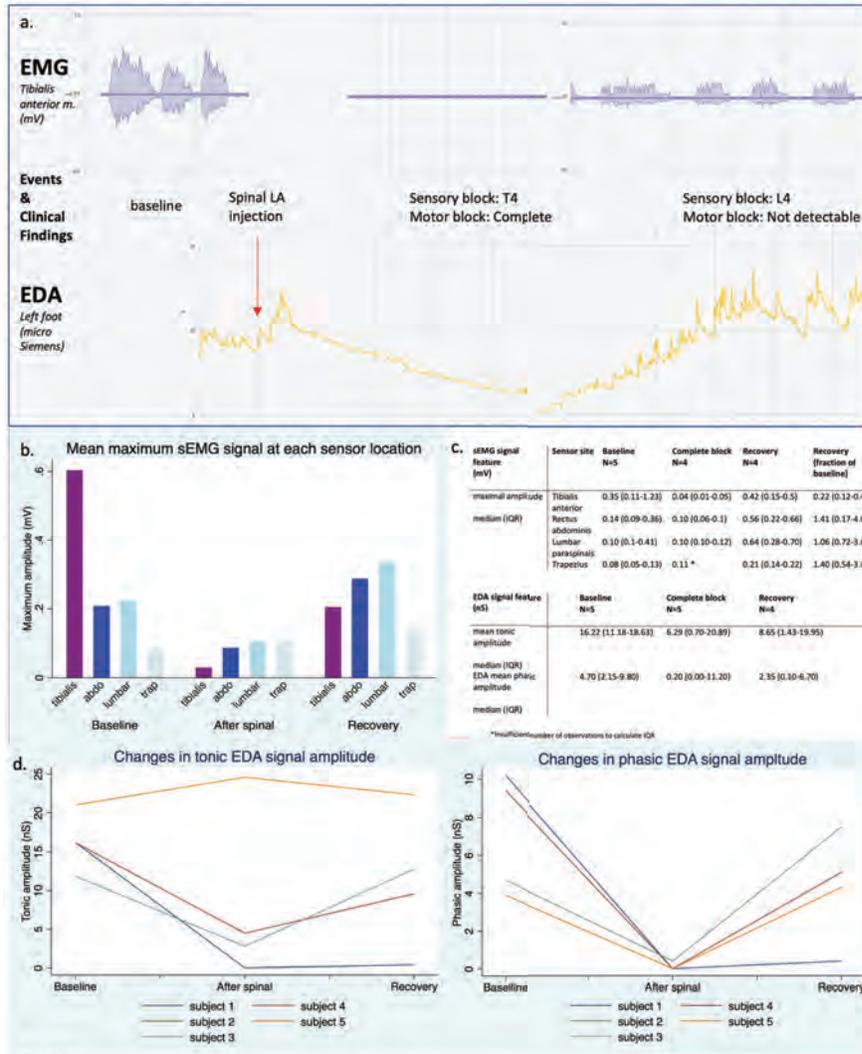
Change in tibialis anterior MVC amplitude reflected clinical findings. MVC recovery amplitudes consistently exceeded baseline for abdominal and paraspinal muscles. However, median tibialis anterior recovery was 22% (11-53%) of baseline MVC despite complete recovery of motor function by clinical assessment.

EDA recordings showed consistent and progressive loss of phasic activity and decrease in tonic activity during block onset in 4/5 patients. These changes reversed during recovery.

Statistical analysis was not performed due to sample size.

### **Conclusion**

Sensors did not interfere with medical care or maternal-neonatal bonding. sEMG and EDA signals contained information that could be correlated with clinical findings. Peripartum application and signal recording was feasible and positively experienced by the women in our study. These findings can be used to facilitate further research.



**Figure 1.**  
 a. Typical sEMG and EDA signal changes recorded in one subject throughout the perioperative period.  
 b. Maximum voluntary contraction amplitude of sEMG signal at each of the time-points.  
 c. Table of numeric values for s(EMG) and EDA signal amplitudes.  
 d. Changes in tonic and phasic features of EDA signal throughout the perioperative period.

Du

Abstract #: TH-RPS1 – Room 1 Analgesia - 04

### Labor Epidural Failure Rate using CompuFlo Epidural System Assistance for Placement

**Presenting Author:** Trent S. Weatherley, BSA

**Presenting Author's Institution:** University of Texas Medical Branch at Galveston - Friendswood, Texas

**Co-Authors:** Allison Mullins, MD - The University of Texas Medical Branch at Galveston

**Background:** Epidurals have been used for many years to provide labor analgesia to parturients in the United States. Unfortunately, failure of epidural anesthesia and analgesia occasionally occurs and is more common in obese patients [1]. The traditional method of epidural placement relies on subjective tactile sensation alone. The CompuFlo Epidural System (CES) provides objective pressure measurements from the distal tip of the Tuohy needle as it traverses various tissue planes during epidural placement that can guide needle advancement decision making. Epidural failure rate using the traditional method for placement has been estimated to be around 9-12%, increasing to 15% in patients with BMI > 35 kg/m<sup>2</sup> [2, 3]. We aim to determine the epidural failure rate when using the CompuFlo epidural system for labor epidural placement.

**Methods/Results:** After obtaining IRB exemption (IRB # 21-0320), we performed a retrospective data analysis of 51 patients who underwent epidural placement with the assistance of CES. Epidural failure was defined as need for epidural replacement or one sided epidural. The failure rate was 5.88% (3/51) Average BMI 33.7 (SD 7.4), see Table 1 for demographic data. Data describing the pressure in the ligamentum flavum and epidural space was available for one patient who required epidural replacement and showed an average ligamentum flavum pressure of 140 mmHg and epidural pressure of 35 mmHg with a pressure waveform rating of 3 on a scale of 1-5. This data was not available for the other 2 patients with failed epidurals. The epidural failure rate for patients with BMI > 35 kg/m<sup>2</sup> was 0%.

**Discussion:** Although the number of patients in this study is small, we demonstrate a decreased epidural failure rate compared to previously published rates when using CES as an objective measure to guide labor epidural placement. This improvement is most apparent in the obese patient population who traditionally are at increased risk of epidural failure and more challenging epidural placement. CES has been shown to aid with the identification of false loss of resistance possibly contributing to the decreased epidural failure rate, particularly in obese patients who are more prone to have false loss of resistance during placement.

Table 1

<b>Patient Characteristics</b>	
	<b>Mean (SD)</b>
<b>Age (years)</b>	<b>22.4 (±5.4)</b>
<b>BMI (kg/m<sup>2</sup>)</b>	<b>33.7 (±7.4)</b>
<b>Height (m)</b>	<b>1.59 (±0.01)</b>
<b>Weight (kg)</b>	<b>88.7 (±25.4)</b>
<b>Race</b>	
African American	<b>5</b>
Asian	<b>1</b>
Caucasian	<b>43</b>
<b>Parity</b>	
Nullipara	<b>20</b>
Multipara	<b>31</b>
<b>Epidural Performer Type</b>	
Faculty	<b>6</b>
Fellow	<b>8</b>
PGY-4	<b>16</b>
PGY-3	<b>12</b>
PGY-2	<b>8</b>
<b>Delivery Mode</b>	
Vaginal	<b>40</b>
Cesarean	<b>11</b>
<b>Complications</b>	
	<b>Percentage</b>
Need for Replacement (all patients)	<b>5.88 (3/51)</b>
Need for Replacement (BMI >35)	<b>0 (0/19)</b>
One Sided Epidural	<b>0 (0/51)</b>
GA for Cesarean Section	<b>27.3 (3/11)</b>

## Complications with CompuFlo Device Assisted Epidural Placement

Presenting Author: Trent S. Weatherley, BSA

Presenting Author's Institution: University of Texas Medical Branch at Galveston - Friendswood, Texas

### Introduction:

Epidural anesthesia is used for pain management in many births worldwide. However, the failure rate of epidural placement has been reported between 1.5-23% with the traditionally used loss of resistance (LOR) technique that relies on surface landmarks and tactile feedback for guidance.<sup>1</sup> In difficult patient populations, such as those with BMI >30 kg/m<sup>2</sup>, the complications and failure rates are further elevated.<sup>2</sup> The CompuFlo device has shown promise as a more precise method of epidural placement, using the continuous fluid path at the tip of the needle to display a representation of exit-pressure.<sup>3</sup> The purpose of this abstract is to investigate the placement of epidurals with CompuFlo assistance, and the rate of complications associated with the procedure.

### Material and Methods:

Following IRB approval, we performed a retrospective data analysis of 51 patients at a single hospital institution admitted for delivery who underwent epidural anesthesia with CompuFlo device assistance (Table 1).

For this abstract, we evaluated the complications after placement of the epidural. These complications included the need for general anesthesia during cesarean section (CS), epidural replacement, dural punctures and postpartum complications such as headache, weakness, or back pain.

### Results:

Among the 51 patients, there were no cases of dural puncture and one postpartum complication (back pain). Epidural replacement was required in 5.88% (3/51) of the parturients. CS was performed in 11 patients and of those deliveries, 3 required general anesthesia (27.3%).

### Discussion:

The results of this retrospective analysis demonstrated that the postpartum complications of epidural placement were minimal. While the sample size is relatively small, with no cases of dural puncture and low rate of epidural failure, the CompuFlo System has displayed potential as an aid for difficult cases. False loss of resistance and dural puncture are common complications of the traditional technique and could potentially be reduced with CompuFlo assistance. Further analysis should be conducted comparing complications of the LOR technique and CompuFlo assisted placement based on patient BMI.

Population (n)		51
Maternal Age (years)	Mean	22.4
	Standard Deviation	5.4
Maternal BMI (kg/m <sup>2</sup> )	Mean	29.35
	Standard Deviation	5.68
Race	African American	5
	Asian	1
	Caucasian	43
Parity	Nullipara	20
	Multipara	31
Epidural Performer	Faculty	6
	Fellow	8
	PGY-4	16
	PGY-3	12
	PGY-2	8
Delivery Mode	Vaginal	40
	Cesarean	11
Complications	Postpartum Complications	2.0% (1/51)
	Dural Puncture	0% (0/51)
	Epidural Replacement	5.88% (3/51)
	GA for Cesarean	27.3% (3/11)

Using CompuFlo to streamline and troubleshoot epidural placement

Presenting Author: Keyin Michelle Lu, MD

Presenting Author's Institution: University of Texas Medical Branch at Galveston

Epidurals have been used for years to provide analgesia to laboring parturients. The traditional method with loss of resistance in the epidural space involves subjective tactile sensation. A loss of resistance indicates that the tip of the needle is in the epidural space, however, there can be a false loss of resistance and multiple redirections of the needle may be necessary before finding the epidural space. The CompuFlo Epidural System (CES) provides objective pressure measurements from the tip of the Tuohy needle and realtime feedback during epidural placement (1). CES can help with safer epidural placement and reduce the number of epidural related complications. We aim to describe the number of attempts at epidurals and redirections using CES.

Retrospective review of 51 obstetric patients (age 18-50 years old of any parity) at one institution who received epidural analgesia using CompuFlo during labor between Sept 2021 and Jan 2022. The number of attempts (a fresh stick at the same or different vertebral level), redirections (defined as a change in the angle of the Tuohy needle but not starting at a different vertebral level) were analyzed. 88.2% (45/51) of patients had an epidural placed in 1 attempt and 15.6% of the epidurals required redirections. The mean number of attempts is 1.13 (58 attempts in 51 patients). The mean time to placing an epidural is 13.7 minutes.

In studies involving similar level of training in physicians placing the epidural, the rate of epidural placement in the first attempt is reported to be 69%-79.6% (2, 3), compared to 88.3% first attempt placements in our study. Reported needle redirection was needed in 33% compared to 15.6% in our study (4). While this sample size of this study is small, the CES is a useful adjunct in epidural placement with high success rates and low number of redirections. It provides objective data while increasing success rate with placement of epidural in 1 attempt thereby decreasing the risk of pain that the parturient experiences in epidural placement.

	<b>Percentage</b>
<b>Placed in 1 attempt</b>	<b>88.2% (45/51)</b>
<b>Placed in 2 or more attempts</b>	<b>11.8% (6/51)</b>
<b>Number of redirections</b>	<b>15.7% (8/51)</b>
<b>Patient Characteristics</b>	
	Mean (SD)
<b>Age (years)</b>	<b>22.4 (±5.4)</b>
<b>BMI (kg/m<sup>2</sup>)</b>	<b>33.7 (±7.4)</b>
<b>Height (m)</b>	<b>1.59 (±0.01)</b>
<b>Weight (kg)</b>	<b>88.7 (±25.4)</b>

**Abstract #: TH-RPS1 – Room 1 – Analgesia – 07**

**Laboring Epidural Analgesia with Compu-Flo: Analyzing Correlation of Ligamentum Flavum and Epidural Pressures with Epidural Success**

**Presenting Author:** Mai-Anh Vu, MD

**Presenting Author's Institution:** University of Texas Medical Branch at Galveston, Texas

**Co-Authors:** Allison Mullins, MD - The University of Texas Medical Branch at Galveston

Placement of laboring epidural analgesia (LEA) in parturient patients traditionally relies on tactile sensation. Unique patient anatomy and higher BMI are among several factors that may cause neuraxial placement to be challenging. The Compu-Flo is an apparatus designed to facilitate a more precise, reliable and effective application of epidural anesthesia to determine accuracy of each layer passed by measuring pressure at the end of the needle.

In our study, we used the Compu-Flo to place LEA in patients. We achieved a 92% epidural success rate in our study, requiring zero re-direction and replacement in nearly every study subject. We measure the average pressures in the ligamentum flavum and epidural space during a successful epidural placement to analyze a correlation with age and BMI. Our data shows that the average ligamentum flavum pressure (LFP) in a successful epidural is 135.4 mmHg. There is no correlation between LFP and age of the patient. There is a negative correlation -- although statistically insignificant -- between LFP and BMI.

The average epidural space pressure (ESP) measured in a successful epidural is 46.3 mmHg. There is no correlation between ESP and the age of the patient. There is no correlation between ESP and BMI of the patient.

In conclusion, our data supports that the Compu-Flo is a precise technique to facilitate accurate placement of LEA. There is approximately  $>/ 50$  mmHg of pressure delineating between ligamentum and epidural space, and the Compu-Flo proves this. Regardless of patient age or BMI, the pressures of ligamentum flavum and epidural space are within the same range for our patients. This further supports that by utilizing the Compu-Flo technique, many patients --irrespective of age or BMI -- can have a precise and effective epidural to improve cost of care by improving patient morbidity, decreasing multiple LEA attempts, and improving the accuracy of a safe and effective epidural for the patient.

Abstract #: TH-RPS1 – Room 1 – Analgesia – 08

## The Effect of an Electronic “Nudge” to Encourage Physician Charting of Replacement Neuraxial Catheters in Obstetric Patients

**Presenting Author:** Kelly Fedoruk, MD FRCPC

**Presenting Author's Institution:** Stanford University - Stanford, California

**Co-Authors:** Brendan Carvalho, MBBCh, FRCA, MDCH - Stanford University

Cedar J. Fowler, MD PHD MPH - Stanford University

Edward Riley, MD - Stanford University

Ellen Wang, MD - Stanford University School of Medicine

James Xie, MD - Stanford University

**Background:** Monitoring the replacement of dysfunctional neuraxial labor epidurals in obstetric patients has been considered a marker of quality care amongst obstetric anesthesiologists (1). Typical labor neuraxial epidural failure rates have been estimated to range between 1.6-15.4% (2). Although replacement may suggest a technical “failure”, it may also represent vigilant follow up and prioritization of satisfactory maternal analgesia. Any measure of quality assurance requires dedication to accurate record keeping and such events often rely on voluntary practitioner actions, memory and willingness to comply with such efforts. “Nudge” reminders executed by way electronic medical records (EMR) alerts have been used across medicine to influence human behaviour and encourage adherence to guidelines, standard of care and quality assurance efforts (3). We hypothesized that the introduction of an EMR “nudge” would improve the documentation of replaced labor neuraxial epidural catheters by anesthesiologists at our institution.

**Methods:** We developed an electronic nudge that would alert the physician to a potential replaced neuraxial epidural catheter based on the detection of two or more neuraxial catheter placement procedure notes in a single patient encounter on our EMR. The nudge encouraged physician documentation of said epidural catheter replacement in order for such information to be compiled as part of our institution’s “failed neuraxial catheter database”. We looked at the rate of compliant physician “failed block charting” prior to the introduction of the nudge beginning in January of 2019 and after implementation of the nudge which took place in October 2019. Data was collected until December of 2020.

**Results:** There was a total of 523 charts that revealed a “failed catheter” requiring replacement between January 2019 to December 2020, based on detection of 2 or more neuraxial procedure notes per encounter. Prior to the introduction of the nudge in October 2019, the rate of uncharted failed/replaced block rate was 18.2%, and after the intervention, the rate was 5.2% ( $p = 0.003$  and 95% CI of 0.054-0.209).

**Conclusions:** Nudge technology improved compliance with quality metric monitoring of neuraxial block failure in obstetric patients.

[p chart + process change + description.pdf](#)

**Abstract #: TH-RPS1 – Room 1 – Analgesia – 09**

**Conversion of labor analgesia for intrapartum cesarean delivery: dural puncture epidural vs combined spinal epidural vs epidural**

**Presenting Author:** Kathryn Clark, M.B., B.Ch., B.A.O.

**Presenting Author's Institution:** Mayo Clinic

**Co-Authors:** Katherine Arendt, M.D. - Mayo Clinic

Andrew Hanson, M.S. - Mayo Clinic

David Olsen, M.D. - Mayo Clinic

Mark Rollins, M.D., Ph.D. - Mayo Clinic

Emily Sharpe, M.D. - Mayo Clinic

Hans Sviggum, M.D. - Mayo Clinic

**Introduction:** The conversion of neuraxial labor analgesia to surgical anesthesia via an epidural catheter is frequently used for laboring women requiring a cesarean delivery (CD). Use of a combined spinal epidural (CSE) during labor compared to epidural may reduce failure of conversion of neuraxial analgesia to surgical anesthesia for CD;<sup>1</sup> however, this finding is not consistently reported.<sup>2</sup> Dural puncture epidural (DPE) has advantages that include quick block onset, less unilateral blocks, and decreased clinician boluses.<sup>3</sup> As use of the DPE technique has increased, it is important to understand how it impacts outcomes. The aim of this study was to determine if the DPE technique was associated with increased successful conversion of neuraxial analgesia to surgical anesthesia for CD compared to epidural and CSE.

**Methods:** Records were retrospectively searched from February 1, 2017 through May 31, 2021 for all patients with neuraxial labor analgesia and subsequent CD. Patients were excluded if no local anesthetic was administered via epidural catheter for an emergent CD or if they had an inadvertent Tuohy dural puncture. The type of block (DPE, CSE, epidural), size of spinal needle, and maternal demographics were collected. Failure of epidural catheter conversion to surgical anesthesia was defined by requirement of either a new neuraxial block at time of CD or use of general anesthesia. Patient, anesthetic, and procedure characteristics are displayed according to type of neuraxial block as median (Q1, Q3) for continuous variables and number (percentage) for categorical variables. Magnitudes of these pairwise comparisons are presented as standardized differences. Rates of failure of surgical conversion were compared across block types using the Chi-square test.

**Results:** During the study period, 706 parturients met inclusion criteria. Labor neuraxial analgesia type distribution was 322 (45.6%) DPE, 255 (36.1%) epidural, and 129 (18.3%) CSE. Women who had a CSE were more likely to be parous (Table). Overall, 83 (11.8%) had failed neuraxial conversion to surgical anesthesia and required a repeat neuraxial procedure (31, 4.4%) or general anesthetic (66, 9.3%). Neonatal outcomes were not significantly different between groups. In univariable analysis, there was no significant difference in the rate of conversion failure across the three groups (DPE 10%, CSE 11%, epidural 14%, Chi-square p-value = 0.34).

**Discussion:** We did not find a statistical difference in neuraxial labor analgesia conversion failure for CD between DPE, CSE, and epidural in univariable analysis. Our study may be underpowered to detect a difference between groups. Larger, randomized, prospective studies are needed to evaluate outcomes of labor analgesia techniques.

[SOAP Table.pdf](#)

Abstract #: TH-RPS1 – Room 1 – Analgesia – 10

## Implementation of a Countdown Timer to Standardize Patient Assessment Times during Neuraxial Labor Analgesia

Presenting Author: James Damron, MD

Presenting Author's Institution: Vanderbilt University Medical Center - Nashville, Tennessee

Co-Authors:

### Introduction

Poorly functioning labor epidural catheters (LEC) can lead to uncontrolled pain, with resulting deleterious effects on patient experience and satisfaction.<sup>1,2</sup> Timely identification of LEC malfunction can prevent these negative experiences. To ensure timely recognition, SOAP recommends “regular assessment of labor analgesia effectiveness,” or rounding on patients with LEC at regular intervals.<sup>3</sup> On a busy labor floor, where constant direct communication among providers can prove challenging, informatics-based systems to ensure consistency of care may ultimately improve patients’ experiences. We hypothesized that the implementation of a countdown timer (CDT) on the patient display board to visually alert clinicians to the need for LEC assessment would decrease the average time between assessments.

### Methods

As part of a quality initiative, we implemented a CDT to the labor and delivery patient display board on 8/12/20. The CDT indicated the number of elapsed minutes since the last patient assessment. Our goal was to encourage patient assessment every 2 hours—an expectation that was in place prior to the CDT. A retrospective review was conducted of LEC charts during the 5-month period prior to and following implementation of the CDT, with a 4-week washout period. Data were obtained by electronic extraction and manual chart review. The primary outcome was the average time between assessments, counting LEC placement as the first assessment. Secondary outcomes included maximum time between assessments, total number of assessments during labor, LEC replacement rates, and general anesthesia rates. Unadjusted comparisons between pre- and post-implementation groups were conducted using Wilcoxon rank-sum and Pearson chi-square tests for continuous and categorical data, as appropriate. A test of variance was conducted for the primary outcome.

### Results

After CDT implementation, average time between assessments decreased from a median of 173[IQR 53,314] to 100[IQR 74,125] minutes ( $p < 0.001$ ), and maximum time between assessments decreased from 330[IQR 60,542] to 162[IQR 125,212] minutes ( $p < 0.001$ ) (Figure 1). Due to more frequent assessments, total number of patient evaluations during labor increased from 3[IQR 2,4] to 5[IQR 3,7] ( $p < 0.001$ ). Decreased variance in average time between assessments was noted following CDT implementation ( $p < 0.001$ ). LEC replacement rates decreased from 14% to 5% pre vs. post CDT ( $p < 0.001$ ). General anesthesia rates were not statistically significantly different ( $p = 0.18$ ).

### Discussion

We demonstrate the implementation of an informatics-based systems solution to encourage standardization of care and adherence to national society guidelines. A simple CDT provided a visual cue to clinicians to perform more frequent assessments of laboring patients with a LEC. In the future, it will be important to link these process improvements to improvements in patient experiences and outcomes.

[Figure 1.pdf](#)

Abstract #: TH-RPS1 – Room 1 – Analgesia – 11

**Fetal Bradycardia in the Peri-Neuraxial Period: Identifying Parturients at Risk for Cesarean Delivery – A Retrospective Study**

**Presenting Author:** Ian Gaston, MD

**Presenting Author's Institution:** McGaw Medical Center of Northwestern University, Illinois

**Co-Authors:**

**Introduction:** The combined spinal-epidural (CSE) technique has been associated with FB due to potential sympathectomy-induced maternal hypotension, tachysystole, and uterine artery vasoconstriction. The incidence of FB after CSE has been cited from 3-20%; however, no studies have shown an increased rate of CD as a result. Our study aims to discern whether parturients with FB within 60 minutes of neuraxial placement are at an increased risk of CD.

**Methods:** In this IRB-approved study, our Obstetric Anesthesiology Quality Dashboard was used to obtain the mode of delivery for all patients in the last year who had a CSE for labor. Additionally, all patients who had FB within 60 minutes of neuraxial placement were identified, and the indication for CD was documented if they did not deliver vaginally. The mode of delivery between patients with and without FB within 60 minutes of CSE placement was compared and analyzed using chi-squared analysis.

**Results:** A total of 9229 patients received a CSE for labor at our institution in the past year, of which 2.7% had documented FB within 60 minutes of CSE placement. The overall conversion rate of CSE for labor to CD was 15%. Of the 2.7% of patients with FB within 60 minutes of CSE, 31% had a CD. A higher percentage of patients who had FB within 60 minutes of CSE placement had a CD than patients who did not have FB within 60 minutes of CSE,  $p < .00001$  (Table 1).

**Discussion:** In addition to maternal hypotension causing FB, it is hypothesized diminished pain can lead to tachysystole via a sympathectomy-driven catecholamine imbalance (decreased epinephrine) resulting in FB. Additionally, the relative increase in norepinephrine is thought to cause uterine artery vasoconstriction leading to utero-placental insufficiency and FB. Phenylephrine, ephedrine, and nitroglycerin are all well-documented, effective treatment modalities for these causes of FB and could be responsible for the overall absence of increased CD resulting from FB. Epidural-only analgesia has been suggested to mitigate catecholamine imbalances and hypotension related to CSE but circulating epinephrine levels can decrease by up to 50% after both techniques. Factors unrelated to neuraxial technique have been associated with FB, namely maternal pain scores and advanced maternal age. We postulate patients with FB within 60 minutes of neuraxial could potentially be a prognostic indicator for CD and that risk factors independent of maternal hypotension, circulating catecholamine levels, or their surrogates could account for this observed increase in CD in this subset of parturients.

[SOAP 2022 Table 1 - Gaston.pdf](#)

Abstract #: TH-RPS1 – Room 2 – Postpartum Headache - 01

**Inpatient Nifedipine Use Prior to Delivery is associated with Increased Risk of Uterine Atony and Use of Secondary Uterotonics: A Retrospective Cohort Study**

**Presenting Author:** Amnon A. Berger, MD, PhD

**Presenting Author's Institution:** Beth Israel Deaconess Medical Center - Westwood, Massachusetts

**Introduction:** Postpartum hemorrhage (PPH) is a leading cause of maternal morbidity and mortality globally, and uterine atony is the leading cause of PPH. While oxytocin is the first-line agent for atony, secondary uterotonics are often used for treatment once atony is diagnosed. Tocolytics act to relax the gravid uterus, increasing the risk of atony and PPH. Nifedipine, a calcium channel blocker that has recently been shown to be superior in the treatment of hypertensive disorder of pregnancy,<sup>1</sup> is also used as a weak tocolytic due to smooth muscle relaxation. In a prior study, outpatient use of nifedipine was not correlated with increased rates of PPH.<sup>2</sup> That study was limited to outpatient prescriptions, a small nifedipine cohort of 27, and did not account for use in the delivery admission. In this study, we evaluate the effect of nifedipine on secondary uterotonic use.

**Methods:** We performed a retrospective, single-center cohort study at our tertiary, academic medical center, a referral center for our healthcare network. We compared the rate of secondary uterotonic or anti-fibrinolytic use between women exposed to nifedipine in the peripartum period to those who were not. We calculated univariate odds ratio (OR), as well as binomial generalized models (GLM) to account for covariates. A  $p < 0.05$  was considered significant.

**Results:** We examined the electronic health, anesthesia, and delivery records for 26,058 parturients in our hospital over a 5-year period (07/2016-06/2021). Univariate, unadjusted OR for uterotonic use after exposure to nifedipine was 2.67 (108/432 vs. 2,708/24,394 in our cohort, 95% CI 2.14-3.33,  $p < 0.001$ ). In a GLM, when controlling for confounding by BMI ( $p < 0.001$ ) and neonate delivery weight ( $p < 0.001$ ), nifedipine exposure remained significantly associated with the primary outcome (OR 3.85, 95% CI 2.75-5.35,  $p < 0.001$ ). Nifedipine use in the 12 hours prior to delivery demonstrated a clear and significant relationship between cumulative dose and risk of secondary uterotonic use (Figure 1a). In a sensitivity analysis comparing only patients treated with any antihypertensive including nifedipine to antihypertensives excluding nifedipine, nifedipine exposure remained significantly associated with the primary outcome in a similar GLM (OR 1.75, 95% CI 1.08-2.87,  $p = 0.03$ ) (Figure 1b).

**Discussion:** Despite progress made in maternal health care, uterine atony and resulting PPH remain a significant cause of morbidity and mortality. We found an association between nifedipine, a commonly used antihypertensive, and uterine atony, defined by the requirement for secondary uterotonics. Further work is required to determine the impact of confounders and the relationship to blood loss and transfusion requirements.

[2022-02-01 - Nifedipine-PPH SOAP2022 Abstract Figure.pdf](#)

## Abstract #: TH-RPS1 – Room 2 – Postpartum Headache – 02

### Evaluation of physician automatic alert-activated anesthesiology interventions for postpartum hemorrhage after vaginal delivery: a prospective pilot study

**Presenting Author:** Diego Villela-Franyutti, MD

**Presenting Author's Institution:** Department of Anesthesiology, Perioperative and Pain Medicine, Brigham & Women's Hospital, Harvard Medical School, Boston, Massachusetts, United States, Massachusetts

**Co-Authors:** Michaela K. Farber, MD, MS - Department of Anesthesiology, Perioperative and Pain Medicine, Brigham & Women's Hospital, Harvard Medical School, Boston, Massachusetts, United States

Mario I. Lumbreras-Marquez, MBBS, MMSc - Department of Anesthesiology, Perioperative and Pain Medicine, Brigham & Women's Hospital, Harvard Medical School, Boston, Massachusetts, United States

#### Background

Anesthesiologists are not routinely at the bedside at the time of vaginal delivery in the labor room, which may contribute to delayed resuscitation of postpartum hemorrhage (PPH). Quantitation of blood loss (QBL) after vaginal delivery with use of electronic physician-alert systems may facilitate timely response. The primary aim of this study was to assess PPH interventions by the anesthesia team in response to an automated physician alert system for QBL  $\geq$  500 mL after vaginal delivery. The threshold QBL  $\geq$  1000 mL as defined by the American College of Obstetricians and Gynecologists (ACOG) [1] was also explored.

#### Methods

This IRB-approved prospective observational pilot study was conducted over a trial month (January 2021) and 6 subsequent months August 2021-January 2022. A wireless QBL system (Stryker, Kalamazoo, MI) installed in every labor room on our labor and delivery unit utilizes calibrated under-buttocks V-drapes, exclusion of amniotic fluid volume and gravimetric quantitation of surgical sponges. A physician notification system at a preset threshold QBL of  $\geq$ 500 mL transmits to smart watches voluntarily worn by members of the anesthesia team, prompting their report to the bedside with a PPH response kit. PPH interventions are then made with multidisciplinary team input. In this pilot study, anesthesia interventions and correlation between QBL and number of interventions were measured. Descriptive statistics were performed.

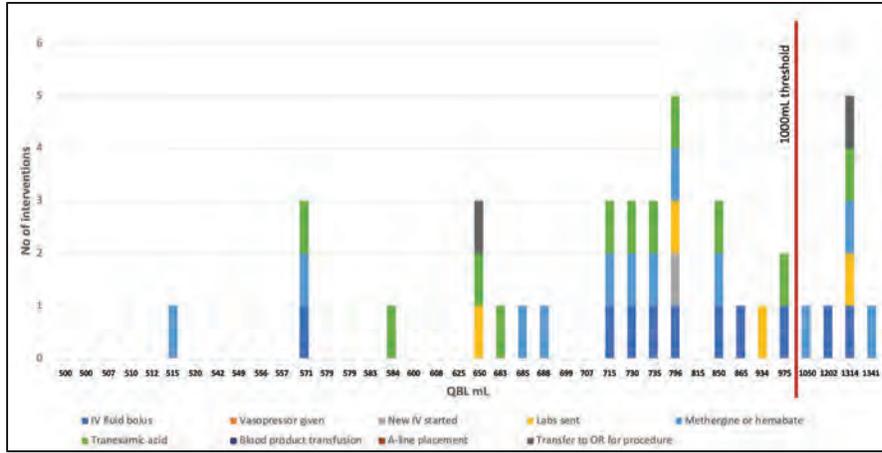
#### Results

In 7 months, a total of 38 triggered alerts for QBL > 500mL were captured as a convenience sample. Of those, 4 alerts were >1000 mL at the time of alert. The median QBL was 637.5 mL (interquartile range [IQR] 556, 796 mL). For 19 alerts (50%), no intervention was required. For 19 alerts (50%), patients received 40 interventions (figure). The most common interventions were administration of a second line uterotonic (31.6%), tranexamic acid (28.9%) and IV fluid bolus (26.3%). Of note, 80% of interventions occurred for QBL < 1000 mL. The correlation coefficient between QBL and the number of interventions was 0.63 ( $P < 0.001$ ).

#### Conclusion

A majority of QBL physician alerts in our cohort occurred prior to 1000mL, with 50% of those cases receiving PPH interventions. Our findings suggest that QBL

$\geq$  500mL represents a clinically relevant trigger for anesthesia management of PPH after vaginal delivery. QBL physician alert-triggered interventions demonstrated in this pilot suggest utility to increase timely response to PPH. Further research is warranted on whether QBL alerts improve maternal outcomes after PPH from vaginal delivery.



Abstract #: TH-RPS1 – Room 2 – Postpartum Headache – 03

## Incorporating a Postpartum Hemorrhage Bundle on the Labor and Delivery Unit: A State-Wide Survey of Anesthesiologists

**Presenting Author:** Kathryn Hackett, MD

**Presenting Author's Institution:** Department of Anesthesiology, Perioperative and Pain Medicine, Brigham & Women's Hospital, Harvard Medical School, Boston, Massachusetts, United States

**Co-Authors:** Arthur Chyan, DO - Department of Anesthesiology, Perioperative and Pain Medicine, Brigham & Women's Hospital, Harvard Medical School, Boston, Massachusetts, United States

Michaela K. Farber, MD, MS - Department of Anesthesiology, Perioperative and Pain Medicine, Brigham & Women's Hospital, Harvard Medical School, Boston, Massachusetts, United States

Mario I. Lumberras-Marquez, MBBS, MMSc - Department of Anesthesiology, Perioperative and Pain Medicine, Brigham & Women's Hospital, Harvard Medical School, Boston, Massachusetts, United States

### Background:

Postpartum hemorrhage (PPH) is a leading cause of preventable maternal morbidity and mortality that calls for multidisciplinary focus. The American College of Obstetricians and Gynecologists recommends use of a PPH bundle to facilitate early recognition and timely intervention.<sup>1</sup> As experts in critical care and transfusion, obstetric anesthesiologists play a vital role in PPH resuscitation.<sup>2</sup> However, anesthesiologists may be inconsistently engaged in PPH bundle implementation, and their attention to pre-delivery risk assessment, early recognition and development of institutional protocols is warranted. In this study, we sought to evaluate anesthesiologists' perspectives on how PPH is managed at birthing facilities in the state of Massachusetts. We hypothesized that anesthesia involvement in PPH bundle implementation varies across institutions.

### Methods:

Hospitals providing obstetric care in the state of Massachusetts were identified, and an electronic anonymous survey was emailed to a representative anesthesia provider at each site. The survey was adapted from Kacmar et al.<sup>3</sup> and explores hospital delivery volume and acuity, anesthesia staffing models, and anesthesia involvement in PPH management bundles.

### Results:

The survey response rate was 68% (23/34), and results for complete responses (20/34) are shown in the Table. Bundles for PPH management exist at 90% of respondents' sites. Only 40% of respondents cover L&D without simultaneously covering other practice areas, and mode of communication of active PPH cases to anesthesiologists was variable. Once PPH occurs, anesthesiologists report key roles in management including initiation of protocols, transfusion, and laboratory evaluation. While a majority reported that they are notified of high-risk patients prior to delivery (89%), only 25% reported knowledge of a PPH database to monitor cases.

### Conclusion:

Multidisciplinary management of PPH is of vital importance to all labor and delivery units. Despite increased awareness and implementation of PPH management bundles, anesthesiology involvement still varies widely in labor and delivery units across Massachusetts. State-wide efforts to engage anesthesiologists in PPH bundle implementation are warranted until preventable morbidity is eliminated.

[Table 1. Summary of survey responses.pdf](#)

Should BMI bear more weight on ACOG guidelines?

Presenting Author: Marah Alian, BS

Presenting Author's Institution: University of New England, College of Osteopathic Medicine

Co-Authors:

**Background:** The use of point of care viscoelastic testing (POCVT) has been previously utilized to describe the hypercoagulable state related to both pregnancy and obesity.<sup>4</sup> Given that Venous Thromboembolism (VTE) is a leading cause of maternal death, the Royal College of Obstetricians and Gynecologists (RCOG) and the American Congress of Obstetricians (ACOG) have created guidelines for pharmacologic VTE prophylaxis. Yet, these guidelines vary significantly in the inclusion criteria for prophylaxis.<sup>1</sup> For instance, body mass index (BMI) is considered in the RCOG but not in the ACOG anticoagulation recommendations<sup>1,2</sup>. The aim of this study is to examine the correlation between ROTEM parameters with patient's BMI. We used Fitem, Extem, and Intem to assess fibrinogen, extrinsic and intrinsic coagulation pathways (functional assessment of the coagulation factors and platelets).

**Methods:** After institutional review board approval, we obtained data from 681 patients presenting for labor at Yale-New Haven Hospital from 2015– 2021. All charts were reviewed by two obstetric anesthesiologists, with any discrepancies resolved by a third. Exclusion criteria included receiving medications affecting coagulation, tranexamic acid, or blood products before conduction of ROTEM and having inherited or acquired thrombophilia. Patients were sorted by BMI and age-adjusted mean differences of all ROTEM parameters were found for the BMI cutoff of 30. (Table 1)

**Results:** A total of 467 charts were reviewed. FIBTEM A10 by BMI is summarized in Table 1. After adjusting for age, patients with a BMI  $\geq 30$  demonstrated higher ROTEM parameters, when compared to their counterparts (Table 1).

**Discussion:** Patients with BMI  $\geq 30$  demonstrated higher ROTEM parameters compared to those with BMI  $< 30$  indicating a greater hypercoagulable state in obese patients. There are conflicting results when POCVT has been utilized to assess the effect of obesity on whole blood, with some studies corroborating our findings and others that refute a statistically significant association between obesity and hypercoagulability.<sup>3,4</sup> Despite these contended results, clinically, obesity has demonstrated to pose a high-risk factor for VTE. Although our results are not confirmatory, they do support that obesity is associated with an increase in fibrinogen, FVIIa, amongst others<sup>5</sup> Besides our study supports the RCOG stance that weight should bear more weight when considering pharmacologic prophylaxis.

Table 1. Mean (SD) values of ROTEM parameters by BMI

ROTEM® Parameter	BMI < 30	BMI $\geq 30$	p-value
n	148	318	
FIBTEM MCF	24.4 (5.9)	26.6 (6.7)	<0.001
FIBTEM A10	22.1 (5.2)	24.4 (5.9)	<0.001
FIBTEM A20	23.8 (5.6)	26.1 (6.3)	<0.001
EXTEM CT	59.8 (11.7)	63.6 (33.4)	0.068
EXTEM MCF	69.4 (6.0)	70.7 (6.7)	0.044
EXTEM A10	61.9 (7.4)	64.0 (7.3)	0.003
EXTEM A20	67.9 (6.5)	69.9 (5.8)	0.001
INTEM CT	165.5 (42.2)	163 (37.1)	0.53
INTEM MCF	67.0 (7.1)	68.7 (7.1)	0.014
INTEM A10	59.8 (8.2)	62.2 (7.5)	0.003
INTEM A20	66.1 (7.5)	68.0 (6.5)	0.008

A10 Amplitude 10 minutes after CT; A20 Amplitude 20 minutes after CT; CT Clotting Time; CFT Clot Formation Time; MCF Maximum Clot Firmness; SD Standard Deviation.

**Abstract #: TH-RPS1 – Room 2 – Postpartum Headache – 05**

**Variation in postpartum hemorrhage prevalence based on hospital of delivery in California**

**Presenting Author:** Rudolph Davis, MD MPH

**Presenting Author's Institution:** Stanford University - Belmont, California

**Co-Authors:** Jessica R. Ansari, MD - Stanford University

Brian Bateman, MD - Stanford University

Alexander J. Butwick, MBBS, FRCA, MS - Stanford University

Nan Guo, PhD - Department of Anesthesiology, Perioperative and Pain Medicine, Stanford University

Elliott Main, MD - Stanford University

**Introduction:**

In the United States, postpartum hemorrhage (PPH) is a leading cause of preventable maternal death and morbidity<sup>1</sup>. However, few studies have examined the extent to which PPH prevalence vary between US hospitals and the contribution of patient-level and hospital-level factors towards such variability<sup>2</sup>.

**Methods:**

We performed a population-based, cross-sectional study of livebirths that occurred in 247 hospitals in California between 2011-2014. The primary outcome of PPH was defined as ICD-9 diagnosis codes 666.x. ICD9 coding was also used to obtain maternal characteristics from this data set and included maternal comorbid conditions, delivery-associated factors, and hospital-based factors. We accounted for established PPH risk factors by including the following covariates in the analysis: sociodemographic factors, chronic hypertension, diabetes, trimester when prenatal care commenced, pre-eclampsia, previous cesarean delivery, placenta previa, polyhydramnios, plurality, fibroids, trial of labor, prolonged labor, induction of labor, chorioamnionitis, placental abruption, gestational age at delivery, and delivery mode. Hospital-level covariates included teaching status and annual delivery volume (in quartiles).

The crude hospital PPH prevalence was calculated. We performed multilevel logistic regression, fitting five models which included a null model with hospital as a random effect (Model 1), then sequential adjustment for patient sociodemographic factors (Model 2), pre-existing medical and pregnancy-related covariates (Model 3), peripartum covariates (Model 4), and hospital-level factors (Model 5). In each model, between-hospital variation was assessed with the median odds ratio (MOR) and the intraclass coefficient (ICC).

**Results:**

Our analytic cohort included 1,904,479 women, of whom 62,830 (3.3%) experienced PPH. The median, lowest, and highest adjusted hospital-level PPH prevalence was 3.4%, 0.6%, and 11.5%. The MOR in Model 1 was 2.1 indicating that, if a woman moved to a hospital with a high probability of PPH, the odds of experiencing PPH would increase by 210%. The ICC was relatively low (15.7%) indicating that a low proportion of the variance is explained by hospitals. Only a modest decrease in the MOR and ICC occurred after adjustment for patient-level factors and adding hospital-level covariates (Models 2-5).

**Conclusions:**

Findings from this study indicate that substantial variation was present in the prevalence of PPH among hospitals in California between 2011 and 2014. This variation was minimally explained by patient-level and select hospital-level factors. Given that a state-wide PPH bundle has been introduced to prevent PPH and reduce maternal morbidity from PPH, further research is needed to examine and explain the extent of variability in the PPH prevalence and PPH-related morbidity across all California hospitals since bundle implementation.

[TableSOAP.pdf](#)

Indication and utilization of fibrinogen replacement therapy in postpartum hemorrhage: a single-center retrospective descriptive study

Presenting Author: Hisako Okada, M.D., Ph.D.

Presenting Author's Institution: Juntendo University Urayasu Hospital - Chiba, Tokyo

**Introduction** Postpartum hemorrhage (PPH) is a leading cause of maternal mortality worldwide. Hypofibrinogenemia is the major cause of PPH, and fibrinogen value is recognized as a predictive factor for severe PPH. National guidelines for PPH management have substantial variations<sup>1</sup>, thus better evidence is required. The trigger and target plasma fibrinogen level in PPH is recommended around 150-200 mg/dL. For fibrinogen replacement therapy (FRT), fibrinogen concentrate (FC) or cryoprecipitate is recommended. The primary purpose of this study is to evaluate whether FRT was properly performed for acquired hypofibrinogenemia in PPH in our institution. Proper FRT was defined as follows; plasma fibrinogen level was measured before FRT and below 200 mg/dL, life-threatening PPH was confirmed by attending physicians, or fibrinogen level increased over 200 mg/dL after FRT. Secondary purpose is to assess the interventional treatment and comorbidities.

**Methods** After IRB approval (H20-0258), we extracted the obstetric patients who received FRT from April 2015 to August 2020 at our institution. Inclusion criteria were PPH more than 2,000 mL. Exclusion criteria was inheriting hypofibrinogenemia, abortion and patient with missing data. **Results** Within 6,610 women who delivered, 28 patients received FRT and 3 patients were excluded. In 25 patients, both FC and cryoprecipitate were administered for severe PPH in 10 patients (group FC). Eleven patients were administered FC alone (group F), and 4 patients were administered cryoprecipitate alone (group C). One patient in group F had 2 bleeding episodes. We analyzed 12 episodes of FRT for group F. All patient had life-threatening bleeding more than 2,000 mL or acquired hypofibrinogenemia less than 200 mg/dL. The fibrinogen level was below 150 mg/dL in 65.4% and below 200 mg/dL in 88.5% of the patients. After FRT, 80.8% of the patients had fibrinogen level more than 150 mg/dl, and 65.4% of the patients more than 200 mg/dL, respectively. Hemostasis had been achieved even the fibrinogen level was less than 200 mg/dL in 8 cases (30.8%). In group F, fibrinogen level more than 200 mg/dL was significantly achieved than other groups. However, in 4 patients in group F, it was above 300 mg/dL and deemed excessive. All the 4 patients received FRT when the fibrinogen level was above 150 mg/dL. **Interventional treatment was performed in 9 cases (34.6%) in total and more frequent in group FC. Comorbidities such as lung edema or thrombosis were similar among the groups.**

**Conclusion.** Our study demonstrated that around 90% of patients with life-threatening PPH who needed FRT found to have an acquired hypofibrinogenemia as low as 200 mg/dL. After FRT, two-thirds of the patients achieved plasma fibrinogen level above 200 mg/dL, but hemostasis was achieved in most of the cases. However, FRT deemed excessive or insufficient in some cases. More strict compliance for FRT in PPH may be necessary.

**Abstract #: TH-RPS1 – Room 2 – Postpartum Headache – 07**

**Evidence-Based Oxytocin Use for Cesarean Delivery: A Quality Improvement Project**

**Presenting Author:** Elliott C. Callahan, MD

**Presenting Author's Institution:** University of California, San Francisco - San Francisco, California

**Co-Authors:** Meghan Duck, RNC-OB, MS, CNS - University of California San Francisco

Ronald B. George, MD FRCPC - UCSF

Stephanie Lim, MD - University of California San Francisco

Melissa Rosenstein, MD, MAS - University of California San Francisco

Stacy Young, MD - University of California San Francisco

**Background:** Postpartum hemorrhage (PPH) remains a leading cause of maternal mortality in the US. Our institution has a high burden of post-cesarean PPH (PC-PPH). Because oxytocin is the first line medication for the treatment and prophylaxis of PPH,<sup>1</sup> we sought to institute a guideline-based quality improvement (QI) project for the administration of oxytocin.

**Methods:** We outlined a modified Plan-Do-Study-Act (PDSA) framework (IRB #22-36077).<sup>2</sup> In the “Plan” phase, we reviewed current literature and guidelines, gathered background data, and convened a multidisciplinary team of anesthesiologists, obstetricians, and nurses to develop an updated protocol for PC-PPH prophylaxis. Current protocol of 30 Units (U) oxytocin in 1000 mL delivered “wide open” intraoperatively was identified as a target for improvement. We built consensus on a modified regimen of 3 U oxytocin bolus over 3 minutes followed by prolonged infusion at 15 U/hour, continued for two hours in the post-anesthetic care unit (PACU). We completed a one-month feasibility pilot and experimental washout period assessing practicality of intraoperative and PACU infusions. “Do” phase of PDSA cycle 1 commenced Feb. 1, 2022 to investigate the effectiveness of these changes on reducing transfusions. Secondary measures will be intraoperative and PACU adherence, quantitative blood loss (QBL), and second-line uterotonic use.

**Results:** Our institution's median monthly PC-PPH (QBL $\geq$ 1000mL) rate is 29% (Figure 1). Over the time periods for which data are available, second-line uterotonic use has increased to >50% of our cesarean deliveries (CD) and transfusion rates in hospital vary from 1-20% (median 13%). We will present complete data on PC-PPH and transfusion rates.

**Discussion:** Our PPH rates exceed the global average of  $\leq$ 10%.<sup>3</sup> Atony is the predominant cause of PPH,<sup>4</sup> therefore we reasoned that QI should focus on evidence-based prophylaxis of atony, for which oxytocin is first line. Previous guidelines suggest one-time prophylactic dosing,<sup>4</sup> or qualitative titration to uterine tone,<sup>1</sup> however recent literature has endorsed a bolus + controlled infusion regimen.<sup>5</sup> This offers the appeal of more controlled oxytocin administration and—by lengthening infusion time—has the potential to reduce delayed PPH. This project is one of several incipient PC-PPH reduction measures at our institution, which will also include prophylactic tranexamic acid for high-risk patients, detailed case review, and focus on improving surgical technique. In making these changes we hope to effect a reduction in PC-PPH.

[Figure 1.pdf](#)

## Abstract #: TH-RPS1 – Room 2 – Postpartum Headache – 08

### Calculated allowable blood loss and transfusion among women with PPH during cesarean delivery: a retrospective cohort

**Presenting Author:** Carmen Lopez, MD

**Presenting Author's Institution:** Northwestern University McGaw Medical Center - Chicago, Illinois

**Co-Authors:**

#### **Introduction:**

Postpartum hemorrhage (PPH) is one of the leading causes of maternal morbidity and mortality worldwide. Physiologic changes in pregnancy help account for this anticipated blood loss with term parturients increasing their blood volume to 94 ml/kg from non-pregnant value of 65 ml/kg.<sup>1</sup> One component of obstetric hemorrhage bundles has been early identification of women at risk for hemorrhage and transfusion. Predicting need for transfusion is challenging. In the non-pregnant population allowable blood loss (ABL) is used to predict need for transfusion. The aim of this study was to apply existing ABL equations and to evaluate if EBL exceeding ABL correlates with need for transfusion in obstetric hemorrhage.

#### **Methods:**

We conducted a retrospective study using a postpartum hemorrhage dataset. Data included deliveries from Northwestern Prentice Women's Hospital from January 2016 to January 2018. Only parturients who underwent cesarean delivery with a subsequent postpartum hemorrhage defined as an estimated blood loss (EBL) of 1000mL or greater were included in the analysis. Extracted data included patient weight, estimated gestational age (EGA), baseline hemoglobin, EBL, discharge hemoglobin, and transfusion of packed red blood cells (PRBCs). Using a minimum hemoglobin of 7.0 g/dl, we calculated the ABL using both the term estimation of blood volume (94 ml/kg) and adjusted for EGA (24-27 weeks: 84 ml/kg, 28-34 weeks: 92 ml/kg, and 35-41 weeks: 96 ml/kg).<sup>2</sup> Difference between ABL and EBL were calculated for both  $ABL_{TERM}$  and  $ABL_{EGA}$ . Women were stratified by need for transfusion. Normality was evaluated using the Shapiro-Wilk test. Categorical data were evaluated using chi-squared test and continuous data were evaluated with Kruskal-Wallis test. P value less than 0.05 was considered significant.

#### **Results:**

A total of 401 patients met inclusion criteria, 53 (13%) required transfusion. EBL exceeded ABL more in patients who were transfused using both equations (Table 1). The sensitivity and positive predictive value of EBL exceeding  $ABL_{TERM}$  was 58% and 97% respectively, and sensitivity and positive predictive value of EBL exceeding  $ABL_{EGA}$  was 55% and 97% respectively.

#### **Conclusions:**

While the sensitivity of EBL exceeding ABL was relatively low using both equations, the positive predictive value was high for both equations suggesting that ABL may be a useful tool in considering resource allocation during PPH particularly in women with low ABL. In the future ABL should be validated prospectively as a predictor for pre-transfusion testing (type and screen, type and cross). Future work should also evaluate ABL in the context of QBL.

[Lopez ABL Table SOAP.pdf](#)

Abstract #: TH-RPS1 – Room 2 – Postpartum Headache – 09

## Phenylephrine Use Alters Shock Index Reliability With Postpartum Hemorrhage During Cesarean Delivery

**Presenting Author:** Emery H. McCrory, MD

**Presenting Author's Institution:** Northwestern University School of Medicine

**Co-Authors:** Emily E. Walsh, BS

Paloma Toledo, MD, MPH - Northwestern Medicine

**Introduction:** Postpartum hemorrhage (PPH) continues to be the leading cause of maternal morbidity and mortality worldwide. Early recognition and prompt management of PPH is critical to improving maternal outcomes. The Shock Index (SI), calculated as heart rate (HR) divided by systolic blood pressure (SBP), has been validated in the trauma population and also recently in low-resource obstetric settings, with a  $SI \geq 0.9$  identifying patients at risk for massive transfusion.[1] However, an international consensus statement recommends the use of prophylactic phenylephrine infusions for prevention of hypotension after spinal anesthesia.[2] Phenylephrine is an alpha-1 adrenergic agonist, which leads to a rise in systolic blood pressure and reflex bradycardia, altering the variables in a calculated shock index. The objective of this study was to evaluate the association between shock index and need for maternal blood transfusion among women who experienced a PPH during a cesarean delivery.

**Methods:** Electronic medical record data was extracted for all women who had a cesarean delivery and PPH (> 1 liter blood loss) between 2016-2018. Extracted data included: maternal demographics, vital sign data at several time intervals relative to the PPH (5, 15, 30, 45, 60, and 90 minutes), total phenylephrine administered, crystalloid and blood product administration, and maternal outcomes (e.g., transfusion, ICU admission, and maternal morbidity and mortality). The shock index (SI) was calculated at each time interval and the maximum SI was determined. Data were stratified by whether or not the patient was transfused. Normal distribution was evaluated with the Shapiro-Wilk test. Categorical data were compared using the chi-squared test and continuous data were compared using the Kruskal-Wallis test. Transfusions were also compared using a SI cutoff of  $\geq 0.9$ .  $P < 0.05$  was used to determine statistical significance.

**Results:** A total of 811 women met inclusion criteria, of which, 148 (18%) received a transfusion. Patients who were transfused had a higher estimated blood loss (EBL), in addition, to higher amounts of crystalloids infused, and phenylephrine totals (Table 1). The maximal shock index was higher in the transfusion group compared to the non-transfused group (1.0 vs. 0.95,  $P < 0.001$ ). Women who were transfused were more likely to be admitted to the ICU or experience maternal morbidity/mortality. A total of 514 women had a maximal  $SI \geq 0.9$ . Of those, 73% were transfused, vs. 61% who were not transfused,  $P = 0.004$ . The positive predictive value of a  $SI \geq 0.9$  was 21% (17.7% - 25.0%).

**Discussion:** Although shock index has the potential to be a valuable tool for predicting need for escalation of care or blood transfusion after postpartum hemorrhage, the use of phenylephrine to manage hypotension in parturients undergoing cesarean delivery alters the ability to use SI as a reliable predictor.

[Table 1.pdf](#)

Abstract #: TH-RPS1 – Room 2 – Postpartum Headache – 10

## Simulation for Postpartum Hemorrhage Management: An Organizational Strategy Reconfigured to Include Professional Wellness

**Presenting Author:** Samantha Smith, DNAP, CRNA

**Presenting Author's Institution:** New York-Presbyterian, Weill Cornell Medical Center - New York, New York

**Co-Authors:** Jaime A. Aaronson, MD - New York-Presbyterian, Weill Cornell Medical Center

Sharon E. Abramovitz, M.D. - New York-Presbyterian/Weill Cornell Medicine

Kris Bulger, MS, CRNA - New York-Presbyterian, Weill Cornell Medical Center

Alaeldin Darwich, MD - New York-Presbyterian, Weill Cornell Medical Center

**Introduction:** Postpartum hemorrhage (PPH) is a leading cause of maternal morbidity and mortality worldwide; a practical approach for PPH management training is necessary for maternal safety. Simulation training prepares multidisciplinary obstetric anesthesiology teams to optimally manage a PPH; the immersive environment promotes engagement for organizational learning. Widespread burnout amongst healthcare providers is another potential simulation target. Elevated stress levels deplete coping mechanisms, thereby adding associated risks of medical errors during emergencies, such as PPH; organizational approaches for professional wellness are, therefore, imperative. By reconfiguring simulation curriculum to address maternal safety and provider wellness concurrently, a multifaceted training approach to operationalize high-performing teams can improve outcomes.

**Case:** Prior to opening a free-standing obstetric hospital, our interdisciplinary steering committee developed a simulation curriculum as an orientation strategy. The training introduced clinicians from the obstetric anesthesiology team to the different landscape and workflows, focusing on maternal safety and site-specific resources. The COVID-19 pandemic unexpectedly disrupted this simulation program, and social distancing protocols prompted the reformatting of in-person training to tele-simulation. Thus, institutional mandates prevented team building initiatives and led to emotional isolation - a common contributor to clinical burnout. Considering the frequency and necessity of team-dependent PPH management, we reconfigured our simulation strategy to reconnect clinicians for maternal and provider well-being. To promote clinical resilience, a new orientation checklist supported mentorship for institutional-specific challenges (i.e., blood bank communication), a strategy that aligns with crisis resource management simulation theory. Competency trainings (i.e. thromboelastography interpretation) were standardized across the multi-professional team in line with team-based simulation principles for mutual support. Overall, this proactive response to an unprecedented situation utilized simulation theory in PPH training to re-engage obstetric anesthesiology clinicians for both provider wellness and maternal safety.

**Discussion:** Considering the high stakes and wide-ranging clinical responsibilities of the obstetric anesthesiology team, institutions should provide strategic organizational learning opportunities. A simulation curriculum that supports clinicians' dynamic needs promotes best practices during obstetric emergencies and is also a practical professional wellness strategy. By reconfiguring existing PPH management training programs with multidisciplinary simulation, outcomes for patients and providers are likely to be improved.

Is pregnancy a risk factor for developing postoperative nausea and vomiting?

Presenting Author: Anuradha Kanaparthy, B.S.

Presenting Author's Institution: College of Medicine, Northeast Ohio Medical University, Rootstown, Ohio, USA

Co-Authors:

**Background:** Postoperative nausea and vomiting (PONV) is a common and unpleasant complication of general anesthesia. There are well known risk factors that predispose a patient to developing PONV. While studies exist that explore PONV incidence in gravid and non-gravid patients separately, no studies exist comparing the two cohorts to identify whether pregnancy is an independent risk factor for PONV and whether intraoperative and postoperative management of PONV varies by pregnancy status.

**Methods:** This is a retrospective case-control cohort study, with 1:2 matching based on age, year of surgery, and surgical procedure. The electronic medical records were abstracted for demographic information, predisposing risk factors, prophylactic antiemetics, PONV documentation, rescue antiemetics, length of PACU stay and length of hospitalization. Multivariable analysis of risk factors was performed with p-values < 0.05 considered statistically significant.

**Results:** 237 gravid women underwent non-obstetric procedures under general anesthesia and were compared with 474 non-gravid women. The PONV rate was 22% in gravid and 15% in non-gravid women. No association was found between gravid status and risk for PONV (adjusted odds ratio 1.35 [95%CI 0.84, 2.17], P=0.222). The overall number of prophylactic antiemetics were less among gravid (median 2 [1, 2]) than non-gravid (3 [2, 3]) women (P< 0.001). Intraoperative administration of four out of five categories of prophylactic antiemetics was significantly lower in gravid patients than non-gravid patients (see table). In addition, gravid women had longer hospital lengths of stay (P< 0.001), despite having shorter surgical duration (P=0.015).

**Conclusions:** PONV incidence (as defined by use of rescue antiemetics in the PACU) showed a trend towards an increase in PONV among gravid patients, but when adjusted for patient and procedural characteristics, there was no significant difference between the two populations. This is a surprising finding, given the physiologic predisposition towards nausea in pregnancy. This may represent a failure to capture episodes of PONV using medication administration as a proxy for PONV. Significantly fewer prophylactic antiemetics were administered to gravid patients, suggesting possible undertreatment. This discrepancy may represent an attempt to limit fetal exposure to medications viewed as carrying risk. Current guidance on an optimal prophylactic regimen for this patient population is lacking.

Table. Prophylactic antiemetics administered.

Variable	Non-pregnant (N=474)	Pregnant (N=237)	Chi-square p-value
Serotonin (5HT3) antagonists, n (%)	399 (84%)	183 (76%)	0.015
Dopamine antagonists, n (%)	364 (77%)	131 (55%)	<0.001
Histamine antagonists, n (%)	5 (1%)	2 (1%)	1.00*
Dexamethasone, n (%)	378 (80%)	93 (39%)	<0.001
Scopolamine patch, n (%)	60 (13%)	6 (3%)	<0.001

\*Fisher's exact test

Abstract #: TH-RPS1 – Room 3 – POCUS – 02

## Optic Nerve Sheath Diameter and Ophthalmic Artery Doppler in Pregnant Patients as Point-of-Care Ultrasound for Anesthesiologists

**Presenting Author:** Eduardo Yamaguchi, MD

**Presenting Author's Institution:** BC Women's Hospital - Vancouver, BC - Vancouver, British Columbia

**Co-Authors:** Alexandre Ferraz, MD - CETRUS - Sao Paulo, Brazil

Marcos Lange, MD - CETRUS - Sao Paulo, Brazil

**Background:** Point-of-care ultrasound (POCUS) is an important tool to guide anesthesia management in patients with preeclampsia (PE). Optic nerve sheath diameter (ONSD) correlates with intracranial pressure (ICP) but a cut-off value for raised ICP in parturient women with PE has yet to be validated.(1) Conversely, ophthalmic artery Doppler is a biomarker in the prediction of maternal PE. An increase in the ophthalmic artery second to first peak of systolic velocity ratio (PSV ratio) has been observed in patients who developed PE.(2) We hypothesized that there would be a positive correlation between ONSD and PSV ratio in pregnant patients during the first and second trimesters of pregnancy.

**Methods:** A prospective cohort study of healthy pregnant women at 11+0 to 27+6 weeks' gestation was undertaken in an antepartum ultrasound clinic. Baseline maternal systolic blood pressure (SBP), diastolic blood pressure (DBP) and heart rate (HR) were taken simultaneously in both arms, and the mean of the readings was considered. A high-frequency linear probe with a small amount of gel was kindly applied to the closed upper eyelid of the patient. The system settings were previously adjusted (mechanical index < 0.23, and the thermal index = 0.0) to prevent any damage to the ocular structures. ONSD was measured 3 mm behind the globe, three times in both eyes in the axial plane. The flow velocity waveforms from the maternal ophthalmic artery were assessed twice in each eye as follows: left eye, right eye, and again from the left eye, and then right eye, considering the mean to reduce variability of the measurements. Ultrasound scanning was performed by one anesthesiologist to maintain standardization. Participants were followed up by telephone call after delivery to confirm whether their pregnancy was complicated by PE.

**Results:** Twenty-eight patients were enrolled in the study [mean  $\pm$  SD; age  $26 \pm 6$  years; height  $160 \pm 8$ ; weight  $71 \pm 14$ ; BMI  $27 \pm 4$ ; SBP:  $122 \pm 8$ ; DBP  $72 \pm 7$ ; HR  $78 \pm 10$ ]. Two patients (7.1 %) developed PE. The mean  $\pm$  SD for OSND was  $4.51 \pm 0.32$  mm, and PSV ratio was  $0.56 \pm 0.13$ . No significant correlation was identified between OSND and PSV ratio ( $P = 0.72$ ), and between these variables and PE ( $P = 0.87$  and  $P = 0.14$ , respectively) using the Pearson correlation coefficient.

### Discussion:

Transorbital ocular ultrasonography works as a window that provides a non-invasive access to the cerebrovascular structures and their changes during pregnancy. (3) It is well-tolerated by the patients and it can be used as a POCUS to guide anesthetic management, especially in patients with PE. Similar to other cohorts, we did not find a clear relationship between ONSD and ophthalmic artery Doppler indices.

[AbstractFigureONSD04FEB2022.pdf](#)

Abstract #: TH-RPS1 – Room 3 – POCUS – 03

## Use of Artificial Intelligence in Cardiac Point-of-Care Ultrasound: Education Amongst Obstetric Anesthesiologists

**Presenting Author:** Sara Feldman, MD

**Presenting Author's Institution:** Department of Anesthesiology, Duke University, Durham, NC - Durham, North Carolina

**Co-Authors:** Yuriy Bronshteyn, MD, FASE - Department of Anesthesiology, Duke University, Durham, NC

Matthew Fuller, MA, MS - Department of Anesthesiology, Duke University, Durham, NC

Ryan Gessouroun, MD - Department of Anesthesiology, Duke University, Durham, NC

Selby Johnson, II, MD - Department of Anesthesiology, Duke University, Durham, NC

Marie-Louise Meng, MD - Department of Anesthesiology, Duke University, Durham, NC

### Introduction

POCUS is useful in the care of obstetric patients and a new core competency in the anesthesiology residency curriculum.<sup>1,2,3,4</sup> Artificial intelligence (AI) in medical devices may help overcome the lack of local POCUS experts to train OB anesthesiologists.<sup>5</sup> This study aimed to examine the association between AI-augmented training and perception of skill and frequency of POCUS use among obstetric anesthesiologists. We hypothesized that those with AI-augmented training would perceive improved image acquisition and use POCUS more frequently compared to those without AI-augmented training.

### Methods

IRB approval was obtained for a prospective randomized study of a POCUS curriculum. Eight obstetric anesthesiologists and two obstetric anesthesiology fellows were randomized into two groups: AI and non-AI-augmented training. Subjects completed a Likert scale pre-training survey to assess the primary outcome of self-perception of image acquisition skill and secondary outcome of frequency of POCUS use. Subjects did online learning modules week 1, and two 2-hour cardiac POCUS teaching sessions (weeks 1 and 5) with a cardiac anesthesiologist and an intensivist. Both groups were asked to complete 20 independent exams in 8 weeks using a touchscreen ultrasound system (Terason Inc). The AI group was taught to use the Terason system with AI software (Caption Health Inc), and the non-AI group without. Surveys were sent at the end of the 8 week curriculum, and 6 and 12 weeks post-training. Responses were averaged by group at each time point and presented descriptively. Due to small sample size no direct statistical comparison was attempted.

### Results

The primary outcome of perception of image acquisition skills improved 6 weeks post-training, remaining improved at 12 weeks with 80% of both groups reporting 'good' skills (Table 1). The secondary outcome of frequency of POCUS use improved 6 weeks post-training in both groups. At 12 weeks post-training, frequency of use remained 'sometimes' or 'frequent' in 60% of the AI group, but declined to 20% in the non-AI group.

### Conclusion

In this study of a POCUS curriculum, perception of image acquisition skill and frequency of POCUS use improved equally in learners regardless of use of AI for independent exam practice. These findings suggest that participation in a curriculum is sufficient to increase confidence and utilization of POCUS, highlighting the benefit of a simple POCUS curriculum for obstetric anesthesiologists. Yet frequency of POCUS use was not sustained in the non-AI group at the 12-week time point. AI-training may improve long-term frequency of POCUS use. Future studies should examine continuing POCUS education for providers and quantifying if and how POCUS use leads to improvements in care.

[Use of AI in Cardiac POCUS\\_Feldman.pdf](#)

### Gastric emptying of water versus carbohydrate drink in early labor with epidural analgesia – A Randomized Controlled Trial

Presenting Author: Mohammed Idris, MD

Presenting Author's Institution: Beth Israel Deaconess Medical Center - Boston, Massachusetts

**Background:** Pulmonary aspiration remains a feared complication of obstetric anesthesia and gastric content volume is one of the main factors in pathophysiology of aspiration. Women in labor are allowed to drink small amount of clear liquids. We have limited precise information about gastric emptying time in women in active labor who have received labor epidural. By better defining this time, we may be able to provide evidence-based recommendations on consumption in early labor.

**Methods:** Women in early labor (cervical dilatation less than 6 cm) who received epidural analgesia and met the inclusion criteria were randomized to drink either 100 ml of water or carbohydrate drink. Study exclusion consisted of ASA >3, preeclampsia, receiving magnesium, diabetes, multiple gestation or having received intravenous narcotics within the last 12 hours. Ultrasound measurements of cross-sectional area (CSA) of the gastric antrum were performed in supine position with 30° head elevation and right lateral position, immediately after 100 ml intake of water or carbohydrate drink (Figure A) and repeated every 20 min for 60 min. Patients were also asked to rate their hunger on a visual analogue scale every 20 min for 120 min. Data collection ended if the patient progressed to more than 6 cm cervical dilation.

**Results:** 22 patients completed the study (12 Water; 10 Carb), with no difference between groups in age, BMI, gestational age and time since last ingestion. Two patients in water group progressed in labor rapidly and could not be examined after 20min; one in the Carb group had suboptimal images after 20min. The CSA increased by  $7.9 \pm 3.2 \text{ cm}^2$  after ingestion. Both CSA curves were similar over time ( $p=0.60$ ; Figure B). The calculated half-life in the two groups were similar: Water  $18.7 \pm 4.2 \text{ min}$  v. Carb  $15.3 \pm 5.4 \text{ min}$ ,  $p=0.62$ . Gastric volumes returned to within 20% of baseline at 40 minutes, and below an estimated 1.5ml/kg. We found an increase in patient reported hunger scores over time ( $P < 0.001$ ) with no difference between water and sports drink ( $P=0.91$ ; Figure C). Three patients had an increase in CSA after their 20 min measure.

**Conclusion:** Gastric emptying for clear liquids remains rapid in women who have received epidural analgesia. Ingestion of 100 ml water or carbohydrate drink will be cleared by 40 min in both groups. There was no difference between water and carbohydrate drink in emptying times, residual volume and hunger scores.

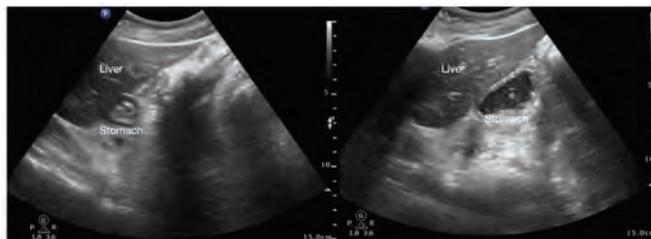


Figure A: Gastric US before and after 100 ml of Carbohydrate Drink

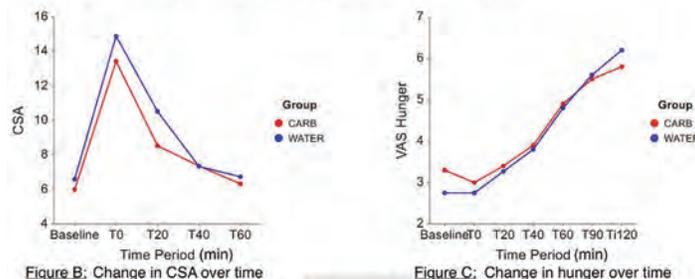


Figure B: Change in CSA over time

Figure C: Change in hunger over time

Abstract #: TH-RPS1 – Room 3 – POCUS – 05

## Translating the probe: education of residents in lung ultrasound

Presenting Author: Alice Sherman-Brown, MD

Presenting Author's Institution: UC Irvine Medical Center

### Introduction:

Pulmonary edema in the obstetric patient can be a sequela from many etiologies, including preeclampsia and massive transfusion, and requires prompt recognition and coordination of the entire obstetric and anesthesiology teams. Ultrasound is a validated tool to diagnose pulmonary edema, even in the hands of a novice sonographer (1,2,3). While both anesthesiologists and obstetricians are well suited to utilize point of care lung ultrasound given their familiarity with ultrasound, many residents have no formal lung ultrasound training. We present the results of a training session aimed at translating the ultrasound experience of OBGYN residents to lung ultrasound.

### Methods:

A one hour training session which included a didactic presentation followed by a hands on simulation session using handheld ultrasound probes, focusing on the identification of B-lines. Residents prior experience in ultrasound training was surveyed, in addition to knowledge and image recognition. An Exact McNemar's test was used to compare participants' pre and post results on knowledge based and imaging questions.

### Results:

Thirteen residents, ranging from PGY1-3 years, participated and completed both pre and posttests. Most (61%) residents had no prior training in non-obstetric ultrasound. The 3 residents (23% of total study group) that identified as having more than 20 hours of ultrasound training attended the same medical school. Improvement was noted across both knowledge-based questions and image recognition of B-Lines, with a mean improvement posttest of 28%. Residents tended to score higher on knowledge-based questions. However, improvement was more notable and significant for knowledge-based questions and overall comfort with lung ultrasonography than in the image based questions.

### Conclusion/Implications:

A brief training resulted in a clear benefit for residents in performing limited lung exam for B-lines. This may allow for earlier recognition and treatment of pulmonary edema, especially mobilizing delivery teams in the setting of antepartum preeclampsia. Limitations include small sample size, however, results are encouraging and call for a larger sample size and additional training.

**POINT-OF-CARE ULTRASONOGRAPHY (POCUS) IN OBSTETRIC ANESTHESIA FELLOWSHIP TRAINING: A SURVEY OF NORTH AMERICAN PROGRAMS**

**Presenting Author:** Juliana A. Barrera Ramirez, MD, MSc

**Presenting Author's Institution:** Department of Anesthesia & Perioperative Medicine. Western University - London, Ontario

Numerous reviews have highlighted the diagnostic and therapeutic impact of utilizing Point-of-Care Ultrasound (POCUS) in anesthesia, as shown by its use in transthoracic echocardiography, lung ultrasound, volume and gastric content assessment [1]. More recently, the use of POCUS in the management of obstetrical patients has become of major interest [2] and educational resources have been put forward by the Society for Obstetric Anesthesia and Perinatology (SOAP). However, it remains unclear what is the current state of POCUS education in obstetrical anesthesia fellowships in North America. The aim of this survey was to explore the prevalence, characteristics, and potential barriers of POCUS education in these programs.

**Methods:** A 12-question web-based survey was sent to 42 fellowship program directors from June to August 2021. Contact information was obtained from the official listing of fellowship programs on the SOAP website. Answers were collected anonymously through the Qualtrics online survey platform.

**Results:** 21(50%) fellowship program directors responded to this survey, of which 18 (86%) were programs located in the United States and 3 (14%) in Canada. 95% of programs currently use POCUS in their clinical work. The main modality identified for delivery of POCUS education was informal teaching (33%), followed by formal longitudinal programs (29%). Most of the training occurred through bedside teaching (81%), and with the use of online modules/lectures (52%). POCUS was primarily applied in vascular access (91%) and neuraxial blocks (81%). Program directors perceived that obstetrical anesthesia fellow's competency in POCUS was extremely important (60%) or very important (20%). Out of the participating programs, 70% had dedicated staff as POCUS educators while 30% did not. The main barriers identified were the number of trained faculty (18/21) and available time during clinical care (13/21).

**Discussion:** This survey shows that utilization of POCUS in obstetrical anesthesia is prevalent across North American programs. However, current obstetrical anesthesia POCUS education remains heterogenous across programs with varying modalities from informal teaching to structured mandatory electives. Barriers such as number of trained staff, time, and equipment were identified, and may be responsible for the lack of consistency between fellowship programs.

Abstract #: TH-RPS1 – Room 3 – POCUS – 07

## Gastric Ultrasound in Parturients Presenting for Scheduled Cesarean Delivery

**Presenting Author:** Michael S. Balot, DO

**Presenting Author's Institution:** Mount Sinai West & Morningside - New York, New York

**Co-Authors:** Ghislaine C. Echevarria, M.D. M.S. - Mount Sinai West & Morningside

Thomas R. Gruffi, M.D. - Mount Sinai West & Morningside

Mickael Khouzami, MD - Mount Sinai Hospital Icahn School of Medicine

Bryan Mahoney, M.D. - Mount Sinai West & Morningside

**Introduction:** Pregnant patients have an increased risk of aspiration, largely due to progesterone induced slowing of gastric motility and the compressive effects of the uterus causing incompetency of the gastroesophageal sphincter. Term parturients are considered to be full stomach, which has led to the routine practice of administering a liquid antacid to prophylactically prevent aspiration pneumonitis. However, the use of oral antacids can lead to adverse side effects, which include nausea, emesis, abdominal pain, and diarrhea. Gastric point-of-care ultrasound (G-PoCUS) is a useful technique to assess gastric volume in pregnant patients presenting for surgery (1,2). We are presenting the G-PoCUS quantitative data of all scheduled cesarean deliveries performed during January-2022.

**Methods:** This study was exempt from the Icahn School of Medicine at Mount Sinai IRB approval. All G-PoCUS data of patients scheduled for an elective cesarean section who had followed standard ASA NPO guidelines were reviewed (n=21). Measurements of the gastric antral cross-sectional area (CSA) were performed using a low frequency curved-array transducer in the semi-recumbent and right lateral semi-recumbent (RLSR) position. Two models were used to calculate the gastric volume (3,4).

**Results:** Table 1 shows basic demographic and obstetric data. Using a cutoff of 9.6 cm<sup>2</sup> for antrum CSA measured in the RLSR position described by Arzola et al (3), 1 patient (4.8%) was considered to have an increased gastric fluid volume. Based on the Roukhomovsky et al model (4), 15 (71.4%) and 3 (14.3%) patients had a quantitative gastric volume of < 0.8 ("empty" or low volume stomach) and ≥1.5 mL/kg (increased gastric fluid volume), respectively.

**Discussion:** In our experience, G-PoCUS is a useful and feasible tool to assess the risk of aspiration in this population. Data suggest that gastric volumes up to 1.5 mL/kg are considered normal in fasted patients (5). Moreover, in pregnant patients in their third trimester, a value above 9.6 cm<sup>2</sup> for the antral CSA in the RLSR position correlates with ingested volumes greater than 1.5 mL/kg with a sensitivity of 80% and specificity of 66.7% (3). In our experience, many of our patients endorse side effects with the administration of sodium citrate/citric acid and state that it had a negative impact on their delivery experience. These findings lead us to question whether universal administration is necessary.

[Balot 'Gastric Ultrasound in Parturients Presenting.pdf](#)

**Antenatal Anesthesia Consultation for Spinal Fusion: Please Bring Your Smartphone!**

**Presenting Author:** Ghislaine C. Echevarria, M.D. M.S.

**Presenting Author's Institution:** Mount Sinai West & Morningside - New York, New York

**Co-Authors:** Michael S. Balot, DO - Mount Sinai West & Morningside

Thomas Gruffi, MD - Mount Sinai West and Morningside

Mickael Khouzami, MD - Mount Sinai Hospital Icahn School of Medicine

**Introduction:** Scoliosis is a relatively common condition within the general population. Females are affected twice as often as males and with a higher degree of severity. Many women will undergo corrective spinal surgery at some point in their life. Parturients with corrected scoliosis have greater rates of inadequate or failed anesthesia/analgesia.[1, 2] Hardware, bone grafts and the scar tissue can make access to the epidural space extremely difficult. Even if the epidural space is successfully entered, the spread of local anesthesia may be disrupted ultimately leading to a patchy or unilateral block. It is therefore crucial for an obstetric anesthesiologist to understand the potential implications that corrective spinal surgery can have when it comes to neuraxial analgesia/anesthesia. Lumbar ultrasound has become a promising tool to assist with neuraxial techniques in this population.[3] We present a method of consultation for antenatal patients who have had prior spine surgery.

**Methods:** An anesthesiologist who is proficient in lumbar ultrasound performed all antenatal anesthesia evaluations. After a thorough history and physical examination, we used ultrasound to scan the patient's lumbar spine to identify the extension of the hardware and potential space(s) where neuraxial anesthesia could be performed. Then, a pen was used to mark the patients back at those exact level(s). An identifiable surgical scar or beauty mark on the patient's back that was close to this area was used as a landmark and its distance to the ideal interspace(s) measured with a ruler. With permission from the patient, we used their smartphone and took clear pictures of both the ultrasound image showing the depth to the epidural space and the markings on their back (Figure 1).

**Discussion:** In our experience, when patients who have had prior spine surgery present in active labor and request neuraxial anesthesia, the procedure can be extremely difficult and time consuming. When they present in active labor, by having the images stored in their phone, the information can be easily accessed and used by the anesthesia team, independently of the proficiency in the use of lumbar ultrasound. Despite the risk of neuraxial block failure due to scar tissue and/or adhesions, we hope this process will increase the rate of successful neuraxial placement, and improve patients' overall birthing experience.

[LumbarUS\\_SOAP.pdf](#)

Abstract #: TH-RPS1 – Room 3 – POCUS – 09

### Strain Echocardiography During Active Labor Pilot Study

**Presenting Author:** Pirianthini Suntharalingam, MD

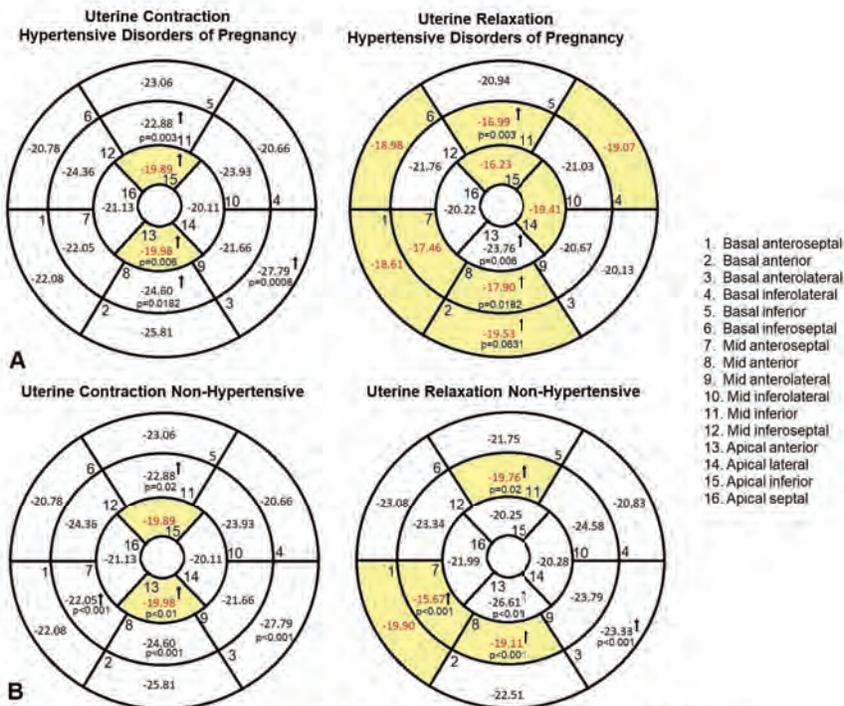
**Presenting Author's Institution:** Dartmouth-Hitchcock Medical Center - Lebanon, New Hampshire

**Introduction:** The physiologic stress of labor may be useful in detecting subclinical cardiovascular disease (CVD). Parturients with hypertensive disorders of pregnancy have a relative risk of 1.45 [1.17-1.80] of developing cardiovascular disorders later in life. [1] Strain abnormality predicts development of major adverse cardiac events and mortality in heart failure with normal ejection fraction. [2] Strain analysis may predict development of superimposed preeclampsia in the setting of chronic hypertension in pregnancy. [3] Strain analysis intrapartum during active labor may enhance detection of abnormal strain due to the physiologic stress of labor.

**Methods:** A modified transthoracic echocardiography protocol was developed for intrapartum monitoring of cardiac function during the physiologic stress of active labor. A total of 50 healthy term parturients ( $\geq 37$  weeks gestational age) in active labor ( $\geq 6$  cm cervical dilation) were consented and enrolled in this pilot study. Speckle tracking echocardiography was acquired for four-, three- and two-chamber views during uterine contraction and relaxation using an S5-1 Philips Sparq probe (Philips, Andover, Massachusetts, USA) and analyzed using QLAB 9 strain analysis software (Philips, Andover, Massachusetts, USA). The cutoff for abnormal strain was  $> -20\%$ .

**Results:** Of the 50 pilot patients, 14 patients had a hypertensive disorder of pregnancy (HDP) (pre-eclampsia, gestational or chronic hypertension). In patients with HDP, strain abnormalities were visualized in eight segments during uterine contraction and nine segments during uterine relaxation. (See Figure 1A) In patients with no HDP, strain abnormalities were visualized in two segments during uterine contraction and four segments during uterine relaxation. (Figure 1B) Strain values normalized (became more negative) during uterine contraction and were more frequently abnormal during uterine relaxation.

**Conclusions:** This pilot data represents the first analysis of echocardiographic strain during active labor. Abnormal strain values were detected at a higher rate in HDP than in patients without HDP. Strain values partially normalized in both groups during uterine contractions which may reflect increased preload from autotransfusion or endogenous catecholamine release. Strain abnormalities occur in echocardiography performed during active labor and are more pronounced in HDP. Future investigation will aim to determine whether strain abnormalities are predictive of developing cardiovascular disease postpartum or major adverse cardiac event.



**Figure 1.** Speckle tracking segmental strain analysis during uterine contraction (left) and relaxation (right) in patients with hypertensive disorders of pregnancy (A) and those without hypertensive disorders of pregnancy (B). ↑ indicates statistically significant difference between strain values measured during uterine contractions as compared to uterine relaxation.

## Feasibility of focused cardiac ultrasound performed by novices during Cesarean delivery

**Presenting Author:** Maria N. Sheikh, M.D., M.P.H.

**Presenting Author's Institution:** Columbia University Irving Medical Center - New York, New York

**Co-Authors:** M. Waseem Athar, MD, MCAI, DESA - UAMS

Brendan Carvalho, MBBCh, FRCA, MDCH - Stanford University

Nan Guo, PhD - Department of Anesthesiology, Perioperative and Pain Medicine, Stanford University

Clemens M. Ortner, MD, MSc, DESA - Stanford School of Medicine

Cesar Padilla, MD - Stanford University Medical Center

### BACKGROUND:

Anesthesia experts advocate for formal education in maternal critical care, including the use of focused cardiac ultrasound (FCU) in high acuity obstetric units.<sup>1</sup> While benefits and feasibility of FCU performed by experts have been well documented,<sup>2</sup> little evidence exists on the feasibility of FCU acquired by examiners with limited experience. The aim of this study was to assess how often echocardiographic images of sufficient quality to guide clinical decision-making were attained by novices evaluating cardiac function and volume status in term parturients undergoing cesarean delivery (CD).

### METHODS:

This was a prospective study (IRB #48857) at an academic hospital with CD rate of 32%. Healthy (ASA  $\leq 3$ ), term ( $\geq 37$  weeks gestation) women undergoing scheduled, elective CD were recruited. After undergoing standardized training, including an 8-hour online E-learning module<sup>3</sup>, a 1-day hands-on FCU course and 20-30 supervised scans until trainee was assessed competent in image acquisition, 8 novices performed apical 4 chamber (A4CH), parasternal long (PLA) and short axis (PSA) view after spinal anesthesia (SPA) and neonatal delivery (ND). Obtained FCU images were graded 1-5 by two blinded instructors (1=no image to 5=perfect image obtainable;<sup>3</sup> defined as image quality sufficient for clinical decision-making). The association of novice examiner, age, gestational age, BMI, timing (SPA vs. ND) of the image and quality of image ( $\geq 3$  vs  $< 3$ ) was assessed using mixed effects logistic regression with examiner as random effects. Cohen's Kappa was used to assess interrater reliability.

### RESULTS:

Following screening of 90 women, 8 novices performed a median of 5 [3-8] FCUs in 64 women. Images of sufficient quality were obtainable in 95.3% and 89.1% of women after SPA and ND, respectively. FCU image with perfect image quality (grade 5) was obtainable in 14.1% and 10.9% of women after SPA and ND, respectively. A PLA-, PSA-, and A4CH-view with grade  $\geq 3$  was obtained in 83%, 91% and 63.5% of women after SPA and in 78%, 77%, and 45% of women after ND. Left and right ventricular function could be assessed in 97.5% and 77.5% of women after SPA, and in 59% and 67% of women post ND (Table 1). Image grading was associated with novice examiner performing the FCU and was higher before delivery in the PSA- and A4CH-view ( $p < 0.05$ ). No association was found between image grading and parturient age, gestational age or BMI. With agreement in image grading ranging from 60-80%, interrater reliability was substantial.

### CONCLUSIONS:

FCU is highly feasible in the parturient undergoing CD and images of sufficient quality for clinical decision-making were obtained by novices with limited experience in almost all parturients. Image acquisition and quality may be more challenging after delivery and impacted by novice performing the FCU.

[Sheikh Feasibility of Focused Cardiac Ultrasound in CD.pdf](#)

**Focused cardiac ultrasound in parturients with congenital and acquired heart disease: a case series**

**Presenting Author:** Maria N. Sheikh, M.D., M.P.H.

**Presenting Author's Institution:** Columbia University Irving Medical Center - New York, New York

**Co-Authors:** Ruth Landau, M.D. - Columbia University

Daniel Tobes, MD - Columbia University Medical Center

**Background:**

Cardiovascular conditions are the leading cause of pregnancy-related mortality in the US,[1] and adverse cardiac events such as arrhythmias and heart failure occur frequently in parturients with preexisting heart disease. The value of transthoracic echocardiography (TTE) use during cesarean delivery [2] and focused cardiovascular ultrasound (FCU) for analysis of cardiac function and volume status in obstetric patients is increasingly reported,[3, 4] including in preeclampsia,[5] however, little is reported on its use in pregnant people with heart disease.

We present a series of 3 cases with heterogeneous heart disease where peripartum care was guided by FCU. Apical 4-chamber, parasternal long and short-axis views were obtained with handheld ultrasound (Butterfly iQ+) using the cardiac preset. Patient demographics and case details are presented in the Table.

**Case 1: Tetralogy of Fallot**

FCU showed hyperdynamic LV, dilated RV with preserved function, mild TR, severe PR. No pulmonary hypertension was noted, which correlated with PA catheter measurements. As RV function was preserved, use of inotropic agents (milrinone, dobutamine) was deemed unnecessary and norepinephrine was utilized for prevention of post-spinal hypotension. FCU demonstrated stable cardiac function through titration of CSE, fetal delivery, and postpartum.

**Case 2: Idiopathic pulmonary hypertension**

FCU revealed dilated RV, paradoxical septal motion, TR, and elevated pulmonary artery systolic pressure (PASP; estimated 52 mmHg) which correlated with PA catheter measurements. CSE was incrementally titrated along with phenylephrine infusion, with nitric oxide and ECMO available on standby. FCU demonstrated stable RV function through CSE, fetal delivery, and the immediate postpartum period.

**Case 3: Mitral stenosis**

FCU showed rheumatic MV with previously demonstrated severe MS, mild LA enlargement, and normal biventricular function (photo). Tachycardia during ECV and 2<sup>nd</sup> stage of labor was treated with IV beta-blockers. FCU in combination with lung ultrasound revealed mild pulmonary edema postpartum for which she received diuretics.

**Discussion:**

As demonstrated in our cohort, FCU allowed rapid assessment of cardiac function and guided clinical decision-making in the OR and obstetric suite in three different scenarios. Hemodynamic changes during labor and delivery can cause additional stress to the diseased maternal heart and often require pharmacologic or surgical intervention. FCU may become a vital skill for obstetric anesthesiologists to acquire in order to optimize the peripartum management of the growing population of cardio-obstetric patients.

[FCU Table 1 and TTE .pdf](#)

**Abstract #: TH-RPS1 – Room 4 – Morbidity – 01**

**Comparative performance of obstetric comorbidity scores within categories of race and ethnicity: an external validation study**

**Presenting Author:** Joe E. Bryant-Huppert, M.D.

**Presenting Author's Institution:** New York Presbyterian - Weill Cornell Medicine, New York

**Co-Authors:**

**Background:** Existing obstetric comorbidity adjustment scores were created without explicitly accounting for sociodemographic diversity in the development populations, which could lead to imprecise estimates if these scores are applied to populations different from the ones in which they were developed. The objective of this study was to externally validate the obstetric comorbidity index from Bateman et al. and Leonard et al.'s expanded obstetric comorbidity scoring system within categories of race/ethnicity.

**Methods:** We selected delivery hospitalizations from the State Inpatient Databases for Florida, Maryland, Kentucky, Washington (2015-2018) and New York (2015-2016). Outcomes were modeled using logistic regression by category of race/ethnicity and overall, with each model having the value of the respective score as the covariate. Discrimination and calibration were assessed.

**Results:** There were 1,604,203 delivery hospitalizations. 1.6% experienced a severe maternal morbidity (SMM); 0.4% of these were SMM excluding cases with blood transfusions only (nontransfusion SMM). 0.5% suffered a maternal end-organ injury or mortality. For the entire patient population, the area under the receiver operating curve (AUROC) for SMM was 0.72 (0.71-0.72) and 0.75 (0.75-0.76) for nontransfusion SMM. The AUROC for maternal end-organ injury or death was 0.65 (0.65-0.66). All scores exhibited poor calibration across categories. There was no substantial variation within categories of race/ethnicity in terms of score performance.

**Conclusion:** Users of these scores should consider performance data in totality when choosing a parsimonious measure for obstetric comorbidity adjustment. Notably, there were no marked differences in model performance observed across categories of race/ethnicity within each score.

**Abstract #: TH-RPS1 – Room 4 – Morbidity – 02**

## **Retrospective Data Analysis for Pulmonary Hypertension in Pregnancy in a County Hospital System**

**Presenting Author:** William Jones, MD

**Presenting Author's Institution:** Baylor College of Medicine - Houston, Texas

**Co-Authors:** Marie-Louise Meng, MD - Department of Anesthesiology, Duke University, Durham, NC

Sonal N. Zambare, MD - Baylor College of Medicine

### **Introduction:**

Pulmonary hypertension (PH) during pregnancy has a reported maternal mortality of 26-51%<sup>1,2</sup> with incidence of major adverse cardiovascular event (MACE) reported as 24.8%.<sup>3</sup> Recommendations regarding management of PH during pregnancy, mode of delivery (MOD), and options for anesthesia lack standardization. The aim of this study was to analyze MOD, anesthetic management trends and outcomes for obstetric patients with PH at our hospital. We hypothesized that mortality and risk of PH crises and heart failure are equivalent regardless of MOD.

### **Methods:**

After IRB approval, we retrospectively analyzed records from 2005 to 2021 in our county hospital system. Inclusion criteria were ICD 9 or 10 codes for pregnancy and PH. Data collected included type of PH, treatment during pregnancy, right heart function, MOD, type of anesthesia for cesarean, details of labor analgesia, gestational age at delivery and fetal outcomes at birth. The primary outcome analyzed was maternal and neonatal mortality in the immediate postpartum period. Secondary outcomes were PH crises and heart failure within 6 weeks postpartum.

### **Results:**

There were 13 patients with 14 discrete pregnancies within the study period. 12 neonates were delivered and 2 pregnancies were electively terminated. The average age was 30.7 years with average BMI 34. Average gestational age at delivery was 35.5 weeks. Mild PH was present in 65% and severe PH in 35% of pregnancies. Right heart dysfunction was present in 29% of pregnancies. All 8 vaginal deliveries had epidural for analgesia, 3 cesareans had successful epidurals and one needed conversion to general for hemorrhage. There were 4 cesarean deliveries: 3 for obstetric indications, 1 for ease of care coordination. There were no mortalities within 6 weeks post-partum. No patients developed PH crisis or heart failure. 7 patients were lost to follow up, but no worsening of PH was noted in patients that had follow-up 6 weeks post-partum.

### **Discussion:**

The goal of this retrospective study was to identify trends and outcomes of pregnancies in obstetric patients with PH in a hospital system with Level IV Maternal Care. There were no maternal mortalities, PH crisis nor heart failure events within 6 weeks post-delivery or termination. This cohort demonstrates that vaginal delivery is safe in women with PH and the historical recommendation of delivery via cesarean solely for the indication of PH may no longer be necessary. Our study is limited by the small sample size of this rare disease. Larger registries of PH and pregnancy are necessary to provide recommendations regarding mode of delivery and optimal anesthetic and PH management of pregnant patients. Our study highlights that with the resources available at a Maternal Level IV care center, pregnant women with PH can be managed to successful and safe delivery.

[PH data final.pdf](#)

Abstract #: TH-RPS1 – Room 4 – Morbidity - 03

## Venovenous Extracorporeal Membrane Oxygenation Treatment Parameter Differences in Obstetric Patients

**Presenting Author:** Brianna Hildreth

**Presenting Author's Institution:** Department of Anesthesiology & Perioperative Medicine, University of Pittsburgh School of Medicine

**Intro:** As maternal mortality rates continue to rise due to increasing medical complexity, cardiac disease, and advanced maternal age, there is an increasing demand for advanced medical therapies such as extracorporeal membrane oxygenation (ECMO). Pregnant and postpartum women experience physiologic changes that lead to expected differences in ECMO treatment parameters, but few studies have identified key ECMO parameter adjustments for obstetric patients. We described differences in ECMO parameters between obstetric patients and non-pregnant matched controls.

**Methods:** This pre-pandemic retrospective case control study compared all pregnant and postpartum patients requiring venovenous (V-V) ECMO at a single institution between 2013-2020, with non-pregnant controls matched by age, body surface area, sex, and ECMO indication in a 1:1 ratio. Hourly vital signs, blood gas values, and ECMO variables for the first 72 hours after initiating ECMO were recorded. Descriptive statistics described indications for ECMO, survival rates, and timing of ECMO initiation. Means were summarized over 12-hour intervals and plotted for trends, and variability was accounted in the form of standard errors. Plots displayed means and the region within 2 standard errors of the mean for each ECMO variable, comparing differences between cases and controls while accounting for parameter variability in the form of standard errors. The frequency of abnormal events in ECMO parameters were reported for each group. Analyses were performed with SAS version 9.3 (SAS Institute, Cary, NC).

**Results:** A total of 10 records (5 cases and 5 controls) were identified; all 5 (100%) obstetric patients and 2 (40%) non-obstetric patients survived to hospital discharge. Indications for V-V ECMO in the cohort were viral pneumonia (4 of 10, 40%), aspiration pneumonia (3, 30%), status asthmaticus (1, 10%), and other acute respiratory illness (2, 20%). All pregnant cases had ECMO initiated on postpartum days  $2.2 \pm 2.7$ , with most initiated in the context of cesarean delivery (4 of 5, 80%). ECMO variables blood flow per kilogram per minute (BFPERKG) and carbon dioxide removal (sweep), were most notably different in pregnant vs. nonpregnant controls across the total treatment time (Figure 1). Pregnant cases had more frequent abnormal instances of ECMO variables than controls for low pH (case 64.6% vs. control 38.6%), respiratory rate (9.7% vs. 2.2%), and low PaO<sub>2</sub> (case 63.3% vs. control 33%). Control cases had more frequent abnormal instances for heart rate (case 10% vs control 66.7%), oxygen saturation SpO<sub>2</sub> (6.7% vs. 25.9%), high mean arterial pressure MAP (2.6% vs. 18.4%), high PaCO<sub>2</sub> (10.1 vs. 95.5%).

**Conclusions:** Obstetric patients requiring V-V ECMO initiation receive treatment initiated in the postpartum period and are likely to survive to hospital discharge. ECMO sweep and BFPERKG parameters and resultant PaCO<sub>2</sub> changes are notably different in obstetric patients compared to non-obstetric patients.

[Figure.pdf](#)

**Abstract #: TH-RPS1 – Room 4 – Morbidity – 04**

### **Hospital Readmissions after Postpartum Emergency Department Visit**

**Presenting Author:** Alexander J. Butwick, MBBS, FRCA, MS

**Presenting Author's Institution:** Stanford University - Stanford, California

**Co-Authors:** Suzan Carmichael, PhD - Stanford University School of Medicine

Ronald Gibbs, MD - Stanford University School of Medicine

Anna Girsén, MD, PhD - Stanford University School of Medicine

Stephanie Leonard, PhD - Stanford University School of Medicine

**Objective:** Up to 12% of pregnant patients have an emergency department (ED) visit within 6 weeks postpartum. However, little is known about the relationship between postpartum 'treat-and-discharge' ED visits and subsequent hospital readmission. Given that preventing hospital readmissions is central to postpartum quality improvement, we sought to examine the incidence of and factors associated with hospital readmission after a 'treat-and-discharge' postpartum ED visit.

**Study Design:** We analyzed linked data from vital records, hospital discharge, and emergency department visits for people who gave birth in California from 2007 to 2012. We included patients with ED visits at < 60 days after discharge from birth hospitalization. Our primary outcome was hospital readmission  $\geq 1$  day after ED visit. We examined the incidence, the most frequent diagnoses codes and risk factors for readmission after ED visit.

**Results:** Among 160,980 patients with a postpartum ED visit, 7,522 were readmitted after discharge to home (4.7%) with a median time period between postpartum ED visit and readmission being 8 (IQR:23) days (Figure). Among patients with readmission after ED visit, the most frequent primary diagnoses for the ED visit were delivery-related complications (24.4%), ill-defined (19.0%) and gastrointestinal (18.7%), whereas the most frequent primary diagnoses for the readmission were gastrointestinal (34.4%), delivery-related complications (26.0%) and infectious (8.7%). After adjustments, the strongest risk factors for readmission after ED visit were prepregnancy obesity (aOR=2.53, 95%CI: 2.13-3.01 for obesity class 3 versus underweight), coagulation disorder (aOR=1.60, 95%CI:1.08-2.38), and severe maternal morbidity during birth hospitalization (aOR=1.52, 95%CI: 1.26-1.51)(Table).

**Conclusions:** Approximately 5% of 'treat and discharge' postpartum ED visits were followed by hospital readmission. Understanding how emergency departments manage medical- and delivery-related complications in postpartum patients and developing quality improvement strategies for ED care may be needed to reduce postpartum readmissions.

Table. Comparisons of sociodemographic and conditions at birth hospitalization as risk factors for postpartum hospital readmission after an emergency department (ED) visit versus no hospital readmission after an ED visit.

	No hospital readmission after postpartum ED visit N=153,458	Hospital readmission after postpartum ED visit N=7,522	Adjusted Odds Ratio (95% CI) for hospital readmission after postpartum ED visit*
<b>Sociodemographic:</b>	N (Column %)	N (Column %)	
Maternal age – mean (SD)	26.6 (6.4)	26.2 (6.4)	0.99 (0.99, 1.00)
Prepregnancy BMI (kg/m <sup>2</sup> ):			
Underweight	5,772 (3.8)	178 (2.4)	0.74 (0.63-0.86)
Normal	64,710 (42.2)	2,634 (35.0)	Ref
Overweight	39,458 (25.7)	1,939 (25.8)	1.22 (1.15-1.30)
Obese 1	23,186 (15.1)	1,364 (18.1)	1.47 (1.37-1.58)
Obese 2	11,752 (7.7)	772 (10.3)	1.63 (1.50-1.78)
Obese 3	8,580 (5.6)	635 (8.4)	1.86 (1.69-2.04)
Race/ethnicity:			
US-born Hispanic	51,940 (33.9)	3,001 (39.9)	1.17 (1.10-1.25)
Foreign-born Hispanic	26,545 (17.3)	1,233 (16.3)	1.03 (0.95-1.12)
Non-Hispanic White	41,998 (27.4)	1,955 (26.0)	Ref
Asian/Pacific Islander	10,657 (6.9)	393 (5.2)	0.89 (0.79-0.99)
Black	14,255 (9.3)	616 (8.2)	0.87 (0.79-0.96)
Other	8,063 (5.3)	334 (4.4)	0.87 (0.77-0.98)
Insurance for prenatal care:			
Medicaid/Government	91,888 (59.9)	4,609 (61.3)	Ref
Commercial	57,395 (37.4)	2,714 (36.1)	1.04 (0.98-1.10)
Self-pay or other	4,175 (2.7)	199 (2.7)	1.02 (0.88-1.18)
Maternal education:			
Less than high school	38,036 (24.8)	1,887 (25.1)	Ref
High school	49,477 (32.2)	2,562 (34.1)	1.04 (0.98-1.11)
Some college/associate degree	42,189 (27.5)	2,083 (27.7)	1.01 (0.94-1.08)
Bachelor's or higher	23,756 (15.5)	990 (13.2)	0.97 (0.88-1.07)
Nulliparous	66,108 (43.1)	3,571 (47.5)	1.21 (1.15-1.28)
<b>Conditions during birth hospitalization:</b>			
Diabetes (preexisting or gestational)	14,881 (9.7)	825 (11.0)	1.03 (0.95-1.11)
Hypertensive disorder	10,822 (7.1)	633 (8.4)	0.95 (0.87-1.03)
Infection	4,160 (2.7)	196 (2.6)	1.01 (0.92-1.10)
Coagulation disorder	244 (0.2)	24 (0.3)	1.60 (1.08-2.38)
Major mental health condition	8,814 (5.7)	584 (7.8)	1.38 (1.26-1.51)
Thyroid disorder	3,230 (2.1)	153 (2.0)	0.91 (0.77-1.08)
Severe maternal morbidity (SMM)	3,457 (2.3)	283 (3.8)	1.52 (1.33-1.73)
Postpartum hemorrhage	4,817 (3.1)	294 (3.9)	1.08 (0.95-1.23)
Perineal trauma	5,418 (3.5)	262 (3.5)	0.99 (0.87-1.13)
Cesarean delivery	64,232 (41.9)	3,267 (43.4)	1.00 (0.94-1.05)
Prolonged length of stay**	34,367 (22.4)	2,029 (27.0)	1.16 (1.10-1.23)
Preterm birth:			
≥37 weeks	137,332 (89.5)	6,490 (86.3)	Ref
<34 weeks	5,037 (3.3)	342 (4.6)	1.33 (1.18-1.50)
34-36 weeks	11,089 (7.2)	690 (9.2)	1.29 (1.18-1.40)

\*Multivariable mixed effects logistic regression model adjusted for all the variables in the table (maternal age, BMI, race/ethnicity, insurance, education, parity, diabetes, hypertensive disorder, infection, coagulation disorder, major mental health condition, thyroid disorder, SMM, postpartum hemorrhage, perineal trauma, cesarean delivery, prolonged length of stay and preterm birth) \*\*Defined as 3 or more days for vaginal delivery and 5 or more days for cesarean delivery.

**Abstract #: TH-RPS1 – Room 4 – Morbidity - 05**

**Quality standards in obstetric anesthesia - adherence to key indicators for quality improvement in obstetric units in the United Kingdom**

**Presenting Author:** James O'Carroll, MBBS FRCA

**Presenting Author's Institution:** Stanford University

**Co-Authors:** Brendan Carvalho, MBChB, FRCA, MDCH - Stanford University

Pervez Sultan, MBChB, FRCA, MD (Res) - Stanford University

Eleanor Warwick, MBBS FRCA - University College Hospital, London, UK

Liana Zucco, MBBS FRCA - St George's Hospital, London, UK

**Background**

A core set of key performance indicators (KPIs), relevant to obstetric anesthesia, have been outlined by the Obstetric Anaesthetists' Association and National Perinatal Epidemiology Unit, to monitor the quality of care provision and facilitate national benchmarking of obstetric units across the United Kingdom (UK).<sup>1</sup> The level of adherence to these measures across UK institutions is currently unknown.

**Methods**

The 'Quality of Recovery in Obstetric Anaesthesia' (ObsQoR) study aimed to investigate postpartum recovery in a multi-center setting across England, Wales, Scotland and Northern Ireland. An institutional survey was included to ascertain aspects of organizational structure, service provision and standards of care associated with improved quality of postpartum recovery. Questions relating to KPIs relevant to obstetric anesthesia, patient safety, experience and outcome were included. The survey was distributed to each of the 107 participating centers and completed with input from obstetricians and anesthesiologists in October 2021.

**Results**

Survey results were received from a total of 106 sites (106/107; response rate 99%) representing 56% of the 194 obstetric units in the UK. The median [range] annual number of deliveries in the included institutions was 4389 [1000 to 8200]. Key performance indicators are summarized in Table 1. Survey responses indicated that documentation of post dural puncture headache rates (PDPH) in the previous year occurs routinely in 52 of 106 (49%) centers (median PDPH rate 1.00% IQR [0.7-1.3%]), whereas the documentation of the rate of adequate pain relief achieved within 45 minutes of labor epidural placement, was reported by only 14 (13.5%) centers (median rate among these centers was 91.5% IQR [86-90%]). Ninety centres (84.9%) reported having a dedicated anesthetic antenatal clinic, of which 89 (98.9%) reported having local guidelines for patient referral.

**Conclusion**

This survey provides insight into current practices in quality, safety and care provision across a large number of UK obstetric centers. It identifies considerable variability in KPIs centered on the measurement and recording of PDPH and timely provision of adequate labor epidural analgesia. These results suggest scope to increase the routine use of performance measures in obstetric anesthesia. Future studies are needed to evaluate the relationship between benchmarking of KPIs, quality of postpartum recovery and patient outcomes.

	<b>Key performance indicator<sup>1</sup></b>	<b>Yes n (%)</b>	<b>No n (%)</b>
<b>Institutional reporting and guideline availability</b>	Does the center record the incidence of post-dural puncture headache (PDPH)?	80 (75.5)	25 (23.6)
	Does the center record the percentage of epidurals for labor analgesia that provide adequate pain relief within 45 minutes of placement?	14 (13.5)	90 (86.5) 2 missing
	Does the center have guidelines available for the antenatal referral of patients to see an anesthesiologist?	89 (98.9)	1 (1.1)
<b>Staffing and infrastructure</b>	Are elective cesarean delivery cases covered by a dedicated anesthesiologist who is not expected to also cover emergency cases?	81 (76.4)	25 (23.6)
	Are elective cesarean delivery cases covered by dedicated obstetric and operating room staff who are not expected to cover emergency cases?	83 (78.3)	23 (21.7)
	Is at least one fully equipped and staffed operating room available within the labor & delivery unit?	106 (100)	0 (0)
<b>Hematology testing capability and transfusion service</b>	Is point of care testing for estimating Haemoglobin value available on the labor & delivery unit?	93 (87.7)	13 (12.3)
	Is O negative blood available within 5 minutes of request?	102 (96.2)	4 (3.8)

Table 1. Key performance indicators measured at 106 institutions in the United Kingdom

**Abstract #: TH-RPS1 – Room 4 – Morbidity – 06**

**State-level nurse workforce diversity and severe adverse maternal outcomes during childbirth.**

**Presenting Author:** Jean R. Guglielminotti, MD, PHD

**Presenting Author's Institution:** Department of Anesthesiology, Columbia University Vagelos College of Physicians and Surgeons - New York, New York

**Background:** Racial and ethnic diversification of the healthcare workforce is suggested to reduce the impact of structural racism on racial and ethnic disparities in maternal health (Ref. 1). However, evidence linking a diverse workforce to reduced risk of severe adverse maternal outcomes (SAMO) is lacking. Registered nurses (RNs) are the frontline healthcare providers identifying warning signs of maternal complications, requiring timely evaluation by advanced practitioners and intervention (Ref. 2). We tested the hypothesis that a racially diverse state RN workforce is associated with a decreased risk of SAMO during childbirth.

**Methods:** Data came from the US Natality file 2017. Mothers who gave birth in a hospital in their residence state were included. The outcome was the composite of SAMO, including eclampsia, blood transfusion, hysterectomy, and ICU admission. The exposure was the proportion of minoritized racial and ethnic RNs in each state, abstracted from the American Community Survey (5-yr estimate, 2013-2017). This proportion was categorized into 3 terciles, with the 1<sup>st</sup> tercile corresponding to the lowest diversity and the 3<sup>rd</sup> tercile to the highest diversity. Adjusted odds ratios (aORs) and 95% confidence intervals (CIs) of SAMO associated with the terciles of the proportion of minoritized RNs were estimated using multilevel models adjusting for patient and hospital characteristics in 6 racial and ethnic groups (White, Black, Hispanic, Asian/Pacific Islander, Native American, and More than 1 race).

**Results:** Data from 3,668,813 birth certificates were analyzed. Native American mothers had the highest SAMO incidence (175.2 per 10,000), followed by Black mothers (110.2 per 10,000), mothers of more than 1 race (103.6 per 10,000), White mothers (73.7 per 10,000), Asian/Pacific Islander mothers (73.3 per 10,000), and Hispanic mothers (69.5 per 10,000). The mean proportion of minoritized RNs was 22.1%, ranging from 3.3% in Maine to 68.2% in Hawaii. Compared to states in the 1<sup>st</sup> tercile of the proportion of minoritized RNs, delivering in states in the 3<sup>rd</sup> tercile was associated with a 32% reduced risk of SAMO for White mothers (95% CI: 23, 41), a 20% reduced risk for Black mothers (95% CI: 1, 35), a 31% reduced risk for Hispanic mothers (95% CI: 18, 42) and a 50% reduced risk for Asian and Pacific Islander mothers (95% CI: 35, 62) (Table). The associations of the proportion of minoritized RNs with the risk of SAMO were not statistically significant for Native American and more than one race mothers, mainly because of the small sample sizes in these groups. Results were similar when blood transfusion was excluded from the outcome measure.

**Conclusions:** A diverse RN workforce on the state level is associated with reduced risk of SAMO, underscoring the need for intervention programs aiming to diversify the healthcare workforce in order to tackle disparities in maternal care.

[02 SOAP 2022 WORKFORCE TABLE V2.pdf](#)

Abstract #: TH-RPS1 – Room 4 – Morbidity – 07

## Decision Analysis for Evaluating Antepartum Risk Prediction of Pre-eclampsia: Minimum Test Tradeoff

**Presenting Author:** Mellany A. Stanislaus, MD

**Presenting Author's Institution:** The Johns Hopkins Hospital - Baltimore, Maryland

**Co-Authors:** Kathryn M. Davis, MD - The Johns Hopkins Hospital

Karen S. Lindeman, MD - The Johns Hopkins Hospital

Pre-eclampsia (PEC) is associated with 16% of US maternal deaths. As anesthesiologists become more involved in prenatal care, there is value in PEC screening to help guide obstetric management. Several studies have evaluated biomarkers and clinical factors using receiver-operating characteristic curve analysis and area under the curve (AUC). A recent study (1) compared a model that included clinical factors plus the biochemical marker, Inhibin-A, with a model adding the biophysical parameter of uterine artery pulsatility index (UtA PI) to the first model. Results showed an improvement (higher AUC) with the latter, but failed to consider costs of data acquisition.

We used decision analysis to compare two models predicting the risk of late-onset (>34 weeks gestation) pre-eclampsia (LO PE) in early (12-14 weeks) pregnancy (1). Baker (2,3) developed a useful decision-analytic metric, the test tradeoff, and a simple approximation of its minimum value. For a given ratio of the benefit of a true positive (TP) to the cost of a false positive, the test tradeoff is the minimum number of data collections per TP to yield a positive net benefit. We used Baker's formula applied to model comparisons to compute an approximate minimum test tradeoff (over benefit-cost ratios) for an added predictor, MTT. Formula inputs included published AUCs (1) that used models incorporating clinical background factors plus measurements of inhibin A with (AUC 0.824) or without (AUC 0.815) the addition of UtA PI. The formula also includes the probability of developing LO PE disease. We compared MTT for the general US population (5% prevalence) with the MTT for a high-risk group of subjects with a history of PE (40% prevalence). We obtained cost data from CPT codes used at our institution. For UtA PI, we assumed that patients already undergo screening doppler studies in the first trimester i.e. the additional cost of UtA PI would not include the doppler cost.

For the low-risk, general US population, MTT = 1250, meaning a positive net benefit would require trading 1250 UtA PI measurements for every TP prediction of LO PE. For the high-risk group, MTT = 156. There were no costs to collect clinical background factors; Inhibin-A \$53; UtA PI \$1395.30.

Adding UtA PI to the clinical factors plus Inhibin A risk prediction model requires 1250 additional UtA PI measurements be traded for a TP prediction of LO PE for a positive net benefit. This number is significantly lower (156) in women with PEC in the past. Costs of the data collection are low for the model that incorporates baseline clinical data with Inhibin-A levels. The costs of adding UtA PI are relatively high compared to the anticipated benefit of a TP that prompts intervention. Implications of a TP might include prophylactic aspirin or more frequent monitoring.

[SOAP2022\\_MTTFig.pdf](#)

Abstract #: TH-RPS1 – Room 4 – Morbidity – 08

## Assessing the Adequacy of Our Labor and Delivery Anesthesia Staffing Model

**Presenting Author:** Samantha Abel, MD, MS

**Presenting Author's Institution:** Department of Anesthesiology, Perioperative and Pain Medicine, Brigham & Women's Hospital, Harvard Medical School, Boston, Massachusetts, United States, Massachusetts

**Co-Authors:** Mario I. Lumbreras-Marquez, MBBS, MMSc - Department of Anesthesiology, Perioperative and Pain Medicine, Brigham & Women's Hospital, Harvard Medical School, Boston, Massachusetts, United States

Sharon C. Reale, MD - Department of Anesthesiology, Perioperative and Pain Medicine, Brigham & Women's Hospital, Harvard Medical School, Boston, Massachusetts, United States

Thi Tran, MD - Department of Anesthesiology, Perioperative and Pain Medicine, Brigham & Women's Hospital, Harvard Medical School, Boston, Massachusetts, United States

**Introduction:** Anesthesia staffing models on labor and delivery [L&D] units vary widely depending on delivery volume, floor and nursing capacity, and institutional maternal level of care classification [1]. As a level IV maternal care center requiring 24-hour anesthesia coverage, our staffing model is composed of day and night teams. Our day team comprises 3 obstetric attending obstetric anesthesiologists, 1 clinical fellow, 4-6 residents, CRNAs, and SRNAs. The night team comprises 1 attending obstetric anesthesiologist, 1 clinical fellow and 2 residents. Here we describe the number of anesthetic and obstetric surgical procedures performed per 24-hour period over 6 years to assess whether our current staffing model aligns with procedural needs.

**Methods:** A cross-sectional study was performed to determine the number of anesthetic and obstetric surgical procedures performed on L&D from 2016 to 2021. Anesthetic procedures (epidural, spinal, combined spinal epidural [CSE], general anesthesia, nerve block), and obstetric surgical procedures (cesarean deliveries [CD], dilation and evacuation [D&E], dilation and curettage [D&C], other (external cephalic version, tubal ligation, hysterectomy, salpingectomy) were stratified by 8-hour periods (0700-1500, 1501-2300, 2301-0659) and by day- and night-time shifts (0700-1500, 1501-0659). Descriptive statistical analyses were performed. Trends were analyzed using a nonparametric test across ordered groups.

**Results:** A total of 36,638 anesthetic procedures over a 6 year period were analyzed as seen in the Table. The majority of anesthetic procedures occurred during the night shift (59.1%) compared to the day shift (40.9%). The proportion of epidural placements was approximately even among the 8-hour periods (31.5%, 36.2%, and 32.4%), yet overall the majority were placed during the night shift (68.6%). The majority of spinal (69.6%) and CSEs (52.8%) were performed during the day shift. Concordant with this, most obstetric surgical procedures were performed during the day shift (59.8%) compared to the night shift (40.3%).

**Conclusion:** While there are many educational aspects involved in the anesthetic management of obstetric patients beyond procedural skills, learning neuraxial techniques remains critical for trainees. On our L&D unit, we found that given the nature of scheduled cesarean deliveries, the majority of spinal and obstetric procedural needs occurred during the daytime, while the majority of all epidural neuraxial procedures occurred during the night shift. Despite this, many L&D units, including our own, are staffed to have much higher numbers of attendings and trainees present during the day. Considering alternative staffing models, such as a larger night team, may facilitate trainee exposure to neuraxial procedures while decreasing the risk of understaffing during nighttime hours.

[01.31.2022 Results.pdf](#)

Abstract #: TH-RPS1 – Room 4 – Morbidity – 09

## Factors Associated with Delayed Administration of Gentamicin in Patients with Suspected Chorioamnionitis

Presenting Author: John Hale, MD

Presenting Author's Institution: Brigham and Women's Hospital

**Background:** Chorioamnionitis, also known as intraamniotic infection, is an infection of the placenta and amniotic fluid and can be associated with maternal bacteremia in 10% of patients.<sup>1</sup> Prompt initiation of antibiotic treatment is critical to prevent both maternal and fetal complications.<sup>2</sup> Clinically, maternal fever ( $T \geq 100.4^\circ\text{F}$ ) persisting > 1 hour or fever  $\geq 101^\circ\text{F}$  is present in 95-100% of cases of chorioamnionitis, along with maternal tachycardia (>100 beats per minute) and fetal tachycardia (>160 beats per minute) with or without fundal tenderness. A preliminary quality initiative (QI) evaluating time from fever onset to antibiotic initiation in laboring patients at our quaternary center suggested frequent delays of >1 hour. Here we report time to treatment and specific factors associated with delayed and timely antibiotic administration among patients with a new diagnosis of chorioamnionitis in labor.

**Methods:** This single-center retrospective cohort study was conducted from January through November 2021. All patients with suspected chorioamnionitis for whom gentamicin was administered (a first-line antibiotic at our institution) during the study period were included for analysis. Descriptive analyses were performed to determine the time to administration of the first dose of gentamicin and the proportion of cases with delayed administration of gentamicin (>1 hour). Likewise, factors associated with delayed or timely administration of gentamicin treatment (i.e., patient characteristics, obstetric factors, anesthetic factors, laboratory data, hospital-related factors, and pharmacy data) were evaluated via univariable logistic regression models.

**Results:** A total of 386 patients were identified. The median time from maternal fever to administration of gentamicin was 110 minutes (interquartile range 72, 179). The proportion of patients for whom there was a delay was 82.1% (317/386 patients). Demographic and hospital factors in patients with and without delayed treatment are in the Table. The most predominant factor associated with delayed treatment was central pharmacy compounding doses that were not available in premix bags (odds ratio 4.44, 95% confidence interval 2.56, 7.72).

**Conclusions:** Doses requiring pharmacy preparation were the primary source of delayed antibiotic administration in women with suspected chorioamnionitis in this cohort. In response to these findings, gentamicin dosing will be rounded to facilitate therapeutic dosage with use of premix bags stocked on the labor and delivery unit. Readily available antibiotics such as cefoxitin and piperacillin-tazobactam will also be added as gentamicin alternatives. Follow-up surveillance will verify whether these measures improve time to treatment for suspected chorioamnionitis in labor.

[Table.pdf](#)

**Optimal baseline mean arterial pressure for the management of spinal hypotension in women undergoing elective cesarean delivery: a case-control study analysis**

**Presenting Author:** Brendan Carvalho, MBBCh, FRCA, MDCH

**Presenting Author's Institution:** Stanford University - Stanford, California

**Co-Authors:** William Armero, BA - David Geffen School of Medicine at UCLA, Los Angeles, CA, USA

David Bishop, MBChB, DA, FCA, PhD - Department of Anaesthesiology and Critical Care University of KwaZulu-Natal

Robert Dyer, MD - Department of Anaesthesia, University of Cape Town, Cape Town, South Africa

Vesela Kovacheva, MD PhD - Department of Anesthesiology, Perioperative and Pain Medicine, Brigham and Women's Hospital, Harvard Medical School, Boston, MA, USA

Guohai Zhou, PhD - Brigham and Women's Hospital

**Introduction:** Current guidelines recommend prophylactic vasopressor administration to maintain intraoperative blood pressure above 90% of the baseline value<sup>1</sup>. However, the optimal baseline mean arterial pressure (MAP) reading [(last office visit, morning of surgery, or operating room (pre-spinal))] has not been determined. Selecting the lower MAP at the last office visit or the morning of surgery as a baseline may lead to lower intraoperative MAP and a higher incidence of nausea<sup>2</sup>. We sought to determine the optimal MAP baseline to guide the management of spinal hypotension during cesarean delivery.

**Methods:** We performed a secondary analysis of data collected from normotensive patients presenting for elective cesarean delivery in a tertiary care institution from 10/2018 to 08/2020. From the original cohort, we selected women in whom the presence or absence of nausea and/or vomiting was documented by a research team member. Demographic, clinical, and hemodynamic variables were obtained from the electronic health records. We compared the magnitude of hypotension in patients who reported nausea versus those who did not, using a case-control design. Baselines MAPs at last office visit, morning of surgery, or operating room (pre-spinal) were determined. We calculated the duration and degree of hypotension using the area under the curve (AUC) when the MAP of the respective patient was below 90% of each baseline.

**Results:** Of 1496 patients in the original study, 285 patients had the presence (n=45) or absence (n=240) of nausea and/or vomiting documented. There were no statistically significant between-group differences (nausea versus no nausea) in demographic characteristics or co-morbidities. There was a significant effect of time ( $P < 0.0001$ ) and group ( $P = 0.02$ ) when comparing the 3 baseline MAP values. A comparison of AUC using MAP baseline at the last office visit or the morning of surgery showed a statistically significant between-group difference,  $P = 0.02$ , and  $P = 0.005$  respectively (Table 1). There was no significant between-group difference in AUC when 90% of the MAP baseline in the operating room was used.

**Discussion:** We demonstrated that patients had the highest preoperative MAP in the operating room before the administration of spinal anesthesia. Those who experienced nausea had longer and more profound periods of hypotension. There was no difference in AUC in those experiencing nausea or no nausea when the pre-spinal MAP baseline was used compared to the other baseline MAP targets. Therefore, maintaining higher intraoperative blood pressure based on the individual pre-spinal MAP should be considered to reduce intraoperative maternal nausea and vomiting.

[BPTarget SOAP\\_2022\\_0127Table.pdf](#)

Abstract #: TH-RPS1 – Room 4 – Morbidity – 11

### Impact of nitrous oxide on parturient recall of neuraxial analgesia risks

Presenting Author: Benjamin D. Brakke, D.O.

Presenting Author's Institution: Mayo Clinic - Rochester, Minnesota

**INTRODUCTION:** Nitrous oxide has been utilized for labor analgesia extensively in Europe and is gaining popularity in the United States. Despite high patient satisfaction with its use, up to 40% of women will transition to neuraxial analgesia during labor<sup>1</sup>. Nitrous oxide is known to affect memory and recall<sup>2</sup>. It is unknown whether its use during labor impacts parturients' mental capacity to process new information and ultimately provide consent. The purpose of this study is to determine if the use of nitrous oxide for labor analgesia affects the ability to learn and recall the risks and benefits of neuraxial analgesia.

**METHODS:** In this observational study, nulliparous patients presenting to our labor unit were consented and enrolled. Parturients chose whether to use nitrous oxide or not. Discussion of four risks (headache, infection, nerve damage, and bleeding) occurred at the time of epidural request in both groups. Labor pain score, time from nitrous discontinuation, and cervical dilation were documented at the time of epidural risk discussion. Patients were assessed for free recall and cued recall of epidural risks on postpartum day 1, and free recall assessment at 6 weeks postpartum. The number and proportion of patients who indicated each true risk (free and cued recall) or distractor (cued recall only) was presented according to treatment group and compared using Pearson's Chi-square test.

**RESULTS:** Of the enrolled patients, 224 did not use nitrous and 96 used nitrous oxide. The two groups were similar except women who used nitrous oxide were more likely to be cared for by midwives, have a higher pain score, and have greater cervical dilation when requesting their epidural. There was no difference in recall of the risks of epidural placement between women who received nitrous oxide for labor analgesia versus those who did not (Table 1). Only 2% and 6% in the nitrous and no nitrous groups, respectively, freely recalled all four risks ( $p = 0.12$ ).

**DISCUSSION:** This study suggests that the use of nitrous oxide for labor analgesia does not influence a parturient's ability to understand or recall the risks of epidural placement. Our findings were consistent with prior studies showing overall, a low rate of recall for epidural risks<sup>3</sup>. Patients who receive nitrous oxide for labor analgesia should still be considered eligible to provide consent for subsequent procedures.

[Impact of nitrous oxide on parturient recall of neuraxial analgesia risks\\_TABLE.pdf](#)

Abstract #: TH – RPS1 – Room 5 – Hematologic/Uterotonics/Bleeding - 01

## FACTOR XI DEFICIENCY: A RETROSPECTIVE REVIEW

**Presenting Author:** Michael Balot, MD

**Presenting Author's Institution:** Mount Sinai Hospital Icahn School of Medicine - New York, New York

**Co-Authors:**

### Introduction

Factor XI deficiency is a rare coagulation disorder. The number of patients presenting to L&D with FXI deficiency has significantly increased, mainly due to antenatal screening in our health system. The test has identified a large number of patients, mostly heterozygotes, that have been asymptomatic. As opposed to other types of hemophilia, FXI deficiency is not well characterized and has a variable bleeding phenotype. There is poor correlation between levels and bleeding, this presents a clinical challenge, specially when considering neuraxial anesthesia. There is paucity of literature on FXI deficiency in OB anesthesia and no consensus on the safe level of FXI for a neuraxial block placement. This is a retrospective review of the anesthetic management of 29 patients whom where incidentally diagnosed with FXI deficiency during routine antenatal screening.

### Methods

After IRB approval was obtained, parturient patients who had labored at MSW, and found to be heterozygotes for FXI deficiency, were included in the study. Data collected included FXI levels, history of bleeding, hematologic management prior to pregnancy, type of delivery and anesthesia, prophylactic treatments, lab abnormalities, EBL and any other abnormalities. Pt were grouped based on FXI levels. Severe deficiency was defined as FXI < 15%. Moderate deficiency as FXI 15-14% and mild deficiency as FXI levels of 46-75%.

### Results

Of the total of 29 patient, 23 received neuraxial analgesia, 2 of the patients were classified as having severe deficiency and did not received neuraxial anesthesia. There were 14 patients classified as having moderate deficiency with FXI levels between 14-45%. The remaining 13 patients had mild deficiency with FXI levels between 46-75%. Of the 14 patients with moderate deficiency, 10 received neuraxial anesthesia, and of the 13 patients with mild deficiency all received a neuraxial block; one patient within the mild group experienced a post partum bleeding due to atony. No complications related to anesthetic management were found for patients who received a block.

### Conclusions

Providers are still hesitant to perform neuraxial anesthesia on patients who are heterozygous for the FXI mutation as they fear that there is still an increased risk of causing a spinal cord hematoma. This results showed that there was no complication from neuraxial anesthesia for patients who were classified as having mild-moderate deficiencies. Although more studies are needed for a clear consensus on the proper management of heterozygous carriers, we hope that the results can help guide other anesthesia providers when they questioning performing a neuraxial technique for FXI patients.

**Factor XI Deficient Parturient Management for Neuraxial Anesthesia: Narrative review**

Presenting Author: Kate Balbi, DO

Presenting Author's Institution: Cedars-Sinai Medical Center

Co-Authors:

**Intro/Methods**

Factor XI (FXI) deficiency, aka Hemophilia C, is a rare autosomal recessive bleeding disorder with a variable bleeding phenotype. Heterozygotes (up to 8% in Ashkenazi Jewish) may also be bleeding phenotype. With fetal genetic screening now common, more parturients have diagnosis of FXI deficiency. Unlike Hemophilia A or B, most patients with FXI deficiency do not bleed spontaneously but occurs after tissue trauma, especially tissues with high fibrinolytic activity e.g. dental, reproductive tract. FXI activity levels do NOT correlate with bleeding risk. Unlike other factors, FXI levels do not increase during pregnancy. FXI level in the third trimester and anesthesia consult should occur. Routine hematologic testing does not correlate with FXI bleeding, traditionally. The hematologic and anesthetic management of parturients with heterozygous mutations and intermediate levels of Factor XI activity has not been well defined, especially for neuraxial anesthesia. In neuraxial procedures, like neurosurgery, a small amount of bleeding can have catastrophic complications. Many choose to elevate FXI levels with FFP transfusion before neuraxial or use Tranexamic acid (TXA) or both. We conducted an extensive literature review and present a novel anesthetic management strategy for FXI deficient parturients for neuraxial anesthesia.

**Results**

Literature review revealed family history and bleeding scoring as predictive of bleeding, while FXI was not. Routine coagulation testing (PT, aPTT, FXI activity level, TEG) do NOT correlate with bleeding phenotype, in spite of FXI levels >40% or < 15%. Newer testing modalities correlate with bleeding phenotype and include thrombin generation assay, and perhaps ROTEM subtypes with specific reagents (recalcification instead of tissue factor) or use of platelet rich plasma. Standard treatment for FXI replacement is fresh frozen plasma (FFP) 10-20ml/kg, which carries volume and transfusion risk. FXI concentrate has limited available in Europe, dose 15U/kg. Recombinant Factor VIIa has also been described at low doses 15 mcg/kg for those refusing blood products.(see Table) Prophylactic TXA 10mg/kg for antifibrinolysis reduces risks from milder forms of FXI deficiency. Concurrent administration of both TXA and FXI concentrate or FVIIa increases the risk of thrombosis.

**Conclusion**

FXI deficiency (homozygous or heterozygous) has varying bleeding phenotypes. New testing modalities that correlate with bleeding are described, and a suggested hematologic prophylaxis for neuraxial anesthesia presented. Individualized interdisciplinary care should still employed.

**Table 1: FXI Prophylaxis for Neuraxial Anesthesia**

FXI classification		Prophylactic Treatment			
Genotype	Phenotype	FXI Level (%)	TXA	Factor Replacement*	
Heterozygous	Bleeding	<15%		X	
		16-39%		X	
		40-49%	X		
		>=50%	N/A	N/A	
	Non-bleeding	<15%			X
		16-39%	X		**
		40-49%	X		
		>=50%	N/A		N/A
Homozygous (FXI Level < 15%)	Bleeding	<15%		X	
	Non-bleeding	<15%		X	

\*Factor replacement either: FFP 10-20 ml/kg, FXI concentrate 15U/kg or rFVIIa 15 mcg/kg

\*\*If viscoelastic testing shows coagulation abnormalities, consider factor replacement

N/A: no prophylactic treatment recommended

Discuss all therapies with interdisciplinary team including hematologist at your local institution

Abstract #: TH – RPS1 – Room 5 – Hematologic/Uterotonics/Bleeding - 03

**Measured vs calculated blood loss at cesarean delivery: correlation and practical use**

**Presenting Author:** Graham J. White, MBChB FRCA

**Presenting Author's Institution:** NHS Greater Glasgow and Clyde - Glasgow, Scotland

**Co-Authors:** Andrew Clark, MBChB FRCA - NHS Ayrshire and Arran

**Introduction:** Direct estimation of blood loss is routinely undertaken during cesarean delivery (CD) by weighing surgical swabs and measuring blood collected via suction. Alternative indirect methods of estimating blood loss from laboratory values (pre and postoperative hemoglobin (Hb) concentrations) alongside patient demographics (height and weight) have been used in non-pregnant surgical patients and rely upon estimating blood volume. The combination of these methods has been used to derive an allowable blood loss calculator to guide intraoperative investigations, resuscitation and transfusion in non-pregnant patients. This study aims to assess the correlation between direct and calculated estimations of blood loss during CD using different theoretical approaches for estimating blood volume.

**Methods:** All CDs at our institution in 2019 were included. Patient height (m), weight at booking (kg), preoperative Hb (g/L), lowest postoperative Hb (g/L) and documented blood loss during surgery were retrospectively reviewed. Five methods for estimating maternal blood volume were compared, with 50% added to account for predicted pregnancy blood volume increases where necessary<sup>1</sup>. A reference model for blood volume based on the conventional lean weight for women of 65ml/kg was included<sup>1,2</sup>. Blood loss was calculated using the *Gross method*<sup>2</sup> and compared to the measured blood loss. An assessment of correlation was made using mean absolute error and Bland-Altman plots.

**Results:** 901 CDs were analysed, 479 (53.2%) were elective. Median [IQR] blood loss was 700ml [500,1000], mean (SD) preoperative Hb was 116g/L (10.1), median [IQR] difference in pre and postoperative Hb was 14g/L [9,20], mean (SD) height was 1.64m (0.07), and median [IQR] weight was 83kg [72,98]. The correlation between models and measured blood loss is presented in Table 1.

**Discussion:** During CD a strategy to ensure adequate Hb concentration for oxygen transport while minimising unnecessary blood transfusion is highly desirable. These results, however, show poor correlation and wide limits of agreement with each model evaluated. Reasons for this include: limitations of a retrospective dataset; assumption of preoperative normovolaemia; administration of fluids or medication; unaccounted for or hidden blood loss; and uterine autotransfusion. Compared to these theoretical methods, modern statistical regression techniques may be more useful to accurately model the relationship between estimated blood loss and the fall in Hb at CD.

[Measured vs Calculated blood loss at cesarean delivery correlation and practical use Table 1.pdf](#)

**The effect of a standardized checklist and multidisciplinary care team on outcomes for planned hysterectomy at time of cesarean delivery: a single center retrospective study**

**Presenting Author:** Hadley Young, M.D.

**Presenting Author's Institution:** Baylor Scott & White Medical Center-Temple

**Co-Authors:** Jessica Ehrig, M.D. - Baylor Scott & White Medical Center-Temple

Kendall Hammonds, M.P.H. - Baylor Scott & White Research Institute

Michael P. Hofkamp, M.D. - Baylor Scott & White Medical Center-Temple

**Introduction:** In July 2018, a maternal fetal medicine (MFM) physician at our hospital created a checklist for planned hysterectomy at time of cesarean delivery (C-HYST) procedures based on guidelines from the Society for Maternal Fetal Medicine and formed a multidisciplinary C-HYST care team. Items on the checklist included but were not limited to patient evaluation, operating room personnel and set-up, sequence of procedure events, intravenous access, administration of tranexamic acid, availability of uterotonic drugs, and supplies to be brought from the labor and delivery suite to the main operating room where the planned C-HYST procedures would usually take place. The multidisciplinary team included members from MFM, anesthesiology, neonatology, and urology along with a surgeon who was experienced in the surgical management of placenta accreta. The primary aim of our study was to compare the number of transfused units of packed red blood cells (PRBC) in the perioperative and postoperative periods between subjects who underwent planned C-HYST before and after implementation of the checklist. We hypothesized that subjects that had planned C-HYST procedures performed by a multidisciplinary team that used a standardized checklist would have a lower number of transfused units of PRBC's in the perioperative and postoperative period compared to subjects that did not.

**Methods:** Informed consent was waived by our institutional review board. We searched our electronic medical record (EMR) for subjects who had planned C-HYST procedures from July 1, 2015 through June 30, 2021. Subjects who had unplanned C-HYST procedures at the time of cesarean delivery were excluded from the study. Demographic and clinical data was entered into REDCap from the EMR by a study investigator.

**Results:** 9 and 21 subjects had planned C-HYST procedures before and after implementation of the checklist, respectively. Demographic and clinical data for the cohorts is presented in Table 1.

**Discussion:** Subjects who underwent planned C-HYST procedures had a median transfused PRBC value of zero units for the perioperative and postoperative periods when the procedure was performed by a multidisciplinary team that used a standardized checklist compared to two units when a standardized checklist and multidisciplinary team was not used, a finding that was not statistically significant. Additionally, a lower percentage of subjects were admitted to the intensive care unit when the standardized checklist and multidisciplinary team was used but this was also not statistically significant. The major limitation of our study was that we were underpowered to arrive at statistically significant results. Another limitation of our study was that our surgical volume was much higher when the multidisciplinary team and standardized checklist were used. Future large-scale studies are needed to further evaluate the use of standardized checklists and multidisciplinary teams for planned C-HYST procedures.

[Table 1.pdf](#)

Abstract #: TH – RPS1 – Room 5 – Hematologic/Uterotonics/Bleeding - 05

## Anemia in Pregnancy and Social Determinants of Health: An Institutional Retrospective Cohort Study

**Presenting Author:** Ioannis (Yanni) Angelidis, MD, MSPH

**Presenting Author's Institution:** University of Chicago, Pritzker school of Medicine, Department of Anesthesiology and Critical Care, section of Obstetric Anesthesiology - Chicago, Illinois

**Co-Authors:** Jennifer M. Banayan, MD - Northwestern University, Prentice Women's Hospital, Section of Obstetric Anesthesiology

Sarah Nizamuddin, MD - University of Chicago, Pritzker school of Medicine, Department of Anesthesiology and Critical Care, section of Obstetric Anesthesiology

Barbara Scavone, MD - The University of Chicago

Sajid Shahul, MD, MPH - University of Chicago, Pritzker school of Medicine, Department of Anesthesiology and Critical Care, section of Obstetric Anesthesiology

**Background:** The Center for Disease Control and Prevention defines anemia as a hemoglobin (Hgb) level below 11 g/dL in the first trimester, 10.5g/dL in the second trimester, and 11 g/dL in the third trimester.<sup>1</sup> In addition, severe anemia is defined as Hgb level below 6 g/dL.<sup>1</sup> The prevalence of anemia in pregnant non-Hispanic Black women is two times higher than that of non-Hispanic white women.<sup>2</sup> This retrospective cohort study aimed to determine the effect of race, ethnicity, insurance status, and socioeconomic status on anemia.

**Methods:** We utilized institutional data to identify all patients who were admitted for delivery between March 1, 2018 and February 28, 2020. Data points included demographic variables including self-identified race and ethnicity, insurance status, and zip code of residence; and admission hemoglobin. Zip codes were matched to median household income from US Census data. We compared variables among patients with Hgb  $\geq$  11 g/dL (non-anemic), Hgb  $\geq$  9 and  $<$  11 g/dL (mildly anemic), Hgb  $\geq$  6 and  $<$  9 g/dL (moderately anemic), and Hgb  $<$  6 g/dL (severely anemic) using chi-squared test and Mann Whitney U test. A multivariable logistic regression calculated odds ratios between anemic states and our predictors of interest.

**Results:** Of 5358 identified patients, 4403 (82%) were anemic (mild 2828 (52.8%), moderate 1566 (29%), severe 8 (0.2%)). African American race and government insurance status were associated with more severe degrees of anemia; also, median household income declined for mild and moderate anemia (Table). The odds of being anemic were 1.99 times higher for African American women than white women ( $p < 0.0001$ ) and 1.73 times higher for patients with government versus non-government insurance ( $p < 0.0001$ ). Conversely, the odds of anemia were 0.72 times lower for Hispanic versus non-Hispanic ethnicity ( $p < 0.01$ ). Anemic states clustered by zip code (bottom of Table).

**Conclusions:** Anemia on admission for delivery is associated with social determinants of health. Understanding determinants of anemia is imperative as it is associated with maternal complications such as transfusion, cesarean delivery, gestational diabetes mellitus, hypertension, premature rupture of membranes, placental abruption, polyhydramnios, and oligohydramnios.<sup>3</sup> Future research should focus on how social determinants of health lead to anemia and possible remedies for this public health issue.

[SOAP table and figure ANEMIA Angelidis \(2\).pdf](#)

Abstract #: TH – RPS1 – Room 5 – Hematologic/Uterotonics/Bleeding - 06

Low-dose oxytocin protocol made no difference in quantitative blood loss in elective Caesarean sections; a single-center, retrospective cohort study

**Presenting Author:** Courtney R. Hood, MD

**Presenting Author's Institution:** SAUSHEC - San Antonio, Texas

**Co-Authors:** Brian J. Baxter, DO - SAUSHEC

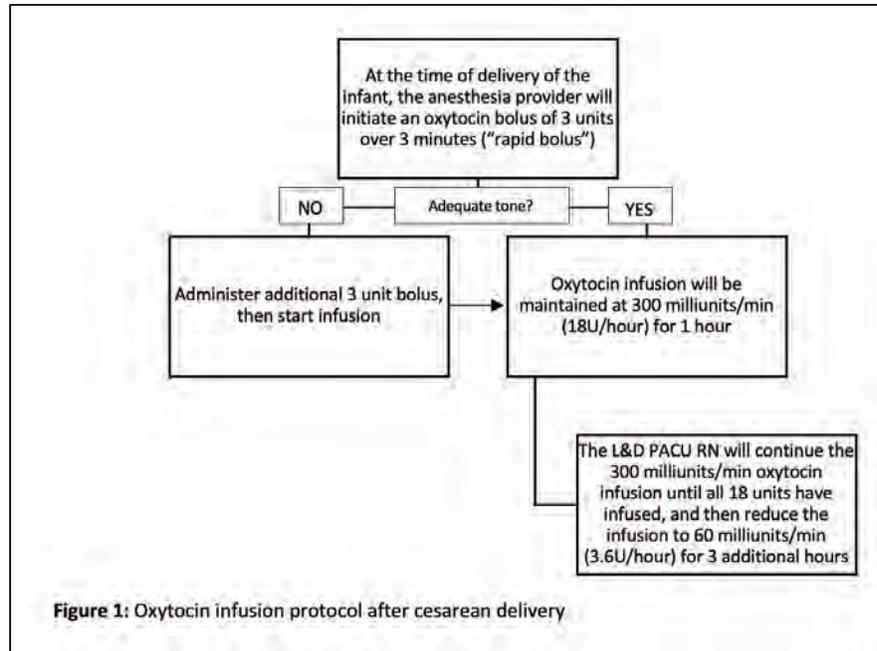
Alyssa R. Zuehl, MD - SAUSHEC

**Background:** The use of oxytocin after vaginal and cesarean deliveries is considered standard of care and reduces blood loss by 40-50%.<sup>1</sup> However, no definitive data exists on the optimal intraoperative dosing strategy for patients undergoing cesarean delivery (CD) to optimize blood loss and reduce unwanted side effects. This study aimed at comparing quantitative blood loss (QBL) after elective CD between patients receiving a high dose, non-protocolized oxytocin strategy (Group H) versus patients receiving a newly implemented, low-dose oxytocin protocol (Group L) over a seven-month period at a single academic institution.

**Methods:** Electronic medical record data was reviewed on gravid patients undergoing elective CD for a single intrauterine pregnancy with neuraxial anesthesia. Exclusion criteria: emergency CD, general anesthesia, placental abnormalities, bleeding disorders, multiple gestation, and failed oxytocin induction prior to CD. Group H patients received 40 units of oxytocin in a 1L bag of crystalloid, infused over an unspecified time at the discretion of the anesthesia provider, and variable boluses as needed based on obstetrician feedback about uterine tone. Group L patients received a 3-unit bolus of oxytocin followed by an infusion of 18 units per hour (see protocol below). An a priori power analysis was performed to an alpha of 0.05 and power of 0.8. Out of the 221 cesarean deliveries performed over the seven-month retrospective study period, 122 were excluded for the previously mentioned criteria. Of the remaining subjects, 62 received Group H treatment, and 37 received Group L treatment.

**Results:** While there were no statistically significant differences between the two groups with respect to patient age, gestational age at time of delivery, cesarean section indication, and hemorrhagic medications given, these factors had a positive effect size on QBL and were therefore controlled for in a multivariate linear regression model. The overall regression was not statistically significant ( $R^2 = 0.08$ ,  $F(8, 90) = 0.95$ ,  $p 0.48$ ).<sup>2</sup>

**Conclusion:** This small, single-center, retrospective study showed oxytocin dosing only had an 8 percent influence on the variability of quantitative blood loss during elective, low-risk cesarean deliveries. Therefore, smaller oxytocin dosing strategies incur no additional risk of bleeding, and larger oxytocin doses could result in a greater side effect profile with no added benefit to hemostasis.



**Figure 1:** Oxytocin infusion protocol after cesarean delivery

Abstract #: TH – RPS1 – Room 5 – Hematologic/Uterotonics/Bleeding - 07

## Cost savings and Prevention of Uterotonics Wastage- A Quality Improvement Project

**Presenting Author:** Shibirath Velutha, MD

**Presenting Author's Institution:** Montefiore Medical Center

**Co-Authors:** Sherif Elsayed Ali Ali, MD - ACGME

Shamantha Reddy, MD, FASA, MD, FASA - Montefiore Medical Center

Uterotonics are essential medications to control obstetric hemorrhage<sup>1</sup>. Commonly used uterotonic includes Carboprost (USD 3728.28/10ml), Methylergonovine (USD 175.48/10ml); these medications increase the uterine tone and control hemorrhage daily in OB anesthesia<sup>2</sup>. However, they are heat-labile and cannot be kept outside the refrigerator for a long time. The stability of these medicines outside the refrigerator is 24 hours. If left out of the refrigerator beyond 24 hours, the potency of these drugs diminishes.

### Problem

Over the period of Jan 2020 to May 2020, our institution incurred a loss of a quarter-million USD due to methylergonovine and carboprost wastage. These drugs were left behind at room temperature in the OR for anticipated hemorrhage and never returned to the refrigerator. In our institution, the hemorrhage kit contains both methylergonovine and carboprost. If only one is used, the other needs to be returned to the refrigerator, and if this is not done, it goes to waste. We realized during the study that most of the team were not aware of the cost of each medication and the significant wastage.

### Aim statement

To reduce uterotonic wastage to 50% from Jan 2021 to May 2021 compared to Jan 2020 to May 2020

### Our Intervention

We used colored laminated signs to remind the residents, nurses & other staff in the OR to return the uterotonic to the refrigerator after surgery. Furthermore, we instructed the nurses to bring uterotonics into the OR only when necessary. Nurses, obstetricians, and anesthesiology team members were educated about the very high cost of these medications and the wastage of medications left at room temperature unreturned to the refrigerator.

### Results

If we compare the cost of uterotonics wastage by the same months, Jan-May 2020 to Jan-May 2021: there is a significant decrease in the carboprost wastage by 36% and methergine wastage by 18%, with a total decrease of 35%. However, if we compare the wastage in the six months prior to our intervention and during the intervention, there was an increase in carboprost wastage by 100% and methergine wastage by 18%, with a total increase of wastage by 81%.

### Conclusion

Our intervention successfully lowered methylergonovine and carboprost wastage in the same months if we compare 2020 to 2021. However, we could not decrease the wastage compared to the previous six months (June to November 2020). This may be due to, Indication for Uterotonics usage by an obstetrician is subjective. Patients' numbers and bleeding rates vary from month to month, which we cannot control.

In the future, we could implement other interventions like, Placing the refrigerator near the to the OR. Bring uterotonics in the icebox and keep it in the OR until needed. A hemorrhage kit could have only one uterotonic, so we do not waste the other if we use one.

[Uterotonic wastage cost table pdf.png copy.pdf](#)

Abstract #: TH – RPS1 – Room 5 – Hematologic/Uterotonics/Bleeding - 08

### When Enough is Enough: A retrospective study of oxytocin delivery before and after implementation of the “Rules of Three” dosing algorithm

**Presenting Author:** Kathryn Hackett, MD

**Presenting Author's Institution:** Department of Anesthesiology, Perioperative and Pain Medicine, Brigham & Women's Hospital, Harvard Medical School, Boston, Massachusetts, United States

**Co-Authors:** Hassan Y. Hassan, BS - Department of Anesthesiology, Perioperative and Pain Medicine, Brigham & Women's Hospital, Harvard Medical School, Boston, Massachusetts, United States

Mahyar Heydarpour, PhD - Department of Medicine, Division of Infectious Diseases, Brigham & Women's Hospital, Harvard Medical School, Boston, Massachusetts, United States

Vesela Kovacheva, MD PhD - Department of Anesthesiology, Perioperative and Pain Medicine, Brigham and Women's Hospital, Harvard Medical School, Boston, MA, USA

#### Introduction:

Postpartum hemorrhage (PPH) due to uterine atony is a leading cause of maternal mortality, and the incidence continues to rise<sup>1</sup>. Active management of uterine tone following delivery with prophylactic uterotonics is widespread, and oxytocin is a first-line agent<sup>1,2</sup>. Though the use of oxytocin in cesarean delivery is nearly universal in high-resource settings, there are wide variations in administration modes<sup>3</sup>. Rapid administration and large doses have been shown to cause hemodynamic instability, cardiovascular collapse, and death<sup>3</sup>. In this study, we compared wide open oxytocin administration to a programmed “Rules of Three” algorithm<sup>3</sup>. We hypothesized that patients receiving oxytocin via the “Rules of Three” protocol received smaller total doses of oxytocin, without increased blood loss or more frequent use of second-line uterotonics.

#### Methods:

We included patients who presented for elective cesarean delivery between April 2021 and January 2022. Patients received an infusion of intravenous oxytocin following delivery, administered by either infusion of oxytocin wide open to gravity, or by the “Rules of Three” algorithm (oxytocin 3 IU bolus over 3 minutes, up to three boluses, followed by a 3 IU/hour maintenance dose). The total dose of oxytocin administered, automated quantitative blood loss (Triton L&D™, Gauss Surgical, Los Altos, CA), and administration of second-line uterotonics (methylergonovine, carboprost, misoprostol) were compared between both groups using the one way analysis of variance (ANOVA) using JMP software (jump pro ver.16).

#### Results:

Out of 396 patients, 217 patients had been dosed with our previous institutional convention wide-open infusion, and 179 patients were dosed using the “Rules of Three” dosing algorithm. The median patient age, BMI and gestational age were 35 years, 31 kg/m<sup>2</sup> and 39.0 weeks, respectively. Significantly more oxytocin was administered in the wide-open vs. protocol group (mean 16.1 vs. 6.3 IU P< .0001). The average quantitative blood loss was similar in both groups (mean 516 ml wide open v. 506 ml protocol, p=.8800). At least one dose of a second line uterotonic was administered in 19 patients in the wide-open group (4.8%) and 23 patients in the protocol group (5.81%); patients were not more likely to receive an additional uterotonic in either group (p=0.194).

#### Conclusion:

Quality Improvement initiatives for prevention and management of PPH have addressed factors such as teams, communication, crisis simulation, checklists, blood loss, and risk assessments; timing and administration of uterotonics are often not included in these bundles. After implementing a protocol for administering oxytocin via a programmed infusion, we noted significantly less oxytocin administration without increased blood loss or the need for additional uterotonics.

[Table 1. wide open v. rules of three.pdf](#)

Abstract #: TH – RPS1 – Room 5 – Hematologic/Uterotonics/Bleeding - 09

### Automated alert system of second-line uterotonic drug administration

**Presenting Author:** Gillian Abir, MBChB, FRCA

**Presenting Author's Institution:** Stanford University School of Medicine - Palo Alto, California

**Co-Authors:** Brendan Carvalho, MBBCh, FRCA, MDCH - Stanford University

Amy Judy, MD, MPH - Stanford University School of Medicine

Ann Marie Oakeson, MSN, RDMS, CPHI - Lucile Packard Children's Hospital Stanford

Edward Riley, MD - Stanford University

Ellen Wang, MD - Stanford University School of Medicine

**Background:** Anesthesiologists, with their resuscitation skill set, are crucial in managing postpartum hemorrhage.(1) However, at our institution (Lucile Packard Children's Hospital, Stanford, a tertiary referral center with 4,500-5,000 deliveries/year and 70% high-risk deliveries), there were incidences when the obstetric anesthesiology team was either alerted late or not at all during vaginal postpartum hemorrhages. We introduced a novel automated system based on secondary uterotonic drug administration to improve the reliability of alerting the anesthesia team.

**Methods:** An alert system based on blood loss estimation and education of nurses and obstetricians was introduced (Figure 1) to alert the anesthesia team early in the case of postpartum hemorrhage, but this intervention had minimal impact. The implementation group believed that thresholds based on blood loss volume or vital sign changes were unreliable due to poor situational awareness or task saturation by the obstetric provider. Therefore, an automated process was introduced that involved a text message to all members of the obstetric anesthesiology team when a second-line uterotonic drug was documented as administered in the electronic medical record after a vaginal delivery or postoperatively after a cesarean delivery. It is assumed that oxytocin has been administered as the first-line uterotonic drug, so the trigger criteria included administration of a second-line uterotonic drug (e.g. carboprost 250 mcg (IM), methylergonovine 200 mcg (IM), or misoprostol 800 mcg (any route)). Uterotonic drugs administered within an anesthesia record (e.g. intraoperatively) are excluded from this alert. The dosage trigger for misoprostol is for a single, not a cumulative dose to exclude false-positive alerts for induction of labor regimens.

**Results:** Introduction of an automated alert process to the obstetric anesthesia team when a second-line uterotonic drug was administered to a patient with a postpartum hemorrhage resulted in 1.06 alerts/day (Jan-Dec 2021). This novel automated alert system ensures prompt bedside evaluation by an obstetric anesthesiology team member to assess hemodynamic stability, obtain additional intravenous access, initiate resuscitation actions, and escalate care when indicated. Since introducing this system, there have been no failed alerts of the anesthesiology team for postpartum hemorrhages.

**Conclusion:** Utilization of this automated second-line uterotonic drug alert system has improved communication and has dramatically reduced failure to inform the obstetric anesthesiology team for postpartum hemorrhages, and as a result, has increased the presence of an obstetric anesthesia team member at the patient's bedside for hemodynamic assessment and clinical care. Future studies are required to determine if this novel automated alert system improves patient outcomes and decreases preventable maternal morbidity and mortality.

[Uterotonic Alerts Figure 1\\_1.31.22.pdf](#)

**Implementation and feasibility of a uterine tone communication and documentation tool for cesarean delivery embedded in the anesthesia information management system**

**Presenting Author:** Jessica R. Ansari, MD

**Presenting Author's Institution:** Stanford University - Stanford, California

**Co-Authors:** Brendan Carvalho, MBBCh, FRCA, MDCH - Stanford University  
Deirdre Lyell, MD - Stanford University Department of Obstetrics & Gynecology  
Ellen Wang, MD - Stanford University School of Medicine  
James Xie, MD - Stanford University

**Introduction:**

Postpartum hemorrhage is the leading cause of death and injury in pregnant patients worldwide, and up to 80% of cases result from uterine atony (1). Lack of standardized assessment language and timepoints for uterine tone assessment during cesarean delivery can present a barrier to effective communication regarding uterine atony between obstetric and anesthesia teams.

Electronic health record (EHR) alerts can provide clinical decision support, enhance communication, increase documentation compliance, and improve resource utilization (2). We present the development, implementation, and initial feasibility of an alert embedded in the Anesthesia Information Management System (AIMS) that prompts the anesthesiologist to communicate with the obstetrician and document serial quantitative uterine tone scores during cesarean delivery.

**Methods:**

To standardize assessments and improve communication about uterine tone, we implemented serial assessments with the aid of an EHR AIMS alert for all cesarean deliveries at our tertiary care institution, using a validated 0-10 quantitative scale (3). The AIMS module in the Epic EHR (Verona, WI) allows time-based intraoperative reminders with triggers based on event markers (i.e. delivery). Once alerted, a pop-up link to a SmartForm to enter the uterine tone score appears (Fig 1). We selected alert intervals of 2, 7, and 12 minutes after fetal delivery based on results of a cluster analysis of 360 historic cesarean records that identified when additional oxytocin boluses and second-line uterotonics were first and/or most frequently administered. These time intervals would also account for the effect of uterotonic drugs given based on their pharmacokinetics.

**Results:**

EHR triggered assessments were introduced in January 2022 after obstetric and anesthesia leadership agreed on practice workflow, and clinicians were educated. Preliminary analysis suggested high compliance with the uterine tone EHR alerts. Uterine tone scores were documented at least one timepoint in 97% of cesarean cases. Uterine tone score was documented for 70% of cases at 2 minutes, 97% at 7 minutes, and 97% at 12 minutes. Assessments are ongoing to make iterative system modifications based on clinician feedback.

**Discussion:**

There is a delicate balance between alert fatigue and appropriate nudging of the care team to perform uterine tone assessments after cesarean delivery. Preliminary results indicate that the 2-minute time point may be too soon to make an assessment in some cases. As we gather more data from this initiative, we hope to answer the broad research questions: 1) Do EHR-triggered alerts improve communication between obstetric and anesthesia teams? and 2) Does institutional implementation of formal, standard uterine tone assessment during delivery impact clinical care and patient outcomes?

Abstract #: TH – RPS1 – Room 5 – Hematologic/Uterotonics/Bleeding - 11

## Trends in blood product usage and cost in obstetrical anesthesia: a single site study

**Presenting Author:** Soniya Sharma, MD, MSc, FRCPC

**Presenting Author's Institution:** Stanford University

**Co-Authors:** Brendan Carvalho, MBBCh, FRCA, MDCH - Stanford University

Kelly Fedoruk, MD FRCPC - Stanford University

Anil Panigrahi, MD, PhD - Stanford University

Roya Saffary, MD - Stanford University

### Background

Blood products are a highly scarce life-saving resource in obstetric hemorrhage, the leading cause of maternal mortality world-wide (1). Responsible blood utilization is essential; recently, the Red Cross declared the first ever national blood crisis in the United States (2). There are limited studies assessing the cost of blood product management. The aim of this study was to quantify financial trends in massive transfusion guideline (MTG) utilization on our labor and delivery ward.

### Methods

Blood management practices at our institution (a tertiary referral center with ~4,700 deliveries/year, ~31% caesarean delivery rate and 70% high-risk deliveries) were assessed from June 2020 to April 2021. At our institution, MTG consists of 6 leukoreduced red blood cells (pRBC), 4 fresh frozen plasma (FFP), and 1 leukoreduced apheresis pathogen-reduced platelet. MTG is utilized for all obstetric hemorrhage where urgency doesn't allow cross-matched blood products to be requested. A multistep model was created to understand the steps and costs associated with MTG. For the purposes of our assessment, all blood product costs were estimated from the 2021 Medicare fee schedule. The true costs to the institution are protected by confidentiality agreements, thus a surrogate was required. A second model was created to understand the costs associated with unused MTG blood products that were either returned or wasted. The cost of return was assessed by personnel costs (average lab technician salary and time required to process the return). Capital costs such as infrastructure of the laboratory were not considered for the purposes of our study.

### Results

89 MTG were ordered during the 11 month study period. When examining individual products, 21% (76) FFP, 20% (105) pRBC, and 25% (22) platelets were transfused. A total of 2% (7) FFP, 0.4% (2) pRBC, and 2.2% (2) platelets were wasted. 40% (36) full MTGs were returned to the blood bank. Return processing time was 15 minutes at a rate of \$60/hr resulting in \$20 per return, resulting in \$720 lost to MTG returns. Wasted products amounted to \$1098.22 lost. There are intangible risks to unnecessary returned blood products including risk of waste, contamination and error.

### Conclusion

This study assesses trends in MTG practices and associated costs in obstetrical care at our institution. The optimal margin of MTG utilization that balances resources, cost, and maternal outcomes are unknown. Given the scarcity of blood products, wastage goals should ideally be lower. Our trends revealed on average 20-25% of products are being transfused, offering an opportunity to match need with use. We will use this data to implement quality improvement strategies to minimize unnecessary MTG ordering and prevent waste.

Figure 1: EHR pop-up alert to prompt communication and documentation of uterine tone

🔔 Document 2 Minute Uterine Tone

Snooze (1 minutes) Jump to Uterine Tone Assessment

Uterine Tone Assessment

2 Minute Tone	0	1	2	3	4	5	6	7	8	9	10	Unable to assess
7 Minute Tone	0	1	2	3	4	5	6	7	8	9	10	Unable to assess
12 Minute Tone	0	1	2	3	4	5	6	7	8	9	10	Unable to assess

Sex-dependent metabolic programming of the offspring after induced birth with oxytocin

**Presenting Author:** Arvind Palanisamy, MD, FRCA

**Presenting Author's Institution:** Washington University School of Medicine - Chesterfield, Missouri

**Co-Authors:** Jonathan R. Brestoff, MD, PhD - Washington University School of Medicine

Tusar Giri, MD, PhD - Washington University School of Medicine

**Introduction:** Oxytocinergic signaling is critical for energy homeostasis, with necessity experiments demonstrating the importance of oxytocin (Oxt) and its receptor (OxtR) in adipose biology and metabolic health.<sup>1</sup> Despite the widespread use of Oxt for the management of labor and evidence for its placental transfer,<sup>2</sup> not much is known about its impact on the metabolic wellbeing of the offspring. Here, using a pregnant mouse model for labor induction with Oxt, we report that female offspring exposed to Oxt are resistant to diet-induced obesity.

**Methods:** To enable mechanistic investigations, we adapted our previously validated pregnant rat model for labor induction with Oxt<sup>3</sup> to pregnant CD-1<sup>®</sup> IGS mice with the following modifications: (i) iPRECIO<sup>®</sup> SMP310-R pump, (ii) surgery on embryonic day (E) 15 followed by Oxt initiation on E17 (term gestation = E19 for this species), and (iii) an approximately 5-fold lower infusion dose of Oxt compared to rats. At weaning, pups born after Oxt or saline (Con) were randomized to either a standard (10% calories from fat; SD) or western diet (41% calories from fat; WD) for 16 weeks. We charted body weight trajectories, assessed body composition with EchoMRI, energy homeostasis with indirect calorimetry, and metabolic homeostasis with plasma assays. We examined the expression of thermogenic genes in the inguinal white adipose tissue (WAT), gonadal WAT, and interscapular brown adipose tissue (BAT). Data were analyzed with either student's t-test or two-way ANOVA with  $p < 0.05$  considered significant.

**Results:** Important results are summarized in Fig.1. Labor induction with Oxt did not affect litter size, pup survival, or their ability to nurse. Milk intake and pup weights were no different between the groups. Oxt-exposed adult females raised on SD showed lower adiposity and increased core body temperature, without any change in food intake or locomotor activity. These findings were amplified in the WD group with Oxt-exposed females demonstrating remarkable resistance to diet-induced obesity, largely due to increased energy expenditure. Thermogenic gene assays revealed a significant female-specific increase in *Adrb3* ( $\beta_3$ -adrenergic receptor), *Ucp1*, and *Pgc1- $\alpha$*  in the iWAT suggesting induction of a metabolically protective 'beiging' phenotype, with significantly lower fasting insulin and leptin levels. No significant changes were observed in the gWAT and iBAT.

**Conclusion:** Our results suggest that perinatal exposure to Oxt can sex-dependently program the metabolic phenotype of the offspring by altering adipose biology. Ongoing work in our laboratory is focused on determining the mechanisms by which Oxt drives iWAT beiging in females and the relative contribution of *in utero* vs. lactational Oxt exposure in the causation of this unique phenotype.

[AP\\_SOAP 2022 Supplemental File.pdf](#)

## Intrapartum epidural fentanyl dose, meconium opioid concentration and short-term neonatal outcomes

**Presenting Author:** Ruth Landau, M.D.

**Presenting Author's Institution:** Columbia University - New York, New York

**Co-Authors:** Serge Cremers, PharmD, PhD - Columbia University

Jean R. Guglielminotti, MD, PHD - Department of Anesthesiology, Columbia University Vagelos College of Physicians and Surgeons

Renu Nandakumar, M.D. - Columbia University

Katharine E. Thompson, M.D. - Columbia University

### Background

The effect of chronic maternal opioid use on the risk of adverse neonatal outcomes including neonatal opioid withdrawal syndrome (NOWS) remains unpredictable. Meconium drug screening is used to detect chronic maternal drug use during pregnancy, however positive testing for fentanyl in meconium in cases where epidural analgesia with fentanyl was given was recently reported.<sup>1</sup>

The effect of acute epidural fentanyl exposure during delivery on clinical outcomes among neonates chronically exposed in utero to opioids has not been evaluated.

We designed a pilot study to evaluate meconium fentanyl concentrations and neonatal clinical outcomes after chronic exposure to systemic opioids prescribed during pregnancy and acute exposure to epidural fentanyl during delivery.

### Methods

We evaluated 13 cases with confirmed chronic maternal opioid use receiving anesthesia care during labor and delivery. Meconium was collected and obstetrical, anesthetic and neonatal clinical data recorded. Fentanyl concentrations were measured in meconium samples using ultra-performance LC-MS/MS. The association between the total epidural fentanyl dose received by the mother (mcg), meconium fentanyl concentrations (ng/g) and a composite assessment for adverse neonatal outcomes defined as presence of more than 2 criteria: neonatal resuscitation, NICU admission > 1 day, IV morphine use, peak Finnegan score > 7, length of hospital stay > 5 days was evaluated.

### Results

There were 4 cases (30.1%) with adverse neonatal outcome.

There was a strong correlation between epidural fentanyl dose (with doses ranging between 0 and 800mcg over up to 36 hours of intrapartum epidural analgesia/anesthesia) and meconium fentanyl concentrations (Figure). We performed a 3-group comparison between cases with cesarean delivery with spinal anesthesia (no epidural fentanyl), intrapartum cesarean delivery and vaginal delivery cases (with epidural fentanyl).

The mean total epidural fentanyl dose was the highest in the intrapartum cesarean delivery group, however, 3 of 4 cases with neonatal adverse outcome occurred in the vaginal delivery group.

### Discussion

We had not expected to find measurable fentanyl levels in meconium following neuraxial labor analgesia with epidural fentanyl, although recently reported.<sup>1</sup>

There was a strong correlation between total intrapartum fentanyl epidural dose and meconium fentanyl concentration, confirming that labor epidural analgesia with fentanyl does result in acute fetal exposure to fentanyl. Nonetheless it is extremely unlikely that this acute exposure, added to the chronic opioid exposure in our cohort, precipitated adverse neonatal outcomes that were observed in 4 of the cases, of which 3 were vaginal births.

That intrapartum epidural fentanyl administration results in measurable meconium fentanyl levels has implications for opioid screening programs but the exact clinical relevance of this finding merits further exploration.

[Figure Fentanyl Meconium.pdf](#)

## Association of chronic maternal opioid use, fetal exposure and short-term adverse neonatal outcomes

**Presenting Author:** Ruth Landau, M.D.

**Presenting Author's Institution:** Columbia University - New York, New York

**Co-Authors:** Serge Cremers, PharmD, PhD - Columbia University

Jean R. Guglielminotti, MD, PHD - Department of Anesthesiology, Columbia University Vagelos College of Physicians and Surgeons

Renu Nandakumar, M.D. - Columbia University

Katharine E. Thompson, M.D. - Columbia University

### Background

To address the neonatal consequences of the raging maternal opioid crisis, rigorous studies are required to assess the effect of chronic fetal opioid exposure on adverse neonatal outcomes such as neonatal opioid withdrawal syndrome (NOWS) and long-term neurocognitive sequelae, and potentially identify neonates at risk for such complications.

Meconium opioid levels (MOL) have been described as a method to detect illicit maternal opioid use, but whether MOL correlate with adverse neonatal outcomes remains unclear.<sup>1,2</sup>

The goals of this pilot study were to first examine the feasibility of quantifying known fetal opioid exposure using MOL and then evaluate the association between maternal opioid exposure with MOL and short-term adverse neonatal outcomes.

### Methods

We enrolled 15 mother/neonate dyads with chronic opioid exposure defined as > 2 weeks of prescribed opioid use during 2<sup>nd</sup> or 3<sup>rd</sup> trimester pregnancy. Meconium was collected at birth and obstetrical and neonatal clinical data recorded.

Meconium concentrations of all opioids prescribed in our cohort (buprenorphine, codeine, fentanyl, hydrocodone, hydromorphone, methadone, morphine, oxycodone, oxymorphone) were measured using ultra-performance LC-MS/MS.

A composite assessment for adverse neonatal outcome was defined when at least 2 of the following criteria were present: neonatal resuscitation, NICU admission (> 1 day), IV morphine use, peak Finnegan score > 7, length of hospital stay > 5 days.

To assess the effect of chronic maternal opioid use on fetal exposure and neonatal outcomes, a 2-group comparison between cases with neonatal adverse outcome versus no adverse outcome examined the effects of high maternal opioid use (defined as morphine milligram equivalent (MME)  $\geq$  90) versus low use (MME < 90) and of total MOL.

### Results

Oxycodone was the most used opioid (N=7). Prescribed maternal opioids (and metabolites) expected to be found in the meconium were found in all samples, except for 1 outlier with levels of unprescribed codeine, morphine, fentanyl.

Adverse neonatal outcomes occurred in five cases (33%). The proportion of high opioid users (MME  $\geq$  90) did not differ between neonates with and without adverse outcome (Table). The total MOL was significantly higher in cases with adverse outcome than in those without with an area under the ROC curve of 0.93, suggesting excellent discrimination.

### Discussion

In this pilot cohort, we found that a high total MOL correlated with neonatal adverse outcome, (i.e. NICU admission and prolonged hospital stay).

Rapid real-time quantification of chronic fetal opioid exposure is feasible within hours of meconium sample collection. The ability to determine MOL at birth offers new avenues for the clinical prediction of neonates at risk for NOWS and further research exploring the impact of fetal opioid exposure on short term outcomes and long-term neurobehavioral development.

[Table for chronic opioid abstract.pdf](#)

## Pregnancy Outcomes Associated Sugammadex Reversal of Neuromuscular Blockade in Pregnant Patients Undergoing Non-Obstetric Surgery During Pregnancy

**Presenting Author:** Natalie Nakles, MD

**Presenting Author's Institution:** University of Pittsburgh

**Co-Authors:** Adam Dunmore, MD - University of Pittsburgh, Anesthesiology & Perioperative Medicine

Grace Lim, MD MSc - Department of Anesthesiology & Perioperative Medicine, University of Pittsburgh School of Medicine

C. Tyler Smith, MD - University of Pittsburgh, Anesthesiology & Perioperative Medicine

**Intro:** Non-obstetric surgery during pregnancy is common. Sugammadex (SGX) is a novel cyclodextrin agent, capable of reversing profound steroidal nondepolarizing neuromuscular blockade quickly and with fewer side effects than neostigmine (NEO)<sup>1</sup>. In-vitro studies show SGX binds other steroids, including progesterone, a vital hormone in maintaining pregnancy<sup>1-4</sup>. It is uncertain whether SGX is safe in pregnancy, and guidelines currently recommend avoiding it until better data is available<sup>4,5</sup>. This study assessed pregnancy outcomes after SGX vs. NEO exposure during non-obstetric surgery during pregnancy. We hypothesized that gestational age and rates of pregnancy loss after surgery would be different between people receiving SGX and NEO for non-obstetric surgery during pregnancy.

**Methods:** This was a retrospective cohort study of pregnant women with UPMC insurance receiving obstetric care and surgery within the UPMC Health System from 2015-2019, a period where little published guidance existed for SGX use in pregnancy. Patients having general anesthesia for non-obstetric surgery during pregnancy and receiving either SGX or NEO were identified. Patients were included if reversal exposure occurred during a documented live pregnancy. Medical records were used to abstract data including non-obstetric surgery types, gestational age at reversal exposure, maternal age, and labor and delivery variables. The primary endpoints of interest were gestational age at delivery and rates of pregnancy loss after exposure. Descriptive statistics were performed between groups, and multivariable logistic regression compared gestational age and pregnancy loss outcomes between groups. A  $P < 0.05$  defined statistical significance.

**Results:** There were 835 non-obstetric surgeries under general anesthesia during the study period. 745 were excluded due to non-viable pregnancy at the time of reversal exposure (e.g., cases of laparoscopic salpingectomy for ectopic pregnancy) or for incomplete data. Ninety (90) patients were included in final analysis (78 NEO, 12 SGX). Demographic information and surgical types are summarized in the Table. The mean gestational age at delivery was similar between groups: 37.5±4.6 weeks in the NEO group and 36.5±4.6 weeks in the SGX group ( $P=0.48$ ). Rates of pregnancy loss were similar between groups, with 4 pregnancy losses (5.1%) in the NEO group and 0 (0%) in the SGX group ( $P=1.00$ ).

**Conclusions:** In this preliminary study there was no evidence of differences in delivery gestational age or frequency of pregnancy loss between patients receiving SGX vs. NEO for non-obstetric surgery during pregnancy. These data support pursuing future prospective trials of randomized designs to definitively answer questions about SGX safety in pregnant patients undergoing non-obstetric surgery during pregnancy.

[Table.pdf](#)

**Abstract #: H – RPS1 – Room 6 – Fetus/Neonatal Outcomes - 05**

**A comparison of fetal outcomes between with and without the use of sugammadex in pregnant patients undergoing non-obstetric surgery : a multicenter retrospective study**

**Presenting Author:** Shohei Noguchi, MD

**Presenting Author's Institution:** Saitama Medical Center, Saitama Medical University - Kawagoe, Saitama

**Co-Authors:** Yusuke Mazda, MD, PhD - Saitama Medical Center, Saitama Medical University

### **Background**

It is unknown whether sugammadex exposure during pregnancy causes progesterone withdrawal and miscarriage. Therefore, we aimed to compare fetal outcomes between the pregnant patients with and without using sugammadex during non-obstetric surgery.

### **Methods**

We retrospectively reviewed the medical charts of the pregnant patients who received non-obstetric surgery at three tertiary perinatal care centers in Japan from January 2013 to December 2020. We divided the records into two groups: patients who underwent general anesthesia with sugammadex (GA with SGX) and those without sugammadex (GA without SGX). We compared miscarriage and preterm birth within one month after the surgeries as the primary outcome. We also analyzed other fetal outcomes, neonate abnormality, and light birth weight as the secondary outcomes.

### **Results**

Among 124 patients, 73 and 51 patients were included in the GA with SGX group and GA without SGX group, respectively. There was no difference in the rate of miscarriage or preterm birth within one month after the surgeries (1.5% vs. 4.3%,  $p=0.57$ ), neonate abnormality ( $p=1.0$ ), and light birth weight for a gestational date ( $p=0.69$ ) between the groups.

### **Conclusions**

We found no difference in fetal outcomes between with and without the use of sugammadex in pregnant patients undergoing non-obstetric surgery. A miscarriage related to sugammadex administration was also not found in this study.

Abstract #: TH - RPS1 - Room 6 - Fetus/Neonatal Outcomes - 06

## Incidence of maternal and fetal/neonatal outcomes in morbidly obese parturients undergoing spinal anesthesia for elective cesarean delivery at term

**Presenting Author:** Tianna Xia, DO

**Presenting Author's Institution:** The Ohio State University Wexner Medical Center, Ohio

**Co-Authors:** Blair Hayes, MD - The Ohio State University Wexner Medical Center

Jason Hoang, BS - The Ohio State University College of Medicine

Ling-Qun Hu, MD - The Ohio State University Wexner Medical Center

Brett Worly, MD - The Ohio State University Wexner Medical Center

Yun Xia, MD, PhD - The Ohio State University Wexner Medical Center

### Introduction

Most cesarean deliveries (CD) are performed under neuraxial anesthesia. Left uterine displacement (LUD) is recommended and commonly used to prevent supine hypotension syndrome during CD. Blood pressure (BP) measurements taken on the arm may not necessarily reflect uterine perfusion pressure as the gravid uterus may physically impede flow. Risk factors for poor fetal/neonatal outcomes in otherwise healthy fetuses prior to CD may include obesity or HTN<sup>[1]</sup>, but need to be further investigated. Our null hypothesis is left ankle BP distal to the uterus is equivalent to upper arm BP during CD. We report the incidence of maternal and fetal/neonatal clinical outcomes and average systolic BP (SBP) measured at the arm and left ankle after spinal anesthesia (SAB) for elective CD at term in morbidly obese parturients.

### Methods

This is a single-center, prospective, self-controlled cohort observational study. The primary outcome is the incidence of maternal hypotension (SBP  $\leq$  100mmHg)<sup>[2]</sup> measured at the arm and left ankle before and after SAB and after delivery in both the supine and 15-degree LUD positions. Secondary outcomes include maternal characteristics such as arm comfort, nausea/vomiting, and shivering, as well as fetal/neonatal characteristics such as fetal heart rates (FHR), APGAR scores, airway support, and NICU admission. Inclusion criteria include term singleton births, English-speaking parturients age  $\geq$ 18 and BMI  $\geq$ 35, presenting for elective CDs. Parturients received SAB (1.6 mL 0.75% hyperbaric bupivacaine + 10 mcg fentanyl + 100 mcg morphine), crystalloid co-loading, and phenylephrine 50 mcg/min at time of SAB.

### Results

Preliminary data from the first 49 cases is reported and data collection is ongoing. Patients averaged  $32 \pm 5$  yo,  $38\text{wd}3 \pm 1.3$  gestational age, BMI  $44 \pm 7.8$ , and fetal weight  $3715.7 \pm 565.8$  g. 82% were ASA-PS  $\geq$ 3 and 31% had HTN. The incidence of maternal hypotension measured at the arm after SAB was 37% in LUD, 31% in the supine position, however, and 12% at the left ankle [Table 1]. The incidence of composite fetal/neonatal outcomes among all patients was 29% with 14% of NICU admission.

### Discussion

The incidence of unexpected NICU admission aligns with the reported 13.1%<sup>[3]</sup>. The relationship between poor neonatal outcomes and the current definition of maternal hypotension could be the initial step to be investigated given the fact that differences in SBP exist between two maternal positions and between two measurement sites. It will be important to correlate objective hypotensive BP readings with poor outcomes and to identify the best blood pressure measurement site and outcome predictors.

[Table 1.pdf](#)

Abstract #: H – RPS1 – Room 6 – Fetus/Neonatal Outcomes - 07

## Fetal Surgery During the COVID-19 Pandemic: A Decision Support Algorithm for Managing Ethical and Clinical Conundrums

**Presenting Author:** Caitlin D. Sutton, MD

**Presenting Author's Institution:** Texas Children's Hospital - Houston, Texas

**Co-Authors:** Claire Naus, MD - Texas Children's Hospital/Baylor College of Medicine

Major elective surgery performed soon after SARS-CoV-2 infection is associated with increased complications, including pneumonia, respiratory failure, pulmonary embolism, sepsis, and death.<sup>1,2</sup> The APSF and ASA recommend postponing surgery to 4-12 weeks after infection depending on the clinical situation.<sup>3</sup> When the risk of delay exceeds the risk of proceeding, surgery is performed sooner.

Fetal surgery is performed when prenatal interventions are expected to improve mortality or morbidity for severe anomalies, such as spina bifida, congenital diaphragmatic hernia, or sacrococcygeal teratoma. While pregnant patients do not derive any direct physiologic benefit from surgery, they do undertake risks associated with the surgery and anesthetic.

At baseline, complex medical and ethical issues exist surrounding fetal surgery. The COVID-19 pandemic has taken this complexity to another level: balancing theoretical and known risk in the setting of a new and evolving disease, the existence of minimal data exacerbated by inappropriate reluctance to include pregnant women in research, competing approaches to optimizing maternal and neonatal outcomes, conflicts between beneficence-based obligations to fetal and pregnant patients, and the role of autonomy and shared decision-making (SDM).

We present three hypothetical cases of pregnant patients presenting for fetal surgery with recent or ongoing SARS-CoV-2 infection. These cases represent a compilation of patients who have presented to our hospital during the COVID-19 pandemic.

1. An unvaccinated 28yo G2P1 (EGA 23w) with fetal diagnosis of sacrococcygeal teratoma presents for minimally invasive laser coagulation of feeding vessels, which will require neuraxial + MAC. The fetus has hydrops and is not expected to survive without intervention. She reports a dry cough and tests positive for SARS-CoV-2 the night prior to surgery.
2. A vaccinated, boosted 36yo G1P0 (EGA 27w) with fetal diagnosis of congenital diaphragmatic hernia presents for fetoscopic endotracheal occlusion balloon placement. She is asymptomatic but tests positive for COVID on pre-op labs.
3. An unvaccinated 22yo G2P0 (EGA 21w) with fetal diagnosis of myelomeningocele presents for evaluation for fetoscopic repair. She reports a COVID infection 3 weeks ago, which was associated with cough and infiltrates on CXR but did not require hospitalization.

In an attempt to optimize medical outcomes for pregnant and fetal patients presenting for fetal surgery during the COVID-19 pandemic, as well as promote ethically supportable care, a decision-making algorithm (Figure) was proposed by our team to guide perioperative planning. With changes that occur as research is published and new variants arise, this algorithm continues to evolve.

[COVID algorithm figure.pdf](#)

**Abstract #: H – RPS1 – Room 6 – Fetus/Neonatal Outcomes - 08**

**Comparison of maternal arterial blood gas differences between oxytocin antagonist atosiban and beta-agonist terbutaline in fetal surgeries for correction of myelomeningocele - prospective cohort study**

**Presenting Author:** Shirley Santos, PhD, MD, EDAIC, TSA

**Presenting Author's Institution:** Mount Sinai Hospital/Hospital das Clínicas da Universidade de São Paulo - Toronto

**Co-Authors:** Diogo Carvalho, MD - Clinics Hospital - University of São Paulo Medical School

Hermann Fernandes, MD PhD DESA - Clinics Hospital - University of São Paulo Medical School

Elaine Imaeda, MD - Clinics Hospital - University of São Paulo Medical School

Gabriela Saba, MD - Clinics Hospital - University of São Paulo Medical School

Fernando Souza Nani, n/a - Hospital das Clinicas da Universidade de São Paulo

Joaquim Vieira, MD PhD - Clinics Hospital - University of São Paulo Medical School

**Introduction:** Myelomeningocele is a frequent severe malformation in which the spinal cord and nerves develop outside of the body, as a result of a defective neural tube closing. Fetal intrauterine surgery is an important alternative for the correction of the defect, once it improves the prognosis of the fetus. However, this procedure increases the risk of preterm labor. Thus, tocolysis must be performed before, during, and after surgery. Terbutaline, a beta-adrenergic agonist, is the most used tocolytic worldwide, but it has no specificity and may have systemic side effects, such as maternal acidosis. On the other hand, atosiban, an oxytocin receptor antagonist, may have better clinical performance with a higher financial cost. This study aimed to evaluate how maternal arterial blood gas changes differ between patients in which atosiban or terbutaline were used as tocolytic agents in fetal surgeries to correct myelomeningocele.

**Methods:** This is a prospective, non-randomized cohort study. Patients were divided into two groups: one received atosiban as a base tocolytic, and the other received terbutaline. Patients received epidural and general anesthesia, and three samples of maternal arterial blood gas were collected: one after intubation and before starting the baseline tocolytic, the second before extubation, and the third two hours after the end of the surgery.

**Results:** Twenty-five patients were included in the study: 16 in the atosiban group, and 9 in the terbutaline group. Data were collected from three arterial blood gas samples from each patient and fetal birth data, such as weight, Apgar, gestational age, and umbilical artery pH. The use of terbutaline was associated with maternal acidosis and higher levels of arterial lactate in the postoperative period.

**Conclusions:** Patients who received terbutaline had higher maternal acidosis and higher levels of arterial lactate, compared to those who received atosiban as a tocolytic in fetal surgery for myelomeningocele correction.

**Abstract #: H – RPS1 – Room 6 – Fetus/Neonatal Outcomes - 09**

**Breastfeeding after Anesthesia: Giving the Greenlight**

**Presenting Author:** Christine P. McKenzie, MD

**Presenting Author's Institution:** University of North Carolina - Chapel Hill, North Carolina

**Co-Authors:** Amy Bingham, MD - University of North Carolina at Chapel Hill Hospitals

Ben Cobb, MD - University of North Carolina

**Introduction:** A common misconception is that breastfeeding patients should “pump and dump” after anesthesia. A general rule is that patients may resume breastfeeding as soon as they are awake, alert, and stable after surgery due to clinically insignificant excretion of anesthetic agents in breastmilk.<sup>1,2</sup> We hypothesized that there would be an improvement in knowledge about evidence-based guidelines about breastfeeding after anesthesia after receiving concise educational materials.

**Methods:** A pre-survey was distributed to attendings, residents, CRNAs, and PACU nurses, consisting of multiple-choice questions asking when to resume breastfeeding after surgery and what pain medications were not recommended. A five-item Likert scale assessed confidence in giving recommendations to patients. A post-survey with identical questions was distributed the following week with a handout and a video explanation. A Fisher's Exact Test was used to compare the percent of correct responses. Likert scale responses were compared using a two-sample t-test.

**Results:** There were 112 pre-survey responses and 37 post-survey responses. On pre-survey, 71% of respondents correctly identified that a breastfeeding patient should resume breastfeeding as soon as they are awake, alert, and stable after surgery. 18% of PACU nurses identified the correct answer, compared to 63% of CRNAs, 86% of attendings, and 89% of residents. This improved to 97% on post-survey ( $p=0.0008$ ). On pre-survey, 69% identified codeine, 62% meperidine, 37% tramadol as medications that should not be given for pain control. On post-survey, 97% correctly identified meperidine, 95% codeine, and 81% tramadol. A five point Likert scale was used with 1 representing Strongly Disagree and 5 representing Strongly Agree. The mean response on pre-survey to “I feel confident providing recommendations to patients about breastfeeding after anesthesia” was  $2.84 \pm 1.23$  and improved to  $4.16 \pm 0.79$ , a statistically significant improvement from pre-survey to post-survey ( $p < 0.00005$ ).

**Discussion:** While the majority of providers were familiar with current evidenced based guidelines regarding breastfeeding after anesthesia, many were unable to identify specific medications and were not confident providing recommendations to patients. This study suggests that this brief educational intervention was effective at improving knowledge in this specific area. In particular, an area of focus for education could be the PACU nurses, as nurses are impactful in answering patient questions and concerns.

## Abstract #: H – RPS1 – Room 6 – Fetus/Neonatal Outcomes - 10

Readability, content, quality, and accuracy assessment of cannabis and pregnancy patient education materials.

Presenting Author: Matthew Sikora, Fellow

Presenting Author's Institution: Cedars Sinai Medical Center - West Hollywood, California

### Intro

Cannabis is commonly used in pregnancy, 2-5% in 2017,<sup>1</sup> and rising to 8.1% in 2020.<sup>2</sup> Many believe it's safe during pregnancy, but continued use is associated with preterm delivery, low birthweight and decreased attention span in offspring.<sup>3</sup>

Over 90% find health information on the Internet, but public websites were less accurate and understandable than society sites.<sup>4</sup> Our study compares medical society and non-society websites' patient educational materials (PEM) for readability, content, quality, and accuracy.

### Method

Google search (cannabis and pregnancy) for PEMs from medical society and non-societal websites were analyzed via standard tools for readability, Patient Education Materials Assessment Tool (PEMAT)<sup>5</sup> and accuracy. Content analysis was performed. Readability, accuracy, PEMAT understandability and actionability scores were compared using independent t-test, and content analysis by Chi-square,  $P < 0.05$ .

### Result

Society PEMAT understandability and actionability scores were significantly higher quality and more accurate ( $P < 0.05$ ) with no significant differences for readability.(see Table) Society PEMs had better overall content. The most frequently mentioned topics in non-society sites were: cannabis crosses into breast milk, low birth weight, decreased attention, and do not use while pregnant or breastfeeding. Both society and non-society sites scored at 11<sup>th</sup> grade to college level readability.

### Discussion

Society PEMs had significantly better information that was more understandable and actionable. No differences for accuracy or readability as in similar studies<sup>4</sup> implies Google improved identifying quality information and filtered out sites aimed at selling cannabis. Non-society group included news sites, increasing the group's accuracy. To better educate pregnant people, PEMs need high quality, easier to understand information, written at the recommended 6<sup>th</sup> grade reading level.<sup>5</sup>  
[Readability accuracy pemat - Table.pdf](#)

Racial and Ethnic disparities in Obstetric Anesthesia – Scoping Review

Presenting Author: Won Lee, MD

Presenting Author's Institution: University of California - San Francisco

Racial and ethnic disparities continue to disproportionately impact ethnic and racial minority women with increased risk of pregnancy-related death and cesarean delivery rate. Yet, the literature on influence of such disparities in obstetric anesthesia service and its clinical outcome is less well known. The objective of this review is to describe racial and ethnic disparities in obstetric anesthesia during peripartum period in the United States via a scoping review of the recent literature. Using Institute of Medicine's definition of disparities, we searched National Library of Medicine's Pubmed/Medline, Embase, Web of Science, APA Psycinfo, and Google Scholar for articles published between January 1, 2000 and August 31, 2020, to identify literature on racial and ethnic disparities in obstetric anesthesia. Eleven studies out of 7,918 articles initially reviewed met our inclusion criteria. All but one study was observational. Five studies were single-institutional while remaining six used multicenter registry databases. All studies used self-identified race and ethnicity classifications. The majority of sample sizes ranged from 200 to 81,883 with one retrospective study including 1,131,653 participants, for a total of 1,322,324 included across all studies. Studies in this review described disparities in rate of general anesthesia for cesarean deliveries, postpartum pain management and labor epidural analgesia utilization. Several studies reported disparities observed in its unadjusted models become no longer significant when adjusted for other covariates like language. This review indicates that multitude of factors may modulate racial and ethnic disparities seen in obstetric anesthesia. Future studies should consider an approach to obstetric anesthesia services through patient value-concordant care.

Publication	Study Design	Patients (N = 1,322,324)	Outcome	Adjustments	Findings
Atherton et al. (2004)	Retrospective cohort study	1,003 (NHW = 490; H = 339; O = 174)*	Use of neuraxial labor analgesia	Age, Insurance Type, Pregnancy Complications	H less likely to receive
Toledo et al. (2012)	Prospective cohort study	509 (NHW = 320; H = 116; NHB = 73)*	Use of neuraxial labor analgesia	Age, Labor Type, Marital status, Education level, Socioeconomic status	H less likely to anticipate neuraxial analgesia
Caballero et al. (2014)	Retrospective cohort study	3,129 (NHW = 908; NHB = 72; H = 1,367; A = 725; NHO = 725)*	Use of neuraxial labor analgesia	Insurance Type, Parity	H less likely to receive
Rust et al. (2004)	Retrospective cohort study	29,833 (NHW = 13,849; NHB = 13,930; H = 1,473; A = 440)*	Use of neuraxial labor analgesia	Age, Metropolitan Status, Number of Anesthesia provider per capita	NHB less likely to receive
Glance et al. (2007)	Retrospective cohort study	81,883 (NHW = 64,358; H = 3,607; NHB = 11,400; O = 2,518)*	Use of neuraxial labor analgesia	Clinical Risk Factors, Socioeconomic Status, Provider effects	H and NHB less likely to receive
Togioka et al. (2019)	Prospective cohort study	200 (NHW = 100; H = 100)*	Use of neuraxial labor analgesia	n/a	H more likely to receive after the educational program
Butwick et al. (2016)	Retrospective cohort study	50,974 (NHW = 21,113; NHB = 14,338; H = 12,990; O = 2,533)*	Mode of anesthesia for c-section	Age, Insurance Type, Gestational Age, Pregnancy Type, Pregnancy complications, Prior Pregnancies	NHB more likely to receive general anesthesia
Tangel et al. (2020)	Retrospective observational study	1,131,653 (NHW = 849,663; NHB = 281,990)*	Mode of anesthesia for c-section	n/a	NHB more likely to receive general anesthesia for c-section
Butwick et al. (2015)	Prospective observational study	11,539 (NHW = 5,288; NHB = 3,671; H = 2,034; O = 546)*	Mode of anesthesia for c-section	Age, BMI, Gestational Age, Number of Gestations, Pregnancy Complications, Prior Cesarean Deliveries, Emergency Indications	NHB, H and O more likely to receive general anesthesia
Johnson et al. (2019)	Retrospective cohort study	1,701 (NHW = 705; NHB = 431; A = 85; H = 349; O = 131)*	Pain scores post cesarean delivery	Age, BMI, Gestational Age, Nulliparity, Prior Cesarean Delivery, Type of hysterectomy, admission to NICU	NHB and H more likely to report severe pain
Badreldin et al. (2019)	Retrospective cohort study	9,900 (NHW = 9,771; H = 2,079; NHB = 1,050)*	postpartum pain score & postpartum opioid use & opioid prescription at discharge	Age, BMI, Gestational Age, Marital Status, Nulliparity, Insurance Type, Substance Use, Anxiety & Depression, Mode of Delivery, Prior Cesarean Delivery	H and NHB reported the highest pain scores, but H and NHB less likely to receive postpartum opioid and opioid prescription at discharge

\*NHW=Non-Hispanic White; NHB=Non-Hispanic Black; H=Hispanic; A=Asian; O=Other patients

**Abstract #: H – RPS1 – Room 7 – Labor Analgesia - 01**

**A Retrospective Cohort Study Comparing Catheter Replacement Rates with Programmed Intermittent Epidural Bolus and Continuous Epidural Infusion.**

**Presenting Author:** Brendan E. Morgan, MD

**Presenting Author's Institution:** Dalhousie University - Halifax, Nova Scotia

**Introduction:** Epidural catheter failure leading to replacement is a common problem, estimated to occur in 2.1-7.7% of epidurals<sup>(1,2)</sup>. The relationship between epidural catheter replacement rate and labor analgesia maintenance regimen is not well defined. Our objective was to investigate whether maintenance of labor analgesia with programmed intermittent epidural boluses (PIEB) is associated with fewer epidural catheter replacements than continuous epidural infusions (CEI).

**Methods:** A historical cohort study was conducted of patients who received epidural labor analgesia initiated with either the common epidural (EPI) or combined spinal epidural (CSE) technique and maintained with PIEB or CEI between January 1, 2012 and December 31 2019. Descriptive statistics were used for demographic data. Chi squared analyses were utilized to assess differences in our primary outcome (epidural catheter replacement) and secondary outcomes: time until catheter replacement, incidence of epidural top-ups, and time until epidural top-up.

**Results:** 11,277 EPIs and 4082 CSEs were included; 13,177 were maintained with PIEB and 2182 with CEI. Incidence of catheter replacement was 2.9%. Incidence of catheter replacement did not differ by labor analgesia maintenance regimen (PIEB vs CEI,  $\chi^2 = 0.846$ ,  $P = 0.35$ ). EPIs were more likely to be associated with a catheter replacement than CSEs (3.0% vs 2.4%,  $\chi^2 = 4.651$ ,  $P = 0.031$ ). Incidence of epidural top-ups was lower in the PIEB group than the CEI group (13.8% vs 17.0%,  $P < 0.001$ ) and time until first top-up was longer in the PIEB group (M = 315.9, SD = 274.3) compared to CEI (M = 270.2, SD = 219.9),  $P = 0.003$ . Time until epidural replacement was not statistically different between groups, and there was no difference in incidence or time until top-up between the CSE and epidural groups. Patient characteristics and labor and delivery characteristics can be found in Table 1.

**Conclusions:** Our incidence of catheter replacement of 2.9% is consistent with previously reported rates. We found no association between type of labor epidural maintenance regimen and incidence of epidural catheter replacement. The CSE technique was associated with a lower rate of catheter replacement than the common epidural technique. PIEB was associated with fewer epidural top-ups and may confer better parturient analgesia than CEI. Further research should target how other risk factors for epidural catheter failure may act as covariates.

Table 1. Patient and Delivery Characteristics						
	EPID (n = 11,277)	CSE (n = 4082)	<i>P value</i>	PIEB (n = 13,177)	CEI (n = 2182)	<i>P value</i>
Patient Characteristics						
Age (mean [SD])	29.73 [5.2]	29.74 [5.2]	0.945	29.7 [5.2]	29.5 [5.2]	0.058
BMI at Delivery (mean [SD])	31.4 [6.4]	31.6 [6.3]	0.139	31.5 [6.4]	31.3 [6.1]	0.301
Gestational Age at Delivery (weeks) (mean [SD])	39.2 [1.8]	39.2 [1.8]	0.814	39.2 [1.8]	39.2 [1.7]	0.604
Multiparous n (%)	4926 (43.9%)	1834 (45.2%)	0.167	5819 (44.4%)	941 (43.4%)	0.383
Multiple Gestation n (%)	184 (1.6%)	78 (1.9%)	0.238	218 (1.7%)	44 (2.0%)	0.224
Presence of Scoliosis n (%)	113 (1.0%)	40 (1.0%)	0.903	127 (1.0%)	26 (1.2%)	0.319
Use of analgesics (%)	974 (8.7%)	355 (8.7%)	0.906	1148 (8.8%)	181 (8.3%)	0.528
Use of Nitrous Oxide (%)	1469 (13.1%)	529 (13.0%)	0.915	1736 (13.2%)	262 (12.1%)	0.137
Type of Labour, n (%)						
• Spontaneous (%)	3306 (29.5%)	1242 (30.6%)	0.196	3856 (29.5%)	692 (31.9%)	0.022*
• Induced (%)	7895 (70.5%)	2817 (69.4%)	0.196	9234 (70.5%)	1478 (68.1%)	0.022*
Method of Delivery, n (%)						
• Spontaneous Vaginal (%)	7891 (70.3%)	2842 (70%)	0.680	9155 (69.8%)	1578 (72.7%)	0.006*
• Instrumental (forceps or vacuum) (%)	1451 (12.9%)	562 (13.8%)	0.143	1777 (13.5%)	236 (10.9%)	<0.001*
• Cesarean delivery (%)	1861 (16.6%)	652 (16.1%)	0.434	2163 (16.5%)	350 (16.1%)	0.672

Abbreviations: BMI, Body Mass Index

Abstract #: TH – RPS1 – Room 7 – Labor Analgesia - 02

## A Trial to Determine the Optimal Bupivacaine Dose for Initiation of Labor Epidural Pain Relief

**Presenting Author:** Diego Vilella-Franyutti, MD

**Presenting Author's Institution:** Department of Anesthesiology, Perioperative and Pain Medicine, Brigham & Women's Hospital, Harvard Medical School, Boston, Massachusetts, United States, Massachusetts

**Co-Authors:** Michaela K. Farber, MD, MS - Department of Anesthesiology, Perioperative and Pain Medicine, Brigham & Women's Hospital, Harvard Medical School, Boston, Massachusetts, United States

Kara G. Fields, MS - Department of Anesthesiology, Perioperative and Pain Medicine, Brigham & Women's Hospital, Harvard Medical School, Boston, Massachusetts, United States

Mario I. Lumbreras-Marquez, MBBS, MMSc - Department of Anesthesiology, Perioperative and Pain Medicine, Brigham & Women's Hospital, Harvard Medical School, Boston, Massachusetts, United States

Ayumi Maeda, MD, MD - Dept. of Anesthesiology, Perioperative and Pain Medicine Brigham & Women's Hospital | Harvard Medical School

Lawrence C. Tsen, MD - Dept. of Anesthesiology, Perioperative and Pain Medicine Brigham & Women's Hospital | Harvard Medical School

The dural puncture epidural (DPE) technique has faster onset, better sacral spread, and improved bilateral coverage when compared to the conventional epidural (EPL) technique(1). Whether these analgesic qualities translate into a lower total amount of bupivacaine to provide initial analgesia is unknown. We sought to compare the DPE and EPL techniques using a biased coin, sequential allocation method to determine the dose of bupivacaine necessary to achieve initial (first 30 min) effective labor analgesia in 90% (ED90) of parturients.

**Methods:** A total of 100 parturients were randomized to receive a DPE(17G Weiss needle, 25G Whitacre needle) versus EPL technique. The placement was performed by an attending or fellow who then mixed an initial dose of bupivacaine (0.25% bupivacaine (10mL) diluted with isotonic sterile 0.9% saline to a total volume of 20mL). Catheter dosing and assessments occurred by an investigator blinded to the technique or dose of bupivacaine at a rate of 5 mL/min x4min. Time0 was when the final bupivacaine dose was administered, with assessments for sensory level, motor blockade and maternal or fetal issues being recorded in 5 min increments for the first 30 min. Bupivacaine doses for the subsequent subject were determined by the response of the previous subject, with unsuccessful doses resulting in an increase in bupivacaine dose by 2.5 mg (1mL); by contrast, successful doses resulted in a decrease in bupivacaine dose by 2.5 mg (1mL) with a probability of 10% (biased-coin, ratio 1:9; ED90) using R statistical software.

**Results:** Our findings are summarized in table 1. To avoid disrupting the conduct of the study and analysis, statistical analysis will be performed when all subjects are recruited; to date, the demographics between groups appear similar and next doses for DPE and EPL are 30mg and 40mg, respectively.

**Discussion:** With approximately 75% of subjects enrolled, there appears to be a significant difference in dose to provide initial analgesia in parturients receiving the DPE and EPL techniques. To date, the bupivacaine dose with the DPE technique is lower, which is likely reflective of the amount of bupivacaine that is translocated through the conduit between the epidural and spinal spaces. The doses to date are consistent with a nonsequential random allocation dose-response methodology of the EPL technique, which identified the effective initial dose of bupivacaine to achieve comfort in 90%(ED90) of laboring women was 33.4 mg, but with a wide dose range (26.2-42.7). Whether initial differences in bupivacaine dose have durable persistence and whether other advantages can be demonstrated is unknown at this time. We find, with approximately 75% of 100 subjects recruited, a difference in bupivacaine dose to provide initial analgesia in mixed parity parturients.

**Table. Participant characteristics.**

	<b>Epidural N=35</b>	<b>Dural Puncture Epidural N=37</b>
Age, years, median, (IQR)	33 [31, 35]	33 [31, 35]
Pre-Delivery BMI, kg/m <sup>2</sup> , median, (IQR)	27.9 [26.8, 29.8]	26.6 [24.5, 29.6]
Gestational Age, weeks, median, (IQR)	39 [39, 40]	39 [39, 40]
Gravidity, median, (IQR)	2 [1, 3]	2 [1, 3]
Parity, median, (IQR)	1 [0, 1]	0 [0, 1]
Anesthesiology Provider, n (%)		
• Fellow	17 (48.5)	19 (51.4)
• Attending	18 (51.5)	18 (48.6)
Ethnicity, n (%)		
• Hispanic	1 (2.85)	7 (18.9)
• Non-Hispanic	34 (97.1)	30 (81.1)
Race, n (%)		
• White	30 (85.7)	28 (75.7)
• Black or African American	3 (8.6)	1 (2.7)
• Asian	2 (5.7)	3 (8.1)
• American Indian/Alaska Native	0 (0.0)	1 (2.7)
• More than one race	0 (0.0)	1 (2.7)
• Unknown / Not reported	0 (0.0)	3 (8.1)
<b>0.25% Bupivacaine Dose for Next Participant, mg</b>	<b>40 mg</b>	<b>30 mg</b>

IQR = Interquartile range; BMI = Body mass index.

Abstract #: TH – RPS1 – Room 7 – Labor Analgesia - 03

## Timing of labor epidural analgesia placement among primigravida non-White and non-English speaking patients: A retrospective cohort study

**Presenting Author:** Mario I. Lumbreras-Marquez, MBBS, MMSc

**Presenting Author's Institution:** Department of Anesthesiology, Perioperative and Pain Medicine, Brigham & Women's Hospital, Harvard Medical School, Boston, Massachusetts, United States - Boston, Massachusetts

**Co-Authors:** Dominique Y. Arce, MD, MPH - Department of Anesthesiology, Perioperative and Pain Medicine, Brigham & Women's Hospital, Harvard Medical School, Boston, Massachusetts, United States

Mahyar Heydarpour, PhD - Department of Medicine, Division of Infectious Diseases, Brigham & Women's Hospital, Harvard Medical School, Boston, Massachusetts, United States

Muhammad Jamil Ur Rehman, IS Programmer/Analyst, Sr - Department of Anesthesiology, Perioperative and Pain Medicine, Brigham & Women's Hospital, Harvard Medical School, Boston, Massachusetts, United States

Rafael Vazquez, MD - Department of Anesthesia, Critical Care & Pain Medicine, Massachusetts General Hospital, Harvard Medical School, Boston, Massachusetts, United States

Diego Villela-Franyutti, MD - Department of Anesthesiology, Perioperative and Pain Medicine, Brigham & Women's Hospital, Harvard Medical School, Boston, Massachusetts, United States

### Background

National data consistently shows that Black, Hispanic/LatinX and limited English proficiency (LEP) parturients are less likely to utilize and anticipate utilizing labor epidural analgesia (LEA) than White parturients [1,2]. The primary aim of this study was to identify differences in timing of LEA initiation in parturients of different race and English proficiency compared to White, native English speakers. We hypothesized that beyond the well documented disparity in LEA use, there also exists a disparity in the timing of the epidural catheter placement with non-White and LEP parturients receiving LEA later in labor as defined by greater cervical dilation.

### Methods

This retrospective cohort study conducted from January through December 2019 was approved by the IRB. All primigravid patients requesting LEA were included in the analysis. Race, primary spoken language, insurance type, cervical dilation at the time of epidural catheter placement, and delivery details were extracted from the electronic medical record and analyzed to determine mean cervical dilation at the time of LEA initiation. We compared cervical dilation at the time of epidural catheter placement between groups using one-way analysis of variance (ANOVA).

### Results

A total of 1,203 parturients were included in the main analysis. The results are summarized in the figure. The mean cervical dilation at time of placement was 4.73 cm (standard deviation [SD] 2.33) for White parturients, and 5.19 cm (SD 2.52) for Black parturients. A significant difference was observed in cervical dilation at the time of epidural catheter placement when comparing Black parturients (5.19 cm [SD 2.52]) with those identifying as Other race (4.54 cm SD [2.14];  $P=0.035$ ; Figure). The mean cervical dilation was 4.79 cm (SD 2.34) for primary English speaking parturients vs. 4.8 cm (SD 2.58) for parturients with LEP.

### Conclusion

The results suggest that Black parturients receive labor analgesia further along in their labor process. The reasons for this are likely multifactorial, including cultural differences, lack of a comprehensive birth plan, cognitive overload associated with patient teaching on labor and delivery, access to adequate prenatal labor analgesia education, and patient preference, among others. Their ability to assimilate vast amounts of information and clarify misconceptions related to LEA may be limited while experiencing the pain and stress associated with labor and delivery thereby creating barriers to informed decision-making about their options for labor pain management. To confirm our findings, we plan to increase the sample size and expand the study population to include multiparous parturients, in addition to investigating differences associated with parturient ethnicity. **Figure**

## Mindful Meditation for Epidural Catheter Placement During Labor: A Single-Center Randomized Controlled Trial

**Presenting Author:** Mario I. Lumbreras-Marquez, MBBS, MMSc

**Presenting Author's Institution:** Department of Anesthesiology, Perioperative and Pain Medicine, Brigham & Women's Hospital, Harvard Medical School, Boston, Massachusetts, United States - Boston, Massachusetts

**Co-Authors:** Dominique Y. Arce, MD, MPH - Department of Anesthesiology, Perioperative and Pain Medicine, Brigham & Women's Hospital, Harvard Medical School, Boston, Massachusetts, United States

Michaela K. Farber, MD, MS - Department of Anesthesiology, Perioperative and Pain Medicine, Brigham & Women's Hospital, Harvard Medical School, Boston, Massachusetts, United States

Kara G. Fields, MS - Department of Anesthesiology, Perioperative and Pain Medicine, Brigham & Women's Hospital, Harvard Medical School, Boston, Massachusetts, United States

Kristin Schreiber, MD, PhD - Department of Anesthesiology, Perioperative and Pain Medicine, Brigham & Women's Hospital, Harvard Medical School, Boston, Massachusetts, United States

Diego Villela-Franyutti, MD - Department of Anesthesiology, Perioperative and Pain Medicine, Brigham & Women's Hospital, Harvard Medical School, Boston, Massachusetts, United States

### Background

Patients can experience anxiety with labor epidural placement. Non-pharmacologic behavioral approaches including meditation and mindfulness have been successfully used to decrease pregnancy-related anxiety [1]. In this single-center randomized controlled trial, we compared the impact of a brief mindful meditation intervention on anxiety associated with labor epidural catheter placement, compared to education alone.

### Methods

This IRB-approved study recruited eligible participants between 1/2021-11/2021. English speaking patients >18 years who were admitted for vaginal delivery, without pain >3 upon presentation and who anticipated receiving epidural analgesia and gave informed consent were enrolled prior to epidural catheter placement. Participants were randomized 1:1 to listen to either a 10-minute mindful meditation recording or a 10-minute neutral content recording (i.e., non-anesthesia related educational recording). After epidural catheter placement, participants reported their level of anxiety (primary outcome), pain, and satisfaction (secondary outcomes) with placement on a 0 to 10 scale recorded by a study investigator. The senior anesthesia provider also completed a satisfaction survey (additional secondary outcome) regarding the epidural catheter placement (perceived participant's anxiety/pain and provider's epidural catheter placement experience). Group comparisons of continuous outcomes were accomplished using Wilcoxon rank-sum tests, with effect sizes presented as Wilcoxon-Mann-Whitney odds (WMWodds) with 95% confidence intervals (CIs).

### Results

A total of 100 participants were included in the intention-to-treat analysis. There was no difference detected in the reported level of anxiety (WMWodds 0.74; 95% CI 0.45, 1.18;  $P=0.21$ ), pain, or satisfaction between groups (Table). Moreover, there were no differences detected in secondary outcomes between the intervention and control groups. The per-protocol analysis excluding participants who deviated from the protocol yielded similar results to the primary analysis. Likewise, since 6% of data for the primary outcome were missing, a multiple imputation sensitivity analysis was performed, and the results were comparable to the principal analysis.

### Conclusion

In contrast to other studies where a brief, guided meditation provided effective anxiety relief during an acute medical procedure [2], in this trial, there was no difference detected in anxiety scores during epidural catheter placement for laboring parturients randomized to a brief mindful meditation intervention or to a neutral content recording. However, further research is warranted to confirm our findings and assess whether mindfulness meditation can decrease anxiety in labor and delivery-related procedures.

[Table.pdf](#)

## **Abstract #: TH – RPS1 – Room 7 – Labor Analgesia - 05**

Communication, education, and beliefs about epidurals among Spanish-speaking parturients; a pilot cross-sectional study

**Presenting Author:** Elizabeth Ozery, MD

**Presenting Author's Institution:** Stanford University

### **Introduction**

In the U.S. obstetric patient population, Hispanic women receive epidural anesthesia at lower rates than other ethnic groups, with the lowest rate of utilization observed in Spanish speaking Hispanic women.<sup>1</sup> Commonly cited reasons for decreased epidural use among the Hispanic population include feelings that women should cope with labor pain, fear of back pain or paralysis, and discouragement from family and friends.<sup>2</sup> We performed a pilot cross-sectional study of Spanish-speaking parturients with the goal of generating testable research hypotheses. Our future research goal is to determine how to optimize shared decision making with regard to labor analgesia in the Spanish speaking community.

### **Methods**

From 12/20/21 to 1/11/22, 20 consecutive Spanish-speaking patients who delivered at Lucile Packard Children's Hospital (LPCH) were surveyed between 12-48 hours postpartum. A standardized survey was administered verbally by author EO with the assistance of a qualified medical interpreter.

### **Results**

Of the 20 patients, 14 (70%) had vaginal delivery and 6 (30%) cesarean. 18 received neuraxial anesthesia or analgesia, and 2 declined neuraxial analgesia for their vaginal delivery. All patients felt they understood explanations from their anesthesia consultation in the hospital.

50% of patients stated that their obstetric team never spoke with them about epidurals at any prenatal care appointments. Prior to delivery, patients received information about epidurals from a variety of sources (Fig 1a). These sources included the hospital (if they had a prior epidural), family, friends, community members, and the internet. Two patients had no prior information.

Reasons for not getting the epidural included fear of back pain or negative effects on the baby and prior experience with unmedicated childbirth. 60% of patients stated their partner, family, or friends felt strongly about whether or not they should receive an epidural (Fig 1b). For 2 patients (17%), friends encouraged the epidural for pain relief. The other 10 patients (83%) were discouraged for reasons including chronic back pain, the belief it would cause problems for mom or baby, or even "to be a mother you need to have pain" (Fig 1c).

### **Discussion**

In this cross-sectional analysis of Spanish-speaking parturients, half of patients never received information about epidurals prenatally from an obstetric provider, and many were told myths about epidurals from family, friends, or community members. Planned future studies include: 1) Identifying differences in prenatal counseling about epidurals received by Spanish vs English-speaking Hispanic patients to determine whether a language barrier is the source of lack of information. 2) Study an informational video or website in the patients' primary language of Spanish as a tool to improve patient understanding of epidurals and increase the rate of neuraxial labor analgesia in this population.

Fig 1a: Sources of information



Fig 1b: People who discouraged epidural use



Fig 1c: Reasons epidurals were discouraged



**Abstract #: TH – RPS1 – Room 7 – Labor Analgesia - 06**

**A comparison of neuraxial labor analgesia utilization rates before and during the COVID-19 pandemic: a single center retrospective study**

**Presenting Author:** Abigail Torres, B.S.

**Presenting Author's Institution:** Texas A&M Health Science Center College of Medicine

**Co-Authors:** Alexandra L. Carlson, B.S. - Texas A&M Health Science Center College of Medicine

Kendall Hammonds, M.P.H. - Baylor Scott & White Research Institute

Michael P. Hofkamp, M.D. - Baylor Scott & White Medical Center-Temple

Megan Howell, B.S. - AT Still University

Luiz Ruiz, M.D. - Baylor Scott & White Medical Center-Temple

**Introduction:** The American Society of Anesthesiologists Practice Guidelines for obstetric anesthesia advise that neuraxial labor analgesia should be offered upon patient request and obstetrician approval.<sup>1</sup> The COVID-19 pandemic that began in March 2020 caused disruptions in hospital staffing during local surges in hospitalized COVID-19 patients. We hypothesized that subjects who had vaginal deliveries from July 2020 through December 2020 would be less likely to receive neuraxial labor analgesia compared to subjects who had vaginal deliveries from July 2019 through December 2019.

**Methods:** Our institutional review board waived informed consent for this study. We used the official handwritten labor and delivery log to search for subjects who delivered vaginally between July 1, 2019 and December 31, 2019 and between July 1, 2020 and December 31, 2020. Subjects who delivered intrauterine fetal demise infants were excluded from the study. A study investigator entered demographic and clinical data from the electronic medical record into REDCap.

**Results:** 846 and 944 subjects delivered vaginally in the pre-COVID and intra-COVID cohorts, respectively. Demographic and clinical data for the cohorts are presented in Table 1. The odds ratio for the intra-COVID cohort to not receive neuraxial labor analgesia compared to the pre-COVID cohort was 0.98 (95% CI 0.75, 1.26).

**Discussion:** We found that approximately 85% of subjects who delivered vaginally in both the pre-COVID and intra-COVID cohorts had neuraxial labor analgesia. We also found a statistically significant difference in the time of day that delivery occurred between the pre-COVID and intra-COVID cohorts. Despite having more deliveries that occurred in the evening hours and after midnight, the intra-COVID cohort had essentially the same neuraxial labor analgesia utilization as the pre-COVID cohort. The mode of vaginal delivery was also not clinically or statistically significant between the pre and intra COVID cohorts. A limitation of our study was that our retrospective review of the EMR did not have accurate data on the exact time that neuraxial labor analgesia was requested and we were therefore unable to determine if there was a difference in timely fulfillment of neuraxial labor analgesia requests.

[Table 1.pdf](#)

**Abstract #: TH – RPS1 – Room 7 – Labor Analgesia - 07**

## **The Effect of Chorioamnionitis on Achieved Labor Analgesia**

**Presenting Author:** Jakayla Harrell, MD

**Presenting Author's Institution:** Ochsner Clinic Foundation - Kenner, Louisiana

**Introduction:** Chorioamnionitis (CAM) is associated with numerous delivery outcomes including longer labor times and a higher incidence of cesarean delivery (1). 70% of parturients elect to receive epidural labor analgesia, and therefore it is important to establish the functionality of epidural catheters when chorioamnionitis is suspected (2). An association between chorioamnionitis and failed conversion of labor epidural analgesia for cesarean delivery has previously been reported (3). We therefore sought to determine if parturients diagnosed with chorioamnionitis were more likely to require anesthesia provider epidural top offs during labor to achieve adequate analgesia.

**Methods:** Ours is a retrospective cohort study including parturients at term who received epidural labor analgesia between January 2018 to December 2020. CAM+ patients were matched with noninfected patients also receiving epidural analgesia by the same anesthesiologist on the same day. Exclusion criteria included preterm labor, premature rupture of membranes, cesarean delivery within 2 hours of epidural placement, chronic pain, opioid abuse, and those carrying a CAM+ diagnosis without meeting standard clinical criteria. The primary outcome was to determine if CAM+ patients required more anesthesiologist intervention and top offs to achieve adequate analgesia compared to the CAM- group. Multivariable logistic regression was performed. Outcomes were estimated along with crude and adjusted odds ratios with 95% confidence intervals.

**Results:** Among the 84 patients analyzed, 30 (35.7%) were CAM+ and 54 (64.3%) were CAM-. There was no difference in the need for anesthesia provider top offs or time to top off request between groups. Among patients requiring anesthesia provider top offs, the CAM+ group was more likely to receive a higher total number of boluses (p 0.007) with 71.4% of CAM- patients receiving only one additional bolus in comparison to 15.4% in the CAM+ group. The CAM+ group received a higher total dose of fentanyl (P 0.012) and local anesthetic. There were no failures to convert epidural labor analgesia for cesarean delivery in either group.

**Conclusion:** Chorioamnionitis was not associated with greater need for anesthesiologist to administer a top off to achieve adequate labor analgesia. However, parturients diagnosed with chorioamnionitis may require more epidural fentanyl and local anesthetic to achieve adequate analgesia, which may be due to increased pain despite an adequate level of labor analgesia in this situation.

**Case failure rate of Spinal Anesthesia and Combined Spinal-Epidurals in the super morbidly obese obstetric patient population**

**Presenting Author:** Safir Abbas

**Presenting Author's Institution:** University of Texas Medical Branch of Galveston

**Co-Authors:** Rovnat Babazade, n/a - University of Texas Medical Branch of Galveston

Haley Hodgins, n/a - UTMB Health

James H. Lane - University of Texas Medical Branch of Galveston

Kristine Lane - University of Texas Medical Branch John Sealy School of Medicine

Alexandria Lehrmann, n/a - UTMB Health

Allison Mullins, MD - The University of Texas Medical Branch at Galveston

**Introduction:**

Spinals and combined spinal-epidurals (CSE) serve as two common modalities for delivering obstetric anesthesia. Spinal anesthesia is administered in a single shot dose into the subarachnoid space<sup>1</sup>, while CSE combines both spinal and epidural techniques by including a catheter placement in the epidural space for continuous drug administration<sup>2</sup>. Given the differences in technique for placing each style of anesthesia, we hypothesize that there may be a difference in failure rate between the two procedure types that will be especially significant in the super morbidly obese population, where body habitus can prove especially challenging for spinal access.

We investigated failure rates between spinal and CSE anesthesia in the morbidly obese population. Case failure rate, in this abstract, is assessed by differences in need for faculty intervention, conversion to general anesthesia, and time of placement.

**Materials and Methods:**

We conducted a retrospective chart review of super obese patients who were admitted to labor and delivery at a single hospital system. We included patients with a BMI  $\geq 50$  and collected data from the electronic medical records. Data was collected regarding patient age, BMI, gestational age, presence of any significant comorbidities, substance use, and anesthetic information.

**Results:**

Figure 1 displays information about the spinal and CSE populations, including anesthetic information like metrics useful in the describing the difficulty of placement and failure rate for each technique, as well as the number of charts that had each value recorded (n), and a statistical comparison of the data for each metric.

The two populations' BMI and age were not statistically different. The average number of attempts and number of redirections for the spinal population, while slightly lower than the CSE averages, were not statistically significantly different. Time required for placement was higher in the CSE group (21.6 vs 16.6). Replacement/conversion to GA and faculty intervention rate was similar between groups.

**Discussion:**

The higher procedure placement times and redirections/re-attempts seen with CSE support the concern that there is increased complexity compared to spinal anesthesia. However, the higher total amount of phenylephrine and morphine administered in the CSE group may indicate that the super obese population needed the longer duration of intrathecal medication that the catheter placement provided.

Stratifying the data based on BMI groups and other vital signs/demographic data may reveal other variables that affect the case failure rate of neuraxial anesthesia placement.

Table 1. Comparison of Anesthetic Placement, Medication Given and Failure Rates in Spinals and CSEs With Statistical Analysis				
Anesthetic Type Administered		Spinal	CSE	Statistical Comparison
Sample Size		85	73	
Maternal Demographics	Maternal Age (years)	29.48 (SD 5.60)	30.67 (SD 5.61)	
	Maternal BMI (kg/m <sup>2</sup> )	54.69 (SD 4.19)	57.21 (SD 7.23)	
Anesthetic Placement Information	Number of Attempts	1.5 (SD 1), n=60	1.72 (SD 1.37), n=54	t = -0.998, p-value= 0.32
	Number of Redirections	0.28 (SD 0.72), n=52	0.49 (SD 1.05), n=39	t = -1.070, p-value= 0.29
		16.64 (SD 11.4), n=75	21.58 (SD 17.88), n=64	t = -1.967, p-value= 0.051
	Time for Anesthesia Placement (min)	931.49 (SD 1414.46), n=85	1732 (SD 2009.98), n=73	t = -2.8, p-value= 0.0057
Anesthesia Medication Information	Total Phenylephrine administered (mcg)	0.57 (SD 1.64), n=86	2.42 (SD 17.53), n=73	t = 0.097, p-value= 0.333
	Total Morphine administered (mg)	40.75 (SD 72.5), n=85	38.7 (SD 62.39), n=73	t = 0.189, p-value= 0.851
	Total Fentanyl Given (mcg)			chi <sup>2</sup> = 0.0133, p-value= 0.908
Anesthesia Failure Statistics	Faculty Intervention Required	13.25%, n=83	13.89%, n=72	
	Ultrasound Guidance Required	0%, n=84	2.78%, n=72	chi <sup>2</sup> = 0.058, p-value= 0.809
	Replacement or Conversion to GA	4.71%, n=85	5.56%, n=72	

Abstract #: TH – RPS1 – Room 7 – Labor Analgesia - 09

**A patient-centered, algorithm-based management of epidural analgesia for labour and delivery: A prospective observational cohort study**

**Presenting Author:** Natalia C. Portela, MD

**Presenting Author's Institution:** Department of Anesthesiology and Pain Medicine, Mount Sinai Hospital, University of Toronto - Toronto, Ontario

**Co-Authors:** Jose C A. Carvalho, MD, PhD - Department of Anesthesiology and Pain Medicine, Mount Sinai Hospital, University of Toronto

Kristi Downey, MSc - Department of Anesthesiology and Pain Medicine, Mount Sinai Hospital, University of Toronto

Sandra Jadin, MD - Department of Anesthesiology and Pain Medicine, Mount Sinai Hospital, University of Toronto

Catherine Lopes Felipe, RN - Department of Nursing, Mount Sinai Hospital, University of Toronto

Heather MacLean, RN - Department of Nursing, Mount Sinai Hospital, University of Toronto

**Introduction:** Despite many advances in epidural analgesia for childbirth, including the use of drug delivery systems capable of administering both programmed intermittent and on demand epidural boluses (PIEB and PCEA), a significant number of parturients receiving epidural analgesia still experience pain during labor (1). The purpose of this prospective pilot observational study was to assess the efficacy of a patient-centered algorithm-based management of labour epidural analgesia.

**Methods:** Epidural catheter was placed at L2/L3 or L3/L4 with ultrasound assistance. A test dose of 3 ml of bupivacaine 0.125% with fentanyl 3.3mcg/mL was administered via the catheter followed by 12 ml of the same solution as loading dose. Maintenance of the epidural analgesia was performed with bupivacaine 0.0625% with fentanyl 2mcg/ml, using a PIEB plus PCEA regimen as follows: PIEB 10mL, PCEA 5 mL, lockout 10 min, maximum hourly 30 mL. Management of epidural analgesia, including trouble shooting insufficient analgesia and excessive motor block, followed strict pre-defined algorithms provided to the patient, the nurse/midwife and the anesthesiologist (Figure 1). The primary outcome of our study was the presence of pain >3 (NRS 0–10) at any time during the first or second stage of labour as documented by hourly nursing assessment. Pain and satisfaction with analgesia throughout labour was also assessed by a satisfaction questionnaire completed by the patient after delivery.

**Results:** Fifty patients consented and forty-eight were included in the analysis. The percentage of patients reporting pain NRS >3 during first or second stage of labor was 20.8%. The median (IQR) peak upper sensory block level to ice was T5 (T4-T6). The percentage of patients that developed motor block >1 (Bromage scale 0-3) was 4.2%. Four patients needed supplementation of the loading dose, one needed mobilization of the catheter and one had the catheter replaced. Two and four patients required nurse and physician top ups, respectively. Twenty-six patients used PCEA; median (IQR) number of attempts and deliveries was 1 (0,3) and 1 (0,2.5), respectively. The percentage of women reporting insufficient analgesia during the first and second stage of labour as assessed by the questionnaire was 25% and 28.6%, respectively. The median (IQR) patient satisfaction (NRS 0-10) with their active involvement with their pain management was 10 (9,10).

**Discussion:** Although our results cannot be directly compared to previous studies, all outcome trends of this pilot study indicate that the use of a standardized algorithm for the management of labour epidural analgesia may improve the quality of epidural analgesia. Patient satisfaction with their involvement with their pain management is high.

[Algorithm Anesthesia Feb 2.pdf](#)

Evaluation of Distal Epidural Catheter Pressure Generation – An in-vitro study

**Presenting Author:** William Turner, MScI (hons) BMBS (hons) FRCA

**Presenting Author's Institution:** 1. Department of Anaesthesia and Pain Management, Mount Sinai Hospital, University of Toronto

**Co-Authors:** Mrinalini Balki, MD - Department of Anesthesiology and Pain Medicine, Mount Sinai Hospital, University of Toronto

Linda Boonstra, MD - 1. Department of Anaesthesia and Pain Management, Mount Sinai Hospital, University of Toronto

**Introduction** Increased distal driving pressure is proposed as a reason for improved efficacy with programmed intermittent epidural bolus (PIEB) and better spread of anesthetic solution.[1,2] This study measured the distal pressure with variation in the proximal driving pressure generated via epidural pump or syringe.

**Methods** This was an in-vitro laboratory research study. We evaluated closed-end multiport and open-end uniport (19Ga 90cm FlexTip Plus® Arrow) catheters. Distal pressure measurement apparatus was made up of a three-way tap attached to a digital manometer, a low resistance saline filled syringe to imitate the potential epidural space, and a SnapLock device that connected the catheter. Pressure was generated using the CADD epidural pump for PIEB 10ml, patient controlled epidural analgesia (PCEA) 5ml, and continuous epidural infusion (CEI) 8ml/hr normal saline. Positive and negative pressures were also evaluated using 3ml, 10ml, and 20ml syringes. Each experiment was repeated three times. The primary outcome was peak pressure generated from each mode of pressure delivery.

**Results** 108 experiments were undertaken. Peak pressure generated via epidural catheter with each modality and with various volumes of syringes is shown in Table 1. Pressure generated by uniport catheter was higher than multiport by 6 and 3 mmHg for PIEB and PCEA. There was 10-fold reduction in distal pressure when compared with pressure measurement.

**Conclusion** Several aspects were associated with higher peak pressure generation, including the removal of the epidural filter and the use of single orifice catheters. Manual injection resulted in similar peak pressures as mechanical pump delivery, and higher peak pressures were achieved when the plunger of the syringe was forcefully withdrawn. It is clear that, while the step down of pressure from proximal to distal is marked, the changes in equipment and method for applying pressure have significant effects on the overall delivered pressure.

Table 1. *Peak pressures with epidural catheter set-ups and syringes*

<i>Epidural catheter distal pressure (mmHg)</i>	<b>PIEB</b>	<b>PCEA</b>	<b>CEI</b>
Multiport (with filter)	18.7 (0.94)	23.0 (7.48)	15.3 (1.70)
Multiport (without filter)	24.7 (0.94)	30.3 (0.94)	29.0 (0.82)
Uniport (with filter)	25.3 (2.62)	26.0 (2.45)	19.3 (0.94)
<i>Epidural catheter proximal pressure (mmHg)</i>	306 (8.18)	325 (9.63)	107 (4.55)
<i>Syringe (mmHg)</i>	<b>3 mL</b>	<b>10 mL</b>	<b>20 mL</b>
Injection – fast	31.5 (3.45)	27.8 (3.25)	17.6 (1.86)
Aspiration – forceful	-28.8 (5.19)	-32.0 (2.68)	-25.6 (3.33)
Aspiration – gentle (over 10s)	-24.0 (5.06)	-26.6 (2.07)	-23.3 (6.12)

Pressures are mean values (SD)

# Program Material

## Friday, May 13, 2022

---

### Research Posters Session #2

Room 1 – Abnormal Placenta & Coagulation

Room 2 – Cesarean Delivery

Room 3 – Obesity

Room 4 – Postpartum Headache, Depression, and Skilled Nursing Care

Room 5 – Cesarean Delivery (general anesthesia)

Room 6 – COVID Education/Global Health

Room 7 – Post Cesarean Pain & Recovery

### Gertie Marx Research Competition

Moderator: Ashraf Habib, MD

Judges: Ruth Landau, MD; Anton Chau, MD; Feyce Peralta, MD; Michaela Farber, MD;  
Jake Beilin, MD

### Oral Presentations

Moderator: Ron George, MD, FRCPC

### Fred Hehre Lecture

Intro: Lisa Leffert, MD

Speaker: Robert Gaiser, MD

### Sol Shnider Clinical Track #1

Moderator: Greg Palleschi, MD

Panelists: Laurie Chalifoux, MD; Marie-Louise Meng, MD; Emily McQuaid, MD;  
Robert White, MD

**An Obstetric-specific Surgical Apgar Score (ObSAS) predicts maternal morbidity from cesarean hysterectomy for Placenta Accreta Spectrum (PAS)**

**Presenting Author:** Jessian L. Munoz, MD PhD MPH

**Presenting Author's Institution:** University of Texas Health San Antonio - San Antonio, Texas

**Co-Authors:** Jacqueline Curbelo, DO - University of Texas Health San Antonio  
Patrick Ramsey, MD, MSPH - UT Health Science Center at San Antonio

Placenta Accreta Spectrum (PAS) is a range of conditions characterized by significant maternal and neonatal morbidity. Recommended management requires coordinated cesarean hysterectomy at 34-36 weeks' gestation by a multidisciplinary team. Associated morbidities include blood transfusion (82%), coagulopathy (29%) and intensive care unit (ICU) admission (26-50%). Tools to accurately predict post-operative morbidity for cesarean hysterectomy have lacked specificity due to failure to consider the hemodynamic changes of pregnancy. The Surgical Apgar Score (SAS) is a 10-point scale which assesses lowest heart rate, mean arterial pressure and estimated blood loss and has been validated for the prediction of ICU-level care requirements and postoperative morbidity such as blood transfusion and reoperation. Yet, the SAS system lacks specificity in pregnancy, as a result, has poor predictive capability for cesarean hysterectomy in the setting of PAS. Thus, we created an Obstetric-Specific SAS scale to account for physiologic changes of pregnancy (2-fold increase in blood loss, 10% increased heart rate and 5% decreased mean arterial pressure) and analyzed 110 cases of pathology-confirmed PAS patients who underwent cesarean hysterectomy. All patients were delivered at our institution's established Placenta Accreta Program from 2005-2020. Fifty-six (50.1%) patients were admitted post-operatively to the ICU, 62 (56.4%) required transfusion of >4 units of blood and 67 (60.1%) experienced overall surgical morbidity. An ObSAS from 0-4 (poorest score) was significantly associated with increased risk of ICU admission (OR=40.6 [95%CI 7.9-742.9]), 100% rate of transfusion >4 units (26/26 patients) and greater surgical morbidity (OR=22.7 [95%CI 4.4-415.0]). The AUC for these outcomes were 0.79 ( $p < 0.0001$ ) and 0.73 ( $p < 0.0001$ ), respectively. An intermediate ObSAS score (5-8) was significantly associated with fewer ICU admissions (OR=0.41 [95%CI 0.18-0.92]), fewer blood transfusions >4 units (OR=0.41 [95%CI 0.16-0.95]) and no difference in overall surgical morbidity (OR=0.57 [95%CI 0.23-1.3]). Conversely, an ObSAS from 9-10 resulted in no ICU admissions (0/12), fewer blood transfusions (OR=0.1 [95%CI 0.1-0.4]), and less surgical morbidity (OR=0.09 [95%CI 0.01-0.37]). Given the overall surgical morbidity associated with PAS cesarean hysterectomy, the ObSAS score is a powerful tool with excellent predictive capabilities for ICU admission, blood transfusion and surgical morbidity, allowing for resource allocation, prophylactic interventions and optimal patient outcomes.

## Abstract #: FRI – RPS2 – Room 1 – Abnormal Placenta & Coagulation - 02

### Patient-Centered Outcomes Associated with Delayed Hysterectomy in Severe Placenta Accreta Spectrum

Presenting Author: Laura L. Sorabella, MD

Presenting Author's Institution: Vanderbilt university Medical Center

Co-Authors: Jeanette Bauchat, MD - Vanderbilt University Medical Center

Holly Ende, MD - Vanderbilt University Medical Center

Anthony Sermarini, n/a - Vanderbilt University Medical School

Lisa Zuckerwise, MD - Vanderbilt University Medical Center

#### Introduction

Placenta accreta spectrum (PAS) is a serious and potentially devastating pregnancy complication, the incidence of which has risen dramatically in parallel with cesarean delivery rates.<sup>1</sup> Given concerns for morbidity and mortality, our PAS team in 2012 began offering delayed hysterectomy (DH) in select PAS cases, based on a predefined treatment algorithm, and with shared decision making between patient and multidisciplinary team. A subsequent review of outcomes comparing DH to immediate cesarean hysterectomy (IH) demonstrated significant reductions in estimated blood loss, packed red blood cell units transfused, and need for massive transfusion.<sup>2</sup> Given these findings, there may be an expanding role for DH in the treatment of severe PAS. Our aim was to describe and compare psychological, personal, and financial outcomes in patients undergoing DH vs. IH for PAS.

#### Methods

We conducted a retrospective cohort study of patients with severe PAS (increta or percreta) who delivered at our institution 2012-2021 (n=54). Five cases were excluded due to intraoperative mortality (n=3) or loss of follow-up (n=2). Cases were identified via our institution's REDCap PAS database, and data were collected from patient charts manually by a study investigator. Variables collected included Edinburgh Postnatal Depression Scale (EPDS) scores, new anxiety or depression not present on admission, breastfeeding status, hospital length of stay (LOS) after cesarean delivery, postpartum outpatient visits, and total hospital charges. LOS and charges were cumulative for cesarean and hysterectomy for DH. Unadjusted comparisons were conducted between patients undergoing DH and IH using Fisher's exact, Mann Whitney U, or t-test as appropriate. A p-value < .05 was considered statistically significant.

#### Results

Of the 49 patients included, 18(37%) underwent DH and 31(63%) IH. DH was associated with higher median EPDS scores (6[3,13] vs. 3[0,6]; p=.04). Rates of newly diagnosed anxiety and depression, however, were not statistically different between groups (DH 39% vs. IH 19%; p=.18). DH was associated with longer LOS (25±19 vs. 5±2 days; p< .001) and significantly larger hospital bills for patients (279,837 ± 139,792 vs. 169,999 ± 87,676; p=.002). Rates of breastfeeding and the number of postpartum outpatient visits were similar in both groups (Table 1).

#### Conclusions

While DH may offer significant benefits in hemorrhage-related morbidity, there may be psychosocial consequences to consider. Higher EPDS scores with DH may indicate unrecognized psychological burden associated with an in-situ placenta. DH patients also spent an average of two additional weeks in the hospital and incurred over \$100,000 in additional charges, both of which may have significant impacts on patients and their families. While DH certainly has an important role in severe PAS, clinicians must understand the potential deleterious effects of this treatment.

[Sorabella PAS SOAP Abstract Table FINAL.pdf](#)

**Strong Linear Correlation Between Functional Fibrinogen by Thromboelastography 6s and Fibrinogen Level by Clauss Method in Pregnant Women**

**Presenting Author:** Anna Moldysz, MD

**Presenting Author's Institution:** Beth Israel Deaconess Medical Center/Harvard Medical School - Boston, Massachusetts

**BACKGROUND:** Prior studies have shown a fibrinogen level  $< 200$  mg/dL is the only value to have a 100% positive predictive value for post-partum hemorrhage progressing to severe hemorrhage requiring transfusion.<sup>1,2</sup> This value has traditionally been ascertained by the Clauss method in a clinical laboratory. A significant disadvantage of this method is that even in emergent conditions, it can take more than an hour to return the result. TEG provides an alternate and quick method of fibrinogen measurement, functional fibrinogen level (FLEV). The Clauss fibrinogen method and FLEV on TEG have been shown to produce different values, but a linear correlation has been seen.<sup>3</sup> The majority of this work has been performed in the cardiac and trauma surgical population. Defining a correlation between TEG 6s FLEV and fibrinogen by the Clauss method in the obstetric population could be critical in rapidly identifying patients at risk for progression to severe hemorrhage.

**METHODS:** We reviewed all TEG manager records on Labor and Delivery at our academic, tertiary medical center. The medical record was then reviewed for all women in their third trimester of pregnancy who met inclusion criteria and had a fibrinogen level and FLEV drawn at the same time. The fibrinogen level was measured by the Clauss method and FLEV assessment was performed on the TEG 6s analyzer. Data was tested for normality using histograms, QQ plots and Shapiro-Wilk tests. Given the normal distribution, a paired t-test was performed between groups. A Pearson Correlation was then performed to assess the linear relationships between the two variables.

**RESULTS:** We identified 107 pairs of values from 72 individual patients for analysis. We found that the FLEV was 44.8 (SD +/- 91.8) mg/dL higher than the laboratory fibrinogen level ( $p < 0.0001$ ). Pearson correlation showed a strong positive linear correlation and statistically significant relationship ( $r=0.698$ ,  $p < 0.0001$ ) between FLEV measured by TEG 6s and fibrinogen measured by the Clauss method throughout our sample range (Figure 1).

**CONCLUSIONS:** Based on our results, FLEV is approximately 50 mg/dL greater than the fibrinogen level using the Clauss method. As such, an FLEV  $< 250$  mg/dL on the TEG 6s may be equivalent to a fibrinogen level  $< 200$  mg/dL. Use of this threshold on TEG 6s FLEV for parturients experiencing hemorrhage should raise significant concern for progression to severe hemorrhage and aid in the rapid and prompt treatment of these patients with either cryoprecipitate or fibrinogen concentrate.

[Moldysz FLEV Fibrinogen.pdf](#)

Abstract #: FRI – RPS2 – Room 1 – Abnormal Placenta & Coagulation – 04

## Normal Thromboelastography 6s Values During Third Trimester of Pregnancy

Presenting Author: Anna Moldysz, MD

Presenting Author's Institution: Beth Israel Deaconess Medical Center/Harvard Medical School - Boston, Massachusetts

**BACKGROUND:** Thromboelastography (TEG) is a valuable point of care device used to assess a patient's hemostatic condition. TEG 6s is a new modality that measures clot viscoelasticity using a resonance method, as opposed to the previous viscoelastic testing modalities that used a pin suspended in a cup to analyze the rate of fibrin clot formation.<sup>1</sup> Preparation of samples is simple and rapid. TEG 6s is cartridge based, which allows simultaneous performance of multiple TEG assays from a single blood sample. By superimposing the results of multiple assays, valuable clinical information can be gathered quickly and acted upon. However, the information is difficult to interpret without knowledge of a normal baseline, which is currently determined from healthy, non-pregnant samples. Pregnancy is a hypercoagulable state that can be detected by TEG, and therefore the physiologically appropriate TEG values may appear abnormal.<sup>2</sup> Normal values in pregnancy have been described for other methods of viscoelastic testing, such as TEG 5000 and ROTEM.<sup>3</sup> However, there are no established reference ranges using TEG 6s in third trimester pregnancy.

**METHODS:** Women in their third trimester of pregnancy who met inclusion criteria and had a global TEG 6s performed for clinical or investigational purposes were included in this retrospective chart review. All TEG samples were drawn per standard practice consisting of a venous blood sample drawn into vacutainer tubes containing a sodium citrate solution. The tubes were incubated for at least ten minutes, after which 1 mL of whole blood was pipetted into the cartridge. The cartridge contains four assays: Kaolin TEG, Kaolin TEG with heparinase, RapidTEG, and TEG Functional Fibrinogen. Histograms, QQ plots and Shapiro-Wilk tests were performed to assess the normality of data distribution. Data are presented as mean ( $\pm$ standard deviation) and median [interquartile range], as appropriate.

**RESULTS:** We analyzed 59 TEG 6s values for women in their third trimester of pregnancy. Table 1 presents the results. Prior reference ranges for healthy pregnant women in their third trimester for TEG 5000 and manufacturer reference ranges for healthy volunteers for TEG 6s are presented alongside our results for comparison.

**CONCLUSIONS:** Reaction time, Kinetic time, and Maximum Amplitude all appear to have a lower normal reference range in TEG 6s than in the TEG 5000. Alpha Angle appears to be increased compared to TEG 5000. Normal TEG 6s ranges for pregnant women in their third trimester are important to establish given the potential value of this rapid point of care modality for assessing hemostatic status in pregnancy.

[Moldysz Normal TEG6s.pdf](#)

## Variability in Preparation for Placenta Accreta Spectrum Surgery

**Presenting Author:** Philip E. Hess, MD

**Presenting Author's Institution:** Beth Israel Deaconess Medical Center - Boston, Massachusetts

**Co-Authors:** Sangeeta Kumaraswami, MD; Laura L. Sorabella, MD; Christine M. Warrick, MD ; Ashraf S. Habib, MD

Patients who present with Placenta Accreta Spectrum (PAS) disorders are at high risk of morbidity and mortality from blood loss during surgery. Standardization of obstetric care has been suggested to reduce maternal risk. Anesthetic care plans have historically been left to each individual. We investigated the degree of standardization in the anesthetic preparation for the care of patients with PAS.

### Methods

A survey was distributed to the OB Anesthesia fellowship program directors belonging to SOAP, and members of the Anesthesia group of the Pan American Society for Placenta Accreta Spectrum. The survey consisted of 34 questions focused on preoperative preparation, interdisciplinary communication, operating room equipment, venous access and invasive monitoring. Respondents were requested to provide copies of preoperative checklists or written materials that are used for PAS surgery.

### Results

26 of 56 unique members began the survey and 23 (41%) completed the survey. All were tertiary care centers caring for patients with PAS. The majority of providers were OB anesthesia-specialized (22, 96%), assisted by fellows (14, 61%) or residents (18, 78%). The location of surgery was more often a non-L&D suite followed by an OR on L&D (Table). Majority of centers (21, 91%) expect less than 5L blood loss, while 2 expect more. 19 (82%) of anesthetics are neuraxial, with half reporting a planned conversion to GA after delivery. When describing Preoperative evaluation, Operating room setup, Anesthetic, Venous access, Monitoring and Blood preparation, greater than 90% report moderate or very uniform behavior at their center (Table). However, only 12 (52%) of anesthesia teams use a checklist for preoperative preparation. Even fewer, 9 (39%) of other services (OB, nursing, IR) use standardized materials. Less than half of respondents described venous access and anesthetic choice (10, 46% for both) as "Very Uniform" at their centers.

Most centers use a multidisciplinary meeting for communication, but there is variability in how often the patient is seen in person by Anesthesia, prior to surgery. Having red blood cells in the OR at the start was typical (21, 91%) but the presence of other blood products was variable. Tranexamic acid was given by most (15, 65%). Variability between centers existed in the choice of venous access and monitoring. Less than half (11, 48%) would place an arterial line for a patient with intermediate risk, but most (22, 96%) would do so for patient at high-risk of PAS.

The submitted preparatory materials varied from paragraph-form education to item checklists, with minimal similarities.

### Discussion

Most of those we surveyed believed at least moderate uniformity existed at their center in preparation for surgery for PAS. However, few relied on checklists. We noted variability in set up among centers, which may be due to local factors. Further sharing of information may improve standardization.

[Presentation1.pdf](#)

**Abstract #: FRI – RPS2 – Room 1 – Abnormal Placenta & Coagulation – 06**

**When To Cross: A single center retrospective study of transfusion stewardship for patients with placenta accreta spectrum disorder**

**Presenting Author:** Jessica H. Kruse, M.D.

**Presenting Author's Institution:** Northwestern University - Chicago, Illinois

**Co-Authors:** Elizabeth M. Lange, MD - McGraw Medical Center of Northwestern University

LaTasha Nelson, M.D. - Northwestern University

Edward Tanner, M.D. - Northwestern University

Paloma Toledo, MD, MPH - Northwestern Medicine

**Introduction:**

Obstetric massive transfusion protocols were derived from trauma literature; however, no formal ratios exist for obstetric hemorrhage. Often anesthesiologists order a bundle of blood products (e.g., obstetric massive transfusion protocol) for cases with anticipated high blood loss, but can alter the ratios given the clinical suspicion for bleeding. In an era of blood product shortages, obstetric anesthesiologists may be constraining limited resources. Patients with placenta accreta spectrum disorder (PAS) have the potential for large blood loss, but in order to better allocate resources, it is important to evaluate blood product use in this population. Given that patients scheduled for a planned hysterectomy likely have more extensive PAS disorder, in this study, we compared blood product ordering and use and use as a function of planned hysterectomy status.

**Methods:**

We conducted a retrospective study using a dataset of parturients with a diagnosis of PAS from the Electronic Data Warehouse at Northwestern University. Women who were scheduled for a possible or planned cesarean hysterectomy between July 1, 2009 and June 30, 2021 were included. Data extracted from the electronic medical record included: planned mode of delivery, the number and type of blood products ordered prior to delivery, intraoperative blood loss, and actual blood product use. Data were stratified by planned hysterectomy status. Normal distribution was evaluated with the Shapiro-Wilk test. Categorical data were compared using the chi-squared test and continuous data were compared using the Kruskal-Wallis test.  $P < 0.05$  was used to determine statistical significance.

**Results:**

A total of 114 patients met inclusion criteria; of these cases 39 (34%) were planned hysterectomies. One hundred and nine patients (96%) had blood products crossmatched, and 56 patients (49%) were transfused. Estimated blood loss and transfusion requirements were greater in the planned hysterectomies (Table 1). Only 50% of patients who had packed red blood cells ordered received a red cell transfusion, while only 30% of patients who had FFP or cryoprecipitate ordered received the product, and 10% of patients who had platelets allocated received platelets.

**Conclusions:**

Even with the increasing number of patients with PAS, the rarity of this disease process makes determining optimal management challenging. Despite the increased risk of hemorrhage seen with PAS, our data suggest that the transfusion requirements are often low and perhaps massive transfusion bundles allocated to these cases should be tailored to include fewer blood products.

[PAS Transfusion Table.pdf](#)

Abstract #: FRI – RPS2 – Room 1 – Abnormal Placenta & Coagulation - 07

Obtaining a Reference Range for Rotational Thromboelastometry (ROTEM) in the Obstetric Population at Northwestern Memorial Hospital (NMH). A Prospective Single-Center Study.

**Presenting Author:** Pauline Ripchik, M.D.

**Presenting Author's Institution:** Northwestern University, Feinberg School of Medicine

**Co-Authors:** Mahesh Vaidyanathan, M.D., M.B.A. - Northwestern University, Feinberg School of Medicine

**Introduction:** Postpartum hemorrhage (PPH) is the leading cause of morbidity and mortality in obstetric patients worldwide. ROTEM, an established viscoelastic method for hemostasis testing, can rapidly assess coagulation for prompt identification and treatment of PPH. Fibrinogenemia is associated with increased risk of progression to severe PPH. Utilization of FIBTEM, an assay that looks specifically at fibrinogen activity, allows for rapid evaluation of fibrinogen levels and the need for cryoprecipitate or fibrinogen concentrate. Effective utilization of ROTEM in our obstetric population, due to pregnancy-induced hypercoagulation, requires unique reference ranges. Because ROTEM reference ranges are site-dependent, and NMH's normal ranges were established in the non-pregnant population, our 1<sup>st</sup> aim was to create a unique ROTEM reference range for parturients. At NMH, ROTEM is solely processed in the main lab, which is 2 city blocks away from L&D, and hospital policy did not allow transport (tubing) of samples via the pneumatic tube system for ROTEM analysis. Thus, our 2<sup>nd</sup> aim was to compare values of walked versus tubed ROTEM samples to allow for a change in policy.

**Methods:** 42 at-term parturients at NMH were recruited according to eligibility criteria into 2 groups: planned to deliver vaginally and planned cesarean delivery. Two 3-mL blood samples were drawn from each patient with one sample walked and the other tubed to the main lab. ROTEM values of parturients and non-parturients were described using median and Interquartile Ranges (IQR). The consistency of ROTEM values between walked and tubed samples were assessed using the students t-test.

**Results:** 77 ROTEM values of parturients were compared to the current established normal values for non-parturients (Table 1). FIBTEM values were significantly elevated in parturients. All parturients had elevated IQR values for INTEM and EXTEM at the low end of the range compared to the current established values. A statistically significant difference was noted between walked and tubed samples for INTEM and EXTEM clot time, however, it was within NMH Blood Bank's acceptable clinical variance of 10% (Table 2).

**Conclusions:** We have provided unique ROTEM reference ranges for intrapartum parturients at NMH. Additionally, given the clinically minimal variance we observed between walked and tubed ROTEM samples, our hospital policy has been changed to allow all ROTEM samples to be tubed.

[SOAP ROTEM Figures Ripchik.pdf](#)

Abstract #: FRI – RPS2 – Room 1 – Abnormal Placenta & Coagulation – 08

**Intraoperative red blood cell transfusion: A systematic review and meta-analysis in patients with placenta accreta spectrum**

**Presenting Author:** Alexander J. Butwick, MBBS, FRCA, MS

**Presenting Author's Institution:** Stanford University - Stanford, California

**Co-Authors:** Seul Ku, AB, SM - Stanford University Department of Obstetrics & Gynecology

Stephanie Leonard, PhD - Stanford University School of Medicine

Deirdre Lyell, MD - Stanford University Department of Obstetrics & Gynecology

Pamela Meza, MD - Stanford University Department of Obstetrics & Gynecology

Sarah Miller, MD - Stanford University Department of Obstetrics & Gynecology

Pervez Sultan, MBChB, FRCA, MD (Res) - Stanford University

**Objective:** Cesarean delivery in patients with placenta accreta spectrum (PAS) is associated with a major risk of severe hemorrhage and requirement for massive transfusion. Given the importance of red blood cell (RBC) availability, we performed a systematic review to summarize the literature on intraoperative RBC transfusion during cesarean delivery in patients with PAS.

**Study design:** We identified studies from developed countries published since 2000 using MEDLINE, Embase, CINAHL, Cochrane Central and Scopus databases. We included studies reporting RBC data for at least 10 patients. We conducted a meta-analysis which computed weighted means and 95% CIs using a random effects model to combine the studies while incorporating the study variation. Heterogeneity was assessed using the Cochran's Q-test and the  $I^2$  statistic. Data were presented in a forest plot to summarize results.

**Results:** We screened 4276 studies; 600 underwent full text review and 20 met inclusion criteria with a total of 1046 patients with PAS. The number of transfused RBCs was inconsistently described across studies, with 5 studies (25%) reporting means, 11 (55%) reporting medians, and 4 (20%) reporting individual patients' transfusion data. All studies were based at tertiary obstetric centers. In the meta-analysis, the weighted mean number of RBCs transfused was 5.2 units (95% CI: 4.2-6.1) (20 studies, n=1,096) (Figure 1). Heterogeneity was high across included studies ( $I^2=91\%$ ).

**Conclusion:** Our study suggests that patients with PAS who undergo cesarean delivery receive a mean of 5.2 units RBCs. However, these results should be considered cautiously due to selection bias, small study sizes, high heterogeneity between studies, and concern for confounding from observational studies. Current published data highlight the lack of high-quality evidence guiding transfusion strategies for patients with PAS.

Abstract #: FRI – RPS2 – Room 1 – Abnormal Placenta & Coagulation – 09

**Anesthetic Techniques During the Development of a Novel Surgical Approach To Placenta Accreta Spectrum Disorder: A Case Series**

**Presenting Author:** Mercedes Meuli, DO

**Presenting Author's Institution:** University of California, San Diego

**Co-Authors:** Rodney Gabriel, MD - University of California San Diego

Erin Martin, MD - University of California, San Diego

Lawrence Weinstein, MD - University of California, San Diego

Placenta accreta spectrum (PAS) disorder refers to the pathologic adherence of the placenta to the uterus. PAS often leads to massive hemorrhage, cesarean hysterectomies and maternal morbidity and mortality as the placenta cannot be separated from the uterus.<sup>1</sup> PAS disorders are increasing and is estimated to occur in 1 in 272 pregnancies.<sup>2</sup> Our center's new approach to PAS includes obtaining femoral access, delivery of the neonate followed by multi-vessel embolization and hysterectomy (Placenta Accreta Spectrum Treatment With Intraoperative Multivessel Embolization, PASTIME, protocol).<sup>3</sup> As this surgical technique continued to advance, so did our anesthetic approach. In this case series, we describe this progression in anesthetic technique from general anesthesia (GA) to GA with thoracic epidural anesthesia (TEA) for post operative analgesia to TEA and single shot lumbar spinal. We included 14 patients, six that received general anesthesia (GA), four that received GA with TEA, and four that underwent spinal anesthesia with TEA with conversion to GA after delivery of the fetus. Our primary outcomes includes APGAR scores, phenylephrine dosing, total opioid consumption, estimated blood loss, blood products transfused, hospital length of stay and case duration. Our results showed a statistical significance improvement in APGAR scores between the GA groups and the spinal pre-delivery group. There was a significant statistical increase in phenylephrine dosing with the spinal pre delivery group compared with the GA groups. There was no difference in total opioid consumptions, estimated blood loss, blood product transfused, hospital length of stay, and case duration. This is likely due to small sample size as we did see a trend in decreasing total opioid consumption, case duration, and hospital length of stay. In the future, we hope with decreasing surgical time, we will only need to utilize thoracic epidural with single shot spinal anesthesia and not need to convert to GA. In addition, as this is a small sample size, we hope to continue to collect data with more cases and continue to optimize our anesthetic technique.

[Accreta Table.pdf](#)

## Utilizing Rotational Thromboelastography to Evaluate Coagulation Status in COVID-19 Positive Parturients

**Presenting Author:** Samantha Abel, MD, MS

**Presenting Author's Institution:** Department of Anesthesiology, Perioperative and Pain Medicine, Brigham & Women's Hospital, Harvard Medical School, Boston, Massachusetts, United States, Massachusetts

**Co-Authors:** Dominique Y. Arce, MD, MPH - Department of Anesthesiology, Perioperative and Pain Medicine, Brigham & Women's Hospital, Harvard Medical School, Boston, Massachusetts, United States

Michaela K. Farber, MD, MS - Department of Anesthesiology, Perioperative and Pain Medicine, Brigham & Women's Hospital, Harvard Medical School, Boston, Massachusetts, United States

Kathryn J. Gray, MD, PhD - Department of Obstetrics and Gynecology, Maternal-Fetal Medicine, Brigham & Women's Hospital, Harvard Medical School, Boston, Massachusetts, United States

Mario I. Lumbreras-Marquez, MBBS, MMSc - Department of Anesthesiology, Perioperative and Pain Medicine, Brigham & Women's Hospital, Harvard Medical School, Boston, Massachusetts, United States

**Background:** The hypercoagulable changes of pregnancy have been demonstrated with rotational thromboelastography (ROTEM®) point-of-care testing and pregnancy-specific reference ranges are well established<sup>1,2,3</sup>. Severity of COVID-19 infection has been associated with hypercoagulable changes on ROTEM® testing in non-pregnant patients<sup>4,5</sup>. A recent report of ROTEM® in pregnant patients with and without COVID-19 infection demonstrated increased hypercoagulability in COVID-19 positive parturients, though coincident severity of illness from COVID-19 was not reported<sup>6</sup>. Further understanding of COVID-19 hypercoagulability in pregnancy is warranted to assess thrombotic risk and appropriate thromboprophylaxis in COVID-19 positive patients at the time of delivery. Here we report ROTEM® analysis and symptomatology of parturients with COVID-19 in their second or third trimester.

**Methods:** A pilot prospective cohort study was performed. ROTEM® parameters (EXTEM, INTEM, FIBTEM, APTEM) were evaluated from 14 COVID-19 positive pregnant patients admitted to our tertiary center in the 1<sup>st</sup>, 2<sup>nd</sup>, and 3<sup>rd</sup> trimesters between May 2020 and April 2021. First trimester data were excluded from the comparative analysis due to small sample size (N=1). We compared 2<sup>nd</sup> and 3<sup>rd</sup> trimester data with trimester-specific obstetric ROTEM® reference ranges using one-sample t-tests<sup>3</sup>. We also analyzed data stratified by disease severity (asymptomatic/mild, moderate, severe, critical, as defined by the NIH COVID-19 treatment guidelines) as an exploratory analysis<sup>7</sup>.

**Results:** ROTEM® results are shown in the Table. Five patients in the 2<sup>nd</sup> trimester and eight in the 3<sup>rd</sup> trimester who were COVID-19 positive were included in the main analysis. All 2<sup>nd</sup> trimester patients were symptomatic on enrollment. Four 3<sup>rd</sup> trimester patients were asymptomatic on enrollment, two of which remained asymptomatic throughout their infection. The ROTEM® FIBTEM maximum clot firmness (MCF) was significantly increased in both trimester groups (P=0.007 and P=0.029). On exploratory analysis stratifying by disease severity (asymptomatic/mild N=5, moderate N=3, severe N=5, and critical N=1), no significant differences were found.

**Conclusion:** Our findings suggest that COVID-19 infection in parturients may cause hypercoagulable changes beyond baseline hypercoagulability of pregnancy, demonstrable with ROTEM® testing and irrespective of degree of illness or symptoms. Taken with a previous study, these data justify careful venous thromboembolism prophylaxis in COVID-19 patients in the peripartum period, irrespective of their degree of illness.

[ROTEM TABLE.pdf](#)

**Abstract #: FRI – RPS2 – Room 1 – Abnormal Placenta & Coagulation - 11**

**Racial/Ethnic Differences on Baseline Coagulation Parameters using Point of Care Viscoelastic Testing for Obstetric Patients**

**Presenting Author:** Jin Yoo, BS

**Presenting Author's Institution:** Rutgers Robert Wood Johnson Medical School - New Brunswick

**Co-Authors:**

Point of Care Viscoelastic Testing (POCVT) time-efficiently monitors whole blood coagulation. Its use in postpartum hemorrhage (PPH) guides blood product management and improves patient outcomes, especially in high-risk women.<sup>1</sup> Baseline parameters for obstetric patients, who are hypercoagulable at baseline, have been reported, but the impact of race/ethnicity has not been described. Our primary aim is to provide baseline parameters for the rotational thromboelastometry (ROTEM) device in a diverse, representative sample.

From 2015 to 2020, ROTEM was conducted on 681 obstetric patients. Inclusion criteria included healthy patients with a history of PPH, preeclampsia, gestational diabetes, and hypertension. Exclusion criteria included antepartum hemorrhage, thrombophilia, and receiving medications affecting coagulation, tranexamic acid, or blood products before ROTEM analysis. Welch's t-tests and pairwise comparisons were performed on ROTEM parameters by self-identified race/ethnicity on a total of 485 charts (Table 1).

Compared to White counterparts, Black patients exhibit a hypercoagulable profile, evidenced by increases in fibrinogen, internal, and external pathway parameters. Asian patients demonstrate a hypocoagulable state, with decreases in fibrinogen and external parameters.

This corroborates previous studies that show lower and higher risk of venous thromboembolism (VTE) in Asian and Black patients, respectively.<sup>2</sup> Despite providing plausible relation between race and coagulopathy, our study does not account for social determinants of health or the obesity prevalence in our sample's Black patients: for instance, social stressors (e.g., unemployment, access to care, obesity) may increase fibrinogen levels, leading to a hypercoagulable state.<sup>3,4</sup> Our results agree with previous population studies that suggest race/ethnicity is associated with variable risk of VTE.<sup>4</sup> Although more research must confirm our findings, some literature suggests that race/ethnicity should be considered when assessing thromboprophylaxis prophylaxis. However, while such algorithms may help, their impact should be closely monitored as they could exacerbate systemic disparities.<sup>5</sup> Rather, our results elicit the need to better understand the intricate relationship of social/ethnic factors and health.

Table 1: Average ROTEM parameters and comorbidity prevalence by self-identified race/ethnicity.

	Self-identified Race/Ethnicity, n(%)				p-value
	White 261(53.8%)	Black 110(22.7)	Asian 22(4.5)	Other 92(19)	
<b>Comorbidities</b>					
BMI >35 kg/m <sup>2</sup>	84 (32)	58 (52.7)	2 (9.1)	34 (37)	
gHTN	66(25.3)	42 (38.2)	2 (9.1)	25 (27.2)	
gDM	29(11.1)	21 (19.1)	7 (31.8)	16 (17.4)	
PEC	40(15.3)	30 (27.2)	0	7 (31.8)	
<b>ROTEM Parameters</b>					
	Mean (standard deviation)				
<b>FIBTEM</b>					
CT	58.0 (18.6)	57.5 (13.1)	57.0 (9.2)	58.1 (10.1)	0.96
Alpha angle	75.2 (4.8)	76.3 (5.0)	72.8 (4.5)	75.8 (4.0)	0.007
MCF	25.5 (6.0)	27.4 (7.8)	21.7 (5.1)	26.2 (6.2)	<0.001
A10	23.0 (5.4)	25.6 (6.7)	19.7 (5.0)	24.1 (5.2)	<0.001
<b>EXTEM</b>					
CT	63.3 (37.3)	61.7 (12.9)	60.6 (7.1)	61.2 (9.7)	0.80
CFT	74.7 (33.3)	63.8 (17.6)	85.5 (24.5)	70.7 (26.3)	<0.001
Alpha angle	76.2 (4.5)	77.5 (3.6)	73.8 (3.2)	76.6 (4.0)	<0.001
MCF	70.1 (6.1)	70.7 (7.5)	67.8 (5.2)	71.0 (6.3)	0.083
A10	62.7 (7.5)	65.0 (6.5)	59.5 (6.4)	64.2 (7.8)	<0.001
<b>INTEM</b>					
CT	164.1 (39.7)	159.6 (34.9)	172.2 (28.9)	166.0 (42.4)	0.30
CFT	73.2 (37.4)	63.3 (21.7)	80.2 (33.7)	63.3 (22.1)	0.001
Alpha angle	76.0 (5.2)	77.3 (3.8)	74.1 (5.0)	77.5 (3.7)	<0.001
MCF	67.7 (6.8)	68.6 (8.4)	66.0 (6.1)	69.6 (6.2)	0.027
A10	60.4 (7.9)	63.2 (7.2)	58.1 (7.2)	63.1 (7.3)	<0.001
Difference of means (standard error), [95 %Confidence interval], p-value					
FIBTEM A10		2.67 (0.73), [1.23, 4.11], p <0.001	-3.38 (1.09), [-5.43, -1.13], p = 0.003		
EXTEM A10		2.40 (0.78), [0.87, 3.93], p =0.002	-3.30 (1.41), [-6.08, -0.52], p = 0.020		
INTEM A10		2.85 (0.86), [1.16, 4.54], p = 0.001		2.69 (0.92), [0.87, 4.50], p = 0.004	

Table 1. Comorbidity prevalence and average ROTEM parameters of 485 patients, stratified by self-identified race/ethnicity, included in statistical analysis for obtaining baseline parameters at our tertiary care unit in the United States. Difference of means indicates a comparison between specified race/ethnic patients to White patients. "Other" included patients identifying as Hispanic/Latino, Pacific Islander, or multiple groups. Y: years; BMI: body mass index; gHTN: gestational hypertension; gDM: gestational diabetes mellitus; PEC: preeclampsia; CT: clotting times; MCF: Maximum clot firmness; A10: amplitude at 10 minutes; A20: amplitude at 20 minutes.

Abstract #: FRI – RPS2 – Room 2 – Cesarean Delivery - 01

## Administration of intravenous adjuvants during cesarean delivery: retrospective cohort study comparing intrapartum versus non-intrapartum cesarean deliveries

**Presenting Author:** Michael Kim, MD

**Presenting Author's Institution:** New York Presbyterian - Columbia University Campus

**Co-Authors:** Ruth Landau, M.D. - Columbia University

Rohan Prabhu, MD - Columbia University

Katharine E. Thompson, M.D. - Columbia University

Daniel Tobes, MD - Columbia University Medical Center

### Introduction

The International Association for the Study of Pain defines pain as ‘an unpleasant sensory and emotional experience associated with, or resembling that associated with, actual or potential tissue damage’.<sup>1</sup> Depending on the circumstances and definitions, the reported incidence of insufficient neuraxial anesthesia with breakthrough pain during cesarean delivery (PDCD) ranges between 0.5% and 20%,<sup>2</sup> which may cause a traumatic birth experience<sup>3</sup> and litigation.<sup>4</sup> With recent focus to prevent, identify, and manage PDCD under neuraxial anesthesia, insufficient analgesia/anesthesia has been defined as “any circumstance when a patient is requesting additional medication to alleviate discomfort or pain”.<sup>2,5</sup> There have been few reports specifically evaluating the use of adjunct anesthetic medication or general anesthesia for PDCD.<sup>6</sup> We designed this retrospective cohort study to identify current patterns of intraoperative intravenous (IV) adjuvant administration as a marker for PDCD.

### Methods

Data from all cesarean deliveries under neuraxial anesthesia performed at our center between 03/2020 -12/2021 were analyzed using the Epic data tool SlicerDicer. The primary goal was to identify all cases with IV administration of midazolam, fentanyl, morphine, ketamine, and combinations of these, comparing intrapartum (epidural) vs non-intrapartum (spinal/CSE) cases. The decision and choice of IV adjuvant administration during cesarean delivery is at the discretion of the anesthesia care team. Chi-square test was used for comparisons between intrapartum vs non-intrapartum cesarean deliveries.

### Results

Excluding cases where general anesthesia was provided for non-pain reasons, there were 3221 cesarean delivery cases during the study period, of which 758 (23.5%) received IV adjuvants. There was a significant difference between intrapartum (29.60%) vs non-intrapartum (20%) cases (Figure;  $p < 0.001$ ). In both, 9% of cases received midazolam (alone), however IV analgesics (ketamine and opioids) were more frequently given during intrapartum cases (Figure). Conversion rate to general anesthesia for pain occurred in 3 (0.25%) intrapartum vs 2 (0.01%) non intrapartum cases ( $p=0.28$ ).

### Discussion

The relatively high use of IV adjuvants during intrapartum cases (29.6%) might have been expected, but we did not anticipate that 20% of cases with a spinal/CSE would receive IV adjuvants. These findings warrant further examination of the triggers for use of IV adjuvants and patient/obstetric/anesthesia-specific factors associated with PDCD. Ultimately the goal is to improve patients’ experience by identifying predictors for PDCD, offering guidance for management of PDCD, and ensuring that women with a traumatic birth experience receive the appropriate follow-up.

[PDCD figure Feb 01 MK.pdf](#)

Abstract #: FRI – RPS2 – Room 2 – Cesarean Delivery - 02

## Reduction of General Anesthesia Rate by Improving Multidisciplinary Communication Before Unscheduled Cesarean Sections

**Presenting Author:** Andrea Girnius, MD

**Presenting Author's Institution:** University of Cincinnati - Cincinnati, Ohio

**Co-Authors:** Candice Snyder, MD - University of Cincinnati

**Background:** The use of general anesthesia (GA) for cesarean section (C/S) is associated with elevated maternal risk. Our overall GA rate for C/S ranges from 9-17%, with GA use for unscheduled C/S specifically as high as 22%. Failures of communication surrounding critical events can lead to suboptimal patient care and can contribute to avoidable use of GA (1).

**Objectives:** 1) Identify modifiable system factors that contribute to the use of GA and design interventions to reduce GA use for unscheduled C sections. 2) Achieve 80% adherence to our interventions.

**Setting:** An 800-bed academic Level 4 Maternal Care Center with a 13-bed Labor and Delivery unit in Cincinnati, Ohio. We have approximately 2500 deliveries/year and a C section rate of 35%. We have a dedicated anesthesia team available 24 hours a day.

**Method:** Using the Model for Improvement, we sought to understand the failures leading up to unscheduled C/S that may lead to avoidable GA use. We found that communication among nursing, anesthesia, and obstetric (OB) teams was fragmented, delayed, and frequently incomplete and inadequate for providing coordinated multidisciplinary care. We developed and introduced a multidisciplinary, patient centered pre-C/S huddle attended by representatives from nursing, anesthesia, and OB. A standard checklist of critical information was used as a discussion guide. It was tested and refined through iterative PDSA cycles prior to implementation.

**Measures:** Outcome measures: 1) GA rate for unscheduled C/S, and 2) satisfaction with communication regarding C/S plan among anesthesia, nursing, and OB teams. Process measures: Adherence to pre-C/S multidisciplinary team huddle. Balancing measure: Decision to incision interval (DTI) for unscheduled C/S.

**Results:** Lack of shared understanding of the urgency of C/S was the most frequent communication failure. A total of 34 PDSA cycles were performed. The average adherence to the pre-C/S huddle reached 84% within 2 months of implementation. The rate of GA for unscheduled C/S decreased from 22% to 8.5%. Satisfaction with communication about unscheduled C/S improved from 2.83 to 4.7 on scale of 0-5. The DTI remained unchanged at 52 minutes. Qualitative patient feedback about the huddle was highly positive.

**Conclusion:** System barriers led to unclear and inaccurate communication surrounding unscheduled C/S. Implementation of a multidisciplinary in-person pre C/S huddle improved communication between teams and reduced general anesthesia rates for unscheduled C/S. Our next steps are to ensure sustainability of the process and continue to mitigate other causes of avoidable GA use for C/S.

## Rates of General Anesthesia for Cesarean Delivery in Women Identifying a Non-English Language as Their Primary Language: A Quality Improvement Project

Presenting Author: Monique Osigbeme, MD

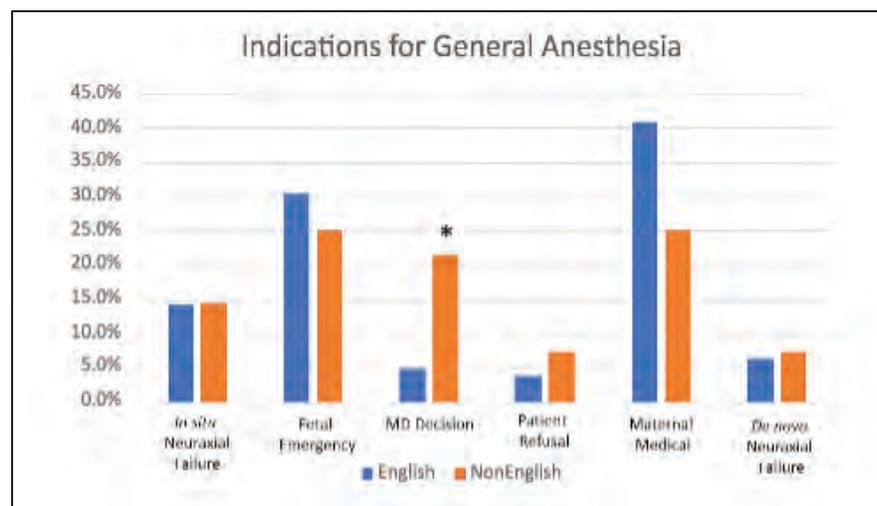
Presenting Author's Institution: Vanderbilt University Medical Center

**Introduction:** Neuraxial anesthesia is widely accepted as the safest anesthetic technique for mothers and babies undergoing cesarean delivery.<sup>1</sup> In the United States, from 2003-2014, “potentially avoidable” general anesthesia (GA) rates in white women declined from 6.1 to 3.6%.<sup>2</sup> Compared to white women, Hispanic women were 15% more likely to receive GA without a documented indication.<sup>2</sup> We hypothesized that language barriers may contribute to higher GA rates in patients with limited English proficiency, due to communication challenges during emergent or time-sensitive situations. We therefore sought to compare rates of GA for cesarean delivery between women who identify English versus non-English as their primary language.

**Methods:** All women undergoing a cesarean delivery from January 2019 to September 2021 at a single institution were retrospectively identified by electronic medical records (EMR) query. Primary language was self-reported by patients. Type of anesthesia (general or neuraxial) was electronically identified from anesthetic records and manually validated and classified by indication by authors. Indications were characterized as in situ neuraxial failure, fetal emergency with no in situ neuraxial, MD decision making, patient refusal, maternal medical contraindication to neuraxial technique, or de novo neuraxial failure. Examples of indications for MD decision making included: NPO status, preterm labor, triplets or intrathecal catheter.

**Results:** 4,936 cesarean deliveries were identified, 4,110 English and 826 non-English. Overall general anesthesia rate was 4.4% and was not statistically different between groups (English 4.6% vs. non-English 3.4%;  $p=0.11$ ). More patients in the non-English group received GA for MD decision making ( $p=0.001$ ). All other indications for GA were not different (Figure 1).

**Conclusion:** We did not show a difference in GA rates at our institution for women who identify a non-English primary language. However, the number of GAs performed for the more subjective “MD decision making” indication was higher in the non-English group, which may indicate some disparities based on primary language. Future directions for this quality improvement project will include continued surveillance of GA rates and indications by language as well as review of intraoperative supplementation data, to ensure that GA is not being inappropriately withheld when patients experience discomfort intraoperatively.



Abstract #: FRI – RPS2 – Room 2 – Cesarean Delivery - 04

## Racial Disparities in Pain after Cesarean: Implementation of a *Plan-Do-Study-Act* (PDSA) Improvement Process

**Presenting Author:** Joseph Reno, MD

**Presenting Author's Institution:** University of Washington

**Co-Authors:** Anjum Anwar, MBBS - University of Washington

Laurant Bollag, MD - University of Washington

Nadine Martinez, DNP, RNC-OB - University of Washington Medical Center

LaVone E. Simmons, MD - University of Washington

### **Background:**

Disparities for black, indigenous, and person of color parturients are well described<sup>1</sup>. With a grant to improve peripartum care our institution began a multidisciplinary Plan-Do-Study-Act (PDSA) process aimed at post cesarean pain scores among different groups.

### **Methods:**

Using AdaptX software to query data from our electronic health record (EHR), we compared maximum pain scores for 8 groups (Black, American Indian/Alaskan Native, Asian, Hawaiian/Pacific Islander, white, other, multiple, or not declared) during the first and second 24 hour periods post cesarean before and after PDSA intervention in September 2021. We included scheduled and unscheduled cesareans. The PDSA intervention aimed at parts of postpartum care open to interpretation. We made a script and visual decision aid for analgesia discussions with the patient, synchronized phrasing between anesthesiologists and nurses, and clarified a vague indication for oxycodone.

### **Results:**

We analyzed 2077 patients in all groups of the Before cohort and 262 in the After cohort. Among all groups, the average maximum pain score changed from 5.45 to 5.38 (first 24h) and 5.38 to 5.58 (second 24h). For Black patients (n=238 Before and 22 After), the average maximum pain score went from 6.18 to 6.09 (first 24h) and 6.06 to 6.55 (second 24h). For American Indian and Native Alaskan patients (n=43 Before and 4 After), the average maximum pain score went from 6.12 to 6.25 (first 24h) and 6.4 to 5.25 (second 24h). Maximum pain scores for the first 24h were outside 3 sigma control limits for Black patients, but after the intervention they were within limits. For the second 24h period, maximum pain scores were outside 3 sigma limits for Black and American Indian/Native Alaskan patients, but these too dropped within limits.

### **Discussion:**

We found that Black patients had higher pain scores compared to other patients. This disparity did not improve with our intervention targeting subjective aspects of care. In our search, we found the EHR had no requirement or ability to document if indicated analgesic doses were not given. This project highlights several important issues. First, audits are key to ensure complete implementation. Second, pain scores are easily tracked but are not ideal as an index of recovery<sup>2-3</sup>. Pain reflects many factors hard to quantify and not well documented in EHRs. Third, it is doable to leverage EHR data in a timely fashion to facilitate PDSA cycles.

### **Acknowledgements:**

Institute for Healthcare Improvement support was funded by a Merck for Mothers grant. AdaptX extracts and analyzes EHR data for daily updates on clinical trends.

[Fig1 Post-Cesarean Pain EDI Abstract.pdf](#)

Abstract #: FRI – RPS2 – Room 2 – Cesarean Delivery - 05

## General anesthesia for cesarean delivery in African Americans: The needle has not moved

Presenting Author: Daniel Couper, Medical Student

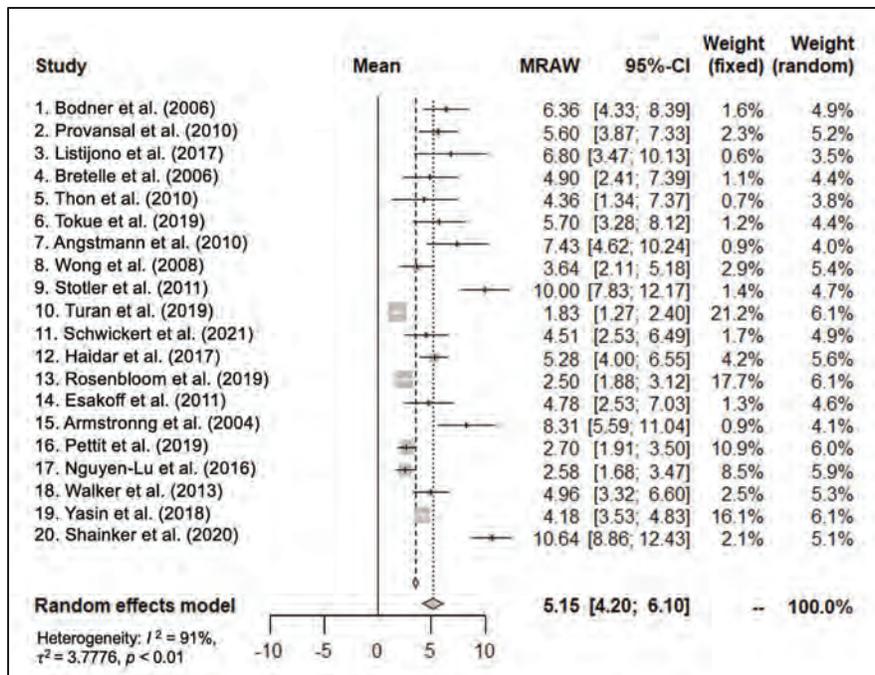
Presenting Author's Institution: Medical University of South Carolina

**Introduction:** Neuraxial anesthesia (NA) is associated with less maternal mortality and morbidity and is the preferred anesthesia technique for cesarean delivery (CD) compared to general anesthesia (GA). Data from two decades ago demonstrated that African Americans (AA) have higher rates of GA for CD. Our observational study investigated current trends in modes of anesthesia care for CD based on race at our institution.

**Methods:** A retrospective analysis of anesthesia encounters for CDs that occurred at a single tertiary academic center between 2019 and 2020 under GA were done. Data collected included: *Race:* AA, white (W), or other (O); *Demographics:* maternal age, BMI, parity, diabetes/hypertension or preeclampsia, gestational age; *GA indication:* primary GA, failed primary NA block, or failed labor epidural conversion; *Urgency of CD:* elective, urgent and emergent; and e) *indications for primary GA:* fetal distress, maternal indication, or contraindication to neuraxial block. A preliminary analysis of differences in rates of CD under GA and primary GA by race were evaluated using a series of chi-square tests.

**Results:** There were 6,077 deliveries between 2019 and 2020, and 2,495 were CDs. Of those, 258 were under GA (10%). There was a significant difference in the proportion of CDs by race ( $P < 0.0001$ ). Specifically, a significantly greater proportion of AA mothers had a CD relative to W mothers ( $P = 0.0044$ ). There was a significant difference in the proportion of CDs with GA by race ( $P = 0.0001$ ). Specifically, a significantly greater proportion of AA mothers had CD with GA compared to W mothers ( $P = 0.0346$ ). The absolute difference in rates of primary GA between AA and W mothers was 9.3% among mothers who had CD with GA (55.5% vs. 46.2%). There were no significant statistical differences in the proportion of CDs under primary GA by race ( $P = 0.3692$ ). Specifically, there was not a statistically significant difference in the proportion of AA mothers compared to W mothers for CDs under primary GA ( $P = 0.2114$ ). Among mothers who had primary GA for CD, the rate of emergent CD was higher for AA mothers relative to W mothers ( $p=0.0003$ ). AA mothers who had primary GA delivered at lower gestational age relative to W mothers ( $P = .0004$ ). Fetal indications for CD were higher for AA cohort under primary GA relative to W mothers ( $P = 0.016$ ).

**Discussion:** Based on data from this single academic institution cohort, rates of CD, emergent CD, and CD under GA were higher in AA mothers relative to W mothers. This may be partially due to AA mothers having a higher rate of preterm and urgent CD's compared to W mothers. While the study was underpowered statistically to determine if the rate of primary GA for CD was higher in AA mothers, the 9.3% difference is clinically significant and efforts to decrease the incidence of primary GA in AA mothers requires a robust peripartum effort.



## Inequities in Cesarean Delivery during the COVID-19 Pandemic

Presenting Author: TRUNG Q. PHAM, MD

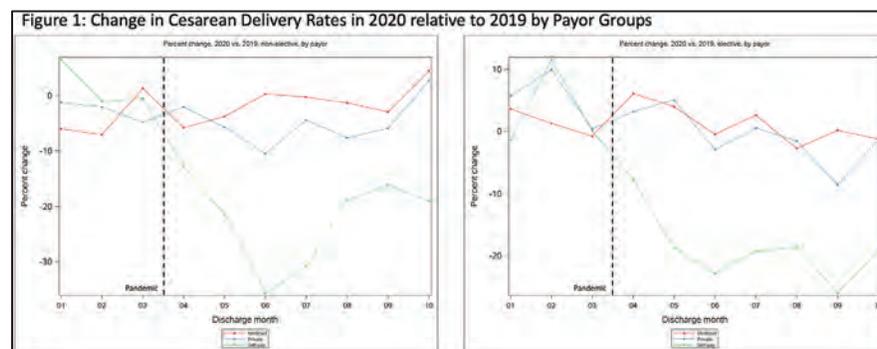
Presenting Author's Institution: Duke University Hospital - MOORE, Oklahoma

**Background:** The impact of the COVID-19 pandemic on Cesarean Delivery (CD) rates in the United States is not known. We examine how restrictions on surgery imposed in March 2020 impacted CD rates, and whether racial, ethnic and payor groups were differentially affected <sup>1-3</sup>.

**Methods:** We conducted this retrospective cohort study using the Premier Healthcare Database (PHD), Premier Inc, the largest all-payor hospital discharge database in the United States. We identified CD encounters between January 1, 2019, and October 31, 2020, using Diagnosis-Related Groupings and International Classification of Diseases, Tenth Revision, Clinical Modification procedure codes. We restricted the analysis to hospitals that submitted data every quarter and excluded patients insured by Medicare (< 1% of this population). Using detailed de-identified and HIPAA-compliant information in the PHD, we identified the procedure (elective versus non-elective), race and ethnicity (Non-Hispanic White (NHW), Non-Hispanic Black (NHB), Hispanic (H), and Other/Unknown); and payor (Medicaid, Private, Self-Pay) in each encounter. For each month in January-October 2020, we calculated the reduction in CD rates relative to the same month in 2019 by: a) procedure type (elective, non-elective), b) race and ethnicity, and c) payor.

**Results:** Among 329,765 CD encounters within 322 US hospitals, 130715 (39.6%) were non-elective and 199050 (60.4%) were elective. Women were 39.5%, 14.5% and 17% NHW, NHB, and Hispanic respectively, while 29% had Other/Unknown race and ethnicity. Overall, 56.5% and 40.4% were insured privately and by Medicaid respectively, and 3.1% were self-pay (uninsured, indigent, charity care). Both elective and non-elective encounters decreased slightly (approx. 5% at most) after March 2020, and by October non-elective CD had slightly (2%) exceeded pre-pandemic levels (Figure 1). While there were no major differences across NHW, NHB, and Hispanic women, women with race and ethnicity listed as other/unknown had significant relative reductions in CD encounters. However, the largest reductions in CD encounters in 2020 were among women in the self-pay group (20-30% decrease versus privately or Medicaid insured women).

**Conclusions:** This is the first nationwide study estimating the impact of the COVID-19 pandemic on Cesarean Delivery rates in the US. Overall, elective and non-elective encounters declined only slightly (unlike a variety of other procedures). There were no major differences by race/ethnicity. However, when compared with insured women, women in the self-pay group had major reductions in CD encounters (20-30% decrease) during the time of the COVID-19 pandemic. This concerning finding warrants further study.



**Abstract #: FRI – RPS2 – Room 2 – Cesarean Delivery - 07**

**General anesthesia at time of emergent cesarean delivery and adverse neonatal outcomes**

**Presenting Author:** Gabriela Dellapiana, MD

**Presenting Author's Institution:** Cedars-Sinai Medical Center - Los Angeles, California

**Co-Authors:** Richard Burwick, MD, MPH - Cedars-Sinai Medical Center

Savannah Gonzales, MD - Cedars-Sinai Medical Center

Candace Levian, MD - Cedars-Sinai Medical Center

**OBJECTIVE:** General anesthesia (GETA) is often necessary for emergent cesarean delivery (CD), but it may impact neonatal resuscitation. We hypothesize that fetal GETA exposure during emergent CD increases the risk for adverse neonatal outcomes.

**STUDY DESIGN:** Cohort study of patients undergoing emergent CD from July 2012 to April 2020 at a single institution. Cases were identified through a natural language search engine and chart validation. The primary exposure was use of GETA compared to use of neuraxial anesthesia. The primary outcome was a composite of markers for neonatal metabolic acidosis including arterial cord pH $\leq$ 7.0, base excess  $\geq$ 12, or 5-minute Apgar < 7. Secondary outcomes included neonatal intensive care unit (NICU) admission and neonatal death. Maternal and delivery characteristics were evaluated as confounders. Statistics by  $\chi^2$ , t-test, Wilcoxon ranksum, and logistic regression;  $\alpha=0.05$ .

**RESULTS:** From 50,494 deliveries, 468 (0.9%) had emergent CD. GETA was required in 26% of patients (N=120) and neuraxial anesthesia in 74% (N=348). Patients requiring GETA were more likely to have lower BMI, twin gestation, or preterm delivery. The indication for emergent CD in patients with GETA was more likely to be cord prolapse, malpresentation in labor, or vaginal bleeding; whereas those with neuraxial anesthesia were more likely to have non-reassuring fetal heart tracing or failed operative vaginal delivery. Compared to patients receiving neuraxial anesthesia, patients requiring GETA for emergent CD were more likely to experience the primary composite neonatal outcome (40% vs 21%,  $p < .001$ ), NICU admission (68% vs 38%,  $p < .001$ ), and neonatal death (6% vs 2%,  $p=0.018$ ), Table 1. These associations with use of GETA remained significant after adjusting for confounders: composite neonatal outcome (aOR 2.5, 95% CI 1.5-4.2); NICU admission (aOR 1.9, 95% CI 1.1-3.4).

**CONCLUSION:** Use of general anesthesia at the time of emergent CD is associated with increased risk for adverse neonatal outcomes and NICU admission, but more research is needed to determine if GETA impacts long-term outcomes.

**Table 1. Neonatal outcomes by exposure to general anesthesia at the time of emergent cesarean delivery**

	General Anesthesia N=120	No General Anesthesia N=348	<i>P</i>
Composite <sup>a</sup>	48 (40)	74 (21)	<.001
Arterial cord blood gas <sup>b</sup>			
pH ≤7.0	18 (16)	43 (14)	.570
BE ≥12	14 (13)	35 (11)	.740
5-minute Apgar <7	37 (31)	38 (11)	<.001
Birthweight (g)			<.001
Low birthweight (≤2500g)	63 (53)	63 (18)	<.001
1-minute Apgar	4.7 ± 2.7	6.6 ± 2.4	<.001
5-minute Apgar	7 ± 2.4	8.2 ± 1.6	<.001
10-minute Apgar <sup>c</sup>	6.5 ± 1.8	7 ± 2.3	.386
pH	7.15 ± 0.1	7.13 ± 0.1	.079
BE	6 ± 5	7 ± 4	.215
pCO <sub>2</sub>	69 ± 22	70 ± 18	.523
pH≤7.1	32 (29)	116 (37)	.093
NICU admission	82 (68)	131 (38)	<.001
Neonatal death	7 (6)	6 (2)	.018

Data are mean ± SD or N (%); P-value by  $\chi^2$  or t-test as appropriate

BE, base excess; NICU, neonatal intensive care unit

<sup>a</sup> Composite neonatal outcome includes arterial cord pH ≤7.0, Base Excess ≥12, or 5-minute Apgar <7

<sup>b</sup> Data available for 422 patients (112 general anesthesia; 310 no general anesthesia)

<sup>c</sup> Data available for 80 patients

Abstract #: FRI – RPS2 – Room 2 – Cesarean Delivery - 08

**Relationship Between Maternal Satisfaction and Quality of Recovery After Cesarean Delivery: A Mixed-Methods, Prospective, Observational Study**

**Presenting Author:** Robert Ffrench O'Carroll, MBCh BAO, MSc, FCAI

**Presenting Author's Institution:** National Maternity Hospital, Dublin, Ireland - Vancouver, British Columbia

**Co-Authors:** Arianne Albert, PhD - Women's Health Research Institute, Vancouver BC

Cyrus Bhiladvala, BSc - University of British Columbia

Anthony Chau, MD FRCPC MSc - BC Women's Hospital, University of British Columbia

Ulrike Mayer, PhD - Women's Health Research Institute, Vancouver BC

Luc Saulnier, BA (Hons.) MA - BC Women's Hospital, Vancouver BC

**Background:** Patient satisfaction and quality of recovery (QoR) are important patient-reported outcomes; however, their relationship is complex. In the non-obstetric population, studies have found patient satisfaction is strongly influenced by certain elements of QoR,(1) yet a weak correlation between these two metrics has also been reported.(2) We sought to evaluate the correlation between patient satisfaction and QoR in women after cesarean delivery (CD). As a secondary aim, we aimed to determine the influence of urgency of procedure and mode of anesthesia on the correlation between satisfaction and QoR.

**Methods:** Upon informed consent, women undergoing CD were invited to complete two paper-based questionnaires at 24 hours after surgery. Satisfaction was assessed using the Maternal Satisfaction Scale for Cesarean Section (MSCS) (3) and QoR was measured using the ObsQoR-11 questionnaire.(4) In addition, patient rated their overall satisfaction score from 0 to 10 followed by three open-ended questions.(Table 1) Correlations were assessed using Spearman's rank tests. The influence of urgency of procedure and mode of anesthesia on the correlation between MSCS and ObsQoR-11 was analyzed by linear transformation followed by multivariable linear regression. Qualitative responses from the open-ended questions were analyzed using thematic content analysis.

**Results:** Data were collected from 164 women. There was a significant correlation between MSCS and ObsQoR-11 scores ( $r=0.33$ ,  $p< 0.0001$ ). Overall patient satisfaction was significantly correlated with MSCS ( $r=0.40$ ,  $p< 0.0001$ ), but not with ObsQoR-11 ( $r=0.12$ ,  $p=0.13$ ). Patients who received spinal anesthesia had significantly lower correlation between MSCS and ObsQoR-11 scores ( $p=0.048$ ); in this subgroup, satisfaction remained consistently high despite lower ObsQoR-11 in some patients. Urgency of procedure did not influence the correlation between MSCS and ObsQoR-11. The most frequent theme for patient satisfaction was excellent communication and information delivery; the most frequent theme for patient dissatisfaction was related to negative postpartum room experiences such as noise level or lack of partner bed.

**Conclusion:** Maternal satisfaction and QoR are distinct entities with a medium-sized correlation between the MSCS and ObsQoR-11 scores. Assessment of quality of care in obstetric patients should consider both metrics. Maternal satisfaction was consistently high after spinal anesthesia, and was unaffected by lower ObsQoR score or urgency of the procedures, indicating specific elements of spinal anesthesia had a significant influence in driving a positive patient experience. Based on patients' feedback, improvement in the physical space and infrastructure of postpartum rooms may further increase satisfaction.

**Table 1. Results from Qualitative Analysis of Three Open-Ended Questions on Satisfaction with Care**

Question	Main Theme	Sub Theme	Frequency
1. What aspects of your care were you most satisfied with?	Positive Interactions with Care Providers	Communicative / Informative Care Providers	33.5 %
		Quality of Care / Attentive Care	14.0 %
		Friendly / Compassionate Care Provider Interactions	13.5 %
		General / Unspecified Satisfaction	12.5 %
		Competent / Professional Care Providers	10.2 %
	Positive Procedure Experience	Anesthesia Efficacy / Feeling Safe	7.8 %
		General / Unspecified Satisfaction	7.4 %
2. What aspects of your care were you most dissatisfied with?	No Negative Concerns	n/a	37.6 %
	Concerns with Hospital Stay	Patient Room Too Outdated, Small, Old, Loud, Etc.	15.3 %
		Extended Waiting Time	8.9 %
		Lack of Partner Bed and/or food for Partner	4.5 %
		Concerns with Sharing Room with Other Patient	3.8 %
		Unsatisfied with Hospital Food	3.8 %
	Concerns Arising from Care Provided	Lack of Communication	3.2 %
		Uncompassionate Encounters	3.2 %
		Resident/Fellow/Preceptor Inexperience	2.5 %
	Experiencing Side Effect(s) from Anesthesia	Shivering / Itching / Nausea / Loss of Control	9.6 %
		General Pain	4.5 %
Syringe Injection Pain or Fear of Syringe		2.6 %	
3. Do you have any suggestions on what would improve your satisfaction ?	No Suggestions	n/a	58.3 %
	Improvements to Hospital Stay	General Room Updates or Improvements	20.9 %
		Improved Food Quality	1.7 %
	Make information more available	n/a	7.0 %
	Improvements to Care Provided	Increased Communication / Compassion / Bedside Manner	6.8 %
		Quicker Response from Care Providers	3.5 %
		Better Staff to Patient Ratio	2.6 %

**Abstract #: FRI – RPS2 – Room 2 – Cesarean Delivery - 09**

**A Retrospective Study: Factors Associated with Conversion of Neuraxial Anesthesia to General Anesthesia for Cesarean Delivery**

**Presenting Author:** Nikhil Kamath, M.D.

**Presenting Author's Institution:** University of Arkansas for Medical Sciences

**Co-Authors:** Nadir El Sharawi, M.D. - University of Arkansas for Medical Sciences  
Shelby Webb, M.D. - The University of Chicago Medical Center

Neuraxial anesthesia (NA) is considered the standard of care for Cesarean delivery (CD) due to its numerous benefits and safety compared to general anesthesia (GA). GA is associated with a higher rate of airway complications, exposes the fetus to GA medications, and is associated with higher postoperative opioid requirements.<sup>1</sup> The primary objective of this study is to determine the incidence of NA anesthetics converted to GA for CD at our institution. The secondary objective is to describe the population in which NA anesthesia failed. We extracted data of all patients at our institution who required conversion of NA to GA for CD from the period January 1, 2015 to November 13, 2019. Inclusion criteria for this group were gravid female patients > 17 years old, presence of a NA procedural note, operative report for CD, administration anesthetic agents, and insertion of an airway device. We excluded patients who underwent any other surgical procedure which was not a CD. We abstracted the following data points: patient demographics, primary NA technique, gravidity and parity, urgency of CD and time of conversion to GA. During our time interval, there were a total of 5686 women who received NA techniques for CD. Of these women, 200 required conversion to GA, therefore the incidence of NA failure was 3.5% (Figure 1). The characteristics of NA failure and primary mode of anesthesia are described in Table 1. NA failure was more common in women undergoing CD with traditional epidural extension anesthesia compared to combined spinal-epidural/dural-puncture epidural (CSE/DPE) as the primary mode of anesthesia. Classical CD and CD with T-extension were more likely to fail in the top-up epidural group than the top-up CSE/DPE group ( $p < 0.0001$ ). There were no statistically significant differences in urgency of CD, time of day, patient demographics and NA anesthesia failure rates. The Society of Obstetric Anesthesia and Perinatology requires a GA rate < 5% to be considered for Center of Excellence status.<sup>2</sup> Our rate of NA failure necessitating conversion to GA for CD was 3.5%. The incidence of NA failure for CD was less in women who received CSE/DPE for labor compared to traditional epidural analgesia. There is emerging evidence that the DPE technique is associated with improved labor analgesia, sacral coverage, and a reduced need for physician intervention for breakthrough pain. Our audit indicates that a CSE/DPE for labor analgesia may also be associated with improved block quality when compared to traditional epidural extension anesthesia. Future prospective studies are required to confirm these findings.

**Table 1: Characteristics of Neuraxial Failures and primary Mode of Anesthesia**

Types of failures	Spinal in OR (n=34)	CSE in OR (n=11)	Top-up Labor Epidural (n=123)	Top-up Labor CSE/DPE (n=32)
<b>Total Neuraxial Performed</b>	3557	1751	902	397
<b>Failure Rate (%)</b>	0.95%	0.63%	13.6%	8.1%
<b>Urgency</b>				
<i>Elective</i>	20 (60.6)	7 (63.6)	34 (27.6)	14 (43.8)
<i>Urgent</i>	9 (26.4)	2 (18.2)	12 (9.8)	1 (31.0)
<i>Emergent</i>	4 (11.8)	0 (0)	64 (52.0)	12 (37.5)
<i>Not Specified</i>	0 (0)	4 (36.3)	13 (10.5)	4 (12.5)
<b>Time</b>				
<i>Day Hours</i>	11 (45.8)	6 (54.5)	32 (26.0)	9 (28.1)
<i>Off Hours</i>	23 (67.6)	5 (45.5)	91 (73.9)	22 (68.8)
<b>Ethnicity</b>				
<i>White</i>	11 (32.4)	5 (45.5)	61 (49.6)	17 (53.1)
<i>Non-White</i>	23 (67.6)	6 (54.5)	62 (50.4)	15 (46.9)

Values within parenthesis indicate percentages  
Off-hours= nights/weekends/holidays

**Abstract #: FRI – RPS2 – Room 2 – Cesarean Delivery - 10**

**The effect of encouraging a combined spinal epidural technique for cesarean delivery: a single center retrospective study**

**Presenting Author:** Alexa Borja, n/a

**Presenting Author's Institution:** Baylor University

**Co-Authors:** Jessica Ehrig, M.D. - Baylor Scott & White Medical Center-Temple

Kendall Hammonds, M.P.H. - Baylor Scott & White Research Institute

Michael P. Hofkamp, M.D. - Baylor Scott & White Medical Center-Temple

Kristen Vanderhoef, M.D. - University of Florida-Jacksonville

**Introduction:** The Royal College of Anaesthetists (RCA) has guidelines on how often regional anesthesia should be converted to general anesthesia (GA) for cesarean delivery (CD), depending on the urgency of the procedure.<sup>1</sup> Prior to May 2019, our hospital employed a practice that almost exclusively used single shot spinal anesthesia (SSS) for patients who presented for CD who did not have a labor epidural in place. In May 2019, we encouraged the anesthesia providers at our hospital to use a combined spinal epidural (CSE) technique instead of SSS for CD. The primary aim of this study was to evaluate the effect of this quality improvement initiative.

**Methods:** Our institutional review board waived informed consent for this study. We searched our electronic medical record for subjects who had CD performed under SSS or CSE anesthesia at our hospital from May 15, 2019 through May 15, 2021. Detailed demographic and clinical data were entered into REDCap by a study investigator. Data was analyzed on an Excel worksheet.

**Results:** 168 and 806 subjects had SSS and CSE anesthesia for CD, respectively. Demographic and clinical data for the cohorts is presented in Table 1. RA was converted to GA prior to incision in 18 subjects and after delivery of the infant in one subject. Six of the 15 CSE subjects who required conversion to general anesthesia did not have documentation of local anesthetic administered through the epidural catheter. The failure rates for elective CD's performed with SSS and CSE were 0% (N=86) and 0.7% (N=438), respectively ( $p=1$ ). The combined failure rates for urgent and emergent CD's performed with SSS and CSE were 5% (N=80) and 3.3% (N=368), respectively ( $p=0.502$ ).

**Discussion:** We found that the overall failure rate of SSS compared to CSE was not clinically or statistically significant. Our CSE failure rate could have possibly been lower if local anesthesia was administered through the epidural catheter. Subjects who had CSE anesthesia were older, heavier, more likely to have had a prior cesarean delivery and a junior resident performing the procedure compared to subjects who had SSS anesthesia. The RCA recommends that elective cesarean deliveries have a less than one percent failure rate of RA<sup>1</sup> and subjects who had both SSS and CSE anesthesia met that guideline. A limitation of our study is that we did not separate subjects who had urgent and life-threatening obstetric indications for CD, but failure rates of SSS and CSE for subjects who had either urgent or life-threatening obstetric indications were both less than 5%. In our study, the SSS and CSE techniques were equivalent for CD and met Royal College of Anaesthetists quality guidelines when performed for CD with an elective obstetric indication.

[Table 1.pdf](#)

**Abstract #: FRI – RPS2 – Room 2 – Cesarean Delivery - 11**

**General anesthesia and systemic anesthetic adjunct medication administration rates at a level 4 maternity care center from 2019-2021: a single center retrospective study**

**Presenting Author:** Hadley Young, M.D.

**Presenting Author's Institution:** Baylor Scott & White Medical Center-Temple

**Co-Authors:** Jessica Ehrig, M.D. - Baylor Scott & White Medical Center-Temple

Kendall Hammonds, M.P.H. - Baylor Scott & White Research Institute

Michael P. Hofkamp, M.D. - Baylor Scott & White Medical Center-Temple

Grace Kohn, B.S. - UTMB Galveston

**Introduction:** The American Society of Anesthesiologists practice guidelines on obstetric anesthesia encourage avoidance of general anesthesia (GA) for cesarean delivery when possible but provide no guidance on acceptable use of systemic anesthetic adjunct medication.<sup>1</sup> The primary aim of our study was to determine our rates of GA and regional anesthesia (RA) with systemic anesthetic adjunct medication administration for cesarean deliveries (CD) performed at our hospital.

**Methods:** Our institutional review board waived informed consent for our study. We searched our electronic medical record system for CD performed between July 1, 2019 and June 30, 2021. Data was entered from the electronic medical record system into REDCap by a study investigator. CD were stratified into scheduled, unscheduled, and due to fetal heart rate abnormalities (FHRA) if that indication appeared in the operative note. CD under GA were categorized as due to a perceived lack of time to initiate RA if RA was not attempted and as a failure of RA if RA was attempted. Cumulative propofol doses less than or equal to 20 mg and dexmedetomidine doses less than or equal to 20 mcg were not characterized as systemic anesthetic adjunct medication as those medications are routinely administered in those doses as treatment for nausea and shivering, respectively.

**Results:** 220 (13.7%), 1,090 (67.7%), and 301 (18.7%) CD during the study period were performed with GA, RA, and RA with administration of systemic anesthetic adjunct medication, respectively. A comparison of cohorts stratified by urgency of operative indication is presented in Table 1. The GA rate for CD was statistically different between CD that had elective and urgent indications ( $p < 0.01$ ) and between CD that had urgent and FHRA indications ( $p < 0.01$ ). The difference in failure rates between activation of a labor epidural catheter and withdrawal of a labor epidural catheter followed by a spinal or combined spinal epidural anesthetic was statistically significant ( $p < 0.01$ ).

**Discussion:** We attribute our approximately 14% GA rate for CD to the patient population we serve as a designated Level IV maternal care center. 18.7% of our anesthetics for CD were RA with systemic anesthetic adjunct medication administration and a comparison with other institutions is not possible because this metric is not commonly reported. We found that withdrawal of a labor epidural catheter followed by either a spinal or combined spinal anesthetic had a clinically and statistically significant lower failure rate than activation of a labor epidural catheter. Future large-scale studies are needed that report general anesthesia rates and use of systemic anesthetic adjunct medication for CD.

[Table 1.pdf](#)

Abstract #: FRI – RPS2 – Room 2 – Cesarean Delivery - 12

**Choice of anesthetic technique for dilation and curettage for pregnancy loss in first and second trimesters: a single center retrospective study**

**Presenting Author:** Alexandra L. Carlson, B.S.

**Presenting Author's Institution:** Texas A&M Health Science Center College of Medicine - Temple, Texas

**Co-Authors:** Jessica Ehrig, M.D. - Baylor Scott & White Medical Center-Temple

Kendall Hammonds, M.P.H. - Baylor Scott & White Research Institute

Michael P. Hofkamp, M.D. - Baylor Scott & White Medical Center-Temple

**Introduction:** The choice of anesthetic technique for dilation and curettage depends on operative indication, patient comorbidities, and the preferences of the patient, anesthesia provider, and obstetrician. We hypothesized that subjects at our hospital who received general anesthesia as the initial anesthetic technique for dilation and curettage for loss of pregnancy during the first or second trimesters would have a higher body mass index and a later gestational age compared to subjects who received sedation for the same procedure.

**Methods:** Our institutional review board waived informed consent for our study. We searched our electronic medical record system for subjects who had dilation and curettage for the indication of loss of pregnancy during the first or second trimesters from July 1, 2018 to June 30, 2021. A study investigator entered demographic and clinical data from the electronic medical record system into REDCap.

**Results:** 164 (71.6%) and 65 (28.4%) subjects had general anesthesia and sedation, respectively, as the initial anesthetic technique for dilation and curettage for the indication of loss of pregnancy during the first or second trimesters during the study period. One subject from the sedation cohort required subsequent conversion to general anesthesia. Demographic and clinical data for the cohorts is presented in Table 1. A multivariate model that controlled for gestational age and location of procedure found that the odds ratio of subjects receiving sedation for dilation and curettage in the labor and delivery suite was 7.0 (95% CI 2.8, 17.3) compared to the main operating room.

**Discussion:** We found that the location of the dilation and curettage procedure was associated with whether the subject received general anesthesia or sedation. A potential explanation why sedation was performed more often in our labor and delivery suite was that the anesthesia and obstetric care teams regularly provide regional anesthesia for cesarean deliveries and that general anesthetics in the labor and delivery suite are relatively uncommon. Conversely, the anesthesia and obstetric care teams provide general anesthesia for most procedures performed in our main operating room suite. We also found that the estimated blood loss was higher in subjects who received general anesthesia and this could be attributed to relaxation of uterine tone mediated by volatile halogenated anesthetic gases. Subjects who had sedation for dilation and curettage were also more likely to receive a paracervical block that could potentially facilitate intraoperative and postoperative analgesia. Limitations of our study were that we did not have body mass index data on every subject and could not use this variable in our multivariate analysis and that we were not powered to detect rare anesthetic complications. Future large scale studies are needed to investigate rare anesthetic complications associated with dilation and curettage.

[Table 1.pdf](#)

Abstract #: FRI – RPS2 – Room 3 – Obesity - 01

## Anesthetic Management of Patients with Class 3 Obesity Undergoing Elective Cesarean Delivery

**Presenting Author:** Oscar van den Bosch, MD

**Presenting Author's Institution:** Department of Anesthesiology and Pain Medicine, Mount Sinai Hospital, University of Toronto

**Co-Authors:** Jose C A. Carvalho, MD, PhD - Department of Anesthesiology and Pain Medicine, Mount Sinai Hospital, University of Toronto

Kristi Downey, MSc - Department of Anesthesiology and Pain Medicine, Mount Sinai Hospital, University of Toronto

Marie-Eve Fiset, MD - Department of Anesthesiology and Pain Medicine, Mount Sinai Hospital, University of Toronto

Cynthia Maxwell, MD - Department of Obstetrics and Gynaecology, Mount Sinai Hospital, University of Toronto

**Introduction:** Patients with class 3 obesity undergoing planned cesarean delivery pose significant challenges to the anesthesiologist and obstetrician. Guidelines are lacking regarding the recommended neuraxial technique for this patient population. We aim to describe the anesthetic management of these patients at our institution.

**Methods:** In this retrospective study, we reviewed data from electronic medical records of patients with BMI  $\geq 40$  kg/m<sup>2</sup> undergoing elective cesarean delivery between July 2014 and December 2020. We collected data regarding patient characteristics, anesthetic technique, surgical technique and anesthetic, surgical and operating room utilization times. For the analysis of the data, we intentionally grouped patients in 3 different categories: BMI 40-49.9, BMI 50-59.9, and BMI  $\geq 60$  kg/m<sup>2</sup>.

**Results:** We included 396 patients, distributed as follows: 258 with BMI 40-49.9 kg/m<sup>2</sup>, 112 with BMI 50-59.9 kg/m<sup>2</sup> and 26 with BMI  $\geq 60$  kg/m<sup>2</sup>. The anesthetic technique differed significantly across the BMI groups (Figure 1a,  $p < .001$ ). For patients with BMI 40-49.9 kg/m<sup>2</sup>, the anesthetic technique of first choice was predominantly spinal anesthesia (70.9%), and less often epidural anesthesia (7.0%) or combined spinal-epidural technique (21.3%). For patients with BMI  $\geq 60$  kg/m<sup>2</sup>, spinal anesthesia was never used as an anesthetic of first choice, whereas epidural anesthesia and CSE were used in 57.7% and 42.3%, respectively. With regard to the surgical incision, spinal anesthesia was almost exclusively used for patients undergoing Pfannenstiel incision and very rarely used for a higher transverse or midline incision (Figure 1b,  $p < .001$ ). The overall incidence of general anesthesia was low ( $n=7$ , 1.8%). The time taken to establish adequate anesthesia (anesthesia time) and the time from incision to skin closure (surgical time) both differed significantly across the BMI groups ( $p < .001$ ). Median [IQR] anesthesia time was 20 [15, 28] minutes, 33 [25, 50] minutes and 38 [27, 51] minutes for BMI 40-49.9, BMI 50-59.9 and BMI  $\geq 60$  kg/m<sup>2</sup>, respectively. Surgical time was 53 [43, 67] minutes, 76 [61, 88] minutes and 96 [82, 114] minutes, respectively.

**Conclusion:** Neuraxial anesthesia was successfully used in 98.2% of patients with obesity class 3 undergoing elective cesarean delivery. The choice of the regional anesthesia technique varies with increasing BMI and with the planned surgical incision. The time required to establish satisfactory regional anesthesia and surgical time markedly increases with increasing BMI. This information is useful for counseling patients, planning of anesthetic management, and allocation of hospital resources.

[vandenBosch-Obesity.pdf](#)

Abstract #: FRI – RPS2 – Room 3 – Obesity – 02

## Labor Epidural Anesthesia Neuraxial Outcomes in Super Morbidly Obese Patients as compared to General Population

**Presenting Author:** Ahmed Butt

**Presenting Author's Institution:** The University of Texas Medical Branch

**Co-Authors:** Hiram Acevedo Bonilla, MD - University of Texas Medical Branch of Galveston

Rovnat Babazade, n/a - University of Texas Medical Branch of Galveston

Haley Hodgins, n/a - UTMB Health

James H. Lane - University of Texas Medical Branch of Galveston

Mauricio Ramos Lozano, NA - University of Texas Medical Branch at Galveston

Mario A. Zuniga Palma, MPH - University of Texas Medical Branch

### Introduction:

When placed successfully, epidural anesthesia does not carry significant risk in cesarean sections and immediate newborn health.<sup>1</sup> While neuraxial anesthesia is often difficult to place in obese patients, it allows the patient to avoid general anesthesia which reduces airway manipulation, curtails the risk of aspiration, and decreases volatile anesthetic exposure to both the fetus and the parturient.<sup>2</sup>

The present study aims to present and analyze the neuraxial outcomes in the super obese patients who received labor epidural anesthesia.

### Materials and Methods:

We conducted a retrospective review of patients who presented with BMI $\geq$ 50.0 upon admission for delivery at a single hospital institution. We collected data from the electronic medical records at to identify patients who were admitted for delivery of a viable fetus between 2015-2021. We reviewed 248 patient encounters, of which 82 received epidural analgesia (24% of the observed population).

Data collected included the parturients' demographic information and their anesthesia information for each L&D admission.

### Results:

Table 1 details the demographics of the patient population and their anesthetic outcomes. Of the 82 patients, maternal age averaged at 28.16 with a SD of 6.29 and maternal BMI averaged at 54.83 with an SD of 4.48. Of the 82 epidurals replaced, 1.21% (1/82) required faculty intervention, 8.54% (7/82) required replacement, 4.87% (4/82) resulted in failure, 3.66% (3/82) were suspected of having dural puncture and 4.87% (4/82) reported post dural punctual headaches. Overall, 23.17% (19/82) of epidurals had complications.

### Discussion:

Although some of the epidurals placed in our obese population resulted in complications, most were placed successfully without complications. Reducing the number of epidural complications can improve a patient's labor experience by reducing the number of headaches experienced, minimize the use of extra equipment that has to be used in neuraxial replacement, and prevent use of general anesthesia and volatile anesthetics in C-sections.

Moving forward, we would need to obtain a control group that is truly representative of the general population to see if the number of complicated cases that we obtained is statistically significant in comparison. If our sample showed statistical significance, the next step would be to investigate the effect of additional interventions, such as ultrasound and other assist devices, on the reduction of epidural complications.

<b>Table 1. Super Obese Parturients Who Received Epidural Anesthesia Outcomes</b>		
Subjects Included (n)		82
Maternal Age (years)	Mean	28.16
	SD	6.29
	Minimum	17
	Maximum	42
Maternal BMI (kg/m <sup>2</sup> )	Mean	54.83
	SD	4.48
	Minimum	50.1
	Maximum	72.63
Neuraxial Outcomes (n) (of 81 charts)	US Guidance Used	2
	Required Faculty Intervention	1
	Neuraxial Failure Requiring Anesthesia Mode Change (ie to Spinal, CSE, or GETA)	4
	Required Epidural Replacement	7
	Suspected Dural Puncture	3
	Post Dural Puncture Headache	4

**Abstract #: FRI – RPS2 – Room 3 – Obesity - 03**

**Impact of Super Morbid Obesity on Duration of Admission in Patients Undergoing Cesarean Section**

**Presenting Author:** Trent S. Weatherley, BSA

**Presenting Author's Institution:** University of Texas Medical Branch at Galveston - Friendswood, Texas

**Co-Authors:**

**Introduction:**

Among super morbidly obese women, the likelihood of requiring a Cesarean section (CS) delivery is almost 50%.<sup>1</sup> Obesity contributes to a heightened risk of experiencing complications after CS, such as epidural failure and surgical site infection.<sup>1</sup> The CS delivery outcomes can also affect length of admission. The length of stay is associated with increased postpartum pain score and financial strain, with a rise in admission cost of approximately \$3500 each day.<sup>2</sup> The purpose of this abstract is to investigate the influence of super morbid obesity on length of admission as compared to the general population and analyze the associated outcomes for those patients.

**Material and Methods:**

Following institutional review board approval, we conducted a retrospective review of patients who had a BMI  $\geq 50$  upon admission for delivery at a single hospital institution between 2015-2021. We collected data from electronic medical records to identify patients between the ages of 16-50 who were admitted for delivery of a viable fetus. We only included patients with a documented anesthesia encounter, including preprocedure, intraprocedure, and post procedure note. There were 701 unique patient medical record numbers obtained. Among those encounters, 248 met the inclusion criteria. For this abstract, we evaluated the patients who underwent a cesarean section for delivery. This included 206 patients, 59.2% of the study population.

**Results:**

The average length of hospital stay among the 206 patients included was 98.51 hours with a standard deviation of 135.72. Additionally, 12.62% of patients experienced a post-operative infection. Only one patient in the population experienced a post-dural puncture headache and there was one recorded case of maternal mortality within 2 months of delivery.

**Discussion:**

In a study at the same institution evaluating length of hospital stay for cesarean delivery in 5350 patients, the average admission was 82.11 hours.<sup>2</sup> In comparison to the super morbidly obese patients in this study, the general population spends on average 16.4 fewer hours in the hospital. This difference could contribute to the number of postoperative infections seen among the obese patient population.

The financial burden of obesity could create added difficulty for these patients as the average hospital admission is likely inflated by thousands of dollars.

Further investigation could analyze if proper weight gain during pregnancy minimizes postoperative infections and duration of admission for super obese patients.

<b>Table 1. Demographics and Outcomes of Super Morbidly Obese Patients Who Underwent Cesarean Section</b>		
Population (n)		206
Maternal BMI (kg/m <sup>2</sup> )	Mean	55.77
	Standard Deviation	5.76
Maternal Age (years)	Mean	29.35
	Standard Deviation	5.68
Gestational Age (Weeks)	Mean	37.29
	Standard Deviation	2.40
	Preterm, <37 weeks, (n) neonates	59
Maternal Comorbidities (n)	Gestational Hypertension	75, (38.46%)
	Preexisting Hypertension	90 (43.90%)
	Diabetes	63(30.58%)
	Asthma	31 (15.05%)
	Obstructive Sleep Apnea	4 (1.95%)
	GERD	47 (22.82%)
	Smoking History	54 (26.34%)
	Substance Abuse	11 (5.34%)
Anesthetic Technique (n)	Epidural	37
	Spinal	84
	Combined Spinal-Epidural	79
	General Anesthesia	6
Maternal Outcomes	Duration of Admission (Hours)	98.51 (SD 135.72)
	Post Dural Puncture Headache (n)	1 (0.49%)
	Post-Operative Mortality Within 2 Months (n)	1 (0.49%)
	Post-Operative Infection (n)	26 (12.62%)
	Estimated Blood Loss (mL)	965.98 (SD 357.28)
Neonatal Outcomes	Birth Weight (grams)	3373.99 (SD 752.60)
	APGAR at 1 Minute	7.44 (SD 1.33)
	APGAR at 5 Minutes	8.66 (SD 0.55)

**Abstract #: FRI – RPS2 – Room 3 – Obesity – 04**

**Comparing the Comorbidities in Super Obese Parturients Who Received Labor Anesthesia Who Had Vaginal Deliveries vs Cesarean Deliveries**

**Presenting Author:** Mauricio Ramos Lozano, NA

**Presenting Author's Institution:** University of Texas Medical Branch at Galveston - San Benito, Texas

**Co-Authors:**

**Introduction:**

Super obese patients, with a BMI  $\geq 50.0$ , have been reported to have higher incidence of cesarean deliveries (CD) even in patients with epidurals for labor anesthesia with the intent of delivering vaginally (1). Simultaneously, obesity-related comorbidities like type 2 diabetes mellitus and hypertension, increase the risk of adverse obstetric outcomes and difficulties with delivery (2).

The purpose of this abstract is to compare the comorbidities of super obese patients who received epidurals to see if any factors were more associated with being able to deliver vaginally vs requiring CD.

**Materials and Methods:**

We conducted a retrospective review of patients with a BMI  $\geq 50.0$  on admission for delivery at a single hospital institution. We collected data from the electronic medical records to identify patients admitted for delivery of a viable fetus between 2015-2021. We reviewed 248 patient encounters, of which 82 received epidural analgesia (24% of the observed population).

Data collected included the patient's demographic and anesthetic information, as well as preexisting comorbidities like gestational hypertension (GHTN), chronic hypertension (CHTN), diabetes, asthma, obstructive sleep apnea (OSA), and gastroesophageal reflux disease (GERD) were also collected.

**Results:**

In the group with SVD, the maternal average BMI was 54.22 kg/m<sup>2</sup> (SD 3.66), maternal age averaged at 28.65 years (SD 6.55). The group that required CD had a BMI average of 56.1 (SD 5.56) and an average age of 27.05 (SD 5.56).

Table 1 compares the preexisting comorbidities of the super obese patient populations based on if they were able to successfully deliver vaginally or if they required a conversion to CS. There was a statistically significant difference found between patients with CHTN, chi-square statistic 5.3892, p-value is .020262, and diabetes, chi-square statistic is 4.3397, p-value is .037234.

**Discussion:**

Comparing pre-existing comorbidities, there was no statistical difference in patients who had GHTN, GERD, asthma, OSA, and a smoking or substance abuse history. However, patients who had chronic hypertension and diabetes were found to have a statistically significant differences with increased CD. The systemic impacts of these particular comorbidities could place extra stress on the super obese patient necessitating CD. As anesthesia providers, understanding the risks of associated comorbidities can help us plan for the chance of needing CD in specific patients.

Further investigations could review if attempted stricter management of these co-morbidities is more likely to prevent CD in this patient population.

**Table 1. Comparing Labor Epidurals with Successful SVD vs Requiring CD**

		Successful SVD	Required CD
<b>Sample Size</b>		42	39
Maternal BMI (kg/m <sup>2</sup> )	Mean	54.22	56.1
	Standard Deviation	3.66	5.56
	Minimum	50.1	50.14
	Maximum	70.31	72.63
Maternal Age (years)	Mean	28.65	27.05
	Standard Deviation	6.55	5.22
Obstetric History	Gravida	3.52 (SD 2.60)	1.94 (1.25)
	Para	1.90 (SD 2.17)	0.58 (SD 1.00)
Gestational Age (weeks)	Mean	37.93	37.50
	Standard Deviation	1.67	2.60
Comorbidities (%)	GHTN	52.38% (22)	56.41% (22)
	CHTN	26.19% (11)	48.72% (20)
	Diabetes	11.90% (5)	30.77% (12)
	Asthma	16.67% (7)	17.95% (7)
	OSA	4.76% (2)	0.00% (0)
	GERD	26.19% (11)	15.38% (6)
	Smoking History	38.10% (16)	30.77% (12)
	Substance Abuse History	4.76% (2)	12.82% (5)

Abstract #: FRI – RPS2 – Room 3 – Obesity - 05

## Epidural Depth Required in Super Morbidly Obese Patients as Compared to General Population

**Presenting Author:** Mauricio Ramos Lozano, NA

**Presenting Author's Institution:** University of Texas Medical Branch at Galveston - San Benito, Texas

**Co-Authors:**

### Introduction:

Epidural anesthesia is an important analgesic modality in pregnancy. Placement is often difficult due to obscure anatomic landmarks from obesity and edema. The management of labor epidurals in obese women often provides less successful analgesia and requires more repeat procedures (2).

We aim to examine the epidural space depth in morbidly obese patients compared to the general population. Predicting the depth in obese patients may ease epidural placement and prevent complications. It's previously been reported that the distance from the skin to the epidural space increases as BMI increases (1). However, most previous studies have looked at parturients' with BMI's >30 and >35.

Our study aims to display epidural depth in obese patients with BMI  $\geq$  50.0.

### Materials/Methods:

We conducted a retrospective review of patients who presented with BMI  $\geq$  50.0 upon admission for delivery at a hospital institution. Data was collected from the EMR to identify patients who were admitted for delivery of a viable fetus between 2015-2021. We reviewed 248 patient encounters, of which 82 received epidural analgesia (24% of the observed population).

Data collected included the parturients' age, BMI at admission, needle insertion depth, catheter length at skin depth, procedure duration, attempts at neuraxial placement, redirections, use of ultrasound or device guide, faculty intervention, and neuraxial failure rate.

### Results:

82 charts were reviewed but only some recorded each data point. Of 81 charts, the average insertion depth was 8.51cm. In 75 charts, the average time of neuraxial placement was 24 minutes and 16 seconds with a SD of 15 minutes and 8 seconds. Of 62 charts with recorded attempts, 67.7% reported being able to place the epidural on the first attempt.

### Discussion:

Morbid obesity can complicate pregnancy and delivery. Mitigating the number of attempts, redirections, and neuraxial failures could lower stress experienced by obese parturients. Generating a separate category of estimates for needle insertion depth in women with BMI's > 50.0, as compared to the general population, may aid in reducing risks of neuraxial anesthesia. Moving forward, obtaining a control group that is representative of the insertion depth average among the general population would allow us to do a statistical analysis and determine how our investigated population differs from the average. Further investigation of the relationship between the use of ultrasound devices and neuraxial failures could add a "success rate" factor to the quantitative aspect that we are primarily concerned with.

<b>Table 1. Super Obese Parturients Epidural Anesthesia Placement Procedure Information</b>		
Subjects Included (n)		81
Maternal Age (years)	Mean	28.16
	SD	6.29
	Minimum	17
	Maximum	42
Maternal BMI (kg/m <sup>2</sup> )	Mean	54.83
	SD	4.48
	Minimum	50.1
	Maximum	72.63
Needle Insertion Depth (cm) (of 81 charts)	Mean	8.51
	SD	1.38
	Minimum	6
	Maximum	15
Duration for Neuraxial Placement (min) (of 75 charts)	Mean	24.26
	SD	15.13
	Minimum	4
	Maximum	83
Number of Attempts Documented (n)	Not Documented	19
	1 Attempt	42
	2 Attempts	13
	3 Attempts	4
	4 + Attempts	3

Abstract #: FRI – RPS2 – Room 3 – Obesity - 06

## General Anesthesia in Super Obese Parturients for Labor and Delivery, a Retrospective Study of a Single Institution

**Presenting Author:** Kristine Lane

**Presenting Author's Institution:** University of Texas Medical Branch John Sealy School of Medicine

**Co-Authors:**

### Introduction:

Super obese patients, with a BMI  $\geq 50$ , are high risk obstetric patients with a higher percentage of cesarean sections (CS) deliveries (1). General anesthesia (GA) for CS is typically reserved for emergent circumstances, only 7% of cases, when there is not enough time for adequate neuraxial coverage (2). Many anesthesiologists have reduced exposure to GA management of CS which may result in inconsistent care (2). Given the risk for pulmonary aspiration for obstetric patients, it is recommended that patients receiving GA have rapid sequence induction endotracheal intubation with applied cricoid pressure (2).

The purpose of this abstract was to review when GA was used for super obese laborers.

### Material and Methods:

We conducted a retrospective review of patients with a BMI  $\geq 50$  on admission for delivery within a hospital system and collected data from electronic medical records. The included charts with complete anesthesia encounters were between 2015-2021. We reviewed 248 patient encounters, 206 of which were CS, and 15 patients were noted to have general anesthesia used in their delivery anesthesia.

### Results:

Of the 15 patients noted to have general anesthesia used in their delivery, 6 of the patients had attempted CSE's that were unsuccessful with epidural placement with attempted boluses that later required conversion to GA. Of the 15 CS, 40% were considered emergent (category 1) and 33.3% urgent (category 2 and 3). Two patients delivered twins, and one patient was currently admitted to the ICU for a suspected infection when she had cardiac arrest and an emergent peri-mortem CS delivery. One of the records did not have a procedure note documenting the intubation.

All the encounters with procedure notes had a successful intubation on first attempt.

### Discussion:

Only 7.2% of reviewed patients with CS received GA, similar to reported averages (2). Advanced airway equipment readily available in the operating room suites allowed the anesthesia team to quickly change their anesthetic plan, with 87.5% of conversions using a CMAC. Only 50.0% of charts documented using cricoid pressure, even though it is part of the rapid sequence induction protocol and the charts had vastly different medication management.

Neonatal APGAR scores for mothers who were given GA and IV anesthetics were not significantly different than the APGARs of the overall observed obese patient population; GA APGAR1 6.88(SD2.0) and APGAR5 8.59(SD0.8) vs APGAR1 7.49 (SD1.45) and APGAR5 8.67 (SD0.63).

For future investigation, it could be beneficial to focus on how obesity affects the pharmacokinetics of fat-soluble inhaled anesthetics.

<b>Table 1. Super Obese Patients Who Received General Anesthesia During Delivery</b>		
Patient Sample Size		15
Maternal BMI (kg/m <sup>2</sup> )	Mean	54.78
	Standard Deviation	3.54
	Highest Value	61.79
	Lowest Value	50.22
Maternal Age (years)	Mean	25.73
	Standard Deviation	5.42
Gestational Age at Delivery (n)	Preterm, <37 weeks	9
	Early Term, >=37 and <39 weeks	4
	Full Term, >=39 and <41 weeks	2
	Post Term, >41 weeks	0
Delivery Methods (n)	Vaginal Delivery	0
	C-Section Delivery	15
Grade Definition of CS Urgency (n)	Category 1 – Immediate threat to life	6
	Category 2 – Maternal or fetal compromise	3
	Category 3 – Needing early delivery	2
	Category 4 – At a time to suit the woman and team	4
Maternal Comorbidities (%)	Gestational Hypertension (%)	26.67%
	Preexisting Hypertension (%)	40.00%
	Diabetes (%)	40.00%
	Obstructive Sleep Apnea (%)	6.67%
	GERD (%)	26.67%
	Smoking History (%)	40.00%
	Substance Abuse (%)	20.00%
Anesthetic Technique (n)	Planned CSE	5
	Planned Spinal	2
	Planned Epidural	1
	Planned GA	7
Mallampati Score (n)	1	2
	2	1
	3	10
	4	2
Intubation (n)	Cuffed ETT Placed (n)	15
	Video Laryngoscopy Used (n)	11
	Cricoid Pressure Used	7
	Stylet Used	14
	Arterial Line Used	2
	Central Line Used	1
	Successful Intubation	15
Anesthesia Medications	Phenylephrine (mcgs), (n) charts used	1374.55 (SD 3013.3), 9charts
	Morphine (mg), (n) charts used	4.35 (SD 3.07), 12 charts
	Fentanyl (mcg), (n) charts used	165.07 (SD 87.17), 14charts
	Propofol (mg), (n) charts used	445.55 (SD 441.35), 15 charts
	Ketamine (mg), (n) charts used	27.5 (SD 31.82), 2 charts
	Midazolam (mg), (n) charts used	2 (SD 0), 6 charts
	Succinylcholine (mg), (n) charts used	132.67 (SD 35.15), 15 charts
	Rocuronium (mg), (n) charts used	66.67 (SD 47.26), 3 charts
Ondansetron (mg), (n) charts used	4.44 (SD 1.33), 9 charts	
Maternal Outcomes	Admitted to ICU (%)	6.67%
	Post-Operative Mortality Within 2 Months (%)	6.67%
	Post-Operative Infection (%)	20.00%
	Post Dural Puncture Headache (%)	0.00%
	Total Length of Hospital Stay (hours)	124.45 (SD 141.09)
	Estimated Blood Loss (mL)	1140.00 (SD 623.13)
Neonatal Outcomes	Birth Weight (grams)	3052.88 (SD 1001.61)
	APGAR 1 Minute	6.88 (SD 2.03)
	APGAR 5 Minute	8.59 (SD 0.80)

Abstract #: FRI – RPS2 – Room 3 – Obesity - 07

## Complications and Outcomes for Emergent vs. Nonemergent Cesarean Delivery in Super Morbidly Obese Patients

Presenting Author: Mario A. Zuniga Palma, MPH

Presenting Author's Institution: University of Texas Medical Branch - Galveston, Texas

Co-Authors:

### Introduction:

The current rate of cesarean delivery (CD) in the US is 32% (1). Concurrently, 31.9% of reproductive-age women are obese and obesity is an established risk in obstetrics with associated comorbidities (2). Increasing obesity rates in the U.S. necessitates an increase in research into obstetric and fetal outcomes associated with obesity. There are few studies examining the maternal and fetal outcomes of emergent CD for super obese mothers. This abstract will evaluate the complications and outcomes of super obese mothers who require an emergent CD compared to nonemergent CD.

### Material and Methods:

We conducted a retrospective review of patients with a BMI  $\geq 50$  upon admission for delivery within a single hospital system from 2015-2021 and collected data from electronic medical records. 206 were identified to have had a CD performed. Using Kinsella and Scrutton's modified CD criteria, we stratified the 206 entries to Emergent/Urgent (n=68) and non-Emergent (n=138) (1).

Statistical analysis was performed in excel and EPItool application. 2 sample T-tests were validated using F-statistic to test sample variance (P-value = 0.09105). Proportions were analyzed using 2 sample Z-test.

### Results:

Table 1.1 shows the patient population stratified into two categories, emergent vs. non-emergent cesarian deliveries. Maternal BMI, age, and comorbidities between the two groups were statistically similar. Gestational age was found to be statistically significant (37.82 vs. 36.2 weeks, P-value < 0.001).

Post-operative infections (POI) were more prevalent in emergent CD (8.70% vs. 19.12%, P-value = 0.0313). There is a numerical difference between the proportion of mothers requiring a blood transfusion and 2-month post-delivery mortality, but these differences were not statistically validated due to the study's small sample size. Regarding infant outcomes, emergent CD was found to have smaller infant weight (3466.07 vs. 3189.82 g, P-value = 0.013), but APGAR scores were not seen to be statistically different.

### Discussion:

This retrospective comparison show super obese emergent CD were more prone to POI compared to their nonemergent counterparts. Risk factors for POI between the groups did not show statistical significance. Previous studies posit the relationship between BMI and POI, but further analysis of other risk factors with a larger sample size should be conducted to better understand the relationship between BMI and POI.

[Complications and Outcomes for Emergent vs. Nonemergent Cesarean Delivery in Super Morbidly Obese Patients Table.pdf](#)

Abstract #: FRI – RPS2 – Room 3 – Obesity - 08

## Labor Anesthesia and Delivery Modalities in Super Obese Patients Receiving Anesthesia

**Presenting Author:** James H. Lane

**Presenting Author's Institution:** University of Texas Medical Branch of Galveston

**Co-Authors:**

### Introduction:

Obese patients receiving anesthesia for delivery are considered to be at a high-risk state because of the associated complications in their obstetric course and have a higher-than-average incidence of cesarean delivery (CD) (1).

The purpose of this abstract is to review the prevalence of various anesthetic modalities used in labor and delivery anesthesia of the super obese parturients (BMI  $\geq$  50) and their delivery methods to better characterize the level of anesthesia that may be required when preparing for delivery involving this population.

### Material and Methods:

We conducted a retrospective review of patients with a BMI  $\geq$  50 upon admission for delivery within a single hospital system and collected data from electronic medical records. The included charts with complete anesthesia encounters were between 2015-2021.

We reviewed 248 patient encounters looking at the anesthesia plans and outcomes in conjuncture with the delivery outcomes.

### Results:

Of the 248 patient charts, 33.1% of patients received epidural anesthesia for laboring, 34.6% received spinal anesthesia, and 29.4 % received CSE anesthesia. Looking at delivery methods, only 17.3 % of the patients had spontaneous vaginal deliveries (SVD), with the majority of patients receiving CD (83.1%). Table 1 displays the maternal and anesthetic information segregated by the delivery outcome.

### Discussion:

Our analysis demonstrated a high rate of CD delivery among the super obese patient population. Even in the patients who received an epidural with the intent of laboring, only 52% of patients were able to delivery vaginally, which is in line with other research that has focused on the super obese patient population (2). Some notes mentioned complications like arrest of descent, oligohydramnios, chorioamnionitis, NRFHT, preeclampsia, and breech position as the indication for the change in delivery plan from VD to CD.

This information reinforces the assertion that obese patient populations have a higher rate of CD, especially in the super morbidly obese patients. Given these findings, anesthetic plans for super morbidly obese patients should be prepared for the increased risk of CD.

Concerning patients pursuing VD with epidurals, the epidural should be checked frequently for level of coverage to ensure it is able to provide adequate anesthesia. Additionally, given the high rate of conversion to CD physicians should carry anesthetic drugs necessary for quick bolus if change is needed and should communicate with the obstetric team to keep up to date on the delivery plan.

Future studies could improve upon this data collection by further stratifying the patient population by their preexisting comorbidities.

<b>Table 1. Comparison of Delivery Methods for Super Obese Patients</b>			
		<b>Spontaneous Vaginal Delivery</b>	<b>Cesarean Delivery</b>
<b>Sample Size (n)</b>		<b>42</b>	<b>206</b>
<b>Maternal BMI (kg/m<sup>2</sup>)</b>	Mean	53.62	55.77
	Standard Deviation	2.77	5.76
	Minimum	50.10	50.08
	Maximum	63.43	94.29
<b>Maternal Age (years)</b>	Mean	28.93	29.35
	Standard Deviation	7.00	5.68
<b>Gestational Age (weeks)</b>	Mean	37.93	37.29
	Standard Deviation	1.67	2.40
<b>Anesthesia Type (n)</b>	Epidural	42	39
	Spinal	0	86
	CSE	0	73
	GA	0	7
	Conversion to GA	0	8

Abstract #: FRI – RPS2 – Room 3 – Obesity - 09

## Hemodynamics of Cesarean Section in Super Obese Patients Comparing Phenylephrine and Estimated Blood Loss

Presenting Author: James H. Lane

Presenting Author's Institution: University of Texas Medical Branch of Galveston

Co-Authors:

### Introduction:

It has been proposed that the practice of administering phenylephrine with neuraxial anesthesia during cesarean sections (CS) to prevent hypotension results in increased blood loss due to prevention of uterine contraction (1). Super obese patients with a BMI  $\geq 50$  are at higher risk of extended delivery times (2) and thus additional bleeding which has the potential to accentuate the relationship between phenylephrine and blood loss.

Our analysis aimed to examine if this theoretical concern resulted in a positive correlation between phenylephrine administered and blood lost during CS in super obese patient populations.

### Material and Methods:

We conducted a retrospective review of patients with a BMI  $\geq 50$  upon admission for delivery within a single hospital system and collected data from electronic medical records. The included charts with complete anesthesia encounters were between 2015-2021.

We reviewed 248 patient encounters, and for the purpose of this abstract are focusing on the 206 patients who had a CS performed, which was 83.0% of the patients.

### Results:

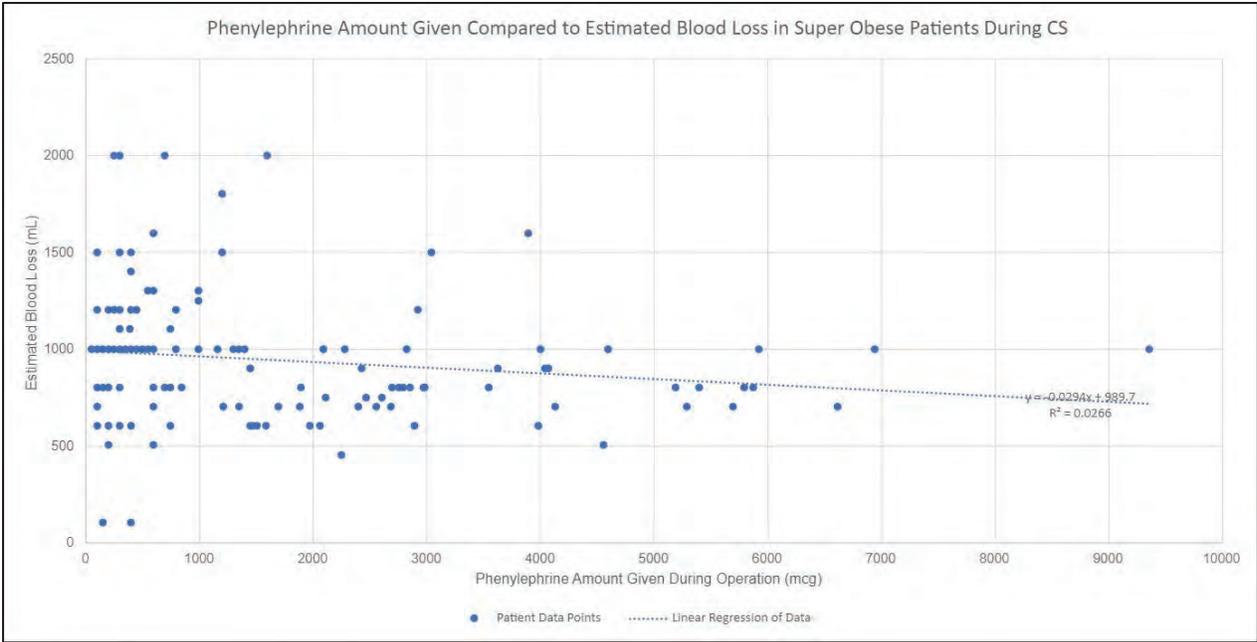
Of the 206 patient charts examined, the average patient BMI was 55.77 kg/m<sup>2</sup> (SD 5.76), the average maternal age was 29.35 years (SD 5.67), and the average gestational age was 37.29 weeks (SD 2.40). Figure 1 is a scatter plot with a calculated linear fit equation of the observed patient estimated blood loss (EBL) (mL) amounts compared to the phenylephrine (mcg) they received during the operation. Of the 206 patient charts reviewed, 9 did not report an EBL and 46 charts did not report phenylephrine use, so these data points were removed from the scatter plot.

The overall average EBL was 965.98 mL (SD 357.28) and the average amount of phenylephrine was 1107.38 mcgs (SD 1637.95). CS delivered with general anesthesia had an average EBL of 1140.00 mL (SD 623.13) which was not statistically significantly different from the overall CS population.

### Discussion:

Linear regression analysis demonstrated a poorly correlated relationship between phenylephrine amount and EBL ( $R^2 = 0.0266$ ). Given our findings, there was no predicted impact on EBL based on the amount of phenylephrine given intra-op, positive or negative.

Considering the charts reviewed, it can be argued that estimated blood loss is somewhat subjective. In future investigations, it may be more helpful to have quantitative blood loss to have a more accurate understanding of the impact of medications on hemodynamics.



Abstract #: FRI – RPS2 – Room 3 – Obesity - 10

## Improving Nursing Compliance with Ventilatory Checks after Neuraxial Morphine Administration

**Presenting Author:** Erin Dengler, MD MBA

**Presenting Author's Institution:** University of North Carolina

**Co-Authors:** Ben Cobb, MD - University of North Carolina

Dayley Keil, MD - University of North Carolina

Lacey Straube, MD - University of North Carolina

Neuraxial morphine is associated with superior pain control and decreased systemic opioid use following cesarean delivery (CD), but it can be associated with delayed respiratory depression, peaking approximately 6-8 hours following administration.<sup>1</sup> The Society for Obstetric Anesthesia and Perinatology (SOAP) revised guidelines for ventilatory checks following neuraxial opioid administration in 2019. These checks should be performed every 2 hours for 11 hours postpartum for  $\leq 150$  mcg of intrathecal preservative free morphine. At our institution, the anesthesia care team routinely places an order for these ventilatory checks post-CD.

To improve compliance with ventilatory checks, we presented a brief educational intervention at a monthly nursing staff meeting on the post-partum unit explaining the risk of delayed respiratory depression following neuraxial morphine via a case presentation.<sup>2</sup> We also highlighted the current order for ventilatory checks and made recommendations for standardized documentation. A survey was administered before and after the presentation to assess nursing awareness of the SOAP guidelines. We compared documentation of respiratory rates during hours 2-11 post-CD for 8 weeks prior to the intervention and 8 weeks after.

Pre-intervention, 254 out of 293 patients undergoing CD received neuraxial morphine, compared to 140 out of 413 patients post-intervention. This difference was due to an institutional shortage of preservative-free morphine during the post-intervention window necessitating more frequent use of hydromorphone. Of those who received neuraxial morphine, 1% had no respiratory rate recorded in hours 2-11 post cesarean pre-intervention, compared to 0% post-intervention ( $p = 0.156$ ). Moreover, 82% had only 1-4 respiratory rates recorded in hours 2-11 post CD pre-intervention, indicating an insufficient number of checks. Post-intervention, 83% had insufficient checks ( $p = 0.84$ ). Only 17% of patient records were compliant with SOAP ventilatory check guidelines with 5 or more respiratory rates recorded during hours 2-11 in the pre- and post-intervention groups ( $p = 0.998$ ).

In conclusion, nursing compliance with documenting SOAP ventilatory checks following neuraxial morphine administration for CD is low (17%) and did not improve following a brief educational intervention. The effectiveness of the intervention may have been limited by the scope of a single virtual meeting during a viral pandemic. However, this project highlights the need for ongoing efforts to improve patient safety via compliance with ventilatory checks post-CD.

Abstract #: FRI – RPS2 – Room 3 – Obesity - 11

**Nursing requirements post-implementation of Society for Obstetric Anesthesia & Perinatology (SOAP) guidelines for prevention and detection of respiratory depression with neuraxial morphine use**

**Presenting Author:** CeCe Cheng, MD

**Presenting Author's Institution:** UT Health Science Center at San Antonio - San Antonio, Texas

**Background:** Due to the risk of significant maternal morbidity and mortality in the obstetric population, SOAP guidelines specify recommended respiratory and sedation monitoring frequency during the first 24 hours postoperatively for patients receiving neuraxial morphine analgesia during cesarean delivery (CD). We sought to compare nurse staffing needs with recommended monitoring of high and low risk patients receiving ultra low-dose vs low-dose neuraxial morphine in accordance with SOAP and Association of Women's Health, Obstetric and Neonatal Nurses (AWHONN) nursing guidelines.

**Methods:** We evaluated the number of deliveries over a 30-day period at our level 4 maternal unit to assess postpartum nursing needs after implementation of SOAP guidelines. We assumed that postpartum patients are discharged on day 2 after a vaginal delivery (SVD) and day 3 after a CD. Patients were classified as low or high-risk based on peri-operative risk factors defined by SOAP. According to AWHONN guidelines, nurses (RNs) in the postpartum period can care for 3 to 4 mother-baby couplets in the postpartum recovery period if they are low-risk. If a patient is high-risk, the recommendation is for one RN to only have 2 couplets due to the increased frequency of monitoring every 1-2 hours. We calculated the number of postpartum RNs based on unit configuration of delivery type and dose of neuraxial morphine. For our modeling to be consistent with SOAP guidelines, patients who received ultra-low dose neuraxial morphine during CD with additional peri-operative risk factors were considered high-risk and all patients who received low-dose neuraxial morphine during CD were considered high-risk.

**Results:** The average daily census on our postpartum unit over the 30-day period was  $34 \pm 4.3$  patients. The mean number of patients with vaginal deliveries was  $23 \pm 2.6$ . Of the patients who had a CD within the past 24 hours, the mean number of low-risk and high risk deliveries were  $2.2 \pm 1.8$  and  $3.4 \pm 1.4$ , respectively. The mean number of CD patients after 24 hours each day was  $5.7 \pm 2.7$ . In an average 24-hour period, use of low-dose neuraxial morphine required a significantly higher number of RNs irrespective of the staffing model. All RNs with 2 couplets had at least one high-risk CD patient based on SOAP criteria. Fewer RNs with 2 couplets were required in the ultra-low dose group due to omission of low-risk CD patients within the first 24 hours from intensive monitoring.

**Conclusion:** Our data demonstrate that nurse staffing in units following guidance from AWHONN and SOAP for monitoring of women who received neuraxial morphine during CD are significantly increased for women who received low-dose neuraxial morphine compared to women who received ultra-low dose neuraxial morphine. Increased nursing needs are important balancing measures that should be considered with improved post-operative pain control, reduced utilization of opioids, and increased patient satisfaction for postpartum pain needs.

[Figures.pdf](#)

Abstract #: FRI – RPS2 – Room 4 – Postpartum Headache, Depression and Skilled Nursing Care - 01

## Accidental Dural Puncture Management and Outcomes Following Obstetric Anesthesia at an Academic Medical Center

**Presenting Author:** Caley Butler, n/a

**Presenting Author's Institution:** Columbia University Vagelos College of Physicians and Surgeons - Greensboro, North Carolina

**Co-Authors:** Richard Smiley, MD, PhD - Columbia University Vagelos College of Physicians and Surgeons

**Introduction:** Accidental dural puncture (ADP), with associated post-dural puncture headache (PDPH), is one of the most common adverse events to occur during epidural procedures (1). There are several proposed methods to prevent PDPH following ADP, and conservative treatments for PDPH prior to attempting epidural blood patch (EBP), but existing reports of ADP outcomes following epidural analgesia or anesthesia have resulted in contradictory reports of treatment efficacy and no consistent guidelines for the management of ADP (2). We studied demographic and procedural factors predisposing patients to ADP and PDPH as well as the efficacy of different management strategies of PDPH following ADP.

**Methods:** Patients were identified from a quality improvement list of all women who were followed for known or suspected ADP or suspected PDPH in the postpartum or postoperative period from 12/2008 to 7/2020 (n=393). Manual chart review was used to collect details surrounding the ADP, PDPH management, and outcomes.

**Results:** Out of approximately 31,500 obstetric neuraxial anesthesia events involving epidural needle insertion, 253 (0.8%) patients had a known or suspected ADP. 175 patients (69%) developed a PDPH. 102/175 (58%) received an EBP, 99 of which (97%) were successful at alleviating symptoms (2 blood patches were attempted but not completed and 1 was unsuccessful). In comparison, only 60/133 (45%) of patients who developed PDPH after an apparently uncomplicated procedure received an EBP (p=.02); 58/60 (96%) were successful at alleviating symptoms. 21/102 (21%) ADP patients required a second EBP, as compared to 5/60 (8%) who received an EBP after an uncomplicated procedure (p=0.04). In the ADP group, 191 had second-stage pushing with a PDPH rate of 140/191 (73%) compared to a PDPH rate of 35/62 (56%) in the 62 patients who did not have second-stage pushing (p=.01). Of the known or suspected ADP patients, 81/253 had an intrathecal catheter left in place for at least 24 hours with 62/81 (77%) developing PDPH as opposed to 113/172 (66%) developing PDPH if an intrathecal catheter was not left in for at least 24 hours (p=0.08). PDPH was seen in 51/80 (64%) known or suspected ADP patients who received intrathecal or epidural morphine, as compared to PDPH in 110/158 (70%) patients who did not receive morphine (15 patients were excluded from analysis due to missing data) (p=0.36).

**Conclusions:** Our ADP, PDPH, and EBP rates match those typically reported in the literature. We found that PDPH was more likely with second-stage pushing, and neither intrathecal catheters nor spinal or epidural morphine were successful at preventing PDPH. Epidural blood patches were extremely successful at alleviating PDPH symptoms, and while 2nd patches were sometimes necessary, patients who had an uncomplicated procedure were less likely to need a second patch than patients that had a known or suspected ADP.

[SOAP abstract Table.pdf](#)

Abstract #: FRI – RPS2 – Room 4 – Postpartum Headache, Depression and Skilled Nursing Care - 02

## Association between headache and childbirth in a chronic pain population: A cross-sectional study including 1018 patients

**Presenting Author:** Jessica R. Ansari, MD

**Presenting Author's Institution:** Stanford University - Stanford, California

**Co-Authors:** Meredith Barad, MD - Stanford University School of Medicine

Pamela Flood, MD, MS - Stanford University School of Medicine

Nan Guo, PhD - Department of Anesthesiology, Perioperative and Pain Medicine, Stanford University

Pervez Sultan, MBChB, FRCA, MD (Res) - Stanford University

**Background:** Headaches are frequently experienced in the postpartum period. [1] Few studies have specifically investigated the influence of childbirth upon incidence, prevalence, severity, or phenotype of headaches during a woman's lifetime. The large Head HUNT-2 study from Norway demonstrated an increased prevalence of both migraine and non-migrainous headache among women who gave birth, a trend which persisted even decades following childbirth. [2] Despite the publication of association between headache and pregnancy from the Head HUNT-2 trial in 2009, to our knowledge no studies and none of the 44 publications citing this reference, have further investigated the link between childbirth and new chronic headache disorders.

**Methods:** In this single-center, cross-sectional study, participants who had attended a chronic pain clinic completed an emailed survey regarding demographics, childbirth history, and headache history including onset, severity, and associated features. The primary outcome was the association between childbirth and headache prevalence analyzed by multiple Poisson regression with robust variance adjusting for age, weight, employment, race and ethnicity, and income. Secondary analysis compared women with onset of headache problems prior to childbirth versus after giving birth.

**Results:** Surveys were sent to 12,776 women with chronic pain who agreed to be contacted for research purposes. 1,018 women provided complete data for analysis. 545 (54%) had a history of childbirth, and 806 (79%) endorsed chronic headache. The prevalence of chronic headache was 81.5% (444 out of 545) in women who had given birth compared to 76.5% (362 out of 473) in women who had not (crude PR=1.06 (95% CI 1.00-1.13); p=0.056). After adjusting for age, weight, employment, race/ethnicity, and income, the adjusted PR was 1.14 (95% CI 1.06-1.23, p< 0.001). Among women with headaches and a history of childbirth, those whose headaches began after childbirth (n=190) differed from those whose headaches began prior to giving birth (n=243) in several ways: women had lower income, less employment, greater headache severity, and a less prevalent migraine phenotype (Table 1).

**Conclusion:** To our knowledge this is the largest survey regarding chronic headache that has been performed in an enriched population of women attending a chronic pain management clinic, with over 1,000 complete survey responses. Childbirth should be considered among chronic headache risk factors for patients receiving care in chronic pain clinic settings. Studies are needed to address causality and mechanism, specifically elucidating whether the act of giving birth or of raising children is responsible for this association.

[Table 1 chronic headache SOAP.pdf](#)

Abstract #: FRI – RPS2 – Room 4 – Postpartum Headache, Depression and Skilled Nursing Care - 03

## Prevalence and Management Guidelines for Parturients with Idiopathic Intracranial Hypertension at an Academic Institution

Presenting Author: Mikayla Troughton, MD

Presenting Author's Institution: University of Arkansas for Medical Sciences - Little Rock, Arkansas

### Introduction

Idiopathic Intracranial Hypertension (IIH) is characterized by elevated intracranial pressure, often manifesting as a headache or visual changes, without underlying intracranial pathology. Failure to properly diagnose and treat IIH can lead to severe visual loss or blindness in 10-20% of patients.<sup>1</sup> Pregnancy, obesity, and exogenous estrogens can worsen IIH symptoms. Despite this knowledge, there are currently no standardized guidelines for the management of IIH in the pregnant patient. We sought to determine the prevalence of IIH in parturients at our institution and the course of their intrapartum management. Using this information, we produced guidelines for future anesthetic peripartum management of women with this condition.

### Methods

We completed a retrospective chart review of all women admitted for delivery at our institution with a diagnosis of IIH using the AR Clinical Data Repository from January 2015 to December 2020. Each chart was individually reviewed to confirm the diagnosis. The following data was also collected: age, Body Mass Index (BMI), anesthetic technique, urgency of delivery, management of IIH symptoms and fetal outcomes. All data was entered into Microsoft Excel, prevalences were calculated and subsequently converted to percentages.

### Results

The prevalence of IIH in laboring women was 71/20,931 (0.34% of all deliveries). 84.7% of all parturients with IIH obtained neuraxial anesthesia, with 40/71 (56.3%) undergoing cesarean delivery (CD). 12.5% of patients underwent general anesthesia for their CD (Figure 1). 98.6% of all patients with a confirmed diagnoses of IIH were at least Class 1 Obesity or greater.

### Discussion and Conclusions

This study demonstrates that women with IIH are more likely to deliver via CD (institutional rate - 41.1%) and more likely to receive general anesthesia (institutional rate - 4.5%) than women without IIH. It is paramount for the anesthesiologist to understand IIH management in the pregnant patient, and thereby prevent acute increases in intracranial pressure and preserve vision. IIH symptom management includes diet modification, acetazolamide, lumbar or ventriculoperitoneal shunts, and serial lumbar punctures. If symptoms are well controlled, there are no contraindications to neuraxial anesthesia for both labor and CD, even in patients with shunt devices. Pregnant women have an increased risk of failed intubation and gastric aspiration. Therefore, general anesthesia should be avoided unless indicated for other reasons. In the future, there may be consideration for intrathecal catheter placement as a mode of labor analgesia due to smaller injectate volumes and faster delivery.<sup>2</sup>

[Prevalence and Management Guidelines for Parturients with Idiopathic Intracranial Hypertension at an Academic Institution\\_Troughton.pdf](#)

### Spontaneous Intracranial Hypotension in Pregnancy: A Case Series

**Presenting Author:** Asantha R. Jayaweera, MB BS BSc (Hons) MRCS (Eng) FRCA

**Presenting Author's Institution:** Queen Charlotte's and Chelsea Hospital, London - London

**Co-Authors:** Vinnie R. Sodhi, MB BS FRCA - Queen Charlotte's and Chelsea Hospital, London

Alex Walls, MB BS FRCA - Queen Charlotte's & Chelsea Hospital, London

**Introduction:** Spontaneous Intracranial Hypotension (SIH) is a rare condition associated with spontaneous dural tear, CSF leak and often debilitating headache. It is more common in females of child-bearing age. There is no consensus opinion on management of these patients during pregnancy or delivery.

#### Case series:

A multip (2xCS) with previously diagnosed SIH experienced a recurrence of symptoms in her third pregnancy at 15 weeks. Epidural Blood Patch (EBP) was performed at 21/40 with 8 weeks symptom relief, before further recurrence. After MDT review, the patient had a CS under GA at term, with no recurrence of headache postnatally.

A pregnant woman (P2 SVDs) with a history of SIH was induced at 39 weeks and had epidural analgesia for labour and forceps delivery. She has since had recurrence of her headaches and is awaiting an EBP.

A primiparous lady with a history of SIH 11 years previously had an uncomplicated pregnancy and SVD with epidural analgesia and no recurrence of symptoms.

A woman (P0) with 18/12 history of SIH and ongoing symptoms declined EBP antenatally and requested an elective CS under GA. Postpartum she is awaiting MRI scan and EBP.

A primip with history of SIH 10 years previously and full recovery declined RA for labour analgesia and had an uncomplicated SVD. She remains asymptomatic.

**Discussion:** In our case series, women who had SIH >10 yrs previously did not have symptom recurrence after delivery. There was no association between MOD or RA and recurrence but 3 women declined RA.

Anaesthetic considerations include the effects of potential iatrogenic dural puncture with RA, which can exacerbate brainstem and cerebellar tonsillar descent (noted on MRI imaging in Case 1) and cause headache. An existing dural tear can lead to intrathecal spread of epidural-administered local anaesthetic. Treatment options are conservative management, EBP, myelography and targeted fibrin sealant, and neurosurgical repair. The preferred option is EBP as it has slightly better initial symptom-control than targeted treatment, and significantly lower recurrence rates <sup>1</sup>.

Abstract #: FRI – RPS2 – Room 4 – Postpartum Headache, Depression and Skilled Nursing Care - 05

## Persistent Intracranial Hypotension Headache after Unintentional Dural Puncture in Obstetric Patients: A Prospective Cohort Study

**Presenting Author:** Anne Wanaselja, MD

**Presenting Author's Institution:** University of Pittsburgh Medical Center - Pittsburgh, Pennsylvania

**Co-Authors:** Grace Lim, MD MSc - Department of Anesthesiology & Perioperative Medicine, University of Pittsburgh School of Medicine

Samer Narouze, MD - Northeast Ohio Medical University

Bryna Torre, MD - University of Pittsburgh Medical Center

### Intro

The International Society of Headache Disorders-3 (ICHD-3) defines post-dural puncture headache (PDPH) as a headache that "remits spontaneously within 2 weeks or after...epidural patch."<sup>1</sup> Yet recent studies suggest PDPH may not be self-limiting,<sup>2,3</sup> begging questions about whether long-term headache after PDPH is a new-onset chronic unspecified headache, or chronic cerebrospinal fluid (CSF) leak. The purpose of this study was to characterize persistent headache after unintentional dural puncture (UDP) in obstetric patients. We hypothesized that women with UDP or PDPH after delivery will have persistent PDPH and signs of chronic CSF leak 6 weeks postpartum.

### Methods

Obstetric patients who had neuraxial labor anesthesia with known UDP or symptoms consistent with PDPH within one day after delivery were enrolled. At baseline and at 6 weeks postpartum, pre-eclampsia, chronic and migraine headache histories, PDPH by ICHD-3 criteria (i.e., daily headache usually but not invariably orthostatic and usually accompanied by neck pain, tinnitus, hearing changes, photophobia or nausea), chronic CSF leak headache, and disability by Headache Impact Test (HIT-6) scores were measured. Worsening headache throughout the day implicated CSF leak as the etiology of persistent headache. The primary outcome was persistent PDPH at 6 weeks, defined by ICHD-3. Headache disability was defined by positive HIT-6 score  $\geq 50$ . Descriptive statistics were performed and event rates for persistent PDPH and CSF leak at baseline and 6 weeks were calculated with binomial exact 95% confidence interval (CI) using the Clopper-Pearson method.

### Results

Of 3,776 neuraxial procedures in the study period, 55 enrolled subjects had initial UDP or PDPH for a baseline event rate of 1.6% (95% CI 0.011 to 0.019). Six-week ICHD-3 PDPH data were available in 30 cases. Five of 55 (9.1%) had a history of pre-eclampsia at baseline, none with headaches attributable to pre-eclampsia; 23 of 55 (41.8%) had pre-pregnancy migraines; 9 of 55 (16.4%) had migraines during pregnancy; 39 of 55 (70.9%) had at least 1 headache monthly (median 1, range 0 to 3). The baseline frequency of PDPH was 56.4% (31 of 55, 95% CI 0.423 to 0.697) and at 6 weeks was 16.7% (5 of 30, 95% CI 0.056 to 0.347). The baseline frequency of chronic CSF leak was 20.0% (11 of 55, 95% CI 0.104 to 0.330) and at 6 weeks was 7.3% (4 of 55, 95% CI 0.020 to 0.175) (Figure). Three of the 5 (60%) with PDPH at 6 weeks had positive HIT-6, indicating ongoing headache disability; 1 of 5 (20%) had no prior history of migraines or headaches before or during pregnancy.

### Conclusions

At 6 weeks after UDP, 16.7% of patients have persistent PDPH; these headaches may indicate chronic CSF leak, and some have new headache disability. Patients reporting persistent headache 6 weeks after UDP may be experiencing persistent CSF leak, which warrants further management.

[Figure-SOAP-1.pdf](#)

## Virtual Reality Biofeedback for Postpartum Anxiety and Depression

**Presenting Author:** Grace Lim, MD MSc

**Presenting Author's Institution:** Department of Anesthesiology & Perioperative Medicine, University of Pittsburgh School of Medicine - Pittsburgh, Pennsylvania

**Co-Authors:** Valeria Altamirano, BA - University of Pittsburgh

Olivia Jarvis, BA - University of Pittsburgh

Aman Mahajan, MD PhD - University of Pittsburgh

### Intro

Cognitive behavioral therapy is a basic element of treatment for postpartum anxiety (ANX) and depression (DEP)<sup>1</sup>. Exacerbations of existing DEP and ANX are rising in concert with the COVID-19 pandemic<sup>2</sup>, whereas the supply of mental health professionals is remaining static. Virtual Reality (VR) offers a potential solution to these care gaps, and VR has demonstrated success in treatment of pain, chronic disease, and other mental health conditions<sup>3-4</sup>. However, VR effectiveness for treatment of postpartum ANX or DEP has not been investigated. The purpose of this pilot trial is to test patient feasibility and acceptability of virtual reality biofeedback program in pregnant and postpartum women for ANX and DEP outcomes.

### Methods

Postpartum women with a history of ANX or DEP participated in a single VR biofeedback session. The VR intervention consisted of a head mounted display (HMD), smartphone with software rendering stereoscopic images to the user and heart rate / respiratory rate sensors connected and displayed to the patient. A 30-minute VR session involved breathing exercises: users saw objects (linked to their heart rate) in a virtual world which changed movements with their breathing. Users were guided on how to modify breathing to change the objects. Pre- and post-session ANX and DEP symptoms were measured by Edinburgh postnatal depression scale (EPDS) and State-Trait Anxiety Inventory (STAI). Acceptability was assessed by questions, "Would you participate in another session?" and "Would you participate in regular repeating sessions?" Enjoyability, ease of use, and other questions were assessed on a 1-5 Likert scale. Experience was rated on 11-point global experience numeric rating scale (NRS) where 0 is the worst and 10 is the best experience possible. Descriptive statistics were reported for acceptability questions and for the global experience ratings. Graphical representations of STAI and EPDS scores evaluated changes in ANX and DEP symptoms.

### Results

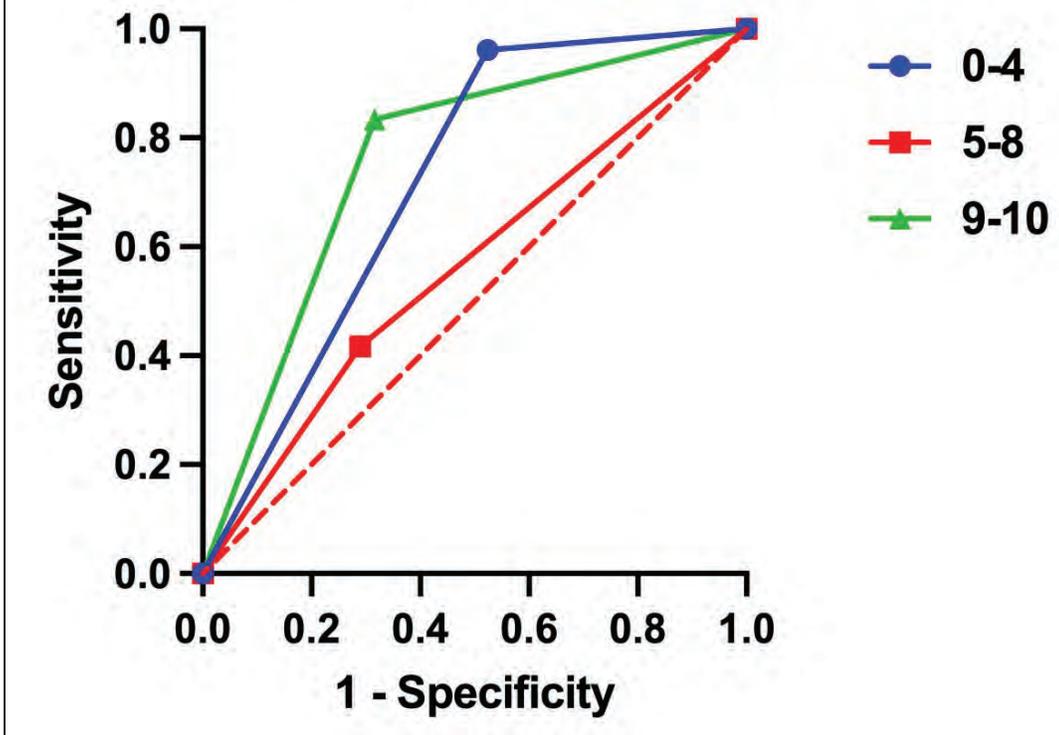
Six postpartum patients with ANX or DEP enrolled and completed sessions and assessment. Five of 6 (83.3%) responded that they would participate in another session in the future and would participate in regular repeating sessions. All subjects gave highest ratings of 5 ("completely agree") for questions on ease of use, worthiness of time, and clarity of directions. Median global experience rating was 9.5 (range, 8.25 to 10.0) on an 11-point NRS. ANX and DEP scores were observed to improve in all participants, while one participant (16.7%) had no change in ANX or DEP symptoms (Figure).

### Conclusions

VR with biofeedback is a feasible and acceptable modality to reduce acute postpartum ANX and DEP symptoms. Future trials will investigate its efficacy for long-term postpartum ANX and DEP symptom reduction and will discern whether potential improvements in DEP scores are primarily driven by modulating ANX symptoms.

[Figure.pdf](#)

## ObSAS score and Maternal Morbidity



Abstract #: FRI – RPS2 – Room 4 – Postpartum Headache, Depression and Skilled Nursing Care - 07

### Long-term Complications of Unintentional Dural Puncture During Labor Epidural Analgesia: A Case-Control Study.

**Presenting Author:** Alexandre Lacombe, MD, FRCPC

**Presenting Author's Institution:** Department of Anesthesia, Jewish General Hospital, McGill University - Toronto, Ontario

**Co-Authors:** Jose C A. Carvalho, MD, PhD - Department of Anesthesiology and Pain Medicine, Mount Sinai Hospital, University of Toronto

Kristi Downey, MSc - Department of Anesthesiology and Pain Medicine, Mount Sinai Hospital, University of Toronto

Xiang Y. Ye, MSc - Maternal and Infant Care Research Centre, Mount Sinai Hospital, University of Toronto, Canada

**Introduction:** Epidural analgesia is the preferred method to manage pain during labor and delivery. The insertion of an epidural catheter can be complicated by unintentional dural puncture (DP) that may result in postdural puncture headache (PDPH)<sup>(1)</sup>. There is increasing, but still limited evidence on the long-term implications of PDPH<sup>(2-3)</sup>. We sought to investigate if women who sustained a DP have a higher risk of developing chronic headache, low back pain, visual or auditory impairment.

**Methods:** We conducted a 1:1 case-control study with women who delivered at our institution from January 2015 to December 2019. Cases were women who received epidural analgesia and sustained an unintentional DP; controls were women who received epidural analgesia but did not sustain such complication. We matched cases and controls for date of delivery, age, and BMI. All women completed an online survey with validated questionnaires<sup>(4-9)</sup> for diagnosis of chronic headache and chronic back pain. We used dichotomic (yes/no) questions to look for the presence of chronic visual and auditory impairment. We defined composite outcome as the presence of any of the chronic symptoms including headache, back pain, auditory or visual impairment. Finally, patients with chronic symptoms were asked questions derived from the Pain Disability Index (PDI) Questionnaire<sup>(10)</sup> to look at the impact of the most bothersome symptoms on their daily activities.

**Results:** Sixty-three case-control pairs were studied. Women who sustained a DP during epidural catheter insertion had a higher risk of developing chronic headache [14.3%, versus 4.8%,  $p=0.057$ , AOR: 3.36 (1.05, 12.82)] and chronic back pain [39.7% versus 19.1%,  $p=0.009$ , AOR: 2.67 (1.25, 5.72)] than women who did not sustain a DP. The incidence of chronic auditory impairment was also higher in the DP group [14.3% versus 1.6%,  $p=0.01$ , AOR: 9.98 (1.21, 82.62)]. Results for the main outcomes of interest are presented in Table 1. There was no difference in the incidence of chronic headache, backache, visual or auditory impairment between those receiving and those not receiving an epidural blood patch.

**Conclusions:** An unintentional DP during epidural catheter insertion in parturients is associated with increased risk of chronic headache, back pain, and auditory impairment. The treatment with an epidural blood patch does not seem to influence these outcomes, however, given the small number of events, further studies are warranted to confirm these findings.

[Carvalho:LacombeLong-term Complications of Unintentional Dural Puncture During Labor Epidural Analgesia.pdf](#)

**Abstract #: FRI – RPS2 – Room 4 – Postpartum Headache, Depression and Skilled Nursing Care - 08**

## **Incidence of post-dural puncture headache during labor analgesia in two time matched retrospective cohorts – A quality study**

**Presenting Author:** Wesley Rajaleelan, MBBS MD DA

**Presenting Author's Institution:** University of Ottawa, Ontario

**Co-Authors:** George Dumitrascu, MD FRCPC - University of Ottawa

Wesley Edwards, MBBS MPH FRCA - University of Ottawa

Mohamed Eissa, MBBCh, MD - The University of Ottawa

Robert Jee, MD FRCPC - University of Ottawa

Shelby Wallace, MD - University of Ottawa

### **Introduction**

Neuraxial analgesia has been widely regarded as the gold standard for control of labor pain but is associated with the risk of accidental dural puncture (ADP) and subsequent development of a post-dural puncture headache (PDPH) which can lead to prolonged hospital stay, further interventions and an impaired ability of the mother to care for the newborn. Recent studies have reported the incidence of accidental dural puncture complicating epidural catheter placement varying 0.9 to 1.3%. In UK, Best practice Standards for the provision of labor analgesia have been defined by the National Institute for Health and Care Excellence and the Royal college of Anaesthesiologists to be less than 1%.

### **Methodology**

This study was a retrospective chart review. The study population were all parturient who underwent labour epidurals at our tertiary care referral centre at two different time intervals: January 01, 2021, to March 31, 2021, and July 1, 2021, to September 30, 2021. These two-time matched cohorts were chosen to look at the impact of new trainees starting in July of 2021. Data were extracted by two independent authors. The variables examined were maternal characteristics (age and BMI), experience of the operator, (level of training), supervision, witnessed accidental dural puncture, positive catheter aspiration and the time interval from dural puncture to symptomatology. Chi square and student's t test were used to assess statistically significant differences between the two groups.

### **Results**

Analysis of 235 labor epidurals in first cohort (January to March) revealed a total of 2 ADPs (0.85%). The ADP rate in cohort 2 (July to September) was 7 out of 305 procedures (2.29%). The odds of ADP were 3.77 times higher for new trainees compared to trainees who were at their 3rd year and above of training. There was no significant correlation between maternal characteristics and ADP. There was a significant correlation between operator experience and the incidence of ADP. The incidence of ADP in cohort 2 was higher than the RCoA standard of 1.3%.

### **Conclusions**

Traditional methodologies of teaching labour epidural placement to junior anesthesia residents continue to show a significant difference in proficiency between junior and senior trainees. It is important for our patients to explore methods for improvement of our education process These could involve increased direct supervision and structured feedback tools, the use of high-fidelity epidural simulation or use of ultrasound imaging

**Clinical characteristics and biomarkers associated with perinatal depression and persistent pain in parturients undergoing cesarean delivery**

**Presenting Author:** Mary Yurashevich, MD, MPH

**Presenting Author's Institution:** Duke University Department of Anesthesiology, North Carolina

**Co-Authors:** Mary Cooter Wright, MS - Duke University Department of Anesthesiology

Ashraf S. Habib, MBCh, MSc, MHSc, FRCA - Duke University School of Medicine

Sierra Camille Mims, BA - Duke University School of Medicine

Hon Sen Tan, MD, MMed, MHSc - Duke University Department of Anesthesiology

**Background**

Severe acute pain after cesarean delivery (CD) increases the risk of developing persistent pain (23% incidence)<sup>1</sup> and perinatal depression (PND) (15% incidence).<sup>2</sup> Both conditions contribute to maternal morbidity and mortality, yet early risk stratification remains limited. Neuroinflammation has emerged as a mediator of persistent pain and depression in non-obstetric populations. However, most studies focus on plasma cytokines, and the relationship between plasma and neuro-cytokines is unclear. Our primary aim is to compare neuroinflammatory cytokine profiles between parturients who develop the composite outcome of persistent pain or PND, versus those who do not develop this outcome.

**Methods**

Patients with term singleton pregnancies undergoing elective CD under spinal or CSE anesthesia were recruited. Baseline demographic, obstetric, pain and Edinburgh postnatal depression scale (EPDS) information was obtained, and quantitative sensory tests performed (mechanical temporal summation and pain tolerance). 10 ml of blood was collected preoperatively and 48 hours post-CD. In the OR, 10 ml of CSF was collected followed by a standardized anesthetic. Intra- and postoperative management was according to standard practice. EPDS was administered at 6-weeks and 3 months. Primary outcome was persistent pain or PND at 3 months. Following univariable analysis, factors associated with the outcome at the 0.20 level were considered for inclusion in the multivariable model. The final model was constructed via backwards selection based on AIC and Firth's correction was applied. Model odds ratios (OR) and 2-sided p-values are reported with significance assessed at the 0.05 level.

**Results**

Eighty subjects were enrolled and 63 patients completed the study; 23 (36.5%) experienced the primary outcome of persistent pain or PND at 3 months. In univariable analysis, history of surgery (non-CD) (91% vs. 50%;  $p < 0.001$ ), higher anxiety scores (median 50 vs. 37.5;  $p = 0.036$ ), and being current or previous smoker (41% vs 10%;  $p = 0.010$ ) were associated with the primary outcome. In the final multivariable model, only history of surgery (non-CD) (OR (95% CI) 11.5 (2.0, 65.8);  $p = 0.006$ ) and anxiety score (1.03 (1.00, 1.05) per point;  $p = 0.024$ ) remained independently associated with PND or persistent pain at 3 months. We successfully collected 79 baseline CSF, 76 baseline plasma and 75 follow-up plasma in this patient cohort. The plasma and CSF samples are currently being analyzed and will be combined with this data in future analysis that will be available for presentation at the meeting.

**Discussion**

We identified significant associations between baseline factors and our primary outcome which will inform future analysis of plasma and CSF biomarkers. We demonstrated the feasibility of collecting plasma and CSF samples in this patient population which may prove useful for future risk-stratification.

[Table 1.pdf](#)

Abstract #: FRI – RPS2 – Room 4 – Postpartum Headache, Depression and Skilled Nursing Care - 10

**Ketamine to prevent postpartum depression after planned cesarean delivery under neuraxial anesthesia. A randomized feasibility pilot-study of intravenous and subcutaneous administration**

**Presenting Author:** David T. Monks, MBChB FRCA MSc

**Presenting Author's Institution:** Washington University School of Medicine - Saint Louis, Missouri

**Co-Authors:**

**Background:** Postpartum depression (PPD) complicates 6-19% of pregnancies, leading to costly consequences for mothers, their families, and the wider society [1]. Evidence is emerging regarding a potential role for ketamine in preventing PPD after cesarean delivery (CD). One large study (n = 654) documented a reduction (12.8 vs. 19.6%) in the 6-week prevalence of PPD after a 48-hour intravenous (IV) infusion (0.04 mg/kg/hr) of ketamine [2]. We assessed the feasibility of studying ketamine to prevent PPD in the post-cesarean population at our institution. We also collected data on the efficacy and tolerability of two different administration strategies: a subcutaneous injection, or a 40-minute intravenous infusion, of 0.5 mg/kg of ketamine.

**Methods:** In an urban maternity center, twenty-three women scheduled for CD under neuraxial anesthesia were randomized to one of three groups: subcutaneous ketamine (SC Group, n = 8), intravenous ketamine (IV Group, n = 8) or placebo (n = 7). We measured depression (Edinburgh Postpartum Depression Scale [EPDS]) scores pre-operatively and at 1, 2, 21 and 42 days postoperatively. Anxiety, adverse effects, surgical site pain and analgesic consumption were also assessed. The feasibility of an anticipated RCT was assessed based on acceptability, burden of disease, data collection and, tolerability of interventions.

**Results:** There were no significant differences in baseline demographic characteristics between groups. There were, however, more women in the placebo group with a pre-existing diagnosis of anxiety disorder ( $p = 0.03$ ). Of the 121 women approached, 20.7% consented to participate, 23 women were assessed and 34.8% screened positive for PPD (EPDS > 12). A full dataset was obtained for depression screening in 78.3% in the 6-week study period. No statistically significant differences between groups were observed for any adverse effect outcomes (Table 1) except for fewer incidences of intra-operative shivering in those who received ketamine (SC: 25%, IV: 0%, Placebo: 87.5%,  $p = 0.01$ ). This study was not powered to detect clinically significant anti-depressant effect. No difference in the proportions of each group that screened positive for depression in the postpartum period was observed (SC: 14.3%, IV: 50% and Placebo: 42.9%,  $p = 0.58$ ).

**Conclusion:** An RCT of ketamine was judged to be feasible and there was no evidence of intolerability of either route of ketamine administration.

[Table 1 Adverse Effects .pdf](#)

## The Futility of Cosyntropin in the Management of Post-Dural Puncture Headache: a Propensity-Matched Retrospective Analysis

**Presenting Author:** Mingchun Liu, MD

**Presenting Author's Institution:** Washington University School of Medicine - St Louis, Missouri

**Co-Authors:** Allison Mitchell, MD - Washington University School of Medicine

Arvind Palanisamy, MD, FRCA - Washington University School of Medicine

Preet Mohinder M. Singh, MD - Washington University School of Medicine

### Introduction

Post-dural puncture headache (PDPH) is a well-documented complication of accidental dural punctures during epidural placements in obstetric patients, with occurrence rate up to 86% (1). Reports have shown successful treatment of PDPH with ACTH (2,3). However, there have not been any studies since to confirm this finding. In this retrospective analysis, we assess whether prophylactic administration of cosyntropin reduced the incidence of PDPH in parturients with accidental dural punctures (ADP) at a large tertiary-care center.

### Methods

This retrospective analysis was conducted under appropriate IRB protocols. The study population was identified by screening our institution's EMR for parturients with a documented ADP who delivered between June 1, 2018 – Oct 31, 2021. We manually reviewed records for patient demographics, mode of delivery, details of epidural placement, level of anesthesia provider experience, prophylactic administration of cosyntropin, PDPH diagnosis, and need for epidural blood patch (EBP). Decision to administer cosyntropin was at the discretion of the anesthesiologist – typically 1mg of cosyntropin as an intravenous bolus or infusion within 30 minutes of delivery. Propensity score was calculated based on the following factors: age, BMI, and placement of intrathecal catheter. Patients were matched allowing 10% variation in scores to reduce potential treatment assignment bias.

### Results

A total of 132 patients met inclusion criteria and 115 patients are included in the final analysis after propensity score matching. Intravenous cosyntropin was administered to 65 patients (55.6%). In those who received cosyntropin, 37 patients (56.9%) developed PDPH compared to 29 patients (58%) in the no-cosyntropin group ( $p=0.08$ ). EBP was performed in 21 patients (56.8%) who received cosyntropin and 13 patients (61.7%) who did not receive it ( $p=0.70$ ) (Fig. 1). The incidence of PDPH was not significantly affected by age ( $p=0.28$ ) or by placement of an intrathecal catheter ( $p=0.34$ ). BMI was negatively correlated with PDPH incidence ( $p=0.04$ ).

### Discussion

The efficacy or lack thereof of cosyntropin in PDPH management remains unchallenged. Our study demonstrates that prophylactic administration of cosyntropin is not associated with a reduced incidence of PDPH or need for EBP. This finding remains true even when considering age, BMI, and placement of an intrathecal catheter. Limitations of our retrospective study include: (i) the possibility that some patients with ADP were not identified, and (ii) inability to ascertain receipt of treatments, including but not limited to analgesics. To our knowledge, this is the largest case series to examine the efficacy of cosyntropin in PDPH prevention.

[Fig 1.pdf](#)

Abstract #: FRI – RPS2 – Room 4 – Postpartum Headache, Depression and Skilled Nursing Care - 12

## Development of an Institutional Protocol for Collaborative Care of Pregnant Patients Undergoing Electroconvulsive Therapy

**Presenting Author:** Mingchun Liu, MD

**Presenting Author's Institution:** Washington University School of Medicine - St Louis, Missouri

**Co-Authors:** Swarup Varaday, MD - Washington University School of Medicine

### Introduction

Pregnancy is a period of increased vulnerability to psychiatric disorders with prevalence ranging from 15% to 29% (1). For patients with severe diseases, electroconvulsive therapy (ECT) remains an effective and safe treatment option (2). Periprocedural management of pregnant patients undergoing ECT is complex and variable. We present two patient cases for illustration leading to the development of an institutional protocol for perioperative care of this patient population.

### Cases

**Case 1:** A 38yo G7P2 female at 22w3d gestation with history of schizophrenia and bipolar disorder presented with acute psychosis and agitation. Given treatment-resistant schizophrenia, she underwent involuntary ECT treatment. Patient completed a total of 4 sessions under general endotracheal anesthesia in the OR as well as ECT suites with pre- and post-procedure fetal monitoring.

**Case 2:** A 36yo G1P0 female at 38wk gestation with no psychiatric history presented with acute bipolar disorder with catatonia following her father's sudden death. Given her disease severity, a decision was made to proceed with ECT sessions at 39 weeks in the OR under general endotracheal anesthesia with continuous fetal monitoring. During her second session, an emergent cesarean delivery was performed due to maternal seizure resulting in a terminal fetal deceleration. A viable fetus was delivered with APGARs 2 and 7 at 1 and 5 minutes respectively.

### Discussion

ECT is primarily used to treat severe psychiatric disorders and considered safe in pregnancy. Common adverse events include uterine contractions, preterm labor, and transient fetal bradycardia that is typically not associated with adverse perinatal outcomes (3). Coordination of periprocedural care for pregnant patients undergoing ECT often involves early multidisciplinary planning to ensure a safe outcome for both the mother and her fetus. Due to a lack of standardized guidelines at our hospital, an institutional protocol was developed. We recommend that pregnant patients receive ECT in settings that include obstetric anesthesiologists, psychiatrists with experience in administering ECT to pregnant patients, and MFM specialists with access to fetal monitoring equipment. Physiological and anatomic changes during pregnancy are crucial to note when implementing the anesthetic plan, and a specific strategy for fetal monitoring must be made (3,4). Treatment sessions can be performed in the ECT suite only if a nearby OR and OB staff are readily available in case of emergency.

Abstract #: FRI – RPS2 – Room 5 – Cesarean Delivery (general anesthesia) - 01

Comparison of umbilical pH between subjects who had cesarean deliveries under general and regional anesthesia for the indication of fetal heart rate abnormalities: a single center retrospective study

**Presenting Author:** Grace Steel, M.D.

**Presenting Author's Institution:** Baylor Scott & White Medical Center-Temple

**Co-Authors:** Jessica Ehrig, M.D. - Baylor Scott & White Medical Center-Temple

Kendall Hammonds, M.P.H. - Baylor Scott & White Research Institute

Michael P. Hofkamp, M.D. - Baylor Scott & White Medical Center-Temple

**Introduction:** The American Society of Anesthesiologists practice guidelines on obstetric anesthesia advises that cesarean deliveries (CD) should be conducted under regional anesthesia (RA) when practical.<sup>1</sup> There are occasions where the benefits of immediate delivery of a fetus due to fetal heart rate abnormalities (FHRA) outweigh the risks of general anesthesia (GA). The primary aim of our study was to compare umbilical blood gases between subjects who had RA and GA as the initial anesthetic technique for CD performed with the indication of FHRA.

**Methods:** Our institutional research board waived informed consent for this study. We searched our electronic medical record for subjects who had cesarean deliveries from July 1, 2020 to June 30, 2021 who had an operative indication of FHRA. A study investigator entered data from our electronic medical record into REDCap.

**Results:** 166 subjects had CD during the study period with an operative indication of FHRA. 21 (12.7%) and 145 (87.3%) subjects had GA and RA as the initial anesthetic technique, respectively. 74 (51.0%) of subjects who had RA for CD had an umbilical blood gas study performed and 19 (90.5%) of subjects who had GA for CD had an umbilical blood gas study performed, a difference that was statistically significant ( $p < 0.01$ ). Demographic and clinical data for subjects who had an infant with an umbilical blood gas performed stratified by initial anesthetic technique are presented in Table 1.

**Discussion:** We found clinically and statistically significant differences in umbilical pH and APGAR scores at 1 and 5 minutes between subjects who had GA and RA for CD that had an indication of FHRA. The cohorts differed in that subjects who had GA as the initial anesthetic technique were much more likely to have had "STAT" or "emergent" documented in the operative or progress notes. A limitation of our study was that we did not have enough data in the electronic medical record to make comparisons between subjects who had CD under GA and RA with similar profiles of fetal distress. Future studies are needed to match levels of fetal distress for subjects who have CD under GA and RA to determine if one anesthetic technique is superior.

[Table 1.pdf](#)

**Abstract #: FRI – RPS2 – Room 5 – Cesarean Delivery (general anesthesia) – 02**

**The effect of a dedicated video laryngoscope in the labor and delivery suite on airway management for cesarean deliveries performed under general anesthesia: a single center retrospective study**

**Presenting Author:** Alyson Win, B.S.

**Presenting Author's Institution:** Texas A&M Health Science Center College of Medicine - Temple, Texas

**Co-Authors:** Kendall Hammonds, M.P.H. - Baylor Scott & White Research Institute

Michael P. Hofkamp, M.D. - Baylor Scott & White Medical Center-Temple

Adam Olson, M.D. - Wake Forest University

**Introduction:** A literature review by Kinsella et al estimated the incidence of failed airway management in the parturient undergoing cesarean delivery with general anesthesia to be approximately one in 443.<sup>1</sup> In July 2019, our institution placed a dedicated video laryngoscope (C-MAC, Karl Storz) on our labor and delivery unit following a near-miss airway management event. The primary aim of our study was to compare the success rates of endotracheal intubation on the first attempt for subjects before and after placement of a dedicated video laryngoscope on our labor and delivery unit. The secondary aim of our study was to compare the glottic view obtained on the first intubation attempt for subjects before and after placement of a dedicated video laryngoscope on our labor and delivery unit.

**Methods:** We searched our electronic medical record system for subjects who had cesarean deliveries under general anesthesia from July 1, 2017 through June 30, 2021. Subjects were included if there was documentation for the primary aim. Subjects who had cesarean deliveries in July 2019 were excluded along with subjects who had cesarean deliveries in our main operating room.

**Results:** 365 subjects had cesarean deliveries under general anesthesia during the study period. Nine, 27, and two subjects were excluded for having a cesarean delivery in July 2019, having a cesarean delivery in main operating room, and having incomplete documentation for the primary aim, respectively. Ultimately, 139 and 188 subjects who had cesarean deliveries under general anesthesia before and after July 2019, respectively, met inclusion criteria for analysis in our study. Demographic and clinical data for the two cohorts are presented in Table 1.

**Discussion:** We found that the success rate on the first intubation attempt was approximately 94% for both cohorts but that the glottic view obtained on the first intubation attempt was clinically and statistically better for subjects prior to placement of a dedicated video laryngoscope on our labor and delivery unit. After we placed a video laryngoscope on our labor and delivery unit, video laryngoscopy was used more often on the first intubation attempt. Junior residents comprised most of the airway management operators and it is possible that they had less facility with video laryngoscopy compared to direct laryngoscopy. A limitation of our study was that we were not powered to detect the rare incidence of airway management failure cited by Kinsella. Although we did not find a difference in the intubation success rate on the first attempt, we continue to have a dedicated video laryngoscope on our labor and delivery unit to prevent the rare event of airway management failure.

[Table 1.pdf](#)

Abstract #: FRI – RPS2 – Room 5 – Cesarean Delivery (general anesthesia) - 03

## Quality Assurance Methods to Reduce General Anesthesia Rates in Cesarean Delivery

**Presenting Author:** C. Tyler Smith, MD

**Presenting Author's Institution:** University of Pittsburgh, Anesthesiology & Perioperative Medicine - Pittsburgh, Pennsylvania

**Co-Authors:** Joe DeRenzo, MD - University of Pittsburgh, Anesthesiology & Perioperative Medicine

Adam Dunmore, MD - University of Pittsburgh, Anesthesiology & Perioperative Medicine

Grace Lim, MD MSc - Department of Anesthesiology & Perioperative Medicine, University of Pittsburgh School of Medicine

Ryan Romeo, MD - University of Pittsburgh, Anesthesiology & Perioperative Medicine

### Intro:

Anesthesiologists are responsible for providing safe and high-quality care not only to individual patients, but also within group practices.<sup>1</sup> Quality Assurance (QA) includes adherence to current evidence-based best practices, reducing risks for harm and optimizing outcomes. In obstetric anesthesia practices, general anesthesia (GA) for cesarean delivery (CD) reduces the quality of recovery and incurs risks for aspiration and morbidity and mortality. GA for CD rates have been identified as a quality metric by the Royal College of Anaesthetists<sup>2</sup> and Society for Obstetric Anesthesia and Perinatology Centers of Excellence.<sup>3</sup> Recommendations are that GA for CD rates should be less than 5% overall, and less than 15% in emergent CD.<sup>2</sup> The purpose of this study was to evaluate the impact of implementing a QA program on rates of GA for CD.

### Methods:

This was a single center impact study. Our institution saw rising rates of GA for CD in late 2020 in parallel with rising high-risk pregnancy referrals. In November 2020, a monthly QA intervention began and consisting of detailed, independent reviews of all GA for CD cases by 2 anesthesiologists. Reviews identified: 1) if GA was “potentially preventable” defined by previously published criteria;<sup>4</sup> and 2) any potential opportunities for improvement. Cases of GA for CD were brought for confidential discussion at monthly anesthesiology staff meetings, to discuss potential areas for improvement and themes associated with potentially preventable GA. Data that were tracked and reported over time included rates of GA for CD both overall and for emergent deliveries.

### Results:

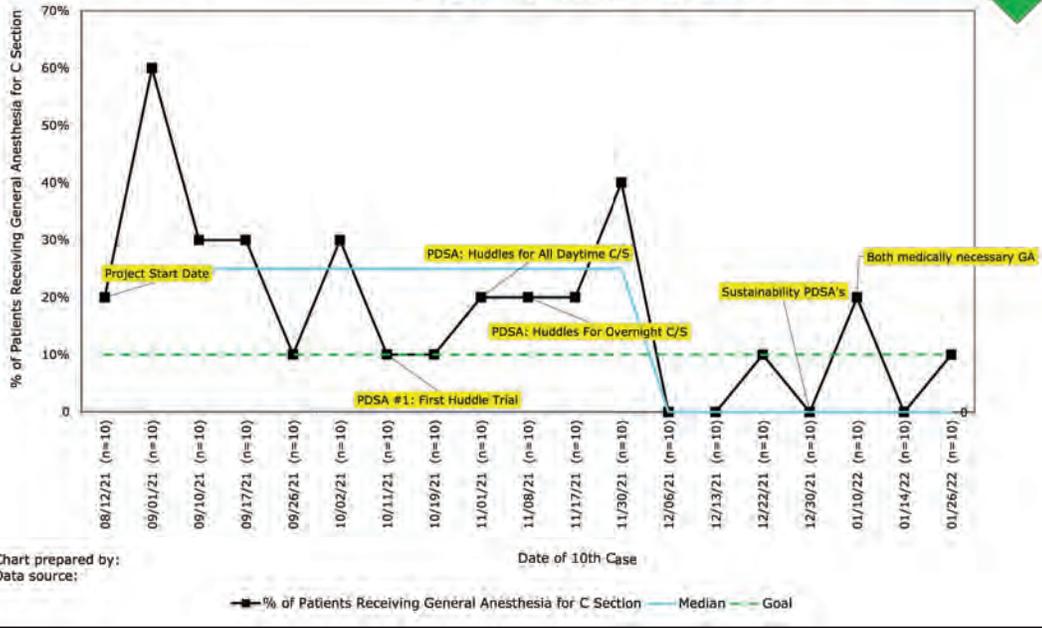
During the 6-month QA implementation period, there were 1,502 CDs (734 emergent); 83 / 1502 (5.5%) were GA, with 68 / 734 (9.3%) emergent GA. Month-to-month variability in GA rates were noted (Fig 1). Ten of 83 (12.1%) GA cases were potentially avoidable. Factors contributing to avoidable GA included lack of early recognition and coordination with multidisciplinary teams for early epidural catheter placements or replacements in complex cases (7 of 10 cases, 70%). Implemented improvements consisted of more thorough evaluation of labor analgesia quality throughout labor by frequent rounding, and better team communication for timely placement or replacement of epidural analgesia. After QA implementation, the rate of GA for scheduled CD went from a peak of 7.4% to 2.9% and the rate of GA for emergent CD went from 11.9% to 3.9%. Rates were sustainably < 5% after the intervention.

### Conclusion:

Implementing a QA process around GA for CD at our institution was associated with a 50% reduction in GA for scheduled and emergent CD. QA programs to reduce GA in CD are feasible, sustainable, and important to maintain high quality care in obstetric anesthesia practices.

[Figure1.pdf](#)

**General Anesthesia for Unscheduled C Sections  
August 2021-January 2022**



**Abstract #: FRI – RPS2 – Room 5 – Cesarean Delivery (general anesthesia) - 04**

**Patient-reported outcome measures to assess postpartum fatigue: a systematic review using COSMIN guidelines**

**Presenting Author:** Perman Pandal, MBBS

**Presenting Author's Institution:** Department of Anesthesiology, Perioperative and Pain Medicine, Stanford University - San Ramon, California

**Co-Authors:** Brendan Carvalho, MBBS, FRCA, MDCH - Stanford University

Sarah Ciechanowicz, MA, BMBCh(Oxon), FRCA, MRes - University College London Hospital

Pervez Sultan, MBChB, FRCA, MD (Res) - Stanford University

Jan Taylor, PhD, RM, FACM - Faculty of Health, University of Canberra

Stafaan Van Damme, PhD - Department of Experimental-Clinical and Health Psychology, Ghent University

**Introduction:** Fatigue is recognised as a key domain of postpartum recovery,[1] and is a burden for a substantial proportion of women.[2] There is wide variation in instruments used to measure fatigue in postpartum women, making data comparison difficult.

**Methods:** We performed a systematic review using Consensus Based Standards for the Selection of Health Measurement Instruments (COSMIN) guidelines to identify the best patient-reported outcome measure (PROM) of postpartum fatigue. We searched four databases with no date limiters, for validated PROMs used to assess postpartum fatigue. Studies were considered if they evaluated at least one author-defined domain of fatigue in the postpartum setting and one psychometric measurement property of a PROM. Unidimensional measures such as single-item numerical rating scales were excluded. Subscale-PROMs were included if an independent psychometric evaluation had been performed. Essential postpartum fatigue domains to include for instrument assessment were decided by author consensus as Physical, Mental and Interference. An overall rating was assigned based upon COSMIN criteria and the Grading of Recommendations Assessment, Development, and Evaluation (GRADE) approach was used to assess the level of evidence for psychometric properties of included PROMs.

**Results:** We identified 49 validation studies using 18 PROMs, in 21,209 women that evaluated postpartum fatigue. All included studies evaluated at least one psychometric property of the included PROMs. All three fatigue domains were assessed by four PROMs: Fatigue Assessment Scale (FAS), Brief Fatigue Inventory (BFI), Checklist Individual Strength (CIS) and Fatigue Severity Scale (FSS). FAS, which is easily accessible and free to use, was the only PROM to demonstrate adequate content validity and at least a low level of evidence of sufficient internal consistency, resulting in a Class A recommendation.

**Discussion:** The FAS is the best currently available PROM of postpartum fatigue. However, this PROM fails to assess several important areas of postpartum recovery, such as care of the infant and the impact of fatigue on psychosocial functioning and employment. Future studies should utilise the FAS to measure postpartum fatigue, but development of a more specific PROM could help advance our understanding of this neglected area of postpartum health research.

Abstract #: FRI – RPS2 – Room 5 – Cesarean Delivery (general anesthesia) - 05

### Quality of recovery in Hispanic versus non-Hispanic patients following vaginal delivery

**Presenting Author:** Perman Pandal, MBBS

**Presenting Author's Institution:** Department of Anesthesiology, Perioperative and Pain Medicine, Stanford University - San Ramon, California

**Co-Authors:** Brendan Carvalho, MBBCh, FRCA, MDCH - Stanford University

Nan Guo, PhD - Department of Anesthesiology, Perioperative and Pain Medicine, Stanford University

Leziga Obiyo, MD, MPH - Department of Anesthesiology, Perioperative and Pain Medicine, Stanford University

James O'Carroll, MBBS FRCA - Stanford University

Cesar Padilla, MD - Stanford University Medical Center

Pervez Sultan, MBChB, FRCA, MD (Res) - Stanford University

**Introduction:** Disparities in maternal pain management Obstetric Quality of Recovery-10 (ObsQoR-10) is a validated measure of inpatient postpartum recovery in all delivery modes<sup>1</sup>. Although healthcare disparities in obstetrics are well described, racial and ethnic variability in recovery following childbirth is underexplored<sup>2</sup>.

**Methods:** We prospectively collected ObsQoR-10 data 24 hours following delivery as part of a quality improvement project at a tertiary, ACOG level 4 institution with an 85% labor epidural rate. We sought to determine differences in ObsQoR-10 scores among Hispanic and non-Hispanic women and between different racial groups (White, Black, Asian and Other) undergoing spontaneous vaginal delivery (SVD).

**Results:** Eighty-four women delivered via vaginal delivery during the data collection period (27% Hispanic; 57% non-Hispanic; 15% declined to state). Demographic, obstetric and medical variables among ethnic and racial groups are presented Table 1. Age, BMI and employment status were significantly different between racial groups. Hispanic patients were younger with higher rates of unemployment. Mean ObsQoR-10 (SD) scores were not significantly different between Hispanic and non-Hispanic patients (84.1 (12.3) vs. 87.6 (9), respectively;  $p=0.177$ ) and no differences were demonstrable between racial groups (Asian 85.2 (9.4); Black 94.3 (4.9); White 86.1 (9.9); Pacific Islander / other 79.5 (27.6);  $p=0.575$ ).

**Conclusion:** Quality of inpatient postpartum recovery was similar between Hispanic and non-Hispanic patients and between racial groups who delivered via SVD at our institution. Optimizing postpartum recovery contributes to women's health and facilitates maternal ability to care for their newborn<sup>3</sup>. Studies are needed to determine optimal methods to eliminate disparities in postpartum recovery.

[Pandal.pdf](#)

**Abstract #:** FRI – RPS2 – Room 5 – Cesarean Delivery (general anesthesia) - 06

**Impact of an interdisciplinary process to increase utilization of neuraxial anesthesia for cesarean delivery: A retrospective database analysis**

**Presenting Author:** Carolyn F. Weiniger, MB ChB

**Presenting Author's Institution:** Tel Aviv Sourasky Medical Center - Tel Aviv, Not Applicable

**Co-Authors:** Boris Aptekman, MD - Tel Aviv Sourasky Medical Center

Rocio Chavez, MD - Tel Aviv Sourasky Medical Center

Elisheva Fiszer, MD - Tel Aviv Sourasky Medical Center

Victor Rabkin, MD - Tel Aviv Sourasky Medical Center

**Introduction:** Cesarean delivery (CD) is safer for mother when performed under neuraxial anesthesia, and the rate of general anesthesia CD in the UK and US is reportedly < 8%. (1,2) Starting Jan 2018 we implemented educational and management strategies to decrease the rate of general anesthesia CD, that was >10% for unplanned cases.

**Methods:** In our tertiary medical center, currently 13,000 labors, 19% cesarean delivery, we instituted monthly anesthesia and interdisciplinary (anesthesia and obstetrician) educational meetings and daily bedside teaching for optimum safe anesthesia for CD. Through these meetings, and daily interdisciplinary hand-overs with the obstetricians, we emphasized the importance of proactive anesthesia and early updates regarding impending unplanned CD. Additionally, from July 2018 we drew up a syringe with lignocaine 18 mL + bicarbonate 8.4% 2ml + 50 mcg epinephrine syringes, kept for 8 hours as per pharmacy recommendation, to be used for labor epidural analgesia augmentation. Following IRB approval we retrieved data from the hospital electronic record for mode of anesthesia, conversion of spinal or epidural to general anesthesia, supplementary intravenous medications for planned and unplanned CD per year, 2018, 2019, 2020 and 2021 to assess the impact of our educational strategies.

**Results**

During the study period, 2018 to 2021, there were 8,946 cesarean deliveries performed; 2,860 were unplanned. The overall rate of general anesthesia for CD decreased from 9.4 to 3.1%, and from 19.7 to 8.1% for unplanned cases, Figure. The rate of general anesthesia performed for women with labor epidural analgesia in place decreased, 4.5% to 1.5%. Supplementary intravenous medications were administered frequently.

**Conclusion**

This study demonstrates the utility of educational interventions to advance patient safety. It highlights the importance of proactive interdisciplinary labor management. Future investigations will investigate use of supplementary intravenous medications during CD.

Planned and Unplanned CD according to year:  
Anesthesia modes, intravenous supplementation medications

	2018 N=2411	2019 N=2227	2020 N=2032	2021 N=2276
Spinal n(%)	1794 (74.4%)	1801 (80.9%)	1756 (86.4%)	1942 (85.3%)
Epidural n(%)	442 (18.3%)	334 (15.0%)	221 (10.9%)	265 (11.6%)
General n(%)	228 (9.5%)	135 (6.1%)	82 (4.0%)	70 (3.1%)
Spinal to GA n(%)	20 (0.8%)	20 (0.9%)	17 (0.8%)	19 (0.8%)
Epidural to GA n(%)	47 (1.9%)	27 (1.2%)	16 (0.8%)	10 (0.4%)
Spinal + IV Suppl n(%)	244 (10.1%)	204 (9.2%)	292 (14.4%)	347 (15.2%)
Epidural + IV Suppl n(%)	206 (8.5%)	120 (5.4%)	85 (4.2%)	115 (5.1%)
IV Suppl Meds n(%)				
Ketamine	140 (5.8%)	44 (2%)	43 (2.1%)	59 (2.6%)
Midazolam	336 (13.9%)	207 (9.3%)	193 (9.5%)	181 (8.0%)
Propofol	392 (16.3%)	272 (12.2%)	283 (13.9%)	357 (15.7%)
Max dose Ketamine given mgJ	21.4(15.8)	22.5(13.7)	19.9(9.0)	18.4(8.7)
Max dose MDZ given mgJ	1.6(0.6)	1.7(0.7)	1.5(0.6)	1.6(0.7)
Max dose Propofol given mgJ	21.6(11.9)	24.1(19.5)	21.9(10.9)	23.8(10.9)

J=mean(SD)

MDZ=midazolam; GA = general anaesthesia

Unplanned CD according to year:  
Anesthesia modes, intravenous supplementation medications

	2018 N=977	2019 N=743	2020 N=554	2021 N=586
Spinal n(%)	464 (47.5%)	376 (50.6%)	331 (59.7%)	330 (56.3%)
Epidural n(%)	373 (38.2%)	288 (38.8%)	189 (34.1%)	232 (39.6%)
General n(%)	192 (19.7%)	114 (15.3%)	61 (11.0%)	40 (8.1%)
Spinal to GA n(%)	11 (1.1%)	9 (1.2%)	5 (0.9%)	5 (0.8%)
Epidural to GA n(%)	44 (4.5%)	25 (3.4%)	14 (2.5%)	9 (1.5%)
Spinal + IV suppl n(%)	92 (9.4%)	58 (7.8%)	68 (12.3%)	70 (11.9%)
Epidural + IV suppl n(%)	180 (18.4%)	104 (14%)	113 (20.4%)	101 (17.2%)

Abstract #: FRI – RPS2 – Room 5 – Cesarean Delivery (general anesthesia) - 07

Retrospective database study to investigate the effect of phenylephrine infusion versus vasopressor boluses during cesarean delivery on neonatal acidosis

**Presenting Author:** Carolyn Weiniger, MB ChB

**Presenting Author's Institution:** Tel Aviv Sourasky Medical Center

**Co-Authors:** Boris Aptekman, MD - Tel Aviv Sourasky Medical Center

Chaim Greenberger, MD - Tel Aviv Sourasky Medical Center

Victor Rabkin, MD - Tel Aviv Sourasky Medical Center

**BACKGROUND:** Maternal hypotension after spinal anesthesia is associated with neonatal acidosis, yet this is potentially modifiable through use of prophylactic vasopressor treatment. (1)

**OBJECTIVE:** This retrospective database study aimed to examine the relationship between the use of prophylactic phenylephrine infusion to avoid spinal hypotension and the occurrence of neonatal acidosis, (defined as neonatal pH < 7.1) in a planned cesarean delivery population, following introduction of prophylactic phenylephrine infusions in 2018.

**STUDY DESIGN:** We performed a retrospective analysis of women with singleton pregnancy undergoing spinal anesthesia for planned cesarean delivery with a retrievable neonatal pH, using electronic medical records. In 2018, prophylactic phenylephrine infusions were introduced for planned cesarean delivery, and prior to that, vasopressor treatment boluses were used. The period of interest during the cesarean delivery was from spinal anesthesia injection until neonatal delivery. Occurrence of spinal hypotension (at least one measurement of systolic blood pressure < 100 mmHg) and use of prophylactic phenylephrine infusion (50 mcg/min) were the primary study variables. The primary outcome was neonatal acidosis (pH of < 7.1). The odds ratios (OR) were calculated using univariate and multivariate logistic regression models; neonatal acidosis was the primary dependent variable and independent variables were binary: use of phenylephrine infusion, at least one occurrence of spinal hypotension.

**RESULTS:** We identified 4,503 women meeting inclusion criteria from Jan 2016 until May 2021. Overall, 1,726 (38.3%) women experienced at least 1 event of spinal hypotension, 1,811 (40.2%) received prophylactic phenylephrine infusion and neonatal acidosis occurred in 70 (1.6%) cases. Neonatal acidosis occurred in 2.6% cases when spinal hypotension occurred and 1.2% cases when spinal hypotension did not occur,  $p=0.001$ . The rate of spinal hypotension was 28.4%, lower, among women who received a prophylactic phenylephrine infusion, versus 49.0% among women treated with vasopressor boluses,  $p<0.001$ . Neonatal acidosis occurred in 1.9% cases when phenylephrine prophylaxis was used, and 1.7% cases with vasopressor boluses,  $p=0.556$ .

In the multivariable regression model, the likelihood of neonatal acidosis when spinal hypotension occurred was OR 2.99; 95% CI, 1.42 to 3.9,  $p<0.001$  and when phenylephrine infusion was used, OR 0.77 (95% CI 0.47 to 1.27),  $p=0.301$ .

**CONCLUSION:** Despite the unsurprising finding that the use of prophylactic vasopressor infusions was associated with a lower frequency of spinal hypotension, they were not associated with decreased likelihood of neonatal acidosis. We plan to further investigate our cohort and to examine other variables associated with neonatal acidosis.

**Abstract #: FRI – RPS2 – Room 5 – Cesarean Delivery (general anesthesia) - 08**

**Adult Attachment Style as a predictor of increased pain after cesarean delivery: a prospective observational study.**

**Presenting Author:** Allen Li, MD

**Presenting Author's Institution:** The University of Western Ontario - LONDON, Ontario

**Co-Authors:**

**INTRODUCTION:** Pain after cesarean delivery (CD) can be problematic for some women. Literature suggests that a patient's psychological characteristics may affect their pain. Adult Attachment Styles (AAS) refer to how a person "generally feels in close relationships" and is prevalent in the chronic pain literature. AAS has been shown to correlate with patients' self-reported pain (1). While there is evidence to show that women with insecure attachment styles experience more pain during labour, this relationship has not been studied in CD patients (2). We hypothesized that women with an insecure attachment style will have higher pain scores as measured on a 0-10 Numeric Rating Scale (NRS) 24-hour after CD.

**METHODS:** Our calculated sample size was 65 patients, assuming the prevalence of insecure to secure attachment to be 1:3. After REB approval and written informed consent, fifty-one women having an elective CD with spinal anesthesia were recruited between January 2020 and February 2022. Attachment style was assessed by the Revised Adult Attachment Scale preoperatively. All women received standardized care including regular multimodal analgesia. In PACU, patients rated their ambulatory pain scores (NRS), and every 4 hours for the first 24 hours. The primary outcome measure was the patient's ambulatory pain at 24-hours. Secondary outcomes included: 1) Quality of recovery at 24-hours as measured by the Obstetric Quality of Recovery-10 (ObsQoR-10) assessment tool; 2) Time-to-First opioid analgesia request; 3) 24-hour opioid consumption; 4) Time-to-First occurrence and number of treatments for nausea, vomiting, pruritis, and sedation.

**RESULTS AND DISCUSSION:** To date, we have recruited 51 patients and recruitment is ongoing. The pandemic affected our recruitment rate for the first eight months. Otherwise, this study is feasible and there is no missing data. With a current recruitment rate of 2-4 patients per week, we anticipate being able to finish data collection and analysis to allow the presentation of our results at the meeting.

## Anesthesia Management for Intrapartum Cesarean Delivery: A Retrospective Comparison Between Extended Epidural and New Spinal Anesthesia

**Presenting Author:** Allison Mootz, MD

**Presenting Author's Institution:** University of Texas Southwestern Medical Center & Parkland Memorial Hospital

**Co-Authors:** Kara Bennett, MD - University of Texas Southwestern Medical Center & Parkland Memorial Hospital

Pamela Fox, MD - University of Texas Southwestern Medical Center & Parkland Memorial Hospital

Courtney Newman, Bachelor of Science - University of Texas Southwestern Medical Center & Parkland Memorial Hospital

David Shu, Bachelor of Science - University of Texas Southwestern Medical Center & Parkland Memorial Hospital

WeiKe Tao, MD - University of Texas Southwestern Medical Center & Parkland Memorial Hospital

Up to 20% of laboring women convert to cesarean delivery (CD) due to maternal or fetal complications, failure to progress, social factors, and malpresentation.<sup>1</sup> In laboring parturients an estimated 20% experience non-reassuring fetal heart tones after initiation of neuraxial analgesia.<sup>2</sup> The optimal anesthesia technique for failed trial of labor and conversion to CD has not been determined. Neither regional nor general anesthesia is considered safer, each carrying individual advantages and disadvantages.<sup>3,4</sup> When failed trial of labor necessitates CD, there are two choices of anesthesia. Labor analgesia can be converted to surgical anesthesia for CD with more potent anesthesia medications or new spinal anesthesia can be performed. If these fail, general anesthesia may be utilized. The goal of this study is to determine whether the type of anesthesia, namely epidural extended from labor analgesia versus new spinal anesthesia, affects the incidence of fetal acidemia in parturients undergoing intrapartum CD.

Delivery records from 699 parturients who underwent CD between September 1<sup>st</sup>, 2019 to February 28<sup>th</sup>, 2021 were collected. Fetal acidemia was defined as an umbilical artery (UA) blood pH of less than 7.15. A labor epidural was converted to epidural surgical anesthesia in 624 patients, while new spinal anesthesia was performed in 75 patients. The relative incidence of fetal acidemia in the spinal anesthesia group was higher, 17.3%, compared to the epidural group, 10.0% (Fischer exact test,  $p = 0.05$ ). The data distribution describing UA pH was similar between the spinal anesthesia and epidural groups, allowing comparison of median pH as well as the mean ranks. Spinal anesthesia resulted in a lower UA pH compared to epidurals in general (Mann-Whitney U test,  $p = 0.015$ ).

Converting a patient's existing epidural analgesia to surgical anesthesia for CD results in fewer instances of fetal acidemia compared to spinal anesthesia in women undergoing intrapartum CD. Our study highlights the importance of high quality labor epidural placement, in effort to avoid new spinal anesthesia in the operating room and fetal acidemia.

**Table 1. Effects of Anesthesia Type on Fetal Acidemia (Fischer exact test,  $p = 0.05$ )**

Type of Anesthesia	pH $\leq$ 7.15	pH $>$ 7.15
Epidural	62 (10.0%)	562 (90.0%)
Spinal	13 (17.3%)	62 (82.7%)

Abstract #: FRI – RPS2 – Room 5 – Cesarean Delivery (general anesthesia) - 10

**Guideline concurrence of timing of sodium citrate administration prior to general anesthesia for cesarean delivery: A retrospective analysis**

**Presenting Author:** Caroline L. Thomas, Obstetric Anesthesiology Fellow

**Presenting Author's Institution:** Northwestern Medicine

**Co-Authors:**

**Background:** Aspiration pneumonitis was once a leading cause of anesthesia-related maternal mortality. To address this, pre-anesthetic antacid and H2-blocker administration were implemented and have reduced maternal mortality from aspiration. The ASA practice guidelines for obstetric anesthesia recommend timely administration of nonparticulate antacids before cesarean delivery. The median duration of action for sodium citrate is approximately 30 minutes. While sodium citrate administration is likely timely when general anesthesia is planned or anticipated, we hypothesized that sodium citrate would not be administered within 30 minutes when general anesthesia is unanticipated (e.g., due to failed conversion from neuraxial labor analgesia to anesthesia or intraoperative conversion to general anesthesia during hemorrhage).

**Methods:** In this IRB approved study, electronic medical record data for all general anesthetics for cesarean deliveries in 2017 were reviewed. For each general anesthetic, the time of sodium citrate administration, time of intubation, and maternal aspiration events were extracted. General anesthetics were categorized into two groups: 1) planned general anesthetics or anticipated general anesthetics for fetal indications (e.g., fetal intolerance to labor, cord prolapse) or 2) unanticipated general anesthetics (e.g., failed conversion to neuraxial anesthesia, intubation for airway protection). Normal distribution was evaluated with the Shapiro-Wilk test. Categorical data were compared using the chi-squared test and continuous data were compared using the Kruskal-Wallis test.  $P < 0.05$  was used to determine statistical significance.

**Results:** Of 3,017 cesarean deliveries, 84 patients underwent general anesthesia (2.8%). Sixty-one patients received sodium citrate prior to intubation (81%). The median time from sodium citrate administration to intubation for anticipated general anesthetics was 9 minutes (interquartile range, [IQR]: 5 – 18 mins) and the median time from sodium citrate administration to intubation for unanticipated general anesthetics was 41.5 minutes (IQR: 22-67 min) ( $P < 0.0001$ ). There were no aspiration events.

**Discussion:** There was a difference in the timing of sodium citrate administration based on the indication for general anesthesia. We also found that not all general anesthetics had sodium citrate administered; however, there were no cases of maternal aspiration in the entire cohort. As the median time between sodium citrate administration and intubation for the unanticipated group was  $>30$  minutes, the practice of administering sodium citrate upon conversion from epidural analgesia to anesthesia should be reevaluated. Alternatively, sodium citrate should be readministered immediately prior to intubation.

## COVID Peripartum Management

**Presenting Author:** Michael McGinnis, MD

**Presenting Author's Institution:** Rush University Medical Center - Chicago, Illinois

**Co-Authors:** Michael Holland, M.D. - Rush University Medical Center

Pete Pelletier, M.D. - Rush University Medical Center

Deborah Tabachnick, M.D. - Rush University Medical Center

We are presenting 5 cases of parturients who developed ARDS from COVID infections. The first two underwent urgent C-sections under general anesthesia. One required veno-venous extracorporeal membrane oxygenation (VV ECMO) due to postoperative decompensation. Subsequent to these cases we postulated that avoidance of mechanical ventilation would be preferable, and neuraxial anesthesia was utilized for the remaining parturients. For maximal safety to both the mother and fetus, prior to starting the C-section, adequate venous access for ECMO was established with insertion of two 9 French introducer catheters to facilitate rapid initiation of ECMO if necessary.

The first parturient was a 25-year-old G1P0 term with a history of asthma and obesity. She underwent urgent Cesarean delivery under general anesthesia with endotracheal intubation for worsening hypoxia. Postdelivery she was extubated to 5L NC, but reintubated for hypoxia. She continued to decompensate and VV ECMO was initiated. She was extubated and ambulatory while on ECMO and was decannulated 10 days later, and discharged home on room air.

The second parturient was a 24-year-old G1P0 at 33w 4d GA with a history of obesity who developed COVID symptoms and was hospitalized. Four days after admission, late decelerations were seen, and she was taken for urgent C-section. She underwent general anesthesia for her procedure and was extubated the following day. She was discharged four days later on room air.

The third parturient was a 25-year-old G3P2 at 33 GA. She was receiving remdesivir, steroids, tocilizumab, and heparin and required high flow nasal cannulas at FiO<sub>2</sub> 0.9. She underwent C-section via spinal two days after arrival with femoral and internal jugular introducer catheter placement to facilitate rapid cannulation for VV ECMO if needed. Following delivery, oxygen was weaned, and she was discharged home on room air on post-operative day 13.

The fourth parturient was a 33-year-old G4P1 at 34w2d GA who presented 6 days following symptom onset. A CT angiogram suggested a possible subsegmental pulmonary embolus. She was on high flow nasal cannulas at FiO<sub>2</sub> 0.6. She went to the operating room for urgent C-section under spinal anesthesia with femoral and internal jugular introducer catheter placement to facilitate rapid cannulation for VV ECMO if needed. She was admitted for another 14 days and was slowly weaned to nasal cannula and discharged home on 4 liters, and was weaned in subsequent weeks.

The fifth case is an obese (BMI 49.5) 33-year-old G4P3 who presented at 32w GA. She was self-proning and required bi-level positive airway pressure at FiO<sub>2</sub> 1.0. Three days later, she was taken for C-section under spinal anesthesia with bilateral femoral introducer catheter placement for VV ECMO backup. Post-operatively, she was initially managed on bi-level positive airway pressure and high flow nasal cannulas but was subsequently weaned to 2 liters NC and discharged home.

## Obstetric services in the UK during the Covid-19 pandemic: a national survey of standards of care

**Presenting Author:** James O'Carroll, MBBS FRCA

**Presenting Author's Institution:** Stanford University

**Co-Authors:** Brendan Carvalho, MBBCh, FRCA, MDCH - Stanford University

Nan Guo, PhD - Department of Anesthesiology, Perioperative and Pain Medicine, Stanford University

Pervez Sultan, MBChB, FRCA, MD (Res) - Stanford University

Eleanor Warwick, MBBS FRCA - University College Hospital, London, UK

Liana Zucco, MBBS FRCA - St George's Hospital, London, UK

### Background

Changes to obstetric care across the United Kingdom (UK) were required in response to the SARS-CoV-2 pandemic. Guidelines from the Royal College of Obstetricians and Gynaecologists, UK<sup>1</sup> (RCOG) were introduced to help guide appropriate care, however adoption and adherence to published guidance is unknown.

### Methods

The multicenter Quality of Recovery in Obstetric Anaesthesia study (ObsQoR) aimed to investigate the quality of inpatient and outpatient recovery following childbirth across the UK. This study included an institutional survey to examine aspects of organizational structure, service provision and standards of care. The Covid-19 questions were developed using the RCOG guidelines to ascertain changes to care implemented in response to the pandemic. This was distributed to all 107 participating centers to be completed with leads from anesthesia and obstetrics in October 2021.

### Results

Covid-19 survey responses were received from a total of 105 ObsQoR study centers (response rate of 98%), representing 54% of the 194 obstetric units in the UK. 99/103 (94.3%) sites had guidelines for how to manage parturients with Covid-19 infection including 61/105 (58.1%) with specific guidance on venous thromboembolism prophylaxis. 37/104 (35.6%) of centres had routine restrictions on parturients' birthing plans (e.g., birthing location or changes to labor and delivery preferences) if a positive diagnosis of Covid-19 was made. A Covid-19 vaccination referral pathway was present in 63/103 centres (61.2%) encouraging full vaccination for all pregnant women.

Isolation precautions were present in 101/105 (96.2%) centers, with Covid-19 positive parturients isolated on labor and delivery, recovery and postnatal wards throughout their admission. Nearly all centers (103/105 (98.1%)) allowed birthing partners to be present during delivery if the parturient was Covid-19 negative, however only 79/104 (76%) allowed birthing partners to be present if the parturient was Covid-19 positive. If birthing partners were Covid-19 positive but asymptomatic, 29/105 (27.6%) of centers allowed them to be present. Requirements for parturients to wear personal protective equipment (e.g., facemask), during their labour and delivery was reported by 42/104 (40.4%) centres, irrespective of Covid-19 status.

### Conclusion

To our knowledge, this is the first survey looking at Covid-19 related practices across a large number of UK centers. The majority of maternity units in the UK adhere to the guidelines produced by the RCOG<sup>1</sup>, recommending alterations in care throughout the pandemic. However, there remains variation in the provision of care, with scope to improve access and pathways to immunisations, birth plans and VTE prophylaxis.

## COVID-19 and the Impact on Pregnancy Outcomes

Presenting Author: Julia Katz

Presenting Author's Institution: Zucker School of Medicine at Hofstra/Northwell

Co-Authors:

### Introduction:

From the onset of the COVID-19 pandemic, there has been concern regarding the effects of contracting SARS-CoV-2 during pregnancy. To date, the impact of COVID-19 on maternal and neonatal health is unclear. The goal of this study was to elucidate the impact that SARS-CoV-2 infection during pregnancy has on maternal and neonatal outcomes.

### Methods:

We conducted a retrospective chart review of women who delivered at a major healthcare facility between March 1, 2020, and June 31, 2021. We divided our study population into two groups: women that tested positive for COVID-19 during pregnancy and women that never tested positive for COVID-19 during pregnancy. Maternal outcomes included intensive care unit (ICU) admission, ventilation requirement, hypertensive disorders of pregnancy, cesarean delivery, and preterm labor. Neonatal outcomes included preterm birth, 1-minute and 5-minute Apgar scores, fetal demise, and neonatal intensive care unit (NICU) admission. Statistical analysis was completed using SPSS version 28.0.

### Results:

Out of 28,872 women, 2,143 (7.4%) had COVID-19 during pregnancy and 26,729 (92.6%) did not. Women that had COVID-19 during pregnancy experienced higher rates of ICU admission (2.0% vs 0.5%;  $p < 0.05$ ), ventilation requirement (1.0% vs 0.0%;  $p < 0.05$ ), preeclampsia (5.0% vs 4.2%;  $p < 0.05$ ), hemolysis, elevated liver enzymes and low platelet (HELLP) syndrome (0.4% vs 0.2%;  $p < 0.05$ ), cesarean delivery (33.0% vs 31.0%;  $p < 0.05$ ), and preterm labor (2.0% vs 1.0%;  $p < 0.05$ ) compared to pregnant women without COVID-19. Neonates born to women who had COVID-19 during pregnancy experienced higher rates of preterm birth (11.0% vs 8.0%;  $p < 0.05$ ), 1-minute Apgar scores less than 7 (7% vs 5%;  $p < 0.05$ ), 5-minute Apgar scores less than 7 (3% vs 2%;  $p < 0.05$ ), fetal demise (1.2% vs 0.8%;  $p < 0.05$ ), and NICU admission (16% vs 14%;  $p < 0.05$ ) compared to neonates born to women who did not have COVID-19.

### Conclusion:

Our findings highlight the importance of counseling pregnant women regarding the risks of COVID-19 as well as the urgency of adhering to preventative measures during this ongoing pandemic.

[SOAP IMAGE.pdf](#)

Abstract #: FRI – RPS2 – Room 6 – COVID Education/Global Health - 04

**#OBAnes: a characterization and analysis of Twitter conversations during the onset of the COVID-19 pandemic**

**Presenting Author:** Aubri Robinson

**Presenting Author's Institution:** University of Minnesota Rochester

**Co-Authors:**

### **Intro**

Social media use in anesthesiology has been increasing by 8% per year. The COVID-19 pandemic has accelerated social media use given the demand for rapid information dissemination.(1) Twitter conversations have been shown to foster collaboration, share ideas, distribute information, improve academic conference experiences, and promote innovations and publications. The hashtag #OBAnes is the most commonly used in obstetric anesthesia conversations.(2) The purpose of this study was to identify categories of Twitter conversations using the #OBAnes hashtag during the onset of the global COVID-19 pandemic.

### **Methods**

This observational study used English language tweets including #OBAnes prospectively collected from 6/30/2019 through 10/19/2020 using TAGS V.6.1.9.1.(3) Original tweet conversations, replies, and retweets were included. Conversation duplicates were excluded. Twitter users were manually assigned into the 19 Symplur Healthcare Stakeholder Segmentation categories.(4) We developed a list of topics we anticipated obstetric anesthesiologists would Tweet about during the study. Tweet conversations then were categorized into these 19 obstetric anesthesia topics in Microsoft Excel. The primary objective was to identify the categories of tweets using #OBAnes to determine the most abundant topics. The secondary objective was to characterize #OBAnes users and describe the effect of COVID-19 on Twitter #OBAnes conversations.

### **Results**

There were 12,431 tweets posted by 1,704 unique users with #OBAnes during the study period. The categories of tweets with #OBAnes are listed in Figure 1. The COVID-19 pandemic was associated with increased conversations regarding support persons, vaccination, and neuraxial anesthesia. The Top 5 user categories included: Doctor n=1,211 (71%), Org Advocacy n=76 (4%), Healthcare professionals n=72 (4%), Individual Non-Health n=61 (4%), and Org Provider n=53 (3%). Twitter users classified as Doctor used #OBAnes most frequently (71%). COVID-19, COVID testing, or vaccination were category topics in 39.68% of total tweets (n=1382, n=130, and n=3420, respectively) over the study period.

### **Discussion**

Twitter conversations facilitate discussions and information dissemination in obstetric anesthesiology particularly among Doctor users. The two most common topics in Twitter conversations with #OBAnes during the study period were about support person and vaccinations. This finding may have been related to the limitation of visitors for laboring women at the onset of COVID-19. We found that Twitter facilitated many physician-initiated obstetric anesthesia-related discussions during the onset of the COVID-19 pandemic.

[OBAnes Twitter Abstract SOAP. RL vRG EM ES 2-5-22 GL020522 EES2-6-22 chart.pdf](#)

**Abstract #: FRI – RPS2 – Room 6 – COVID Education/Global Health - 05**

**Development of a milestone-based competency list for obstetric anesthesia residency training through Delphi expert consensus**

**Presenting Author:** Maytinee Lilaonitkul, MBBS BSc

**Presenting Author's Institution:** University of California San Francisco

**Co-Authors:** Christopher Cosden, MD - Alta Bates Summit Medical Center

**Background:**

The standard for anesthesia residency training mainly relies on the Accreditation Council for Graduate Medical Education (ACGME) Milestone Project, a framework that lacks specific directives for sub-specialties including obstetric anesthesia. Much of obstetric anesthesia education defaults to the In-Training Examination and the Board exam topics, which lack practical skills assessment and tangible milestones for residents. In face of rising maternal mortality rates in the US with evidence that 60% are preventable deaths, we aim to develop a more specific competency-based training for obstetric anesthesia to improve the quality of training and increase the accountability of the institution's training program. Through a Delphi method, the project aims to 1) identify essential competencies in obstetric anesthesia, 2) determine at what level of training these competencies should be attained.

**Methods:**

A preliminary list of competencies was identified from review of existing competency-based obstetric anesthesia training curricula and practice guidelines. A modified delphi methodology was used to achieve expert consensus amongst members of the education committee of the national Society of Obstetric Anesthesiology and Perinatology who represent institutions from five regions of the United States. The investigators were asked to evaluate the importance of each competency using a 5-point Likert scale (5=extremely important;1=not at all important) via online survey. A cutoff for final inclusion was established as 75% or more of responders rating it as  $\geq 4$  after two rounds. After round 1, respondents were given the mean and median ratings to recalibrate their initial ratings. The third round asked the responders at which level (junior versus senior) should each competency be attained.

**Results:**

The questionnaire response rate (n=16) was 81.3% in round one, 75% in round two and 56.3% in round three. 69% of responders had more than 10 years of obstetric anesthesia experience and the majority (62%) worked in institutions with 2500-5000 deliveries per year. The Delphi survey derived 99 essential competencies, categorized under the six ACGME domains, to be achieved by the end of residency: Patient Care (n=39), Medical Knowledge (n=48) and Practice-based learning and Improvement, Communication and Professionalism (n=12). Seven new competencies were added and 10 were removed. The responders felt 61 and 38 competencies should be achieved at junior and senior level of training respectively.

**Conclusion:**

Using a Delphi method, we were able to generate a milestone-based competency list for obstetric anesthesia through expert consensus. This list can be used by residency training programs to help develop a more formalized obstetric anesthesia competency-based curriculum, plan education strategies that are targeted at specific competencies and guide evaluation methods to assess attainment of the competencies.

## Social Media Presence of Obstetric Anesthesiology Fellowship Programs

**Presenting Author:** Thomas R. Gruffi, M.D.

**Presenting Author's Institution:** Mount Sinai West & Morningside - New York, New York

**Co-Authors:** Michael S. Balot, DO - Mount Sinai West & Morningside

Ghislaine C. Echevarria, M.D. M.S. - Mount Sinai West & Morningside

**Introduction:** The explosion of social media (SM) over the past decade has impacted almost every aspect of our lives. As of February 2021, approximately 72% of adults in the United States use one social media platform.(1) SM has had an increasing presence in medical professional recruitment. This became more apparent during the COVID-19 pandemic when in-person interviews were suspended. Apps such as Twitter and Instagram allowed anesthesiology departments the opportunity to highlight their accomplishments directly to the public. Fellowship programs have begun to use these apps to market their program for recruitment purposes. We evaluated the presence of obstetric anesthesiology (OB-A) fellowship programs on Twitter and Instagram. We hypothesized that a more active account would have a greater public engagement in the amount of followers.

**Methods:** The institution and number of fellows per year of all ACGME-accredited OB-A fellowship programs were retrieved from the Fellowship Directory on the SOAP website. Accounts were identified by searching each program's website for profile links and by direct query on both platforms. Non-departmental and residency program-only accounts were excluded. All posts over the period of July 1, 2020 to June 31, 2021 were analyzed. For all SM accounts identified, the number of posts and followers were recorded. Each post was categorized as medical education (intent to instruct house staff, faculty, or the community at large), branding (promotion of departmental recognition/achievements), or social (social activities both in the professional and out-of-hospital environments).

**Results:** Of the 39 ACGME-accredited OB-A fellowship programs, 4 (10.3%) had both Twitter and Instagram accounts, 6 (15.4%) only Twitter, and 29 (74.4%) had neither. For every 1-fellow increase in the program, the odds of having a fellowship Twitter account (TWA) was estimated to increase by 2.6 times (OR 2.6, 95%CI:1.2, 7.3;p=0.021).

Nine (90%) of the 10 programs with a TWA were considered active, defined as posting at least once in the last year. The median number of tweets and followers were 62 (IQR 23-78) and 365.5 (IQR 117-692), respectively. For every 50-follower increase, the number of tweets increased by 3.9 (95%CI:1.4, 6.4;p=0.007).

Figure 1 shows the distribution of tweets from active fellowship accounts by number of fellows.

Only 2 out of the 4 programs with an Instagram account were active. The median number of posts and followers were 27.5 (IQR 17-38) and 213 (IQR 125.5-334.5), respectively.

**Conclusion:** Only a quarter of OB-A fellowship programs are utilizing SM. More programs appear to use Twitter compared to Instagram. Our analysis showed that the larger the fellowship program, the larger their presence is on Twitter.

[SOAP 2022 Figure 1.pdf](#)

## Anesthesia resident preferences regarding learning to perform neuraxial procedures in obstetrics – a qualitative phenomenological approach

**Presenting Author:** Giselle D. Jaconia, MD

**Presenting Author's Institution:** New York Presbyterian - Columbia University - Leonia, New Jersey

**Co-Authors:** Allison Lee, MD, MS - Columbia University

Claire Naus, MD - Texas Children's Hospital/Baylor College of Medicine

### Introduction

Performance of epidural anesthesia is considered to be one of the most difficult skills for anesthesiology trainees to acquire, largely because it is a “blind” procedure relying on tactile feedback from the needle and tissues and is frequently performed in non-sedated patients in severe pain.<sup>1-3</sup> The *cognitive apprenticeship (CA)* framework, developed in the 1980s for non-clinical education domains, describes a learning environment situated within the social and functional context of the authentic environment in which the learned skills are to be applied ([table 1](#)).<sup>4</sup> The objective of the study was to explore (1) what trainees perceive to be the best approaches to teaching epidural anesthesia techniques, (2) ways in which these perceptions align or differ from those of their faculty, and (3) how these approaches fit into the theoretical model of ideal learning environments presented in the CA framework.

### Methods

A qualitative, phenomenological approach was utilized to describe the essence of experience of anesthesiology trainees and faculty learning and teaching epidural anesthesia techniques in obstetrics. Semi-scripted interviews were conducted with 10 residents sampled from all clinical anesthesiology training classes and 3 faculty members from the division of obstetric anesthesiology. Audio recorded interviews were de-identified, transcribed, and broken into fragments. A thematic analysis was conducted and codes were organized into the CA framework. Throughout the study process, investigators consciously reflected on how their own sociocultural position and personal experiences affected all stages of the study from script development, data collection, and data analysis.

### Results

Trainees described preferences for teaching approaches and environments that aligned with the CA framework in the dimensions of (1) *content*, (2) *method* (including subcategories *modeling*, *coaching*, *scaffolding*, *articulation*, *reflection*, and *exploration*; [table 2a](#)), (3) *sequence*, and (4) *sociology* (including *situated learning* and *culture of expert practice*; [table 2b](#)).

### Conclusions

Anesthesiology trainees value a staged approach to learning epidural anesthesia techniques, opportunities for independent troubleshooting, graded independence, focused feedback, and a patient and calm instructor. The perceived challenges of learning and teaching epidural techniques include the tactile nature of the procedure, teaching the procedure on an awake and aware patient, finding time to teach, and creating an environment of psychological safety on a busy labor and delivery unit. CA may provide a useful framework for approaching the instruction of epidural anesthesia techniques.

[Epidural SOAP Submission Tables.pdf](#)

**Serious gaming to learn how to perform general anesthesia for cesarean delivery: a randomized controlled trial comparing two debriefing methods**

**Presenting Author:** Allison Lee, MD, MS

**Presenting Author's Institution:** Columbia University - New York, New York

**Co-Authors:** Madhabi Chatterji, PhD - Columbia University Teachers College

Chen-Miao Chen, PhD - Columbia University Teachers College

Stephanie Goodman, MD - Columbia University

Ruth Landau, M.D. - Columbia University

Teaching the performance of general anesthesia (GA) for cesarean delivery (CD) requires innovative strategies, as residents' exposure to clinical cases declines.[1] We previously developed EmergenCSim™ a serious 3-D videogame (SG) that reproduces the environment of an obstetric operating room with an embedded scoring and debriefing tool. The learner, via an avatar, must perform GA for emergent CD for cord prolapse. The optimal debriefing method after learners play SGs is unknown. We hypothesized that an in-person debrief in addition to the SG-embedded electronic debrief will provide superior learning outcomes than SG electronic debriefing alone.

**Methods** Novice CA-1 residents (n=51) participating in the study first (1) watched a recorded lecture on GA for emergent CD (2) took a 26-item MCQ pre-test and (3) played the SG (maximum score 196.5). Then, they were randomized to the intervention group (Group IPD+ED, n=25) where the SG electronic debrief was followed by an in-person debrief or to the control group (Group ED, n=26) where they only received the SG electronic debrief. All in-person debriefs were conducted by the same trained investigator. All played the SG a 2<sup>nd</sup> time, with instructions to try to increase their SG score, then took again the 26-item MCQ post-test. Pre-and post-tests were validated parallel forms.

**Results** Our preliminary results are presented in the Table and Figure.

**Table:** Scores on MCQ test and Serious Game by Group

Scores	Intervention group (IPD+ED) n=25	Control group (ED) n=26	P value
26-item MCQ pre-test scores	19.4 (SD 2.3)	18.6 (SD 2.5)	p=0.185
26-item MCQ post-test scores	22.1 (SD 1.6)	22.6 (SD 2.2)	
1 <sup>st</sup> SG score (maximum 196.5)	141 (SE 4.5)	135 (SE 4.4)	p < 0.001
2 <sup>nd</sup> SG score (maximum 196.5)	173.3 (SE 2.9)	163.1 (SE 2.9)	

Data presented as mean (standard deviation (SD) or error (SE))

**Discussion**

An in-person debrief led to a significant improvement in the SG score but not on the MCQ test scores, suggesting some benefit to in-person individualized debriefing. We speculate that the relative lack of improvement on the 26-item MCQ test (only 2-3 point improvement) may be due to the relatively high scores obtained in the pre-test at baseline.[2] Further work to determine whether this modest test score improvement might actually correlate with meaningful gain in clinical competence might be of interest. Regardless, the overall gain in performance suggests that SGs have a role as independent, less resource-intensive educational tools, with both debriefing approaches.

[SOAP Figure.pdf](#)

## Inpatient Postpartum Recovery of Nulliparous women following Elective Cesarean Delivery and Spontaneous Vaginal Delivery in Japanese

**Presenting Author:** Yusuke Mazda, MD, PhD

**Presenting Author's Institution:** Saitama Medical Center, Saitama Medical University - Kawagoe, Saitama

**Co-Authors:** Kazuo Ando, MD, PhD - Stanford University School of Medicine

Nan Guo, PhD - Department of Anesthesiology, Perioperative and Pain Medicine, Stanford University

Shohei Noguchi, MD - Saitama Medical Center, Saitama Medical University

Daisuke Sakamaki, MD - Saitama Medical Center, Saitama Medical University

Pervez Sultan, MBChB, FRCA, MD (Res) - Stanford University

**Background:** Postpartum recovery can be assessed using the validated Obstetric Quality of Recovery-10 item (ObsQoR-10) measure. Inpatient recovery following cesarean delivery (CD) vs. spontaneous vaginal delivery (SVD) is underexplored.

**Methods:** Following IRB approval, we recruited nulliparous parturients who delivered via elective CD or SVD. Participants completed ObsQoR-10JP (Japanese version) EuroQoL (EQ5D3L), and global health visual analog scale (GHS; 0-100; 0=worst and 100=best health state) postpartum at 24-h, 25-h, and ObsQoR-10JP was completed daily until hospital discharge. The primary aim of this study was to evaluate recovery following CD and SVD up to 1 week postpartum. Secondary aims were to develop and validate ObsQoR-10JP.

**Results:** 87 and 84 enrolled women completed the surveys at 24 h and 25 h. Daily ObsQoR-10 scores for each delivery mode are provided in Figure 1. ObsQoR-10JP scores significantly improved daily until days 2 and 4 for SVD and CD, respectively. Validity: (i) Convergent validity: ObsQoR-10JP correlated strongly with EQ5D ( $r=-0.716$  [95% CI -0.817, -0.584],  $p<0.001$ ) and GHS ( $r=0.638$  [95% CI 0.463, 0.764],  $p<0.001$ ) at 24 h. (ii) Discriminant validity: ObsQoR-10 discriminated between good versus poor recovery (GHS score  $\geq 70$  versus  $< 70$ ; difference in mean scores 23.3 [95% CI 13.62, 33.07];  $p<0.001$ ). (iii) Hypothesis testing: 24-h ObsQoR-10JP scores correlated with gestational age ( $r=0.463$ , [95% CI 0.271, 0.630];  $p<0.001$ ), SVD ( $r=-0.387$ , [95% CI -0.632, -0.089]  $p=0.005$ ) and CD blood loss ( $r=-0.306$ , [95% CI -0.534, -0.018],  $p=0.043$ ), time till first analgesic request ( $r=0.379$ , [95% CI 0.170, 0.558],  $p<0.001$ ), morphine consumption ( $r=-0.275$ , [95% CI -0.446, -0.104],  $p=0.010$ ), time to first fluid intake ( $r=-0.518$ , [95% CI -0.662, -0.350],  $p<0.001$ ), time to ambulation ( $r=-0.608$ , [95% CI -0.731, -0.459],  $p<0.001$ ), time to first solid food intake ( $r=-0.569$ , [95% CI -0.685, -0.428],  $p<0.001$ ), time to urinary catheter removal ( $r=-0.395$ , [95% CI -0.626, -0.120],  $p=0.005$ ), and time to discharge ( $r=-0.554$ , [95% CI -0.684, -0.365],  $p<0.001$ ). (iv) Cross-cultural validity: Differential item functioning analysis suggested bias in 2 items. Reliability: (i) Internal consistency was good (Cronbach's alpha=0.880 and inter-item correlation=0.423). (ii) split-half reliability was very good (Spearman-Brown Prophecy Reliability Estimate=0.938). (iii) Test re-test reliability was very good (intra-class correlation coefficient=0.893 [95% CI 0.773, 0.943]). (iv) Floor and ceiling effects:  $< 5\%$  women scored either 0 or 100 (lowest or highest possible scores).

**Conclusion:** Inpatient postpartum recovery is largely achieved by women within 2 and 4 days following SVD and CD, respectively. ObsQoR-10JP is valid, reliable and responsive, and should be considered for use in Japanese-speaking women to assess the quality of inpatient postpartum recovery.

[Figure 1.pdf](#)

## Time Series Analysis of Racial Disparities in Postpartum Care during the COVID-19 Pandemic: A Real-World Data Study

**Presenting Author:** Jie Zhou, MD, MS, MBA

**Presenting Author's Institution:** Brigham and Women's Hospital, Harvard Medical School - Boston, Massachusetts

**Co-Authors:** Jingui He, RN - Brigham and Women's Hospital, Harvard Medical School

Peivin Hung, PhD - University of South Carolina Arnold School of Public Health

Xiaoming Li, Ph.D. - University of South Carolina

Alecia McGregor, Ph.D. - Harvard School of Public Health

Tianyue Mi, MS - Brigham and Women's Hospital, Harvard Medical School

**Background:** Racial/ethnic disparities in postpartum care (PPC) access have been well identified in the United States. Such racial/ethnic disparity could be exacerbated by the COVID-19 pandemic because of amplified economic distress and compromised social capital among pregnant women of color. We would like to examine whether the COVID-19 pandemic widens the existing racial/ethnic disparity in PPC access.

**Methods:** Retrospective cohort study using electronic health records data from eight hospitals with obstetric units in the Mass General Brigham system was conducted. Multinomial logistic regressions in an interrupted time series approach were employed to assess monthly changes in PPC access across non-Hispanic White, non-Hispanic Black, Hispanic, Asian, and other racial groups, controlling for maternal demographic and clinical characteristics.

**Result:** Eligible cases were 31,054 women who gave live birth at eight hospitals in Boston, Massachusetts, from January 15, 2019 to December 15, 2020, allowing us to track 90-day postpartum access up to March 15, 2021. We categorized 3 groups by the delivery months: pre-pandemic (January 2019-December 2019), early-pandemic (January 2020-March 2020), and post-initial-pandemic (April 2020-December 2020). PPC within 90 days after childbirth was categorized into three groups: attended, canceled, and not scheduled. Participants were racially/ethnically diverse (62.2% non-Hispanic White [hereafter, White], 7.5% non-Hispanic Black [hereafter, Black], 14.8% Hispanic, 10.6% Asian, and 3.1% other race). In the pre-pandemic period (January-December 2019), the overall PPC attendance rate was 74.8%, dropping to 41.5% during the early-pandemic period (January-March 2020), and rebounding back to 53.1% in the post-initial-pandemic period (April-December 2020). During the post-initial-pandemic, the odds of canceling (aOR=.36, [95% CI .33-.40]) and non-scheduling (aOR=.45, [95% CI .42-.47]) among White women decreased per month, with widening Black-White gaps in canceling (aOR=1.68, [95% CI 1.32-2.14]) and non-scheduling (aOR=1.25, [95% CI 1.06-1.48]). Similarly, Hispanic-White gaps in canceling (aOR=1.47, [95% CI 1.21-1.80]) and non-scheduling (aOR=1.33, [95% CI 1.17-1.50]) increased during the months of post-initial-pandemic.

**Conclusions and Relevance:** Racial/ethnic disparities in PPC were exacerbated following the onset of the COVID-19 pandemic, when PPC access recovered more slowly among Black women than Whites. These disparities require swift attention and amelioration to address barriers for these women to obtain much needed PPC during this pandemic.

**THE INFLUENCE OF A KYBELE TEACHING PROGRAM ON THE USE OF REGIONAL ANESTHESIA FOR LABOR AND CESAREAN DELIVERY, DURING COVID-19 PANDEMIC, IN TUZLA, BOSNIA AND HERZEGOVINA**

**Presenting Author:** Ivan Velickovic, M.D.

**Presenting Author's Institution:** SUNY Downstate Health Sciences University - Tenafly, New Jersey

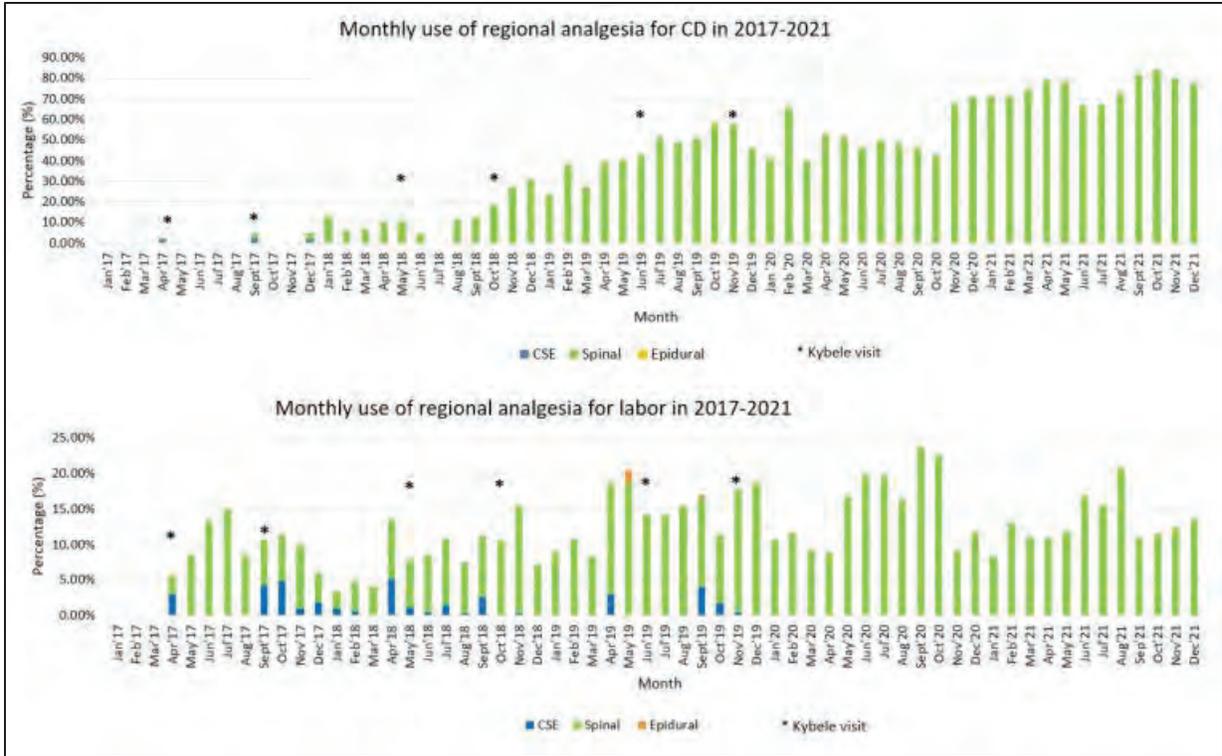
**Introduction:** University Clinical Center Tuzla (UCCT) is the second largest Clinical Center in Bosnia, with approximately 3200 deliveries per year. Prior to Kybele visit, regional anesthesia (RA) and analgesia techniques were not used at Labor and Delivery unit. Members of the Department of Anesthesia at UCCT, requested a multi-year Kybele program in 2016 to help train physicians in the use of RA techniques for labor and Cesarean Delivery (CD). This study updates the efforts of Kybele and UCCT physicians to increase obstetric RA use during 2021.

**Method:** During 2021, two planned visits by a Kybele team were canceled. Obstetric anesthesia team in Tuzla continued to provide all medical and critical care of COVID positive pregnant patients in addition to their regular work at Department of Obstetrics and Gynecology. A phone consultations with a local team were done several times each month. The data were retrospectively collected on the use of RA for CD and on the use of RA for labor for the period of January 1st, 2021 to December 31st, 2021. Chi-Square test was used for comparison with 2020 data. Data was also collected on number of COVID positive patients with type of delivery and anesthesia technique used.

**Results:** The monthly and annual use of RA for labor and CD is shown in the Figure 1. Comparing 2021 with 2020 there was an increase in percentage of patient that received RA for CD (75.6% vs. 51.6%,  $p < 0.00007$ ) and decrease in RA for labor (13.1% vs. 15.4%,  $p < 0.002$ ). Out of 18 COVID positive patients, 14 had CD, all under RA and 4 delivered vaginally with spinal anesthesia.

**Discussion:** This data show increase in usage of RA for CD during COVID-19 pandemic. During the 2021 the percentage of patients that got labor analgesia went down (Figure 1.) and percentage of patients that had RA for CS went up. At the same time OB anesthesiologists took care of COVID positive patients in local ICU. Local team communicated with us that RA for CD was strongly encouraged in COVID positive patients in order to decrease the risk of transmission to anesthesia and OR team. Without our presents local team was reluctant to perform CSE and labor epidurals.

**Conclusion:** Regional anesthesia usage for CD at UCCT improved significantly during 2021. Staff at UCCT performed only spinal anesthesia so further visits are necessary to continue training in CSE and epidural anesthesia. Usage of RA for labor during the COVID epidemic decreased and will hopefully recover with decreased number of COVID positive patients.



**Generation of Obstetric Anesthesia Entrustable Professional Activities through a Delphi methodology in Colombia**

**Presenting Author:** Carolina Rincón, MD, MSc

**Presenting Author's Institution:** Hospital Universitario San Ignacio - Bogota, Distrito Capital de Bogota

**Co-Authors:** Rebecca Minehart, MD - Massachusetts General Hospital-Anesthesia, Critical Care and Pain Medicine

Globally, maternal mortality remains unacceptably high. Anesthesia plays a significant role in these mortalities, being directly related to almost 3% of all maternal deaths. However, anesthesia is a necessary component of obstetrical care throughout the world, with more than 60% of women requiring anesthetic involvement at some point during their labour and delivery. The unique physiology of obstetric patients places them at higher risk of complications from all types of anesthesia, necessitating obstetric high quality and focused training for anesthesia providers. An educational priority should be to appropriately train anesthesiology residents to ensure they will develop the skills that will allow them to deliver competent obstetric anesthesia care. Unfortunately in Colombia this training is often inconsistent with a lack of national standardized regulations. This gap could be very filled by institution of a Competency Based Medical Education (CBME) program, an outcome based approach that could provide transparency, accountability and support to residents. The building blocks of CBME are the Entrustable Professional Activities (EPAs) that translate competencies into clinical practice. Focusing attention on identifying specific achievable obstetric anesthesiology EPAs acknowledging what best adapts to our local needs would help to gain experience and expand our specialty education in Colombia.

The overall aim of this study was to improve the obstetric anesthesia training of residents in Colombia. This was met by developing a list of EPAs using a Delphi process that included Colombian experts in obstetric anesthesia. During the first round, a combined brainstorming phase was performed. Participants were asked to answer a 5-point rating questionnaire using 17 pre-existing EPAs from the Competence by Design as a starting point. Furthermore open-ended questions were added asking changes, combinations, rewording and new suggested EPAs. The responses to open ended questions were compared with identification of emerging and common themes and then included into the list of preliminary EPAs to undergo further evaluation from the participants in the following rounds. A standard Delphi Methodology was employed until 80% of agreement was achieved. As a result 11 new EPAs were suggested, 8 EPAs were reworded and combined. The final round was a confirmatory round asking agreement to include the high rated EPAs and to delete the low rated EPAs from the definitive list. This resulted into 9 definitive and 5 discarded EPAs.

After reaching expert consensus and establishing the EPAs adapted to local needs, we aim to generate National Standards in obstetric anesthesia, and start the process of introducing CBME curriculum in anesthesia in Colombia. Ultimately, this project seeks the opportunity for improvement in safe obstetric care and intervenes in the anesthesia-related maternal mortality.

**Abstract #: FRI – RPS2 – Room 7 – Post Cesarean Pain & Recovery – 01**

**Quality of recovery after unplanned and planned cesarean deliveries – an application of ObsQoR-10 tool.**

**Presenting Author:** Juan Morales, MD

**Presenting Author's Institution:** Mount Sinai Hospital - University of Toronto - Toronto, Ontario

**Co-Authors:** Jose Carvalho, MD, PhD, FRCPC - Department of Anesthesiology and Pain Medicine, Mount Sinai Hospital, University of Toronto.

Kristi Downey, MSc - Department of Anesthesiology and Pain Medicine, Mount Sinai Hospital, University of Toronto

Andrea C. Gomez, MD - Clinical OBS Anesthesia fellow, Mount Sinai Hospital, Toronto, Canada

Naveed T. Siddiqui, MD, MSc - Department of Anesthesiology and Pain Medicine, Mount Sinai Hospital, University of Toronto.

**Background:** There is a paucity of literature examining differences in patient reported outcomes measures after planned an unplanned cesarean delivery using a validated quality of recovery tool. The Obstetric Quality of Recovery-10 scoring tool (ObsQoR-10) has been validated to quantify functional recovery after cesarean delivery.<sup>1,2</sup>

**Objective:** We aimed to use the ObsQoR-10 tool to compare the recovery profile of patients undergoing planned and unplanned cesarean deliveries after trial of labor.

**Methods:** We conducted a prospective, single-center observational study. Women undergoing planned and unplanned cesarean deliveries under neuraxial anesthesia were asked to complete the ObsQoR-10 questionnaire at 24 hours, 48 hours, and one week postpartum. Furthermore, we collected information on total in-hospital post-operative opioid consumption and on patient's own perception of readiness for discharge from hospital at 24 and 48 hours postpartum. In addition, clinical parameters (e.g., maternal age, American Society of Anesthesiologists classification grade, body mass index, gestation weeks at delivery, caesarean section category, estimated blood loss, pre-existing medical conditions of the mother, need for a postnatal intensive care unit, intraoperative events, length of hospital stay) were collected to address its correlation with our findings.

**Results:** We studied 112 patients, 56 in each group. There were no statistical differences in ObsQoR-10 scores at 24 hours, 48 hours and one week postpartum between planned and unplanned cesarean delivery. Moreover, there was no difference between groups in patients' perception of readiness for hospital discharge at 24 and 48 hours, and opioid consumption in the first two days after surgery. Most patients in both groups did not think they would be ready for discharge at 24 hours postpartum. The number of patients requiring more than 2 night's stay in hospital was higher in the unplanned group.

**Conclusions:** The quality of recovery, as assessed by the ObsQoR-10, is not different in patients undergoing planned and unplanned cesarean delivery. The apparent discrepancy between ObsQoR-10 scores and patients' perception of readiness for discharge warrants further studies.

[ObsQoR-10 table .pdf](#)

**Abstract #: FRI – RPS2 – Room 7 – Post Cesarean Pain & Recovery - 02**

## **Development and validation of a Turkish version of Obstetric Quality of Recovery-10 (ObsQoR-10-Turkish)**

**Presenting Author:** James O'Carroll, MBBS FRCA

**Presenting Author's Institution:** Stanford University

**Co-Authors:** Oguzhan Gunenç, MD - University of Health Sciences, Konya Education and Training Hospital

Betul Kozanhan, MD - University of Health Sciences, Konya Education and Training Hospital

Aysenur Polat, MD - University of Health Sciences, Konya Education and Training Hospital

Pervez Sultan, MBChB, FRCA, MD (Res) - Stanford University

Sami Mahmut Tutar, MD - University of Health Sciences, Konya Education and Training Hospital

Munise Yildiz, MD - University of Health Sciences, Konya Education and Training Hospital

### **Background**

The 10-item Obstetric Quality of Recovery 10 (ObsQoR-10) has been shown to be a valid patient-reported outcome measure (PROM) for the quality of recovery following all types of delivery in multiple countries and languages.<sup>1</sup> A Turkish language version has yet to be evaluated.

### **Methods**

The aim of this study was to develop and validate a Turkish translated version of the ObsQoR-10 score. A Turkish version (ObsQoR-10-T) was translated using a standardized method for PROMs.<sup>2</sup> Following ethical approval, parturients delivering at a single center who had had either vaginal or elective cesarean delivery were asked to complete (ObsQoR-10-T) scoring tool at 24 hours postpartum. Demographic, medical, obstetric and delivery metrics were collected, in addition to EuroQoL (EQ-5D-3L) and global health visual analogue scale (GHVAS) scores at 24 hours.

### **Results**

One hundred parturients completed the ObsQoR-T at 24 hours following their delivery. ObsQoR-T showed good correlation with day 1 composite EQ-5D-3L scores ( $r=0.611$ ) and GHVAS score ( $r=0.652$ ) at 24 hours. It discriminated well between good versus poor recovery (GHVAS score  $\geq 70$  versus  $< 70$ ; median [IQR] were 86 [80-90] and 68 [59-75] ( $p < 0.001$ ), respectively. Median ObsQoR-T scores were similar for cesarean and vaginal delivery, 83 [76-89] and 82.5 [69-90] respectively ( $p=0.5$ ). It showed good internal consistency with Cronbach's alpha of 0.87. The measure showed good inter-item correlation  $r=0.41$  and a split-half reliability reported as very good (Spearman-Brown Prophecy Reliability Estimate 0.86). Test re-test was performed in 25 patients and the reliability was excellent with an intra-class correlation coefficient of  $r=0.99$ . There were no floor or ceiling effects demonstrated.

### **Conclusions**

The Turkish version of ObsQoR-10 is a valid, reliable, and clinically feasible measure for assessment of inpatient postpartum recovery following cesarean and vaginal delivery modes and it should be considered for use in Turkish speaking women.

**Abstract #: FRI – RPS2 – Room 7 – Post Cesarean Pain & Recovery - 03**

**A systematic review of patient-reported outcome measures for maternal postpartum depression using the Consensus-based Standards for the selection of health Measurement Instruments (COSMIN) checklist**

**Presenting Author:** James O'Carroll, MBBS FRCA

**Presenting Author's Institution:** Stanford University

**Co-Authors:** Kazuo Ando, MD, PhD - Stanford University School of Medicine

Brendan Carvalho, MBBCh, FRCA, MDCH - Stanford University

Pervez Sultan, MBChB, FRCA, MD (Res) - Stanford University

### **Introduction**

Maternal depression is frequently reported in the postpartum period and a key domain of postpartum recovery.<sup>1</sup> Despite the high prevalence of postpartum depression, there remains no consensus regarding which patient-reported outcome measure (PROM) should be used to screen for this complex multidimensional construct. We performed a systematic review using Consensus Based Standards for the Selection of Health Measurement Instruments (COSMIN) guidelines to evaluate the psychometric measurement properties of existing PROMs of postpartum depression.

### **Methods**

Following registration with PROSPERO, we searched 4 databases for validated PROMs used to assess postpartum depression. Studies were considered if they evaluated at least 1 author-defined domain of postpartum recovery and  $\geq 1$  psychometric measurement property of a PROM. Unidimensional measures such as single-item numerical rating scales were excluded. Essential postpartum depression domains to include for instrument assessment were decided by author consensus. An overall rating was assigned based upon COSMIN criteria and the Grading of Recommendations Assessment, Development, and Evaluation (GRADE) approach was used to assess the level of evidence for psychometric properties of included PROMs. Recommendations were then made for the best available PROM for postpartum depression assessment.

### **Results**

We found 43 studies involving 22,095 postpartum women in which  $\geq 1$  psychometric measurement property was assessed for the 10 validated PROMs for depression. The essential depression domains were decided through author consensus, as affective, behavioral, somatic and interference. Content validity was deemed sufficient in all 10 PROMs. Edinburgh Postnatal Depression Scale (EPDS) was the only PROM to demonstrate adequate content validity and at least a low level of evidence for sufficient internal consistency, resulting in a Class A recommendation. EPDS can therefore be recommended for use and results obtained with this PROM can be trusted. All other PROMs evaluated received a class B recommendation and therefore require further psychometric evaluation prior to being recommended for use.

### **Conclusion**

The EPDS is the best currently available PROM of maternal postpartum depression. Future studies should focus on evaluating the cross-cultural validity, reliability, and measurement error of EPDS in order to improve our understanding of its psychometric properties and clinical utility.

**Abstract #: FRI – RPS2 – Room 7 – Post Cesarean Pain & Recovery - 04**

**Continuous Wound Infusions Added to a Multimodal Analgesia Regimen for Cesarean Delivery: A Quality Improvement Practice Change Evaluation**

**Presenting Author:** Cedar J. Fowler, MD PHD MPH

**Presenting Author's Institution:** Stanford University - Stanford, California

**Co-Authors:** Brendan Carvalho, MBBCh, FRCA, MDCh - Stanford University

Nan Guo, PhD - Department of Anesthesiology, Perioperative and Pain Medicine, Stanford University

Dan Hoang, DO - Kaiser

Edward Riley, MD - Stanford University

Emily Stockert, MD/MBA - Stanford

Pervez Sultan, MBChB, FRCA, MD (Res) - Stanford University

**Introduction:**

Continuous wound infusions (CWI) can improve post-cesarean delivery analgesia in the absence of neuraxial morphine.<sup>1</sup> Limited data exists to determine if CWI provide additional analgesia in the setting of neuraxial morphine and multimodal analgesia. The aim of this analysis was to assess if CWI can provide additional post-cesarean analgesia when added to an analgesic regimen of neuraxial morphine, and scheduled acetaminophen and ibuprofen.

**Methods:**

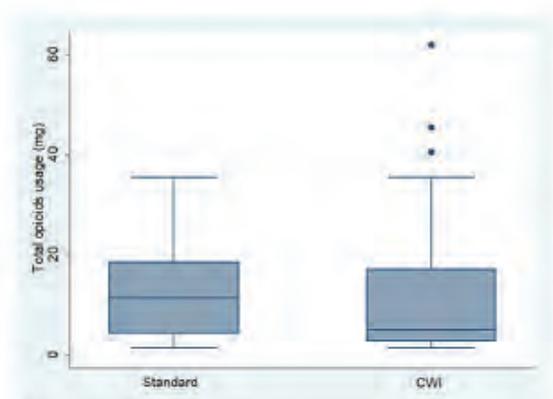
Following institutional IRB approval, we instituted a 4-month CWI implementation quality improvement project. During this period, we placed CWI (On-Q 5 inch silversaker catheter with 0.5% bupivacaine at 4ml/h for up to 72hrs) for all scheduled elective cesarean deliveries on an alternate week schedule (CWI for a week then no CWI the next week). Standard post-operative care consisted of intrathecal morphine 100 mcg, intraoperative acetaminophen 1g IV then scheduled 650 mg every 6 hours plus intraoperative ketorolac 30 mg then ibuprofen 600 mg every 6 hours. Breakthrough pain was managed with oxycodone as needed. The primary aim of the study was 72h opioid use in Morphine Milligram Equivalents (MMEq). We analyzed electronic medical records and routine follow-up survey data to determine the impact of CWI added to our standard multimodal analgesia regimen for cesarean delivery.

**Results:**

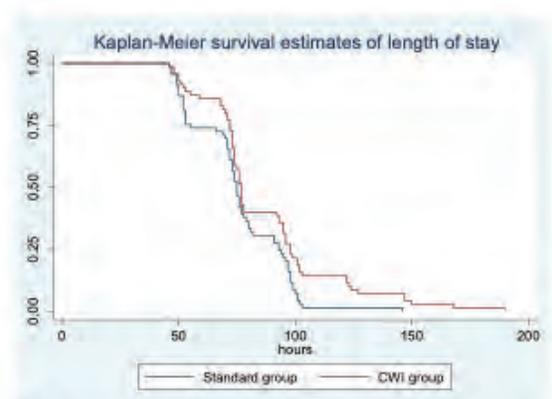
All elective scheduled cesarean deliveries (n=139; 70 with CWI and 69 standard care) during the trial period were included in the analysis. There were no differences between the CWI and standard group with respect to the primary outcome measure of 72h opioid consumption (Figure 1A). 57% in the CWI group vs 68% in the standard group required opioids (p=0.22). 24 hour post-op pain scores at rest were less in the CWI group (p=0.05), but there were no differences at 72 hours (p=0.24). Movement pain was similar between groups. Satisfaction scores in the first 24 hours were higher in the CWI group (94±9 % vs 89±13%; p=0.014) but not different at 72 hours (p=0.26). Length of stay was similar between groups (Figure 1B).

**Conclusion:**

The addition of a CWI to a comprehensive multimodal analgesia regimen did not significantly impact opioid consumption following cesarean delivery. The modest improvement in rest pain and maternal satisfaction needs to be balanced with increased cost of the medication and devices. Future studies are needed to determine benefits of CWI in women with chronic pain, opioid-use disorder or those at risk for severe pain and higher opioid use.



**1A**



**1B**

Abstract #: FRI – RPS2 – Room 7 – Post Cesarean Pain & Recovery - 05

## Implementation of a Standardized Post-cesarean Analgesia Protocol for Patients on Chronic Buprenorphine Associated with Decreased Pain Scores and Opioid Consumption

**Presenting Author:** Jenny J. Kim, MD

**Presenting Author's Institution:** Vanderbilt University Medical Center

**Co-Authors:**

### Introduction:

Maternal opioid use disorder (OUD) has increased dramatically in recent decades, and patients are commonly maintained on buprenorphine to reduce morbidity associated with withdrawal.<sup>1,2</sup> Buprenorphine can impair post-cesarean analgesia as a result of its unique pharmacologic properties, and studies indicate that buprenorphine-maintained patients have higher post-cesarean pain scores and opioid requirements.<sup>3,4</sup> As a quality improvement initiative, we implemented a standardized, multimodal analgesic protocol for patients undergoing cesarean delivery while receiving chronic buprenorphine and hypothesized that standardization and optimization of care would improve post-cesarean pain control in these patients.

### Methods:

Our protocol was developed based on literature review, clinical experience, and multidisciplinary discussions with addiction medicine and maternal-fetal medicine and was implemented on March 17, 2021 (Figure 1). Data on post-cesarean numeric rating scale (NRS) pain scores and daily opioid consumption in morphine milligram equivalents (MME) were retrospectively collected from the charts of protocol patients following hospital discharge (n=32). NRS and MME data were also collected from a historic cohort of buprenorphine-exposed cesarean delivery patients at our institution who delivered 2010-2020 (n=214). We conducted an unadjusted comparison of median NRS and median MME between groups using the Mann Whitney U test. A p value < 0.05 was considered statistically significant.

### Results:

Following protocol implementation, patients demonstrated significantly decreased median pain scores 0-24h, 24-48h, and 48-72h following cesarean delivery, compared to historic controls (0-24h: 7 [IQR 6, 8] vs. 5 [IQR 3, 7]; p< 0.001 | 24-48h: 7 [IQR 6, 7] vs. 5 [IQR 4, 6]; p< 0.001 | 48-72h: 7 [IQR 6, 8] vs. 5 [IQR 4, 6]; p< 0.001). There was also a significant reduction in daily MME consumption in all measured time periods following protocol implementation (0-24h: 53 [IQR 25, 75] vs 23 [IQR 8, 43]; p< 0.001 | 24-48h: 68 [IQR 40, 90] vs. 32 [15, 53]; p< 0.001 | 48-72: 60 [IQR 30, 75] vs 24 [IQR 8, 45]; p< 0.001).

### Conclusions:

Our results demonstrate a clinically significant improvement in post-cesarean pain scores following implementation of an analgesic protocol for patients chronically exposed to buprenorphine for OUD. These findings suggest that setting expectations, maximizing multimodal analgesic doses, engaging psychiatric and addiction medicine resources, and daily pain service rounding may all be important components in optimally caring for this vulnerable patient population.

[JJK\\_finaldiagram.pdf](#)

Abstract #: FRI – RPS2 – Room 7 – Post Cesarean Pain & Recovery - 06

## Effect of Dexamethasone as an Adjuvant Analgesic for Quadratus Lumborum Block Following Cesarean Delivery: A Retrospective Review

**Presenting Author:** Adem Idrizi, B.S.

**Presenting Author's Institution:** SUNY Downstate Health Sciences University

**Co-Authors:** David Kim, M.D. - SUNY Downstate Health Sciences University

Donna Lee, B.S. - SUNY Downstate Health Sciences University

Peter Park, B.S. - SUNY Downstate Health Sciences University

Justine Pollack, B.S. - SUNY Downstate Health Sciences University

Ivan Velickovic, M.D. - SUNY Downstate Health Sciences University

Lulu Wei, B.S. - SUNY Downstate Health Sciences University

### Introduction

Appropriate pain management is critical following cesarean delivery in order to improve patient outcome and reduce opioid analgesia usage and dependence. Dexamethasone has been proposed, yet controversial, as a potential adjuvant analgesic in patients. However, studies analyzing its effect as an adjuvant following cesarean delivery remain limited and unclear. The purpose of this study is to analyze the effect of perineural dexamethasone as an adjuvant analgesic for quadratus lumborum block (QLB) following cesarean delivery.

### Methods

Charts of patients who received a QLB after cesarean delivery during 2017-2021 were reviewed. Patients were divided into a control group who did not receive dexamethasone and a study group which included patients who received dexamethasone. In addition to baseline demographics, outcome variables studied were opioid request rate, time to first rescue opioid analgesia, and opioid consumption measured as morphine milligram equivalents (MME). Statistical analysis was performed using ANOVA, Fischer's exact test, or  $\chi^2$  test when appropriate.  $P < 0.05$  was considered significant.

### Results

Of the 175 patients who received a QLB after cesarean delivery, 144 patients (82.3%) met inclusion criteria. Exclusion criteria included patients who were  $< 16$  years old, received intrathecal morphine intraoperatively, or continuous epidural postoperatively. 56 patients (38.9%) did not receive perineural dexamethasone with QLB while 88 patients (61.1%) did. Patient demographics were comparable between the two groups with the exception of the number of patients who received a sedative prior to QLB. 26.8% of patients in the control group had received a sedative prior to QLB compared to 44.3% of patients in the study group. There was no significant difference in the opioid request rate between the control and study groups (85.7% vs. 83.0%,  $p=0.816$ ) after receiving a QLB. Interestingly, there was an observational difference in median time to rescue opioid analgesia between women who did not receive dexamethasone (382 [175.0-925.5] min) and women who did receive dexamethasone (568 [180.0-1451.0] min) with QLB following cesarean delivery. However, this did not reach statistical significance ( $p=0.064$ ) suggesting an increase in sample size may be warranted. Analysis of median MME consumed within the first 24hrs of receiving a QLB revealed no significant difference between control and study groups, (22.50 [7.50-30.00] vs. 10.00 [0.00-22.50],  $p=0.186$ ) respectively. No difference was also observed between 24-48hrs and 48hrs+.

### Conclusion

Our results suggest that dexamethasone may potentially act as an adjuvant analgesic for QLB following cesarean delivery. However, further analysis with an increased sample size is needed to draw any conclusions. Further studies investigating potential adjuvant analgesics is needed to provide adequate pain management in women undergoing cesarean deliveries.

[Idrizi Table 1.pdf](#)

## Interim Safety and Efficacy of HTX-011 Administered Postpartum to Women Undergoing a Planned Cesarean Section

**Presenting Author:** Katie Luepke, PharmD, BCPS

**Presenting Author's Institution:** Heron Therapeutics, Georgia

**Co-Authors:** Timothy Melson, MD - Shoals Medical Trials, Inc.

Craig Saffer, MD, FACOG - West Coast OB/GYN, Inc.

Chris Storgard, MD - Heron Therapeutics

### Introduction:

New postpartum analgesic therapies that reduce opioid consumption are needed. HTX-011 is an extended-release, dual-acting local anesthetic comprising bupivacaine and low-dose meloxicam in a novel polymer that provides sustained analgesia over 72 hours and reduces opioid consumption.

### Materials and Methods:

This was a Phase 2, open-label, study of HTX-011 administered intraoperatively with or without scheduled postoperative oral non-opioid multimodal analgesia (MMA) in women undergoing planned C-section (NCT03955211). The primary objective was to characterize pharmacokinetics (PK) of active ingredients and excipients in breast milk and/or plasma. The secondary objective was to assess safety of HTX-011, and an exploratory objective was to characterize efficacy. After delivery, a single dose of HTX-011 was administered via instillation into the surgical site (300 mg/9 mg [bupivacaine/meloxicam] in Cohort 1, 400 mg/12 mg in Cohort 2). All patients underwent ropivacaine spinal anesthesia ( $\leq$  20 mg). In Cohort 1, additional intraoperative anesthesia was managed by institutional practice and in Cohort 2 patients received intrathecal morphine sulfate 50  $\mu$ g and fentanyl 20  $\mu$ g plus scheduled postoperative acetaminophen and ibuprofen. Rescue analgesia was available upon request.

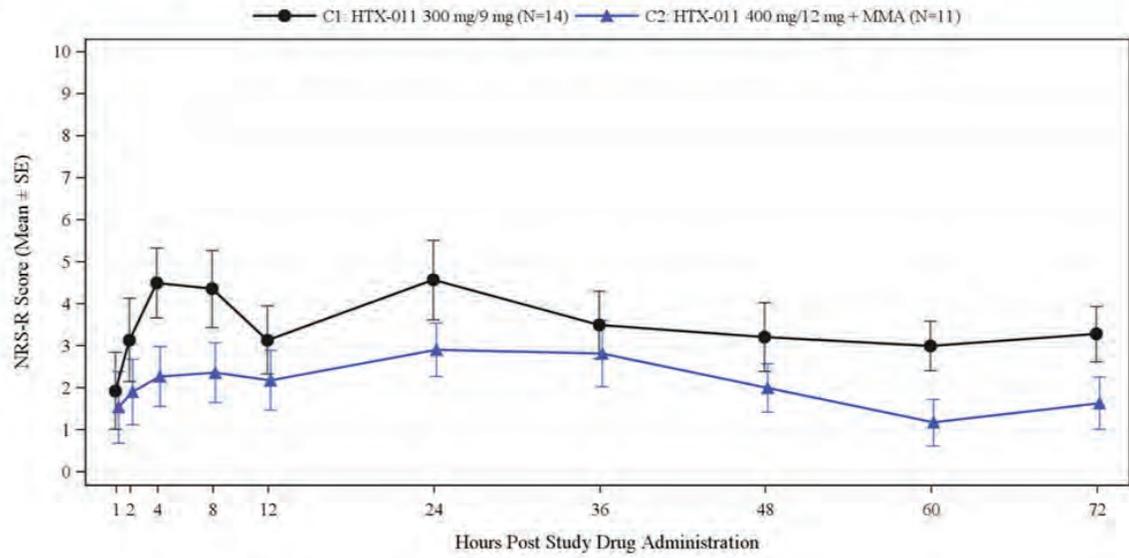
### Results:

Safety and efficacy from 25 patients, 14 in Cohort 1 and 11 in Cohort 2, are presented. Interim PK data were previously presented. Patients were predominantly white (80%), with mean (SD) age of 27.9 (5.2) yrs. Mean (SD) body mass index was 37.6 (7.7) kg/m<sup>2</sup>. Overall, 20 patients (80.0%) reported at least one adverse event (AE). The most common AEs were constipation, flatulence, nausea, pruritis, and anemia. Addition of scheduled MMA did not impact the incidence of potential NSAID-related AEs (50% in Cohort 1, 54.5% Cohort 2; none related). Mean (SD) area under the concentration curve (AUC) of the numeric rating scale of pain intensity (NRS) through 72 hours (AUC<sub>0-72</sub>) was 252.8 (165) for Cohort 1 and 154.0 (138) for Cohort 2. Mean  $\pm$  SE NRS scores over time are illustrated in Figure 1. Mean (SD) opioid use over 72 hours was 32.1 (34.3) intravenous morphine milligram equivalents for Cohort 1 and 10.0 (9.76) for Cohort 2, respectively, and majority of opioid use was within first 48 hours. 7.1% and 27.3% of patients in Cohorts 1 and 2, respectively, had an opioid-free recovery.

### Discussion/Conclusion:

In this interim analysis of HTX-011 in planned C-section, treatment was well-tolerated both with and without MMA. Preliminary data suggest that HTX-011 400 mg/12 mg may effectively manage postpartum pain and minimize opioid use.

Figure 1. Mean (SE) NRS-R Scores at Each Assessed Timepoint Through 72 Hours



**Abstract #: FRI – RPS2 – Room 7 – Post Cesarean Pain & Recovery - 09**

**Patient and staff satisfaction and confidence in a continuous wearable monitor to detect respiratory depression following neuraxial opioid use for postoperative pain relief after cesarean section.**

**Presenting Author:** Attila Kett, MD, MBA, FASA

**Presenting Author's Institution:** Saint Peter's University Hospital

**Co-Authors:** Jessie Lever Taylor, MSc - Current Health

Matt Wilkes, MD, PhD - Current Health

Nicole Zahradka, PhD - Current Health

Ashley Zapolski, BNS, RNC-MNN - Saint Peter's University Hospital

**Introduction:** Respiratory depression following neuraxial opioid administration for cesarean section is rare, but nonetheless best practice recommends women are monitored every 1-2 hours for the first 24 hours. This may interfere with sleep, breastfeeding, and bonding, and is labor-intensive for maternity staff. Remote monitoring with Current Health, an FDA-cleared platform with an upper-arm wearable, enables continuous transmission of heart rate, respiratory rate, SpO<sub>2</sub>, and activity, without disturbing or confining the patient to a bed. It may also reduce the time to detect respiratory depression through smart alarming.

Our group is conducting an open-label, prospective, randomized non-inferiority study comparing Current Health to standard of care in detecting respiratory depression, alongside measures of patient and staff experience. Target recruitment is 100 women at high risk of respiratory depression following neuraxial opioid administration during spinal anesthesia for cesarean section. Patients randomized to the intervention arm wore the Current Health device for 24 hours postpartum. At the study end point, both groups and maternity staff completed satisfaction surveys. A preliminary assessment of these surveys is presented here.

**Methods:** Patients rated 8 statements on a 5-point Likert scale ("strongly disagree" to "strongly agree"), alternating between positive and negative language. The survey was administered to both intervention and control groups 24-hours post-cesarean. Staff rated 10 statements regarding Current Health monitoring compared to standard monitoring, alongside a modified version of the Telehealth Usability Questionnaire (TUQ), following their shift caring for a patient in the intervention group.

**Results:** There were 15 responses to the patient survey (8 from the intervention group) and 25 responses to the staff survey (shift patterns meant there could be up to two staff responses for every patient response). The intervention group "strongly agreed" with 4 of 5 positive statements and "strongly disagreed" with 3 of 3 negative statements. Responses were more favorable in the intervention group compared to the control group (who only "strongly agreed" with 2 of 5 positive statements). Staff "agreed" to 5 statements in favor of Current Health and were "neutral" to 3. They "strongly agreed" that Current Health did not give more false alarms than standard monitoring. The average scores of TUQ subdomains (usefulness, ease of use, interface quality, reliability, and satisfaction) were 5 out of 7 ("somewhat agree").

**Conclusion:** The preliminary assessment of mother and maternity staff satisfaction and confidence in Current Health monitoring was very positive. Mothers strongly agreed that Current Health did not interfere with sleep, and allowed them to breastfeed and bond with their baby better than standard of care. Staff had confidence in Current Health and its ability to match (and potentially exceed) standard monitoring.

Incidence of oral hydromorphone use after elective cesarean delivery under spinal anesthesia: a clinical audit

Presenting Author: Luc Saulnier, BA (Hons.) MA

Presenting Author's Institution: BC Women's Hospital, Vancouver BC - Vancouver, British Columbia

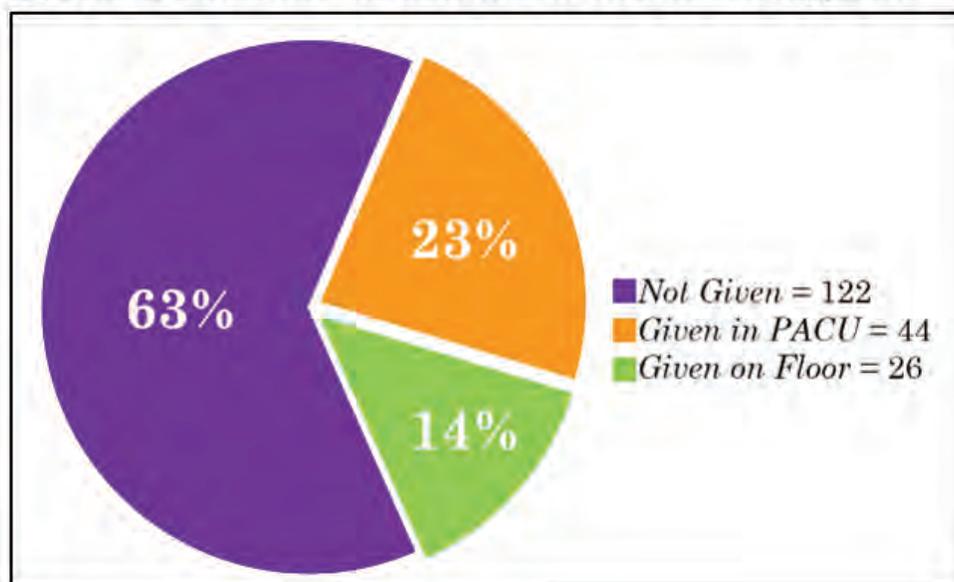
**Introduction:** Severe postoperative pain has been associated with negative health outcomes including delayed functional recovery, chronic pain, opioid use disorder, and postpartum depression(1,2). At our institution, oral hydromorphone (HM) is given as a rescue pain medicine after elective cesarean delivery (CD) under spinal anesthesia in addition to spinal morphine and scheduled postoperative non-opioid analgesics. The primary aim of this audit was to determine the incidence of HM administration after CD to assess the effectiveness of our multimodal analgesia regimen.

**Methods:** Institutional ethics approval was not required. From 193 consecutive patient files we retrospectively collected times of spinal anesthesia placement, post-anesthesia care unit (PACU) admission and discharge, floor admission, and times and doses of HM. Primary outcome (P1) was incidence of HM administration within 6 hours after spinal using intrathecal bupivacaine 0.75% 1.6-1.8 mL. Secondary outcomes included: incidence of HM given in PACU vs. postpartum floor (S1), mean dose of HM (S2), and median elapsed time from spinal to HM administration (S3).

**Results:** P1: Incidence of HM given within 6 hours of spinal administration was 37%. S1: 23% and 14% of patients received HM in PACU and on postpartum floor, respectively. S2: Mean dose of HM was 3.1 mg ( $SD = 1.1$ ), independent t-test indicating significantly higher dosages for PACU ( $M = 3.4$ ,  $SD = 0.9$ ) compared to postpartum floor ( $M = 2.4$ ,  $SD = 1.1$ ),  $t(67) = 3.9$ ,  $p < 0.001$ , 95% CI [0.48, 1.46]. S3: Median time to first HM given was 2 hours 35 minutes.

**Discussion:** At our institution more than one third of elective cesarean delivery patients received oral HM for breakthrough pain within 6 hours after spinal anesthesia. HM was given more often and in higher doses in PACU compared to the postpartum floor. We conclude that our current multimodal analgesia regimen provided adequate pain control in about two thirds of parturients.

**Figure 1. Incidence and location of HM given**



Abstract #: FRI – RPS2 – Room 7 – Post Cesarean Pain & Recovery - 10

## Acute Postpartum Pain and Anxiety Influence Long-term Postpartum Pain, Maternal-Infant Attachment and Parenting Self-Efficacy

**Presenting Author:** Mutasim Makeen, MB.BS

**Presenting Author's Institution:** University Of Pittsburgh - Pittsburgh, Pennsylvania

**Co-Authors:** Lia Farrell, MD - University Of Pittsburgh

Tanya Kenkre, PhD - University Of Pittsburgh

Grace Lim, MD MSc - Department of Anesthesiology & Perioperative Medicine, University of Pittsburgh School of Medicine

### Introduction

Pain and depression are bi-directionally related in chronic pain settings, and worse labor pain has been linked to postpartum depression symptoms<sup>1-3</sup>. These findings raise questions about whether improving pain and mood after delivery can improve maternal parenting function. However, few studies have examined relationships between postpartum pain and negative mood, and their effects on parent-infant relationship outcomes. We aimed to assess the relationships between postpartum pain, depression, parent-infant attachment, and parenting self-efficacy.

### Methods

This was a prospective longitudinal observational study of healthy, adult, nulliparous women, at term gestation presenting for labor and delivery at  $\geq 38$  weeks gestational age. Baseline self-reported outcome assessments included validated inventories of depression (Edinburgh postnatal depression screen, EPDS), anxiety (state trait inventory, STAI), pain (brief pain inventory short, BPI). Demographic and labor variables were recorded. At 6 weeks and 3 months postpartum, self-reported assessments included EPDS, STAI, BPI, maternal infant attachment (MPAS), and parenting self-efficacy (PMPSE). Pain severity scores were calculated as the average of items 2-5 on the BPI and pain interference scores were averaged on items 8-14 from the BPI. Linear regression was used to estimate the effects of 6-week pain scores on 3-month pain scores. A P-value less than 0.05 was considered statistically significant.

### Results

187 subjects participated; 87 subjects had complete data on parent-infant attachment and 85 had complete parenting self-efficacy data. Worse postpartum anxiety scores were associated with lower parenting self-efficacy scores (Table 1). Higher pain severity at 3 months was associated with lower parent-infant attachment and parenting self-efficacy scores (Table 1). Pain severity scores at 6 weeks postpartum were significantly associated with pain severity at 3 months (Parameter Estimate 0.25, 95% CI 0.07 to 0.43,  $P=0.01$ ) (Table 2). The potential strength and dose-responsiveness of these relationships will be assessed and reported.

### Conclusions

We observe a pattern of association between worse postpartum anxiety and pain with worse parenting outcomes. The potential relationships between postpartum anxiety, pain, and parenting self-efficacy deserve further investigation because reducing both postpartum pain and improving mood can potentially improve long-term postpartum parenting outcomes.

[SOAP Tables\\_v2.pdf](#)

Abstract #: FRI – RPS2 – Room 7 – Post Cesarean Pain & Recovery - 11

## Quantitative Sensory Correlates of Pain in Pregnant Women with Opioid Use Disorder

**Presenting Author:** Bryna Torre, MD

**Presenting Author's Institution:** University of Pittsburgh Medical Center

**Co-Authors:** Benedict Alter, MD PhD - University of Pittsburgh Medical Center

Elizabeth Krans, MD - University of Pittsburgh Medical Center

Kelsea LaSorda, MPH - Quinnipiac University

Grace Lim, MD MSc - Department of Anesthesiology & Perioperative Medicine, University of Pittsburgh School of Medicine

### Introduction:

Opioid use disorder (OUD) and opioid-related deaths in pregnant women are rising.<sup>1,2</sup> Pregnant women treated with medications for OUD (MOUD) may have challenges with pain control due to interactions with mu agonist or partial agonist therapies. Elucidating appropriate treatment options for labor and postpartum pain management in women with OUD can be informed by better characterizing pain difference between women with and without OUD. This study evaluated evoked pain dimensions by quantitative sensory testing (QST) among women with OUD compared to matched controls.

### Methods:

In this case control study, informed and consenting pregnant women treated with MOUD in their third trimester (27 weeks gestation or greater) were enrolled. These cases were matched by age with women without OUD. Baseline psychosocial assessments included depression symptoms, anxiety symptoms, fear of pain, and pain catastrophizing. QST protocols included light touch sensitivity, pressure pain threshold, and pressure pain tolerance, heat pain threshold and pain tolerance, and heat temporal summation and aftersensations. Area under the curve was calculated by the trapezoidal method to assess pain burden. QST data were compared between cases and controls using T tests or Wilcoxon tests where appropriate.

### Results:

There were 91 data points and complete QST data for analysis provided by 2 cases (receiving buprenorphine) and 2 controls. Baseline psychosocial assessments and gravidity, age, and body mass index were similar between groups. Women with OUD required heavier monofilaments before reporting a sensation of light touch compared to controls (OUD = 4.01g +/- 0.23 vs. controls = 2.60g +/- 0.33, *P*-value = 0.04). Women with OUD reported pain at lower pressure velocities on the left trapezius than controls (OUD = 1.20 +/- 0 kg vs. controls = 3.70 +/- 0.28 kg, *P*-value = 0.01). In temporal summation testing, women with OUD experienced greater pain burdens during ten seconds of applied heat in heat tolerance testing and during the full minute after heat was removed (Figure).

### Conclusions:

These findings suggest that pregnant women with OUD experience pain at lower thresholds than controls, and they experience greater pain burden under temporal summation paradigms. Central sensitization and hyperalgesia may account for some of these findings and warrants further examination. Rigorous clinical and mechanistic research is needed to inform appropriate pain treatments for this special population.

[SOAP Abstract 2022 Figure 1.pdf](#)

Abstract #: FRI – RPS2 – Room 7 – Post Cesarean Pain & Recovery - 12

The effect of epidural administration of a small dose (0.75 mg) of morphine on postpartum pain relief after vaginal delivery: A randomized, single-blind study

**Presenting Author:** Hiroaki Kondo, MD

**Presenting Author's Institution:** Division of Obstetric Anesthesia, Center for Perinatal Care, Child Health and Development, Kitasato University Hospital - Sagami-hara City, Kanagawa

**Co-Authors:**

### Background

Postpartum pain can cause significant discomfort and interfere with daily activities. A previous study showed that epidural administration of 1 to 2 mg of morphine after vaginal delivery reduces postpartum pain, however, side effects such as urinary retention may occur.<sup>1)</sup> In this study, we investigated whether morphine at a smaller dose (0.75 mg) than that reported in previous studies could reduce the side effects while maintaining postpartum pain relief.

### Method

This study was approved by the relevant IRB (no. C19-300). It included pregnant women with a term singleton fetus ( $\geq 37$  weeks) delivered vaginally and who had received combined spinal-epidural analgesia during labor and delivery. Written informed consent was obtained from all patients. We assessed postpartum pain and side effects in both groups: epidural morphine 0.75 mg administered after delivery (M group) or normal saline administered at the same volume (NS group). Assignments were randomized and the patients were blinded to the group allocation. Visual analog scale (VAS) scores at 1, 2, 6, 12, 18, and 24 h after delivery were obtained separately for both perineal and postpartum cramping pain. The mean area under the curve for VAS was compared using the Mann-Whitney U test. The time to the first request for additional analgesics was compared using the log-rank test. The hazard ratio was analyzed using Cox proportional hazards regression. The number of analgesic medications used for 24 h was compared using the Mann-Whitney U test. Side effects (respiratory depression, nausea, vomiting, pruritus, and urinary retention) were compared using the Fisher's exact test. Statistical significance was set at  $P < 0.05$ .

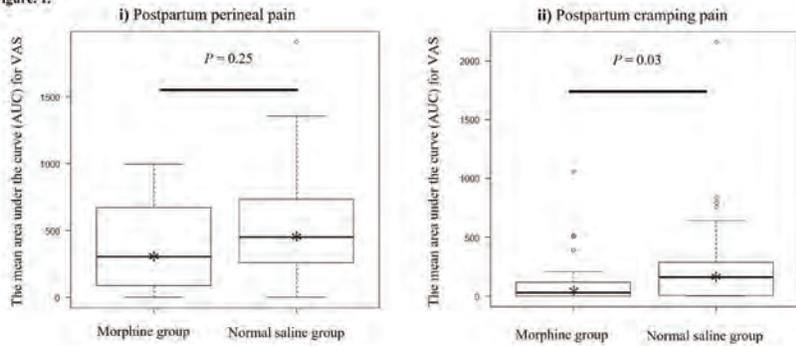
### Results

Sixty-eight women were randomly allocated to receive either epidural morphine ( $n = 33$ ) or normal saline ( $n = 35$ ) after delivery. There were no significant differences in the patient background, number of episiotomies, severity of perineal laceration, or side effects between the two groups. There was not a significant difference for postpartum perineal pain between the two groups ( $P = 0.25$ ), but there was a significant difference for postpartum cramping pain between the two groups ( $P = 0.03$ ; Figure.1). The time to the first request for additional analgesics was significantly prolonged in the M group (hazard ratio, 0.44; 95% confidence interval, 0.26-0.76;  $P = .003$ ; Figure. 2). Furthermore, the number of analgesic medications used was higher in the NS group than in the M group ( $P = .02$  Figure. 3).

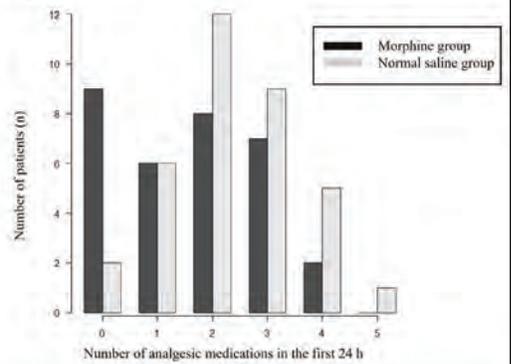
### Conclusion

Epidural administration of morphine 0.75mg after vaginal delivery could maintain the analgesic effect and did not cause side effects such as urinary retention, despite using a lower dose than that previously reported (1 mg).

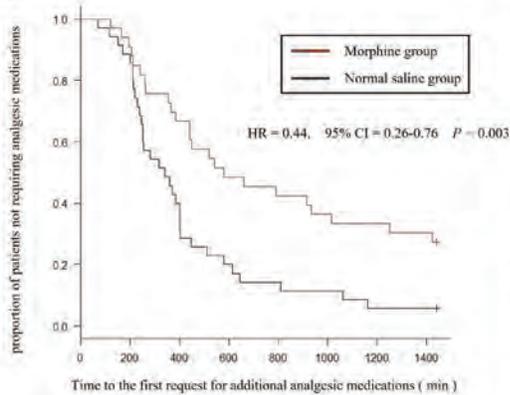
**Figure 1.**



**Figure 3.**



**Figure 2.**



**Figure 1. The mean area under the curve (AUC) for VAS in two groups.**

**i) Postpartum perineal pain scores in two groups.** The mean AUC of perineal pain was not a significant difference between the M group (median 305, IQR 90.0-670) and the NS group (median 450, IQR 257.5-735,  $P = 0.25$ ).

**ii) Postpartum cramping pain in two groups.** The mean AUC of postpartum cramping pain was a significant difference between the M group (median 30.0, IQR 0-120) the NS group (median 162.5, IQR 7.5-290,  $P = 0.03$ ).

The box-plot shows the median (the asterisk), 25th and 75th percentiles (lower and upper limits of the box), and the minimum and maximum observations (whiskers).

**Figure 2. Kaplan-Meier curves analyzing the time to the first request for additional analgesic in both groups.**

The time to the first request for additional analgesics was significantly prolonged in the M group (hazard ratio, 0.44; 95% confidence interval, 0.26-0.76;  $P = .003$ ).

**Figure 3. Histogram of the number of analgesic medications used in both groups for 24 h.**

The median (IQR) number of analgesic medications in the first 24 h was 2 (0-3) in the M group and 2 (2-3) in the NS group. The number of analgesic medications used was higher in the NS group than in the M group ( $P = .02$ ). The highest number of analgesics was 0 in the M group ( $n=9$ ), and the highest number of analgesics was 2 in the NS group ( $n=12$ ).

Abstract #: FRI-GM - 01

## Ketorolac Inhibits Platelet Function After Cesarean Delivery

Presenting Author: Anna Moldysz, MD

Presenting Author's Institution: Beth Israel Deaconess Medical Center/Harvard Medical School - Boston, Massachusetts

Co-Authors:

**BACKGROUND:** Scheduled ketorolac after cesarean delivery has been shown to improve quality of post-cesarean analgesia and reduce opioid consumption.<sup>1</sup> Ketorolac is known to inhibit platelet aggregation and prolong bleeding time in healthy volunteers, but platelet inhibition in the obstetric population is not well studied.<sup>2,3</sup> This has limited incorporation of ketorolac into protocols for postpartum analgesia. We hypothesized that exposure to intravenous ketorolac impairs platelet function of healthy parturients undergoing elective cesarean delivery.

**METHODS:** We studied women undergoing scheduled cesarean delivery with neuraxial anesthesia. We measured preoperative platelet aggregation with platelet aggregometry, thromboelastography (TEG 6s) and TEG 6s Platelet Mapping. Baseline CBC, PT, PTT, INR and fibrinogen were also collected. Patients were randomized to receive ketorolac 30 mg or placebo at skin closure. Randomization and drug preparation was performed by the research pharmacy to ensure blinding. 30 min after drug administration, the tests were repeated. The primary outcome was >70% platelet inhibition to arachidonic acid (AA) and analyzed by Chi-squared test. Secondary outcomes included platelet inhibition to AA, area under the curve of platelet inhibition in the presence of AA, TEG AA platelet inhibition and TEG ADP platelet inhibition. T-tests and Mann-Whitney tests were used to compare outcomes. Data are presented as mean ( $\pm$ standard deviation) and median [interquartile range].

**RESULTS:** 40 patients were enrolled and 28 were included in analysis. 12 patients were excluded due to criteria. There was no difference in demographic characteristics. There was no difference in baseline labs or platelet aggregometry values. Baseline TEG R time was placebo:5.94 $\pm$ 0.78 min vs. ketorolac:5.3 $\pm$ 0.87 min ( $p=0.04$ ) and K time was placebo:1.05 min [0.9 to 1.2] vs. ketorolac: 0.9 min [0.8 to 0.9] ( $p=0.03$ ). After administration of the study drug, all patients exposed to ketorolac had >70% platelet inhibition compared to no patients in the placebo group ( $p< 0.0001$ ). There was a 69.07% ( $\pm 9.28$ ) reduction in platelet function with ketorolac versus 0.23% ( $\pm 7.00$ ) with placebo ( $p< 0.0001$ ) (Figure 1). Percentile decrease in area under the curve of platelet inhibition was -9.93% [-18.46 to 4.10] for placebo and 99.64% [88.57 to 99.96] for ketorolac ( $p< 0.0001$ ). No significant change in TEG AA ( $p=0.078$ ) or ADP ( $p=0.150$ ) platelet inhibition were seen.

**CONCLUSION:** Ketorolac after cesarean delivery results in marked platelet inhibition. Despite being effective in multi-modal pain control, administration of ketorolac should be carefully considered in postpartum hemorrhage. Our findings highlight a lack of sensitivity of TEG platelet mapping in detecting abnormalities in platelet aggregation, which were clearly demonstrated by platelet aggregometry.

[Moldysz Ketorolac Platelet Inhibition.pdf](#)

## Ketorolac Inhibits Platelet Function After Cesarean Delivery

Anna Moldysz MD, Maria C. Borrelli DO, Shihui Guo PhD, Somal Khan MD,  
Yunping Li MD, Philip E. Hess MD, John J. Kowalczyk MD  
Beth Israel Deaconess Medical Center, Harvard Medical School, Boston, MA

**Ketorolac in obstetrics**

- ERAC: multimodal analgesia
- Opioid consumption

**Ketorolac in healthy volunteers**

- Inhibition of platelet aggregation
- Prolonged bleeding time
- Contradictory results on TEG

**Platelet inhibition in cardiac and vascular patients**

- Increased chest tube output
- Increased EBL

Hypothesis: Exposure to intravenous ketorolac inhibits platelet function of healthy parturients undergoing elective cesarean delivery.

1. Anesthesiology 2005; 103:226-234  
 2. Acta Anaesthesiologica Scandinavica 2000; 44:555-9  
 3. Eur J Clin Invest 1998; 28:285-9

## Methods

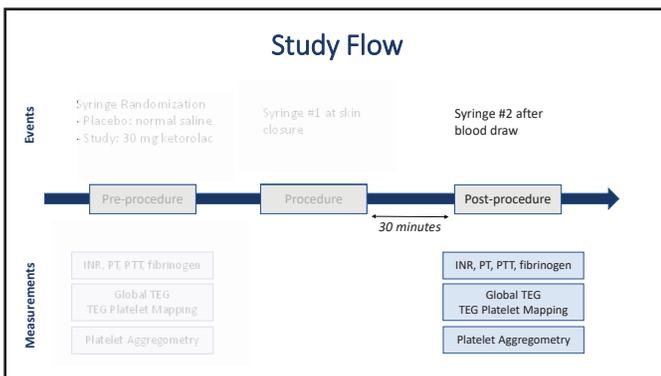
**Inclusion Criteria**

- 18-40 years of age
- Gestational age >37 weeks
- Singleton gestation
- Scheduled or non-urgent
- Neuraxial anesthesia
- Cesarean section will likely finish before 4 PM

**Exclusion criteria**

- Allergy/contraindication to NSAID
- Renal disease
- Platelet count <100 x 10<sup>9</sup>/L
- History of coagulation disorder
- Pre-existing treatment with any of the following: Aspirin, NSAIDs, Opioids, Anticoagulants, Anti-platelet agents
- Intra-operative EBL >1000 mL

<b>Primary Outcome</b>	<b>&gt;70% platelet inhibition in presence of arachidonic acid (AA)</b>	<b>Chi-squared analysis</b>
<b>Selected Secondary Outcomes</b>	1) % Platelet inhibition to AA 2) Area under the curve of platelet inhibition in presence of AA 3) TEG AA platelet inhibition 4) TEG ADP platelet inhibition	T-tests, Wilcoxon rank-sum and Signed rank tests



## Results

**Sample Size Analysis**

- Alpha error 0.05
- Power 0.8
- Sample size 12 per group

**Flowchart:**

```

      graph TD
        A[Assessed for enrollment (n=73)] --> B[Enrolled and Randomized (n=40)]
        A --> C[Excluded Pre-operatively (n=33)]
        B --> D[Placebo (n=20)]
        B --> E[Ketorolac (n=20)]
        D --> F[Analyzed (n=13)]
        E --> G[Analyzed (n=15)]
      
```

Demographics	Placebo (n= 13)	Ketorolac (n= 15)	p-value
Age (years)	36 [34-37]	35 [34-38]	0.92
Weight (kg)	79 [77-91]	83 [73-94]	0.95
Body mass index (kg/m <sup>2</sup> )	29 [28-34]	32 [28-35]	0.49
Gestational Age (weeks)	39.0 [39.0-39.2]	39.3 [39.0-39.6]	0.29
Gravida	2 [2-3]	2 [2-3]	1.00
Parity	1 [1-2]	1 [1-1]	0.64
Nulliparous	1 (8%)	2 (13%)	
Multiparous	12 (92%)	13 (87%)	

## Results: Platelet Aggregometry

### % Platelet Inhibition to AA

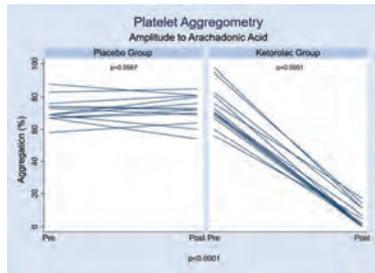
	Placebo (n=13)	Ketorolac (n=15)
>70% platelet inhibition	0 (0%)	15 (100%)

$p < 0.0001$

### Platelet Aggregation: Relative Change in Area Under the Curve to AA

	Placebo (n=13)	Ketorolac (n=15)
Relative Change	9.9% [-4.1 - 18.5]	-99.5% [-87.2 - -100]

$p < 0.0001$



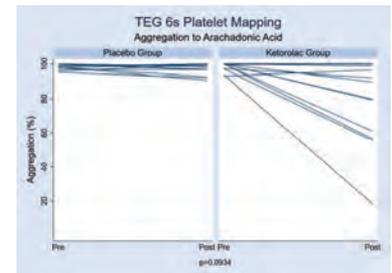
## Results: TEG Platelet Mapping

### TEG AA inhibition

- Ketorolac 3.2 [0-30.4]
- Placebo 1.4 [-1.3-3.1]
- $p=0.093$

### TEG ADP inhibition

- Ketorolac 0.3 [0-5.85]
- Placebo 0 [0-2.2]
- $p=0.153$



## Discussion

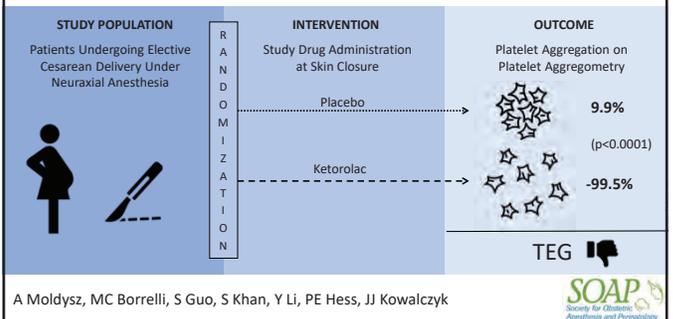
### Limitations

- Clinical significance
- Cannot generalize: PPH, thrombocytopenia
- May not be powered for TEG

### Conclusions

- Ketorolac → **99% Inhibition of Platelets** by Aggregometry
- TEG and TEG Platelet Mapping: Lack sensitivity

## RCT: Ketorolac Inhibits Platelet Function After Cesarean Delivery



## Acknowledgments



Yunping Li, MD



John Kowalczyk, MD



Philip Hess, MD



Shihui Guo, PhD



Maria Borrelli, DO



Somal Khan, MD

Beth Israel Deaconess Medical Center  
SOAP Young Investigator's Grant

Additional Thanks: Robert Flaumenhaft MD PhD,  
Alexander Butwick MBBS FRCA,  
Brendan Carvalho MBCh FRCA

Abstract #: FRI-GM - 02

## Spontaneous and oxytocin-induced contractility after exposure to intravenous anesthetic agents: an *in-vitro* study in human myometrium

Presenting Author: Natalia C. Portela, MD

Presenting Author's Institution: Department of Anesthesiology and Pain Medicine, Mount Sinai Hospital, University of Toronto - Toronto, Ontario

Co-Authors: Mrinalini Balki, MD - Department of Anesthesiology and Pain Medicine, Mount Sinai Hospital, University of Toronto

Jose CA Carvalho, MD, PhD - Department of Anesthesiology and Pain Management, Mount Sinai Hospital, University of Toronto

Thomas Drew, MD - Department of Anesthesiology and Pain Management, Mount Sinai Hospital, University of Toronto

Tess Engel, Research Technician - Department of Anesthesiology and Pain Management, Mount Sinai Hospital, University of Toronto

### Introduction

General anesthesia is associated with higher blood loss than neuraxial anesthesia after cesarean delivery (CD) [1] and the effects of anesthesia drugs on uterine tone have been pointed as contributors for bleeding [2]. The objective of this study was to investigate the dose-response profiles of anesthesia induction agents on gravid human myometrium.

### Methods

In this *in vitro* study, myometrial samples were obtained from patients undergoing elective CD. Individual strips were mounted in organ bath chambers filled with physiological salt solution (PSS) to mimic physiologic conditions. Samples were allocated to one of the 7 groups (Grs): 1) Propofol (P), 2) Etomidate (E), 3) Ketamine (K), 4) Propofol+Oxytocin (PO), 5) Etomidate+Oxytocin (EO), 6) Ketamine+Oxytocin (KO), and 7) Oxytocin (O) (Control Gr). After equilibration, each strip was subjected to dose-response (DR) testing with the study drug in a pattern of 0.5 log molar increase from  $10^{-7}$ M to  $10^{-4}$ M; however, PO, EO and KO Grs received additional oxytocin 20 nM during DR. Amplitude (g) and frequency (contractions (c) per 10 min) were recorded. The primary outcome was motility index (MI; amp x freq; g\*c/10 min). All outcomes were expressed as a % change from baseline during equilibration. Generalized linear regression models with log link function were used to compare the groups. Generalized estimating equation was implemented in all models to account for repeated measures from the same patient. All tests were 2-tailed;  $P < 0.05$  was considered statistically significant.

### Results

We analyzed 189 experiments on samples from 35 patients. MI decreased progressively with increasing concentration of study drug in all Grs. MI during spontaneous contractions with each study drug was significantly lower when compared to control Gr O (Fig1). When compared with Gr O, the estimated mean diff (EMD) (95% CI) in Gr P -71.3% (-90.50% to -13.3%)  $P=0.027$ , Gr E -86.7% (-3.9% to -71.0%)  $P < 0.0001$  and Gr K was -82.6% (-90.2% to -69.0%)  $P < 0.0001$ . Amongst oxytocin treated groups, PO demonstrated significantly lower MI (-69.8% (-85.2% to -38.4%)  $P=0.001$ ), while EO and KO were not different from Gr O. Grs EO (308.6% (76.2% to 847.3%)  $P=0.001$ ) and KO (374.3% (152.9% to 789.8%)  $P < 0.0001$ ) produced higher MI than E and K, respectively, however, Grs PO and P were not significantly different.

### Discussion

All the studied intravenous induction agents cause dose dependent decrease in uterine contractility. Oxytocin helps augment contractility produced by etomidate and ketamine, but not propofol. We suggest the use of etomidate or ketamine rather than propofol in the postpartum period along with oxytocin to produce superior uterine tone. This finding warrants further clinical studies to explore uterine responsiveness to oxytocin in women with oxytocin-augmented labor requiring general anesthesia for CD.

[Induction agent figure for abstract. Feb 07 2022 KD \(1\).pdf](#)



**Mount Sinai Hospital**  
Sinai Health System  
Jewish & Mount Sinai  
Health Canada



Anesthesiology & Pain Medicine  
**UNIVERSITY OF TORONTO**

**Spontaneous and oxytocin-induced contractility after exposure to intravenous anesthetic agents: an *in-vitro* study in human myometrium**

Natalia C. Portela, Thomas Drew, Jose C. A. Carvalho, Tess Engel, Mrinalini Balki

Department of Anesthesiology and Pain Medicine, Mount Sinai Hospital, University of Toronto



**SOAP 2022**  
ANNUAL MEETING

### Introduction

- Cesarean delivery under general anesthesia → higher blood loss
- Induction agents → may contribute to bleeding due to effects on uterine tone
- Some studies in rats have shown a dose dependent decrease in myometrial contractility to different anesthesia induction agents
- Evidence regarding the effect of intravenous induction agents on human myometrium is sparse
- Objective:** to investigate the effects of intravenous induction agents on gravid human myometrium in the presence or absence of oxytocin *in vitro*
- Hypothesis:** We hypothesized that intravenous induction agents would cause a dose dependent decrease in spontaneous uterine contractility

### Methods

- Myometrial samples obtained from patients undergoing elective CD
- Individual strips → organ bath chambers with physiological salt solution (PSS)
- 7 study groups
  - Propofol (P)
  - Etomidate (E)
  - Ketamine (K)
  - Propofol+Oxytocin (PO)
  - Etomidate+Oxytocin (EO)
  - Ketamine+Oxytocin (KO)
  - Oxytocin (O) (Control Group)



### Methods

Study Drug	Equilibration	Wash-in	Study Drug	Cumulative dose-response to study drug (M)	Wash-out
Oxytocin	PSS 1 hour	KCl	Oxytocin 20 nM 10 min	10 <sup>-7</sup> , 5x 10 <sup>-7</sup> , 10 <sup>-6</sup> , 5x 10 <sup>-6</sup> , 10 <sup>-5</sup> , 5x 10 <sup>-5</sup> , 10 <sup>-4</sup> Oxytocin 20 nM	KCl
Study Drug (Anesthetic)	PSS 2 hour	KCl	PSS 10 min	10 <sup>-7</sup> , 5x 10 <sup>-7</sup> , 10 <sup>-6</sup> , 5x 10 <sup>-6</sup> , 10 <sup>-5</sup> , 5x 10 <sup>-5</sup> , 10 <sup>-4</sup>	KCl
Control	PSS 1 hour	KCl	Oxytocin 20 nM 10 min	Oxytocin 20 nM	KCl

- Cumulative Dose-Response with the study drug in a pattern of 0.5 log molar increase from 10<sup>-7</sup>M to 10<sup>-4</sup>M
- Amplitude (g) and frequency (contractions (c) per 10 min) were recorded
- Primary outcome: **motility index (MI)**; amp x freq; g\*c/10 min
- All outcomes expressed as % change from baseline during equilibration
- Generalized linear regression models with log link function were used to compare the groups

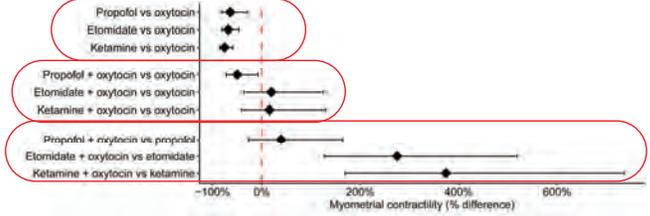
\* P < 0.05 was considered statistically significant

Results



- 189 experiments on samples from 33 patients
- MI decreased progressively with increasing concentration of study drug in all groups
- MI for each study drug was significantly lower when compared to Group O

Results

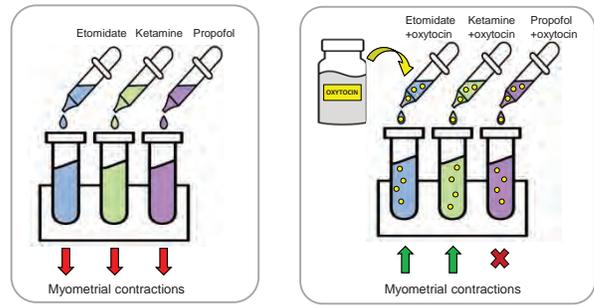


- All combinations of oxytocin and induction agents significantly improved contractility of Ketamine and Etomidate but not of Propofol
  - compared to the induction drug alone

Discussion

- All intravenous induction agents cause dose dependent decrease in uterine contractility *in vitro*
- Oxytocin improves contractility of etomidate and ketamine, but **not of propofol**
- Etomidate and ketamine along with oxytocin seem to produce superior uterine contraction compared to propofol
- Clinical studies to correlate these findings with clinical practice are warranted
- Further studies are warranted to understand the interaction of intravenous induction agents and oxytocin in the oxytocin-desensitized myometrium

Uterine contractility after exposure to intravenous anesthetic agents +/- oxytocin: an *in-vitro* study in human myometrium



Abstract #: FRI-GM - 03

## A multicenter evaluation of quality of recovery following cesarean delivery

**Presenting Author:** James O'Carroll, MBBS FRCA

**Presenting Author's Institution:** Stanford University

**Co-Authors:** Brendan Carvalho, MBBSCh, FRCA, MDCH - Stanford University

Nan Guo, PhD - Department of Anesthesiology, Perioperative and Pain Medicine, Stanford University

Pervez Sultan, MBChB, FRCA, MD (Res) - Stanford University

Eleanor Warwick, MBBS FRCA - University College Hospital, London, UK

Liana Zucco, MBBS FRCA - St George's Hospital, London, UK

### Introduction

Cesarean delivery is the most frequently performed inpatient operation worldwide, however recovery profiles, population norms and outliers are largely unknown. The aim of this study was to sample a large cohort of women from multiple centers to determine recovery profiles and predict women with prolonged length of stay or complicated recovery.

### Methods

Following ethical approval for 107 centers in the United Kingdom, all eligible women at these institutions were screened, consented and enrolled at 18-30 hours following delivery during a selected 3-day study window. At day 1 and 30 following cesarean delivery, we examined recovery using validated measures of the Obstetric Quality of Recovery-10 score (ObsQoR), EuroQoL quality of life (EQ5D-5L measured as composite score [5- 25 with lower score representing improved health state]) and global health visual analog scale (GHVAS) score [0-100]. We recorded hospital length of stay (LOS); unanticipated readmissions, reattendance or investigations; pain scores and level of activity [0-10]. Correlation between day 1 ObsQoR-10 score, LOS and quality of life at 30-days postpartum were determined. Values presented as median [IQR].

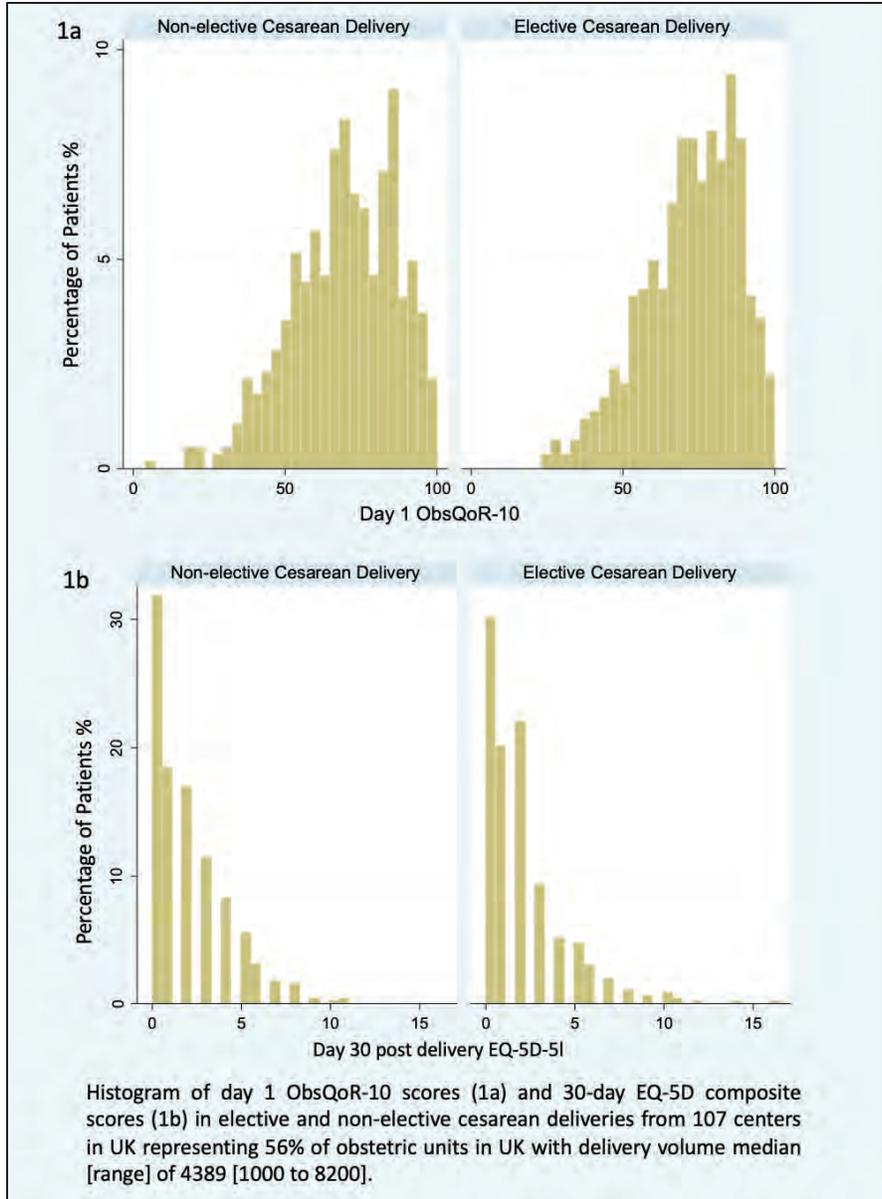
### Results

We recruited 1167 patients who delivered via cesarean delivery (587 elective and 580 non-elective) Fig. 1 shows histograms for day 1 ObsQoR (1a) and 30-day EQ-5D(1b) scores for elective and non-elective cesarean deliveries. Median [IQR] LOS was 38.5 [28.3-61] hours and day 1 ObsQoR score was 72 [60-84]. There was a correlation between day 1 ObsQoR score and LOS  $r=-0.293$  (95% CI: -0.344- -0.244),  $p< 0.001$ . Median [IQR] ObsQoR scores for women with normal recovery were 75 [63-86] vs. 70 [57-82] in those with prolonged or complicated recovery (defined as length of stay  $>90\%$  percentile or unanticipated readmissions, reattendance or investigations;  $P< 0.001$ ). Median [IQR] day 1 EQ-5D composite score was 6 [4-9], and GHVAS at day 1 and 30 were 65 [50-80] and 80 [70-90] respectively. Day 1 ObsQoR score and 30-day EQ5D and GHVAS correlations were  $r=-0.327$  (95% CI: -0.389- -0.268),  $p< 0.001$  and  $r=0.276$  (95% CI: 0.214-0.343),  $p< 0.001$ , respectively.

Pain scores at rest and movement at postpartum day 1 and 30 days were 4 [2-6], 6 [4-8] and 0 [0-1] and 1 [0-3] respectively. Non-opioid analgesia was required by 27.5% of patients between days 23 and 30 following discharge, with 3.2% requiring opioids.

### Conclusion

This study is the first to comprehensively evaluate in-hospital and after-discharge recovery following cesarean delivery in a large multicenter population. The recovery profiles and population norms/outliers for ObsQoR scores presented can be used to identified women that may have prolonged or complicated recovery. Future studies are required to determine if escalation of postpartum clinical care or treatment interventional can optimize recovery trajectories following cesarean delivery.



Abstract #: FRI-GM - 04

## Fetal Delivery During Maternal Mechanical Ventilation for Severe COVID-19: The Relationship of Maternal PaO<sub>2</sub>, PaCO<sub>2</sub>, and Acid-Base Status on Neonatal Outcomes

Presenting Author: Katelyn T. Scharf, MD

Presenting Author's Institution: University of Maryland School of Medicine

### Background

In pregnancy few relevant data exist to guide respiratory management during acute respiratory distress syndrome (ARDS), thus permissive hypercapnia is controversial. For instance, a goal maternal PaCO<sub>2</sub> < 50mmHg is traditionally suggested, yet this threshold is extrapolated from data from healthy patients with very transient hypercarbia during vaginal delivery with methoxyflurane anesthesia.<sup>1</sup>

This study analyzed the relationship between maternal acid-base status and fetal outcomes in parturients who delivered while requiring mechanical ventilation for severe COVID.

### Methods

With Institutional Review Board approval, we identified from April 2020 until January 2022 all fetal deliveries during maternal mechanical ventilation for severe COVID-19. We recorded maternal demographics, life support and ventilatory management (including extracorporeal membrane oxygenation; ECMO), length of stay, maternal and neonatal disposition, as well as maternal blood gas parameters (just prior to delivery, and nadir/maximum values prepartum) and cord gas values. Data are summarized as mean±SD or median [interquartile range]. Linear regression was used to assess the relationship between maternal pH, PaCO<sub>2</sub>, PaO<sub>2</sub>, and HCO<sub>3</sub> and neonatal Apgar scores at 1 min and 5 min ( $\alpha = 0.05$ ).

### Results

23 parturients delivered while ventilated, with 4 (17%) also on ECMO and 7 (30%) had ICU bedside delivery. Average gestational age was 31.6±3.3 weeks, and day of delivery post-admission was 4 [6]. No maternal or fetal deaths occurred.

Maternal blood gas values pre-delivery: pH 7.38±0.08, PaO<sub>2</sub> 125±40, PaCO<sub>2</sub> 37±6, HCO<sub>3</sub> 21±4.

Neonatal data: birth weight 2044±625 g; NICU length of stay 23 [22]; ventilatory support at delivery: intubated 11 (48%), CPAP 9 (39%), none needed 3 (13%); Apgar score: 1 min 4 [3], 5 min 7 [3].

Umbilical cord gas measurements: Venous (PaCO<sub>2</sub> 52±8 mmHg, PaO<sub>2</sub> 29.6±13, pH 7.28±0.04, HCO<sub>3</sub> 24±3); Arterial (PaCO<sub>2</sub> 61±11, PaO<sub>2</sub> 21±5, pH 7.23±0.05, HCO<sub>3</sub> 25±4).

There was significant inverse relationship between maternal pre-delivery PaCO<sub>2</sub> and Apgars at 1 and 5 min (Figure). Lower nadir prepartum maternal PaO<sub>2</sub> values also predicted lower Apgars at 1 and 5 min. More remote prepartum maternal hypercarbia did not predict low Apgars, nor did maternal pH (pre-delivery or nadir).

### Conclusion

The regression model shows that maternal hypercarbia > 40 mmHg at delivery may be associated with Apgar score ≤ 4 at 1 min, and >45 mmHg with ≤5 at 5 min. Lower nadir prepartum PaO<sub>2</sub> values also predicted lower Apgars at 1 and 5 min. Maternal pH did not predict Apgars due to protocolized sodium bicarbonate infusion.

**Figure.** Maternal acid-base values and neonatal Apgar scores. Relationship of most recent maternal PaCO<sub>2</sub> prior to delivery and Apgars at 1 minute (A) and 5 minutes (B). Relationship of prepartum PaO<sub>2</sub> nadir and Apgars at 1 minute (C) and 5 minutes (D). Blue line shows linear regression trend and 95% confidence interval (grey shading).

UNIVERSITY of MARYLAND  
SCHOOL OF MEDICINE

## Fetal Delivery During Maternal Mechanical Ventilation for Severe COVID-19: The Relationship of Maternal PaO<sub>2</sub>, PaCO<sub>2</sub>, and Acid-Base Status on Neonatal Outcomes

Katelyn Scharf, MD; Michael Wong, MD; Allison Lankford, MD; Shobana Bharadwaj, MBBS; Bhavani Kodali MBBS, MD

Department of Anesthesiology, University of Maryland School of Medicine, Baltimore, MD



UNIVERSITY of MARYLAND  
SCHOOL OF MEDICINE

## Background

 Little data exists to guide ventilatory management for pregnant patients with acute respiratory distress syndrome (ARDS).

 An arterial partial pressure of CO<sub>2</sub> (PaCO<sub>2</sub>) < 50 mmHg has been traditionally suggested, but this is based on a very limited study.

 This study analyzed the relationship between maternal acid-base status and fetal outcomes in parturients who delivered while requiring mechanical ventilation for severe COVID-19 ARDS.

1. Am J OBGYN 1970;107:939-46.



UNIVERSITY of MARYLAND  
SCHOOL OF MEDICINE

## Methods

**WHO**  All fetal deliveries during maternal mechanical ventilation for severe COVID-19 from April 2020 - January 2022

**HOW**  Retrospective chart review

**WHAT**

- Maternal demographics
- Ventilator/ECMO requirement
- Length of stay
- Maternal and neonatal disposition
- Maternal blood gases
- Neonatal cord gases
- Apgar scores at 1 min and 5 min



UNIVERSITY of MARYLAND  
SCHOOL OF MEDICINE

## Results - Maternal Demographics and Baseline Characteristics of the Neonates

- 23 Parturients on mechanical ventilation

- Average gestational age 33± 3.19 weeks

ECMO (17%)

Intubation (48%)

CPAP (39%)

Room Air (13%)

Apgar Score 1 minute: 4 [3]

Apgar Score 5 minute: 7 [3]

Maternal Race/Ethnicity

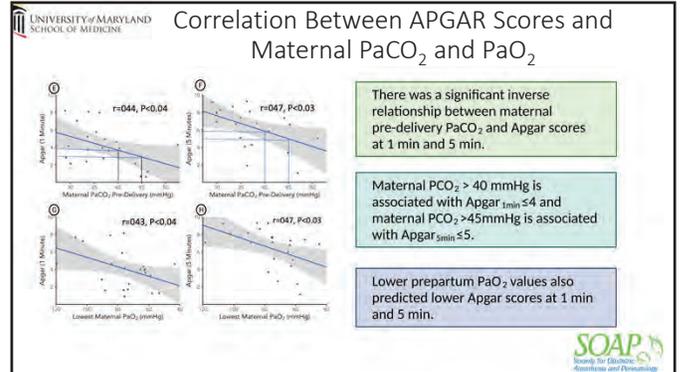
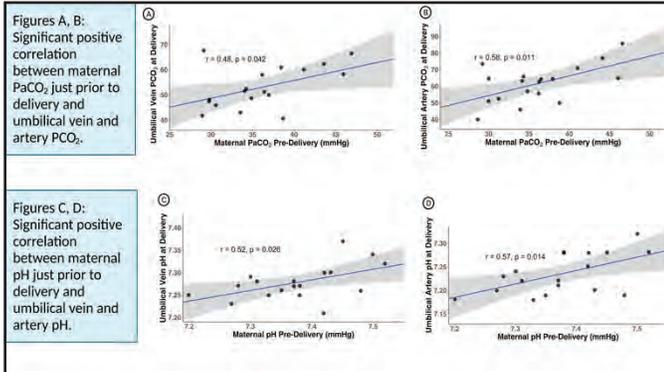
- 69.6% delivered in the OR

- 30.4% delivered in the ICU

- Neonatal birth weight 2044±625 g

- NICU length of stay 23 [22] days





UNIVERSITY of MARYLAND SCHOOL OF MEDICINE

### Conclusion

- Umbilical cord blood gas analysis at delivery demonstrated normal pH and PaO<sub>2</sub> values.
- PCO<sub>2</sub> values exceeded the normal range in both umbilical artery and umbilical vein samples.
- A maternal PaCO<sub>2</sub> of 40-45 mmHg pre-delivery was associated with Apgar scores ≤ 3-4 at 1 min and ≤ 5-6 at 5 min.
- Ventilation strategies in pregnant women with ARDS may consider maintaining PaCO<sub>2</sub> levels < 40 mmHg.

SOAP  
Quality for Evidence-Based Assessment and Performance

UNIVERSITY of MARYLAND SCHOOL OF MEDICINE

### Limitations

- Retrospective study
- Small sample size
- Confounding variables (maternal comorbidities, changing hemodynamics, anesthetic agents)
- Translation of Apgar score to long-term neonatal developmental outcomes

SOAP  
Quality for Evidence-Based Assessment and Performance

The Effect of Maternal PaCO<sub>2</sub> on Neonatal Outcomes in 23 Parturients with Severe COVID-19 on Mechanical Ventilation

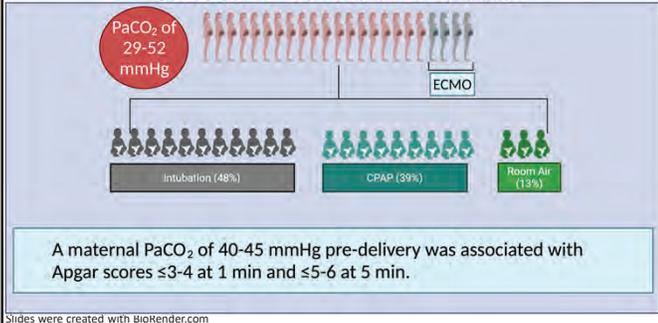
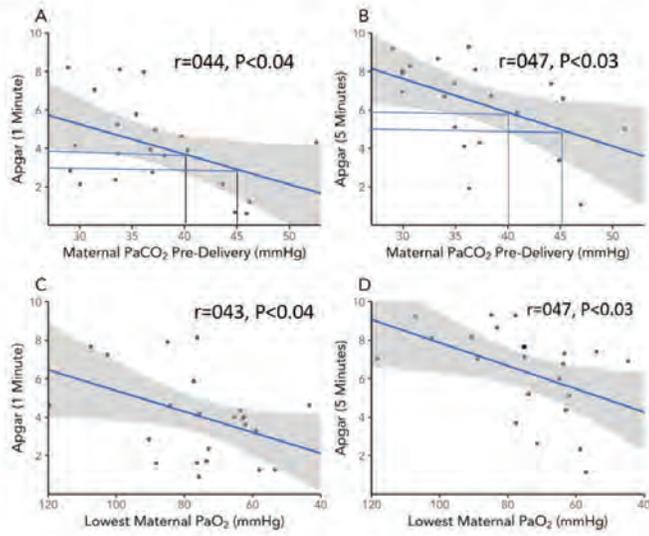


Figure.



Abstract #: FRI-GM - 05

## Changes in sensory block level during a programmed intermittent epidural bolus regimen for labor analgesia: a prospective observational cohort study

**Presenting Author:** Julia Fernandes Casellato, MD

**Presenting Author's Institution:** Department of Anesthesiology and Pain Medicine, Mount Sinai Hospital, University of Toronto

**Co-Authors:** Jose C A. Carvalho, MD, PhD - Department of Anesthesiology and Pain Medicine, Mount Sinai Hospital, University of Toronto

Kristi Downey, MSc - Department of Anesthesiology and Pain Medicine, Mount Sinai Hospital, University of Toronto

Xiang Y. Ye, MSc - Maternal and Infant Care Research Centre, Mount Sinai Hospital, University of Toronto, Canada

**Introduction:** A bolus injection of local anesthetic into the epidural space determines two distinct distribution patterns within the space. The first, closer to the injection site, is circumferential in nature; the second, farther from the injection site, is asymmetric and irregular (1). In the context of a PIEB regimen for labor analgesia, two different sensory block levels to cold can be identified: 1) an upper sensory block level (USBL), defined as the highest dermatome with any altered sensation to cold; and 2) a lower sensory block level (LSBL), defined as the highest dermatome with complete sensory block to cold (2). The USBL and LSBL may be the expression of the two different patterns of local anesthetic distribution. It is unknown whether the USBL and LSBL vary during the maintenance of labor analgesia with a PIEB plus PCEA regimen. This study investigated whether the USBL and LSBL vary within PIEB cycles.

**Methods:** We enrolled patients requesting epidural analgesia for labor. The epidural catheter was placed at L2/L3 or L3/L4. A test dose of 3 ml of bupivacaine 0.125% with fentanyl 3.3mcg/mL was administered through the catheter, followed by 12 ml of the same solution as the loading dose. Maintenance of the epidural analgesia was performed with bupivacaine 0.0625% with fentanyl 2mcg/ml, using a PIEB plus PCEA regimen: PIEB 10mL, PIEB interval 40 min, PCEA 5 mL, lockout interval 10 min, maximum hourly 30 mL. As per institutional protocol, patients had their sensory block levels to ice assessed at 20 minutes after the loading dose and then hourly. Patients included in the study underwent 8 extra assessments: immediately before the 2<sup>nd</sup> and 4<sup>th</sup> PIEB bolus; and 10, 20, and 30 minutes after the 2<sup>nd</sup> and 3<sup>rd</sup> boluses. The changes in USBL/LSBL over time were examined using linear quantile regressions for repeated measures

**Results:** We studied 30 patients. All results are expressed as median and interquartile range (IQR). The changes in USBL and LSBL over time are shown in Figure 1. There was a statistically significant increase in USBL and LSBL until 100 minutes after the loading dose, when sensory levels achieved their peak, remaining stable thereafter until the end of the study. Median (IQR) USBL was T8 (T9-T7) and T6 (T7-T4) at 20 and 100 minutes after the loading dose, respectively; LSBL was T10 (T11-T6) and T8 (T9-T6) respectively. There was no variation in the USBL or LSBL within the 2<sup>nd</sup> and 3<sup>rd</sup> PIEB cycles.

**Discussion:** Once peak sensory block levels are achieved, around 100 minutes after loading dose, both USBL and LSBL remain stable within the PIEB cycles. These findings confirm the efficacy of our PIEB regimen, suggesting a steady state of the local anesthetic. Furthermore, our results support the recommendation that sensory block levels can be assessed at any time during the PIEB cycles.

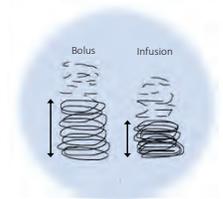
[Casellato Abstract Figure1.pdf](#)

## Changes in sensory block levels during a programmed intermittent epidural bolus regimen for labor analgesia: an observational cohort study

J. Casellato, X Y Ye, K. Downey, JCA Carvalho  
Department of Anesthesia and Pain Management  
Mount Sinai Hospital, University of Toronto

## Introduction

- Epidural analgesia for childbirth has evolved into a new era
- PIEB superior to CEI: better epidural spread
- Two patterns of epidural spread
  - circumferential vs asymmetric
- Two levels of sensory block to ice have been described
  - LSBL and USBL
  - Clinical significance is unclear



### Research question:

- How do USBL and LSBL vary within PIEB cycles?

### Hypothesis:

- USBL and LSBL would be highest soon after a PIEB and lowest just preceding the subsequent PIEB

## Methods

### Inclusion criteria

- ≥ 18 yo
- No conditions that could compromise sensitivity to cold

### Exclusion criteria

- Major spine condition
- Unintentional dural puncture
- Delivery before 160 min
- PCEA/top-up in the first 80 min

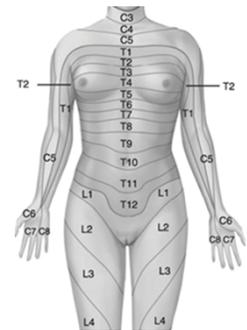
### Anesthetic technique

- Pre-procedural US, epidural catheter placement at L2/L3 or L3/L4 interspace
- Loading dose: 15 ml 0.125% bupivacaine + fentanyl 5mcg/ml
- Maintenance: 0.0625% bupivacaine + fentanyl 2mcg/ml (started 40 min after loading dose)
- PIEB regimen: PIEB bolus 10ml, Q40min, PCEA 5ml, Lockout 10min, Max hourly 30 mL

## Methods

### Primary outcome:

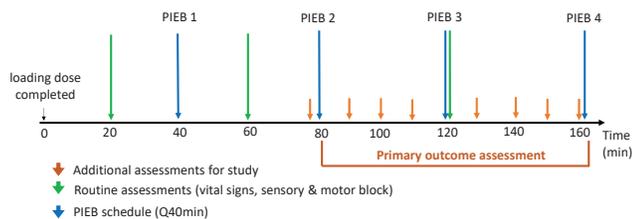
- Sensory block level to ice:**
  - Mid-clavicular line, starting at L1 and moving cephalad
  - Control area: C3-C5 dermatome
  - LSBL:** first perception of cold sensation
  - USBL:** feels as cold as the control area



### Secondary outcomes:

- Motor block (Bromage 0-3)
- Pain (VNRS 0-10)
- Satisfaction (VNRS 0-10)
- SBP

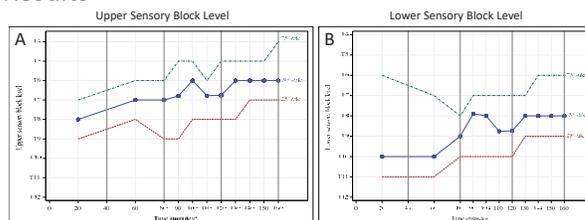
## Methods



### Statistical Analysis

Changes within each cycle: quantile regression model for repeated measures.  
Block stability: Post hoc analyses using a similar method with time being treated as continuous

## Results



- 2 distinct sensory block levels:
  - USBL and LSBL
  - peak around 100 min
  - no variation within PIEB cycles
- Excellent pain control
- No motor block
- Stable SBP

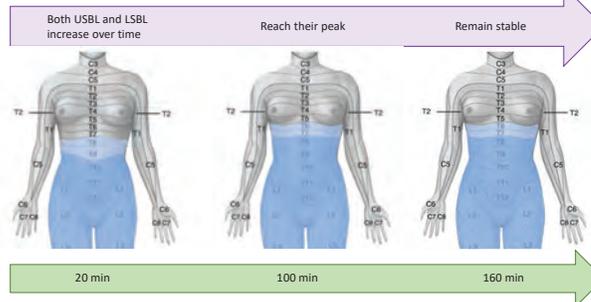
## Discussion/Conclusion

- Two sensory block levels to ice
  - clinical significance?
- Peak around 100 min, stable thereafter
  - Time for assessment?
- No variation of the USBL and LSBL within the PIEB cycles
  - Assessment may be done at any point during the cycle
  - Confirms "steady-state" of this PIEB regimen (proof of concept)

### Limitations

- Small sample size underpowered to correlate with clinical outcomes
- Limited duration of the study limits validity for late 1<sup>st</sup> stage and 2<sup>nd</sup> stage

## How do the USBL and LSBL change within PIEB cycles?



Abstract #: FRI-OP – 01

## Acute Pain After Vaginal Delivery and Subsequent Persistent Opioid Use

**Presenting Author:** Grace Lim, MD MSc

**Presenting Author's Institution:** Department of Anesthesiology & Perioperative Medicine, University of Pittsburgh School of Medicine - Pittsburgh, Pennsylvania

**Co-Authors:** Marian Jarlenski, PhD - University of Pittsburgh  
Elizabeth Krans, MD - University of Pittsburgh Medical Center  
Lingshu Xue, PhD - University of Pittsburgh

**Intro:** Opioid prescription (Rx) fills after uncomplicated vaginal deliveries are common<sup>1</sup>, raising questions about whether in-hospital acute pain after vaginal deliveries factors into ongoing opioid use. However, the association between acute pain after vaginal delivery and subsequent persistent opioid use is unknown. We assessed the associations between acute pain after vaginal delivery and filling an opioid Rx at discharge (short-term opioid use) and refilling an opioid Rx in the year after delivery (long-term opioid use).

**Methods:** A national healthcare administrative data set from Optum Labs that links electronic medical record (EMR) and medical claims data, identified women with inpatient vaginal deliveries and live births from 2011-2019. An “uncomplicated” cohort was defined as vaginal deliveries excluding hospital stays >5 days, tubal ligation, episiotomy, or third- or fourth-degree lacerations. The primary exposure was acute pain, quantified by mean and maximum pain scores in the first 48 hours after delivery recorded in EMR. Two outcomes were constructed: short-term opioid use (defined as opioid Rx fill between 1-3 days after discharge) and long-term opioid use (defined as an opioid Rx fill between 4-365 days after discharge). Multivariable regression models tested the association between mean and maximum pain score and opioid Rx fills. Confounders were demographics, socioeconomic factors, mental illness, opioid use (opioid use disorder and filling opioid Rx in pregnancy), substance use disorder, and tobacco use. Odds ratios (OR) and 95% confidence intervals (CI) were reported. A  $P < 0.05$  defined statistical significance.

**Results:** Among 12,536 women included, 1,995 (15.9%) had short-term opioid use; 1,284 (10.2%) had long-term opioid use in the year after delivery. There was a non-linear association between pain severity and persistent opioid use (Figure). Those with maximum pain scores of 3-6 and >6 had 80% (95%CI: [1.49,2.17],  $P < 0.001$ ) and 75% (95%CI: [1.46,2.10],  $P < 0.001$ ) higher risk of short-term opioid use vs. those with scores  $\leq 3$ , respectively. Risk of long-term opioid use increased by 13% (adjusted OR [95%CI]: 1.13[1.08, 1.18],  $P < 0.001$ ) for every 1-point increase in mean pain score. The risk was highest in those with mean pain scores >6 (adjusted OR [95%CI]: 1.76[1.22, 2.54],  $P < 0.01$ ). There was a high likelihood of long-term opioid use in those with maximum pain scores >6 (OR [95%CI]: 1.44[1.17, 1.77],  $P < 0.001$ ) vs. maximum pain scores  $\leq 3$ . Mental illness, opioid use in pregnancy, substance use disorders, and tobacco use were more prevalent among those with long-term opioid use vs. those without it.

**Conclusion:** In-hospital acute pain after uncomplicated vaginal delivery is associated with significantly increased odds of persistent opioid use in the first year after delivery. Patients with mental illness, substance use disorder, tobacco use, and opioid use during pregnancy are at particularly elevated risk.

[Figure.pdf](#)

Abstract #: FRI-OP - 02

**Obstetric pain management for women with opioid use disorder: A longitudinal, QUalitative mixed-methods Evaluation of patientS and provider perspecTives (The QUEST Study)**

**Presenting Author:** Sanjana Dayananda, BS

**Presenting Author's Institution:** Department of Anesthesiology & Perioperative Medicine, University of Pittsburgh School of Medicine

**Co-Authors:**

**Intro:** Patients with opioid use disorder (OUD) may experience inadequate pain management, potentially due to hyperalgesia or a fear of return to use after opioid analgesia exposure<sup>1</sup>. Simultaneously, poorly treated pain can trigger return to opioid use. Women are particularly susceptible to suboptimal pain therapies during pregnancy and lactation<sup>2</sup>. A knowledge gap exists on patient-provider perspectives on labor and postpartum pain management in pregnant people with OUD.

**Methods:** This prospective mixed-methods study included longitudinal semi-structured interviews from prenatal to postpartum periods, among pregnant people treated with medication for OUD (MOUD) and their providers (nurses, obstetricians, anesthesiologists). Quantitative measures included questions on pain attitudes and beliefs. Qualitative interviews were transcribed from recordings and independently coded and analyzed for major themes using an iterative process of content analysis. The final coding scheme was used to recode all of the transcripts to ensure consistency. A coding diary was kept to identify when thematic saturation had been met. Quantitative data were analyzed using descriptive statistics with comparisons by Fisher Exact test. All data analyses were completed using ATLAS.ti and Stata SE 17; a  $P < 0.05$  defined statistical significance.

**Results:** A total of 33 participants (18 patients, 15 providers) were interviewed and gave complete survey results. Ten of 18 (55.6%) had buprenorphine monotherapy. Five major themes emerged on patient perspectives on labor pain: 1) OUD limits analgesia options and ability to achieve adequate pain control; 2) System and healthcare-based barriers prohibit patients from receiving adequate pain relief; 3) Multimodal and non-pharmacological methods, can potentially be effective; 4) Patients are determined to limit opioid-use during pregnancy, labor, and the postpartum period; and 5) There is limited patient satisfaction associated with neuraxial blocks. Four major themes emerged on provider perspectives: 1) There is confusion about how to plan for and make perinatal adjustments to MOUD; 2) There is a need for improved interdisciplinary provider collaboration; 3) Motivation and education can increase the effectiveness of non-pharmacological methods; and 4) Unique challenges in pain management exist in patients with OUD. Quantitative results are summarized in Table 1.

**Conclusions:** Patients and providers alike identify the importance of pain management for pregnant patients with OUD. Non-pharmacologic options require study. System improvements must expand interdisciplinary prenatal consultation for pain management to reduce stigma, provide information, eliminate fears and misunderstandings, and create individualized pain management plans prior to labor and delivery. These improvements can be evaluated in future studies focused on improved analgesia and reduced risk for return to opioid use.

[Dayananda QUEST Table 1 Quantitative Survey Results.pdf](#)

## Obstetric pain management for women with opioid use disorder: A longitudinal, Qualitative mixed-methods Evaluation of patientS and provider perspec Tives (QUEST)

Sanjana Dayananda BS<sup>1</sup>, Emma Nowakowski BS<sup>1</sup>, Olivia Jarvis BA<sup>1</sup>, Valeria Altamirano MS<sup>1</sup>, Kelsea R. Lasorda MPH<sup>1</sup>, Elizabeth Krans MD Msc<sup>2</sup>, Grace Lim MD Msc<sup>1,2,3</sup>

<sup>1</sup>Department Of Anesthesiology And Perioperative Medicine, University Of Pittsburgh School Of Medicine  
<sup>2</sup>Department Of Obstetrics, Gynecology & Reproductive Sciences, University Of Pittsburgh School Of Medicine  
<sup>3</sup>Center For Innovation In Pain Care, University Of Pittsburgh



## BACKGROUND and METHODS

- Patients with opioid use disorder (OUD) often have inadequate pain management due to hyperalgesia and a fear of relapse that is associated with opioid analgesia exposure<sup>1</sup>.
- Poorly treated pain can also trigger treatment noncompliance and relapse. Women are particularly susceptible to suboptimal therapies during pregnancy and lactation<sup>2</sup>.
- We conducted qualitative, semi-structured interviews with 18 pregnant people treated with medication for OUD (MOUD) and 12 providers (nurses, obstetricians, and anesthesiologists).
  - Thematic saturation was reached during the 12<sup>th</sup> patient interview and the 6<sup>th</sup> provider interview.
- We also collected surveys from these patients addressing their pain attitudes and beliefs.



Wachholtz et al, 2015 and Raymond et al, 2018

### Pain Attitudes and Beliefs amongst Patients with OUD and their Providers

	Patient N= 18	Providers N= 15	Total N= 33	P-value
<b>Obstetric patients with OUD who are taking buprenorphine or methadone experience worse pain than patients without OUD no./total no. (%)</b>				
Agree	2/18 (11.1)	10/15 (66.7)	12/33 (36.4)	<b>0.003*</b>
Neither agree nor disagree	9/18 (50.0)	3/15 (20.0)	12/33 (36.4)	
Disagree	7/18 (38.9)	2/15 (13.3)	9/33 (27.3)	
<b>For obstetric patients with OUD, good options for labor pain management strategies include: no./total no. (%)</b>				
Epidural	16/18 (88.9)	15/15 (100)	31/33 (93.9)	0.11
Parenteral opioids	4/18 (22.2)	7/15 (46.7)	11/33 (33.3)	0.14
Parenteral non-opioid analgesia	3/18 (16.7)	10/15 (66.7)	13/33 (39.4)	<b>0.003*</b>
Nitrous oxide	2/18 (11.1)	7/15 (46.7)	9/33 (27.3)	<b>0.02*</b>
Complementary and alternative medicine	7/18 (38.9)	11/15 (73.3)	18/33 (54.6)	<b>0.05*</b>



"I have a discussion and shared decision-making process to determine whether or not a woman would like to use opioids for the acute management of pain. And also a separate discussion of whether or not she wants to continue on her opioid maintenance therapy."

"My husband literally had to scream at the top of his lungs in the delivery room for them to understand what I was trying to tell them - I'm in pain, I can feel it."

System, their willingness, and where they are in their motivation scale."



Key Steps to Improving Obstetric pain management in Pregnant women with OUD

 Providers advocate for early, interdisciplinary, prenatal consultations with these patients

 Patients are interested in non-pharmacological options but they require counseling and education

 We need to reduce stigma, increase multidisciplinary research, and work toward evidence-based guidelines on this topic

**Check out the full abstract, tables, and more data!**



This project was funded in part by the UPSOM Department of Anesthesiology & Perioperative Medicine, the NIH Building Interdisciplinary Research Careers in Women's Health (K12HD043441) and the NIH CRISP Grant (UL1TR001857).



## References

1. Psychophysiology of pain and opioid use: implications for managing pain in patients with an opioid use disorder. *146*, 1-6 (2015).
2. The opioid epidemic and pregnancy. *31*, 243-250 (2018).



Abstract #: FRI-OP - 03

## Need of packed red blood transfusion before and after the inclusion of intraoperative continuous non-invasive hemoglobin monitoring technology in a real-life setting in a developing country

**Presenting Author:** YULIANA OLIVERO, Anesthesiologist

**Presenting Author's Institution:** General Hospital of Mexico - Mexico City, Distrito Federal

**Co-Authors:** Paulina Gonzalez, Anesthesiologist - General Hospital of Mexico

Raigam Martinez, MFM - National Institute of Perinatology

Rocio Reyes, Anesthesiologist - General Hospital of Mexico

Johnatan Torres, MMF - National Institute of perinatology

### Introduction

The use of intraoperative continuous non-invasive hemoglobin monitoring (ICNHM) has demonstrated its effectiveness in reducing the need of packed red blood transfusion in developed countries. The objective of this study is to compare the need for transfusion of packed red blood and other blood products before and after the inclusion of ICNHM technology in a real-life setting in a developing country.

### Methods

This is a retrospective cohort of pregnant women presenting with obstetric hemorrhage between 2013 and 2020. Groups were divided by the use of ICNHM (Radical-7 pulse CO-oximeter [Masimo Corp, USA]) which started in 2015, meaning that all women before 2015 did not have ICNHM available. Descriptive and inferential statistics were used. The number of obstetric hemorrhages packed red blood cells, platelet concentrates, cryoprecipitates, and fresh frozen plasma were analyzed by year using a quadratic fit analysis.

### Results

A total of 1,479 pregnant women presented with obstetric hemorrhage during the study period, 399 (27%) before 2015 and 1,080 (73%) after 2015 and therefore after the use of ICNHM. There was no significant difference on the median number of cases before and after the use of ICNHM (Figure 1). However, there was a significant difference on the median number of packed red blood cells used (317 vs 95;  $p=0.004$ ), fresh frozen plasma (136 vs. 23;  $p=0.002$ ), platelet concentrates (62 vs. 13;  $p=0.026$ ), and cryoprecipitates (47 vs. 9;  $p=0.001$ ) used after initialization of ICNHM technology.

### Conclusions

In a real-life setting in a developing country, the introduction of ICNHM does not reduce the number of obstetric hemorrhages but significantly decreases the requirement of packed red blood, fresh frozen plasma, platelet concentrates, and cryoprecipitates transfusion.

[Grafica abstarc.pdf](#)

Abstract #: FRI-OP - 04

## Multimodal Analgesia Use After Cesarean Delivery Under General Anesthesia

Presenting Author: Nicole C. Zanolli, BA

Presenting Author's Institution: Duke University School of Medicine - Wauwatosa, Wisconsin

**Background:** Optimizing analgesia following cesarean delivery is essential to quality of patient recovery. The American Society of Anesthesiologists and the Society for Obstetric Anesthesia and Perinatology recommend multimodal analgesic (MMA) regimens. However, little is known about the clinical implementation of these guidelines in the setting of cesarean deliveries under general anesthesia (GA). The objectives of this study were to describe the use of MMA regimens following cesarean delivery under GA in the United States, and determine factors associated with the use of MMA, variation in analgesia practice across hospitals, as well as trends in MMA use over time.

**Methods:** A retrospective cohort study of all women over the age of 18 who had a cesarean delivery under GA between 2008 and 2018 was conducted using the Premier Healthcare database (Premier Inc., USA). Optimal MMA was defined as receipt of a non-steroidal anti-inflammatory drug, acetaminophen, and opioids during hospitalization. Any use of these agents within a combination drug preparation was not considered optimal MMA. We also examined use of additional local anesthesia and neuraxial techniques. Mixed-effects logistic regression models were used to examine the association of demographic, clinical, and hospital characteristics, as well as treatment year, with the use of the optimal MMA regimen.

**Results:** 130,946 patients were included in analysis. The average age at time of delivery was 28 years and the majority of the patients were White (57.9%) and non-Hispanic (55.1%). The optimal MMA regimen was used in 11,133 patients (8.5%). Use of optimal MMA increased over the duration of the study, from 2.0% in 2008 to 18.8% in 2018. A local anesthetic technique such as a truncal block or local anesthetic infiltration was used in addition to the optimal MMA regimen in 2,122 patients (1.6%) and neuraxial anesthesia was documented in 5,296 (4.0%). The association of patient and hospital characteristics with receipt of optimal MMA is listed in Table 1. Black race and Hispanic ethnicity were associated with less receipt of optimal MMA compared to White and non-Hispanic patients. Medical co-morbidities were generally not associated with receipt of optimal MMA, though patients with preeclampsia were less likely to receive optimal MMA, while those with drug abuse were more likely to receive optimal MMA. There was moderate variation in the use of optimal MMA across individual hospitals (Intraclass correlation=0.38).

**Conclusions:** Variation in optimal MMA utilization was observed following cesarean delivery under GA in the United States. Racial and ethnic disparities in receipt of optimal MMA need attention and highlight the importance of provider awareness of implicit bias. While increasing trends in optimal MMA are encouraging, the low overall percentage of patients receiving optimal MMA highlights the need for improved postoperative analgesia practices in women receiving GA for cesarean delivery.

[Multimodal Analgesia Use After Cesarean Delivery Under General Anesthesia Table 1 .pdf](#)

# Multimodal Analgesia Use After Cesarean Delivery Under General Anesthesia



Nicole C. Zanolli, BA, Matthew E. Fuller, MS, Vijay Krishnamoorthy, MD, Tetsu Ohnuma, MD, MPH, Karthik Raghunathan, MD, Ashraf Habib, MBBCh, MSc, MHSc, FRCA



## Background

- Multimodal analgesia (MMA) regimens recommended
- Optimal regimen following cesarean delivery (CD) under general anesthesia (GA):
  - NSAIDs + Acetaminophen + Opioids +/- Local anesthetic techniques
- No data about use of MMA following CD under GA in the USA

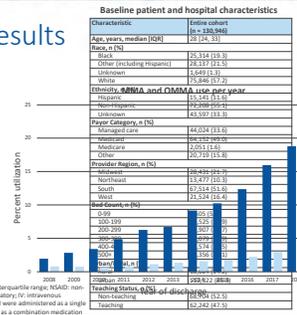
## Objectives

- Describe the use of analgesic regimens following cesarean deliveries under GA in the USA
- Determine associated factors and trends in the use of MMA

## Methods

- Retrospective cohort study using the Premier Healthcare database
  - Women  $\geq 18$  years old
  - Cesarean delivery under GA
    - GA: presence of a charge code for rocuronium, succinylcholine and/or inhaled agents
  - 2008-2018
- MMA was defined as receipt of an NSAID, acetaminophen and opioid drug
- Optimal MMA (OMMA) was defined as receipt MMA and use of a local anesthetic technique
  - Charge code for TAP block or OnQ pump, or charges for liposomal bupivacaine, bupivacaine or ropivacaine
- Mixed-effects logistic regression models
  - Examine associations with demographic, clinical, and hospital characteristics, as well as treatment year

## Results



## Strengths and Limitations

- Large national database
- Administrative-financial database rather than electronic health record-based
  - No indication for medications given
  - Hard to identify dosing schemes

## Conclusions

- Overall low use of MMA and OMMA regimens, increasing trends
- Racial and ethnic disparities exist in receipt of MMA

## Trends in use of multimodal analgesic (MMA) regimens following cesarean delivery under general anesthesia

MMA and OMMA are used infrequently



8.5% MMA use  
1.6% OMMA use

MMA and OMMA use is steadily increasing



MMA = 2% → 18%  
OMMA = 0.8% → 4.1%  
(percent per year: 2008 vs 2018)

Racial and ethnic disparities exist



Black and Hispanic patients are less likely to receive MMA or OMMA

MMA: NSAID + acetaminophen + opioid  
Optimal MMA (OMMA): MMA + local anesthesia



Zanolli et al. *Society for Obstetric Anesthesia and Perinatology Annual Meeting, May 2023*



Abstract #: FRI-OP-05

## Is there an association of labor neuraxial analgesia with autism spectrum disorder in children? A systematic review and meta-analysis

**Presenting Author:** Mario I. Lumbreras-Marquez, MBBS, MMSc

**Presenting Author's Institution:** Department of Anesthesiology, Perioperative and Pain Medicine, Brigham & Women's Hospital, Harvard Medical School, Boston, Massachusetts, United States - Boston, Massachusetts

**Co-Authors:** Alexander J. Butwick, MBBS, FRCA, MS - Stanford University

Melissa Campos-Zamora, MBBS, MMSc - Postgraduate Medical Education, Harvard Medical School, Boston, Massachusetts, United States

Gabriela Capdeville, MBBS - Escuela de Medicina, Universidad Panamericana, Mexico City, Mexico

Michaela K. Farber, MD, MS - Department of Anesthesiology, Perioperative and Pain Medicine, Brigham & Women's Hospital, Harvard Medical School, Boston, Massachusetts, United States

Ana Ferrigno, MBBS - Escuela de Medicina y Ciencias de la Salud, Tecnológico de Monterrey, Monterrey, México

Diego Villela-Franyutti, MD - Department of Anesthesiology, Perioperative and Pain Medicine, Brigham & Women's Hospital, Harvard Medical School, Boston, Massachusetts, United States

### Background

A systematic review of studies published up to December 16, 2021, was conducted to determine if neuraxial labor analgesia (NLA) exposure during pregnancy is associated with a higher risk of autism spectrum disorder (ASD) in children compared to no NLA exposure [1].

### Methods

PubMed, Embase, Web of Science, and Google Scholar were systematically searched (PROSPERO registration number CRD4202229786). Bibliographies of relevant articles were examined for additional articles. Findings from observational studies examining the risk of ASD in patients exposed vs. non-exposed to NLA were included in the analysis. Two authors independently assessed the identified studies for eligibility and extracted data in duplicate. Study bias was evaluated using the Risk Of Bias In Non-randomized Studies – of Interventions (ROBINS-I) tool. The quality of evidence was appraised according to Grading of Recommendations, Assessment, Development and Evaluations (GRADE) criteria. Random-effects models were performed using the inverse-variance method to calculate pooled effect sizes. We estimated corresponding prediction intervals (PIs) and used the Hartung-Knapp method to adjust test statistics and confidence intervals (CIs). Additional sensitivity analyses were performed for (i) studies with a low or moderate risk of bias and (ii) studies that reported sibling and within-mother analyses, which account for familial confounding [2].

### Results

Data from 6 observational studies were included in our analysis, in which 1,475,505 individuals were exposed to NLA and 1,895,528 were non-exposed individuals. Very low-certainty evidence showed a statistically significant but modest increased risk of ASD in children of individuals exposed to NLA compared to non-exposed individuals (adjusted hazard ratio [aHR] 1.12; 95% CI: 1.01, 1.23;  $P = 73\%$ ; PI: 0.88, 1.41). There were no studies at low risk of bias. In all sensitivity analyses, there was no statistically significant difference in the offspring risk of ASD between exposed vs non-exposed women (studies with a moderate risk of bias [aHR 1.06; 95% CI: 0.90, 1.24;  $P = 0\%$ ]; the sibling analyses [aHR 1.07; 95% CI: 0.93, 1.23;  $P = 0\%$ ; PI: 0.71, 1.61]; the within-mother analyses [aHR 1.06; 95% CI 0.94, 1.19;  $P = 0\%$ ]).

### Conclusion

In this systematic review, compared to non-exposed individuals, offspring of individuals exposed to NLA had a modestly higher risk of ASD. However, the certainty of current evidence is very low. Moreover, this association was not observed among studies with a low-to-moderate risk of bias and in studies that accounted for familial factors. These findings suggest that residual confounding and bias may explain the weak association observed in our main analysis. The combined evidence from published studies should provide reassurance to patients and providers that there is no meaningful increased risk of ASD associated with NLA. [FOREST PLOT.pdf](#)

**Brigham and Women's Hospital**  
Founding Member, Mass General Brigham

**HARVARD MEDICAL SCHOOL**

## Is there an association of labor epidural analgesia with autism spectrum disorder in children? A systematic review and meta-analysis

Mario I. Lumbreras-Marquez MBBS, MMSc; Gabriela Capdeville, MBBS; Ana S. Ferrigno-Guajardo, MBBS; Diego Villela-Franyutti, MBBS; Paul A. Bain, PhD; Melissa Campos-Zamora, MBBS, MMSc; Alexander J. Butwick, MBBS, FRCA, MS; Michaela K. Farber, MD, MS

**Background**

- Labor epidural analgesia (LEA) is used by 73% of US pregnant individuals
- Previous reports regarding autism spectrum disorder (ASD) risk in offspring after maternal LEA exposure have yielded conflicting results

**Objective**

- To conduct a systematic review and meta-analysis to assess the presence and magnitude of a potential association between LEA exposure and ASD risk in offspring

Issue 2022:05:149-154 | DOI: 10.1097/ASA.0000000000000334

**SOAP 2022 ANNUAL MEETING**

Maternal and Neonatal Healthcare Inequities:  
How We Can Do Better for Our Patients

**SOAP 2022**  
Society for Obstetric Anesthesia and Perinatology

**Methods**

- PubMed, Embase, Web of Science Core Collection, and Google Scholar were systematically searched (PROSPERO: CRD4202229786)
- Observational studies of pregnant individuals exposed and non-exposed to LEA that reported ASD in children were included in the analysis
- Included studies were assessed for risk of bias using the ROBINS-I tool
- Quality of evidence was appraised using GRADE
- Random-effects models were performed using the inverse-variance method to calculate pooled effect sizes

Issue 2022:05:149-154 | DOI: 10.1097/ASA.0000000000000334

**SOAP 2022 ANNUAL MEETING**

Maternal and Neonatal Healthcare Inequities:  
How We Can Do Better for Our Patients

**SOAP 2022**  
Society for Obstetric Anesthesia and Perinatology

**Results**

- 1,475,505 offspring were exposed to LEA and 1,895,528 were not exposed
- Very low-certainty evidence showed a statistically significant but modest increased risk of ASD in offspring after maternal exposure to LEA compared to non-exposed offspring

Study	TE	SE	Weight	Hazard Ratio IV, Random, 95% CI
Qiu 2020	0.31	0.0557	14.0%	1.37 [1.23; 1.53]
Wall-Wiesler 2021	0.08	0.0543	14.2%	1.08 [0.97; 1.20]
Mikkelsen 2021	0.05	0.0318	18.2%	1.05 [0.99; 1.12]
Hanley 2021	0.09	0.0357	17.5%	1.09 [1.02; 1.17]
Ren 2021	0.10	0.0322	18.1%	1.11 [1.04; 1.18]
Straub 2021	0.07	0.0334	17.9%	1.07 [1.00; 1.14]
<b>Total (95% CI)</b>			<b>100.0%</b>	<b>1.12 [1.01; 1.23]</b>
<b>Prediction Interval</b>				<b>[0.88; 1.41]</b>

Heterogeneity: Tau<sup>2</sup> = 0.0059; Chi<sup>2</sup> = 18.62, df = 5 (P < 0.01); I<sup>2</sup> = 73%

**SOAP 2022 ANNUAL MEETING**

Maternal and Neonatal Healthcare Inequities:  
How We Can Do Better for Our Patients

**SOAP 2022**  
Society for Obstetric Anesthesia and Perinatology

**Results**

- In all sensitivity analyses, there was no significant difference in ASD risk between LEA exposed vs. non-exposed offspring

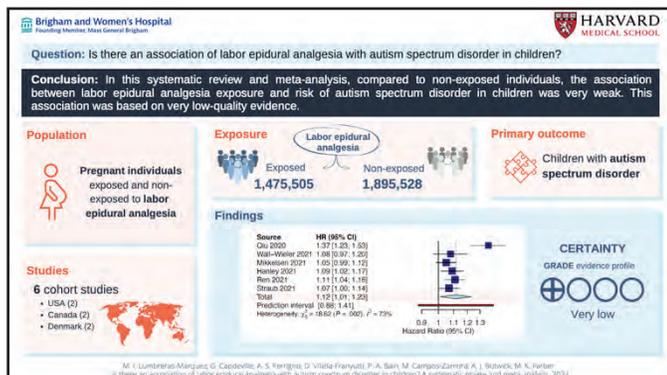
Studies with a moderate risk of bias

Study	TE	SE	Weight	Hazard Ratio IV, Random, 95% CI
Wall-Wiesler 2021	0.08	0.0543	25.5%	1.08 [0.97; 1.20]
Mikkelsen 2021	0.05	0.0318	74.5%	1.05 [0.99; 1.12]
<b>Total (95% CI)</b>			<b>100.0%</b>	<b>1.06 [0.99; 1.24]</b>

Heterogeneity: Tau<sup>2</sup> = 0; Chi<sup>2</sup> = 0.20, df = 1 (P = 0.65); I<sup>2</sup> = 0%

Study	TE	SE	Weight	Hazard Ratio IV, Random, 95% CI
Wall-Wiesler 2021	-0.03	0.1141	17.6%	0.97 [0.78; 1.21]
Ren 2021	0.03	0.1055	20.6%	1.03 [0.84; 1.27]
Mikkelsen 2021	0.05	0.0755	40.1%	1.05 [0.91; 1.22]
Hanley 2021	0.07	0.1025	21.8%	1.07 [0.88; 1.31]
<b>Total (95% CI)</b>			<b>100.0%</b>	<b>1.04 [0.98; 1.10]</b>

**Prediction Interval** [0.95; 1.12]  
Heterogeneity: Tau<sup>2</sup> = 0; Chi<sup>2</sup> = 0.47, df = 3 (P = 0.93); I<sup>2</sup> = 0%





Management of Common Cardiac Disorders on L&D

Marie-Louise Meng, MD  
 Duke University Medical Center, Durham, North Carolina  
 Assistant Professor of Anesthesiology  
 Division of Women's Anesthesia  
 Division of Cardiothoracic Anesthesia

SOAP 2022  
ANNUAL MEETING

No financial relationships with commercial interests

Foundation for Anesthesia Education and Research  
(Mentored Research Training Grant)

Duke-UNC-Chapel Hill CTSA Consortium Collaborative  
(Translational Research Pilot Grants)



SOAP 2022  
ANNUAL MEETING

Outline

- Physiologic changes
- Peripartum planning
- Uncommon stuff

Outline

- Physiologic changes
- Peripartum planning
- Uncommon stuff

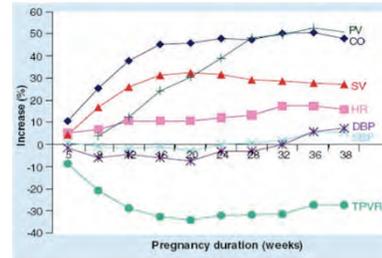
## Outline

Physiologic changes

Peripartum planning

Uncommon stuff

## Hemodynamic changes in pregnancy



## Cardiac output changes in labor and delivery

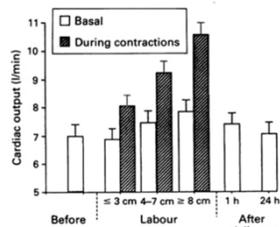


Figure 2 Changes in cardiac output and stroke volume during normal labour.

Hunter S, Robson SC. Adaptation of the maternal heart in pregnancy. Br Heart J. 1992;68(6):540-543.

## Physiologic challenges in labor and delivery

PAIN  
ANXIETY  
CATECHOLAMINES  
CONTRACTIONS  
AUTO TRANSFUSION



RELIEF OF AORTO-CAVAL COMPRESSION  
BLEEDING  
INCREASED OXYGEN CONSUMPTION

Eikayam et al. JACC VOL. 68, NO. 4 and 5, 2016

## Physiologic challenges in labor and delivery

**Blood Pressure = Cardiac Output \* Systemic Vascular Resistance**

Cardiac Output = Heart Rate \* Stroke Volume  
 Systemic Vascular Resistance = Afterload & RBC viscosity

Heart Rate is influenced by Rate & Rhythm.  
 Stroke Volume is influenced by Contractility & Preload.

**ISSUES:**

- ↑ Catecholamines → ↑ Tachycardia & arrhythmias
- ↓ Systemic vascular resistance → ↓ Coronary perfusion = A<sub>0</sub>D - LVEDP
- ↑ Cardiac output (preload changes) → ↑ Heart failure
- ↑ Pulmonary blood flow + ↓ Pulmonary vascular resistance → ↑ Pulmonary pressure
- ↓ Oncotic pressure → ↑ Pulmonary edema

**PLAN:**

- Avoid sudden alterations in heart rate & rhythm → neuraxial anesthesia for pain control
- Control sudden decreases in afterload (SVR) → vasopressors
- Support the myocardium → inotropes
- Maintain preload (control sudden changes in blood volume) → diuresis and pulmonary vasodilators

In summary, "GO SLOW she's surviving right now, don't change much if you can help it" -Richard Smiley, MD, PhD

## Heart failure warning signs

Condition (n)	Delayed response to clinical warning signs (%)	Ineffective care (%)
Cardiovascular disease (n=20)	~45	~55
Preeclampsia (n=36)	~35	~65
Obstetric hemorrhage (n=20)	~40	~60
Venous thromboembolism (n=20)	~30	~70
Amniotic fluid embolism (n=18)	~25	~75

- Change in maternal symptoms
- Tachycardia
- Arrhythmia
- Hypotension
- Hypoxia (new O<sub>2</sub> requirement)
- Decreased urine output
- Decompensation of fetal tracing

\* Delayed response to clinical warning signs  
 \* Ineffective care  
 \* Misdiagnosis  
 \* Lack of continuity of care  
 \* Failure to consult

Physiology-related deaths due to healthcare provider factors

Main EK et al. Obstet Gynecol. 2015; 125:938-47

## Steps of Peripartum Planning

SOAP 2019 MATERNAL CARDIAC DISEASE: A FRAMEWORK FOR PLANNING CARE

Who

What

When

Where

How

## Steps of Peripartum Planning

SOAP 2019 MATERNAL CARDIAC DISEASE: A FRAMEWORK FOR PLANNING CARE

Who

What

When

Where

How

Steps of Peripartum Planning

- Who
- What
- When
- Where
- How

Steps of Peripartum Planning

- Who
- What
- When
- Where
- How

Steps of Peripartum Planning

- Who
- What
- When
- Where
- How

Steps of Peripartum Planning

- Who
- What
- When
- Where
- How

## Steps of Peripartum Planning



Who    What    When    Where    How

## Who: Patient

### Lesion

- Type
- Severity
- Current condition

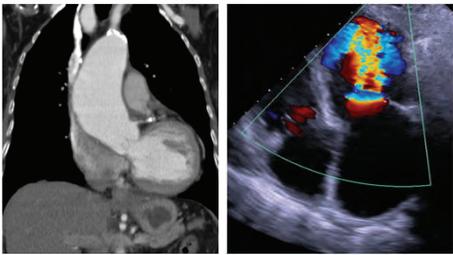
1. Valvular
2. Shunt
3. Arrhythmias
4. Complex congenital
5. Myocardial dysfunction
6. Vascular/Aortopathy

Who    What    When    Where    How

## Who: Patient

### Lesion

- Type
- Severity
- Current condition



Who    What    When    Where    How

## Who: Patient

### Lesion

- Type
- Severity
- Current condition



Who    What    When    Where    How

**Who: Patient**

**Lesion**

- Type
- Severity
- Current condition

Who    What    When    Where    How

**Who: Patient**

- BNP is mildly elevated in normal pregnancy
- Maternal cardiac events have been associated with **high BNP concentrations** (>100 pg/mL)
- Negative predictive value** of NT-pro-BNP <128 pg/mL at 20 weeks gestation exceeded 95%

International Journal of Cardiology, Volume 228, 2017, 749-753. J Am Coll Cardiol. 2010 Oct 5;56(15):1247-53. European Heart Journal, Volume 35, Issue 11, 14 2014, 708-715

Who    What    When    Where    How

**Who: Patient**

**Focus Assessed Transthoracic Echo (FATE)**  
 Splitting through umbilicus is a 100% successful technique

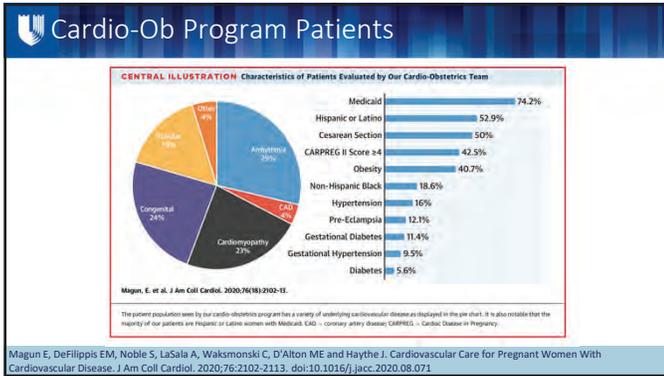
**Basic FATE views**

Dennis. International Journal of Obstetric Anesthesia (2011) 20, 160-168, Dennis et al. Anesth Analg. 2012 Nov;115(5):1033-7.

Who    What    When    Where    How

**Other medical history**

Who    What    When    Where    How



### Who: Patient

#### Risk stratification

- mWHO
- CARPREG II
- ROPAC 2019

ESC guidelines on the management of cardiovascular diseases during pregnancy. *Eur Heart J* 2011;32:3147-97.

	WHO-1	WHO-2	WHO-3	WHO-4	WHO-5
Diagnosis	<ul style="list-style-type: none"> <li>Uncomplicated aortic valve (AV) disease and bicuspid aortic valve (BAV)</li> <li>Uncomplicated mitral regurgitation (MR)</li> <li>MR, NYD, NYA and non-rheumatic NYD</li> </ul>	<ul style="list-style-type: none"> <li>Aortic stenosis (AS) and aortic regurgitation (AR)</li> <li>Dissecting aortic aneurysm (AAA)</li> <li>Dissecting aortic aneurysm (AAA) with aortic regurgitation (AR)</li> <li>Dissecting aortic aneurysm (AAA) with aortic regurgitation (AR) and aortic dissection (AD)</li> </ul>	<ul style="list-style-type: none"> <li>Dissecting aortic aneurysm (AAA) with aortic regurgitation (AR) and aortic dissection (AD)</li> <li>Dissecting aortic aneurysm (AAA) with aortic regurgitation (AR) and aortic dissection (AD) and aortic regurgitation (AR)</li> <li>Dissecting aortic aneurysm (AAA) with aortic regurgitation (AR) and aortic dissection (AD) and aortic regurgitation (AR) and aortic dissection (AD)</li> </ul>	<ul style="list-style-type: none"> <li>Dissecting aortic aneurysm (AAA) with aortic regurgitation (AR) and aortic dissection (AD) and aortic regurgitation (AR) and aortic dissection (AD) and aortic regurgitation (AR) and aortic dissection (AD)</li> <li>Dissecting aortic aneurysm (AAA) with aortic regurgitation (AR) and aortic dissection (AD) and aortic regurgitation (AR) and aortic dissection (AD) and aortic regurgitation (AR) and aortic dissection (AD)</li> </ul>	<ul style="list-style-type: none"> <li>Dissecting aortic aneurysm (AAA) with aortic regurgitation (AR) and aortic dissection (AD) and aortic regurgitation (AR) and aortic dissection (AD) and aortic regurgitation (AR) and aortic dissection (AD) and aortic regurgitation (AR) and aortic dissection (AD)</li> <li>Dissecting aortic aneurysm (AAA) with aortic regurgitation (AR) and aortic dissection (AD) and aortic regurgitation (AR) and aortic dissection (AD) and aortic regurgitation (AR) and aortic dissection (AD) and aortic regurgitation (AR) and aortic dissection (AD)</li> </ul>
Risk	Low	Small	Intermediate	High	Extremely high
Management	Conservative	Conservative	Conservative	Conservative	Conservative
Case during pregnancy	Local hospital	Local hospital	Regional hospital	Expert centre for pregnancy and cardiac disease	Expert centre for pregnancy and cardiac disease
Location of delivery	Local hospital	Local hospital	Regional hospital	Expert centre for pregnancy and cardiac disease	Expert centre for pregnancy and cardiac disease

### Who: Patient

#### Risk stratification

- mWHO
- CARPREG II
- ROPAC 2019

Prospective database of 1,938 pregnancies in women with heart disease

- Toronto (1994) and Vancouver (2005)
- Examine **cardiac complications** during pregnancy and **temporal trends**
- Identify **predictors** of cardiac complications → **new risk index**

Silversides, C et al. "Pregnancy Outcomes in Women with Heart Disease: The CARPREG II Study". *Journal of the American College of Cardiology.* Vol 71, No 21, 2018.

### Who: Patient

#### Risk stratification

- mWHO
- CARPREG II
- ROPAC 2019

**ANY CARDIAC EVENT: 15.8%**

**MOST COMMON CARDIAC EVENTS: ARRHYTHMIAS – 9.3% HEART FAILURE – 6.2%**

Silversides, C et al. "Pregnancy Outcomes in Women with Heart Disease: The CARPREG II Study". *Journal of the American College of Cardiology.* Vol 71, No 21, 2018.

Who: Patient

### Risk stratification

- mWHO
- CARPREG II
- ROPAC 2019

The x-axis shows the timing of presentation in women who develop arrhythmias (blue bars) or pulmonary edema (orange bars). The y-axis shows the total number of adverse events. HF = heart failure.

Silversides, C et al. "Pregnancy Outcomes in Women with Heart Disease: The CARPREG II Study". Journal of the American College of Cardiology. Vol 71, No 21, 2018.

Who | What | When | Where | How

Who: Patient

### Risk stratification

- mWHO
- CARPREG II
- ROPAC 2019

PRELATOR	WEIGHT
Prior cardiac death (myocardial infarction)	1
Baseline NYHA class (vs. cyanosis)	1
Mechanical valve	1
Ventricular dysfunction	2
High risk left-sided valve disease*	2
Left ventricular midline tract obstruction	2
Pulmonary hypertension	1
Coronary artery disease	2
High risk arrhythmia	2
No prior cardiac intervention	1
Late pregnancy assessment	1

The CARPREG II (Cardiac Disease in Pregnancy Study) II risk score is based on 10 predictors, shown in the box. Each predictor is assigned a weighted point score. The sum of points represents the risk score. Risk scores are categorized into the 5 groups (x-axis). The predicted (light blue) bars and the observed frequency of primary cardiac events in the derivation (medium blue) and validation (dark blue) groups are shown on the y-axis. HF = heart failure.

Silversides, C et al. "Pregnancy Outcomes in Women with Heart Disease: The CARPREG II Study". Journal of the American College of Cardiology. Vol 71, No 21, 2018.

Who | What | When | Where | How

Who: Patient

### Risk stratification

- mWHO
- CARPREG II
- ROPAC 2019

Prospective cohort: January 2007 - January 2018  
5739 pregnancies (all lesions)

- 138 centers, 53 countries

Primary outcome:

- Maternal mortality or heart failure
- 1-week post-partum

Roos-Hesselink et al. Pregnancy outcomes in women with cardiovascular disease: evolving trends over 10 years in the ESC Registry Of Pregnancy And Cardiac disease (ROPAC). European Heart Journal (2019) 00, 1-8

Who | What | When | Where | How

Who: Patient

### Risk stratification

- mWHO
- CARPREG II
- ROPAC 2019

Pre-pregnancy risk factors:  
Clinical signs of heart failure  
NYHA class ≥ II  
Systemic ventricular ejection fraction < 40%  
mitral regurgitation  
Aortic regurgitation

Roos-Hesselink et al. Pregnancy outcomes in women with cardiovascular disease: evolving trends over 10 years in the ESC Registry Of Pregnancy And Cardiac disease (ROPAC). European Heart Journal (2019) 00, 1-8

Who | What | When | Where | How

## Who: Patient

### Risk stratification

- mWHO
- CARPREG II
- ROPAC 2019

Ross-Hesselink et al. Pregnancy outcomes in women with cardiovascular disease: evolving trends over 10 years in the ESC Registry Of Pregnancy And Cardiac disease (ROPAC). European Heart Journal (2019) 00, 1-8

WHO Category	Number of patients with heart failure (%)
WHO 1-2	1
WHO 3-4	1
WHO 5-6	1
WHO 7-8	1
WHO 9-10	1
WHO 11-14	1
WHO 15-18	1
WHO 19-22	1
WHO 23-26	1
WHO 27-30	1
WHO 31-34	1
WHO 35-38	1
WHO 39-42	1
WHO 43-46	1
WHO 47-50	1
WHO 51-54	1
WHO 55-58	1
WHO 59-62	1
WHO 63-66	1
WHO 67-70	1
WHO 71-74	1
WHO 75-78	1
WHO 79-82	1
WHO 83-86	1
WHO 87-90	1
WHO 91-94	1
WHO 95-98	1
WHO 99-100	1

Who What When Where How

## Who: Pregnancy Heart Team

- Obstetrician/Maternal Fetal Medicine
- Anesthesiologist (Obstetric and Cardiothoracic)
- Cardiologist
- Neonatologist
- Hematologist
- Cardiothoracic surgeon
- ECMO surgeon
- Perfusionist
- Intensivist
- Critical Care Obstetric Nurse
- Critical Care Nurse

Who What When Where How

## Cardio-Ob Program

**FIGURE 3 Triggers for Referral to Cardio-Obstetrics Program**

- Pre-conception counseling with known cardiovascular disease
- Pregnancy with suspected or known cardiovascular disease

Patients with known cardiovascular disease should be referred to cardio-obstetrics for pre-conception counseling, as well as in cases of known pregnancy with suspected or known cardiovascular disease. Referrals can be initiated by obstetricians, primary care providers, cardiologists, and emergency room physicians. MFM = maternal fetal medicine, NT-proBNP = N-terminal pro-B-type natriuretic peptide.

Magnin E, DeFilippis EM, Noble S, LaSala A, Wakomonski C, D'Alton ME and Haythe J. Cardiovascular Care for Pregnant Women With Cardiovascular Disease. J Am Coll Cardiol. 2020;76:2102-2113. doi:10.1016/j.jacc.2020.08.071

Who What When Where How

## What

Who What When Where How

## What: Valsalva maneuver

Phase	Action	Blood pressure	Pulse rate	Mechanism
I	Onset of straining	Increases	Stable	Increased intrathoracic pressure
II	Continued straining	Decreases	Increases	Decreased venous return resulting in decreased pulse pressure and stroke volume
III	Release of straining	Decreases	Stable	Returns of blood to equilibrium; vascular bed due to abrupt decrease in intrathoracic pressure
IV	Continued release	Increases	Decreases	Increase in sympathetic activity and increase in venous return. Reflex increase in vagal drive

	No Valsalva* (n=45)	Valsalva (n=17)	P-value
Duration and stage (min)	60 (22, 144) <sup>†</sup>	21 (8, 120)	0.079
Chlamsis rate (%)	0	1 <sup>‡</sup>	0.605
3rd or 4th laceration	7	0	0.027
Cesarean delivery	0	1	0.680
Pink putium hemorrhage	9	0	0.017

\* Women who did not use Valsalva had planned assisted deliveries.  
<sup>†</sup> Median (interquartile range).  
<sup>‡</sup> Median (interquartile range).

Nishimura RA, Tajik AJ. Mayo Clin Proc 1986. 61: 211-217. Int J Cardiol 144 (2010) 195-199

Who | What | When | Where | How

## What: Vaginal delivery plan

- Mode of Delivery
  - VD usually preferred
- Pain relief
  - Early analgesia to minimize tachycardia & arrhythmias
- Manage Fluid Shifts
- Duration of Second Stage
  - Passive SS
  - Active SS (assist?)
- Third stage management
  - If no contraindication oxytocin as usual

Think you might be in labor?

- How a walk
- Beak scratching
- Go for a walk
- Take a warm shower or bath
- Take a nap

Nishimura RA, Tajik AJ. Mayo Clin Proc 1986. 61: 211-217. Int J Cardiol 144 (2010) 195-199

Who | What | When | Where | How

## What: Heart Disease is RARELY indication for CD

- Recent Warfarin
- Aortopathy
- Critical valvular stenosis
- Heart failure
  - Severe **decompensated** pulmonary HTN
  - Maternal or fetal decompensation

Surgical Pearls  
 Fast, bloodless surgery  
**\*\*NO UTERINE EXTERIORIZATION\*\***

Is a planned caesarean section in women with cardiac disease beneficial?

Table 3 Both maternal and fetal outcomes compared between patients in the planned vaginal delivery group and patients who had elective planned and performed caesarean section

	VA CS (n=342)	EM CS (n=442)	p Value
Perioperative (%)	8.2	4.9	0.54
Anticoagulant use (%)	75.3	71.0	0.213
Maternal mortality (%)	1.8	0.7	0.48
Fetal mortality (%)	7.1	6.9	0.91
Postpartum hemorrhage, severe (%)	4.1	5.6	0.17
Neonatal mortality (%)	5.8	6.7	0.88
Neonatal mortality (%)	0.3	0.7	1.00
Pregnancy duration (weeks)	37.1	36.7	0.268
Placenta previa (%)	27.4	29	0.201
Birth weight (g)	3280	3201	0.076
Birth weight (kg/m <sup>2</sup> ) <sup>*</sup>	3189	3165	0.21
Apgar score < 7 at 1 min (%)	13.5	11.3	0.26

\* Mean weight were converted to kg/m<sup>2</sup> by dividing age, height, weight, height.  
 † Median age, duration, and per centiles.  
 ‡ VA CS, planned and performed elective caesarean section; EM CS, planned vaginal delivery and performed emergency caesarean section; HE, heart failure.

Cauldwell et al. Int J Cardiol 222 (2016) 732-736.

Who | What | When | Where | How

## When

Who | What | When | Where | How

Where

### Type of medical center



Who    What    When    **Where**    How

Where

### Location within the medical center



Who    What    When    **Where**    How

Joe Wilder, MD

How

### Hemodynamic goals & Peripartum risks

Intrapartum care  
Postpartum care

Who    What    When    Where    **How**

How: Hemodynamic goals & Peripartum risks

$$\text{Blood Pressure} = \text{Cardiac Output} * \text{Systemic Vascular Resistance}$$

Heart Rate    Stroke Volume    Afterload & RBC Viscosity  
 ↓                    ↓                    ↓  
 Rate & Rhythm    Contractility & Preload

ISSUES:

- ↑ Catecholamines → ↑ Tachycardia & arrhythmias
- ↓ Systemic vascular resistance → ↓ Coronary perfusion = A<sub>o</sub>D - LVEDP
- ↑ Cardiac output (preload changes) → ↑ Heart failure
- ↑ Pulmonary blood flow + ↓ Pulmonary vascular resistance → ↑ Pulmonary pressure
- ↓ Oncotic pressure → ↑ Pulmonary edema

PLAN:

- Avoid sudden alterations in heart rate & rhythm → neuraxial anesthesia for pain control
- Control sudden decreases in afterload (SVR) → vasopressors
- Support the myocardium → inotropes
- Maintain preload (control sudden changes in blood volume) → diuresis and pulmonary vasodilators

In summary, "GO SLOW" she's surviving right now, don't change much if you can help it" -Richard Smiley, MD, PhD

Who    What    When    Where    **How**

How

### Intrapartum care

- Medications
- Anesthesia
- Monitoring/Access/ECMO
- Hemorrhage prevention/management

Vasopressors  
Inotropes  
Pulmonary vasodilators



Who    What    When    Where    How

How

### Intrapartum care

- Medications
- Anesthesia
- Monitoring/Access/ECMO
- Hemorrhage prevention/management

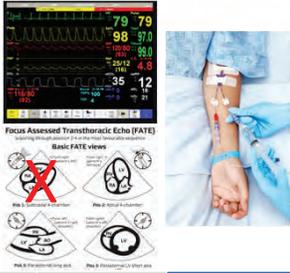
Neuraxial anesthesia  
Versus  
General anesthesia

Who    What    When    Where    How

How

### Intrapartum care

- Medications
- Anesthesia
- Monitoring/Access/ECMO
- Hemorrhage prevention/management



Who    What    When    Where    How

How

### Intrapartum care

- Medications
- Anesthesia
- Monitoring/Access/ECMO
- Hemorrhage prevention/management

Uterotonics

- Oxytocin
- Misoprostol
- Methylergonovine
- Carboprost

Compression suture  
Bakri Balloon

Who    What    When    Where    How

How

**Postpartum care**

- Recovery location
- Treatment goals

Who | What | When | Where | **How**

How

**Postpartum care**

- Recovery location
- Treatment goals

Diuresis  
Sodium restriction  
Stool softeners  
Anticoagulation

Who | What | When | Where | **How**

Steps of Peripartum Planning

- Who
- What
- When
- Where
- How

Pathways to VA ECMO: And when each is most appropriate

ECPR	ECMO Consult	VA ECMO Standby
(ECMO for cardiac arrest)	(Urgent VA or VV ECMO)	(Cardiac OR, perfusionist, Cardiohelp circuit on standby, micropunctures)
Dial XXX and explain you need ECMO deployment	Page XXX Page CT Anesthesia	Page XXX Page CT Anesthesia: XXX
<ul style="list-style-type: none"> <li>Cardiac Arrest</li> <li>No prior suspicion ECMO would be needed</li> </ul>	<ul style="list-style-type: none"> <li>Intraprocedural concern</li> </ul>	<ul style="list-style-type: none"> <li>Preprocedural suspicion/high likelihood of needing ECMO               <ul style="list-style-type: none"> <li>EF &lt; 20%</li> <li>Pulmonary hypertension</li> <li>Severe right heart dysfunction</li> </ul> </li> </ul>

Ben Bryner, MD: Duke CT Surgery, ECMO specialist

## Reasons to consult ECMO team

### Lesion triggers:

- **Severe right or left heart failure**
- Systemic right ventricle with moderate or severely decreased ventricular function
- Fontan with complications
- Symptomatic heart failure (especially if complicated by pre-eclampsia)
- PASP >50, **pulmonary hypertension with right heart failure**, PH with cyanosis with or without RV failure
- Any unstable cardio-obstetrics patient (i.e. dissecting major vessel)

### Anticipated monitor/procedure triggers:

- **Dual inotrope requirement**
- Maternal decompensation

### Obstetric trigger:

- Any of the above and **preeclampsia**

Page 970-ECMO  
Page CT Anesthesia: 1699

## Consider delivery/termination ON ECMO

### Lesion triggers:

- Severe right or left heart failure (EF<15%)
- Systemic right ventricle with severely decreased function (inotropes initiated pre-delivery and decompensating)
- Decompensated Fontan
- PASP >70 or mean PAP >50, severe pulmonary hypertension with severe right heart failure
- PH with cyanosis with RV failure (VA) or without RV failure (may only need VV)
- Eisenmenger syndrome (shunting, low sat use VV), with RV failure use VA
- Any unstable cardio-obstetrics patient (i.e. dissecting major vessel)

### Anticipated monitor/procedure triggers:

- Dual inotrope requirement may fail (initiated pre-delivery and decompensating)
- Maternal decompensation (only pulmonary use VV: hypercarbic, hypoxic or cardiopulmonary use VA)

### Obstetric trigger:

- Any of the above and preeclampsia

## ECMO Standby Includes

- Cardiac OR
- Cardiac Anesthesiologist & TTE / TEE probe
- Perfusionist dedicated to OR
- Cardiohelp circuit primed
- CT surgeon present
- Micropuncture sheaths (5Fr)
  - After neuraxial or before or after general anesthesia
  - Placed under ultrasound in femoral artery and femoral vein
  - Placeholders
  - Removed with manual compression if not needed



Ben Bryner, MD: Duke CT Surgery, ECMO specialist

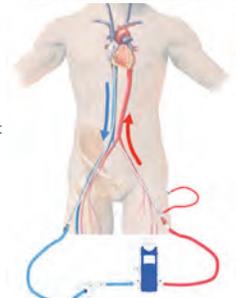
## If ECMO is needed:

Micropuncture catheters are exchanged over a wire for much larger ECMO cannulae

- 25Fr drainage cannula in the femoral vein → IVC
- 17-21Fr reinfusion cannula in the femoral artery
- Faster than surgical cutdown on femoral vessels, and in cardiac arrest percutaneous access is difficult



The Portable ECMO machine (Cardiohelp) is usually used to facilitate any other procedures and then ICU care.



Ben Bryner, MD: Duke CT Surgery, ECMO specialist

Thank you

Questions?

 @maloumeng







Extraordinary care through a unique culture of innovation, education, research, and professional growth.

 Maternal Cardiac Arrest

Page ECMO  
Page CT Anesthesia

**TEE: assist with diagnosis**

- MI/cardiomyopathy/HF (right/left)
- Pericardial effusion/tamponade
- Dissection
- Large PE
- Pleural effusion
- AFE/clot vs. extreme coagulopathy
- Volume status

**VA ECMO: assist with resuscitation**

Madden AM, Meng ML. Cardiopulmonary resuscitation in the pregnant patient. BJA Educ 2020; 20: 252-258



 ECMO cardiopulmonary resuscitation (ECPR/ECLS)

**30%** General adult population survival with ECPR was 29%

**60%** Population-based study on maternal cardiac arrest survival was 58.9%

**90%** 57 cases of maternal cardiac arrest with ECPR survival was 87.7%

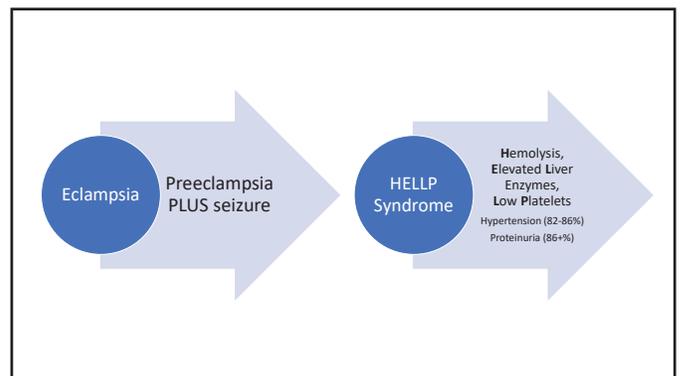
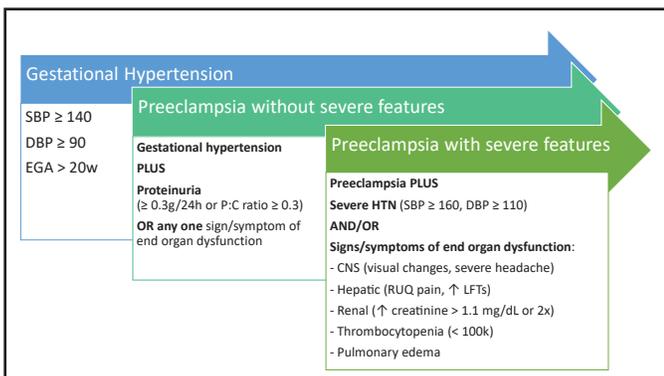
1. Madden AM, Meng ML. Cardiopulmonary resuscitation in the pregnant patient. BJA Educ 2020;20:252-8.  
 2. Naoum EE, Chalupka A, Haft J, et al. Extracorporeal Life Support in Pregnancy: A Systematic Review. J Am Heart Assoc 2020;9:e016072.  
 3. ELSO registry report. July 2019.  
 4. Mhyre JM, Tsai LC, Einav S, Kuklina EV, Leftert LR, Bateman BT. Cardiac arrest during hospitalization for delivery in the United States, 1998–2011. Anesthesiology. 2014;120:810–818.

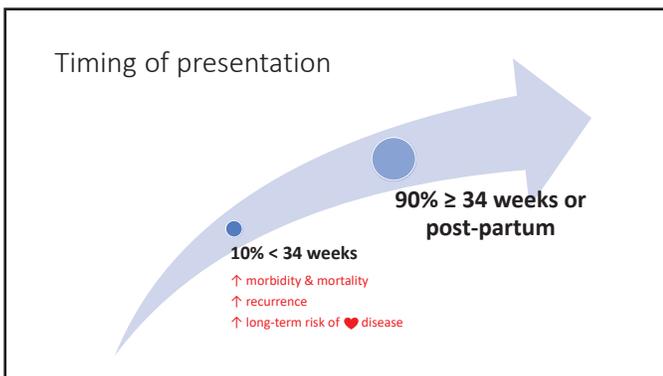
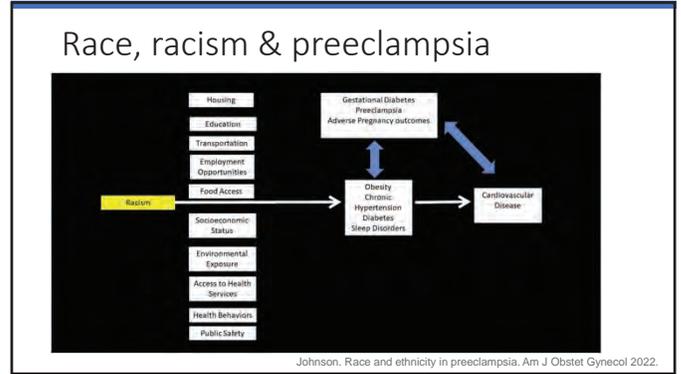
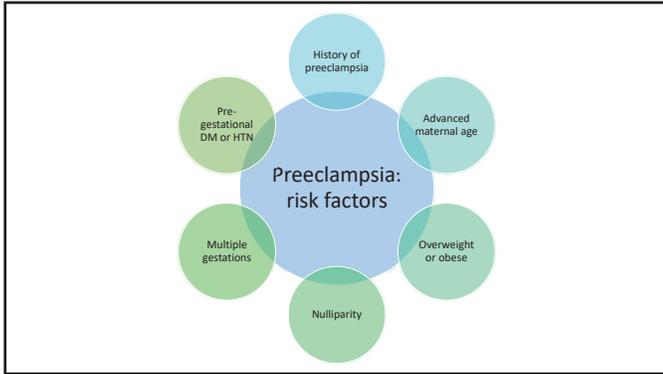
# Preeclampsia – What are we doing now?

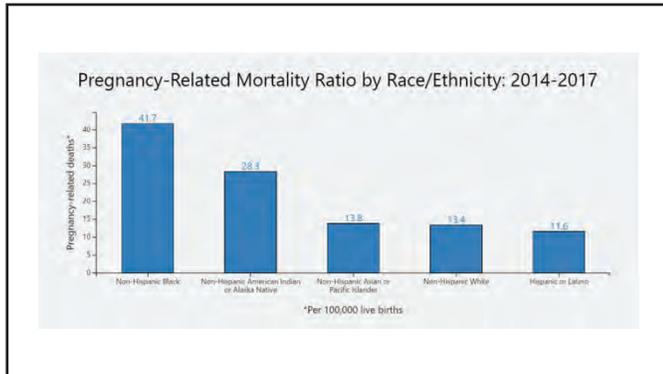
Emily McQuaid-Hanson, MD  
Providence Anesthesiology  
Spokane, WA

# Definitions, Diagnosis & Prognosis

What is preeclampsia  
and how does it impact  
maternal morbidity &  
mortality?







## Preeclampsia & Anesthesia

What is the role of the anesthesia team in reducing maternal morbidity & mortality?

### Pre-anesthesia evaluation

<b>Potential complications</b>	<b>Focused evaluation</b>
DIC & bleeding complications	✓ Severity of disease
Pulmonary edema	✓ Hemodynamic status
Intracranial hemorrhage	✓ Platelets & coagulation
Acute kidney injury	✓ Airway exam
Hepatic rupture	
Placental abruption	
Emergent cesarean delivery	

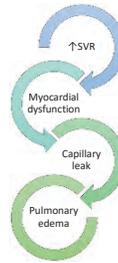
### Care setting

<b>Labor &amp; Delivery</b>	<b>ICU</b>
<ul style="list-style-type: none"> <li>✓ Proximity of OB &amp; anesthesia teams</li> <li>✓ Proximity to OR &amp; NICU</li> <li>✓ Nursing expertise – assessment of labor, FHR monitoring, labor-specific procedures &amp; drugs</li> </ul>	<ul style="list-style-type: none"> <li>✓ Superior resources for maternal resuscitation</li> <li>✓ Nursing expertise – invasive monitoring, vasoactive infusions</li> </ul>

## Hemodynamic monitoring & goals

Art line	<ul style="list-style-type: none"> <li>✓ Indications: vasoactive infusions, frequent lab draws, cesarean delivery</li> <li>✓ Risks: minimal</li> </ul>
CVC/PAC	<ul style="list-style-type: none"> <li>✓ Indications: Inadequate IV access, vasoactive infusions, measurement of preload/cardiac function</li> <li>✓ Risks: thrombosis, infection</li> </ul>
Goals	<ul style="list-style-type: none"> <li>✓ Aggressive treatment of severe-range hypertension</li> <li>✓ Maintain uteroplacental perfusion → permissive mild hypertension</li> </ul>

## Fluid management



- ✓ IV fluids 80-100mL/hr *including* oxytocin & magnesium
- ✓ Labor epidural: fluid bolus typically not necessary
- ✓ Neuraxial anesthesia for cesarean delivery: ≤ 500mL crystalloid
- ✓ Albumin not superior to crystalloid

## Labor analgesia in preeclampsia

## Benefits of epidural analgesia in preeclampsia

Superior pain control as compared to systemic analgesics

↓ catecholamines

↓ hypertensive response to pain

Ability to rapidly convert to surgical anesthetic

↓ risk of general anesthesia

### Benefits of epidural analgesia in preeclampsia

 <p><b>Analgesic</b></p> <ul style="list-style-type: none"> <li>✓ Superior pain control compared to systemic analgesics</li> </ul>	 <p><b>Hemodynamic</b></p> <ul style="list-style-type: none"> <li>✓ Decreased catecholamines</li> <li>✓ Decreased hypertensive response to pain</li> </ul>	 <p><b>Cesarean delivery</b></p> <ul style="list-style-type: none"> <li>✓ Rapid conversion to surgical anesthetic</li> <li>✓ Decreased risk of general anesthesia</li> </ul>
---	---	---

### Epidural test dose

 <p><b>PRO</b></p> <ul style="list-style-type: none"> <li>Overall increased safety</li> </ul>	<ul style="list-style-type: none"> <li>✓ Consider alternative test dose</li> <li>✓ Be prepared to treat severe hypertension</li> </ul>
 <p><b>CON</b></p> <ul style="list-style-type: none"> <li>Risk of severe HTN with intravascular injection</li> </ul>	

### Thrombocytopenia & neuraxial procedure

Obstetric Anesthesiology  
SPECIAL ARTICLE

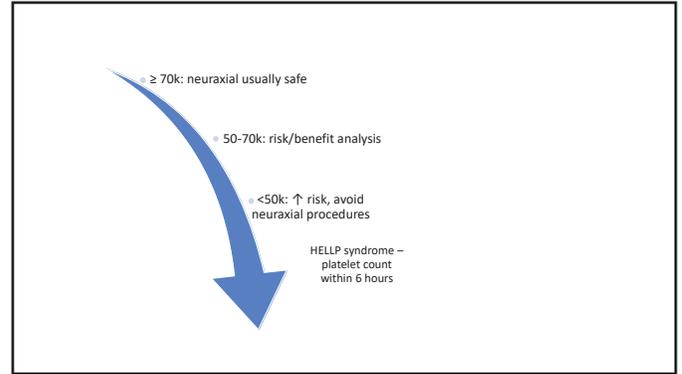
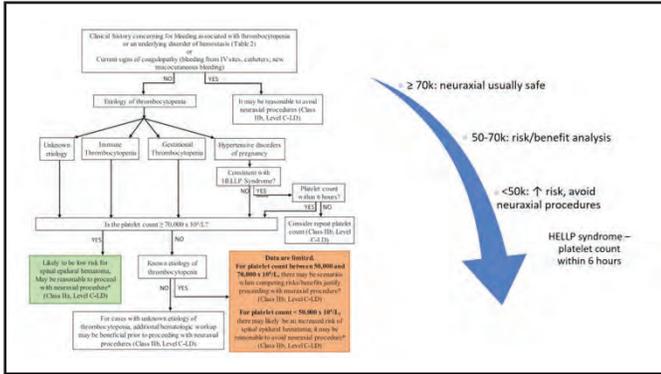
**The Society for Obstetric Anesthesia and Perinatology Interdisciplinary Consensus Statement on Neuraxial Procedures in Obstetric Patients With Thrombocytopenia**

Melissa E. Bauer, DO,\* Katherine Arendt, MD,† Yaakov Beilin, MD,‡ Terry Gernsheimer, MD,§ Juliana Perez Bolero, MD,|| Andra H. James, MD,¶ Edward Yaglmour, MD,¶ Rouilac D. Toledano, MD, PhD,\*\* Mark Turentine, MD,†† Timothy Houle, PhD,‡‡ Mark MacEachern, MJS,§§ Hannah Madden, BS,‡‡ Anita Rajasekhar, MD, MS,||| Scott Segal, MD,††† Christopher Wu, MD,‡‡‡ Jason P. Cooper, MD, PhD,§§§ Ruth Landau, MD,\*\*\*\* and Lisa Leffert, MD‡‡

Anesth Analg 2021;132:1531-44

### Thrombocytopenia & neuraxial procedure

- Clinical coagulation status
- Comorbidities
- Obstetric complications & likelihood of cesarean delivery
- Airway exam
- Facility resources
- Patient preference



Cesarean delivery in preeclampsia

### General considerations for cesarean delivery in preeclamptic patients

<p><b>Lines</b></p> <ul style="list-style-type: none"> <li>✓ Good IV access</li> <li>✓ Consider arterial catheter</li> </ul>	<p><b>Equipment</b></p> <ul style="list-style-type: none"> <li>✓ Ultrasound</li> <li>✓ Difficult airway equipment</li> <li>✓ Blood products</li> </ul>	<p><b>Drugs</b></p> <ul style="list-style-type: none"> <li>✓ Magnesium                     <ul style="list-style-type: none"> <li>• Continue intraop</li> <li>• ↑ risk of atony</li> <li>• Potentiates nondepolarizing NMBDs</li> </ul> </li> <li>✓ Uterotonics</li> <li>✓ Anti-hypertensives</li> </ul>
--	--	--

## Benefits of neuraxial anesthesia for cesarean delivery in preeclampsia

- Standard: better post-op pain control, social support, maternal-infant bonding
- Avoids risk of severe hypertension a/w induction/intubation & emergence/extubation
- Spinal, CSE, epidural – all safe options
- Neuraxial-induced hypotension similar (or less) than normal, easily treatable

## Vasopressors in preeclampsia

- Choice of vasopressor dictated by maternal hemodynamics
- No evidence of superior maternal or fetal outcomes with any one vasopressor
- Small, incremental doses (or titration of infusion) to avoid severe hypertension
- Hemodynamic goals: avoid severe HTN, avoid hypotension & IONV → permissive mild-range HTN

## Uterotonics & fibrinolytics

- Oxytocin (Pitocin) is first line (may need higher doses if on magnesium)
- Misoprostol (Cytotec) and/or carboprost (Hemabate) for persistent atony
- Tranexamic acid for persistent bleeding
- Avoid methylergonovine, can precipitate severe HTN

## Induction of general anesthesia

### Rapid sequence induction

- |                        |  |
|------------------------|--|
| Propofol 2mg/kg        | Blunt sympathetic response to laryngoscopy & intubation  |
| AND                    |  |
| Succinylcholine 1mg/kg | <ul style="list-style-type: none"> <li>Labetalol (pre-induction - 10mg IV boluses)</li> <li>Esmolol 2mg/kg (or 1mg/kg with lidocaine)</li> <li>Lidocaine 1.5 mg/kg</li> <li>Nitroglycerine 1.5-2.5mcg/kg</li> <li>Nicardipine 100-200mcg (or 15-30mcg/kg)</li> <li>Remifentanyl 1mcg/kg</li> <li>Fentanyl 1-3mcg/kg</li> </ul> |
| PLUS                   |  |

### Maintenance of anesthesia

- ✓ Inhaled anesthetics +/- N2O
- ✓ Propofol 100-200 mcg/kg/min → ↓ uterine atony & PONV
- ✓ Nondepolarizing NMJb PRN (decrease dose if on magnesium – use TOF & reverse)

### Intra & post op analgesia

- ✓ Midazolam 1-2mg
- ✓ Hydromorphone 1-2mg
- ✓ Ketamine 0.5 mg/kg
- ✓ TAP blocks

### Emergence & extubation

- ✓ Be prepared to treat severe HTN
- ✓ Watch for airway obstruction

## Morbidity & mortality during emergence from general anesthesia

- 5 out of 8 during emergence from GA or in PACU – none during intubation
- 6 out of 8 obese
- 7 out of 8 women of color

**Table 4. Profile of Anesthesia-related Maternal Deaths, 1995-2013**

Patient	Maternal Condition	BMI	Race	Procedure	Anesthesia Team	Most Likely Complication of Anesthesia Presentation	Primary Cause of Death
1	Term pregnancy with severe preeclampsia	33	Black	Cesarean delivery (urgent) for placental abruption	GA, ETT	Asphyxiation, CP	CP arrest, fatal
2	24-week spontaneous abortion, maternal placental abruption	37	Black	Obstetric and emergency cesarean for hemorrhage	GA, ETT, endotracheal intubation by hematologist	Asphyxiation, CP	CP arrest, fatal
3	Unplanned pregnancy in the first trimester	29	Black	Vaginal aspiration (elective)	Deep sedation IV	Respiratory arrest	CP arrest, fatal
4	Term pregnancy with chronic hypertension, pre-eclampsia/abruption	33	Black	Cesarean delivery (elective repeat)	General	Asphyxiation, CP	CP arrest, fatal
5	All 33 weeks gestation, severe preeclampsia, placental abruption	42	White	Cesarean delivery (urgent) for placental abruption	GA, ETT, endotracheal intubation by anesthesiologist	Asphyxiation, CP	CP arrest, fatal
6	Term pregnancy with placental abruption	30	Hispanic	Cesarean delivery (elective repeat)	GA, ETT, endotracheal intubation by anesthesiologist	Asphyxiation, CP	CP arrest, fatal
7	Term pregnancy with severe preeclampsia and placental abruption	42	Black	Cesarean delivery (urgent) for placental abruption	GA, ETT, endotracheal intubation by anesthesiologist	Asphyxiation, CP	CP arrest, fatal
8	All 33 weeks gestation, fetal demise, maternal placental abruption	WNL	Black	Obstetric and emergency cesarean for hemorrhage	GA, ETT	Asphyxiation, CP	CP arrest, fatal

Abbreviations: BMI = body mass index; BP = blood pressure; CAD = coronary artery disease; CP = cardiopulmonary; ETT = endotracheal tube; GA = general anesthesia; ICU = intensive care unit; N/A = not reported; P&O = postoperative care unit; PCA = patient-controlled analgesia; S&B = subarachnoid block; SV = spontaneous ventilation; WNL = within normal limits.

## Conclusions

- Caring for patients with preeclampsia is multidisciplinary and collaborative
- Neuraxial anesthesia/analgesia is safe and preferred in most cases
- Severe hypertension should be avoided or aggressively treated
- The anesthesia team plays a key role in reducing morbidity and mortality related to preeclampsia

# Update on Postdural Puncture Headache

**Society for Obstetric Anesthesia and Perinatology (SOAP)**

**Sol Shnider Clinical Track #1**

**Robert S. White, M.D., M.S.  
Assistant Professor of Anesthesiology  
Weill Cornell Medicine**



# Disclosure information

Dr. White is the recipient of FAER Grant ID:  
MRTG-08-15-2021-White (Robert).

# Purpose of talk

Unintentional dural puncture complicates **0.7–1.5%** of all obstetric epidural anesthetics with **50-80%** developing PDPH.

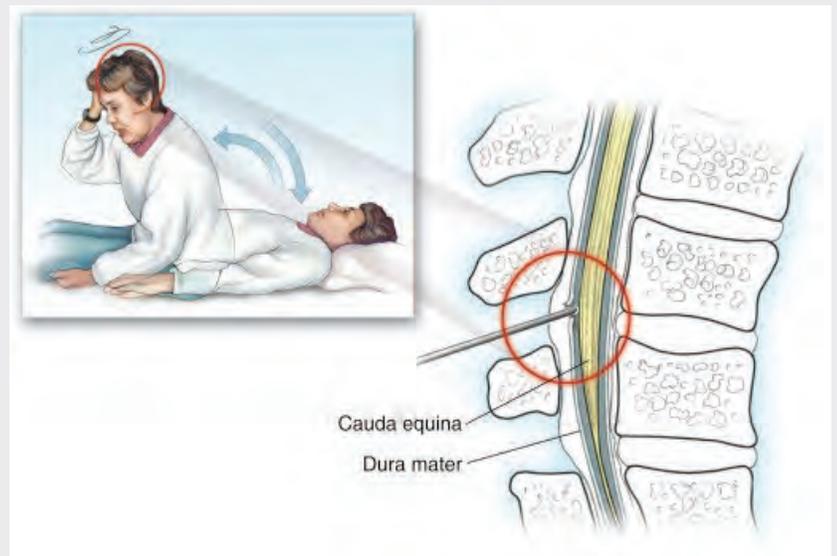
Typically, **positional** in nature; **dull aching or throbbing headache**, added **auditory and/or visual dysregulation**.

Long-term complications: **chronic headache** and **backache** question historical classification as “a self-limiting headache.”

Underlying mechanism remains under investigation.

**Epidural blood patch (EBP) is the criterion standard treatment for severe PDPH.**

A wide variety of prophylactic and therapeutic measures have been explored with various degree of success.



# The International Classification of Headache Disorders 3rd edition



## 7.2.1 Post-dural puncture headache

### Previously used term:

Post-lumbar puncture headache.

### Description:

Headache occurring within 5 days of a lumbar puncture, caused by cerebrospinal fluid (CSF) leakage through the dural puncture. It is usually accompanied by neck stiffness and/or subjective hearing symptoms. It remits spontaneously within 2 weeks, or after sealing of the leak with autologous epidural lumbar patch.

### Diagnostic criteria:

- A. Headache fulfilling criteria for 7.2 *Headache attributed to low cerebrospinal fluid (CSF) pressure*, and criterion C below
- B. Dural puncture has been performed
- C. Headache has developed within 5 days of the dural puncture
- D. Not better accounted for by another ICHD-3 diagnosis.

### Comment:

Independent risk factors for 7.2.1 *Post-dural puncture headache* have recently been demonstrated: female gender, age between 31 and 50 years, a previous history of 7.2.1 *Post-dural puncture headache* and orientation of the needle bevel perpendicular to the long axis of the spinal column at the time of the dural puncture.

# PDPH severity classification

No universally accepted severity scale.

## 10-point analog scale

1–3 : “mild”

4–6 : “moderate”

7–10 : “severe”

Lybecker et al further categorized patients according to **restriction in physical activity, degree of confinement to bed, and presence of associated symptoms.**

### Severity of PDPH

Mild	Postural headache slightly restricting daily activities Patient is not bedridden at any time during the day No associated symptoms
Moderate	Postural headache that significantly restricts daily activities Patient is bedridden part of the day Associated symptoms may or may not be present
Severe	Postural headache severe enough to stay in bed all day Associated symptoms always present

### Associated Symptoms of PDPH

Vestibular	Nausea, vomiting, dizziness
Cochlear	Hearing loss, hyperacusis, tinnitus
Ocular	Photophobia, teichopsia, diplopia, difficulty with accommodation
Musculoskeletal	Neck stiffness, scapular pain

Lybecker H, Møller JT, May O, Nielsen HK. Incidence and prediction of postdural puncture headache. A prospective study of 1021 spinal anesthetics. *Anesth Analg*.

# PDPH course

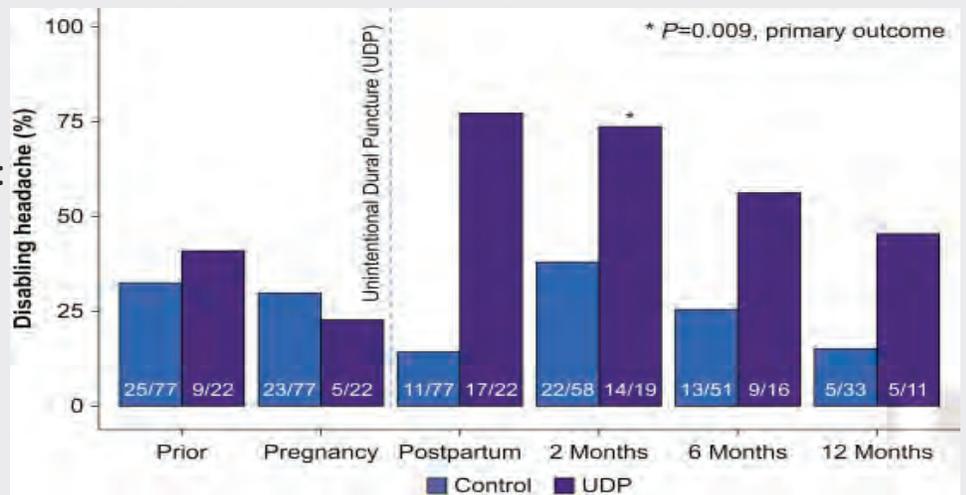
Usually occurs within a few days (1–2) and lasts for 7 to 10 days.

Differential diagnosis: caffeine withdrawal, migraines, meningitis, sinus related, preeclampsia, pneumocephalus and intracranial pathology such as an intracranial subdural hematoma and posterior reversible encephalopathy syndrome.

PDPH is considered self-limited and frequently resolves spontaneously within 2 weeks or following the placement of an autologous epidural blood patch which seals the cerebrospinal fluid (CSF) leak.

However, new research suggests long term morbidity: chronic headaches and low back pain symptoms.

Such potential long-term sequelae should be mentioned in procedure informed consent.



Ansari JR, Barad M, Shafer S, Flood P. Chronic disabling postpartum headache after unintentional dural puncture during epidural anaesthesia: a prospective cohort study. *Br J Anaesth.* 2021;127(4):600-607.

# Risk factors: non-modifiable

**Table 2** Modifiable and non-modifiable risk factors for PDPH

Non-modifiable risk factors	Female sex
	Younger age
	Lower body mass index (BMI)
	Pregnancy
	Vaginal delivery
	Non-smoker
	History of prior PDPH
	History of prior chronic headache
Modifiable risk factors	Needle shape
	Needle size
	Direction of needle bevel
	Stylet replacement
	Operator skill

Li, H., Wang, Y., Oprea, A.D. *et al.* Postdural Puncture Headache—Risks and Current Treatment. *Curr Pain Headache Rep* (2022).

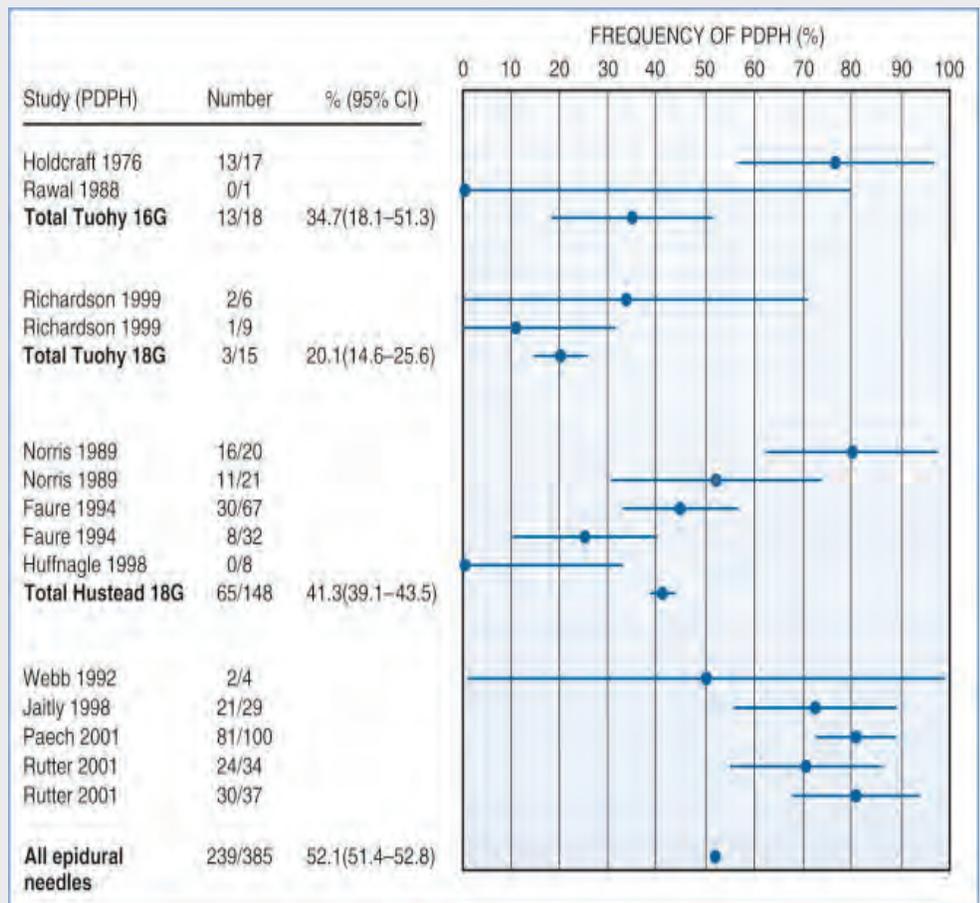
# Risk factors: modifiable

The most important equipment-related details for risk of PDPH are **needle gauge** (larger > smaller) and **needle tip design** (cutting > noncutting).

**Orientation of the needle bevel:** parallel (longitudinal or cephalad to caudal direction) vs perpendicular (transverse direction)

**Number of attempts**

**Clinical experience of provider**

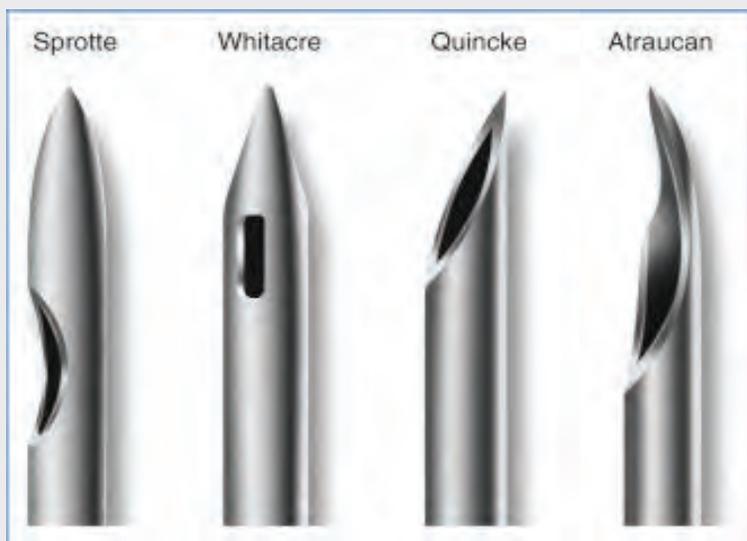


Choi PT, Galinski SE, Takeuchi L, et al. PDPH is a common complication of neuraxial blockade in parturients: a meta-analysis of obstetric studies. *Can J Anaesth.* 2003;50:460–469

# Needle tip design

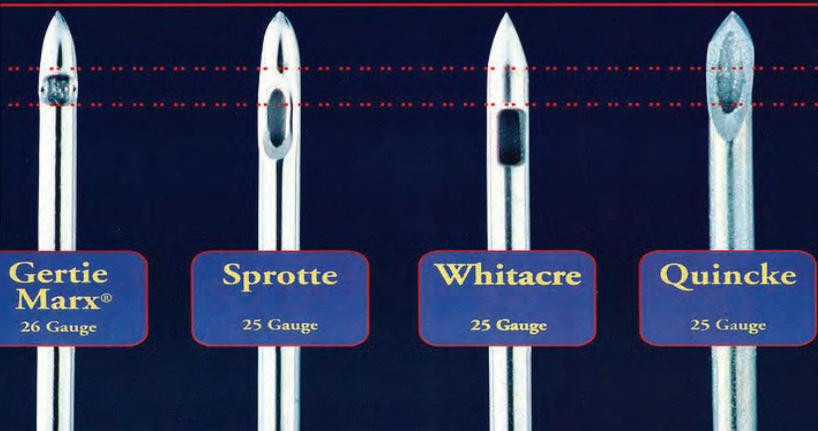
**TABLE 30.2 Frequency of Post-Dural Puncture Headache in Obstetric Patients According to Spinal Needle Design**

Needle Design	Gauge	n/N	Frequency of PDPH (%) <sup>a</sup>	95% Confidence Interval <sup>b</sup>
Quincke	24	15/238	11.2	10.2–12.2 <sup>42,46</sup>
	25	114/1792	6.4	5.3–7.6 <sup>42,46</sup>
	26	139/2467	5.6	5.6–5.7 <sup>42</sup>
	27	34/1167	2.9	2.0–4.0 <sup>42,46</sup>
Atraucan	26	16/350	4.6	2.6–7.3 <sup>43,45</sup>
Whitacre	22	1/68	1.5	1.2–2.8 <sup>42</sup>
	25	137/6992	2.0	1.6–2.3 <sup>42,44,46</sup>
	27	13/820	1.6	0.08–2.7 <sup>42,46</sup>
Sprotte	24	57/1767	3.5	3.5–3.5 <sup>42</sup>
Polymedic	25	22/292	6.6	5.9–7.4 <sup>42</sup>
BD	26	205/2560	5.8	5.6–5.9 <sup>42</sup>
Gertie Marx	24	8/201	4.0	1.7–7.7 <sup>45</sup>



## The Gertie Marx® Needle for Regional Anesthesia

Actual photograph magnified 21 times



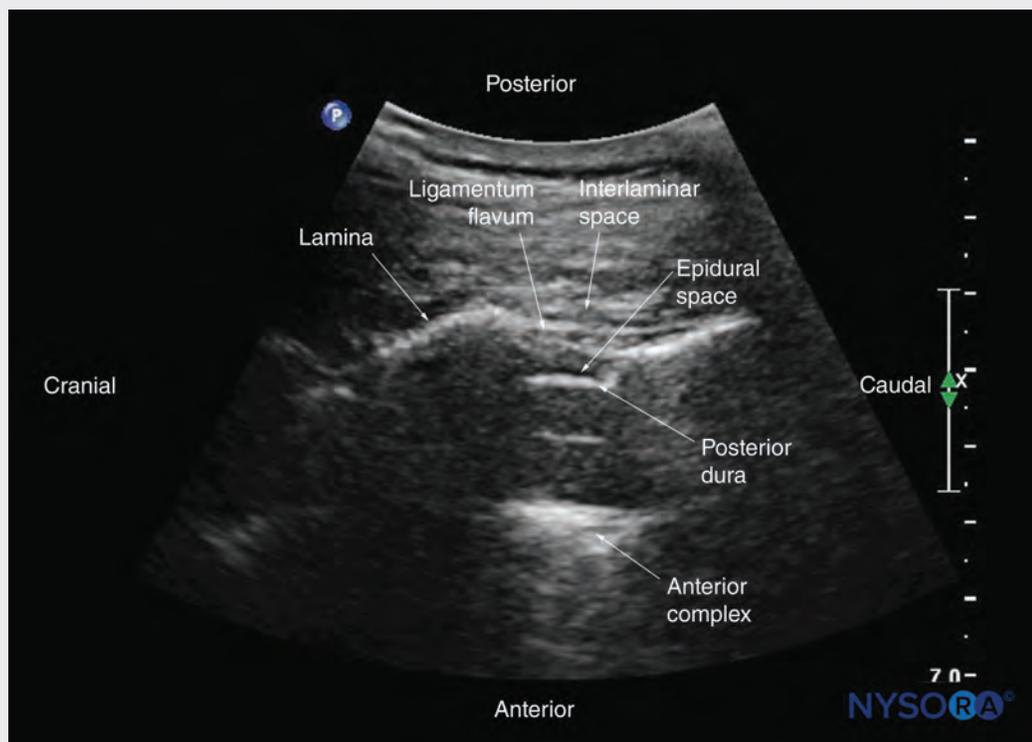
Peralta P., Macarthur A. Chapter 30. Postpartum headache, Chestnut's Obstetric Anesthesia Principles and Practice

Designs of spinal needle tips (not to scale). Illustration by Naveen Nathan, MD, Northwestern University Feinberg School of Medicine, Chicago, IL. [Image top left].

Page 351

# Ultrasound for neuraxial procedures

Ultrasound can decrease the number of needle passes required for regional procedures and has been shown to accurately predict the depth of the epidural space.



Karmakar MK, Jinn Chin K. Spinal Sonography and Applications of Ultrasound for Central Neuraxial Blocks. In: Hadzic A. eds. *Hadzic's Textbook of Regional Anesthesia and Acute Pain Management, 2e*

# Pathophysiology

Pathophysiology and underlying mechanism remains under investigation.

Results from a disruption of normal CSF homeostasis.

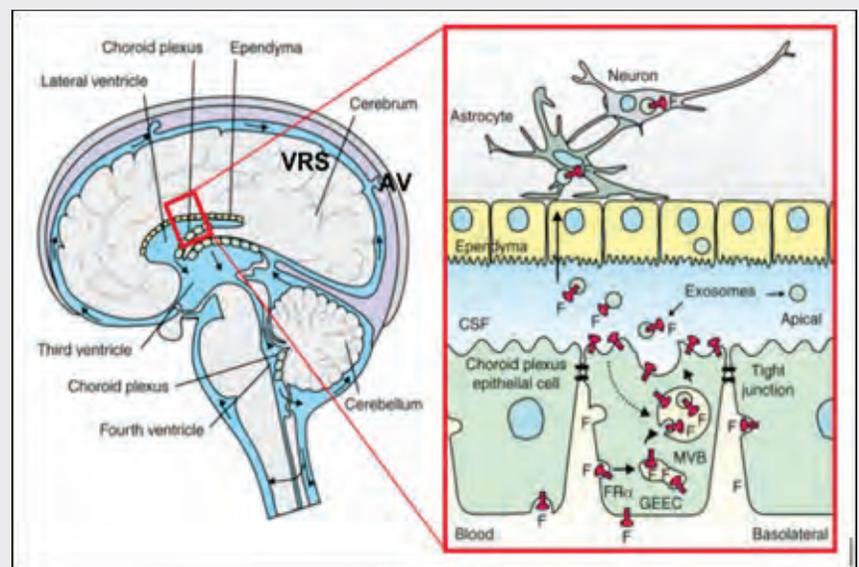
CSF is produced primarily in the choroid plexus at a rate of approximately 0.35 mL/min and reabsorbed through the arachnoid villa.

Total CSF volume in adults is around 150 mL.

Continuous downward pull on the intracranial pain-responsive structures in the upright position.

Nerves: the upper cervical, 5th cranial, 9th cranial, and 10th cranial

Compensatory vasodilatation of the intracranial vessels (with increase in cerebral blood flow).



Johanson CE, Johanson NL. Choroid Plexus Blood-CSF Barrier: Major Player in Brain Disease Modeling and Neuromedicine. *J Neurol Neuromedicine* (2018) 3(4): 39-58

# If UDP: measures to reduce PDPH risk

The efficacy of these discussed measures is debatable.

Patient should be informed of high risk of PDPH development and should have daily follow-up (phone call if needed) for at least 48 hours.

Stylet replacement

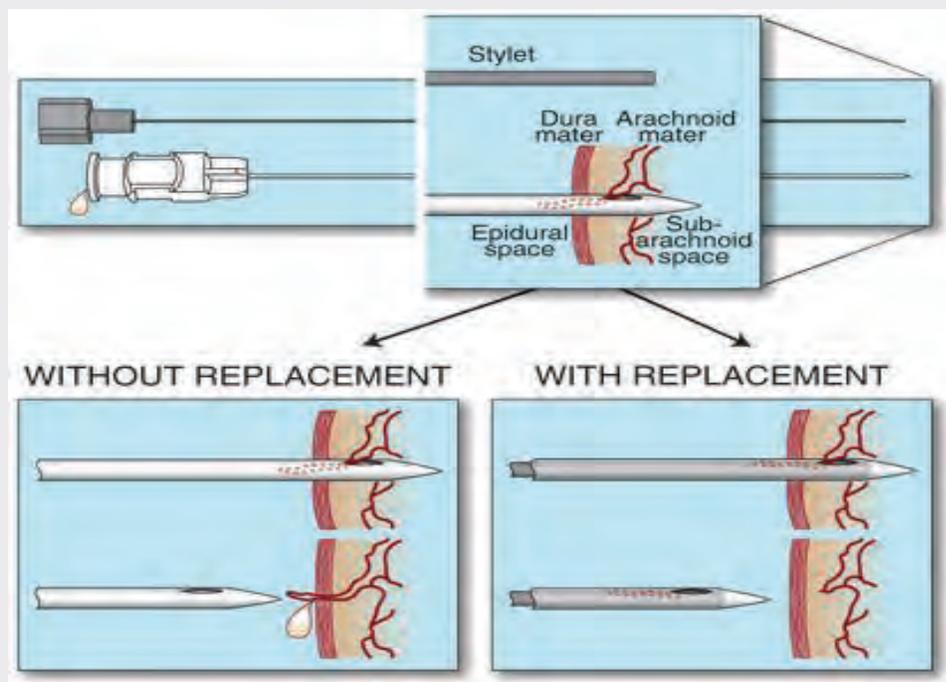
Subarachnoid saline

Limiting/ avoiding pushing

Intrathecal catheters

Epidural opiates

Epidural saline



Strupp M, Brandt T, Muller A. Incidence of post-lumbar puncture syndrome reduced by reinserting the stylet: a randomized prospective study of 600 patients. *J Neurol* 1998;245:589-592

# Current treatments

PDPH symptoms may interfere with maternal-neonatal bonding.

Intervention is frequently needed.

Management options can be divided into conservative and invasive measures.

**Table 3** Available treatment options for PDPH

Severity of PDPH	Available treatment options			
	Conservative management	Pharmacological management	Nerve blocks	EBP
Mild	+	+/-	-	-
Moderate	+	+	+/-	+/-
Severe	+	+	+	+

Li, H., Wang, Y., Oprea, A.D. *et al.* Postdural Puncture Headache—Risks and Current Treatment. *Curr Pain Headache Rep* (2022).

# Conservative/ non-pharmacological treatments

Consider conservative management for first 24-48 hours.

May control symptoms but do not provide complete relief.

Bed rest: no particular benefit to PDPH prevention; however, did alleviate headache severity to some extent. Increase risk of thromboembolic complications.

Abdominal binder: shown to relieve headache by raising pressure in the epidural space, although it is not practical in the postpartum period.

Prophylactic fluid administration: no conclusive evidence.

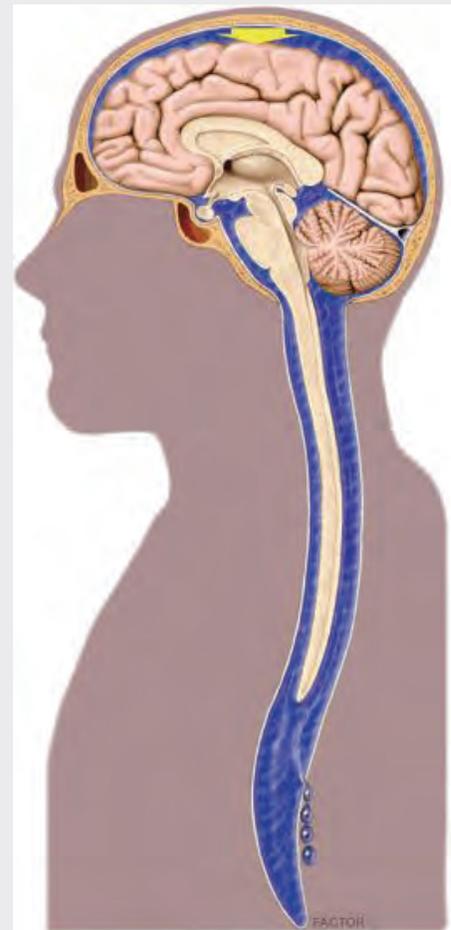


Image by David Factor [Mayo Clinic, Rochester, MN]  
Website: Aneskey

# Pharmacological management

These options have generally been poorly studied and are of questionable value due to the small number of patients treated, methodological flaws in published reports, publication bias, and the self-limited nature of the disorder.

Analgesics (nonsteroidal anti-inflammatory drugs, aspirin, acetaminophen, and oral opioids e.g., oxycodone) are widely used to provide initial symptomatic relief.

In addition, combination analgesics may be prescribed for symptomatic treatment, including butalbital-acetaminophen-caffeine or caffeine-acetaminophen.

**Investigations/ insufficient evidence** for aminophylline, theophylline, adrenocorticotrophic hormone (ACTH), desmopressin (DDAVP), hydrocortisone, dexamethasone, methylprednisolone, triptans, gabapentinoids, methylergonovine, ondansetron, mannitol, neostigmine and atropine.

# Pharmacological management: caffeine

Caffeine: has been demonstrated to be associated with safety and effectiveness in reducing PDPH.

Effects of caffeine do not change the underlying course; it is only for short term symptomatic treatment.

## Cerebral arterial vasoconstriction

Oral caffeine in the dose of 300-500 mg is recommended once or twice a day.

Intravenous caffeine can be given.

If used, treatment with caffeine should not exceed 24 hours, **oral therapy is preferred**, and doses should not exceed 300 mg, with a maximum of 900 mg in 24 hours.

A lower maximum dose of 200 mg in 24 hours should be considered for women who are breastfeeding, particularly those with low birth weight or premature infants.

# Therapeutic epidural blood patch (EBP)

Epidural blood patch remains the cornerstone standard therapy for PDPH patients.

EBP is reserved for PDPH patients who do not respond to conservative therapy (i.e., bed rest, IV hydration, PO analgesics, and IV/PO caffeine).

Current evidence does not support the prophylactic utilization of EBP.

Be aware of postnatal thromboprophylaxis.

An epidural blood patch should not be performed where there is a contraindication to a neuraxial block: injection site infection, anticoagulation, coagulopathy, and patient's refusal or lack of cooperation, existing intracranial hypertension, and signs of acute intracranial bleeding.



## Suspected mechanism

Blood clot forms → plugs the dural leak, enabling rapid healing of the puncture wound.

Epidural blood patch via mass effect in the lumbar epidural space → raises intracranial CSF pressure and volume.

The upregulation of CSF volume removes mechanical traction on pain-responsive sites and temporary central venous dilation.

# Procedure

Predominantly cranial spread of blood injected.

Recommended performed at the same level or one space lower than that at which the original dural puncture occurred.

A volume of blood of 20 mL is recommended; however, injection should stop before 20 mL if not tolerated by the patient.

A full aseptic technique should be employed for both the epidural component and drawing of blood.

Blood should be injected immediately into the epidural space through the epidural needle.

Immediately after an EBP, the patient should be kept in the supine position for up to 1-2 hours for best results.

Patients should be seen before hospital discharge; appropriate follow-up until symptoms resolve.

# Efficacy

EBP placed after an initial observation period of greater than 24 hours have a higher success rate approaching 93% after one EBP and 97% after a second EBP.

Success greater with a longer interval between dural puncture and EBP.

Severity of PDPH symptoms should dictate EBP timing.

EBP: complete resolution (1/3 of patients) and partial relief of symptoms in about 50-80%

Up to 20% of women receive little or no relief from an EBP, even if repeated.

Second EBP may be performed In cases of partial or no relief, after consideration of other causes of headache. No evidence on the optimum time interval.

If two EBPs have failed to relieve symptoms, other causes of headache must be considered, and involvement of other specialties is recommended before performing a third EBP. Further neurological workup or neurological consultation including brain imaging should be considered.

# Risk, side effects, complications

The most prevalent complications of epidural blood patch include failure to achieve pain relief (15% to 20%), worsening PDPH via generation of additional dural puncture, back pain (during EBP 50% of women; at 24 hours post EBP more than 80%), and infection.

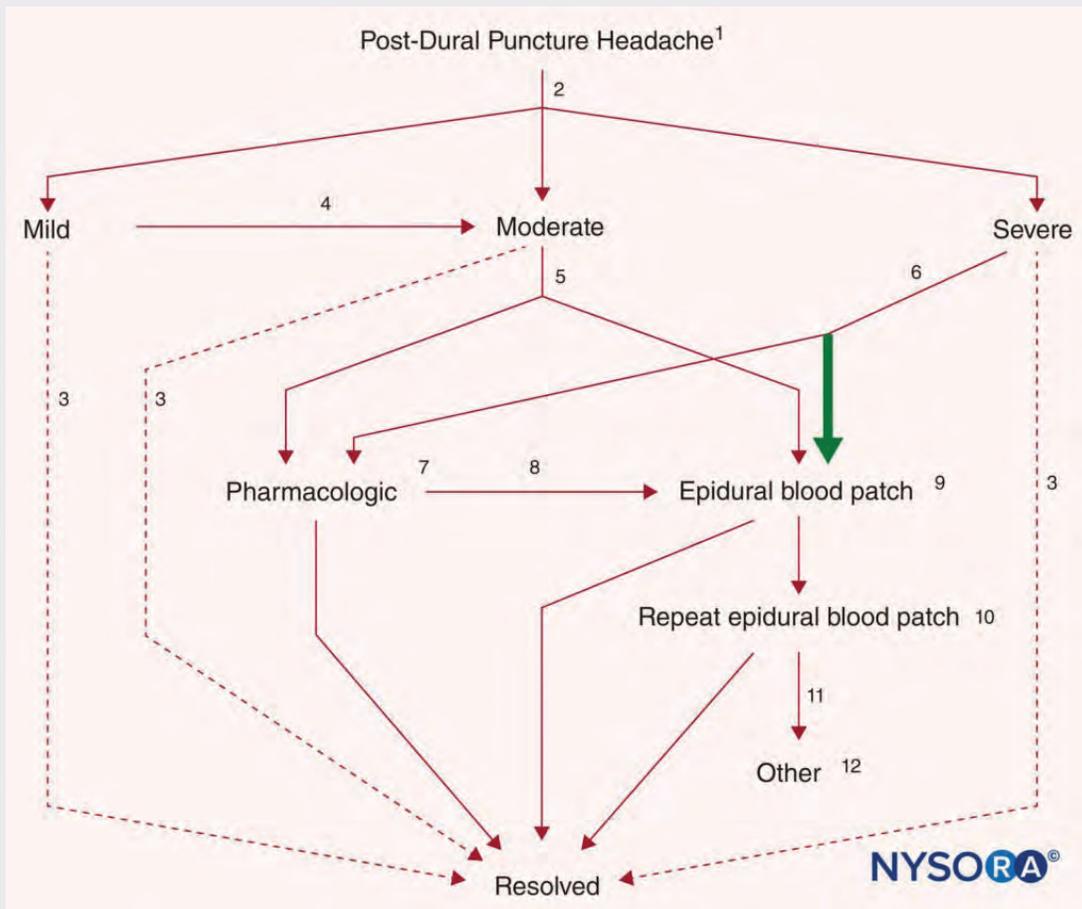
Mild to moderate back pain is common during the injection and immediately post injection in most epidural blood patch cases.

Self limited and it typically resolves within days.

Patients need to be aware of signs and symptoms of infection.

Epidural blood patch can also induce rare but severe complications like meningitis, epidural or intrathecal hematoma, pneumocephalus, arachnoiditis, epidural or subdural abscess, facial nerve palsy, and the cauda equina syndrome.

# Treatment algorithm



Harrington BE. Chapter 73. Postdural Puncture Headache. In: Hadzic A. eds. *NYSORA Textbook of Regional Anesthesia and Acute Pain Management*. McGraw Hill; 2007.

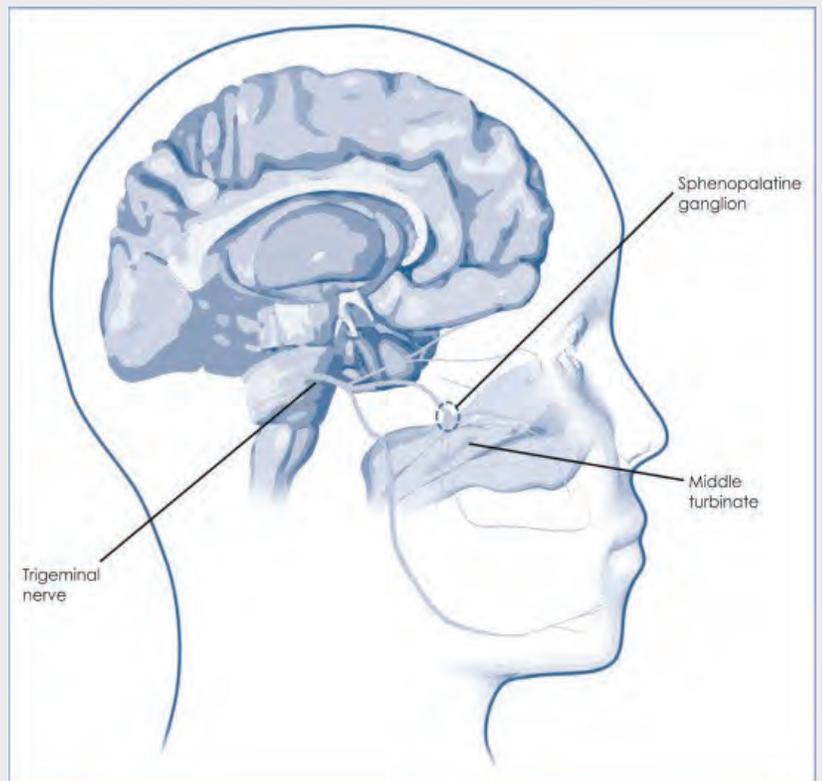
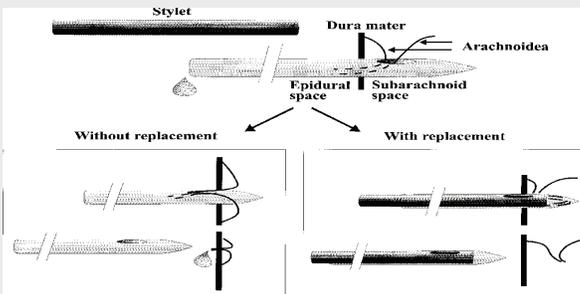
# Alternatives

**Intrathecal catheter placement:** catheter is left in situ for 24 hours. Evidence is equivocal. Consider inadvertent epidural dosing and infection risk.

## Other Alternative Invasive

**Techniques:** currently insufficient evidence to recommend the use of acupuncture, greater occipital nerve blocks, sphenopalatine ganglion blocks, epidural morphine, and prophylactic intrathecal morphine via an intrathecal catheter after UDP.

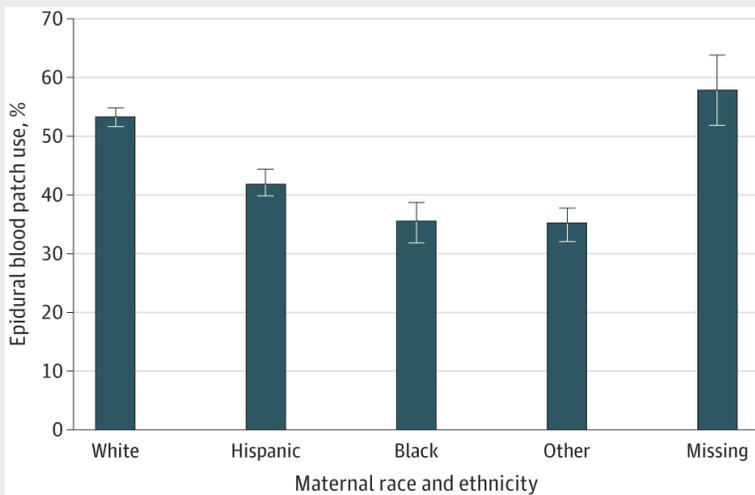
**Stylet replacement to push out strand of arachnoid.**



Anatomy of the sphenopalatine ganglion block. Illustration by Naveen Nathan, MD, Northwestern University Feinberg School of Medicine, Chicago, IL.

From: **Racial and Ethnic Disparities in the Management of Postdural Puncture Headache With Epidural Blood Patch for Obstetric Patients in New York State**

JAMA Netw Open. 2022;5(4):e228520. doi:10.1001/jamanetworkopen.2022.8520



2650 White patients with PDPH (53.4%) used an EBP compared with 543 Hispanic patients (41.7%), 367 Black patients (35.7%), and 478 of other race and ethnicity (35.2%)

Table 4. Adjusted Odds Ratios of Epidural Blood Patch Use for Postdural Puncture Headache After Neuraxial Analgesia or Anesthesia for Childbirth in the Main and in the 4 Sensitivity Analyses (New York State Hospitals, 1998-2016)

Characteristic	Adjusted odds ratio (95% CI) <sup>a</sup>				
	Main analysis (imputation of missing values)	Sensitivity analysis 1 (complete case analysis)	Sensitivity analysis 2 (exclusion of hospitals with a proportion of missing values for maternal race and ethnicity >20%)	Sensitivity analysis 3 (exclusion of hospitals with a proportion of missing values for hospital number of obstetricians and gynecologists >20%)	Sensitivity analysis 4 (exclusion of discharges in 2016)
No. of observations	8921	7213	8647	8492	8486
No. of hospitals	158	149	154	137	158
Maternal race and ethnicity					
White	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]
Hispanic	1.11 (0.94-1.30)	1.17 (0.98-1.40)	1.10 (0.94-1.30)	1.10 (0.93-1.30)	1.10 (0.93-1.30)
Black	0.80 (0.67-0.94)	0.81 (0.67-0.97)	0.80 (0.68-0.95)	0.81 (0.68-0.96)	0.79 (0.66-0.94)
Other <sup>b</sup>	0.85 (0.73-0.99)	0.84 (0.71-0.99)	0.84 (0.72-0.98)	0.85 (0.73-0.99)	0.85 (0.73-0.99)
Missing	1.31 (0.98-1.75)	1.73 (1.16-2.58)	1.52 (1.07-2.15)	1.31 (0.98-1.75)	1.26 (0.94-1.68)

<sup>a</sup> Adjusted for the following 21 characteristics: (1) maternal age; (2) health insurance; (3) obesity; (4) comorbidity index for obstetric patients; (5) admission during a weekend; (6) cesarean delivery; (7) coagulation factor deficit, Von Willebrand disease, and thrombocytopenia; (8) fever or infection during labor; (9) chorioamnionitis; (10) teaching hospital; (11) rural hospital; (12) hospital annual volume of delivery; (13) hospital cesarean delivery rate; (14) hospital proportion of racial and ethnic minority obstetric patients; (15) hospital proportion of safety-net parturients; (16) hospital proportion of admissions for delivery during a weekend; (17) hospital proportion of patients receiving neuraxial analgesia or anesthesia for delivery; (18) hospital coding intensity in deliveries; (19) hospital county number of obstetricians and gynecologists; (20) hospital county number of physician anesthesiologists; and (21) year of delivery. Missing values were handled using multiple imputations.  
<sup>b</sup> Includes Asian and Pacific Islander, Native American, and other race and ethnicity.

aOR of Epidural Blood Patch Use for Postdural Puncture Headache After Neuraxial Analgesia or Anesthesia for Childbirth in the Main and in the 4 Sensitivity Analyses

# Summary

To achieve optimal outcomes, an interdisciplinary care team approach to patients with PDPH is recommended.

In case of mild PDPH, conservative management involving bed rest and pharmacological management should be used as first-line treatment.

In case of moderate-to-severe PDPH, epidural blood patch remains the criterion standard treatment.

Maintain appropriate follow-up with patient and documentation in medical record.

Nerve blocks are alternatives for PDPH patients who do not respond well to conservative treatment, but lack of evidence precludes recommendation from ASA.

# References

- American Society of Anesthesiologists (ASA). Statement on Post-Dural Puncture Headache Management Committee of Origin: Obstetric Anesthesia. Approved by the ASA House of Delegates on October 13, 2021.
- Arevalo-Rodriguez I, Muñoz L, Godoy-Casasbuenas N, Ciapponi A, Arevalo JJ, Boogaard S, Roqué I Figuls M. Needle gauge and tip designs for preventing post-dural puncture headache (PDPH). *Cochrane Database Syst Rev*. 2017 Apr 7;4(4):CD010807. doi: 10.1002/14651858.CD010807.pub2. PMID: 28388808; PMCID: PMC6478120.
- Peralta P., Macarthur A. Chapter 30. Postpartum headache, *Chestnut's Obstetric Anesthesia Principles and Practice*, 2019 6th Edn. Philadelphia: Mosby Elsevier. Pages 724-750.
- D'Angelo R, Smiley RM, Riley ET, Segal S. Serious complications related to obstetric anesthesia: the serious complication repository project of the Society for Obstetric Anesthesia and Perinatology. *Anesthesiology*. 2014 Jun;120(6):1505-12. doi: 10.1097/ALN.0000000000000253. PMID: 24845921.
- Gaiser R. Postdural puncture headache. *Curr Opin Anaesthesiol*. Jun 2006;19(3):249-53. doi:10.1097/01.aco.0000192809.71408.b.
- Guglielminotti J, Landau R, Li G. Major Neurologic Complications Associated With Postdural Puncture Headache in Obstetrics: A Retrospective Cohort Study. *Anesth Analg*. Nov 2019;129(5):1328-1336. doi:10.1213/ANE.0000000000004336.
- Harrington BE. Chapter 73. Postdural Puncture Headache. In: Hadzic A. eds. *NYSORA Textbook of Regional Anesthesia and Acute Pain Management*. McGraw Hill; 2007.
- Headache Classification Committee of the International Headache Society (IHS) The International Classification of Headache Disorders, 3rd edition. *Cephalalgia*. Jan 2018;38(1):1-211.
- Li, H., Wang, Y., Oprea, A.D. *et al*. Postdural Puncture Headache—Risks and Current Treatment. *Curr Pain Headache Rep* (2022).
- Lee A, Guglielminotti J, Janvier A, Li G, Landau R. Racial and Ethnic Disparities in the Management of Postdural Puncture Headache With Epidural Blood Patch for Obstetric Patients in New York State. *JAMA Netw Open*. 2022;5(4)
- Obstetric Anaesthetists Association. Treatment of obstetric post-dural puncture headache: Executive summary of recommendations. 2018. Accessed May 25, 2021. [https://www.oaa-anaes.ac.uk/Clinical\\_Guidelines](https://www.oaa-anaes.ac.uk/Clinical_Guidelines).
- Russell R, Laxton C, Lucas DN, Niewiarowski J, Scrutton M, Stocks G. Treatment of obstetric post-dural puncture headache. Part 1: conservative and pharmacological management. *Int J Obstet Anesth*. May 2019;38:93-103. doi:10.1016/j.ijoa.2018.12.006.

# Program Material

## Saturday, May 14, 2022

---

### Sol Shnider Clinical Track #2

Moderator: Nakia Hunter, MD

Panelists: Katie Seligman, MD; Jen Lucero, MD; Jaime Daly, MD; Kathleen Smith, MD

### Best Case Reports – So You Did What?

Moderator: Emily Sharpe, MD

Panelists: Brenda Bucklin, MD; Richard Wissler, MD; Katie Arendt, MD

### ASA Update

Intro: Ted Yaghmour, MD, FASA, President, SOAP

Speaker: Randall Clark, MD, FASA, President, ASA

### Gerard W. Ostheimer Lecture

Intro: Grace Lim, MD, M.S.

Speaker: Michaela Farber, MD, M.S.

### Resident/Fellows Case Presentations

## Parturients with Opioid Use Disorder- Anesthetic Considerations

Katherine Seligman, MD FRCPC D.ABA  
Clinical Associate Professor  
University of British Columbia



## LECTURE OUTLINE

Definition of Opioid Use Disorder

Scope of Disease in Parturients

Long Term Use- Maternal/Fetal Effects

Medication Assisted Treatment (MAT)

Intrapartum & Postpartum Care

Multimodal Analgesia & Adjuvants

## CASE STUDY

- 27F G3P1 at 37w4d with one prior vaginal delivery comes to triage complaining of regular painful contractions.
- PMH: Opioid use disorder (OUD), HCV+, depression, anxiety, & limited prenatal care. Difficult IV start.
- PSH: Nil
- Medications: 90mg Methadone PO daily
- Labs: Plts 178, Hgb 12.2
- Vitals: BP-112/68, HR-76, O2-98
- Exam: Patient in extremis with contractions, 2cm dilated. Airway reassuring

What is the anesthetic plan?

### DSM-5 Criteria for Opioid Use Disorder

- Opioids are often taken in larger amounts or over a longer period than was intended
- There is persistent desire or unsuccessful efforts to cut down or control opioid use
- A great deal of time is spent in activities necessary to obtain the opioid or prevent withdrawal
- Craving or a strong desire to use opioids
- Recurrent opioid use resulting in a failure to fulfill major role obligations at work, school, or home
- Continued opioid use although having persistent or recurrent social or interpersonal problems caused or exacerbated by the effects of opioids
- Important social, occupational, or recreational activities are given up or reduced because of opioid use
- Recurrent opioid use in situations in which it is physically hazardous
- Continued use despite knowledge of having a persistent or recurrent physical or psychological problem that is likely to have been caused or exacerbated by opioids
- Tolerance, as defined by either of the following:
  - Need for markedly increased amounts of opioids to achieve intoxication or desired effect
  - Markedly diminished effect with continued use of the same amount of opioid
- Withdrawal, as manifested by either of the following:
  - Characteristic opioid withdrawal syndrome
  - Some (or a clinically relevant substance in cases of substance-paired withdrawal symptoms)

## OPIOID USE DISORDER DSM-5

- Chronic & recurrent use of opioids that causes clinically significant distress or functional impairment
  - Mild: 2-3 symptoms
  - Moderate: 4-5 Symptoms
  - Severe: > 6 Symptoms

## RISK FACTORS FOR OUD

- Psychiatric Disorders: Depression, PTSD, Anxiety
- History of childhood trauma and abuse
- Opioid exposure with Rx for Surgery or Injury
- 50% Heritability

## EPIDEMIOLOGY OF OUD

Figure 1. National Drug-Involved Overdose Deaths\* Number Among All Ages, by Gender, 1999-2020

- 3 million in USA with OUD
- 90,000 Opioid related deaths in USA per year (2020)

Desai et al. Obstet Gynecol 2014 May;123(5):997-1002  
Straub L. Pharmacoeconomist 2021 Apr;33(4):504-513

## OUD IN PREGNANCY

- 1.5 parturients fill an opioid prescription during pregnancy
- 1.4% of parturients report opioid misuse use within last month

Desai et al. Obstet Gynecol 2014 May;123(5):997-1002  
2016/17 National Survey on Drug Use

## LONG TERM OPIOID USE

- Withdrawal**
  - Tachycardia, HTN, Hyperthermia, Diaphoresis, Rhinorrhea, Mydriasis, Myalgia
  - Short Acting: 6-12 Hrs.
  - Long Acting: 24-48 Hrs.
- Tolerance**
  - Alterations in receptor density & changes in G protein signal transduction
- Opioid Induced Hyperalgesia**
  - Increased Baseline Sensitivity to Pain
  - Hyperesthesia, Allodynia

## MATERNAL EFFECTS OF OPIOID EXPOSURE

Health Sequela	Peripartum Complications
<ul style="list-style-type: none"> <li>Mental Illness Co-Morbidities (64.6%)               <ul style="list-style-type: none"> <li>PTSD, Depression, Anxiety</li> </ul> </li> <li>Polysubstance Use (35%)</li> <li>Risk of Infectious Diseases               <ul style="list-style-type: none"> <li>HCV, HIV</li> </ul> </li> <li>Poor Nutrition</li> <li>Minimal/Disrupted Prenatal Care</li> </ul>	<ul style="list-style-type: none"> <li>IUGR</li> <li>Placental Abruptio</li> <li>Preterm Delivery</li> <li>Meconium</li> </ul>

Committee Opinion No. 711 Obstet Gynecol 2017 Aug;130(2):e81-e94

## FETAL EFFECTS OF OPIOID EXPOSURE

Congenital Abnormalities	Neonatal Abstinence Syndrome
<ul style="list-style-type: none"> <li>Neural Tube Defects</li> <li>Heart Defects</li> <li>Gastroschisis</li> </ul>	<ul style="list-style-type: none"> <li>Postnatal drug withdrawal disorder               <ul style="list-style-type: none"> <li>Irritability, high pitched cry, poor feeding</li> </ul> </li> <li>5.8 per 1,000 deliveries</li> <li>Mean 23-day hospitalization - \$93,400</li> </ul>

Broussard CS Am J Obstet Gynecol 2011 Apr;204(4):314e1-11  
Patrick DW Pediatrics 2015 Pediatrics 2015; 135:842-850

Not recommended due to high relapse rates

59-90% Relapse

Consider under care of experienced physician if...

Extremely motivated patient	No Medication Assisted Treatment (MAT) available	Parturient does not accept MAT
-----------------------------	--	--------------------------------

**MEDICALLY SUPERVISED WITHDRAWAL**

Saia KA Curr Obstet Gynecol Rep 2016;5:257-63

## MEDICATION ASSISTED TREATMENT (MAT)



- Physician Supervised provision of opioid agonist pharmacotherapy for the treatment of opioid use disorder
  - Methadone
  - Buprenorphine (Subutex)
  - Buprenorphine + Naloxone (Suboxone)
- MAT Benefits
  - Improved adherence to prenatal care
  - Reduces risk of relapse
  - Reduces risk of pregnancy complications

## STABILIZATION IN PREGNANCY: MAT

### Methadone

- Standard of Care since 1970s
- Dispensed daily by registered program
- 86% need up titration during pregnancy
- Many drug interactions
- Prolonged QT

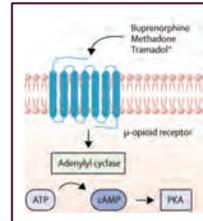


### Buprenorphine (Subutex)

- Only opioid agonist approved for treatment of OUD in office-based setting
- Less dosage adjustment in pregnancy
- Less severe NAS
- Increased diversion risk



## METHADONE



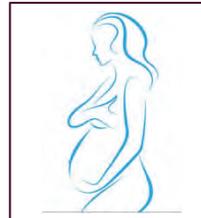
- Synthetic racemic mixture
  - R-Methadone: Full  $\mu$ - and  $\delta$ -opioid receptor agonist
  - S-Methadone: Non-competitive NMDA antagonist
- Reduces opioid cravings and withdrawal symptoms, avoids euphoric effects of non-medical opioids
- Plasma Peak: 2-6 hours
- Variable elimination half life
- Requires 5 half lives for steady state plasma level
- 60mg-120mg/day

## BUPRENORPHINE



- Synthetic opioid- Partial  $\mu$ - opioid receptor agonism
- Displaces & blocks other opioid binding
- Ceiling Effect
  - Respiratory depression
  - Sedation
- Dosing 4-32mg/day
- Pharmacokinetics
  - Onset: 30-60min
  - Half-life: 32 hours
- May precipitate withdrawal

## INTRAPARTUM CARE



- Antenatal Anesthesia Assessment
- Continue MAT during labor & delivery
- Challenging pain management
  - Parturients may require higher opioid analgesic doses
  - Multimodal approach is key
- Avoid mixed agonist - antagonists
  - Nalbuphine (Nubain), butorphanol (Stadol), pentazocine
  - May precipitate withdrawal

## MAT- LABOR ANALGESIA

- Continue MAT
  - Buprenorphine can be increased by 50% -> Divide into TID dosing
  - Maintain Methadone dose
- Neuraxial Analgesia
  - Consider Dural Puncture Epidural (DPE)
  - Increase local anesthetic concentration
    - 0.08% Bupri to 0.125% Bupri
  - Increase opioid concentration in Epidural
    - 4mcg/ml Fentanyl
  - Adjuvants
    - Epidural Clonidine – 1µg/kg up to 60µg
    - Nitrous Oxide



## POST PARTUM CARE-VAGINAL DELIVERY

- Continue maintenance MAT
- Scheduled Acetaminophen
  - 1000mg Q8 hours PO
- Scheduled NSAIDs
  - Ketorolac- 15mg Q6 hours IV
  - Ibuprofen- 600mg Q6 Hours PO
  - Naproxen- 500mg Q 12 Hours PO



## CESAREAN DELIVERY

### Intrathecal Morphine

- Increase Dose – 200-300mcg
- Synergistic w/ Buprenorphine

### Spinal Adjuvants

- Intrathecal Clonidine: 30mcg
- Intrathecal Epinephrine: 100-200mcg

### Intraoperative breakthrough Pain

- Dexamethasone (10mg IV Bolus)
- Ketamine (10mg-30mg IV Bolus)
- Dexmedetomidine (16mcg-30mcg IV Bolus)
- Nitrous Oxide

Chen LH Acta Pharmacol Sin. 2000 Aug;21(8):685-9  
 Leighton BL Anesth Analg. 2017 Nov;125(5):1779-1783  
 Yang Exp Ther Med. 2020 Mar;10(3):1741-1754.

## POST PARTUM CARE- CESAREAN DELIVERY

### Continue Maintenance MAT

- Methadone
- Buprenorphine

### Multimodal Analgesia

- Scheduled:
  - Acetaminophen
  - NSAIDs

### IV/PO Opioids

- Hydromorphone: 1.5 to 2x dose

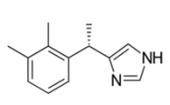


## DEXMEDETOMIDINE

**Preoperative analgesia with dexmedetomidine in opioid tolerance during pregnancy**

Chen Y, et al. J Clin Anesth. 2018;47:1-6. doi:10.1016/j.jclinan.2017.11.005

- Alpha-2 agonist
  - Sedative, anxiolytic, analgesia, antisympathetic effect
- Dosing:
  - Loading dose: 1mcg/kg over 10 mins
  - Consider infusion: 0.2-0.7mcg/kg/hr
- Side Effects
  - Bradycardia
  - Sedation



## KETAMINE

**The persisting analgesic effect of low-dose intravenous ketamine after spinal anaesthesia for caesarean section**

Chen Y, et al. J Clin Anesth. 2018;47:1-6. doi:10.1016/j.jclinan.2017.11.005

- NMDA Antagonist
- Dosing:
  - Bolus: 0.5mg/kg IV
  - Infusion: 0.1-0.3mg/kg/hr IV
- Side Effects
  - Dysphoria
  - Sedation

**Low-dose ketamine infusion for post-caesarean delivery analgesia in patients with opioid use disorder**

Chen Y, et al. J Clin Anesth. 2018;47:1-6. doi:10.1016/j.jclinan.2017.11.005

## GABAPENTIN

**Post-caesarean gabapentin is not associated with lower opioid consumption or pain scores in women on chronic hyperalgesic therapy: A six-year retrospective cohort study**

Chen Y, et al. J Clin Anesth. 2018;47:1-6. doi:10.1016/j.jclinan.2017.11.005

- Anticonvulsant
- Dose
  - 600mg PO Once Pre-op
  - 200mg POTID Post-op
- Side Effects
  - Sedation
  - Dizziness
  - Breast Milk Transfer



**Perioperative gabapentin and post caesarean pain control: A systematic review and meta-analysis of randomized controlled trials**

Chen Y, et al. J Clin Anesth. 2018;47:1-6. doi:10.1016/j.jclinan.2017.11.005

## SUMMARY

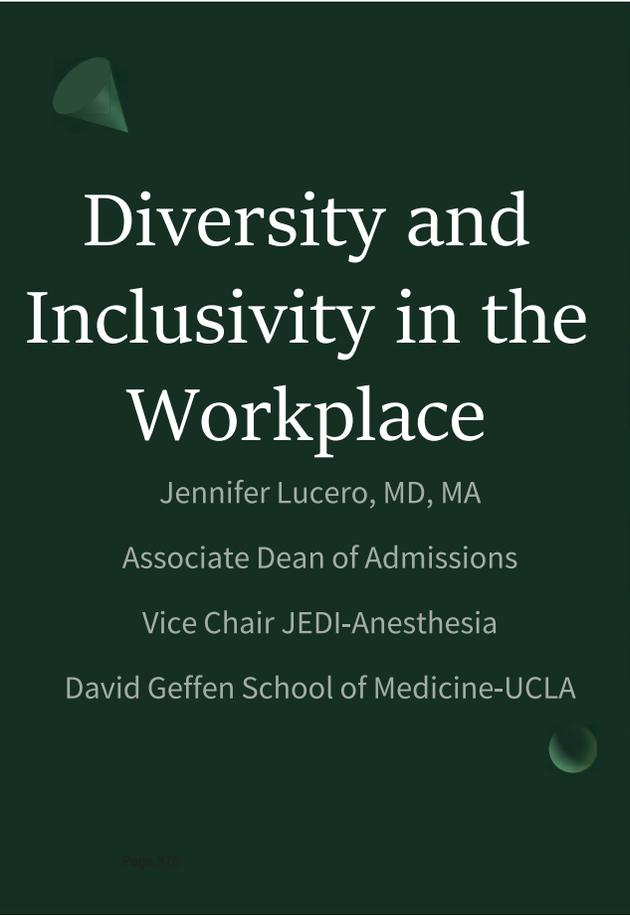
- Antenatal Anesthesia Consultation
- Continue Medication Assisted Therapy
- Monitor for withdrawal
- Early Epidural for labor
- Multimodal Analgesia
- Judicious Use of Adjuvants & Regional Blocks
- Discharge planning & coordinating with MAT prescriber



## REFERENCES

- 1. See SA, SAEF D, Whitmore DR, Peltus P, Wilson A, Lu M, et al. Gating for pregnant women with opioid use disorder in the USA: assessing and improving treatment. [doi:10.1111/daa.12337-03](#)
- 2. [http://dx.doi.org/10.1111/daa.12337-03](#)
- 3. Chen LH, Nemessy A, Song QY. Interaction of combined administration of naltrexone with buprenorphine or buprenorphine. *Asia Pac J Obstet Gynaecol*. 2018;18(1):61-6. PMID: 31021174.
- 4. *Commons Open Access*. 11. [https://doi.org/10.1111/daa.12337-03](#)
- 5. *Commons Open Access*. 11. [https://doi.org/10.1111/daa.12337-03](#)
- 6. *Commons Open Access*. 11. [https://doi.org/10.1111/daa.12337-03](#)
- 7. *Commons Open Access*. 11. [https://doi.org/10.1111/daa.12337-03](#)
- 8. *Commons Open Access*. 11. [https://doi.org/10.1111/daa.12337-03](#)
- 9. *Commons Open Access*. 11. [https://doi.org/10.1111/daa.12337-03](#)
- 10. *Commons Open Access*. 11. [https://doi.org/10.1111/daa.12337-03](#)
- 11. *Commons Open Access*. 11. [https://doi.org/10.1111/daa.12337-03](#)
- 12. *Commons Open Access*. 11. [https://doi.org/10.1111/daa.12337-03](#)
- 13. *Commons Open Access*. 11. [https://doi.org/10.1111/daa.12337-03](#)
- 14. *Commons Open Access*. 11. [https://doi.org/10.1111/daa.12337-03](#)
- 15. *Commons Open Access*. 11. [https://doi.org/10.1111/daa.12337-03](#)
- 16. *Commons Open Access*. 11. [https://doi.org/10.1111/daa.12337-03](#)
- 17. *Commons Open Access*. 11. [https://doi.org/10.1111/daa.12337-03](#)
- 18. *Commons Open Access*. 11. [https://doi.org/10.1111/daa.12337-03](#)
- 19. *Commons Open Access*. 11. [https://doi.org/10.1111/daa.12337-03](#)
- 20. *Commons Open Access*. 11. [https://doi.org/10.1111/daa.12337-03](#)
- 21. *Commons Open Access*. 11. [https://doi.org/10.1111/daa.12337-03](#)
- 22. *Commons Open Access*. 11. [https://doi.org/10.1111/daa.12337-03](#)
- 23. *Commons Open Access*. 11. [https://doi.org/10.1111/daa.12337-03](#)
- 24. *Commons Open Access*. 11. [https://doi.org/10.1111/daa.12337-03](#)
- 25. *Commons Open Access*. 11. [https://doi.org/10.1111/daa.12337-03](#)
- 26. *Commons Open Access*. 11. [https://doi.org/10.1111/daa.12337-03](#)
- 27. *Commons Open Access*. 11. [https://doi.org/10.1111/daa.12337-03](#)
- 28. *Commons Open Access*. 11. [https://doi.org/10.1111/daa.12337-03](#)
- 29. *Commons Open Access*. 11. [https://doi.org/10.1111/daa.12337-03](#)
- 30. *Commons Open Access*. 11. [https://doi.org/10.1111/daa.12337-03](#)
- 31. *Commons Open Access*. 11. [https://doi.org/10.1111/daa.12337-03](#)
- 32. *Commons Open Access*. 11. [https://doi.org/10.1111/daa.12337-03](#)
- 33. *Commons Open Access*. 11. [https://doi.org/10.1111/daa.12337-03](#)
- 34. *Commons Open Access*. 11. [https://doi.org/10.1111/daa.12337-03](#)
- 35. *Commons Open Access*. 11. [https://doi.org/10.1111/daa.12337-03](#)
- 36. *Commons Open Access*. 11. [https://doi.org/10.1111/daa.12337-03](#)
- 37. *Commons Open Access*. 11. [https://doi.org/10.1111/daa.12337-03](#)
- 38. *Commons Open Access*. 11. [https://doi.org/10.1111/daa.12337-03](#)
- 39. *Commons Open Access*. 11. [https://doi.org/10.1111/daa.12337-03](#)
- 40. *Commons Open Access*. 11. [https://doi.org/10.1111/daa.12337-03](#)
- 41. *Commons Open Access*. 11. [https://doi.org/10.1111/daa.12337-03](#)
- 42. *Commons Open Access*. 11. [https://doi.org/10.1111/daa.12337-03](#)
- 43. *Commons Open Access*. 11. [https://doi.org/10.1111/daa.12337-03](#)
- 44. *Commons Open Access*. 11. [https://doi.org/10.1111/daa.12337-03](#)
- 45. *Commons Open Access*. 11. [https://doi.org/10.1111/daa.12337-03](#)
- 46. *Commons Open Access*. 11. [https://doi.org/10.1111/daa.12337-03](#)
- 47. *Commons Open Access*. 11. [https://doi.org/10.1111/daa.12337-03](#)
- 48. *Commons Open Access*. 11. [https://doi.org/10.1111/daa.12337-03](#)
- 49. *Commons Open Access*. 11. [https://doi.org/10.1111/daa.12337-03](#)
- 50. *Commons Open Access*. 11. [https://doi.org/10.1111/daa.12337-03](#)
- 51. *Commons Open Access*. 11. [https://doi.org/10.1111/daa.12337-03](#)
- 52. *Commons Open Access*. 11. [https://doi.org/10.1111/daa.12337-03](#)
- 53. *Commons Open Access*. 11. [https://doi.org/10.1111/daa.12337-03](#)
- 54. *Commons Open Access*. 11. [https://doi.org/10.1111/daa.12337-03](#)
- 55. *Commons Open Access*. 11. [https://doi.org/10.1111/daa.12337-03](#)
- 56. *Commons Open Access*. 11. [https://doi.org/10.1111/daa.12337-03](#)
- 57. *Commons Open Access*. 11. [https://doi.org/10.1111/daa.12337-03](#)
- 58. *Commons Open Access*. 11. [https://doi.org/10.1111/daa.12337-03](#)
- 59. *Commons Open Access*. 11. [https://doi.org/10.1111/daa.12337-03](#)
- 60. *Commons Open Access*. 11. [https://doi.org/10.1111/daa.12337-03](#)
- 61. *Commons Open Access*. 11. [https://doi.org/10.1111/daa.12337-03](#)
- 62. *Commons Open Access*. 11. [https://doi.org/10.1111/daa.12337-03](#)
- 63. *Commons Open Access*. 11. [https://doi.org/10.1111/daa.12337-03](#)
- 64. *Commons Open Access*. 11. [https://doi.org/10.1111/daa.12337-03](#)
- 65. *Commons Open Access*. 11. [https://doi.org/10.1111/daa.12337-03](#)
- 66. *Commons Open Access*. 11. [https://doi.org/10.1111/daa.12337-03](#)
- 67. *Commons Open Access*. 11. [https://doi.org/10.1111/daa.12337-03](#)
- 68. *Commons Open Access*. 11. [https://doi.org/10.1111/daa.12337-03](#)
- 69. *Commons Open Access*. 11. [https://doi.org/10.1111/daa.12337-03](#)
- 70. *Commons Open Access*. 11. [https://doi.org/10.1111/daa.12337-03](#)
- 71. *Commons Open Access*. 11. [https://doi.org/10.1111/daa.12337-03](#)
- 72. *Commons Open Access*. 11. [https://doi.org/10.1111/daa.12337-03](#)
- 73. *Commons Open Access*. 11. [https://doi.org/10.1111/daa.12337-03](#)
- 74. *Commons Open Access*. 11. [https://doi.org/10.1111/daa.12337-03](#)
- 75. *Commons Open Access*. 11. [https://doi.org/10.1111/daa.12337-03](#)
- 76. *Commons Open Access*. 11. [https://doi.org/10.1111/daa.12337-03](#)
- 77. *Commons Open Access*. 11. [https://doi.org/10.1111/daa.12337-03](#)
- 78. *Commons Open Access*. 11. [https://doi.org/10.1111/daa.12337-03](#)
- 79. *Commons Open Access*. 11. [https://doi.org/10.1111/daa.12337-03](#)
- 80. *Commons Open Access*. 11. [https://doi.org/10.1111/daa.12337-03](#)
- 81. *Commons Open Access*. 11. [https://doi.org/10.1111/daa.12337-03](#)
- 82. *Commons Open Access*. 11. [https://doi.org/10.1111/daa.12337-03](#)
- 83. *Commons Open Access*. 11. [https://doi.org/10.1111/daa.12337-03](#)
- 84. *Commons Open Access*. 11. [https://doi.org/10.1111/daa.12337-03](#)
- 85. *Commons Open Access*. 11. [https://doi.org/10.1111/daa.12337-03](#)
- 86. *Commons Open Access*. 11. [https://doi.org/10.1111/daa.12337-03](#)
- 87. *Commons Open Access*. 11. [https://doi.org/10.1111/daa.12337-03](#)
- 88. *Commons Open Access*. 11. [https://doi.org/10.1111/daa.12337-03](#)
- 89. *Commons Open Access*. 11. [https://doi.org/10.1111/daa.12337-03](#)
- 90. *Commons Open Access*. 11. [https://doi.org/10.1111/daa.12337-03](#)
- 91. *Commons Open Access*. 11. [https://doi.org/10.1111/daa.12337-03](#)
- 92. *Commons Open Access*. 11. [https://doi.org/10.1111/daa.12337-03](#)
- 93. *Commons Open Access*. 11. [https://doi.org/10.1111/daa.12337-03](#)
- 94. *Commons Open Access*. 11. [https://doi.org/10.1111/daa.12337-03](#)
- 95. *Commons Open Access*. 11. [https://doi.org/10.1111/daa.12337-03](#)
- 96. *Commons Open Access*. 11. [https://doi.org/10.1111/daa.12337-03](#)
- 97. *Commons Open Access*. 11. [https://doi.org/10.1111/daa.12337-03](#)
- 98. *Commons Open Access*. 11. [https://doi.org/10.1111/daa.12337-03](#)
- 99. *Commons Open Access*. 11. [https://doi.org/10.1111/daa.12337-03](#)
- 100. *Commons Open Access*. 11. [https://doi.org/10.1111/daa.12337-03](#)





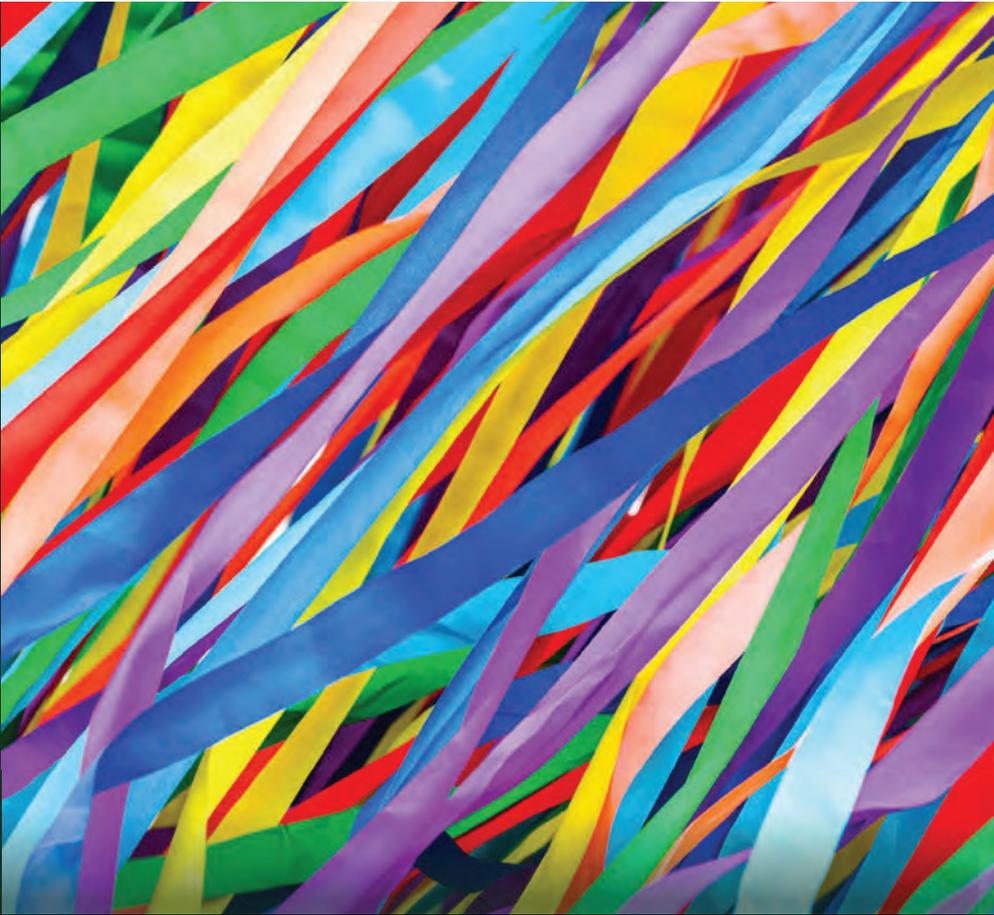
# Diversity and Inclusivity in the Workplace

Jennifer Lucero, MD, MA

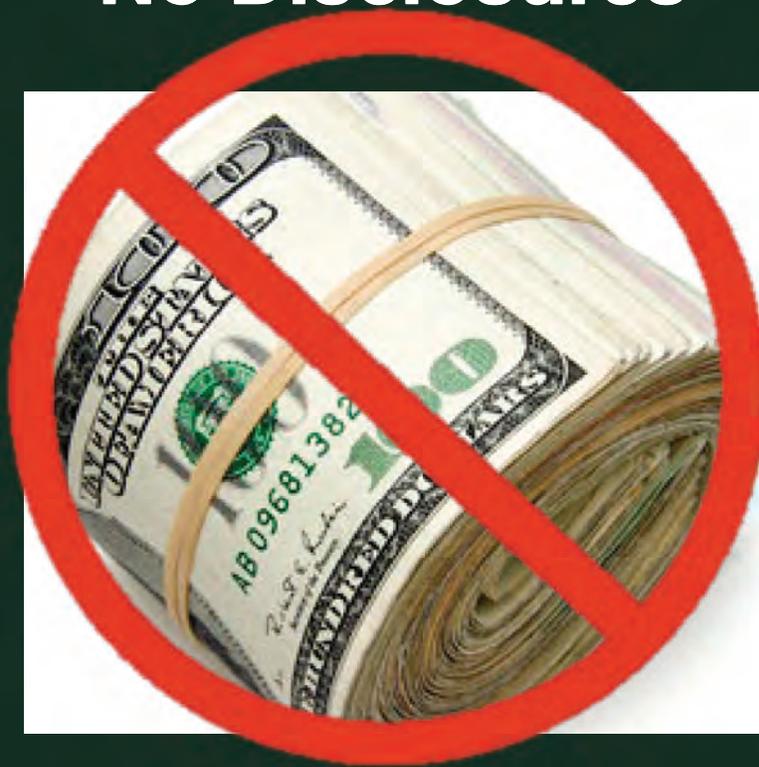
Associate Dean of Admissions

Vice Chair JEDI-Anesthesia

David Geffen School of Medicine-UCLA



# No Disclosures





# What is the Current State?

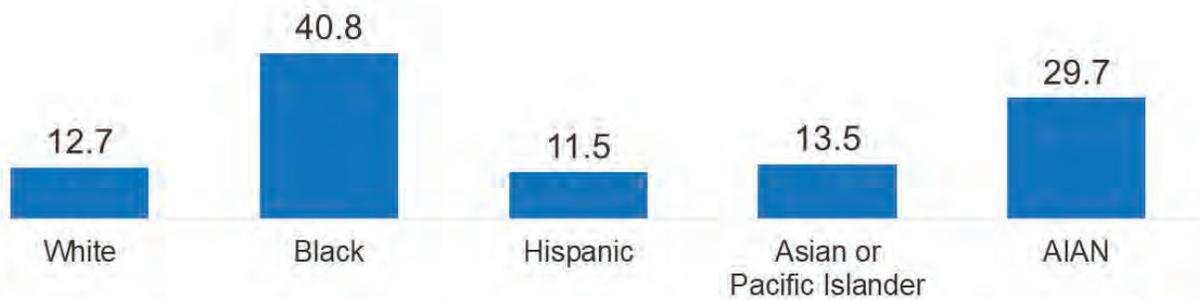
Why are we hearing about Diversity and Inclusion in the Workplace



Figure 1

## Pregnancy-Related Death Rate by Race/Ethnicity, 2007-2016

Per 100,000 live births:



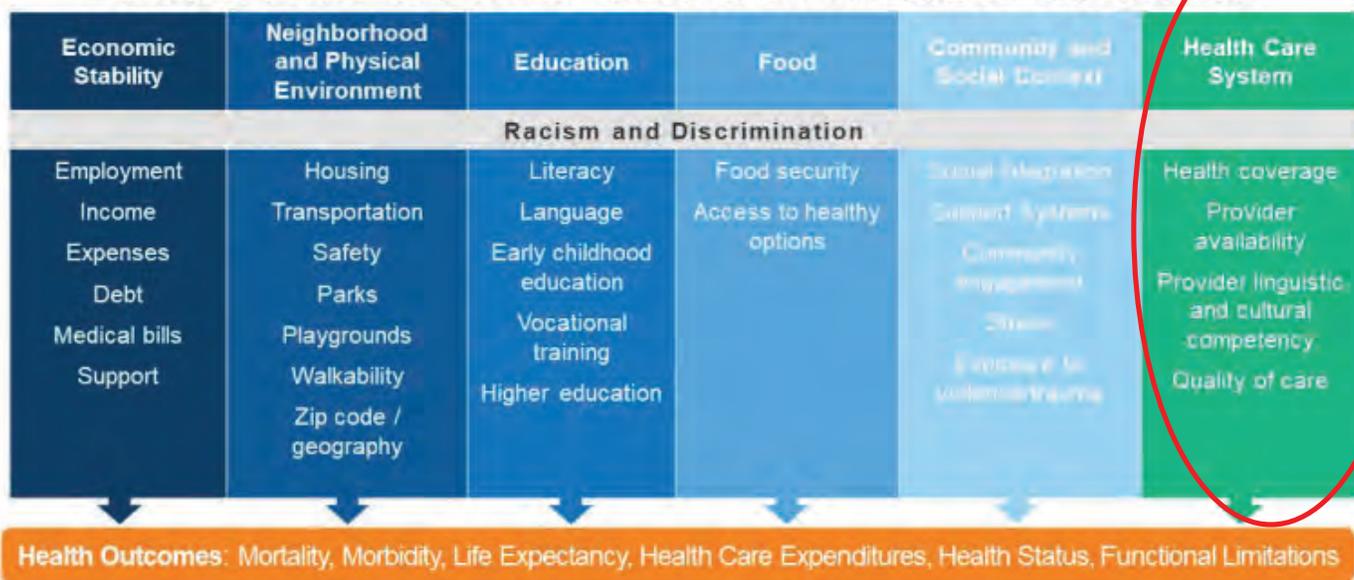
NOTE: AIAN refers to American Indian and Alaska Native people. Persons of Hispanic origin may be of any race but are categorized as Hispanic for this analysis; other groups are non-Hispanic.

SOURCE: Emily E. Petersen et al., "Racial/Ethnic Disparities in Pregnancy-Related Deaths—United States, 2007–2016," *Morbidity and Mortality Weekly Report* 68, no. 35 (September 2019): 762–765, <https://www.cdc.gov/mmwr/Volumes/68/wr/mm6835a3.htm>

**KFF**

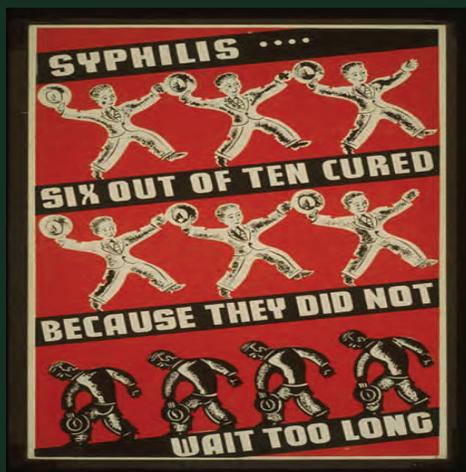
Figure 5

## Social and Economic Factors Drive Health Outcomes



# DARK HISTORY OF MEDICINE

TUSKEGEE: 1932 TO 1972



• HENRIETTA LACKS - HELA CELLS



# Historical Perspective

- Human Research Sordid Past
  - Tuskegee Syphilis Study
  - Chicago Malaria study of Prisoners
  - Henrietta Lacks-HeLa Cells
  - Cancer cells injected into Prisoners
  - Pneumocephalography Skull X-Ray studies



# Historical Perspective

- Havasupai Native Americans-Isolated tribe in Arizona
- Tribe concerned about devastating rates of Diabetes
- 1990 agreed to give DNA samples to University researchers to help understand the genetics of Diabetes
- The tribe found they had used the samples for other things such as, mental illness, and geographical origins



# Family Planning Health: Ethics and Disparities

- Family Planning in the 70's benefited primarily White middle Class
  - Access to reversible contraception
  - Minority and working class communities wanted greater reproductive control (reversible)
- 1975 Madrigal v. Quilligan – Class action lawsuit
  - Patients Mexican-origin were coerced into post-partum tubal ligations
  - Minutes or hours after cesarean deliveries
  - Some patients never even consented



# Family Planning Health : Ethics and Disparities

- Prisoners targeted for permanent sterilization procedures
  - 150 inmates from 2006-2010
  - At least 148 received Tubal ligations in violation of prison rules during those 5 years
  - Possibly 100 more dating back to late 1990's
  - 1997- 2010 state "We" paid doctors \$147,460 to perform procedure



*Quote from an OB-GYN Physician that performed  
these procedures*

“Over a 10- year period that isn’t a huge amount of money”

“Compared to what you save in welfare paying for these unwanted children- as they procreated more”



# Diversity



[trainingjournal.com](http://trainingjournal.com)

- Diversity is a presence of difference in a given setting
- Diversity is about a collective or a group and can only exist in relationship to others
- Individuals may bring diversity to your team, but they in themselves are not diverse



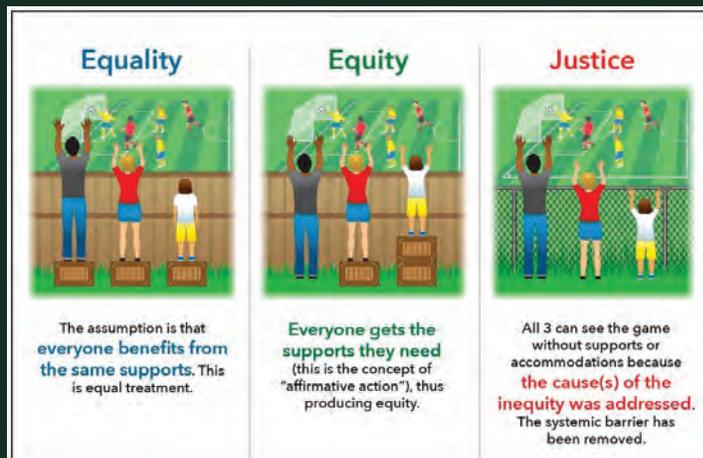
# Inclusion



- Inclusion is about folks with different identities feeling and/or being valued, leveraged, and welcomed within a given setting
- What is the experience for individuals who are the minority within the organization?
- What barriers stand in the way of people with marginalized identities feeling a sense of welcome and belonging?

# Equity

- Ensures everyone access to the same opportunities
- Equity is a process that begins by acknowledging that unequal starting place and continues to correct and address the imbalance





**DISPARITIES IN PATIENT EXPERIENCES,  
HEALTH CARE PROCESSES, AND OUTCOMES:  
THE ROLE OF PATIENT-PROVIDER RACIAL,  
ETHNIC, AND LANGUAGE CONCORDANCE**

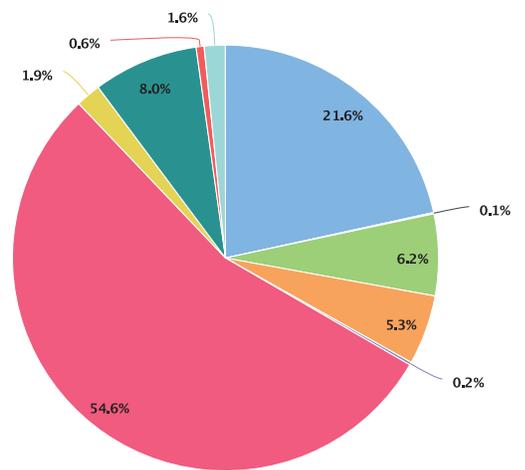
Lisa A. Cooper and Neil R. Powe  
Johns Hopkins University

July 2004

- Health Policy revision to support recruitment of minority students and medical faculty
- Health systems to optimize provider ability to establish rapport with minority patients to improve clinical practice and health care delivery
- Cultural competency training incorporated into the education of health professionals
- Future research should provide additional insight into the mechanisms by which concordance of patient and physician race, ethnicity and language influences processes and outcome of care.

That was  
2004....Where  
are we now?

Figure 13. Percentage of U.S. medical school graduates by race/ethnicity (alone), academic year 2018–2019.



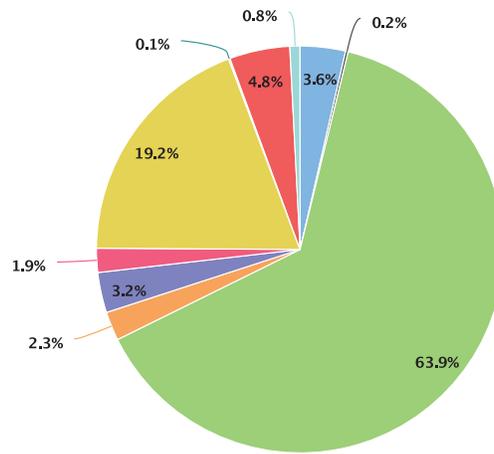
Click on legend item below to add or remove a section from the report.

- American Indian or Alaska Native (38)
- Asian (4,299)
- Black or African American (1,238)
- Hispanic, Latino, or of Spanish Origin (1,063)
- Multiple Race/Ethnicity (1,598)
- Native Hawaiian or Other Pacific Islander (9)
- Non-U.S. Citizen or Nonpermanent Resident (309)
- Other (380)
- Unknown Race/Ethnicity (124)
- White (10,879)

Note: Race/ethnicity "alone" indicates that an individual is reported in only one race/ethnicity category. The "Multiple Race/Ethnicity" category includes individuals who selected more than one race/ethnicity response. The "Non-U.S. Citizen or Nonpermanent Resident" category may include individuals with unknown citizenship.

Source: AAMC Data Warehouse: STUDENT and IND as of Aug. 19, 2019.

Figure 15. Percentage of full-time U.S. medical school faculty by race/ethnicity, 2018.



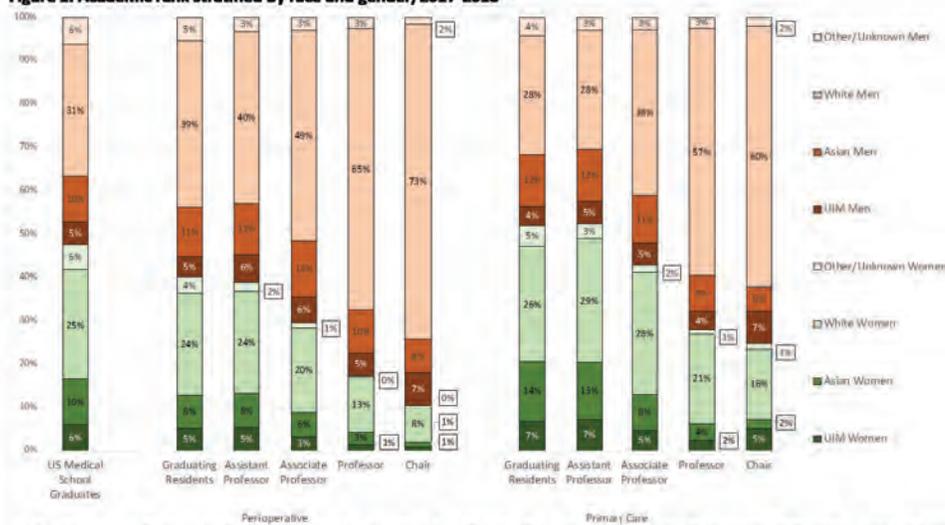
Click on legend item below to add or remove a section from the report.

- American Indian or Alaska Native (274)
- Asian (34,015)
- Black or African American (6,288)
- Hispanic, Latino, or of Spanish Origin (5,734)
- Multiple Race - Hispanic (3,978)
- Multiple Race - Non-Hispanic (3,441)
- Native Hawaiian or Other Pacific Islander (141)
- Other (1,456)
- White (112,894)
- Unknown (8,511)

Note: To allow for unduplicated counts of faculty, "Multiple Race - Hispanic" includes all faculty who were reported as Hispanic and at least one other race/ethnicity. "Multiple Race - Non-Hispanic" includes all faculty who were reported as more than one race/ethnicity but who were not reported as Hispanic.

Source: AAMC Faculty Roster as of Dec. 31, 2018.

**Figure 1: Academic rank stratified by race and gender, 2017-2018<sup>1-6</sup>**

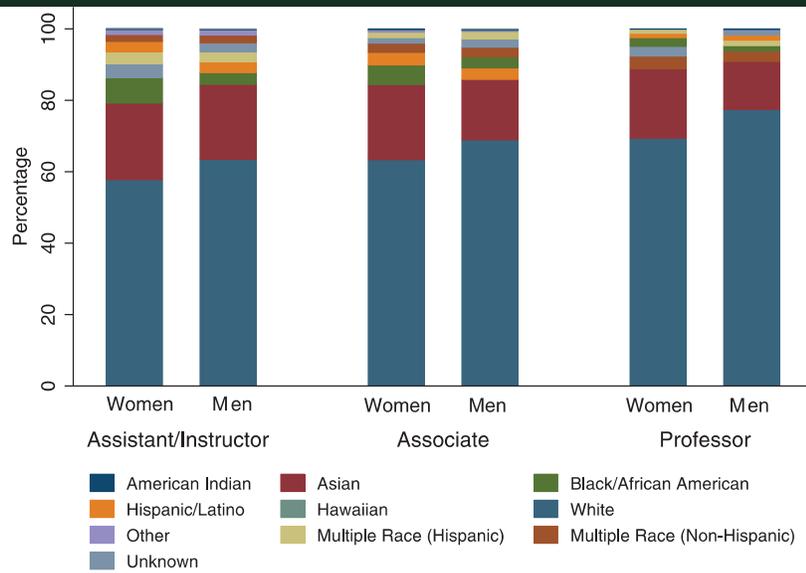


1. The category, "Perioperative," includes Departments of Anesthesiology, Obstetrics/Gynecology, Ophthalmology, Otolaryngology, Orthopedic surgery, and Surgery as listed in the AAMC Faculty Roster. The AAMC Faculty Roster groups all other surgical specialties not explicitly listed on the AAMC Faculty Roster into the "Surgery" category.
2. The category, "Primary Care," includes Departments of Internal Medicine, Family Medicine, and Pediatrics as listed in the AAMC Faculty Roster.
3. Specialties at the resident rank were categorized to be consistent with the specialty categories listed in the Faculty Roster.
4. "UIM" is an acronym for Underrepresented in Medicine and includes the following male and female categories at all academic ranks: American Indian or Alaskan Native, Black or African American, Hispanic, Latino or of Spanish Origin, Native Hawaiian or Other Pacific Islander. UIM at the faculty and chair rank also includes individuals categorized as "Multiple Race-Hispanic." The "Other/Unknown" category includes "Multiple Race" at the medical student and resident ranks and "Multiple Race-Non-Hispanic" at the faculty and chair ranks, and "Other" or "Unknown" at every rank. Non-U.S. citizens and non-permanent residents at the medical student and resident ranks were excluded.
5. The weighted average percentage of each race and gender category at each academic rank was determined by calculating the combined race and gender percentages for each specialty multiplied by the frequency weight (i.e., the proportion of individuals within each specialty included in the "Perioperative" or "Primary Care" categories at each rank, respectively), then summing the weighted percentages for each combined gender and race category within each rank.
6. 2018 medical school graduate data was obtained from the AAMC Facts Table at [https://www.aamc.org/system/files/2019-11/2019\\_FACTS\\_Table\\_B-4.pdf](https://www.aamc.org/system/files/2019-11/2019_FACTS_Table_B-4.pdf). A custom data report for 2017 residency graduates categorized by specialty, race and gender was obtained directly from the AAMC. Faculty data was obtained from the 2018

Chen, C.L., Lucero, J.M. We Asked the Experts: Breaking the Cycle of Attrition in Perioperative Academic Medicine. *World J Surg* 45, 53–56 (2021). <https://doi.org/10.1007/s00268-020-05651-7>

# Intersection of gender, race and academic rank in Anesthesia

Figure Percentage of anesthesiologists by gender, race, and academic rank



[Redacted]

## Calling Out Aversive Racism in Academic Medicine

Catherine L. Chen, M.D., M.P.H., Gregg J. Gold, Ph.D., Maxime Cannesson, M.D., Ph.D., and Jennifer M. Lucero, M.D.

*“We want diversity, but we also want qualified people.”*

*“They are clearly qualified for the job, but they’re too ‘in your face’; I’m worried people won’t respect their opinions.”*

*“If he just kept his head down and stayed under the radar, he would be a lot more successful.”*

*“She was a promising candidate, but she just wasn’t the right fit for our department.”*

*“But I voted for Obama.”*

# Aversive Racism in Medicine

- Aversive Racism definition: *a social psychology concept defined in the 1990's aversive racism occurs when people endorse egalitarian values in principle, but when faced with an ambiguous situation or unclear guidelines, discriminate against people from historically marginalized groups, while justifying their actions on the basis of other factors other than race.*

## Racial Attitudes, Physician-Patient Talk Time Ratio, and Adherence in Racially Discordant Medical Interactions

Naoy Hagiwara<sup>1</sup>, Louis A. Penner<sup>2</sup>, Richard Gonzalez<sup>3</sup>, Susan Eggly<sup>2</sup>, John F. Dovidio<sup>4</sup>, Samuel L. Gaertner<sup>5</sup>, Tessa West<sup>6</sup>, and Terrance L. Albrecht<sup>2</sup>

### Aversive Racism and Medical Interactions with Black Patients: A Field Study

**Louis A. Penner**,  
Karmanos Cancer Institute and Department of Family Medicine and Public Health Sciences Wayne State University Research Center for Group Dynamics University of Michigan  
**John F. Dovidio**,  
Department of Psychology Yale University  
**Tessa V. West**,  
Department of Psychology New York University  
**Samuel L. Gaertner**,  
Department of Psychology University of Delaware  
**Terrance L. Albrecht**,  
Karmanos Cancer Institute and Department of Family Medicine and Public Health Sciences Wayne State University  
**Rhonda K. Dalley**, and  
Department of Family Medicine and Public Health Sciences  
**Tsveti Markova**,  
Department of Family Medicine and Public Health Sciences

### Physician Racial Bias and Word Use during Racially Discordant Medical Interactions

Naoy Hagiwara<sup>a</sup>, Richard B. Statcher<sup>b</sup>, Susan Eggly<sup>c</sup>, and Louis A. Penner<sup>d</sup>

<sup>a</sup>Department of Psychology, Virginia Commonwealth University

<sup>b</sup>Department of Psychology, Wayne State University

<sup>d</sup>Department of Oncology, Wayne State University/Karmanos Cancer Institute

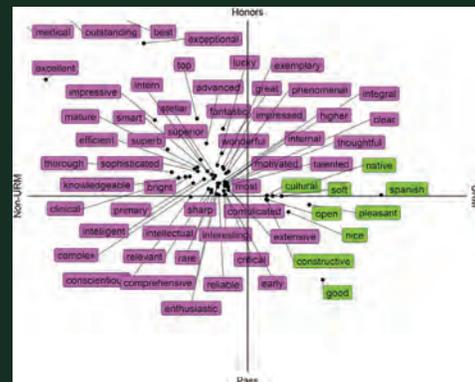
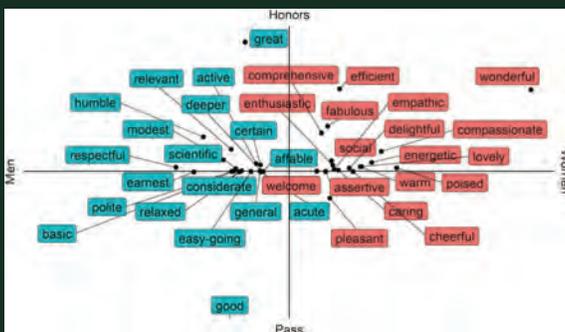
# Aversive Racism in Undergraduate and Graduate Medical Education

## Differences in Narrative Language in Evaluations of Medical Students by Gender and Under-represented Minority Status



Alexandra E. Rojek, AB<sup>1</sup>, Raman Khanna, MD, MAS<sup>2</sup>, Joanne W. L. Yim, PhD<sup>3</sup>,  
Rebekah Gardner, MD<sup>4</sup>, Sarah Lisker, BA<sup>1,5</sup>, Karen E. Hauer, MD, PhD<sup>1</sup>, Catherine Lucey, MD<sup>1</sup>, and  
Ummimala Sarkar, MD, MPH<sup>1,5</sup>

<sup>1</sup>University of California, San Francisco School of Medicine, San Francisco, CA, USA; <sup>2</sup>Division of Hospital Medicine, University of California, San Francisco, School of Medicine, San Francisco, CA, USA; <sup>3</sup>Health Informatics, UCSF Health, University of California, San Francisco, San Francisco, CA, USA; <sup>4</sup>Warren Alpert Medical School of Brown University, Providence, RI, USA; <sup>5</sup>UCSF Center for Vulnerable Populations, San Francisco, CA, USA.

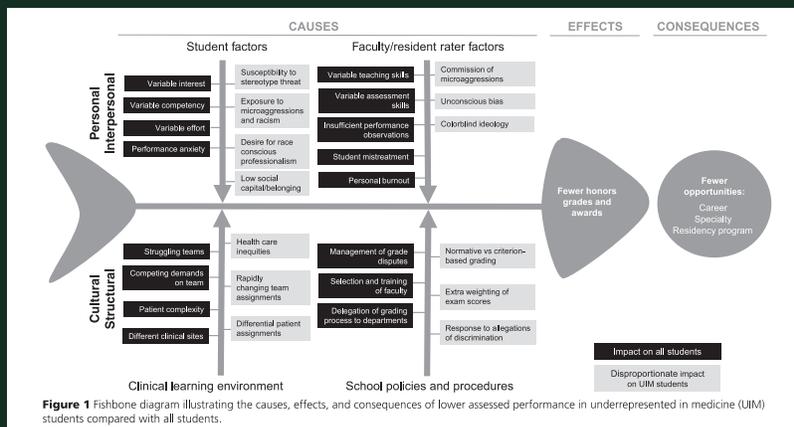


# Aversive Racism in Undergraduate and Graduate Medical Education

Perspective

## How Small Differences in Assessed Clinical Performance Amplify to Large Differences in Grades and Awards: A Cascade With Serious Consequences for Students Underrepresented in Medicine

Arianne Teherani, PhD, Karen E. Hauer, MD, PhD, Alicia Fernandez, MD, Talmadge E. King Jr, MD, and Catherine Lucey, MD





FEATURE  
**Why America's Black Mothers and Babies Are in a Life-or-Death Crisis**

Latinos see big jump in death rates

Latinos suffered the highest percentage increase in the mortality rate between 2019 and 2021 in Los Angeles County.



lost mothers: maternal mortality in the u.s.

**Black Mothers Keep Dying After Giving Birth. Shalon Irving's Story Explains Why**

December 7, 2017 · 7:51 PM ET  
Heard on All Things Considered

NINA MARTIN, PROPUBLICA  RENEE MONTAGNE

Listen · 12:11

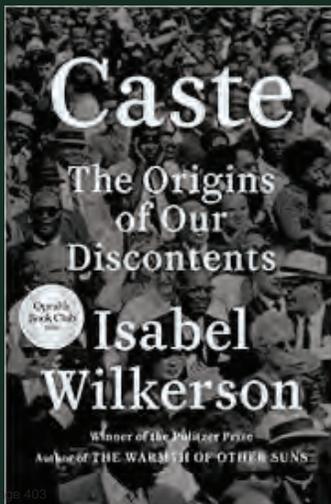
**Native American women tackle high rate of maternal mortality**



# Action Items- Best Practices

Educate	Educate yourself on the historical context of those who belong to historically marginalized communities
Understand	Understand the concepts within interpersonal dynamics: ingroup/outgroup, Aversive racism, implicit bias and social dominance theory-legitimizing myths
Understand and Practice	Understand and Practice Allyship
Redefine	Redefine the In-group to be more inclusive
Adopt	Adopt more Inclusive language

Dovidio JF; Gaertner SL. Aversive Racism. In. *Advances in Experimental Social Psychology*. Vol 36: Elsevier; 2004.



#### The Imperative for Transgender and Gender Nonbinary Inclusion

Heidi Moseson, PhD, MPH, Noah Zazanis, Eli Goldberg, BA, Laura Fix, MSW, Mary Durden, MA, Ari Stoeffler, BA, Jen Hastings, MD, Lyndon Cudlitz, BA, Bori Lesser-Lee, BA, Laz Letcher, PhDc, BA, Aneidys Reyes, MSW, BA, and Juno Obedin-Maliver, MD, MPH

(Obstet Gynecol 2020;00:1–10)

DOI: 10.1097/AOG.0000000000003816

# What's New with Postpartum Hemorrhage?

SOAP 54th Annual Meeting

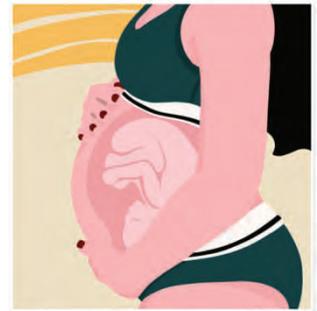
Jaime Daly MD Assistant Professor University of Colorado - Anschutz

I have no financial disclosures or conflicts of interest with the presented material in this presentation

## PPH: A Quick Review

**Blood flow to the uterus is 600 ml/min**

Postpartum blood loss control is **primarily dependent on uterine contraction** and to a lesser degree the coagulation cascade



## Postpartum hemorrhage is a leading preventable cause of maternal mortality

- 8% in the developed world (WHO)
- 20% in the developing world (WHO)
  - 11% in the US (CDC)

## PPH is defined as

blood loss of **1000 ml or more** associated with signs or symptoms of hypovolemia, **irrespective of the route of delivery**



**Primary PPH** occurs within the first 24 post delivery

**Secondary PPH** occurs between 24 hours and 12 weeks after delivery



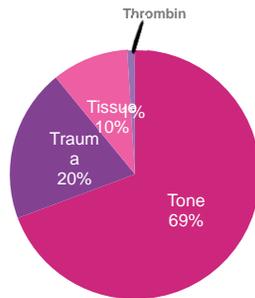
## PPH Risk Factors

- Placenta Accreta Spectrum (PAS)
- Abruptio
- Labor duration >12 hrs
- Infection
- Over-distended uterus
  - e.g LGA, poly, mult. gestation
- Any hypertensive disease of pregnancy
- Grand multiparity
- Obesity



## 4 T's of PPH

- **Tone**
- **Trauma**
  - Lacerations, rupture
- **Tissue**
  - Retained placenta
- **Thrombin**
  - Clotting factor deficiency



## PPH Management

### General Approach

- Coordinated multidisciplinary approach
- Accurate estimation of blood loss
- Good communication
- VS monitoring
- Fluid Replacement
- **Stop the source of bleeding**



## What's New with PPH Screening and Assessment?

## PPH Screening

### Prior to Delivery

- Screen all patients for PPH risk factors
- Identify patients at risk for PPH
- Optimize Hgb prior to delivery
- Seek multidisciplinary planning if appropriate
- Identify all patients at risk for PAS
- Identify appropriate location for delivery



## ACOG Maternal Levels of Care

Identifying and planning for the appropriate delivery location is critical

Level of Care	Requirement Description	Typical Conditions
Birth Center	Midwives	Low risk, singleton, vertex
Level 1: Basic Care	Capable of timely CD, physicians on-call, blood bank	Twins, TOLAC, uncomplicated CD, mild preeclampsia
Level 2: Specialty Care	OB/GYN medical directorship, OB in house, MFM consultants, Anesthesiologist with OB experience	Severe preeclampsia, placenta previa with NO hx of prior uterine surgery
Level 3: Subspecialty Care	ICU available, MFM medical directorship, Anesthesiologist in house	Placenta accreta and/or previa, adult respiratory management
Level 4: Comprehensive Care	Care for complex issues, Perinatal system leadership, all services in house	Severe maternal comorbidities

## PPH Screening

On Admission to L&D

- Assess patients for PPH risk factors
- Categorize risk strata (low, med, high)
- 2 IV cannulas for increased risk patients
- Obtain baseline labs
- Anesthesia service evaluation
- Document any contraindications to specific pharmacotherapies (e.g. asthma, htn)



In developed countries, PPH is a preventable cause of maternal mortality and morbidity.

Toolkits were created to overcome the human factors that lead to PPH related maternal mortality and morbidity.

## PPH Risk Assessment Resources

- California Maternal Quality Care Collaborative
- Association of Women's Health, Obstetric, and Neonatal Nurses (AWHONN)
- American College of Obstetricians and Gynecologists' Safe Motherhood Initiative

## Operationalizing PPH Risk Assessment

- PPH risk assessment is now a Joint Commission requirement
- Observational data indicates risk assessments are associated with reduced maternal mortality
- Embedding a toolkit within EHR improves efficiency, provides visual alerts and links to evidence based guidelines
- Studies are needed to look into the outcomes of these toolkits embedded within EHR, specifically in obstetrics

## Accuracy of Category-Based PPH Risk Assessment Toolkits

- Long story short: **There's room for improvement**
- Data shows variability in terms of which risk strata patients are placed
- 40% of PPH happens in low-risk patients, emphasizing the need for continuous assessment and vigilance
- Toolkits are part of the solution, but not **the total solution**



Current State and Future Direction  
of Postpartum Hemorrhage Risk Assessment  
Ende H. et al. Obstet Gynecol 2021

## Is QBL superior to EBL?

### Estimated Blood Loss

**Strengths:** doesn't require extra resources, cost effective

**Weaknesses:** imprecise, underestimates, may delay diagnosis of PPH

### Quantitative Blood Loss

**Strength:** more accurate

**Weaknesses:** time consuming, resource intensive, unclear if changes clinical outcomes



## Is QBL superior to EBL?

- A retrospective observational study done at a center that switched from EBL to QBL
- QBL is more sensitive test for detecting clinically significant blood loss
- QBL results in higher documented hemorrhage rates
- Conclusions
  - when comparing hemorrhage rates it is important to recognize if the center uses QBL or EBL
  - other studies have found QBL to overestimate, specifically in CD



QBL Improves Detection of PPH and Accuracy of PPH Rates  
Blosser C. et al 2021

## What's New with PPH Treatment?

## Use of Blood Products

### When to transfuse

- Blood loss >1500 ml or as soon as there are hemodynamic changes
- Hgb <7 or 8 g/dl
- FFP 1:1 with RBCs, titrate to INR of 1.5
- Plts < 75,000
- Fibrinogen < 2g/L
- Observational studies support TEG or ROTEM as part of PPH management



## Does TXA reduce PPH in a high resource setting?

### TRAAP Studies

- WOMAN Trial: TXA reduces mortality due to PPH in low resource settings
- TRAAP Study: TXA did not reduce the rate of PPH in patients who delivered vaginally and received prophylactic oxytocin when compared with placebo
- TRAAP2: TXA resulted in a lower incidence of calculated EBL greater than 1000 ml or red-cell transfusion by day 2 than placebo in patients who underwent CD and received prophylactic uterotonic. It did not result in a lower incidence of hemorrhage-related secondary clinical outcomes. **Clinical relevance unclear.**



Tranexamic Acid for the Prevention of Blood Loss after Vaginal Delivery  
Gentiles L. et al NEJM 2019

## Does PPH simulation training improve PPH outcomes?

- Long story short: **it does**
- OB-STaT curriculum improved communication, teamwork, and protocol adherence
- Implementation of a multidisciplinary sim program at a large academic center found faster administration times of meds and blood products



## Final Thoughts

## Final Thoughts

- A patient's PPH risk should be reevaluated throughout their labor course
- Remember 40% of PPH originally met a low risk criteria
- Whether OBL or EBL, take steps to be proficient at the approach in your unit
- Transfer care when indicated
- TXA doesn't reduce PPH morbidity in a high resource setting
- Start a sim program if you don't have one



## What the future may hold

- There is promising data supporting machine learning and AI to improve PPH prediction models
- More inter-society protocols and consensus statements
- Many opportunities for research



## Sources

1. Bienstock et al. *Postpartum Hemorrhage*. N Engl J Med 2021;384:1635-45
2. Ende et al. *Current State and Future Direction of Postpartum Hemorrhage Risk Assessment*. Obstet Gynecol 2021;138:924-30
3. Kawakita et al. *Evaluation of Risk Assessment Tools for Severe Postpartum Hemorrhage in Women Undergoing Cesarean Delivery*. Obstet Gynecol 2019;134:1306-16
4. Blosser et al. *Quantification of Blood Loss Improves Detection of Postpartum Hemorrhage and Accuracy of Postpartum Hemorrhage Rates: A Retrospective Cohort Study*. Cureus 13(2): e13591
5. ACOG Committee Opinion: QBL in Obstetric Hemorrhage
6. Sentilhes et al. *Tranexemic Acid for the Prevention of Blood Loss after Vaginal Delivery*. N Engl J Med 2018;379:731-42
7. Sentilhes et al. *Tranexemic Acid for the Prevention of Blood Loss after Cesarean Delivery*. N Engl J Med 2021; 384:1623-1634
8. Dillon et al. *Does Simulation Improve Clinical Performance in Management of Postpartum Hemorrhage?* Am J Obstet Gynecol 2021;225:435.e1-8.
9. Greer et al. *Obstetric Simulation Training and Teamwork: Immediate Impact on Knowledge, Teamwork, and Adherence to Hemorrhage Protocols*. Sim Healthcare 100:00-00, 2022.
10. Meyer et al. *External Validation of Postpartum Hemorrhage Prediction Models Using Electronic Health Record Data*. Am J Perinatol 2021



## The Obese Parturient

Sol Shnider Clinical Tract

Kathleen A. Smith MD, FASA  
 Professor of Anesthesiology and Obstetrics and Gynecology  
 University of North Carolina, Chapel Hill

SOAP 2022  
 ANNUAL MEETING

## Disclosures

I have no disclosures



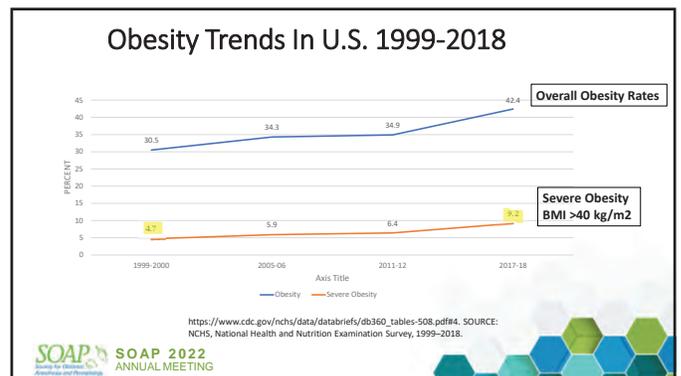
SOAP 2022  
 ANNUAL MEETING

## WHO Body Mass Index Classification

Category	BMI*
Underweight	Less than 18.5
Normal weight	18.5–24.9
Overweight	25.0–29.9
Obesity class I	30.0–34.9
Obesity class II	35.0–39.9
Obesity class III	40 or greater

BMI, body mass index.  
 \*Weight in kilograms divided by height in meters squared (kg/m<sup>2</sup>)  
 Obesity: preventing and managing the global epidemic. Report of a WHO consultation. World Health Organ Tech Rep Ser 2000;894:xi, 1–253.

ACOG Bulletin. Obesity in Pregnancy. Obstet Gynecol 2021





Obesity = ↑ Risk in Pregnancy

### Increased Fetal-Neonatal Risk

Congenital Anomaly	Increased Risk
Neural tube defects	OR, 1.59; 95% CI, 1.62–2.15
Spina bifida	OR, 2.34; 95% CI, 1.86–2.99
Cardiovascular anomalies	OR, 1.30; 95% CI, 1.12–1.51
Septal anomalies	OR, 1.20; 95% CI, 1.09–1.31
Cleft palate	OR, 1.23; 95% CI, 1.03–1.47
Cleft lip and palate	OR, 1.20; 95% CI, 1.03–1.40
Anorectal atresia	OR, 1.48; 95% CI, 1.12–1.97
Hydrocephaly	OR, 1.68; 95% CI, 1.19–2.36
Limb reduction anomalies	OR, 1.34; 95% CI, 1.03–1.73

Abbreviations: CI, confidence interval; OR, odds ratio.  
 Data from Stothard KJ, Tennant PW, Bell R, Rankin J. Maternal overweight and obesity and the risk of congenital anomalies: a systematic review and meta-analysis. JAMA 2009;301:636–50.

1-ACOG Bulletin #230. Obstet Gynecol 2021. 2-Nohr EA et al. Obstet Gynecol 2007. 3-Suk et al. J Mat Fetal Neonat Med 2016.

- Stillbirth
  - BMI > 50 kg/m<sup>2</sup>
    - 5.7-fold increase after 39 weeks
- Neonatal Mortality (RR 1.6)
- Neonatal ICU admissions (RR 1.76)

Comorbid Diseases	Hypertension/Cardiac dysfunction Proteinuria Non-alcoholic fatty liver Diabetes Sleep apnea Severe COVID disease
Obstetric Complications	GDM Preeclampsia Macrosomia, shoulder dystocia Abnormal labor, CD
Postpartum Complications	Hemorrhage, anemia Wound dehiscence, infection VTE Early termination breastfeeding Offspring- metabolic syndrome, DM, CV disease, cancer, asthma

ACOG Bulletin. Obesity in Pregnancy. Obstet Gynecol 2021. Kelly et al. Clin Sci (Lond) 2020.

### Just Another Day on L&D....

A 26 year-old G1P0 presents to L&D endorsing contractions. She is 3cm dilated and is requesting a labor epidural. Past medical history includes class 3 obesity (BMI 62 kg/m<sup>2</sup>), asthma and chronic hypertension. On exam, she has a Mallampati class 4 airway with short TM distance and limited neck range of motion.



## Labor Analgesia in Obese Parturients



- Epidural placement may be more challenging
  - Longer time to place neuraxial<sup>1</sup>
  - Higher replacement rate
- Lack of anatomic landmarks
- Difficult patient positioning
- Increased distance to epidural space
- False loss of resistance
- ↑ Hypotension and FHR decelerations<sup>2</sup>

1-Tonidandel et al. IJQA 2014. 2-Vricella et al. AJOG 2010.

SOAP 2022 ANNUAL MEETING

## Increasing Neuraxial Success



- Early epidural
- Sitting flexed position → shorter distance to epidural space
- Locate spinous process
- Elicit patient feedback
- Equipment
  - Longer epidural (5in), spinal (6.5in) needles
- Neuraxial ultrasound

Hamza et al. J Clin Anesth 1995, Sahin et al. J Anesth 2104, Tan. Curr Opin Anes 2019 (QR)

SOAP 2022 ANNUAL MEETING

## Securing Epidural Catheter



Position catheter  
LOR + 5cm



Patient Relaxes



Secure Lateral or  
Relaxed Position

SOAP 2022 ANNUAL MEETING

## Dural Puncture Epidural (DPE)

- Presence of CSF → Confirms loss of resistance, midline
- Conflicting evidence
  - Faster onset of analgesia, improved sacral spread
  - Improved catheter function (reduced top-ups and unilateral blocks)
- Ensure catheter functionality (advantage over CSE)

Heesen M et al. IJQA 2019. Wilson SH et al. Anesth Analg 2018. Layera S et al. J Clin Anesth 2019

SOAP 2022 ANNUAL MEETING

## Active Management of Epidural Catheter

- DENSITY
- LATERALITY
- COMFORT
- MOTOR BLOCKADE



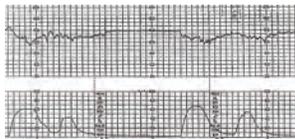
## The Next Day....

The following morning, when you arrive to work, the obstetrician informs you that this patient has met criteria for failure to progress and requires a cesarean delivery.



## Abnormal Labor Patterns and Increased Cesarean Rate

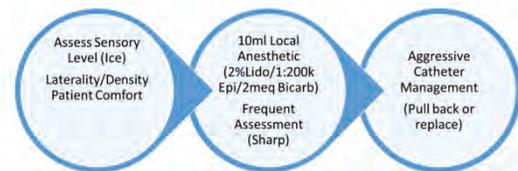
- Cesarean delivery increases linearly with increasing BMI
  - 52% of class 3 obese patients had CD in U.S., 2020<sup>1</sup> (aOR 2.89)
- Increased risk<sup>3-5</sup>
  - Failed IOL and VBAC<sup>3</sup>
  - Abnormal labor patterns
  - Pitocin augmentation
  - Prolonged 1<sup>st</sup> stage of labor<sup>5</sup>
  - Emergency CD, OR 3.4<sup>2</sup>



1-NCHS, CDC, 2021. 2- Lauth et al. J Gynecol Obstet Hum Repro 2021. 3-Wu et al. BMC Pregnancy Childbirth 2019. 4-ACOG Practice Bulletin 230. 5-Toniandandel et al. UOA 2014.

## Dosing Labor Epidural for Cesarean Delivery

### Existing Labor Epidural



## Catheter-Based Anesthetic for CD

Prolonged surgical times, Frequently >2 hours

CSE

- Fast onset, dense surgical block
- Ability to extend block
- Untested catheter

Epidural/DPE

- Slow Onset
- Proven epidural catheter
- DPE may improve success

Continuous Spinal

- In event of ADP or impossible neuraxial
- Incremental dosing, fast, dense block
- PDPH (40%), meningitis, neurological injury




## Spinal Dose in Obese Parturients

- Mixed findings in literature
- SOAP Serious Complication Repository Project (SCORE)<sup>1</sup>
  - Review of serious complications in OB anesthesia
  - Most common complication high block (1:4,336)
  - Obesity 31%
- MRI studies- reduced lumbar CSF volume in obese<sup>2</sup>
- Unpredictable local anesthetic spread
- Consider reduced spinal dose (BMI  $\geq 50$  kg/m<sup>2</sup>)<sup>3</sup>

1) D'Angelo et al. Anesthesiology 2014. 2) Hogan et al. Anesthesiology 1996. 3) Lamon et al. J Anesth 2017.




## Appropriate Equipment and Personnel

- Maximum **OR table weight**
  - Standard 500lb/205kg
  - Bariatric 800-1000lb (500lb side tilt)
  - Center of gravity not over fulcrum in lithotomy
  - Check bed manufacturer and name for weight limits
- Table extenders
- Safety belts, step stools
- Motorized lifts, additional personnel





## Appropriately Sized Blood Pressure Cuff






## Panniculus Retraction

- ↑ Aortocaval compression, hypotension
- ↑ Respiratory compromise
- Allows for low transverse skin incision
  - ↓ Postop pain, +/- wound complications<sup>1,2</sup>
- Vertical skin incision
  - Large panniculus → Supraumbilical
- Know surgical plan, incision location



SOAP 2022 ANNUAL MEETING

Wall P et al. Obstet Gynecol 2003.  
Marrs CC et al. Am J Obstet Gynecol 2014. ACOG #230.

## General Anesthesia

- Aspiration Prophylaxis, ↑ GERD
- Airway Preparedness
  - Difficult Intubation  
1:533-1:808, BMI ≥ 40, OR 2.02
  - Patient Positioning (ramp, reverse-T)
- Pre-oxygenate- 8 vital capacity breaths
- Apneic oxygenation
- FRC << CC in obese, supine



SOAP 2022 ANNUAL MEETING

Reale SC et al. Anesthesiology 2022

## Airway Management



- Video laryngoscopy with rigid stylet
- Most experienced provider
- Backup plan, help on standby
- Extubation
  - Fully awake, upright
  - NMBD reversed
  - CPAP, HFNC

SOAP 2022 ANNUAL MEETING

## Increased Risk of Hemorrhage

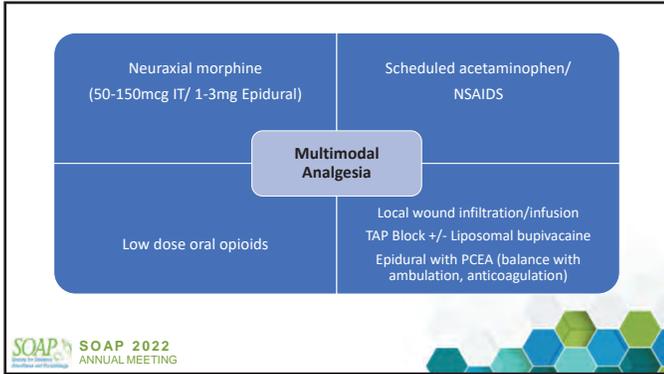
Dose response between maternal BMI and hemorrhage from uterine atony

- Active T&S
- Blood available if other risk factors
- Adequate intravenous access
  - 2<sup>nd</sup> IV if expect difficulty
  - Ultrasound, long IV catheter
  - Intraosseous in emergency
- Uterotonic agents in the room
  - Beware of comorbidities
- Obstetric hemorrhage bundle

Class 3 Obesity (BMI ≥40)	Odds Ratio
Uterine Atony (>1000ml)	2.14
Blood Transfusion	2.03

SOAP 2022 ANNUAL MEETING

Blomberg M. Obstet Gynecol 2011



### Obstructive Sleep Apnea (AHI ≥ 5/h)

- In-hospital mortality, OR 5.28
- Postoperative hypoxemia, hypercapnia, sudden death
- Post neuraxial opioid monitoring
  - RR and sedation score **q1 hour x12 hours**, then **q2 hours x 12-24 hours**
  - Continuous pulse oximetry → step down/ICU setting if needed
  - Supplemental oxygen (hypoxemia, respiratory depression)
  - Avoid sedatives, hypnotics
  - Reversal agents available
- Utilize non-invasive PPV (CPAP)

ACOG Bulletin #230. Obstet Gynecol 2021. Dominguez JE et al. Anesth Analg 2018.  
SOAP Consensus Statement. Anesth Analg 2019. ASA Practice Guidelines. Anesthesiology 2016.

SOAP 2022 ANNUAL MEETING

### Venous Thromboembolism Prophylaxis

- VTE in obese parturient (OR 5.3)<sup>2</sup>
- Pneumatic Compression Devices prior to CD
- Chemoprophylaxis for high risk patients**
  - BMI>50 + Cesarean delivery

Risk Factors (recommend chemoprophylaxis with ≥2)	
Thrombophilia (not already prophylaxis)	Peripartum hemorrhage
Age >40	Hysterectomy
BMI >30kg/m <sup>2</sup>	General anesthesia
Medical Complications (SCD, lupus, IBD, heart or kidney disease, DM, major infection)	Infection
Obstetric complication (Multiples, IUGR, HTN)	
Immobilization	

1- D'Alton ME et al. NPMs. Obstet Gynecol 2016.  
2- Larsen TB et al. Thromb Res 2007.

SOAP 2022 ANNUAL MEETING

### SOAP Consensus Statement

Anesthetic Management of Pregnant/Postpartum Women Receiving Thromboprophylaxis

Low	<ul style="list-style-type: none"> <li>Enoxaparin SQ 40mg QD/30mg BID</li> <li>Wait 12 hours</li> </ul>
Inter-mediate	<ul style="list-style-type: none"> <li>Enoxaparin SQ &lt;1.5mg/kg QD</li> <li>Insufficient Evidence (12-24h)</li> </ul>
High	<ul style="list-style-type: none"> <li>Enoxaparin SQ ≥ 1.5mg/kg QD or 1mg/kg BID</li> <li>Wait 24 hours</li> </ul>

Leffert et al. Anesth Analg 2018.

SOAP 2022 ANNUAL MEETING

## Take Home Points



- Obesity increases risk to mother and baby
- Labor
  - Early epidural
  - Active management, secure catheter lateral, DPE
- Caesarean delivery
  - Catheter based technique, consider reducing spinal
  - Beware of panniculus retraction
- Videolaryngoscopy 1<sup>st</sup> line
- Prepare for hemorrhage
- Multimodal analgesia, IT morphine
  - SOAP/ASA guidelines for post neuraxial opioid monitoring
- Incorporate recent anticoagulation into safety check

## 3 'Must Read' References



ACOG Practice Bulletin, Number 230. **Obesity in Pregnancy.** *Oster Gynecology* 2021.

Lamon AM , Habib AS. **Managing anesthesia for cesarean section in obese patients: current perspectives.** *Local Reg Anesth* 2016;16(9):45-57.

M. C. Mushambi et al. **Obstetric Anaesthetists' Association and Difficult Airway Society guidelines for the management of difficult and failed tracheal intubation in obstetrics.** *Anesthesia* 2015;70:1286-1306.

SOAP 2022 ANNUAL MEETING



Abstract #: SAT-BCR – 01

**Sustained Vasovagal Response Requiring Transvenous Pacing after Bakri balloon placement: A Case Report.**

**Presenting Author:** Won Lee, MD

**Presenting Author's Institution:** University of California - San Francisco

**Introduction:** Vasovagal responses can create circulatory collapse through bradycardia and paradoxical vasodilation. Procedure such as neuraxial anesthesia and abdominal insufflation have all been associated with vasovagal response via pain, anxiety, or stretch of tissues. With circulatory support and resuscitation, most vasovagal responses terminate quickly.[1] Here, we present an unusual case of sustained vasovagal response requiring transvenous pacing following Bakri Balloon placement for postpartum hemorrhage.

**Case:** A 33-year-old G1P0 patient at 37-week gestation with di-di gestation on flecainide for fetal tachyarrhythmia (last dose 100mg two hours prior to delivery) underwent spontaneous vaginal delivery with epidural analgesia. The course was complicated by postpartum hemorrhage of 1.3 liters due to uterine atony requiring Bakri Balloon placement, with later development of severe bradycardia. At a sustained nadir of junctional rhythm at 20 bpm, systolic blood pressure decreased to 60s. The patient had minimal heart rate response to glycopyrrolate or atropine. Initiation of dopamine infusion increased blood pressure without affecting HR. Given recent hemorrhage and unclear etiology of bradycardia, trial of Bakri Balloon deflation was deferred until pacing was obtained and hemodynamics had stabilized. After transfer to ICU, a right internal jugular introducer was placed and transvenous pacing was initiated with significant improvement in her heart rate and hemodynamics, allowing for cessation of dopamine. Bakri Balloon deflation was trialed after stabilization, 4 hours after hemorrhage, and upon deflation bleeding was minimal and patient shortly returned to normal sinus rhythm.

**Discussion:** Uterine and cervix tissues have vagus nerve innervation and insertion of intrauterine devices has triggered vasovagal shock.[2] Bakri Balloons, designed to temporize postpartum hemorrhage by inducing intrauterine tamponade can trigger the vagal afferent system, which can lead to increased parasympathetic activity at the sinoatrial and the atrioventricular (AV) nodes with profound bradycardia and circulatory collapse. Unlike typical vasovagal response, this patient experienced sustained hemodynamic instability requiring transvenous pacing. Although never been previously reported, it is possible that flecainide may have potentiated the vasovagal response. Flecainide is a sodium channel blocker with greatest effect on the His-Purkinje system. It can prolong atrial, AV nodal and ventricular refractory periods, and increase the endocardial pacing threshold.[3] Patients taking sodium channel or AV nodal blockade medications may warrant careful obstetric anesthesia evaluation, especially if the risk of postpartum hemorrhage is increased.

# Sustained Vasovagal Response Requiring Transvenous Pacing after Bakri balloon placement: A Case Report

Won Lee, MD,; Joyce Chang, MD; Dylan Masters, MD; Ronald George, MD FRCPC



33 G1P0 @ 37 week

Spontaneous Vaginal Delivery

PPH 1.3 L  
Uterine Atony



- Bakri Balloon Placed for PPH
- Subsequent Severe Symptomatic Bradycardia

•Nadir: 20 bpm, MAP 30mm Hg



- Flecainide for fetal tachyarrhythmia
- Last Dose Today

- Sodium Channel Blocker
- AV Nodal Blockade
- Increased Refractory Period



Transvenous Paced



Recovery after Bakri Deflation



Uterine Vagal Response

Abstract #: SAT-BCR - 02

## Reaction(R) Time prolongation on TEG in Parturients with Antiphospholipid Syndrome after discontinuation of Heparin

Presenting Author: Mohammed Idris, MD

Presenting Author's Institution: Beth Israel Deaconess Medical Center - Boston, Massachusetts

### Introduction:

Antiphospholipid Syndrome (APLS) is characterized by the presence of lupus anticoagulant and anticardiolipin antibodies (antibodies against phospholipids), which leads to an increased risk of recurrent venous and arterial thrombosis. APLS accentuates the hypercoagulable state of pregnancy and hence ACOG recommends these parturients be placed on heparin. These antibodies prevent the assessment of anticoagulation by interfering with assembly of prothrombinase complex on phospholipids in the aPTT assay leading to a false prolongation. Thromboelastography (TEG) assesses the effect of heparin by comparing coagulation with and without heparinase, thereby bypassing this error. We report two patients with APLS with prolonged Reaction (R) time, even in the kaolin TEG with heparinase channel, for up to 27 hrs after their last dose of heparin.

*Case 1:* A 36 y/o G2P0 at 37 weeks with APLS, Systemic Lupus Erythematosus, and h/o Deep Venous Thrombosis (DVT) and Pulmonary Embolus (PE) on 7500 U of subcutaneous heparin BID presented to the Labor and Delivery (L&D) in early labor. Her last dose of heparin was 6 hours prior. Since her baseline aPTT was prolonged, a TEG 6s global cartridge was used to monitor coagulation status. Several of her initial TEG values (Figure 1) were outside the reportable range at R>17.0 min, R with heparinase of 11.6 min, Kinetic Time>5.0 min, Alpha Angle< 43.8°. Her TEG was repeated four additional times with near normalization at 27 hrs.

*Case 2:* A 29 y/o G2P0 at 27 weeks with APLS, history of DVT/PE, epilepsy, and preeclampsia with severe features presents for cesarean delivery due to severe fetal growth restriction, abnormal dopplers, and fetal decelerations. Her heparin infusion was stopped 14 hrs prior. Initial TEG showed R of 11.2 min, R with heparinase of 9.1 min. Her TEG values normalized 22 hrs after discontinuation of the infusion.

Both patients received neuraxial analgesia/anesthesia safely.

### Discussion:

Parturients with APLS present a complex management challenge on L&D due to heparin administration and monitoring difficulties. Our patients had abnormally prolonged R values for about 22-27 hrs after their last dose of heparin and significantly longer than the current recommendations. Furthermore, the R values were only partially corrected in the heparinase channel of TEG 6s. This finding may represent prolonged activity of heparin or an unknown artifact affecting the TEG 6s assay. The normalization of these values over time would argue against the latter. Additional studies should be performed to better characterize these findings and their implications on the safe care of parturients with APLS.

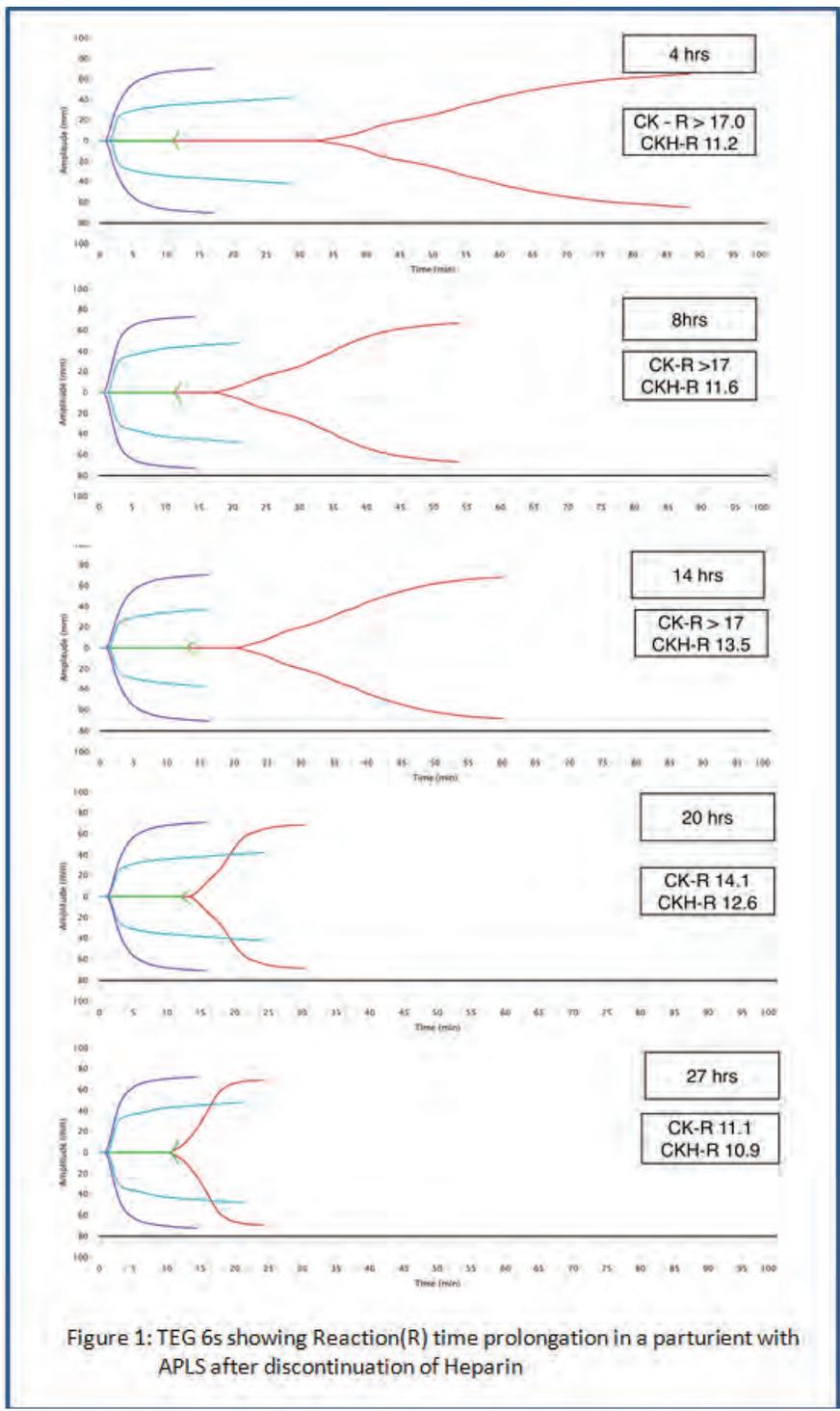


Figure 1: TEG 6s showing Reaction(R) time prolongation in a parturient with APLS after discontinuation of Heparin

## Reaction Time Prolongation on TEG in Parturients with Antiphospholipid Syndrome after discontinuation of Heparin

Mohammed Idris MD, John J. Kowalczyk MD, Yunping Li MD, Philip E. Hess MD

Beth Israel Deaconess Medical Center, Harvard Medical School, Boston, MA

### Introduction

- Antiphospholipid Syndrome (APLS): Presence of lupus anticoagulant and anticardiolipin antibodies (antibodies against phospholipids).
- Risk of recurrent venous and arterial thrombosis (up to 3%)
- APLS accentuates the hypercoagulable state of pregnancy.
- ACOG recommends APLS parturients receive anti-thrombotic treatment.
- Monitoring difficulty: These antibodies prevent the assessment of anticoagulation by interfering with assembly of prothrombinase complex on phospholipids in the aPTT assay leading to a FALSE prolongation<sup>1,2</sup>.
- TEG: Assesses<sup>3</sup> the effect of heparin by comparing coagulation with and without heparinase, thereby bypassing this error.

### Case 1

29 yo G2P0 at 27 weeks, scheduled for Cesarean delivery due to severe fetal growth restriction, abnormal dopplers, and fetal decelerations

**Medical History:** APLS, DVT/PE, epilepsy and preeclampsia with severe features

**Heparin:** Heparin infusion was stopped 14 hrs prior.

**Labs:** Baseline aPTT prolonged

**TEG 6s:** Global cartridge used

**Findings on TEG 6s:** Reaction time (R) of 11.2 min, R with heparinase of 9.1 min. All other TEG values were normal. Her TEG values normalized 22 hrs after discontinuation of the infusion.

## Reaction Time Prolongation on TEG in Parturients with Antiphospholipid Syndrome after discontinuation of Heparin

Mohammed Idris MD, John J. Kowalczyk MD, Yunping Li MD, Philip E. Hess MD

Beth Israel Deaconess Medical Center, Harvard Medical School, Boston, MA

### Case 2

A 36 yo G2P0 at 37 weeks in early labor

**Medical History:** APLS, SLE and h/o Deep Venous Thrombosis (DVT) and Pulmonary Embolus (PE)

**Med:** Heparin 7,500 U subcutaneous BID

**Heparin:** last dose 6 hours prior.

**Labs:** Baseline aPTT prolonged

**TEG 6s:** Global cartridge w/ heparinase used.

**Findings on TEG:** Several of the initial TEG values were outside the reportable range with Reaction time >17.0 min, Reaction time with heparinase of 11.6 min, Kinetic Time>5.0 min, Alpha Angle<43.8°. Her TEG was repeated four additional times and normalized after 27 hrs (Figure 1).

Both patients received neuraxial analgesia/anesthesia safely.

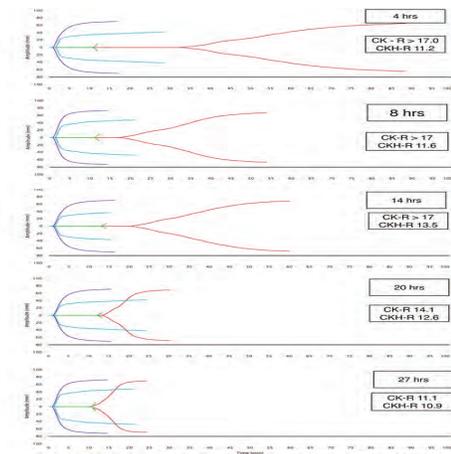


Figure 1: TEG 6s Global Cartridge with heparinase of Patient 2 at 4, 8, 14, 20 and 27 hours.

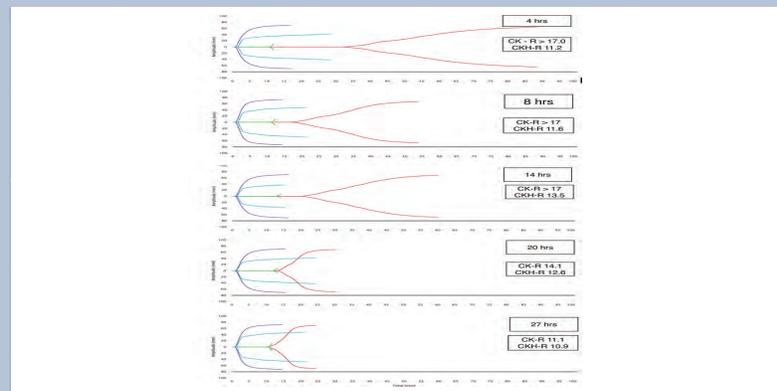
## Reaction Time Prolongation on TEG in Parturients with Antiphospholipid Syndrome after discontinuation of Heparin

Mohammed Idris MD, John J. Kowalczyk MD, Yunping Li MD, Philip E. Hess MD

Beth Israel Deaconess Medical Center, Harvard Medical School, Boston, MA

### Discussion

- Management is complicated in APLS due to heparin administration and baseline prolonged aPTT.
- Both patients had abnormally prolonged R values for about 22-27 hrs after their last dose of heparin and significantly longer than the current recommendations.
- R Values only partially corrected in the heparinase channel of TEG 6s.
- It may represent prolonged activity of heparin or an unknown artifact affecting the TEG 6s assay. The normalization of these values over time would argue against the latter.
- Additional studies should be performed to better characterize these findings and their implications on the safe care of parturients with APLS.



### References

1. ACOG Practice Bulletin No. 197 Summary, Obstet Gynecol. 2018 Jul;132(1):249-251
2. The Utility of Thromboelastography (TEG) In the Management of patients with Isolated Antiphospholipid Antibodies: Blood. 2010;116(21):3179-3179
3. International Journal of Obstetric Anesthesia. 2006, Vol.15 (2), p.177-177
4. The Society for Obstetric Anesthesia and Perinatology Consensus Statement on the Anesthetic Management of Pregnant and Postpartum Women Receiving Thromboprophylaxis or Higher Dose Anticoagulants

## Reaction Time Prolongation on TEG in Parturients with Antiphospholipid Syndrome after discontinuation of Heparin

Mohammed Idris MD, John J. Kowalczyk MD, Yunping Li MD, Philip E. Hess MD

*Beth Israel Deaconess Medical Center, Harvard Medical School, Boston, MA*

APLS  
Case 1  
Case 2  
On heparin



Stopped  
Heparin



TEG



'R' Prolonged for  
22-27 hrs



Abstract #: SAT-BCR -03

## Cardiovascular Collapse, Multi-Chamber Intracardiac Thrombosis, and Disseminated Intravascular Coagulation Following Dilation & Evacuation in a Post-partum Cardiomyopathy Patient

**Presenting Author:** Hilary Gallin, MD/MBA

**Presenting Author's Institution:** Massachusetts General Hospital

**Co-Authors:** Marvin Chang, MD - Massachusetts General Hospital

Rebecca Minehart, MD - Massachusetts General Hospital-Anesthesia, Critical Care and Pain Medicine

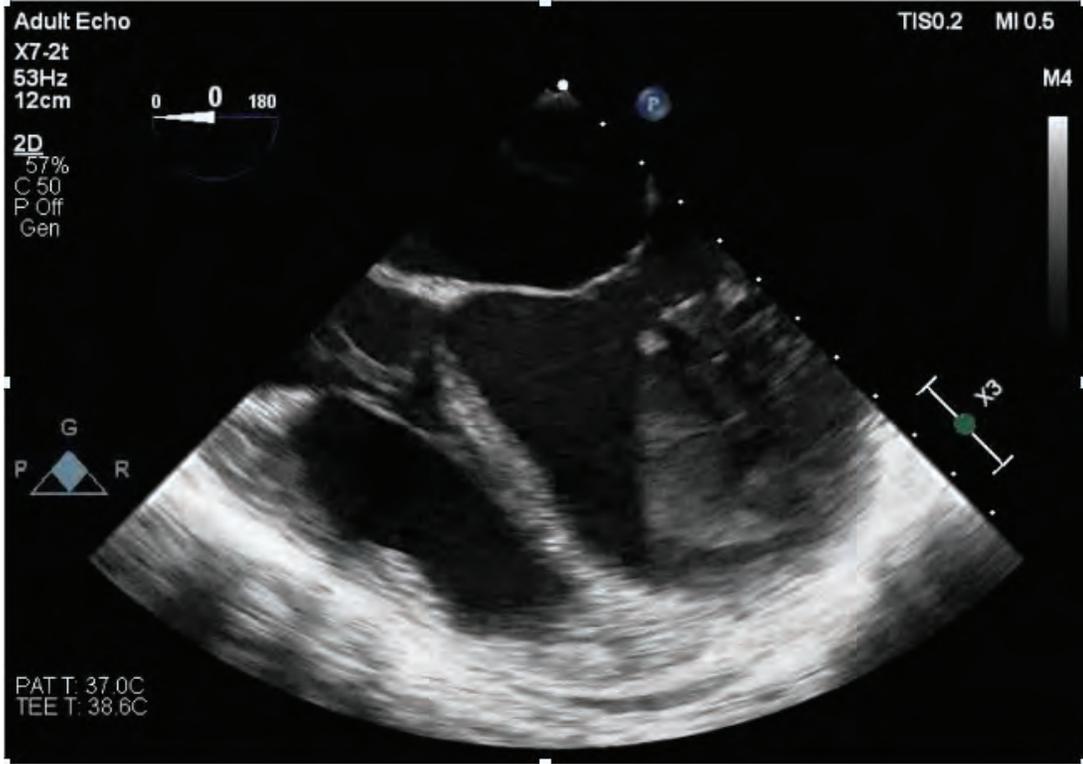
**Intro:** Peripartum cardiomyopathy (PPCM) is associated with 11% of maternal deaths<sup>1</sup>, both of which can be mitigated by performing a D&E in the highest risk patients. D&E are low risk procedures often performed in the office setting with low complication rates. We present a case of a patient with PPCM (EF 10%) who had cardiovascular collapse immediately following completion of a second trimester D&E procedure in the OR.

**Summary:** A 32yo female G4P3 at 16 weeks with PMH asthma and prior asymptomatic COVID was transferred from OSH where she presented with 4 months of worsening SOB. TTE revealed an LVEF 10%, moderately reduced RV function, moderate to severe MR, and RSVP of 60. Imaging was negative for PE, CAD, and DVT. She agreed to undergo a D&E to reverse her PPCM. Of note, she had tolerated a laparoscopic cholecystectomy under GA 3 weeks earlier. Her hemodynamics and volume status, as well as rhythm control of ventricular tachyarrhythmias was optimized by cardiology, and her prophylactic enoxaparin held the day before her D&E.

Her planned anesthetic for the D&E was MAC with a propofol infusion and ketamine. Initial vitals were BP 117/79, HR 115, and SpO<sub>2</sub> 100%, and were stable during the case. Immediately upon D&E completion, SpO<sub>2</sub> fell to the 70's despite no change in her spontaneous breathing. PPV was started and chest compressions were initiated. She was placed on peripheral ECMO. Differential diagnosis at the time included AFE, PE, or VAE. TEE was notable for a PFO and diffuse clots in all chambers of her heart including at the interface of the IVC and RA. Labs were notable for an INR 2.5, platelets 52, and Fibrinogen 177.

She was transferred to the ICU. She underwent surgical thrombectomy, biventricular assist device (BiVAD), and central ECMO cannulation. Her neurologic status deteriorated with imaging revealing significant embolic infarcts and was deemed not a candidate for heart transplant. Care was withdrawn by the family on POD 14.

**Discussion:** Our patient with cardiovascular collapse, multi-chamber intracardiac thrombosis, and DIC likely suffered an AFE, a rare complication of second trimester D&E<sup>2</sup>. Pregnant patients placed on extracorporeal life support (ECLS) have high survivability rates compared to other etiologies if the cause is primarily cardiac in nature<sup>3</sup>. In our patient, an embolic event may not have been preventable and likely decreased her survivability despite ECLS<sup>3</sup>.



# Neuraxial Anesthesia in a Patient with a Chronic Epidural Cerebrospinal Fluid Collection

Hilary Gallin, MD, MBA  
Obstetric Anesthesia Fellow  
Massachusetts General Hospital  
Boston, Massachusetts



Page 430



## Patient History

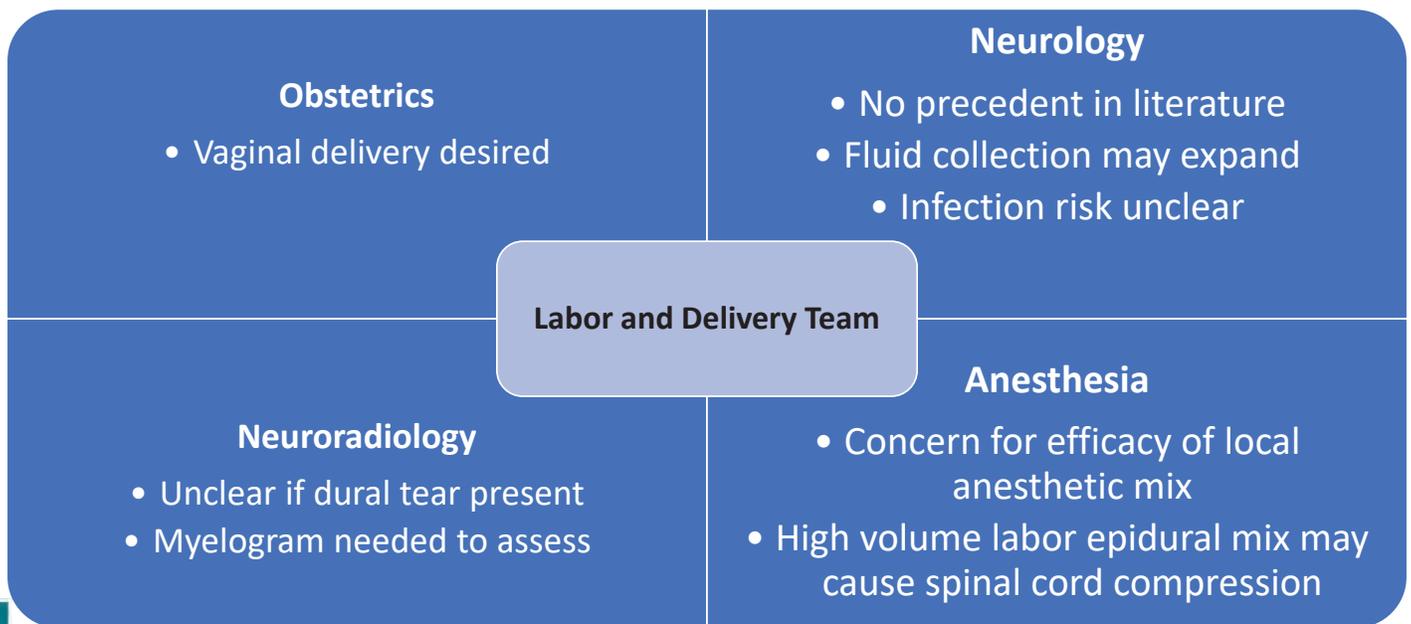
---



- A 36 yo G1P0 at 30w5d for consult
- PMH Multiple Sclerosis and epidural CSF leak
- Routine imaging for MS surveillance and had a stable “[anterior] epidural fluid collection [that] extended from the level of **C6 through L1**” thought to be due to a traumatic LP for MS diagnosis resulting in positional headaches
- CSF collection volume appeared **stable** on MRI and the patient **denied active symptoms**
- **Patient requested a labor epidural**



# Multidisciplinary Discussion



# Management and Outcome

## Labor Epidural to C-section

- Labor epidural placed
- Patient reported good coverage of labor pain
- Proceeded to Cesarean delivery due to failure to progress
- Epidural failed to convert despite chloroprocaine 3% 20cc
- General anesthesia induced due to non-reassuring fetal heart tracing
- **No neurological complications reported by patient**

## Discussion

- In the setting of neurological complications in planning for pregnancy, most emphasis is placed on intrinsic spinal cord lesions or intracranial lesions
- Epidural fluid collections are rarer with unclear management
- Multidisciplinary discussions were useful to delineate the potential risks from different clinical perspectives
- Emphasis placed on multidisciplinary monitoring of patient

**Abstract #: SAT-BCR – 04**

## **Cushing's Syndrome in Pregnancy: A Diagnostic Dilemma**

**Presenting Author:** Caroline L. Thomas, Obstetric Anesthesiology Fellow

**Presenting Author's Institution:** Northwestern Medicine

### **Background:**

Cushing's syndrome is rare in pregnancy due to the association of hypothalamic-pituitary-adrenal axis dysfunction with infertility. Diagnosis in pregnancy is challenging as it can be confounded by normal symptomatology of pregnancy and by the overlapping diagnostic criteria between Cushing's and pre-eclampsia.

### **Case:**

A 36-year-old G4P2 female was admitted at 21w1d for hypertension and dyspnea. Her past medical history was significant for an adrenal mass without follow up. Review of systems was concerning for swelling in her legs, blurry vision, intermittent episodes of panic, irritability, palpitations, excessive hair growth, easy bruising, and weight gain. Laboratory evaluation revealed transaminitis, elevated UPC, hyperglycemia, and hypokalemia.

Despite her early gestational age, the patient met criteria for pre-eclampsia with severe features, but also had a constellation of findings suggestive of endocrine pathology. A CT abdomen showed a 3.5cm adrenal mass with interval growth. Given that the obstetric recommendations would differ significantly based on a diagnosis of pre-eclampsia versus secretory adrenal mass (pheochromocytoma or cortisol-secreting), an endocrine evaluation was pursued. Free urine cortisol returned markedly elevated (2186, normal < 50) and plasma metanephrines were undetectable.

Clinical deterioration requiring aggressive diuresis and antihypertensive management prompted an uncomplicated laparoscopic adrenalectomy at 23w3d under general anesthesia. She was managed with rapid sequence induction, pre-induction arterial line, large bore IV access and maintenance of anesthesia with sevoflurane for uterine relaxation. Intra-operative hydrocortisone was administered. Close perioperative monitoring of hemodynamics, volume status and electrolytes was required given abrupt cessation of cortisol. Pre- and post-procedural fetal heart tones were normal.

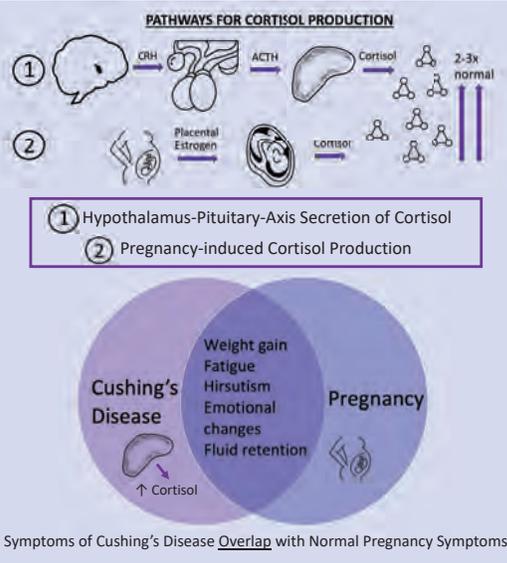
Post-operatively, she received a steroid taper. The patient's symptoms improved, hypertension resolved and she was discharged on post-operative day 7. Final pathology was consistent with diagnosis of a cortisol-secreting adrenal cortical adenoma.

### **Discussion:**

Multidisciplinary care between maternal fetal medicine, endocrinology, endocrine surgery, and anesthesia is required for diagnosis and management of Cushing's syndrome in pregnancy. While pre-eclampsia is common, a broader differential for hypertension and/or hypervolemia must be considered in a patient who presents at an early gestational age with co-morbid electrolyte disturbances, excessive hair growth, psychiatric complaints and palpitations. Treatment of hypertension for potential pre-eclampsia with beta-blockade could potentially lead to un-opposed alpha-agonism in the setting of yet-undiagnosed pheochromocytoma. Decisions regarding timing of delivery, fetal monitoring, and postpartum management should be shared to ensure optimal maternal and fetal outcomes.

# Cushing's Disease in Pregnancy

## PHYSIOLOGY



## CASE PRESENTATION & DIAGNOSIS

- 36-year-old G4P2 at 23 weeks EGA
- Hypertension, hypoxia, fatigue, anxiety, edema, and hirsutism
- History of adrenal mass

○ BP 164/81      ○ SpO2: 94%, 5L NC, RR 20  
○ HR 87            ○ Temperature 36.9 °C

○ ↑ Urine cortisol      ○ ↓ Metanephrines  
○ ↓ ACTH                ○ ↑ AST/ALT  
○ ↑ Urine protein:creatinine ratio

**MRI:** 3.5 cm adrenal mass with growth  
**Chest Radiograph:** pulmonary edema

Pre-eclampsia?  
Cushing's Disease?

## MANAGEMENT

**Clinical Optimization** with diuretics and antihypertensives

+

Multi-disciplinary care plan

↓

Laparoscopic adrenalectomy

↓

**Cortisol-secreting adrenal adenoma**

↓

Term vaginal delivery  
Healthy mom and baby

**Abstract #: SAT-BCR – 05**

**Medically Challenging Case: Intracranial hemorrhage in a pregnant patient with HELLP syndrome**

**Presenting Author:** Mohammed A. Hussain, DO

**Presenting Author's Institution:** University of Texas Medical Branch at Galveston - Houston, Texas

### **Introduction**

Intracranial hemorrhage (ICH) is relatively uncommon in pregnancy, with an estimated incidence of 0.01 to 0.05%, with vascular malformations as the most common cause of hemorrhagic stroke in this patient population [1-3]. Often, the presenting symptom is new onset tonic-clonic seizures. In contrast, the incidence of eclampsia is relatively higher at 0.08%, which also has a similar presentation of generalized tonic-clonic seizures in a woman with preeclampsia [5]. Treatment and diagnostics are very different for the two. The added urgency of fetal wellbeing, compounded by the diagnostic limitations associated with pregnancy, often pigeonholes providers into a narrower differential diagnosis that can lead to devastating morbidity and mortality.

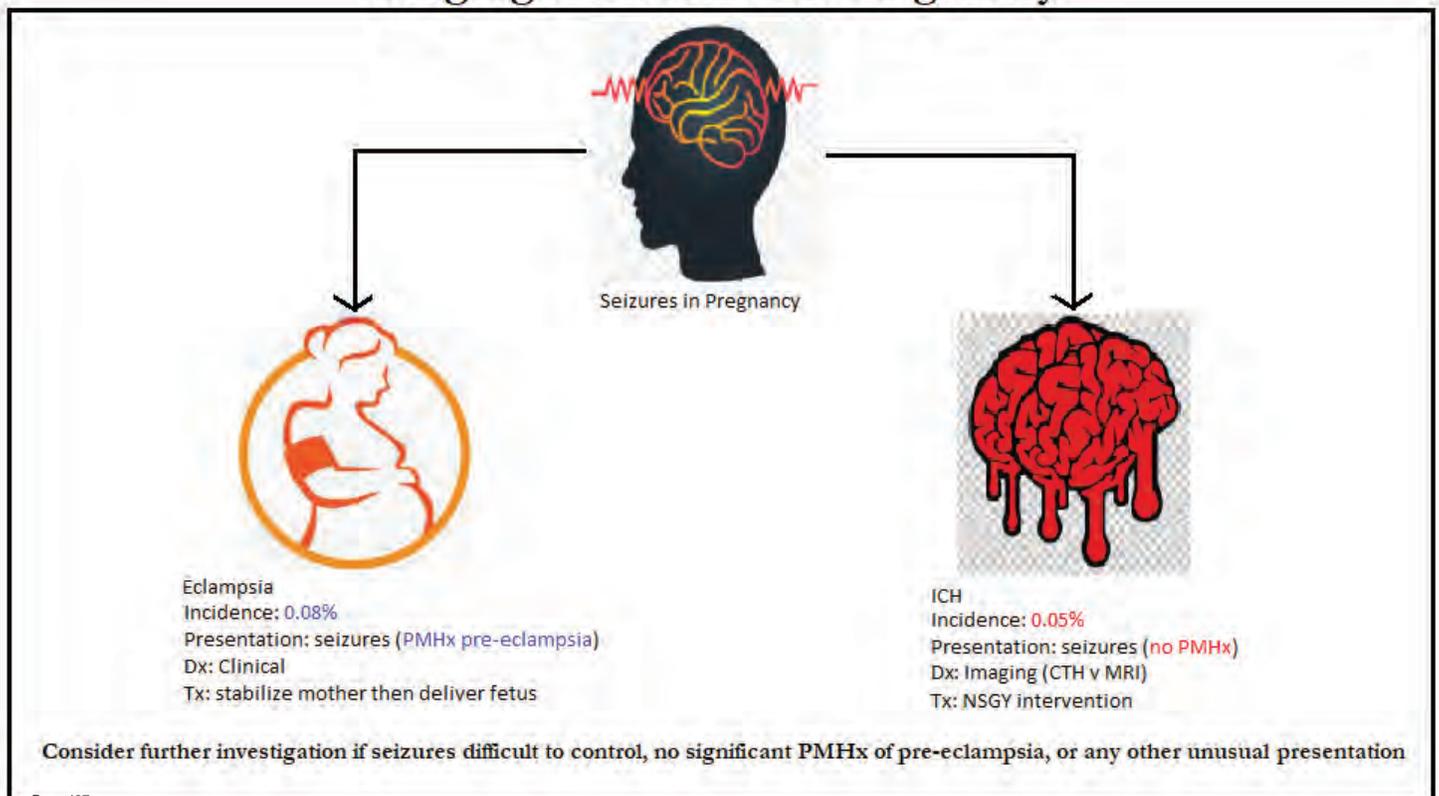
### **Methods (review of the case report)**

A 32-year-old and 26 weeks pregnant female was transferred to our institution for severe ranging blood pressures and seizures concerning for eclampsia. The patient arrived obtunded after administration of 55 mg valium by an outside institution and non-reassuring fetal heart tones. Shortly after arrival, and prior to labs resulting, she was taken for an emergent c-section under GETA. During surgery a coagulopathy was noted on labs, later diagnosed as HELLP syndrome. She was left intubated and sedated due to a poor neurologic exam, and admitted to the Surgical ICU. Despite sedation being stopped her neurological function did not improve, and she was further evaluated with an EEG and head CT. This revealed a large intraparenchymal hemorrhage with midline shift. Before any neurosurgical intervention, the patient's neurologic status abruptly worsened due to herniation. The family decided on a palliative extubation and autopsy, which noted her cause of death as ICH due to eclampsia.

### **Conclusion**

This case of a parturient with ICH in the setting of HELLP syndrome demonstrates a few crucial points in managing high risk parturients with neurologic abnormalities. The medical team should seek to stabilize the mother prior to delivery if possible. While the seizures in this case were initially attributed to eclampsia, given the difficulty in treating the seizures compounded by HELLP syndrome, further investigation into an underlying etiology is warranted. Perhaps if cerebral imaging had occurred earlier in her presentation, the ICH would have been detected and acted upon prior to devastating neurologic injury.

## Imaging for seizures in Pregnancy



**Abstract #: SAT-BCR-06**

**Severe Factor XI Deficiency in a Jehovah's Witness Parturient**

**Presenting Author:** Shradha D. Khadge, MD

**Presenting Author's Institution:** Cedars-Sinai Medical Center - West Hollywood, California

**Introduction:**

Factor XI (FXI) deficiency, also known as Hemophilia C, is a rare, autosomal recessive disorder with a variable phenotype with bleeding diathesis in some, but not all. Factor level correlates poorly with bleeding risk, even with a prolonged PTT. A positive bleeding history is the strongest predictor of postpartum hemorrhage. Treatment is FXI replacement with FXI concentrate (UK, France) or fresh frozen plasma (FFP), activating intrinsic clotting pathway beyond FXI with recombinant Factor VIIa (rFVIIa) and prevention of clot lysis with tranexamic acid (TXA). Management may be further complicated by refusal of human blood products.

**Case:**

37 y.o. G1P0 with PMH severe FXI deficiency and bleeding with: heavy menses, dental procedures, and gum bleeding with brushing. Prenatal FXI activity level < 1% (severe deficiency) and PTT 85. She was followed in Interdisciplinary Conference, including Hematology and Ethics for high-risk bleeding/refusal blood (Jehovah's Witness). Induced at 39 weeks. Admission FXI level 11%, PTT 67, and hematocrit 35. Our Jehovah's Witness refusal form lists for checkoff all specific components; she refused all human blood products, but accepted rFVIIa, cell salvage, and hetastarch. Per hematologist, the patient received TXA 1g Q6h and rFVIIa 15 mcg/kg Q6H initial prophylaxis. She received fentanyl PCA for initial pain control and continued as TEG was unavailable to evaluate adequacy of clotting for neuraxial in a timely fashion. She later went for cesarean delivery under general anesthesia. There were no issues with uterine tone or surgical site bleeding. She was continued on TXA and rFVIIa for 72h after delivery without bleeding nor thrombotic events.

**Discussion:**

Homozygous FXI results in severe deficiency with activity level < 15% and for bleeding history prophylaxis or treatment replacement is with FFP 10-20 cc/kg (FXI concentrate not available USA). As an alternative to FFP (refusal), prophylactic TXA and low dose rFVIIa were used. Thrombotic risks may be increased, especially at higher doses (90 mg/kg) rFVIIa or replacement of FXI in addition to TXA. This case required multidisciplinary planning and consideration of many points including FXI deficiency in pregnancy, Jehovah's Witness blood refusal, use of rFVIIa, safety and alternatives to neuraxial anesthesia, FXI testing, and correlation of viscoelastic testing as a predictor of neuraxial anesthesia safety or other site bleeding. Preoperative optimization opportunities include Hb support, high-risk consultations, specialized coagulation testing and the balance between thrombin generation and clot lysis.

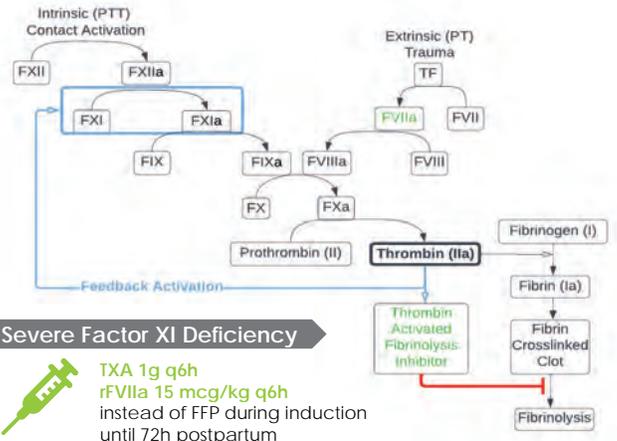
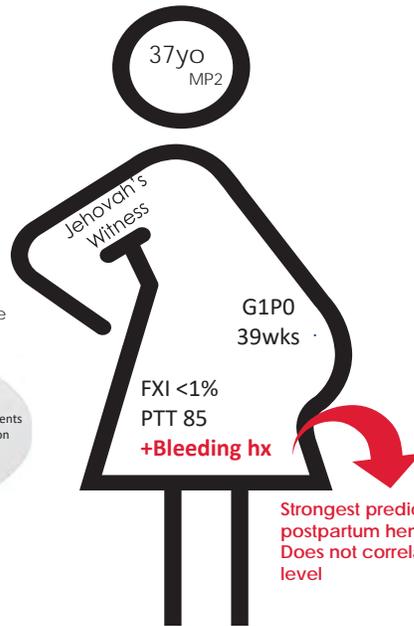
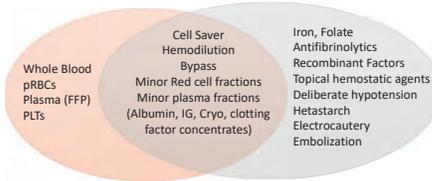
# Severe Factor XI Deficiency in a Jehovah's Witness Parturient

Shradha Khadge M.D., Kishan Patel M.D., Katherine Gelber M.D., Mark Zakowski M.D.  
 Department of Anesthesiology, Cedars Sinai, Los Angeles, CA



## Jehovah's Witness

Early diagnosis/treatment of preoperative anemia  
 Discuss with patient what they are willing to receive



## Severe Factor XI Deficiency

TXA 1g q6h  
 rFVIIa 15 mcg/kg q6h  
 instead of FFP during induction until 72h postpartum

- Fentanyl PCA for Labor
- General Anesthesia for Cesarean Section
- Prophylactic uterotonics
- Cell Saver

Abstract #: SAT-BCR – 07

## Lymphangiomyomatosis (LAM) Complicated by Bilateral Pneumothorax in Pregnancy: A Case Report

**Presenting Author:** Michael Kim, MD

**Presenting Author's Institution:** New York Presbyterian - Columbia University Campus

**Co-Authors:** Jeanine D'Armiento, MD - Columbia University

Monica Goldklang, MD - Columbia University

Ruth Landau, M.D. - Columbia University

Katharine E. Thompson, M.D. - Columbia University

Daniel Tobes, MD - Columbia University Medical Center

### Background

Lymphangiomyomatosis (LAM) is a rare cystic lung disease seen in women of childbearing age.<sup>1</sup> Patients present with dyspnea and in addition to cystic disease on thoracic imaging, a workup may reveal pneumothorax (PTX), chylothous effusion, or renal angiomyolipomas. The mTOR inhibitor sirolimus is the only FDA approved therapy.<sup>2</sup> Data suggests that most women with LAM may tolerate pregnancy, but cases in which LAM was diagnosed during pregnancy have a higher rate of respiratory complications.<sup>3-5</sup> LAM cells have estrogen and progesterone receptors that stimulate cell proliferation. LAM diagnosed during pregnancy may be a marker of more aggressive disease, and pregnancy itself may accelerate the rate of lung deterioration in LAM. We report a case diagnosed with LAM during 2nd trimester, managed by a multidisciplinary team, resulting in a successful induction of labor (IOL) with vaginal delivery at 36 weeks.

### Case

A 36 year-old G5P3013 presented to her local emergency room at 21 weeks' gestation, with progressively worsening dyspnea on exertion. PTX was diagnosed, and 1 week later she developed large bilateral PTX, requiring bilateral surgical chest tubes. Chest CT and lung biopsy confirmed the diagnosis of LAM. Sirolimus was started for active disease. At 32 weeks, she was transferred to our high-risk antepartum unit for LAM treatment, with 2 pigtail catheters. She had multiple acute hypoxic and dyspneic episodes, precipitated by chest tube malfunction. The pigtail tubes were upsized at 33 weeks to prevent tube clots, but this caused worsening pain. Escalating doses of hydromorphone were given for severe acute pain at her lung apices following each new PTX and lung re-expansion. At 34 weeks, mid-thoracic erector spinae plane (ESP) block catheters were discussed and offered, with good pain relief. She underwent IOL at 36 weeks with early combined spinal epidural analgesia and an assisted forceps vaginal delivery 6 hours later. A week later, she underwent a planned uncomplicated bilateral video assisted thoracoscopic pleurectomy and talc pleurodesis (under general anesthesia with a thoracic epidural for post-operative pain management).

### Discussion

Peripartum care of patients with LAM requires a multidisciplinary team able to coordinate LAM care, thoracic surgical care, analgesia for both labor and pain associated with chest tubes and PTX, and high-risk obstetric care. This patient's care for over 4 weeks required an immense amount of effort from each team involved, especially when dealing with unexpected complications related to PTX and pain management. The combination of continuous monitoring, specialized care teams (LAM treatment specialists, maternal fetal medicine, thoracic surgery, obstetric anesthesiology, acute pain), and shared decision making facilitated an optimal outcome for this patient.

Abstract #:SAT-BCR – 08

## Neurocovid in the Peripartum Period

Presenting Author: Monique Osigbeme, MD

Presenting Author's Institution: Vanderbilt University Medical Center

### Introduction:

Although COVID-19 is conventionally represented as a febrile illness with respiratory involvement, unusual sequela such as sensory inhibition and vasculitis have also been reported.<sup>1</sup> In fact, up to 40%–88% of patients with severe COVID-19 are reported to present with neurological symptoms, such as neurodegeneration, neuroinflammation and demyelination signs.<sup>2</sup> The physiologic impacts of pregnancy may exacerbate the severity of these neurologic symptoms and presents diagnostic and therapeutic challenges in the parturient.

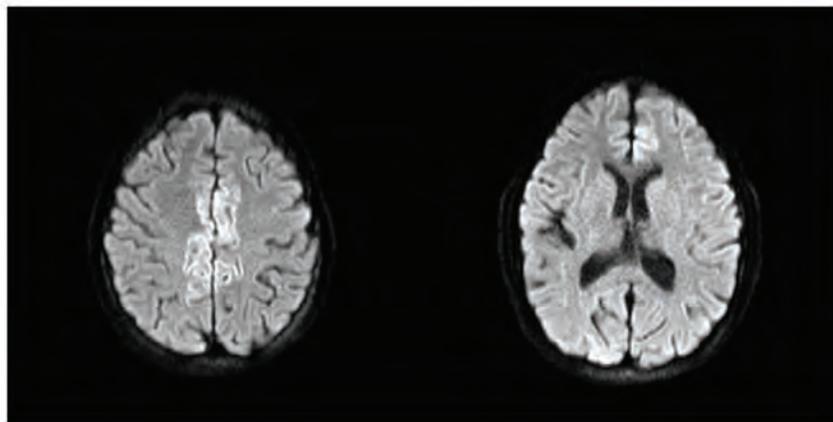
### Case:

A 16-year-old G1P0 at 30 weeks presented to the Intensive Care Unit with sepsis and respiratory failure secondary to COVID-19 with superimposed pneumonia. She was treated with remdesivir, steroids, antibiotics, and subsequently recovered and discharged home.

At 33w5d, she was readmitted with tonic-clonic seizures. Magnetic Resonance Imaging of the brain demonstrated symmetric cortical diffusion restriction of the frontal lobes, likely representing sequela of acute seizures, which was confirmed via electroencephalogram monitoring. Subsequent labs were unremarkable. Although eclampsia was strongly considered, the differential was broadened after the patient began to exhibit an unusual presentation of bilateral ascending paralysis that progressed to respiratory failure requiring intubation. Without a clear etiology, multiple specialties became involved to help assist in diagnosis, which ultimately was attributed to a neurologic presentation of COVID. On hospital day 6, a cesarean delivery was indicated due to worsening critical condition and nonreassuring fetal status. The delivery was uncomplicated, and the patient was able to wean toward extubation by the following day. Her clinical course postoperatively was complicated by frontal lobe infarct, continued weakness, delirium, and abnormal behavior requiring antipsychotic therapy. With some clinical improvement, she was discharged on hospital day 24 to an inpatient rehabilitation facility with aspirin, levetiracetam, and verapamil.

### Discussion points:

1. Review the most recent COVID data on its presentation and severity in parturients compared to the general population.
2. Discuss the expected course, treatment options, and recovery from neurologic COVID.
3. Consider the differential diagnoses for seizure and ascending paralysis in pregnancy.





# Neurocovid in the Peripartum Period

Monique Osigberne MD, Laura Sorabella MD, Kait Brennan DO MPH, Stephanie Woodward MD, Britany Raymond MD

DEPARTMENT OF ANESTHESIOLOGY  
VANDERBILT UNIVERSITY  
MEDICAL CENTER

## INTRODUCTION

- COVID-19 is conventionally represented as a febrile illness with respiratory involvement; however, unusual sequela have also been reported:<sup>1</sup>
- Up to 40%–88% of patients with severe COVID-19 are reported to present with neurological symptoms, such as neurodegeneration, neuroinflammation and demyelination signs.<sup>2</sup>

*The physiologic impacts of pregnancy may exacerbate the severity of these neurologic symptoms, presenting diagnostic and therapeutic challenges.*

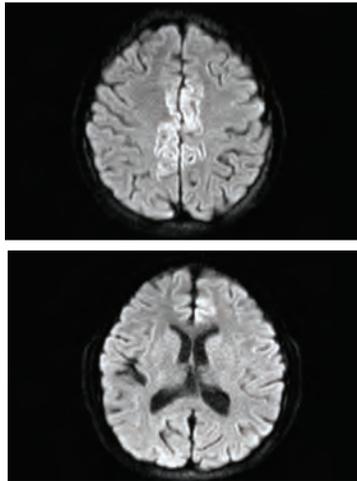
## CASE HISTORY

A 16yo G1P0 at 30w presented to the ICU with respiratory failure secondary to COVID-19 and sepsis from superimposed pneumonia. She was treated with remdesivir, steroids, antibiotics, and subsequently recovered to home discharge.

- Seizures**
  - Readmitted at 33.5w with tonic-clonic seizures  
MRI brain reveal ischemia, consistent with seizures
- Paralysis**
  - Rapid, bilateral ascending paralysis  
→ respiratory failure requiring intubation
- Cesarean**
  - Fetal distress prompted CD on hospital day 6  
pt still intubated and sedated, so performed under general
- Recovery**
  - Course c/b frontal lobe infarct, weakness, delirium, and abnormal behavior requiring antipsychotic therapy
  - HD 24 – discharged to inpatient rehabilitation facility

## IMAGES

Figure 1. MRI of the patient's brain showing symmetric cortical diffusion restriction of the frontal lobes



## REFERENCES



## LEARNING POINTS

### Manifestation of neurocovid

- Inflammation of the CNS can produce mild symptoms such as anosmia to severe such as seizures (occurs 1-2 days after the symptomatic phase)
- Hypercoagulability can result in stroke, which usually occurs 2 weeks after the onset of the symptoms<sup>3</sup>

### COVID in parturients vs general population

Pregnant women are more susceptible to thromboembolic complications due to baseline hypercoagulability and the procoagulant state associated with COVID-19

### Treatment options of COVID-19 in pregnancy

Treatment options for patients with clear inflammatory and vascular changes include<sup>4</sup>:  
steroids  
aspirin  
IVIg  
Remdesivir

### DDX of seizures in pregnancy

When considering a differential diagnosis for seizures in pregnancy, it should remain broad. It's not always eclampsia!  
Consider: epilepsy, PRES, stroke, infection, electrolytes, and drugs

Abstract #:SAT-BCR – 09

## Anesthetic Management for Cesarean Delivery of a Parturient with COVID-19 Infection while on Extracorporeal Membrane Oxygen Support

**Presenting Author:** Samantha Rubright, MD

**Presenting Author's Institution:** Duke University Medical Center - Durham, North Carolina

**Co-Authors:** Matthew Buck, MD - Duke University Medical Center

**Introduction:** COVID-19 infection can cause Acute Respiratory Distress Syndrome (ARDS), sometimes requiring ventilatory and circulatory support. With the physiologic changes of pregnancy, parturients are especially vulnerable to severe disease. Case reports have demonstrated that extracorporeal membrane oxygen (ECMO) support is effective in these patients but can lead to difficult medical and ethical decision-making regarding delivery planning and maternal and fetal well-being.

**Case:** A 25-year-old G1P0 with BMI of 53 kg/m<sup>2</sup> presented at 26 weeks gestation with acute respiratory failure due to COVID-19. Despite treatment, she required intubation and ECMO cannulation by hospital day seven. Her ICU course was further complicated by preeclampsia with severe features, requiring multiple infusions to control her blood pressure. On hospital day 15, given her tenuous respiratory status, ECMO requirement, and worsening preeclampsia, the multidisciplinary decision was made to proceed with urgent Cesarean delivery (CD). The patient was now at 28 weeks gestation and intermittent fetal monitoring was reassuring.

The patient was transported to the operating room where she was maintained under total IV anesthesia while on a portable ICU ventilator and ECMO support. Her starting hemoglobin was 7.1 g/dL, and she was transfused 3 units of red blood cells prior to incision. After delivery of the neonate, a high-dose oxytocin infusion was started and one gram of tranexamic acid was given. Hysterotomy was rapidly closed and a B-lynch suture was placed. A prophylactic Bakri balloon was inserted and left deflated in case of postpartum hemorrhage. She remained hemodynamically stable throughout the case.

After delivery, the patient's respiratory and hemodynamic parameters improved. She was decannulated from ECMO on post-operative day (POD) 5, and discharged home with tracheostomy on POD 15. The infant required chest compressions and intubation at delivery, but was ultimately discharged home at 48 days old.

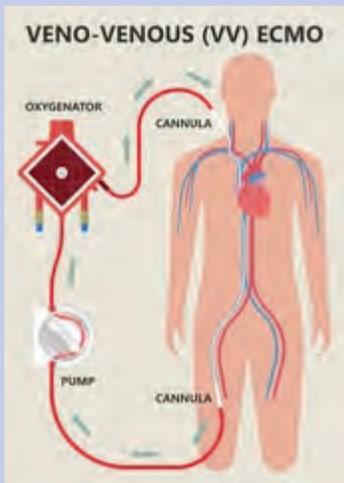
**Discussion:** Even prior to the COVID-19 pandemic, ARDS was the most common indication for peripartum ECMO, with almost 80% of patients surviving<sup>1</sup>. It has also been shown that respiratory parameters in ventilated ICU parturients tend to improve after delivery<sup>2</sup>.

In our case, the patient's preeclampsia with severe features and respiratory status both improved after CD. However, the decision to proceed with delivery and potential maternal benefit must be balanced with the acute stress of surgery, hemodynamic changes, bleeding risk, and fetal well-being. Thus, a multidisciplinary team approach is necessary to best determine the timing of delivery and ensure the safety of these patients.

# Anesthetic Management for Cesarean Delivery of a Parturient with COVID-19 Infection while on Extracorporeal Membrane Oxygen Support

Samantha Rubright, MD, Matthew Buck, MD. Duke University, Durham, NC

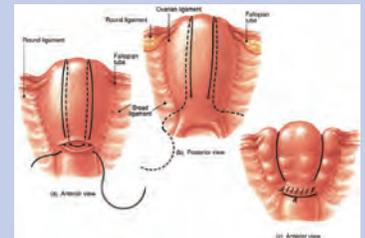
COVID-19 infection at 26 weeks gestation requiring VV-ECMO cannulation



Development of preeclampsia with severe features and worsened respiratory parameters



Urgent cesarean delivery at 28 weeks with prophylactic measures against PPH



Abstract #: SAT-BCR – 10

## Preterm delivery in a patient with spontaneous hemoperitoneum in pregnancy and concurrent placenta accreta

Presenting Author: Emily F. Nasser, MD

Presenting Author's Institution: University of California Los Angeles - Los Angeles, California

### Introduction:

Spontaneous hemoperitoneum in pregnancy (SHiP) is a rare condition characterized by unprovoked intraperitoneal bleeding in pregnancy. SHiP is most commonly seen in women with endometriosis or ovarian hyperstimulation from artificial reproductive techniques, and is associated with adverse perinatal outcomes. We present a 38 year old G1P0 with endometriosis, open myomectomy for fibroids, and in-vitro fertilization (IVF) pregnancy transferred from an outside hospital (OSH) at 23w0d gestational age (GA) for SHiP.

### Case Description:

The patient is a 38 year old G1P0 female with recurrent stage 4 endometriosis with multiple prior open laparotomies, fibroids requiring open myomectomy, and IVF pregnancy. She presented to an OSH at 22w4d gestation with abdominal pain and severe anemia (hemoglobin 6), and was found to have large hemoperitoneum requiring 3 liter drainage and massive transfusion. She was transferred to our institution at 23w0d gestation, at which time her clinical presentation was thought to be consistent with SHiP from ruptured endometrioma, now walled-off. Placenta accreta was suspected due to MRI finding of poorly delineated utero-placental interface in the left anterior uterus. At 25w3d, she suddenly developed preterm labor with fetal distress, oral intolerance, and acute kidney injury. New, enlarging retroplacental hematoma was noted on ultrasound concerning for placental abruption versus uterine rupture. Emergent cesarean delivery was performed in the main operating room with delivery of a live neonate under a combined-spinal epidural anesthetic. Dense bladder adhesions were noted, preventing uterine exteriorization (Figure 1a). The placenta was noted to be completely abrupted from the uterine wall, though without evidence of uterine dehiscence (Figure 1b). Patient-controlled epidural anesthesia with a bupivacaine 0.0625% fentanyl 2 mcg/mL mixture was used for postoperative analgesia until transition to oral analgesics. The patient was discharged home on postoperative day 11.

### Discussion:

This case highlights the perinatal morbidity associated with SHiP, a rare condition, and concomitant placenta accreta spectrum. Though expectant management was pursued to allow pregnancy to progress to fetal viability, preparations were in place for emergency cesarean hysterectomy and massive intrapartum hemorrhage. Detailed multidisciplinary antepartum planning amongst the anesthesia, maternal-fetal medicine, and gynecologic-oncology teams were crucial to a favorable maternal and neonatal outcome in this complex, emergent delivery.

[Nasser - Preterm delivery of SHiP with placenta accreta images.pdf](#)

# Preterm delivery in a patient with spontaneous hemoperitoneum in pregnancy and concurrent placenta accreta

Emily Franko-Tobin Nasser, MD & Sapna Satyanarayan-Victor, MD, MPH

## Case Report

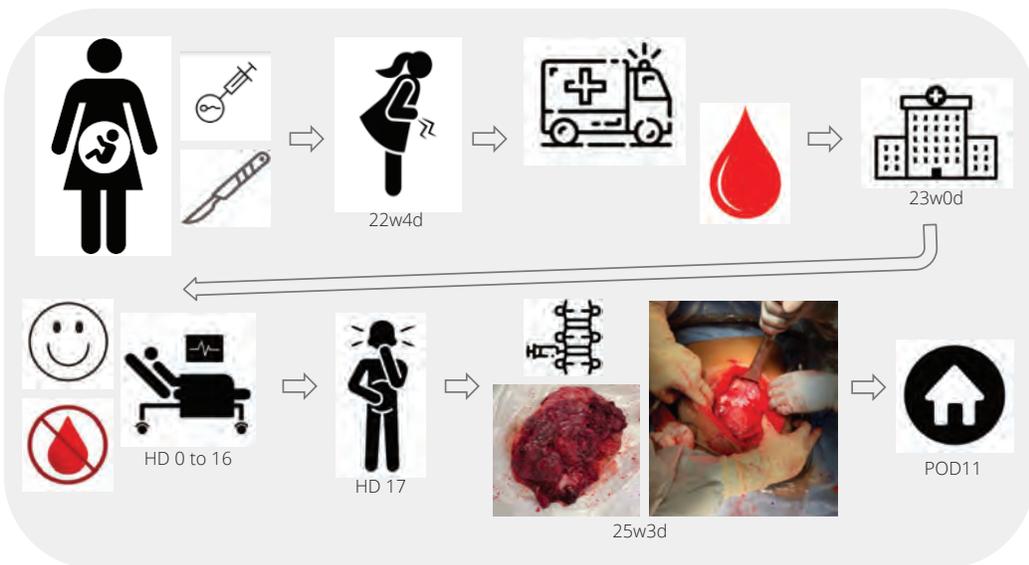
- 38yo G1PO with stage IV endometriosis, prior open abdominal abdominal and uterine surgeries, IVF pregnancy
- Presented to OSH with Hgb 6.0, received massive transfusion
- Transferred to our institution at viability 23w0d
- Emergent c-section with combined-spinal epidural anesthetic at 25w3d

## Spontaneous Hemoperitoneum in Pregnancy (SHiP)

- Unprovoked intraperitoneal bleeding
- Associated with IVF, endometriosis
- Maternal and fetal morbidity

## Conclusion

- Expectant management of SHiP is possible and requires extensive multidisciplinary coordination
- Contingency planning for emergent delivery necessary (clear criteria for delivery, anesthetic plan, delivery location)



**Gerard W. Ostheimer Lecture**  
**What's New in Obstetric Anesthesia? 2021**  
**Presented at SOAP 2022, Chicago IL**  
Michaela K. Farber MD MS  
Brigham and Women's Hospital, Boston MA

The Gerard W. Ostheimer Lecture, What's New in Obstetric Anesthesia presents publications from the preceding calendar year that are novel and relevant to the practice of obstetric anesthesiology.

**Objectives:** The syllabus summarizes selected manuscripts published between January and December 2021. Its purpose is to be a high-yield resource of contemporary literature in obstetric anesthesiology, perinatology, and other relevant subspecialties.

**Methods:** A high-impact selection of 76 journals was chosen based on their scientific integrity and relevance to obstetric anesthesia, guided by journal lists and frequency of citations of prior Ostheimer lecturers and impact factor. The tables of contents of each of these journals were reviewed monthly to compile a library of manuscripts. An additional 9 journals were captured by use of key word searches performed by multiple search engines including Google Scholar, PubMed, and Ovid Search. Additional resources included the monthly OB Division News by Dr. Joanne Douglas, the Obstetric Anesthesia Digest, general news outlets, and accompanying editorials, replies, and letters to published manuscripts. Selected manuscripts (N=1,398) were systematically evaluated and scored for their relevance, novelty, scientific integrity, clinical importance, and research implications. Highest scoring papers were then selected, and their results summarized for inclusion to the Syllabus, organized by topics and themes.

**Acknowledgement:** Despite the rigor of the manuscript selection process for this syllabus, the speaker acknowledges that there is an abundance of high-quality, important papers that were ultimately not included. I am grateful for this unique opportunity to have gained a broad perspective of literature, and to realize the vigorous research being conducted toward enhancing obstetric anesthesiology care and women's health.

**List of Journals:**

**Anesthesia and Critical Care Journals**

Acta Anaesthesiologica Scandinavica  
Anaesthesia  
Anaesthesia and Intensive Care  
Anesthesia & Analgesia  
Anesthesiology  
BMC Anesthesiology  
British Journal of Anaesthesia  
Canadian Journal of Anesthesia  
Critical Care Medicine  
Current Opinion in Anaesthesiology  
European Journal of Anesthesiology  
European Journal of Pain  
Intensive Care Medicine  
International Journal of Obstetric Anesthesia  
Journal of Clinical Anesthesia  
Journal of Anesthesia

Journal of Pain  
Minerva Anesthesiologica  
Paediatric Anaesthesia  
Pain  
Regional Anesthesia and Pain Medicine  
Resuscitation

**Epidemiology, Simulation, and Quality Journals**

American Journal of Epidemiology  
BMJ Quality and Safety  
Epidemiology  
Health Affairs  
Journal of Clinical Epidemiology  
Journal of Quality and Patient Safety  
Morbidity and Mortality Weekly Report  
National Vital Statistics Report

### General Medicine and Science Journals

American Journal of Clinical Nutrition  
Annals of Internal Medicine  
Annals of Thoracic Surgery  
British Medical Journal (BMJ)  
Brain Research  
Chest  
Circulation  
Clinical Journal of the American Society  
of Nephrology  
Cochrane Database of Systematic Reviews  
Diabetologia  
Early Human Development  
European Journal of Pharmacology  
European Heart Journal  
Heart  
Hypertension  
International Journal of Developmental  
Neuroscience  
Journal of the American College of  
Cardiology  
Journal of the American Medical  
Association (JAMA)  
Lancet  
Lancet Global Health  
Magnetic Resonance Imaging  
Nature  
Neurotoxicology and Teratology  
New England Journal of Medicine  
PLoS Medicine  
Science  
Sleep  
Stroke

### Hematology and Transfusion Journals

British Journal of Haematology  
Journal of Thrombosis and Haemostasis  
Thrombosis Research

### Obstetrics and Gynecology Journals

Acta Obstetrica et Gynecologica Scandinavica  
American Journal of Obstetrics & Gynecology  
(AJOG)  
AJOG Maternal Fetal Medicine  
Archives of Gynecology and Obstetrics  
Australian and New Zealand Journal of  
Obstetrics and Gynaecology  
Birth-Issues in Perinatal Care  
British Journal of Obstetrics and Gynaecology  
European Journal of Obstetrics Gynecology  
& Reproductive Biology  
Fertility and Sterility  
Human Reproduction Update  
International Journal of Gynecology  
& Obstetrics  
Journal of Maternal-Fetal & Neonatal  
Medicine  
Journal of Women's Health  
Maternal Child Health Journal  
Obstetrics & Gynecology  
Placenta  
Pregnancy Hypertension  
Reproductive Science  
Ultrasound in Obstetrics & Gynecology

### Perinatology and Pediatric Journals

American Journal of Perinatology  
Journal of Pediatrics  
Journal of Perinatology  
JAMA Pediatrics  
Paediatric and Perinatal Epidemiology  
Pediatrics

## **GLOSSARY**

3-IQ: 3-item questionnaire  
AHA: American Heart Association  
AARCC: Alliance for Adult Research in Congenital Cardiology  
ASD: autism spectrum disorder  
AUC: area under receiver operating characteristic curve  
BMI: body mass index (kg/m<sup>2</sup>)  
BP: blood pressure (mmHg)  
CCM: critical care medicine  
CD: cesarean delivery  
CDC: Centers for Disease Control  
CDH: congenital diaphragmatic hernia  
CEI: continuous epidural infusion  
CHD: congenital heart disease  
CHF: congestive heart failure  
CI: confidence interval  
CIAO: common iliac artery occlusion  
CPR: cardiopulmonary resuscitation  
CSE: combined spinal epidural  
CV: cardiovascular  
DPE: dural puncture epidural  
ECMO: extracorporeal membrane oxygenation  
ECR: epidural catheter replacement  
EHR: electronic health record  
EPI: epidural  
ELISA: enzyme-linked immunosorbent assay  
EFM: electronic fetal monitor  
EPDS: Edinburgh Postnatal Depression Scale  
ER: emergency room  
ERAC: enhanced recovery after cesarean delivery  
FETO: fetoscopic endoluminal tracheal occlusion  
FFP: fresh frozen plasma  
FHR: fetal heart rate  
GA: general anesthesia  
GDM: gestational diabetes mellitus  
gHTN: gestational hypertension  
HA: headache  
HDP: hypertensive disorders of pregnancy  
HFNC: high flow nasal cannula  
HELLP: hemolysis, elevated liver enzymes and low platelets  
HIE: hypoxic ischemic encephalopathy  
HTN: hypertension  
Ig: immunoglobulin  
IOL: induction of labor  
IRR: interrater reliability  
ITC: intrathecal catheter  
ITM: intrathecal morphine  
IVF: in vitro fertilization  
UFH: unfractionated heparin  
LB: liposomal Bupivacaine  
L&D: labor and delivery  
LEA: labor epidural analgesia  
LMICs: low- and middle-income countries  
LMWH: low molecular weight heparin  
LPS: lipopolysaccharide  
LTCD: low transverse cesarean delivery  
LRC: low-resource country  
LUS: lung ultrasound  
MAP: mean arterial pressure  
MCA: maternal cardiac arrest  
MEWS: maternal early warning system  
MFM: maternal fetal medicine  
MMR: maternal mortality ratio  
MMRC: maternal mortality review committee  
MOD: maternal opioid-related diagnosis  
MOH: major obstetric hemorrhage  
mRNA: messenger RNA  
NAS: neonatal abstinence syndrome  
NICU: neonatal intensive care unit  
NIS: national inpatient sample  
NRS: numeric rating scale  
OB: obstetric  
OB-CMI: obstetric comorbidity index  
OUD: opioid use disorder  
PACU: post anesthesia care unit  
PAS: placenta accreta spectrum  
PIEB: programmed intermittent epidural bolus  
PMCD: perimortem cesarean delivery  
POCCT: point-of-care coagulation test  
PPH: postpartum hemorrhage  
PPROM: preterm premature rupture of membranes  
PROM: patient reported outcome measure  
PPD: postpartum depression  
PPV: positive pressure ventilation  
PRBC: packed red blood cell  
PTSD: post-traumatic stress disorder  
QBL: quantitative blood loss  
QLB: quadratus lumborum block  
REBOA: resuscitative endovascular balloon occlusion of the aorta  
ROTEM: rotational thromboelastometry  
SBR: stillbirth rate  
SGA: small for gestational age  
SMM: severe maternal morbidity  
SOFA: sequential organ failure assessment  
sPPH: severe postpartum hemorrhage  
SVD: spontaneous vaginal delivery  
TAP: transversus abdominis plane  
TdP: Torsades de Pointes  
TEG: thromboelastography  
TNG: nitroglycerin  
TOLAC: trial of labor after cesarean  
UA: umbilical artery  
UDP: unintentional dural puncture  
US: United States  
VBAC: vaginal birth after cesarean  
VHA: viscohemostatic assay  
VTE: venous thromboembolism  
vWD: von Willebrand Disease

## TABLE OF CONTENTS

### MATERNAL MORTALITY

Maternal mortality reports (1,2,3)  
American Heart Association call to action (4)  
Non-survival after maternal cardiac arrest (5)  
Statewide SMM in Illinois (6)  
Preventing pregnancy mental health deaths (7)  
Improved capture with data analytics (8)

### MATERNAL CRITICAL CARE

Critical care OB to address maternal mortality (9)  
Critical OB care during the COVID19 pandemic (10)  
Clinical outcomes of ECMO in pregnancy (11)  
POCUS for pulmonary interstitial syndrome (12)

### MATERNAL MORBIDITY AND COMORBIDITIES

#### **Acquired and congenital heart disease (13-19)**

OB Anesthesia considerations (13)  
Valvular heart disease (14)  
Complications from CHD (15)  
Fontan bleeding/thrombosis (16)  
Fontan anesthesia (17)  
Turner syndrome outcomes (18)  
Marfan syndrome outcomes (19)

#### **Anemia in pregnancy (20-22)**

ACOG practice bulletin (20)  
And severe acute morbidity (21)  
IV ferric carboxymaltose in LMICs (22)

#### **COVID-19 in pregnancy (23-32)**

Respiratory emissions during L&D (23)  
Pregnant vs. nonpregnant outcomes (24)  
SOAP COVID registry, US outcomes (25,26)  
International pregnancy outcomes (27)  
Neonatal outcomes (28)  
Immune response to infection (29)  
mRNA vaccine safety in pregnancy (30)  
Immune response to mRNA vaccine (31)  
Impact on GA rate for CD (32)

#### **Hematologic/Thrombosis (33-36)**

Impact of a heparin VTE prophylaxis protocol (33)  
SOAP: thrombocytopenia guidelines (34)  
Neuraxial techniques and hemophilia (35)  
Neuraxial techniques and vWD (36)

#### **Neuromuscular disease (37)**

#### **Liver and biliary disease (38)**

#### **Postdural puncture headache (39-44)**

Temporal trends in the US (39)  
Chronic pain after ADP (40)  
Persistent headache and backache (41)  
Chronic disabling headache (42)  
Psychological and physical outcomes (43)  
Intrathecal catheter use after ADP (44)

### HYPERTENSIVE DISORDERS OF PREGNANCY

#### **Prevalence and Diagnosis (45-51)**

Epidemiology in Sweden and China (45)  
Prevalence by ACC/AHA guidelines (46)  
Impact of new definitions on outcomes (47)  
Genetic predisposition to comorbidities (48)  
Machine learning to predict readmission (49)  
sFlt-1/PIGF ratio and clinical adverse outcomes (50)  
PIGF and morbidity (51)

#### **Prevention and Treatment of Hypertension (52-57)**

Aspirin and bleeding complications (52)  
Aspirin to prevent preeclampsia (53)  
Pravastatin to prevent preeclampsia (54)  
Semiautonomous algorithm for treatment (55)  
Pulse pressure to guide treatment (56)  
Furosemide for postpartum preeclampsia (57)  
**Cerebral perfusion and autoregulation (58)**

### INFECTION, INFLAMMATION, & ANTIBIOTICS

Optimal antibiotics for chorioamnionitis (59)  
Chorioamnionitis and risk for sepsis (60)  
Sepsis facility resources and services (61)  
FAST-M for sepsis in LMICs (62)  
Top 10 pearls for sepsis management (63)

#### **Labor epidural associated maternal fever (64-67)**

Peak fever duration and neonatal outcomes (64)  
Epidural use and neonatal infection (65)  
Epidural analgesia, intrapartum hyperthermia (66)  
Acetaminophen to reduce maternal fever (67)

### NEONATAL OUTCOMES

Maternal O2 for intrauterine resuscitation (68)  
Umbilical cord gases and neonatal outcomes (69)  
1<sup>st</sup> trimester opioid use and malformations (70)  
Labor epidural analgesia and neonatal morbidity (71)  
Neonatal deaths after PPH in the WOMAN trial (72)  
Epidural analgesia and autism (73,74,75)  
GA and neurocognitive outcomes (76,77)  
Neonatal abstinence syndrome in the US (78)  
Anesthesia for maternal-fetal interventions (79)  
Fetal surgery for diaphragmatic hernia (80,81)  
Neonatal resuscitation (82,83)

### POSTPARTUM HEMORRHAGE

PPH review (84)  
Recognizing excessive blood loss (85)  
Incidence, etiology, coagulation management (86)  
**Risk factors for PPH (87-91)**  
Predicting risk of PPH (87)  
Risk factors for atonic PPH (88)  
PPH risk assessment on admission (89)  
Gestational age and risk of PPH (90)  
Poor uterine contractility and risk of PPH (91)

### **Treatment of PPH (92-95)**

Prophylactic secondary uterotonics for FTP CD (92)  
TRAAP-2 Prophylactic TXA for CD (93)  
Optimal dose of TXA during CD (94)  
FIDEL trial TXA for PPH after vaginal delivery (95)

### **Coagulopathy Detection (96-99)**

Blood loss thresholds for abnormal ROTEM (96)  
ROTEM to predict severe bleeding (97)  
TEG 6S for the management of PPH (98)  
Low-cost coagulopathy detection during PPH (99)

### **Placenta Accreta Spectrum (100—105)**

Risk factors for posterior PAS (100)  
PAS epidemiology in the US (101)  
PACCRETA: clinical profiles of PAS (102)  
PAS Ultrasound Markers (103)  
PAS and twin gestation (104)  
Open vs. endovascular REBOA for PAS (105)

### **LABOR & DELIVERY**

#### **Epidural techniques and catheters (106-111)**

Difficulty advancing flexible epidural catheters (106)  
Palpation vs. ultrasound prior to neuraxial (107)  
Resited epidural catheters and labor outcomes (108)  
DPE plus PIEB for labor analgesia (109)  
Low volume high concentration PIEB interval (110)  
Dosing labor epidurals for cesarean delivery (111)

### **CESAREAN DELIVERY**

#### **Airway management and oxygenation (112-114)**

General anesthesia airway management for CD (112)  
DL vs. VL for tracheal intubation in obstetrics (113)  
High flow nasal oxygen during RSI (114)

#### **Oxytocin and carbetocin (115-119)**

Oxytocin dose finding for obese patients (115)  
Carbetocin and arrhythmia risk (116)  
IV oxytocin regimens (117)  
Long-term effects of peripartum oxytocin (118)

#### **Intraoperative management (119-125)**

Carbohydrate loading and temperature (119)  
Phenylephrine vs. norepinephrine (120)  
Lateral tilt during surgical preparation (121)

Hyperbaric bupivacaine dose and hypotension (122)  
Uterine tone score reliability (123)  
Low dose dexmedetomidine for shivering (124)  
Pitfalls of switching to sugammadex (125)

### **POSTPARTUM ANALGESIA and RECOVERY**

SOAP ERAC guidelines (126)  
PROSPECT guidelines for post CD pain (127)  
Analgesia after CD in the US (128)  
Uterine contraction pain after SVD (129)  
IV acetaminophen for pain control (130)  
Predicting pain after CD (131)  
QL block for CD (132)  
QL vs. TAP block for CD (133)  
Liposomal bupivacaine TAP block (134)  
Opioid sparing protocol after CD (135)  
State law limiting post CD opioids (136)  
Methadone and buprenorphine postpartum (137)

### **UNIT SAFETY, SIMULATION, and COMMUNICATION**

Personality and teamwork (138)  
7 features of safety on L&D (139)  
Implementing a MEWT tool (140)  
Transfusion preparedness (141)  
QI to lower CD rate in California (142)

### **GLOBAL HEALTH and DISPARITIES**

Causes of maternal mortality in Rwanda (143)  
Anesthesia practice for CD in Sierra Leone (144)  
Hypothermia for HIE in LMICs (145)  
No pain labor & delivery initiative in China (146)  
Obesity and racial ethnic disparities (147)  
SMM failure to rescue, critical care (148,149)  
Black womens' perspective on structural racism in obstetric care (150)  
Disparate morbidity in a military health system (151)  
A VBAC calculator without race and ethnicity (152)

### **PATIENT EXPERIENCE AND RECOVERY**

Respiratory depression after neuraxial MSO<sub>4</sub> (153)  
PROM to assess postpartum pain (154)  
Postpartum specific vital sign reference ranges (155)  
PTSD after spontaneous vaginal birth (156)  
A mobile application for mothers having CD (157)  
Anxiety and depression in women with antepartum complications (158)

### **BASIC SCIENCE AND ANIMAL MODELS**

Outcomes after uterine transplantation (159)  
Resuscitation with hgb vesicles for MOH (160)  
Impaired host defense by phenylephrine (161)  
Thermography to confirm epidural analgesia (162)  
TNG and oxytocin-desensitized myometrium (163)

## SYLLABUS

### MATERNAL MORTALITY

1. Knight M, Bunch K, Tuffnell D, et al. on behalf of MBRRACE-UK. **Saving Lives, Improving Mothers' Care – Lessons learned to inform maternity care from the UK and Ireland Confidential Enquiries into Maternal Deaths and Morbidity 2017-19.** Oxford: National Perinatal Epidemiology Unit, University of Oxford 2021.

This 2021 report of the triennium 2017-2019 yields a MMR of 8.8 deaths per 100,000 births up to 6 weeks from delivery with no statistically significant reduction from the previous triennium. Cardiac disease remained the leading cause of indirect maternal death and neurologic (epilepsy, stroke) second. VTE was the leading direct cause; hemorrhage and stroke second with equal frequency, followed by suicide. Persistent disparities with 3 and 4-fold increased mortality rates in Asian and Black compared to White mothers are prompting renewed initiatives.

2. Joseph KS, Boutin A, Lisonkova S et al. **Maternal mortality in the United States.** *Obstet Gynecol* 2021; 137:763-71.

This commentary summarizes the challenges raised by the 2020 National Center for Health Statistics report of US mortality rate up to 2018. Its review of surveillance artefact from pregnancy checkbox and coding changes underscores the need for more accurate identification of maternal death and increased focus on reducing disparities.

3. Main EK, Druzin M, Gregory K et al. **CA-PMSS Surveillance Report: Pregnancy-Related Deaths in California, 2008- 2016.** Sacramento: California Department of Public Health, Maternal, Child and Adolescent Health Division; 2021.

This first surveillance report from CA-PMSS on pregnancy-related mortality trends in California includes 9 years up to 2016, identifying 1,934 maternal deaths within 1 year of pregnancy, 608 pregnancy-related. Mortality ratios remained low and stable between 9.5 and 14.9 deaths per 100,000 live births with a 2009 spike from influenza A H1N1 in 2009 (17.1 per 100,000). Leading causes were cardiovascular disease 28%, sepsis 17%, HDP 13%, and VTE 7%. Temporal data by cause of death, sociodemographic, and racial-ethnic data is provided.

4. Mehta LS, Sharma G, Creanga AA et al. **Call to Action: Maternal health and saving mothers. A policy statement from the American Heart Association.** *Circulation.* 2021 Oct 12; 144(15): e250-69.

CV disease is the leading cause of US maternal mortality. The AHA has taken a stand to advocate for improved maternal CV care. This policy statement highlights inequities that influence disparities in maternal outcomes with 8 specific recommendations. Policy changes that emphasize CV health can be impactful to save mothers' lives.

5. Zelop CM, Shaw RE, Edelson DP et al. **Factors associated with non-survival from in-hospital maternal cardiac arrest: An analysis of Get with the Guidelines data.** *Resuscitation.* 2021 Jul; 164:40-5.

The AHA GWTG-resuscitation voluntary registry from 2000-2017 was analyzed to seek factors affecting death from in-hospital MCA. Hospital death was the primary outcome. Of 561 cases of MCA, 57.2% (321/561) did not survive to hospital discharge. In a final model, in-hospital death was associated with pre-arrest hypotension and hypoperfusion (OR 1.8) and occurrence of MCA outside of the delivery suite or operating room: PACU (OR 3.32); ER/other (OR 1.89). Age, race, year of event, and initial pulseless rhythm were not associated with worse outcomes. This useful information about pre-arrest characteristics may be impactful to improve maternal outcomes.

6. Geller SE, Garland CE, Horne AA. **Statewide severe maternal morbidity review in Illinois.** *Obstet Gynecol.* 2021 Jan; 137(1):41-8.

This retrospective review evaluated 408 SMM cases compared to all live births in Illinois in 2018 (n = 141, 595). Women with SMM were more likely to be non-Hispanic Black, multiparous, older, have public insurance and receive inadequate prenatal care. The leading causes of SMM were hemorrhage (48%) and preeclampsia or eclampsia (20%) and 42% of cases were considered to need improved care. These data provided state-specific opportunities to improve quality of care.

7. Trost SL, Beauregard JL, Smoots AN et al. **Preventing pregnancy-related mental health deaths: Insights from 14 United States maternal mortality review committees, 2008-17.** *Health Aff.* 2021 Oct; 40(10):1551-9.

Approximately 700 women die in the US each year from pregnancy-related complications. This cross-sectional analysis of deaths from 2008-17 reviewed by MMRCs in 14 states determined characteristics of and factors contributing to pregnancy related deaths caused by mental health conditions. Pregnancy-related mental health deaths were more likely than other causes to be determined as preventable (100% vs. 45%) and to occur 43-365d postpartum (63 vs. 18%). Of all mental health deaths,

63% were by suicide and 75% had a history of depression, 66% past or current substance use. Strategies to improve screening, care coordination, and supportive care into the first year postpartum are urgently needed. Mental health should be evaluated and supported at every encounter. Trauma-informed care, sensitivity about opioid exposure and appropriate pain control are important.

8. Hollenbach SJ, Drennan K, Pressman EK, Gray L. **Improved recognition of maternal deaths using modern data analytics.** *Obstet Gynecol.* 2021 May 1; 137(5): 772-8.

The measurement of maternal mortality in the US has been fraught with inaccuracy. This retrospective cohort study at a tertiary medical center used linked medical record data to identify pregnancy-associated deaths from 2011-18. Standard medical informatics query of hospital data identified 23 maternal deaths. A second query for hospital location and markers for pregnancy exposure identified the original 23 plus an additional 18 maternal deaths. Use of this novel query approach captured deaths that are likely to be undercounted at the hospital level, throughout the nation. Improved capture and characterization of maternal death will better shape strategies to address it and should be top priority for state MMRCs.

*With an editorial* by MacDorman MF and Declercq E. **The continuing challenge of measuring maternal mortality.** *Obstet Gynecol* 2021 May 1; 137(5): 761-2.

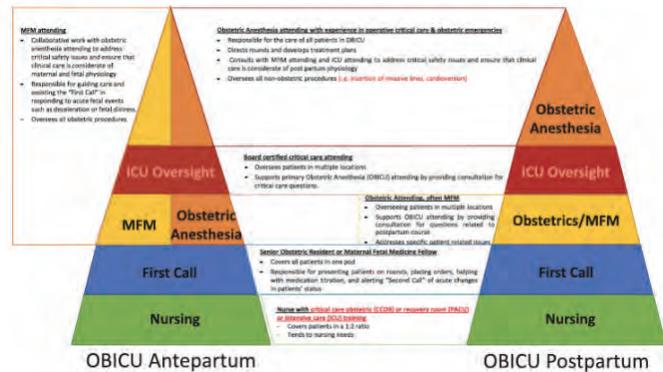
**MATERNAL CRITICAL CARE**

9. Padilla C, Markwei M, Easter SR et al. **Critical care in obstetrics: a strategy for addressing maternal mortality.** *Am J Obstet Gynecol.* 2021 Jun; 224(6):567-73.

This clinical opinion piece by OB Anesthesiologists, MFM Specialists, and CCM specialists emphasizes the importance of early recognition of OB patients who may require critical care (1-3%) and how recognizing high-risk parturients with use of scoring tools such as the MEWS, SOFA, and OB-CMI may facilitate early treatment or transfer to an appropriately resourced facility. Future avenues to explore are use of telemedicine and POCUS for OB CCM and CCM resources on L&D.

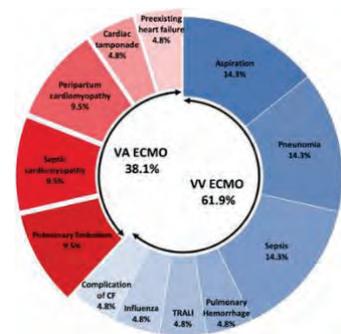
10. Martinez R, Bernstein K, Ring L et al. **Critical obstetric patients during the coronavirus disease 2019 pandemic: operationalizing an obstetric intensive care unit.** *Anesth Analg.* 2021 Jan; 132(1): 46-51.

As the COVID19 pandemic threatened to overwhelm hospital systems in NYC in the second half of 2020, innovations occurred to expand the ICU care team so that critical OB patients could be safely and effectively managed on the L&D unit. This report details steps taken to develop the OB ICU. An innovative tiered staffing model for patients before and after delivery allowed 1 critical care attending to oversee multiple levels of staff in a collaborative, efficient pyramid infrastructure. Effective communication and nimble adaptation were prioritized. OB anesthesia leadership was instrumental to the success of the model. Can we embrace a similar model for routine, non-COVID critical care OB as our specialty evolves and patient morbidities demand more critical care?



11. Lankford AS, Chow JH, Jackson AMA et al. **Clinical outcomes of pregnant and postpartum extracorporeal membrane oxygenation patients.** *Anesth Analg.* 2021 Mar 1; 132(3): 777-87.

The use of ECMO in obstetrics is expanding as rescue therapy for cardiopulmonary failure. This report describes 21 consecutive pregnant or postpartum patients requiring VV or VA ECMO between 2009 and 2019 at a single quaternary referral center. Overall survival and outcomes for mother and neonate were excellent in a high-volume ECMO center. ECMO is a critical component to management of highest risk OB patients in cardiopulmonary failure, and transfer to a facility that offers ECMO with some frequency is helpful for maternal treatment and survival.



12. Macias P, Wilson JG, Austin NS et al. **Point-of-care lung ultrasound pattern in healthy parturients: prevalence of pulmonary interstitial syndrome following VD, elective, and unplanned intrapartum CD.** *Anesth Analg.* 2021 Sep 1; 133(3): 739-46.

There's limited data on the impact of labor and peripartum hemodynamics on LUS-identified pulmonary edema. This exploratory prospective observational cohort evaluated LUS within 4h of delivery with an 8-region technique among 75 women; 25 after SVD, 25 after elective CD and 25 after unplanned CD. An 8-region technique for LUS image acquisition was utilized. Pulmonary interstitial syndrome did not occur other than in 3 women who had unplanned CD. However, single lung regions had edema in more women, largely in the lateral regions. This demonstrates clinical feasibility of LUS and helps define baseline prevalence among healthy parturients after all delivery models. Various pathologic groups (those on magnesium, with congestive heart failure, or after major transfusion) can be compared.

## **MATERNAL MORBIDITY AND COMORBIDITIES**

### **Acquired and congenital heart disease**

#### **13. Meng ML, Arendt KW. *Obstetric anesthesia and heart disease: Practical clinical considerations.***

*Anesthesiology.* 2021 Jul 1; 135(1): 164-83.

This clinically relevant review considers the physiology of pregnancy and anesthesia management in the context of known cardiac disease. Maternal morbidity and mortality from cardiac disease is increasing in the US. Appropriate monitoring, IV access, labor pain relief, anesthetic techniques, and medication titration for high-risk cardiac patients is outlined. Risk assessment for delivery in the appropriate setting, crisis management, cardiac emergencies, and future research is discussed.

#### **14. Minhas AS, Rahman F, Gavin N et al. *Cardiovascular and obstetric delivery complications in pregnant women with valvular heart disease.***

*Am J Cardiol* 2021; 158:90-7.

Physiologic changes during pregnancy, labor, delivery and postpartum put women with valvular heart disease at unique risk for complications. This study analyzed the NIS for delivery hospitalizations from 2016-18 to compare comorbidities, OB, and CV complications during delivery hospitalizations. 11.2 million deliveries were identified, 20,349 with valvular disease. Women with both stenotic or regurgitant lesions had increased burden of CV comorbidities and warrant care from a cardio-OB team.

#### **15. Lammers AE, Diller GP, Lober R et al. *Maternal and neonatal complications in women with CHD.***

*Eur Heart J.* 2021 Nov 1; 42(41):4252-60.

This dataset from a large German health insurance company evaluated pregnancies in women with CHD from 2005-2018 with age-matched non-CHD pregnancies with a focus on maternal and neonatal outcomes. 7512 pregnancies in 4015 women with CHD were matched to 11,225 pregnancies in 6502 non-CHD women. In women with CHD, CD rate was higher (40.5 vs. 31.5%). Overall complication rate was low but women with CHD had higher risk for stroke, CHF, and arrhythmias in pregnancy. Low birth weight and extreme immaturity was more common. CHD was 6.1 times higher in infants to CHD mothers. The need for specialized care for such risks is warranted for women with CHD.

#### **16. Girnius A, Zentner D, Valente AM et al. *Bleeding and thrombotic risk in pregnant women with Fontan physiology.***

*Heart* 2021; 107:1390-7.

This retrospective observational cohort among 13 international centers evaluated thrombotic and bleeding events, antithrombotic therapy, and pre-pregnancy thrombotic risk factors among 108 pregnancies in 84 parturients with Fontan circulation. Aspirin was the most common antithrombotic therapy (43.5%), then UFH or LMWH (30%). Three pregnancies were complicated by thrombotic events (2.8%) while 38 (35%) were complicated by bleeding, 5 (13%) severe. This illustrates the challenge of achieving hemostatic balance in patients with Fontan circulation.

#### **17. McCabe M, An N, Aboulhosn J et al. *Anesthetic management for the peripartum care of women with Fontan physiology.***

*Int J Obstet Anesth.* 2021 Nov; 48:103210.

A total of 37 pregnancies and 20 live births among 19 patients with Fontan physiology were identified in the Ahmanson/UCLA Adult CHD Center database. OB and cardiovascular outcomes are detailed and anesthesia considerations including physiology, hemodynamics, anticoagulation, analgesia, anesthesia, and critical care are discussed.

#### **18. Grewal J, Valente AM, Egbe AC et al. *Cardiovascular outcomes of pregnancy in Turner Syndrome.***

*Heart* 2021; 107:61-6.

This retrospective analysis of pregnant and age-matched non-pregnant controls with TS was conducted through the AARCC network from 2005-17 across 10 centers. Adverse outcomes were defined as CV death, aortic dissection, aortic intervention. Among 68 pregnancies in 60 women, 80% had a structurally normal heart, 25% XO. There were no CV events; 13% had HDP, 18% SGA neonates and 15% preterm delivery, 3% fetal death. Women with TS but no structural heart disease had low risk, and those with structural heart disease had better outcomes than previously described.

19. Narula N, Devereux RB, Malonga GP et al. **Pregnancy-related aortic complications in women with Marfan syndrome.** *Am Coll Cardiol* 2021; 78:870-9.

This single-center retrospective study reports on women with Marfan syndrome managed at a single center from 1982-2020; 74 of 169 whom had 152 pregnancies and 112 live births, 17 miscarriages, and 23 elective terminations. Pregnancy-related type A dissection only occurred in patients unaware of their diagnosis, and those with aortic diameters  $\leq 4.5$  cm demonstrated stable dimensions through pregnancy.

### Anemia in pregnancy

20. **ACOG Practice Bulletin Number 233: Anemia in Pregnancy.** *Obstet Gynecol* 2021; 138: e55-e64.

This report reinforces that all pregnant women should be screened for anemia with appropriate lab work for those with mild to moderate anemia. All women should be on iron supplementation. Guidelines for oral vs. IV iron supplementation are reported.

21. Guignard J, Deneux-Tharoux C, Seco A, et al, EPIMOMS group. **Gestational anemia and severe acute maternal morbidity: a population-based study.** *Anaesthesia.* 2021 Jan; 76(1):61-71.

Gestational anemia and its association with SMM warrant focus. This cohort-nested case-control analysis from the epidemiology of severe maternal mortality (EPIMOMS) prospective study was conducted in 6 French regions (2012-2013, n = 182,309). 1669 women had acute SMM, and gestational anemia was significantly more frequent in women with acute SMM (25.3%) than in controls (16.3%),  $p < 0.001$ . This association was also found for severe PPH (adjusted OR (95%CI) 1.7 (1.5-2.0)). These results suggest utility for optimizing the diagnosis and management of anemia during pregnancy.

22. Vanobberghen F, Lweno O, Kuemmerle A et al. **Efficacy and safety of IV ferric carboxymaltose compared to oral iron for the treatment of iron deficiency anemia in women after childbirth in Tanzania.** *Lancet Glob Health* 2021; 9: e189-98.

This is the first RCT assessing efficacy and safety of IV ferric carboxymaltose compared to oral iron for iron deficiency anemia in a resource-limited setting. 553 patients within 7 days of childbirth were screened and 230 randomized and reassessed at 6 weeks. 80% vs. 51% of patients had normalized hgb. 188 adverse events were reported, 55 in the IV group vs. 146 in the oral group, including only 1 IV infusion reaction and one pruritis, neither requiring intervention. Safety and feasibility of this study to better correct iron deficiency in a limited resource setting is impactful due to the high prevalence of peripartum anemia and can inform funding sources and catalyze global health policies.

### COVID-19 in pregnancy

23. Mok T, Harris E, Vargas A et al. **Evaluation of respiratory emissions during labor and delivery: Potential implications for transmission of SARS-CoV-2.** *Obstet Gynecol.* 2021 Oct; 138(4):616-21.

This observational study of women who tested negative for SARS-CoV-2 had background-oriented schlieren imaging to measure speed and propagation of breath through labor. In the second stage with Valsalva and forced expiration, propagation speeds 6x that of expulsion by coughing, in a warm and vigorous cloud. Those in proximity for extended hours may have increased risk of transmission of respiratory pathogens including SARS-CoV-2.

24. DeBolt CA, Bianco A, Limaye MA et al. **Pregnant women with severe or critical coronavirus disease 2019 have increased composite morbidity compared with nonpregnant matched controls.** *Am J Obstet Gynecol.* 2021; 224:510.e1-12.

This multicenter, retrospective case-control study of laboratory-confirmed SARS CoV-2 infection with severe or critical COVID 19 in 4 centers from 3/12/20 through 5/5/20 evaluated 38 pregnant cases admitted for COVID, not obstetrical reasons, vs. 94 non-pregnant reproductive age female cases admitted for the same indication. The primary outcome of composite morbidity (death, intubation, ECMO, PPV, or need for HFNO) was higher among pregnant patients (for severe cases: 13.8 for pregnant patients vs. 5% for nonpregnant) despite lower comorbidity, suggesting pregnancy itself is associated with worse outcome from SARS CoV-2.

25. Katz D, Bateman BT, Kjaer K, et al. **The SOAP COVID19 registry: An analysis of outcomes among pregnant women delivering during the initial SARS CoV-2 outbreak in the United States** *Anesth Analg.* 2021 Aug 1; 133(2):462-73.

This registry included institutions with nearly complete universal testing, for capture of COVID positive cases with or without symptoms. 14 US medical centers submitted patient outcome data (490 COVID positive; 35.9% symptomatic; 964 controls). Differences in OB and neonatal outcomes were predominant among symptomatic COVID19 patients. A higher rate of GA for CD was used among COVID positive patients, for respiratory failure. Neuraxial analgesia was used at a lower frequency among COVID positive patients, which warrants further attention.

26. Son M, Gallagher K, Lo JY et al. **Coronavirus disease 2019 (COVID-19) pandemic and pregnancy outcomes in a U.S. population.** *Obstet Gynecol* 2021 Oct; 138(4): 542-51.

This is a retrospective database analysis of pregnancy outcomes in 838,489 women (225,225 who delivered pre-pandemic). There were no differences in adverse pregnancy outcomes. Test-positive patients were less likely to be non-Hispanic White or Asian, obese, and live in socially vulnerable zip codes. The frequency of preterm birth or still birth was unchanged. This study helps elucidate the question of whether preterm birth rates have increased – it showed no association.

*With editorial* by Joseph NT and Metz TD. **COVID-19 and pregnancy outcomes: State of the science.** *Obstet Gynecol* 2021 Oct; 138(4):539-41.

27. Villar J Ariff S Gunier RB et al. **Maternal and neonatal morbidity and mortality among pregnant women with and without COVID19.** *JAMA Pediatr.* 2021; 175(8): 817-26.

This multinational (INTERCOVID) cohort study from March to October 2020 at 43 institutions in 18 countries enrolled 2 unmatched consecutive non-infected women after each infected woman at any stage of pregnancy or delivery, at the same level of care. COVID19 was defined by positive serology and/or radiologic findings or 2 or more symptoms. Primary outcomes were maternal and severe neonatal morbidity and mortality, and models were adjusted for country, month of entry, maternal age, and morbidity history. 706 pregnant women with COVID19 diagnosis and 1424 without were enrolled all with similar demographics. Women with COVID19 had higher BMI, preeclampsia, severe infection, ICU, mortality, and other morbidity outcomes.

*With commentary* by Messinger CJ, Hernandez S, McElrath T. **Further observations on pregnancy complications and COVID-19 infection.** *JAMA Pediatr.* 2021; 175(11): 1184-5.

*With commentary* by Papadopoulos KI, Manipalviratn S, Aw TC. **Further observations on pregnancy complications and COVID-19 infection.** *JAMA Pediatr.* 2021; 175(11):1185.

*With editorial* by Healy CM. **COVID-19 in pregnant women and their newborn infants.** *JAMA Pediatr.* 2021; 175(8):781-3.

28. Dumitriu D, Emeruwa UN, Hanft E et al. **Outcomes of neonates born to mothers with SARS CoV2 infection at a large medical center in NYC.** *JAMA Pediatr.* 2021; 175(2): 157-67.

This retrospective cohort analysis of maternal and newborn medical records for 101 neonates born to 100 mothers positive for or with suspected SARS-CoV-2 infection March 13-April 24, 2020 evaluated perinatal exposure to maternal asymptomatic to severe COVID-19. The primary outcome was newborn SARS-CoV-2 test results compared across maternal COVID-19 severity. No evidence of vertical transmission was identified, and most newborns roomed in and directly breastfed.

*With editorial* by Kimberlin DW, Puopolo KM. **Balancing risks in the time of COVID-19.** *JAMA Pediatr.* 2021 Feb; 175(2):129-30.

29. Joseph NT, Dude CM, Verkerke HP et al. **Maternal antibody response, neutralizing potency, and placental antibody transfer after SARS CoV-2 infection.** *Obstet Gynecol.* 2021 Aug; 138(2):189-97.

This prospective cohort study of 32 pregnant women who tested positive for SARS CoV-2 at any point in pregnancy had maternal plus cord blood samples at delivery. ELISA measured maternal plasma and cord blood immunoglobulin concentrations (IgG, IgA, IgM) against the SARS-CoV-2 spike protein. Anti IgG was found in 100% maternal and 91% cord samples. Functional antibody was found in 94 vs. 25 % maternal and cord samples. A robust maternal neutralizing and anti-receptor binding domain IgG response after SARS-CoV-2 infection was seen, but lower than expected transplacental efficiency of antibody transfer.

30. Shimabukuro TT, Kim SY, Myers TR et al. **Preliminary findings of mRNA COVID-19 vaccine safety in pregnant persons.** *N Engl J Med.* 2021 Jun; 384(2): 2273-82.

When mRNA COVID-19 vaccines became available in the US in December 2020, limited human data on safety during pregnancy were available. Data from December 14, 2020 through February 28, 2021 were extracted from the CDC v-safe after vaccination health checker surveillance system, the v-safe pregnancy registry, and the Vaccine Event Reporting System for this initial characterization of vaccine safety of mRNA COVID-19 vaccines in pregnant persons. 35,691 participants identified as pregnant. Injection site pain was more frequently reported, but HA, myalgia, fever/chills less frequently. No safety signals occurred among this population of initial vaccine recipients.

*With editorial by Riley LE. mRNA Covid-19 vaccines in pregnant women.* *N Engl J Med* 2021 Jun; 384(24): 2342-3.

31. Gray KJ, Bordt EA, Atyeo C et al. **COVID 19 vaccine response in pregnant and lactating women Preliminary findings of mRNA COVID19 vaccine safety in pregnant persons.** *Am J Obstet Gynecol.* 2021 Sept; 225:303.e1-17.

This study evaluated the immunogenicity and reactogenicity of COVID19 mRNA vaccine in pregnancy and lactating women compared to nonpregnant controls and natural COVID19 infection in pregnancy. 131 vaccine recipients (84 pregnant, 31 lactating, 16 non-pregnant) had titers of SARS-CoV-2 spike and receptor IgG, IgA, and IgM in sera, breastmilk, at baseline, 2-6 weeks after second dose. Umbilical cord sera titers were assessed. COVID19 mRNA vaccines generated robust humoral immunity in pregnant and lactating women, like nonpregnant and greater in response than natural infection. Transfer to neonates occurred via both placenta and breastmilk.

32. Bhatia K, Columb M, Bewlay A et al. **The effect of COVID 19 on general anesthesia rates for caesarean section: A cross-sectional analysis of six hospitals in the north-west of England.** *Anaesthesia.* 2021 Mar; 76(3):312-19.

The rate of GA for CD in the UK is 8.75%. The investigators evaluated anesthetic information across 6 maternity units from April 1 to July 2020 compared to the same period in 2019. They found a decreased GA rate, 7.7 to 3.7%, and attributed this to the need to don more personal protective equipment and concern of higher transmission during positive pressure ventilation with use of GA. The decision to delivery time was not reported in the study, and the authors note this is a critical consideration in that the trend in lowering GA rate with prolongation of decision to delivery time may impact fetal well-being. The authors contend that there will be delays unrelated to fetal status, urgency, or use of GA in COVID positive patients as well.

*With commentary by Russell R, Lucas DN. The effect of COVID-19 on general anaesthesia rates for caesarean section.* *Anaesthesia.* 2021 Mar; 76 Suppl 3:24.

### Peripartum Thrombophilia or Coagulation Defects

33. Lu MY, Blanchard CT, Ausbeck EB et al. **Evaluation of a risk-stratified heparin-based OB thromboprophylaxis protocol.** *Obstet Gynecol.* 2021 Oct 1; 138(4): 530-8.

This retrospective cohort from 2013-2018 evaluated pre-protocol (2013-15; no standardized heparin-based thromboprophylaxis) and post-protocol (2016-18) safety and efficacy: PP VTE rate and wound hematomas as co-primary outcomes. Patients on anticoagulation for active VTE or high VTE risk were excluded. Patients received more VTE prophylaxis post-protocol 15.5 vs. 1.2%, but there was no difference in VTE frequency (0.1 vs. 0.1%; OR 1.0). Wound hematomas increased post-protocol 0.7 vs. 0.4% along with unplanned surgical procedures and blood transfusions (aORs 1.29 and 1.34). Risk-stratified heparin-based VTE prophylaxis in the general OB population was associated with increased wound and bleeding complications without coincident decrease in postpartum VTE. The editorial points out this study was the first with a sample size powerful enough to detect small differences in VTE and bleeding outcomes.

*With an editorial by Kotaska A. Postpartum heparin prophylaxis: more harm than good.* *Obstet Gynecol* 2021; 138:527-9.

34. Bauer ME, Arendt K, Beilin Y et al. **The SOAP interdisciplinary consensus statement on neuraxial procedures in obstetric patients with thrombocytopenia.** *Anesth Analg.* 2021 Jun 1; 132(6): 1531-1544.

This is a multidisciplinary statement with experts representing SOAP, ASRA, ACOG, SMFM, and the American Society of Hematology. The guideline is evidence-based, to emphasize the incorporation of clinical risk and benefit analysis rather than solely focusing on the platelet count for those with isolated thrombocytopenia in the range of 50-70,000 x10<sup>6</sup>/L.

*With an editorial* by Scavone BM, Wong CA. **Neuraxial anesthesia and the ubiquitous platelet count question: How low is too low?** *Anesth Analg.* 2021 Jun 1; 132(6):1527-30  
*and a comment* by Seiler FA, Arnolds DE. **Platelet counts and neuraxial procedures in parturients.** *Anesth Analg.* 2021 Nov 1; 133(5): e59-60.

35. Togioka BM, Burwick RM, Kujovich JL. **Delivery and neuraxial technique outcomes in patients with hemophilia and hemophilia carriers: a systematic review.** *J Anesth* 2021 Apr; 35(2): 288-302.

This systematic review of case reports and series describes neuraxial techniques in patients with hemophilia (pregnant or not) and bleeding outcomes in parturients with hemophilia. The primary outcomes were diagnosis of neuraxial hematoma and postpartum bleeding complications, respectively. 13 manuscripts met criteria; 8 case reports, 5 case series. 134 patients with inherited FVIII or IX deficiency had a neuraxial technique; 3 whom developed a neuraxial hematoma and paraplegia. These patients were males with severe type A hemophilia receiving lumbar punctures for infection workup and whose factor levels were 1%. The OB population included 2,712 deliveries among 2,657 women who were unspecified type (2508), type A carriers (114), type B carriers (31) or with hemophilia B (4). PPH occurred in 7.1%, and twice as likely if FVIII or IX levels were <50%. Hemophilia carriers (more likely to occur in women) can have lyonization with variable clotting factor levels; factor levels should be checked in the 3<sup>rd</sup> trimester in all females with hemophilia or carrier status. Current guidelines for factor levels >50% prior to neuraxial can't be confirmed with this study but was not refuted by the findings among pregnant and non-pregnant hemophiliacs or carriers.

36. Reale SC, Farber MK, Lumbreras-Marquez MI et al. **Anesthetic management of von Willebrand Disease in pregnancy: a retrospective analysis of a large case series.** *Anesth Analg.* 2021 Nov 1; 133(5):1244-50.

This retrospective analysis identified 106 deliveries among 71 women with vWD; 54 with type 1, 6 with type 2, and 11 with unknown type. Neuraxial techniques were used in 88.7% of deliveries, 28.7% received desmopressin or vWF/FVIII concentrate prior to neuraxial technique, and 10.4% had PPH. Neuraxial anesthesia can be safely offered to patients with vWD with multidisciplinary planning to evaluate and optimize coagulation status.

### Neuromuscular Disease

37. Walsh E, Zhang Y, Madden H et al. **Pragmatic approach to neuraxial anesthesia in obstetric patients with disorders of the vertebral column, spinal cord, and neuromuscular system.** *Reg Anesth Pain Med* 2021 Mar; 46(3):258-67.

Patients with disorders of the vertebral column, spinal cord, and neuromuscular system raise concerns for labor epidural provision including mechanical interference, patient injury, or need for imaging. There is little data to drive care. Understanding current evidence may mitigate unwarranted fear of patient harm, unnecessarily avoiding neuraxial use in such patients. This is a narrative review offering a framework for consideration of neuraxial anesthesia in such patients.

### Liver and Biliary Disease

38. Hansen JD, Perri RE, Riess ML. **Liver and biliary disease of pregnancy and anesthetic implications: A review.** *Anesth Analg.* 2021 Jul 1; 133(1): 80-92.

This review illustrates how liver disease impacts pregnancy, including signs, symptoms, and laboratory markers for prompt diagnosis and treatment. Pregnancy-specific manifestations of liver dysfunction such as intrahepatic cholestasis, hyperemesis gravidarum, HELLP, and acute fatty liver of pregnancy are discussed, along with clinical considerations for neuraxial anesthesia.

### Postdural Puncture Headache

39. Guglielminotti J, Landau R, Ing C, Li G. **Temporal trends in the incidence of PDPH after labor neuraxial analgesia in the United States 2006 to 2015.** *Int J Obstet Anesth.* 2021 Feb; 45:90-8.

While neuraxial anesthesia can lower maternal risk by avoidance of general anesthesia, PDPH is a complication that is now recognized for its association with longer-term morbidity. This paper examines the temporal trends of PDPH associated with labor neuraxial analgesia with analysis of 29,011,472 deliveries the NIS from 2006-2015. PDPH was coded for 29.8 per 10,000 cases, 11.7 per 10,000 without EBP and 18.1 per 10,000 with EBP. A decrease in incidence over time was observed: 31.5 to 29.2 per 10,000 from 2006 to 2015. This is a call to action to reduce the incidence of this serious complication. The correspondence suggests considering the contribution of spinal anesthesia for CD to PDPH and discusses the analysis of trends performed. Further studies of more granularity and efforts to standardize reporting are warranted.

*With correspondence* from Bamber JH, Hassan A. **Temporal trends in postdural puncture headache.** *Int J Obstet Anesth* 2021 Aug; 47:103171.

40. Binyamin Y, Heesen P, Orbach-Zinger S et al. **Chronic pain in parturients with an accidental dural puncture: A case-controlled prospective observational study.** *Acta Anaesthesiol Scand.* 2021 Aug; 65(7):959-66.

While the International HA Society defines PDPH as self-limiting, persistent HA and back pain after PDPH requires further exploration. In this prospective observational case-control study, 4 groups of patients post vaginal delivery were defined: those with uncomplicated LEA; those with no LEA; those with PDPH and EBP, and those with PDPH and no EBP. Women with CD or those with chronic HA or backache were excluded. Women with PDPH with or without EBP had chronic HA incidence of 20.3 and 16.1% and chronic backache of 23.7 and 17.9%. Women with uncomplicated LEA or no LEA had HA rates of 0% and backache at 6 and 1.7%. The difference in outcomes between conservative vs. EBP treatments for PDPH in this cohort was not significant.

41. Niraj G, Mushambi M, Gauthama P et al. **Persistent headache and low back pain after accidental dural puncture in the obstetric population: a prospective, observational, multicenter cohort study.** *Anaesthesia.* 2021 Aug; 76(8): 1068-76.

This prospective multicenter cohort study evaluated these outcomes at nine UK OB units. Participants with or without UDP with a 16g Tuohy were followed every 6 months for 18 months and the primary outcome was incidence of persistent HA at 18 months. Those with UDP had persistent HA at 18 months, 58.4% vs. 17.4% without UDP after adjustment for history of HA, depression, and anxiety. Incidence of low back pain at 18 months was 48.3% vs. 17.4 in UDP vs. control groups. Longer-term sequelae from UDP must be considered, appropriate counseling provided, and further study on remediation performed.

42. Ansari JR, Barad M, Shafer S, Flood P. **Chronic disabling postpartum headache after unintentional dural puncture during epidural anesthesia: A prospective cohort study.** *Br J Anaesth.* 2021 Oct; 127(4): 600-7.

Chronic disabling HA was defined as 1 or more functionally limiting HAs within a 2-week interval at 2, 6, or 12 months postpartum. Parturients who experienced UDP were matched 1:4 with controls in this prospective observational study. Questionnaires about HA and back pain were completed before, during, and after pregnancy. The primary outcome was HA within the last 2 weeks, assessed at 2 months postpartum. 99 patients were enrolled; disabling HA was greater among patients with UDP (74% at 2 months vs. 38%, RR 1.9) and at 6 months (56 vs. 25%, RR 2.1). There was no difference in back pain at any time point. These findings have implications for risk counseling when consenting patients for labor epidural. Specifically, the possibility of a chronic HA that persists at least 2 months after UDP, and appropriate referral for supportive care.

*With commentary by Liu CW and Loh LW.* **Chronic disabling postpartum headache after unintentional dural puncture during epidural anesthesia: A prospective cohort study. Comment on Br J Anaesth 2021 Oct; 127: 600-7.** *Br J Anaesth* 2021 Dec; 127(6):e204-5.

43. Orbach-Zinger S, Eidelman LA, Livne MY et al. **Long-term psychological and physical outcomes of women after postdural puncture headache: A retrospective, cohort study.** *Eur J Anaesthesiol.* 2021 Feb 1; 38(2): 130-7.

This retrospective, case-matched cohort study evaluated whether PDPH after UDP leads to chronic sequelae including PPD, PTSD, HA, or backache. Women with documented UDP and matched controls over 7-year period were identified. 132 cases and 276 controls demonstrated PPD of 52.3% vs. 11.2% in controls; PTSD 12.8 vs. 0.4%; lower breastfeeding rate (54.5 vs. 76.8%); and current HA and backache. Longer-term follow-up is warranted, as is acute strategies that mitigate these longer-term sequelae.

44. Orbach-Zinger S, Jadon A, Lucas DN et al. **Intrathecal catheter use after accidental dural puncture in obstetric patients: Literature review and clinical management recommendations.** *Anaesthesia.* 2021 Aug; 76(8):1111-21.

An international set of OB anesthesia experts reviewed 35 articles and created 8 practice recommendations for the management of ITC management. Aspirating the catheter for CSF, initiating analgesia with low-dose solution, monitoring frequent NIBP and FHR for 30 minutes, gradually titrating for CD, keeping the catheter in situ for 24h, considering saline injection and clear labeling are emphasized. If ITCs are used, institutional guidelines are critically important.

## **HYPERTENSIVE DISORDERS OF PREGNANCY**

### **Prevalence and Diagnosis**

45. Yang Y, Le Ray I, Zhu J et al. **Preeclampsia prevalence, risk factors, and pregnancy outcomes in Sweden and China.** *JAMA Network Open.* 2021 May; 4(5): e218401.

This cross-sectional study compared preeclampsia prevalence, risk factors and outcomes among deliveries from the Swedish national Medical Birth Register (2007-2012). And the China Labor and Delivery Survey (2015-2016). The Swedish registry of 555,446 deliveries captures nearly all births in Sweden; the China registry of 79,243 deliveries was reweighted to enable national comparisons. While prevalence between countries was similar, China had a higher proportion of severe preeclampsia and worse birth outcomes including a 10-fold higher rate of stillbirth. This global analysis helps fill data gaps for Asian population and can guide further evaluation of ethnicity and genetic determinants for preeclampsia risk, utility of serum biomarkers among different populations, and achieving equitable outcomes by targeted focus on high-risk groups.

46. Bello NA, Zhou H, Cheetham TC et al. **Prevalence of hypertension among pregnant women when using the 2017 American College of Cardiology/American Heart Association Blood Pressure Guidelines and association with maternal and fetal outcomes.** JAMA Network Open. 2021 Mar; 4(3): e213808.

A lower diagnostic threshold for HTN was recommended by the 2017 ACC/AHA guidelines. This cohort study of EHR data evaluated 137,389 deliveries between 2009 and 2014 in a large US regional health system. The primary endpoint was development of preeclampsia or eclampsia; fetal/neonatal primary endpoint was composite of preterm birth, SGA, and NICU admission within 28d of delivery. Comparison with the current ACOG definition of HTN was made. With more stringent diagnostic criteria, a 17.8% absolute increase in overall prevalence of HTN from 10.3 to 28.1% was found. 2.1% of women were reclassified with cHTN rather than gHTN and had the highest risk of developing preeclampsia compared to women without HTN by either criterion. The marked improvement of the new threshold to identify women who go on to develop preeclampsia may be benefit patients for preventive therapy such as low-dose aspirin.

47. Lai J, Syngelaki A, Nicolaides KH et al. **Impact of new definitions of preeclampsia at term on identification of adverse maternal and perinatal outcomes.** Am J Obstet Gynecol. 2021 May; 224(5): 518.e1-518.e11.

This prospective cohort study from 2 maternity hospitals in England investigated the ACOG and ISSHP definitions at term gestation and identification of adverse maternal and perinatal outcomes. The broad definition of preeclampsia (proteinuria or one or more maternal symptoms, signs, or abnormal laboratory tests) better identified women and newborns at risk for adverse outcomes. Whether implementation of this broader definition can lead to improved outcomes requires further research.

*With commentary by Shennan AH, Hurrell A. The evolving definition of pre-eclampsia. BJOG 2021; 128:1383.*

48. Gray KJ, Kovacheva VP, Mirzakhani H et al. **Risk of pre-eclampsia in patients with a maternal genetic predisposition to common medical conditions: a case-control study.** BJOG 2021; 128: 55-65.

This case-control study evaluated 498 preeclampsia vs. 1864 control women of European ancestry for genotype on a cardiovascular gene-centric array using significant SNPs of 21 traits in 7 disease categories with published GWAS. A genetic instrument for each trait was created with the SNPs for specific traits with published GWAS and odds of preeclampsia compared. Preeclampsia risk was associated with increased alleles for elevated DBP and increased BMI while alleles for alkaline phosphatase were protective. DPB genetic loci was even more impactful in early onset preeclampsia cases. No other traits showed association. A genetic predisposition to increased DBP and obesity also increases the risk of preeclampsia.

49. Hoffman MK, Ma N, Roberts A. **A machine learning algorithm for predicting maternal readmission for hypertensive disorders of pregnancy.** Am J Obstet Gynecol MFM 2021 Jan; 3:100250.

Can a machine learning algorithm predict maternal readmission for HTN? This study prospectively collected data from 2015 to 2019 at a large tertiary center for women readmitted within 42 days of delivery requiring magnesium or BP control. Of 20,032 delivering women, 238 were readmitted for HDP (1.2%) and included in a derivation cohort. Then, 5823 women with 82 readmissions were used as a validation cohort. Both algorithms used 31 clinical features. The study identifies both previously identified and novel risk factors. Trends in vital signs with mathematical modelling was superior to a single vital sign, and weight gain was a novel readmission marker. Ketorolac use was a model feature potentially a surrogate for CD vs. through kidney injury mediated HDP. This model should be validated at other centers.

50. Droge LA, Perschel FH, Stutz N et al. **Prediction of preeclampsia-related adverse outcomes with the sFlt-1/PlGF ratio in clinical practice.** Hypertension. 2021 Feb; 77(2): 461-71.

Do the antiangiogenic/angiogenic sFlt-1/PlGF ratios work for real-world prediction of preeclampsia in conjunction with clinical features? The PROGNOSIS trial defined a ratio range of 38-85 for lack of diagnosis for 1 week-high sensitivity to detect disease and adverse outcome, respectively. This retrospective real-world study of 1117 patients at high risk for preeclampsia were evaluated with sFlt-1/PlGF ratio alone or in combination with other clinical tests to predict adverse maternal or fetal outcomes in patients with signs and symptoms of preeclampsia. Prediction of adverse outcomes was (1) poor using HTN and proteinuria alone (AUC 69%), better with sFlt-1/PlGF ratio alone (AUC 85.7%); and best with all clinical information including the ratio (AUC 88.7%). More real-world studies for both prediction and management will be helpful and may expedite uptake of their use in the US among various patient populations. Since adverse outcomes continued to occur despite knowing the ratios, protocols for escalation of care may be warranted.

*With an editorial by Suresh SC and Rana S. Real-world use of biomarkers in management of hypertension during pregnancy. Adjunct to clinical care. Hypertension. 2021 Feb; 77(2) 472-4.*

51. Hayes-Ryan D, Khashan AS, Hemming K. **Placental growth factor in assessment of women with suspected preeclampsia to reduce maternal morbidity: a stepped wedge cluster randomized control trial (PARROT Ireland).** *BMJ.* 2021 Aug 13; 374: n1857.

This national multisite stepped wedge cluster RCT enrolled 2313 of 4000 anticipated participants from 2017 to 2019 who had signs or symptoms suggestive of evolving preeclampsia, to receive usual care or usual care plus point-of-care PlGF testing with suggested management guidelines. Maternal morbidity was similar between groups; 38% in the control vs. 32% in the intervention group, and neonatal morbidity was also similar. These results do not support the incorporation of PlGF testing as part of routine care for preterm preeclampsia until further studies can show benefit.

### Prevention and Treatment of Hypertension

52. Hastie R, Tong S, Wikstrom AK et al. **Aspirin use during pregnancy and risk of bleeding complications: A Swedish population-based cohort.** *Am J Obstet Gynecol* 2021 Jan; 224:95.e1-12.

This register-based cohort study evaluated the Swedish Pregnancy Register including 313,624 women giving birth from January 2013 - July 2017. By logistic regression, risk of antepartum, intrapartum, and PPH was assessed among ASA users vs non-ASA users. ASA users had higher rates of intrapartum (2.9 vs. 1.5%) and postpartum (10.2 vs. 7.8%) hemorrhage but not antepartum hemorrhage. Neonatal intracranial hemorrhage was also increased (0.07 vs. 0.01%). Stratifying by mode of delivery, this effect was seen among vaginal but not CDs. This provides good data for risk-benefit discussions to take ASA, and for risk stratification for bleeding complications around the time of delivery.

53. Henderson JT, Vesco KK, Senger CA, Thomas RG, Redmond N. **Aspirin use to prevent preeclampsia and related morbidity and mortality.** Rockville (MD): Agency for Healthcare Research and Quality (US); 2021 Sep. Report No. 21-05274-EF-1.

This Evidence Report evaluated 23 RCTs including 26,952 pregnancies. 18 included patients at increased risk for preeclampsia. Incidence of preeclampsia ranged from 4-30% in untreated groups. ASA use was significantly associated with lower risk of preeclampsia (0.85), perinatal mortality and preterm birth (0.79, 0.80), and IUGR (0.82) and there were no significant associations with risk of PPH (1.03). Daily low-dose aspirin during pregnancy was associated with lower risk of serious perinatal outcomes for individuals at increased risk for preeclampsia, without serious harm. Of note, trial were majority White and high-dose recent trial did not report hemorrhage outcomes. Further work within high-risk ethnicities and dose safety is warranted.

*Accompanied by the USPSTF Recommendations, US Preventive Services Task Force Recommendation Statement.* *JAMA* 2021 Sep 28; 326(12):1186-91.

*With an editorial by Espinoza J. Low-dose aspirin for the prevention of preeclampsia.* *JAMA* 2021; 326:1153-4 and Patient Page.

54. Constantine MM, West H, Wisner KL et al. **A randomized pilot clinical trial of pravastatin vs. placebo in pregnant patients at high risk of preeclampsia.** *Am J Obstet Gynecol* 2021 Dec; 225:666.e1-15.

This is a small second randomized placebo-controlled trial in 20 women total to receive oral pravastatin 20 mg vs. placebo starting in the second trimester for the prevention of preeclampsia in high-risk patients. It focused stringently on safety from the neonatal standpoint – congenital anomalies, infant birthweight, auditory function as a marker of auditory neural myelination; and collection of maternal adverse events. Transplacental transfer of this hydrophilic statin was expected to be low and this study showed majority of umbilical cord plasma pravastatin below detectable levels. Both this and original

trial showed reduced rates of preeclampsia and preterm deliveries in those on pravastatin – with a postulation that pravastatin may reverse pregnancy-specific angiogenic imbalance, oxidative and inflammatory stress, and endothelial health. The favorable risk-benefit analysis justifies a larger clinical trial; until then, pravastatin use in pregnancy for preeclampsia prevention remains investigational.

55. Martin C, Pappas J, Johns K et al. **Semiautonomous treatment algorithm for the management of severe HTN in pregnancy.** *Obstet Gynecol* 2021 Feb; 137(2):211-7.

The ACOG recommends that acute severe HTN be treated with no more than 30-60 minutes' delay. This single-center retrospective cohort evaluated 959 patients treated for severe HTN; 373 (38.9%) prior to implementing a semiautonomous treatment algorithm; 334 (34.8%) during implementation; and 252 (26.2%) after implementation. Severe HTN treatment within 30 minutes was 65.9 pre vs. 79.0% after implementation. There was no difference in treatment within 60 minutes; 86.3 vs. 92.9%. This demonstrates the impact of a BP management tool for rapid clinical decision-making.

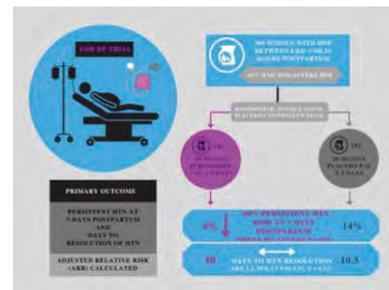
*With an editorial by Hauspurg A. Reducing maternal morbidity and racial disparities in hypertension care using an automated care pathway.* *Obstet Gynecol* 2021 Feb; 137(2): 209-10.

56. Mullan SJ, Vricella LLK, Edwards AM et al. **Pulse pressure as a predictor of response to treatment for severe HTN in pregnancy.** *Am J Obstet Gynecol* MFM 2021 Nov; 3:100455.

Which antihypertensive agent should be first line for severe HTN? This retrospective cohort from a single academic tertiary care center evaluated 479 women hospitalized with severe maternal HTN (SBP  $\geq$  160 or DBP  $\geq$  110 mmHg lasting at least 15 minutes and treated with IV labetalol, IV hydralazine, or immediate-release oral nifedipine) between 2015 and 2018. Primary outcome was time to resolution of severe HTN. Pulse pressure (SBP-DBP) was evaluated as a baseline characteristic for its association with response to treatment with the concept that a narrow pulse pressure indicating high SVR state more responsive to nifedipine or hydralazine vs. a wide pulse pressure indicating a high CO state more responsive to labetalol. Wide pulse pressure was predictive of persistent HTN at >60 minutes regardless of medication used. Other predictors of persistent HTN were use of IV labetalol and gestational age <37 weeks. Further work on identifying HTN phenotypes and response to treatment is warranted.

57. Perdigao JL, Lewey J, Hirshberg A. **Furosemide for accelerated recovery of blood pressure postpartum in women with hypertensive disorder of pregnancy: A randomized controlled trial.** *Hypertension*. 2021 May 5; 77(5): 1517-24.

This single-center, double-blind, placebo-controlled RCT treated women with gHTN, preeclampsia, or preeclampsia superimposed on cHTN with a 5-day course of 20 mg oral furosemide vs. placebo. Primary outcomes were prevalence of persistent HTN 7 days postpartum and number of days to achieve resolution of HTN. HTN was 60% less in the treated group, 6 vs. 14%. Further studies to explore impact on severe HTN, impact on biomarkers, and long-term impact on CV health are warranted. In the meantime, low-dose furosemide immediately postpartum for women with HDP is feasible and for every 13 women treated, 1 woman will be prevented from having persistent postpartum HTN.



*With an editorial by Docheva N, Nieman KM, Rana S. Treat it while you can: Use of furosemide in management of postpartum hypertension.* *Hypertension*. 2021 May 5; 77(5): 1525-7.

58. Bergman L, Cluver C, Carlberg N et al. **Cerebral perfusion pressure and autoregulation in eclampsia- a case control study.** *Am J Obstet Gynecol*. 2021 Aug; 225(2): 185.e1-e9.

Preeclampsia in 3-6% of pregnancies can evolve to cerebral complications of seizure, cerebral edema, and hemorrhage, severe morbidity and mortality, and later life white matter lesions, stroke, seizure disorder and vascular dementia. Determining the underlying pathophysiologic mechanism of cerebral complications in preeclampsia is of interest. This prospective case control study in Cape Town, South Africa included 16 women with eclampsia, 18 women with preeclampsia with severe features, and 21 normotensive women. Transcranial doppler exams, continuous noninvasive BP measurements and end-tidal CO<sub>2</sub> monitoring for cerebral perfusion pressure and dynamic cerebral autoregulation index were calculated. Women with eclampsia had increased cerebral perfusion pressure; 109.5 mmHg compared to those with preeclampsia without severe features (84 mmHg) or no HTN (80 mm Hg). Dynamic cerebral autoregulation and cerebral perfusion pressure require study in expanded populations and may be preventive and therapeutic targets.

## **INFECTION & INFLAMMATION, and ANTIBIOTICS**

59. Alrowaily N, D'Souza R, Dong S et al. **Determining the optimal antibiotic regimen for chorioamnionitis: A systematic review and meta-analysis.** Acta Obstet Gynecol Scand. 2021 May; 100(5): 818-31.

This systematic review and meta-analysis evaluated 14 RCTs of antibiotic regimens for chorioamnionitis and maternal and neonatal outcomes. The prompt intrapartum initiation of antibiotics upon diagnosis was superior to delaying until postpartum for maternal and neonatal outcomes, and single-dose postpartum vs. multi-dose antibiotics to reduced hospital length of stay. However, there was a paucity of evidence about choice, combination, dosage, or duration of antibiotics for chorioamnionitis. The implications of maternal sepsis and other morbidity of this common intrapartum complication warrant further work to fill this knowledge gap.

60. Beck C, Gallagher K, Taylor LA et al. **Chorioamnionitis and risk for maternal and neonatal sepsis: A systematic review and meta-analysis.** Obstet Gynecol. 2021 Jun 1; 137(6):1007-22.

This systematic review identified 103 studies, and 55 met criteria for meta-analysis. Three studies evaluating chorioamnionitis and maternal sepsis provided inconclusive evidence for an association. However, both histologic and clinical chorioamnionitis were associated with early and late-onset sepsis in neonates, supporting the current guidelines for preventive newborn care. This is important information to indicate the benefit of preventive newborn care likely outweighs the risks of antibiotic exposure such as necrotizing enterocolitis.

61. Brizuela V, Cuesta C, Bartolelli G et al. **Availability of facility resources and services and infection-related maternal outcomes in the WHO maternal sepsis study: a cross-sectional study.** Lancet Glob Health 2021; 9: e1252-61.

Maternal sepsis is the 3<sup>rd</sup> leading cause of global maternal mortality (11%) and this Global Maternal Sepsis (GLOSS) sub-study evaluated facility-based characteristics and compliance with patient assessment of women with suspected or confirmed maternal infection. Even when resources and services were in place in low-resource settings, women still had poor outcomes. For example, 85 of 355 sites (24%) did not measure respiratory rate and 184 of 325 (57%) utilized available pulse oximetry. Bundle implementation, reinforcement of the modified OB SOFA score, and carefully training personnel should be prioritized to lower morbidity and mortality.

*With an editorial by Maswime S and Buga E.* **Surviving sepsis in low-income countries.** Lancet Glob Health 2021; 9: e1183-4.

62. Cheshire J, Jones L, Munthali L et al. **The FAST-M complex intervention for the detection and management of maternal sepsis in low-resource settings: a multi-site evaluation.** BJOG. 2021 Jul; 128(8):1324-33.

The 'FAST-M' maternal sepsis bundle was developed by international expert consensus via a Delphi process, and consists of Fluids, Antibiotics, Source identification, Transfer if needed, and ongoing Monitoring. FAST-M was designed for LRC settings in which compliance with tools from the Surviving Sepsis Campaign bundle are not feasible. This before-after study evaluated FAST-M for impact on recognition of maternal sepsis and improved care in 15 facilities in Malawi, 2017-18. A MEOWS chart and FAST-M decision tool, a FAST-M maternal sepsis care bundle, and a FAST-M implementation program were implemented. All hospital staff attended FAST-M training workshops and champions were designated at each site. Two months pre-intervention was followed by 1 month of training, then 6 months of follow-up, with improvement in clinical care for women with suspected sepsis including timely antibiotic administration. This feasibility study can inform large-scale multi-country intervention studies.

63. Shields A, de Assis V, Halscott T. **Top 10 pearls for the recognition, evaluation, and management of maternal sepsis.** Obstet Gynecol. 2021 Aug 1; 138(2):289-304.

This useful review defines 10 clinical pearls for recognition, evaluation, and management of maternal sepsis. The central themes are: recognition is key; move fast during the "golden hour" to save lives; stabilize and get to the source of the problem; and anticipate and prevent adverse pregnancy outcomes.

## **Labor Epidural-Associated Maternal Fever**

64. Hochler H, Lipschuetz M, Guedalia J et al. **The impact of peak duration of maternal intrapartum fever on perinatal outcomes.** Am J Obstet Gynecol MFM. 2021 Jul; 3(4): 100390.

This retrospective cohort of term singleton births at 2 centers from 2003-2015 identified 85,713 deliveries, with 1517 (1.8%) experiencing fever during delivery. The maximal maternal fever by itself or in combination with duration was associated with a higher incidence of composite neonatal complications. This confirms previous studies and warrants further study on continuous temperature monitoring with rigorous control to evaluate its impact on neonatal outcomes.

65. Jia L, Cao H, Guo Y et al. **Evaluation of epidural analgesia use during labor and infection in full-term neonates delivered vaginally.** JAMA Network Open. 2021 Sep 1; 4(9): e2123757.

This propensity score-matched cohort study is from China and reports 37,786 parturients who had vaginal delivery, 52.8% with LEA. In n = 15,401 per group, LEA was associated with a higher incidence of neonatal infection (absolute risk difference, 2.6%, 95% CI, 2.2%-3.0%; RR, 2.43; 95% CI, 2.11-2.78) including sepsis and uncharacterized infection compared to those in mothers with no LEA. The increased risk of neonatal infection associated with LEA in full-term nulliparous patients undergoing SVD warrants further evaluation.

66. Morton S, Kua J, Mullington CJ. **Epidural analgesia, intrapartum hyperthermia, and neonatal brain injury.** Br J Anaesth. 2021 Feb; 126(2): 500-15.

A systematic review and meta-analysis explored the following three questions: Does LEA cause intrapartum hyperthermia? Is intrapartum hyperthermia (from any cause other than chorioamnionitis) associated with neonatal brain injury? And is epidural-induced hyperthermia associated with neonatal brain injury? 41 studies (13 RCTs with remainder observational) were included for question 1, 36 for question 2 and 2 studies for question 3. When they randomized the mode of analgesia, LEA was associated with intrapartum hyperthermia (OR 4.21), intrapartum hyperthermia was associated with neonatal brain injury (OR 2.79), but they were unable to quantify a relationship between epidural-induced hyperthermia and neonatal brain injury. Whether intrapartum epidural-induced hyperthermia is a cause of neonatal brain injury requires further study.

67. Mehraban S, Nematian S, Mehraban SS et al. **Randomized controlled trial of IV acetaminophen for reduction of intrapartum maternal fever.** Am J Obstet Gynecol MFM. 2021 Jan; 3(1):100287.

IV acetaminophen reaches peak plasma concentration faster than PO acetaminophen. This randomized, comparator controlled, double-dummy double-blind clinical trial administered either 1000 mg acetaminophen either PO or IV upon intrapartum temp  $\geq 38^{\circ}\text{C}$ . Maternal and neonatal cord blood oxidative stress markers (glutathione), cytokines, and placentas were evaluated among 121 patients. The mean time to defervescence was 54.9 vs. 52.6 for IV vs PO acetaminophen and there was no difference in inflammatory marker concentrations. There is no need to prioritize IV over PO acetaminophen for maternal fever.

### **NEONATAL OUTCOMES**

68. Raghuraman N, Temming LA, Doering MM et al. **Maternal oxygen supplementation compared with room air for intrauterine resuscitation - a systematic review and meta-analysis.** JAMA Pediatr. 2021 Apr 1; 175(4): 368-76.

Oxygen is frequently administered at time of scheduled CD or labor to prevent fetal hypoxia or acidemia, but what is the utility of this practice? This meta-analysis of 16 RCTs (n = 1078 oxygen group and n = 974 room air group) evaluated the primary outcome of UA pH and secondary outcomes UA pH < 7.2, UA PaO<sub>2</sub>, UA base excess, 1- and 5-minute Apgar scores, and NICU admission. Oxygen supplementation at delivery was associated with improved UA PaO<sub>2</sub> but no difference in UA pH compared to room air. While maternal O<sub>2</sub> supplementation yielded no benefit for neonatal outcomes, administration in anticipation of a need for GA and/or for maternal hypoxemia remains paramount. Furthermore, well-powered trials are needed to evaluate maternal O<sub>2</sub> supplementation in response to category II fetal tracings.

*With a commentary by Saugstad OD and Vento M. Potential value of maternal oxygenation.* JAMA Pediatr. 2021 July; 175(7): 749.

69. Johnson GJ, Salmanian B, Denning SG et al. **Relationship between umbilical cord gas values and neonatal outcomes.** Obstet Gynecol. 2021 Sep 1; 138(3):366-73.

This retrospective cohort involving 29,787 singleton healthy fetuses evaluated umbilical cord gas values and Apgar scores and found a weak or missing correlation between UA pH and base excess and 1 and 5- minute Apgar scores. This finding weakens the assumption that fetal intolerance is correlated with low pH. Trying to enhance EFM to better predict

newborn pH is unlikely to improve fetal outcomes, given that acidosis and Apgar scores don't correlate. This study is provocative to question the value of EFM.

*With a commentary from Devoe LD, Britt DW, Evans MI. Obstet Gynecol. 2021 Dec 1; 138(6):946-7.*

**Relationship between umbilical cord gas values and neonatal outcomes: Implications for electronic fetal heart rate monitoring.**

The finding that umbilical cord blood arterial pH or base excess values fail to predict Apgar scores is put in the context that Apgar scores do not accurately predict long-term childhood developmental outcomes either. However, rather than discount EFM because its use as a surrogate to acidosis doesn't correlate with Apgar-based well-being at birth, the editorial suggests further attention to EFM particularly since nonelective CDs are driven by EFM data. The focus should expand rather than shrink, to explore the fetal deterioration and the Fetal Reserve Index and better detect changes early in labor to permit intervention and resuscitation.

**70. Bateman BT, Hernandez-Diaz S, Straub L et al. Association of 1st trimester prescription opioid use with congenital malformation in the offspring: population-based cohort study. BMJ. 2021 Feb 10; 372:n102.**

What is the risk of 1<sup>st</sup> trimester exposure to prescription opioids for major congenital malformations? This nationwide sample of publicly and commercially insured pregnant women linked to their liveborn infants was identified via the Medicaid Analytic eXtract (2000-14) and MarketScan Research Database (2003-15). 70,447 of 1,602,580 (4.4%) publicly insured and 12,454 of 1,177,676 (1.1%) commercially insured pregnant women had 2 or more opioid dispensations during their 1<sup>st</sup> trimester. While absolute risk of malformations was 41 vs. 32 per 1000 and 42.6 vs. 37.3 in the exposed vs. unexposed for the Medicaid and MarketScan cohorts, respectively, adjustment shifted risk estimates toward the null except for oral clefts (RR 1.21) and 1.62 for cleft palate. Pain is common in pregnancy, and opioids are prescribed with some frequency. This analysis was reassuring in the lack of major congenital malformations overall after exposure to opioids in the 1<sup>st</sup> trimester, with a small risk of oral clefts associated with opioid use a possibility.

**71. Butwick AJ, Wong CA, Lee HC et al. Association between neuraxial labor analgesia and neonatal morbidity after operative vaginal delivery. Anesthesiology. 2021 Jan 1; 134(1): 52-60.**

This population-based cross-sectional study analyzed US birth certificates from 2017 of women who underwent operative vaginal delivery. Composite neonatal morbidity (5-min Apgar score less than 7, immediate assisted ventilation or greater than 6 h, NICU admission, transfer to a different facility, and neonatal neurologic dysfunction) was evaluated. 3,864,754 live births were identified, 3,749,761 were excluded, and 106,845 were analyzed. Women receiving epidural analgesia (87%) were more likely to be non-Hispanic White, have secondary education, private insurance, no previous live births, have GDM, gHTN, preeclampsia, IOL, have late prenatal care, and live in the North, Midwest, or South census region than the 13.4% who did not receive it. Composite neonatal morbidity was higher in those who received neuraxial analgesia: 11.3% vs. 8.9%. A neonatal benefit of neuraxial analgesia for operative vaginal delivery was not observed. Confounding by indication may explain the observed association between neuraxial analgesia and neonatal morbidity.

**72. Hough A, Shakur-Still H, Roberts I et al. Stillbirths and neonatal deaths among 18,942 females with PPH: Analysis of perinatal outcomes in the WOMAN trial. Int J Gynaecol Obstet. 2021 Apr; 153(1): 146-53.**

PPH is the leading global cause of maternal death, and while stillbirth and neonatal death often occurs in conjunction, there is limited research on this association and particularly in LMICs. This was a secondary analysis of the WOMAN trial that collected infant outcome data to assess TXA drug safety. Among 18,942 singleton births with PPH, maternal death rate was 2.4% (n = 455 deaths), SBR 10.4% (n = 1978), and predischARGE neonatal death 1.4% (n = 264). SBR was 104 per 1000 births; 371 per 1000 births in mothers who died and 98 per 1000 in mothers who lived. The SBR of 105 per 1000 births is shockingly high compared to global SBR of 18.4. Patients recruited to the WOMAN trial from the UK had comparatively low neonatal death rates. Perinatal mortality is a marker for challenges of PPH management specific to LMICs and reporting perinatal outcomes can help delineate context. Interpretation of outcomes, including the efficacy of TXA for PPH, should be considered in the context of LMICs vs HICs.

**73. Wall-Wieler E, Bateman BT, Hanlon-Dearman A, et al. Association of epidural labor analgesia with offspring risk of autism spectrum disorders. JAMA Pediatr. 2021 Jul a; 175(7):698-705.**

LEA has been associated with increased offspring risk of ASD but concern for residual confounding has been raised. This longitudinal cohort study of vaginal deliveries 2005-2016 of a population-based Manitoba, Canada data set captured 123,175 offspring (50.9% boys) with 38.2% exposed to LEA and reports 2.1% exposed vs. 1.7% unexposed offspring diagnosed with ASD up to 2019. Adjustment for maternal sociodemographic, prepregnancy, pregnancy, and perinatal covariates lowered the HR from 1.25 to 1.08 with a CI 0.97-1.20. Within-sibling design adjusting for baseline covariates found no association of LEA with ASD (HR 0.97). There was no association between LEA and increased offspring risk of

ASD. These results contrast with a prior study by Qui et al in 2020 in which a statistical technique relied on an assumption that all confounders are known, adequately measured, and included in the model and therefore for which causation was questioned.

*With a comment from the editor:* Christakis DA. **More on epidurals and autism.** JAMA Pediatr. 2021 Jul 1; 175(7):705

*and an editorial from* Hanley GE, Ip A, Oberlander TF. **Epidural analgesia and ASD risk – the challenges inherent in complex observational research.** JAMA Pediatr. 2021 Jul 1; 175(7): 675-77.

74. Mikkelsen AP, Greiber IK, Scheller NM, Lidegaard O. **Association of labor epidural analgesia with autism spectrum disorder in children.** JAMA. 2021 Sep 28; 326(12): 1170-77.

This nationwide retrospective cohort study identified all live-born children in Denmark, 2006-2013 with follow-up from 1<sup>st</sup> birthday through December 2017. 485,093 live-born children were evaluated; exposure of interest was LEA by procedure code; and main outcome was ASD diagnosis. Secondary within-mother sibling analysis was performed with or without exposure for different deliveries. Median follow-up was 7 years; exposure to LEA was 19.4%. ASD occurred in 6248 children; 1.5% in the LEA group and 1.3% in the non-LEA group; 23.1 per 10,000 vs 18.5 per 10,000 person-years LEA vs unexposed; crude and adjusted HR 1.29 to 1.05 and within-mother analysis was 20.8 vs. 17.1 per 10,000 person-years aHR 1.05. There was no significant association with ASD among mothers who received LEA.

75. Hanley GE, Bickford C, Ip A, Lanphear N, Lanphear B, Weikum W, Zwaigenbaum L, Oberlander TF. **Association of epidural analgesia during labor and delivery with autism spectrum disorder in offspring.** JAMA 2021 Sep 28; 326(12): 1178-85.

This population-based retrospective cohort study included term, singleton children born in British Columbia, Canada between April 1, 2000 and December 31, 2014 by vaginal delivery. All children were followed through 2016 via linked databases. The exposure was LEA use, and ASD diagnosis was made by pediatric or psychiatric specialists. Models were adjusted as was done in previous studies. 5192 children were diagnosed with ASD (1.34%) and 28.7% were exposed to LEA. 1.53% vs. 1.26% ASD occurred in LEA vs. unexposed with a HR of 1.32 and adjusted HR of 1.09. The small increase in ASD among offspring with maternal LEA use was attributed to likely residual confounding in this model.

*With an editorial by* Wong CA and Stevens H. **LEA and ASD: Is there an association?** JAMA. 2021 Sep 28; 326(12):1155-7.

The increased prevalence of ASD, its heritability, and research to date is discussed. Challenges of selection and ascertainment biases common to observational studies, residual confounding, and potential misclassification of ASD diagnosis is emphasized. A common theme among studies is that women who request LEA are different than women who did not, and even adjustment for covariates may not have eliminated risk of residual confounding. This is a valuable piece to read for the ability to provide thoughtful, accurate counseling to patients who may be concerned about LEA and ASD.

76. Bleeser T, Van Der Veecken L, Fieuws S et al. **Effects of general anesthesia during pregnancy on neurocognitive development of the fetus: a systematic review and meta-analysis.** Br J Anesth. 2021 Jun; 126(6):1128-40.

This systematic review and meta-analysis evaluated the effect of GA on neurocognitive fetal development. 65 preclinical studies were identified, mostly involving rodent animal models. GA during pregnancy impaired learning and memory and resulted in neuronal injury in all models. However, higher doses and less monitoring was done in many studies. Clinical observational studies are warranted.

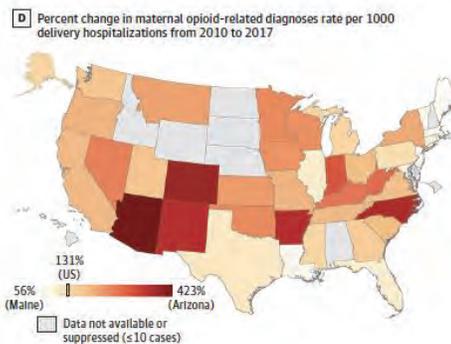
77. Ing C, Landau R, DeStephano D et al. **Prenatal exposure to general anesthesia and childhood behavioral deficit.** Anesth Analg. 2021 Sep 1; 133(3):595-605.

This observational cohort study from Perth Australia re-evaluated participants of the Raine Study: mothers enrolled during pregnancy, and children born from 1989-1992 included with neuropsychological and behavioral tests at age 10 (n = 2024). Outcome scores of children prenatally exposed to GA were compared to those who were not. Prenatal exposure to GA was associated with increased externalizing behavioral problems in childhood. However, surgery when required would still need to be prioritized. Editorialists make a point that as more surgery is done in pregnancy (i.e., fetal) we may be able to get a better sense of this phenomenon.

With an editorial by Fardelmann K and Gaiser R. **Does anesthesia and surgery during pregnancy really affect learning and behavior in the offspring: The Holy Grail in anesthesiology research.** *Anesth Analg.* 2021 Sep 1; 133(3): 592-4.

78. Hirai AH, Ko JY, Owens PL et al. **Neonatal abstinence syndrome and maternal opioid-related diagnoses in the United States, 2010-2017.** *JAMA.* 2021 Jan 12; 325(2): 146-55.

Temporal trends in maternal opioid-related diagnoses are important for anticipation of NAS and management of anesthesia and pain control for delivery. This repeated cross-sectional analysis of the 2010-2017 Healthcare Cost and Utilization Project's NIS and State Inpatient Databases examined national and state variation in MOD and NAS in 2017 and changes since 2010. The primary outcomes were NAS and MOD per 1000 births and delivery hospitalizations, respectively. In 2017, 751,037 birth hospitalizations for 748,239 deliveries were identified and 5375 newborns with NAS and 6065 women with MOD. NAS rate increased from 4.0 to 7.3 per 1000 and MOD rate increased from 3.5 to 8.2 per 1000 delivery hospitalizations. There was wide state-level variation, with 1.3 compared to 53.5 per 1000 in Nebraska vs. West Virginia.



79. Chatterjee D, Arendt KW, Moldenhauer JS, et al. **Anesthesia for maternal-fetal interventions: A consensus statement from the ASA committees on OB and pediatric anesthesiology and the North American Fetal Therapy Network.** *Anesth Analg.* 2021 Apr 1; 132(4): 1164-73.

As maternal-fetal surgery continues to evolve, more interventions are being performed at different stages of pregnancy and anesthetic techniques have evolved. This consensus statement is a comprehensive source for preoperative evaluation, intraoperative management, mode of anesthesia, and postoperative care for minimally invasive and open maternal-fetal interventions.

80. Deprest JA, Nicolaides KH, Benachi A et al. **Randomized trial of fetal surgery for severe left diaphragmatic hernia.** *N Engl J Med* 2021 July 8; 385(2): 107-18; and

81. Deprest JA, Benachi A, Gratacos E et al. **Randomized trial of fetal surgery for moderate left diaphragmatic hernia.** *N Engl J Med* 2021 July 8; 385(2): 119-29.

CDH occurs in approximately 1 of 4000 births and is on the left side 85% of the time. CDH is associated with a high risk of neonatal death due to respiratory failure and pulmonary hypertension. FETO has been associated with increased survival among infants with severe CDH. This pair of open-label trials was conducted at centers experienced with FETO randomized patients 1:1 to FETO at 27-29 weeks or expectant care if severe CDH and at 30-32 weeks or expectant care if moderate CDH. FETO for severe CDH was associated with increased survival to discharge and well-being at 6 months of age. FETO for moderate CDH, however, did not show a significant benefit in survival to discharge or need for oxygen at 6 months. In both CDH groups, FETO increased the risks of PPROM and preterm birth. These studies advance understanding of FETO efficacy for moderate and severe CDH and facilitate counseling about associated risks and benefits specific to disease severity and timing of intervention.

With an editorial by Cole FS. *N Engl J Med* 2021 July 8; 385(2): 177-8.

82. Madar J, Roehr CC, Ainsworth S et al. **European resuscitation council guidelines 2021: Newborn resuscitation and support of transition of infants at birth.** *Resuscitation.* 2021 Apr; 161:291-326.

These newborn life support guidelines come from the European Resuscitation Council and are based on the International Liaison Committee on Resuscitation (ILCOR) 2020 Consensus on Science and Treatment Recommendations (CoSTR) for Neonatal Life Support. A resuscitation algorithm, pre-delivery considerations, training and educations, temperature regulation, umbilical cord management, parent counseling, and considerations for discontinuing support are covered. This is a comprehensive update since 2015 with excellent educational infographics. Key changes recommend 60 seconds delay of umbilical cord clamping and/or cord milking >28 weeks, avoiding immediate DL in non-



vigorous meconium deliveries, consideration of an LMA >34 weeks, inflation pressures and FiO<sub>2</sub>, and use of 100% FiO<sub>2</sub> if providing chest compressions.

83. Ali N, Lam T, Gray MM, Clausen D et al. **Cardiopulmonary resuscitation in quaternary neonatal intensive care units: a multicenter study.** Resuscitation. 2021 Feb; 159:77-84.

CPR is required in the NICU at 10-fold the incidence as the delivery room. This multicenter retrospective cohort study of four quaternary NICUs over 6 years (2011-2016) evaluated demographics, resuscitation data, and post-arrest outcomes with a primary outcome of survival to discharge. 17,358 patients were admitted to the 4 NICUs, 200 (1.1%) required CPR, and 45.5% survived to discharge. Most neonates were on ventilation (79%) and had a central venous line (90%) at the time of the arrest. Decreased survival was associated with multiorgan failure, septic shock, pneumothorax, longer duration of CPR, primary cardiac arrest, and receipt of epinephrine during the arrest. This is useful information for both vigilance and prognostics for family counseling.

### POSTPARTUM HEMORRHAGE

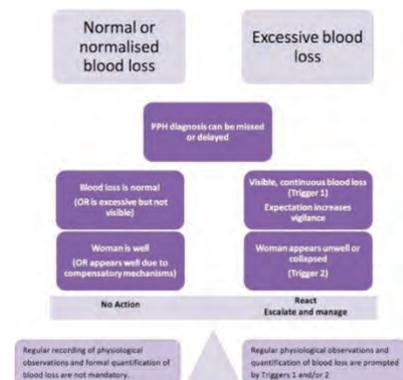
84. Bienstock JL, Eke AC, Hueppchen NA. **Postpartum Hemorrhage.** N Engl J Med 2021; 384:1635-45.

This review on PPH is worthwhile reading for every OB anesthesiologist. It is written from the perspective of maternal fetal medicine OB experts, in essence encouraging our work with the multidisciplinary team by shared perspectives and teamwork.

85. Hancock A, Weeks AD, Furber C, Campbell M, Lavender T. **The recognition of excessive blood loss at childbirth study (REACT): a two-phase exploratory sequential mixed methods inquiry using focus groups, interviews and a pilot, randomized crossover study.** BJOG 2021 Oct; 128(11): 1843-54.

It's not clear whether QBL can lower preventable morbidity and mortality from PPH. This group studies how decision-making processes rather than QBL play into the response to PPH. Here, they use qualitative methods (Phase 1) to explore how PPH is evaluated by providers. From that they designed phase 2, a clinical simulation to test the hypothesis that providers react to the nature, speed, and visibility of BL rather than a specific QBL-derived volume.

This study was completed between June 2014 and October 2017 at two large hospitals in England. For phase 1, a combination of patients, partners, midwives, 1 anesthesiologist, and obstetricians participated in either a focus group or a one-to-one semi-structured interview (their choice); 8 focus groups and 20 interviews were completed with a single investigator using a topic guide, were audio-recorded, transcribed verbatim, and anonymized. Results indicated that providers respond to speed and nature of visible bleeding rather than an actual volume – tested in Phase 2 with 10 midwives and 11 obstetricians: slow vs. fast blood loss simulated scenarios. In these drills, activation of response was faster for fast blood loss simulation compared to slow. The authors conclude that QBL is not to be prioritized; rather, focusing on cues of 'abnormal' or 'fast' BL are more realistic and impactful. Further research on how to combine these strategies or other cues with QBL for PPH are warranted.



86. Bell SF, Collis RE, Bailey C et al. **The incidence, aetiology, and coagulation management of massive postpartum hemorrhage: a 2-year national prospective cohort study.** Int J Obstet Anesth. 2021 Aug; 47:102983.

Viscoelastic testing implementation improved over a 2-year national QI initiative that introduced VHA to guide blood product transfusion. This prospective cohort from Wales looked at maternal outcomes for those with massive PPH defined as > 1000 mL, defined as ≥ 2500 mL and/or ≥ 5 U RBC transfusion. Massive PPH occurred at 5.7 per 10000; VHA testing increased from 44.9% first 6 months to 81.8% final 6 months. VHA allowed targeted, patient-specific blood product administration.

87. Neary C, Naheed S, McLernon DJ, Black M. **Predicting risk of postpartum hemorrhage: a systematic review.** BJOG. 2021 Jan; 128(1):46-53.

The ability to accurately predict patients at risk for PPH would lower maternal morbidity and death. This systematic review of 14 eligible studies on PPH risk factors evaluated women with placenta previa, PAS, vaginal bleeding, CD, and the general OB population. All studies had high risk of bias due to low sample size, no internal validation, and minimal

external validation. Of 14 prognostic models for PPH risk, 3 have potential for clinical utility: CD, PAS disorders with MRI, and placenta previa. Further work to establish risk assessment tools and corresponding protocols are in critical need.

*With a mini commentary by Contag S. Benefit of standardised risk assessment for postpartum haemorrhage. BJOG. 2021 Jan; 128(1): 54.*

88. Ende HB, Lozada MJ, Chestnut DH et al. **Risk factors for atonic postpartum hemorrhage. A systematic review and meta-analysis.** *Obstet Gynecol.* 2021 Feb; 137:305-23.

As uterine atony remains the most common source of PPH and contemporary PPH risk assessment tools have only moderate predictive value, better identification and quantification of risk factors for atonic PPH is clinically important. Also, accounting for relative contribution of each risk factor would be helpful for developing more reliable, weighted risk stratification tools. With a systematic review of 27 identified RCTs, prospective or retrospective cohort studies and case-control studies of pregnant women who developed atonic PPH and that reported risk factors, the authors identify 47 potential risk factors for atonic PPH, 15 of which were judged definite or likely and 32 with no association or conflicting/unclear evidence. Many risk factors in current tools were confirmed including prior PPH from any etiology, placenta previa, placental abruption, uterine rupture, and multiple gestation. Novel risk factors identified in this analysis included HTN, diabetes, and ethnicity. Obesity and magnesium were not found to be associated with atonic hemorrhage. Further refinement of risk assessment tools is now in order, with studies to define weighting of factors and incorporation genetic factors and additional variables as they are identified.

89. Ahmadzia HK, Phillips JM, Kleiman R et al. **Hemorrhage risk assessment on admission: utility for prediction of maternal morbidity.** *Am J Perinatol.* 2021 Sep; 38(11):1126-33.

This retrospective cohort analyzed a multicenter database of women admitted for L&D from January 2015 through June 2018 at 20 hospitals. The AWHONN risk assessment tool for PPH was implemented across all hospital sites on June 1, 2016, and pre- and post- comparisons in maternal morbidity were evaluated. 14,8611 women were categorized as low-risk (26%); 26,080 as moderate risk (46%) and 15,730 as high risk (28%). Women with high-risk scoring had a relative risk of 4.9 for blood transfusion and 5.2 for EBL >1000. For pre- and post-implementation comparisons, 39,027 vs. 71,606 women were compared. A 20% reduction in blood transfusion and EBL > 1000 was observed after implementation of the PPH risk tool. While these outcomes may be related to factors other than the tool implementation, these findings indicate that the AWHONN tool works moderately well and incorporation of this or a similar PPH risk assessment tool in every unit is recommended.

90. Butwick AJ, Liu C, Bentley J et al. **Association of gestational age with PPH.** *Anesthesiology.* 2021 Jun 1; 134(6): 874-86.

This was a retrospective analysis of data from both California and Sweden that found the incidence of PPH varied from 3.2% in California to 7.1% in Sweden. Incidence was highest when deliveries were at the highest end of the spectrum 41 to 42 weeks gestation. Difference in prevalence in Sweden vs. California may be from differences in measurement of QBL, or in intrapartum practice. Adding gestational age as a risk factor for PPH may enhance sensitivity and specificity of our current existing risk assessment tools.

*With an editorial by Reale SC, Bateman BT, Farber MK. Exploring new risk factors for postpartum hemorrhage: Time to consider gestational age? Anesthesiology. 2021 Jun 1; 1434(6): 832-4.*

91. Nishida K, Sairenchi T, Uchiyama K et al. **Poor uterine contractility and PPH among low-risk women.** *Int J Gynaecol Obstet.* 2021 Jul; 154(1): 17-23.

Can we look at contractility in labor – abnormal labor patterns, use of uterotonics – to predict PPH? This case-control study evaluated 174,082 primiparas who had a term live singleton vaginal birth from 2013-2016 recorded in the Japan Perinatal Registry Database. Of note, women with known risk factors for PPH were excluded. 10,508 women (6%) had PPH. Women with abnormal patterns had an aOR of 1.23 and 1.3 with or without uterotonics, respectively. Abnormal labor patterns were defined as hypotonic uterine dysfunction: < 10mm Hg at cervical dilatation 4-8cm and < 40 mm Hg at cervical dilatation of 9cm in the second stage; prolonged labor, or arrest of labor. While prolonged labor and arrest of labor may be associated with multiple confounders, a focus on uterine dysfunction in labor as a risk for PPH is compelling and should be pursued with additional studies on contractility that is tracked through the course of labor.

92. Balki M, Downey K, Walker A. **Prophylactic administration of uterotonics to prevent PPH in women undergoing CD for arrest of labor: A randomized controlled trial.** *Obstet Gynecol.* 2021 Mar 1; 137(3):505-13.

For women with arrest of labor undergoing CD with epidural anesthesia and  $\geq 4$ h oxytocin augmentation: is a combination of uterotonics better than oxytocin alone in preventing need for additional uterotonics? This was a double-blind, 3-arm RCT. Participants received either oxytocin 5U IV alone, or with ergonovine 0.25 mg IV or carboprost 0.25 IM immediately after delivery, followed by a standardized oxytocin infusion. All providers were double-blind to allocation. Primary outcome was need for additional uterotonics. 100 patients were enrolled over 6 years. There was no difference in tone between the 3 groups, and 62% had satisfactory tone at 3 minutes. Hypotension was present in all 3 groups, and the combination groups had higher nausea and vomiting. Use oxytocin for providing initial uterine tone in women having a CD for labor arrest (after augmentation of labor with oxytocin), be prepared for hypotension after its use, and save ergonovine and carboprost to treat PPH or where oxytocin is ineffective.

93. Sentilhes L, Sénat MV, Le Lous M et al. **TXA for the prevention of blood loss after CD (TRAAP-2).** *N Engl J Med* 2021 Apr 29; 384(17): 1623-34.

This was a multicenter, double-blind RCT of women undergoing CD to receive prophylactic uterotonic agent and TXA 1g or placebo. The primary outcome of PPH was defined as a calculated EBL > 1000 mL or receipt of RBC transfusion within 2d after delivery. 4551 women were randomized, 4431 underwent CD, 4153 (93.7%) completed the study. The primary outcome occurred in 31.6% of controls compared to 26.1% of the TXA group. However, clinical PPH outcome measures including QBL or physician diagnosed significant PPH were not different. With no clinical benefit from prophylactic TXA in this study, careful consideration of VTE risk and TXA risk/benefit is warranted. In addition, further refinement of blood loss – calculated vs. standardized QBL – deserves further study with consideration of limitations of each method.

*With comment by Bibas M.* *N Engl J Med.* 2021 Aug 5; 385(6):574-5.

The specific exclusion criteria in the study for those requiring VTE prophylaxis is questioned, noting that 59% of patients in the study received VTE prophylaxis after delivery. The authors clarify that women at risk for VTE were excluded but those enrolled were administered VTE prophylaxis PP if they had 1-2 risk factors: age 35y, BMI >30, history of smoking, preeclampsia, fetal growth restriction, cardiac disease, varicose veins, or intestinal inflammatory disease, IVF pregnancy, multiple pregnancy, preterm delivery, >1L BL or need for transfusion.

94. Ahmadzia HK, Luban NLC, Li S, Guo D, Miszta A, Gobburu JVS, Berger JS, James AH, Wolberg AS, van den Anker J. **Optimal use of intravenous tranexamic acid for hemorrhage prevention in pregnant women.** *Am J Obstet Gynecol.* 2021 Jul; 225(1): 85.e1-85.e11.

International trials have demonstrated the effectiveness of 1000 mg TXA, but dose-finding studies are lacking for PPH prevention. 30 women undergoing CD were enrolled in an open-label, dose ranging study. 3 cohorts were created: 5, 10, or 15 mg/kg (max 1000 mg) of IV TXA at umbilical cord clamping. Primary endpoints were pharmacokinetic and pharmacodynamic profiles with >10 mcg/mL and max lysis < 17% defined as therapeutic targets. The lowest dose cohort received 448 mg and all cohorts had therapeutic indices. An optimal dose of 600 mg was proposed.

95. Ducloy-Bouthors S, Mercier FJ, Grouin JM et al. **Early and systematic administration of fibrinogen concentrate in postpartum haemorrhage following vaginal delivery: the FIDEL randomized controlled trial.** *BJOG.* 2021 Oct; 128(11):1814-1823.

PPH is a leading cause of maternal morbidity, and coagulopathy can be an aggravating factor. Since fibrinogen is the first procoagulant to drop due to hyperfibrinolysis, hemodilution, or both and has been determined as a biomarker to predict progression to sPPH, it is a therapeutic target. This multicenter placebo controlled RCT across 30 centers in France compared early systematic administration of 3g fibrinogen or placebo for patients with vaginal bleeding  $\geq 500$  mL after vaginal delivery requiring IV prostaglandin (sulprostone) administration. From April 2014 to August 2018, 437 were randomized; 224 in the fibrinogen group and 213 in the placebo group. Primary outcome of composite failure endpoint (loss of at least 4 g/dL Hb or need to transfuse at least 2 u PRBCs within 48h of receiving study medication) were similar between fibrinogen and placebo groups. BL was 1555 vs. 1723 mL in placebo vs. control groups. Transfusion of 2 or more PRBCs was similar, as were hgb drop >4 g/dL. This well-powered large study failed to demonstrate utility of 3g fibrinogen concentrate and joins the Danish FIB PPH trial and British OBS2 trial discouraging use of empiric fibrinogen concentrate for PPH. Fibrinogen concentrate should not be recommended routinely for PPH. Low-fibrinogen states should be identified with POC or standard testing prior to repletion.

96. Schol PBB, de Lange NM, Smits LJM, Henskens YMC, Scheepers HC. **TEM in daily obstetric practice: at what amount of blood loss do we find abnormal results?** *Thromb Res.* 2021 Sep 28; 207: 140-2.

This retrospective report of 139 women with PPH ( $\geq 500$  mL) at a single center from 2014-2016 had ROTEM performed at QBL 500 mL. QBL was measured by gravimetry after discarding the first towel directly after childbirth. Abnormal ROTEM values were evaluated by each blood loss group of 500-999, 1000-1999, and  $>2000$  mL. Women with PPH 500-2000 mL had only 1.5-4.6% rate of abnormal ROTEM testing. At 2000 mL blood loss, 80% of women had normal ROTEM coagulation parameters. Standard administration of procoagulant therapy should therefore be discouraged unless ongoing blood loss is massive. ROTEM prevents a one-size-fits-all solution and allows tailored, targeted management.

97. Ramler PI, Gillissen A, Henriquez DDCA. **Clinical value of early viscoelastometric point-of-care testing during PPH for the prediction of severity of bleeding: A multicenter prospective cohort study in the Netherlands.** *Acta Obstet Gynecol Scand.* 2021 Sep; 100(9): 1656-64.

This prospective cohort study in the Netherlands evaluated women with PPH 800-1500 mL (quantitated by gravimetry plus fluid collector bag) within 24h of delivery, measuring ROTEM FIBTEM and serum fibrinogen. Predictive accuracy for progression to severe PPH (composite endpoint of total BL  $>200$  mL, transfusion of 4 or more PRBCs, and/or need for invasive intervention) was measured. Of 391 women enrolled, 72 (18%) developed severe PPH. Prediction for progression to sPPH with AUC was 0.53 and 0.58 for FIBTEM A5 and fibrinogen, respectively. PPV for progression to sPPH for FIBTEM A5  $\leq 12$ mm was only 22.5%, vs. 50% for fibrinogen  $\leq 200$  mg/dL. The ability for ROTEM FIBTEM A5 to predict evolution to sPPH was limited in this controlled setting. Further studies are warranted to evaluate the utility of POC coagulation testing in cases of rapid, unanticipated PPH for which coagulopathy may be more common, and may evolve more quickly and detrimentally.

98. Roberts TCD, De Lloyd L, Bell SF et al. **Utility of viscoelastography TEG 6s to direct management of hemostasis during obstetric haemorrhage: a prospective observational study.** *Int J Obstet Anesth.* 2021 Aug; 47:103192.

This prospective real-world observational cohort study of 521 patients with moderate to severe PPH ( $>1000$  mL blood loss) is the first to evaluate TEG 6s for PPH. TEG 6s and laboratory coagulation tests were evaluated 327 women with a non-pregnant control group as a reference. TEG 6s citrated functional fibrinogen, citrated kaolin and citrated rapid TEG were compared to fibrinogen, PT, aPTT, and platelet count during PPH. The AUC for CFF amplitude at 10 min to detect Clauss fibrinogen  $<200$  mg/dL was 0.95. The CK-R had some utility for detecting prolonged PT/aPTT but a threshold for plasma administration was not established. A CRT max amplitude  $<57$  mm with CFF  $\geq 15$  mm identified 8 samples with platelet count  $<75/k$ . This study is the first to illustrate that cartridge based, user-friendly POC TEG 6s CFF can identify low fibrinogen during PPH. The use of this cartridge-based device may facilitate early identification of hypofibrinogenemia. Further investigation to define platelet and plasma infusion thresholds will be next.

99. Mishra N, Ekka SV, Pal S, Mishra I. **Point-of-care blood clotting test and its correlation with fibrinogen level: Potential in goal-directed transfusion in postpartum hemorrhage.** *Int J Gynaecol Obstet.* 2021 Aug; 154(2): 343-51.

POC coagulation testing during PPH is advocated and may lower morbidity, but the technology for TEG or ROTEM is difficult in low-resource areas where PPH occurs most frequently. A simple POCCT using a red top tube with no anticoagulants to assess for clot within 5-10 minutes was first described by Lee and White but hasn't been integrated into practice as a trigger for transfusion. This important paper prospectively collected 68 samples: 40 in women with primary major PPH, 20 from women without PPH, and 8 samples FFP – to evaluate using this simple POCCT. A simple POCCT was performed at the same time laboratory fibrinogen was sent:

*POCCT: the tube was held in a closed fist to keep it warm and after 4 min, was tilted to observe whether a clot was forming; it was then tilted every 30 s until the blood clotted and the tube could be turned upside down. If a solid clot failed to form by 30 min, the test was not pursued further.*



Subgroups were created for analysis based on time to clot formation and included  $<7$  minutes, 7-11 minutes, and  $>11$  minutes. These clotting times correlated well with fibrinogen decrements and with fibrinogen levels. Since the red top tube is essentially free, using it until more sophisticated tests like ROTEM can be implemented is warranted, in both high and especially LRC settings.

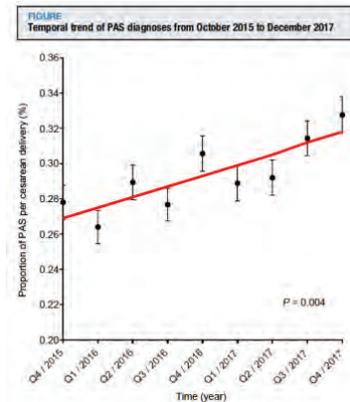
## Placenta Accreta Spectrum

100. Tinari S, Buca D, Cali G. **Risk factors, histopathology, and diagnostic accuracy in posterior PAS disorders: systematic review and meta-analysis.** *Ultrasound Obstet Gynecol* 2021; 57:903-9.

Prenatal diagnosis of suspected PAS is crucial for appropriate delivery planning and location. There is uncertainty as to whether posterior PAS shares the same diagnostic detectability or clinical characteristics as anterior PAS. This systematic review explored the risk factors, histopathological correlations, and diagnostic accuracy of prenatal imaging for posterior PAS. Twenty studies including 2,619 women at risk for PAS were included, of whom 812 (31%) were affected by PAS and 126 (4.8%) affected by posterior PAS. Placenta previa was present in 93% of studies of pregnancies complicated by posterior PAS and 76% had prior uterine surgery (CD or curettage) and 83% of patients in this group were multiparous. 77.5% were placenta accreta, 19.5% placenta increta, and 9.3% percreta. Only 52.4% of posterior PAS cases were detected prenatally by ultrasound. Placental lacunae were present in 39%, loss of clear zone in 41% and bladder wall interruption in 17% but none showed hypervascularization at the bladder-wall interface. This study defines the risk factors for posterior PAS and demonstrates that US has a very low diagnostic accuracy for detecting this subtype.

101. Matsuzaki S, Mandelbaum RS, Sangara RN et al. **Trends, characteristics, and outcomes of placenta accreta spectrum: a national study in the US.** *Am J Obstet Gynecol.* 2021 Nov; 225(5): 534.e1-38.

This was a population-based, retrospective observational study using the NIS to identify women who underwent CD from October 2015 through December 2017 and had a diagnosis of PAS. The aim was to examine national trends, characteristics, and perioperative outcomes. 2,727,477 cases of CD were identified in the study period, with 8030 (0.29%) diagnosed with PAS (0.23% accreta, 0.04% percreta, 0.03% increta). PAS case frequency increased by 2.1% every quarter year from 0.27 to 0.32%. Patient demographics, pregnancy characteristics, and hospital factors were evaluated. Considerably higher surgical morbidity was reported for women with placenta increta and percreta. With an incidence at the end of study of 1 in 313 women undergoing CD having PAS, this study provides a clinically relevant picture of PAS morbidity. Continued focus on management of PAS will help prevent or lower maternal morbidity and mortality.



102. Kayem G, Seco A, Beucher G et al. **Clinical profiles of PAS: the PACCRETA population-based study.** *BJOG.* 2021 Sep; 128(10): 1646-55.

This prospective study from 8 regions of France evaluated the population-based incidence of PAS, characteristics, and pregnancy outcomes. 249 women with PAS were identified, with an incidence of 4.8/10,000. 48% had previa and prior CD and had higher rate of hysterectomy (53% vs. 21%) higher rate of blood transfusion, complications, preterm births, and NICU admissions. Editorialists emphasize the urgent need for standardization in how PAS is diagnosed, suggesting that the cases with no previa or prior CD may have been over-diagnosed.

*With a commentary by* Einerson BD, Silver RM, Jauniaux E. **Placenta accreta spectrum: Welcome progress and a call for standardization.** *BJOG.* 2021 Sep; 128(10): 1656-7.

103. Shainker SA, Coleman B, Timor-Tritsch IE et al. **Special report of the society for maternal-fetal medicine placenta accreta spectrum ultrasound marker task force: Consensus on definition of markers and approach to the ultrasound examination in pregnancies at risk for placenta accreta spectrum.** *Am J Obstet Gynecol.* 2021 Jan; 224(1): B2-14.

As the incidence of PAS continues to rise, the importance of prenatal prediction is increasingly important to minimize associated morbidity associated with this condition. The standardization of ultrasound evaluation for PAS and identification of research gaps is discussed in this special report from the SMFM and associated task force. Specific features including placental lacunae, retroplacental hypoechoic zone, myometrial thinning, hypervascularity near the bladder wall, cesarean scar pregnancy and other imaging is demonstrated and discussed, along with their relative predictive sensitivity by trimester. Research gaps are identified for PAS specialists in OB anesthesia interested in multidisciplinary research in this area.

104. Miller HE, Leonard SA, Fox KA et al. **Placenta accreta spectrum among women with twin gestations.** *Obstet Gynecol.* 2021 Jan 1; 137(1): 132-8.

In this retrospective analysis, all live births in California from 2016 to 2017 were identified from previously linked records of birth certificates and birth hospitalization discharges. Primary outcome was PAS identified from ICD10 coding. The association between twin gestation and PAS was evaluated. 918,452 live births were identified, and 1,126 had the diagnosis of PAS. Prevalence of PAS was 11.8 per 10,000 among singleton pregnancies and 41.6 per 10,000 among twin pregnancies. Unadjusted regression analysis-based relative risk was 3.41, to 2.96 when adjusted for age, prior CD, and sociodemographic factors. Twin pregnancy PAS cases were less likely to have coincident placenta previa. Understanding this risk factor, particularly in the absence of placenta previa, will help prioritize ultrasonographic surveillance of twin pregnancies to evaluate for this increased risk of PAS.

105. Riazanova OV, Reva VA, Fox KA et al. **Open versus endovascular REBOA control of blood loss during cesarean delivery in placenta accreta spectrum: A single-center retrospective case control study.** *Eur J Obstet Gynecol Reprod Biol.* 2021 Mar; 258:23-8.

This retrospective study compared cases of PAS using either open bilateral CIAO (October 2017-October 2018) or REBOA (November 2018-November 2019), to prevent pathologic hemorrhage in women with extensive PAS during scheduled CD. The CIAO group had intervention after delivery while the REBOA group was performed pre-delivery with inflation after delivery. There were 12 CIAO patients and 16 REBOA patients. Median QBL was lower for the REBOA group: 541 [300-750] vs 3331 [1150-4750] mL. Concurrent fluid and blood replacement was also less in the REBOA group and median surgical time was 50% shorter. No REBOA patients required hysterectomy, while 8/16 women in the CIAO group had a hysterectomy. While this study is not randomized, use of the REBOA more recently yielded improved outcomes and warrants further study on defining risk-benefit for patients of variable risk for PAS, contraindications, and optimal training for REBOA use across the disciplines of trauma surgery, OB anesthesiology, and radiology.

### **LABOR AND DELIVERY**

106. Pancaro C, Purtell J, LaBuda D et al. **Difficulty in advancing flexible epidural catheters when establishing labor analgesia: An observational open-label randomized trial.** *Anesth Analg.* 2021; 133(1): 151-159.

This was an observational open-label RCT comparing ability to thread two types of flexible epidural catheters: multi-orifice vs. single end-hole. In an interesting study design, one type of catheter was used for 2 weeks, followed by the other for 2 weeks in a random fashion. The multi-orifice polyamide nylon blend catheter had more bending stiffness and higher rate of successful advancement (99.2%) compared to the single end-hole polyurethane catheter (85%). This illustrates that variation of catheters may critically impact the successful establishment labor pain relief.

107. Young B, Onwochei D, Desai N. **Conventional landmark palpation vs. preprocedural ultrasound for neuraxial analgesia and anaesthesia in obstetrics - a systematic review and meta-analysis with trial sequential analysis.** *Anaesthesia.* 2021 Jun; 76(6): 818-31.

The efficacy, time taken, and safety of neuraxial blockade for OB patients with the assistance of preprocedural US was compared to the landmark palpation method in this systematic review and meta-analysis of 22 trials and 2462 patients. Use of US increased first-pass success rate by a risk ratio of 1.46 (13 trials with 1253 patients). No difference in total time taken was seen (50.1 seconds) in 8 trials with 709 patients. The quality of evidence was low to very low. However, subgroup analysis did indicate increased benefit of preprocedural US in for whom neuraxial was predicted to be difficult, and complications including HA and backache were decreased with use of US. The authors recommend preprocedural US as standard of care based on these findings.

108. Orbach-Zinger S, Eidelman LA, Wazwaz SA et al. **The relationship between resited epidural catheters after secondary epidural catheter failure and vaginal delivery: A retrospective case-control study.** *Acta Anaesthesiol Scand.* 2021; 65:397-403.

This is the first study specifically examining outcomes and risk factors of ECR. The rate of epidural failure in labor is reported to be 8.9-12% but the definition is uncertain and epidural catheter failure is a definitive variable. ECR occurs in 2-25.4% and its impact on OB outcomes is unclear. Replacing a non-functional epidural catheter did not decrease the rate of vaginal delivery in this retrospective case-control study of 22,362 epidurals including 118 ECRs and 472 non-resited epidurals. Risk factors for ECR were having an early epidural (less than 3cm cervical dilation) and nulliparity. However, ECR was not associated with an increased rate of operative vaginal or CDs which is reassuring to those who may hesitate to replace a catheter for fear of increasing risk of CD.

109. Song Y, Du W, Zhou S et al. **Effect of DPE technique combined with PIEB on labor analgesia onset and maintenance.** *Anesth Analg.* 2021 Apr 1; 132(4):971-8.

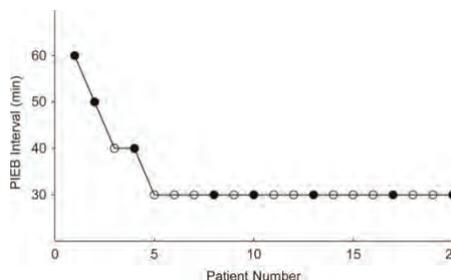
This study randomized nulliparous women with a VAS pain score >50 mm and cervical dilatation < 5cm to one of 3 groups: EPI+CEI, DPE+CEI, or a DPE+PIEB. All groups had initiation of analgesia with a 3 mL 1.5% lidocaine with epi 15 mcg test dose then 10 mL 0.1% ropivacaine with 0.3 mcg/mL sufentanil given over 2 minutes. The same mix of 0.1% ropivacaine with 0.3 mcg/mL sufentanil was started with an 8 mL/h infusion (CEI groups) vs 8 mL starting 1h after initiation and every hour afterward (PIEB group). All patients could have a PCEA bolus of 5 mL with 20-minute lockouts and breakthrough pain was treated with 5 mL 0.125% ropivacaine. The DPE technique had a faster onset and when combined with PIEB maintenance had less local anesthetic consumption without impacting maternal or newborn side effects. The PIEB infusion choice was not compared directly in this study between EPI and PIEB by choice, as PIEB has been shown to have benefit over EPI in prior studies.

*With a comment* by Kodali BS, Wong M. **Routine dural puncture epidural technique; Caution is in order.** *Anesth Analg.* 2021 Sep 1; 133(3): e39-e40.

A follow-up validation study may be warranted comparing bupivacaine and ropivacaine in this context. Use of lumbar US to identify L3-4 may be reassuring for all DPE techniques to avoid proximity to the spinal cord or the cauda equina.

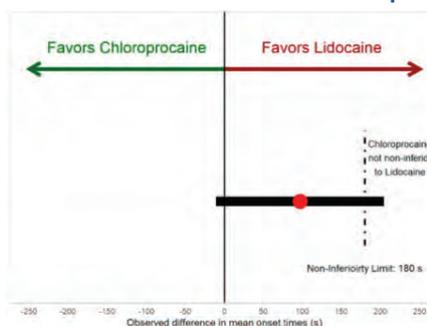
**110. Shatalin D, Arzola C, Downey K et al. PIEB for labor analgesia during first stage of labor: a sequential allocation trial to determine the effective interval time between boluses of a fixed volume of 2.5 mL of bupivacaine 0.25% plus fentanyl 8 mcg/mL.** *Can J Anaesth.* 2021 May; 68(5): 653-60.

Can use of a more concentrated solution in smaller volume for PIEB lower unnecessary sensory blockade for labor analgesia? PIEB for analgesia maintenance has been shown to lower local anesthetic consumption, last longer, lower breakthrough pain, and increase maternal satisfaction compared to continuous infusion. This group's previous work on optimal bupivacaine concentration, volume, and bolus intervals found T6 level blocks to ice sensation in 40% of women with bupivacaine 0.0625% fentanyl 2 mcg/mL 10 mL q 40 minutes, and in 58.4% of women with bupivacaine 0.125% 5 mL with fentanyl 2 mcg/mL every 35 minutes. To evaluate even smaller volumes with more concentrated solutions, this double-blind sequential allocation trial with a biased coin up-down design sought to determine the effective analgesia in 90% of women (EI90) for PIEB time interval between boluses of 2.5 mL bupivacaine 0.25% with fentanyl 8 mcg/mL. With 20 women, an EI90 of this formulation was extrapolated to be 20 minutes (the PIEB bolus interval of the lower bound of 30 min was insufficient 1/3 of the time). While there was no motor block, one patient had asymptomatic hypotension. There was no benefit of lower upper-level sensory block (T5-7 for all subjects). These findings suggest no advantage in this regimen compared to more dilute doses B1/8 or B1/16 PIEB.



**111. Sharawi N, Bansal P, Williams M et al. Comparison of chloroprocaine versus lidocaine with epinephrine, sodium bicarbonate, and fentanyl for epidural extension anesthesia in elective CD: A randomized triple blind noninferiority study.** *Anesth Analg.* 2021; 132(3):666-75.

This was a single-center, randomized noninferiority trial comparing onset time of chloroprocaine (CP) vs. lidocaine with epinephrine, sodium bicarbonate, and fentanyl (LEBF) for extending epidural analgesia to cesarean anesthesia. Women undergoing elective CD were randomized to epidural anesthesia with either CP or LEBF, with sensory blockade of T10 established prior to OR entry. Time to loss of touch sensation at T7 was the primary outcome, and a noninferiority margin was set for 3 minutes. 70 women were enrolled, and mean onset of primary outcome was 655 vs. 558 seconds for CP and LEBF, respectively, a 97 second difference. Statistically they were unable to demonstrate the noninferiority of CP to LEBF.



*With an editorial* by Toledo P et al. **Can noninferior be superior?** *Anesth Analg* 2021; 132:663-5.

The elegance of this model for replicating epidural analgesia to anesthesia for CD was highlighted for its innovation and use for future studies that otherwise were not possible to execute. They also discuss the good choice of an inferiority study design, with a prespecified noninferiority margin. Important tips on designing noninferiority studies are discussed. Despite the study being inconclusive, this model may be used to compare alternative medications to our standard medications in the era of drug shortages, among other clinical questions.

## **CESAREAN DELIVERY**

### **Airway Management and Oxygenation**

112. Odor PM, Bampoe S, Moonesinghe SR et al. **General anesthetic and airway management practice for obstetric surgery in England: A prospective, multicentre observational study.** *Anaesthesia.* 2021 Apr; 76(4):460-71.

This prospective observational study evaluated GA and airway management through a secondary analysis of the DREAMY study on accidental awareness during GA in OB in England. 3115 patients who received GA (2554 CDs; 1329 (42.6%) categorized as emergency) in 72 hospitals from May 2017-August 2018 were included and a descriptive analysis performed. Thiopental was used for induction in 52.9% vs. 45.5% for propofol, with increased use of propofol over time. Succinylcholine was used in 86.1% of cases vs. 11.8% rocuronium. This comprehensive summary of GA trends and outcomes in the UK highlights a strikingly high incidence of difficult intubation (1 in 19) compared to a previously reported 1 in 30 in Australia and New Zealand, and an incidence of failed intubation 1 in 312 consistent with previous studies. An overall call to update practices is discussed. Increasing use of VL was reported for only 1.9% of these cases and having VL immediately available on L&D units for first attempt may have marked impact on outcomes.

*With an editorial* by Wilson MJA and Wrench IJ. **Iconoclasm and evidence implementation. The case for change in obstetric general anaesthesia.** *Anaesthesia* 2021; 76:448-51

*and a comment* by: Dibb K, Stallard M. **General anaesthetic and airway management practice for obstetric surgery in England: prospective, multicentre observational study.** *Anaesthesia;* 2021 Apr; 76(4):579.

113. Howle R, Onwochei D, Harrison SW, Desai N. **Comparison of VL and DL for tracheal intubation in obstetrics: a mixed-methods systematic review and meta-analysis.** *Can J Anaesth.* 2021; 68(4): 546-65.

Evaluating whether VL improves success rate of intubation compared with DL for obstetrical surgery is important. This systematic review of four RCTs with 428 participants, 9 observational studies, and 35 case reports with 100 participants and meta-analysis of 3 trials, the primary outcomes of 1<sup>st</sup> attempt success rate and time to tracheal intubation were evaluated to find no differences. However, observational studies identified VL as useful as first-line for anticipated difficult airway or after failed DL. Given the success of 1<sup>st</sup> pass DL in this study (96%), demonstrating an improvement to 99% with VL would require 800 subjects compared to 417 in this analysis. The utility of VL in the mixed cohort of this study supports having VL immediately available as the first-line device for endotracheal intubation in obstetrics.

114. Zhou S, Zhou Y, Cao X et al. **The efficacy of high-flow nasal O<sub>2</sub> for maintaining maternal oxygenation during RSI in pregnancy: a prospective randomized clinical trial.** *Eur J Anaesthesiol.* 2021 Oct 1; 38(10): 1052-8.

Many HFNO studies have been conducted in volunteer parturients without intubation. In this prospective RCT, 34 parturients were randomized to HFNO vs. standard FM, and arterial lines inserted prior to induction by RSI. HFNO was provided at 50 L/min with instruction to close their mouth and breathe for 3 minutes. Cannulae were left in place during DL and intubation. Facemask had an FiO<sub>2</sub> of 1.0 at 10L/min for 3 min and then no oxygenation during intubation. Compared with standard facemask, HFNO provided higher paO<sub>2</sub> and EtO<sub>2</sub> immediately after intubation. HFNO may be a reasonable option for RSI.

115. Peska E, Balki M, Maxwell C et al. **Oxytocin at elective cesarean delivery: a dose-finding study in women with obesity.** *Anaesthesia.* 2021 Jul; 76(7):918-23.

Women with obesity may require higher dose prophylactic oxytocin administration for the third stage of labor since they have a higher rate of uterine atony and PPH. This study established the bolus dose of oxytocin for effective uterine contractions in 90% (ED90) of women with obesity at elective CD using a biased coin up-down method. Compared to the ED90 of 0.35 IU previously demonstrated, women with BMI ≥ 40 require 0.75 IU, approximately twice as much.

116. Clunies-Ross N, Roston TM, Taylor J et al. **The effect of carbetocin dose on transmural dispersion of myocardial repolarization in healthy parturients scheduled for elective CD under spinal anesthesia.** *Anesth Analg* 2021 Feb 1; 132(2): 485-92.

Patients with QTc prolongation are prone to arrhythmias including TdP – which can be life-threatening. Evaluating myocardial repolarization measurements is more reliable for risk of TdP than the QT interval. Oxytocin in a 5 IU bolus can prolong the QTc but less is known about carbetocin, which is being used more frequently. Women with no baseline QTc prolongation, known arrhythmia or cardiac disease were randomized to receive either 50 or 100 U of carbetocin, then

their EKGs evaluated by a blinded cardiologist. The primary outcome was change in time interval between peak and end of the T wave (Tp-e) as a superior marker for drug torsadogenicity than QT interval. Tp-e was unaffected by 50 U IV carbetocin and was minimally prolonged by 100 U carbetocin in these healthy patients undergoing CD under spinal anesthesia. The 100 U carbetocin dose increased repolarization on EKG but likely clinically less relevant. The authors conclude that the minimal Tp-e prolongation at higher-dose carbetocin is unlikely to have a clinical impact, and the risk of TdP is low.

**117. Phung LC, Farrington EK, Connolly M et al. Intravenous oxytocin dosing regimens for postpartum hemorrhage prevention after cesarean delivery: a systematic review and meta-analysis. Am J Obstet Gynecol. 2021 Sep; 225(3): 250.e1-250.e38.**

This analysis evaluated evidence on IV oxytocin dosing regimens for prevention of PPH after CD. All papers with at least two dosing regimens were included and the primary outcome was PPH  $\geq$  1000 mL. 35 studies met criteria including 30 RCTs and 5 nonrandomized studies. Data was limited for many outcomes, but bolus doses  $\leq$  5 IU may be optimal.

**118. Monks DT, Palanisamy A. Oxytocin: At birth and beyond. A systematic review of the long-term effects of peripartum oxytocin. Anaesthesia 2021 Nov; 76(11): 1526-37.**

This systematic review involves 2,767 references narrowed to 4 categories: PPD, breastfeeding, neurodevelopmental disorders, and persistent pain to explore the possible long-term effects on mother and offspring after exposure to oxytocin in the peripartum period. Modest but inconsistent evidence linked peripartum oxytocin with PPD, lower breastfeeding rate, neurodevelopmental disorders, and anti-hypersensitivity to analgesics. This is a solid foundation for future observational research.

**119. Yang C, Cheng Y, Liu S et al. The effect of preop oral carbohydrate loading on body temperature during CSE for elective CD. Anesth Analg. 2021 Sep 1; 133(3): 731-738.**

A preceding animal study demonstrated that carbohydrate loading maintained body temperature of rats during GA. In this RCT 3 groups were evaluated: a control group who fasted; an oral carbohydrate loading group who took 300 mL 2h preop, and a placebo group who received 300 mL water 2h preop. Women who received the carbohydrate load had a lower drop in body temperature. This may have important implications for ERAC after further validation.

**120. Mohta M, Lakshmi R, Chilkoti GT, et al. A randomized double-blind comparison of phenylephrine and norepinephrine for the management of post-spinal hypotension in preclampsic patients undergoing cesarean section. Eur J Anaesthesiol. 2021 Oct 1; 38(10):1077-84.**

This RCT looked at 86 women with preeclampsia and singleton pregnancies who developed post-spinal hypotension during CD. Patients were randomized to receive 50 mcg IV phenylephrine vs. 4 mcg norepinephrine bolus if SBP dropped by 20% or greater or was lower than 100 mmHg. The primary outcome was umbilical artery pH and was no different between groups. All other maternal and neonatal outcomes measured were also similar.

**121. Liu T, Zou S, Guo L et al. Effect of different positions during surgical prep with combined spinal-epidural anesthesia for elective cesarean delivery: A randomized controlled trial. Anesth Analg. 2021 Nov 1; 133(5):1235-43.**

This RCT evaluated a 15° vs. 30° left lateral tilt position following CSE prior to CD, compared to supine position. 25 per group were randomized and the primary outcome was umbilical arterial pH. Secondary outcomes were maternal SBP within 15 minutes of induction, vasoactive medication requirement, and incidence of hypotension. The 30° left tilt position during surgical preparation had no impact on fetal acid-base status, but significantly lowered the vasopressor requirement. Consider the consequences of liberalizing vasopressor and abandoning uterine displacement for convenience. This infographic (Anesthesiology 2021; 135:DOI: 10.1097/ALN.00000000004031) depicts a study on cerebral macro- and microcirculation during ephedrine and phenylephrine treatment in anesthetized brain tumor patients. While not obstetrics, it illustrates the microcapillary neurologic consequences of vasopressor therapy to remind us it's always favorable to minimize pharmacologic treatment of blood pressure when a mechanical maneuver (tilt) is feasible.



122. Weiniger CF, Heesen M, Knigin D et al. **Association between hyperbaric bupivacaine dose and maternal hypotension: Retrospective database study of 8226 women undergoing cesarean delivery under spinal anesthesia.** *Anesth Analg.* 2021 Oct 1; 133(4): 967-75.

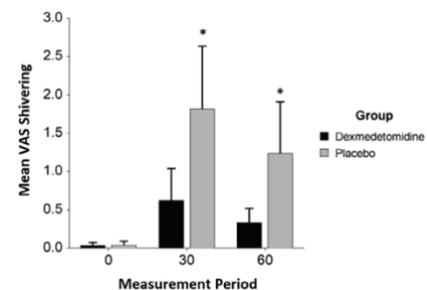
This large retrospective database study included 8226 women from January 2012 through 2018 at a center with a delivery volume of 11,000 per year and CD rate of 20%. CSE and spinal anesthetics for CD were included. The recommended dose was 10 mg hyperbaric bupivacaine, and prophylactic vasopressors were not protocolized. Women who received 10 mg or more had a higher incidence of hypotension, though both groups (<10 and >10mg) developed hypotension. Ultimately the use of prophylactic vasopressors for any dose of hyperbaric spinal bupivacaine was justified by these findings, since hypotension occurred at every dose range.

123. Cole NM, Abushoshah I, Fields KG et al. **The interrater reliability and agreement of a 0 to 10 uterine tone score in cesarean delivery.** *Am J Obstet Gynecol MFM.* 2021 May; 3(3): 100342.

This prospective analysis reevaluated IRR and agreement of a 0 to 10 visual numeric rating scale for uterine tone during CD between August and November 2018 by assessing two operating obstetrician scores independently and in a blinded nonverbal fashion (pointing through a clear drape to the scale). 82 and 84 pairs of scores were collected at 3 and 10 minutes, among 62 unique obstetricians with good to excellent IRR and good interrater agreement. The use of this 0 to 10 NRS for uterine tone may be reliable to standardize scoring for research on uterine tone at the time of CD.

124. Sween LK, Xu S, Li C et al. **Low dose dexmedetomidine and shivering after cesarean delivery.** *Int J Obstet Anesth.* 2021 Feb; 45:49-55.

30 mcg of IV dexmedetomidine reduces shivering after CD but may result in sedation and dry mouth. This RCT hypothesized that prophylactic administration of 10 mcg IV dexmedetomidine may lower patient-reported severity of shivering with fewer side effects than 30 mcg. 85 of 100 women enrolled to receive spinal or CSE for scheduled CD received either dexmedetomidine 10 mcg or placebo and then rated shivering with a 10cm VAS at 30 and 60 minutes after arrival to the PACU. The treated group had lower reported shivering scores at both time points 1.8 vs. 0.6 at 30 minutes and 1.2 vs. 0.3 at 60 minutes. There was no increase in side effects between control and treated groups. These results indicate that prophylactic dexmedetomidine after delivery during CD at 10 mcg IV should be considered, as well as further studies for optimizing dose, generalizability and timing are warranted.



125. Dwan, RL, Raymond BL, Richardson MG. **Unanticipated consequences of switching to sugammadex: Anesthesia provider survey on the hormone contraceptive drug interaction.** *Anesth Analg* 2021 Oct; 133:958-66.

Sugammadex is a highly effective neuromuscular blocker antagonist but its high-affinity binding to progesterone poses a possible risk of hormonal contraceptive failure after administration. The SOAP consensus statement on sugammadex and manufacturer recommend alternate contraceptive methods in women of childbearing age who receive sugammadex during anesthesia. This important survey among anesthesiology providers (both MD and RN) at a single tertiary center with a response rate of 60% demonstrated incomplete knowledge about the sugammadex-progesterone interaction and very few people provided patient counseling before or after administration of sugammadex. This highlights the need to keep reproductive justice front and center when caring for women of childbearing age, the importance of department-wide education upon rollout of new frequent-use medications with distinct side effect profiles; and the important role OB anesthesiologists can play when the two demands overlap as with this medication.

### **POSTPARTUM ANALGESIA and RECOVERY**

126. Bollag L, Lim G, Sultan P et al. **SOAP: Consensus statement and recommendations for enhanced recovery after cesarean.** *Anesth Analg.* 2021 May 1; 132(5): 1362-77.

This article summarizes the ERAC protocol written by a SOAP committee approved by the SOAP BOD in May 2019. The consensus statement provides practical and when available evidence-based recommendations regarding ERAC. This is a compendium to the previously published NICE, International ERAS Society guidelines. The guidelines are divided into preoperative, intraoperative, and postoperative considerations. Limiting fasting duration, use of nonparticulate antacids and carbohydrate loading, patient education, lactation, and breastfeeding education, and hgb optimization were emphasized.

*With a comment* by Scott MJ, Wrench I. **ERAS for CD.** *Anesth Analg.* 2021 May 1; 132(5): 1359-61.

This commentary by US and UK authors points out that many recommendations are probably already emphasized by OB anesthesiologists, including neuraxial anesthesia, optimization of analgesia with multimodal medication, and BP management with vasopressor infusion. What is lacking in the guideline is a multidisciplinary perspective.

**127. Roofthoof E, Joshi GP, Rawal N, Van de Velde M. PROSPECT guidelines for elective CD: updated SR and procedure-specific pain management recommendations. Anaesthesia. 2021 May; 76(5): 665-80.**

This updated systematic review for elective CD under neuraxial anesthesia recommends multimodal anesthesia with ITM 50-100 mcg or diamorphine 300 mcg (not available in North America), acetaminophen, NSAIDs, and IV dexamethasone after delivery. If ITM is not used, single injection local anesthetic wound infiltration, continuous infusion, or TAP or QL blocks are warranted. The editorial suggests further delineation of pain management after CD with a focus on enhancing the maternal experience, and specific to the condition of the CD itself: elective, emergent, repeat, GA vs. neuraxial, and increased surgical complexity. This is a call for more research to further refine ERAC guidelines.

*With an editorial by Landau R, Richebe P. Tailoring postoperative pain management with a procedure-specific approach: how best to apply this concept to CDs. Anaesthesia 2021; 76:587-9.*

**128. Reed SE, Tan HS, Fuller ME et al. Analgesia after CD in the United States 2008-2018: A retrospective cohort study. Anesth Analg. 2021 Dec 1; 133(6):1550-8.**

This retrospective study evaluated post-surgical analgesic regimens after CD under neuraxial anesthesia using a nationwide inpatient administrative-financial database, Premier Inc (Charlotte NC) over 10 years, 2008-2018. The primary outcome was postoperative analgesic regimen used: neuraxial morphine, multimodal analgesia. Differences over time and that were site-specific were evaluated. Among 2 million patients, only 6.1% received the current recommended combination of neuraxial morphine, NSAIDs, and acetaminophen. This may reflect that current recommendations from ACOG and SOAP were in 2018-2020, after data collection for this study. Follow-up surveillance is warranted.

**129. Fang X, Huan Y, Tao Y et al. Incidence, severity, and determinants of uterine contraction pain after vaginal delivery: a prospective observational study. Int J Obstet Anesth. 2021 May; 46:102961.**

Pain from uterine contractions after vaginal delivery is an area that has been under-studied. This observational study measured this pain at 6, 12, 24, and 48h after delivery to evaluate risk factors for significant postpartum uterine contraction pain with an NRS  $\geq 3$ . Postpartum uterine contraction pain occurred in 47% within 48h of delivery, with higher risk among multiparous women, those with dysmenorrhea history, and while breastfeeding. The editorialists highlight study limitations including lack of a non-breastfeeding control group, sampling bias, and questionable significance of low pain score threshold NRS of 3. Informing breastfeeding women of this associated pain and recommending NSAIDs as part of enhanced recovery may be warranted.

*With an editorial by Sultan P and Carvalho B. Pain after vaginal delivery and during breastfeeding: underexplored and underappreciated. Int J Obstet Anesth 2021 May; 46:102969.*

**130. Felder L, Riegel M, Quist-Nelson J, Berghella V. Perioperative intravenous acetaminophen and postcesarean pain control: a systematic review and meta-analysis of randomized controlled trials. Am J Obstet Gynecol MFM. 2021 May; 3(3): 100338.**

When should IV acetaminophen be given for post-CD pain control in healthy women receiving regional anesthesia? This systematic review of 4 RCTs included 190 with the intervention vs. 174 women in the control group. Intervention patients received 1000 mg acetaminophen in 3 of the studies and 2000 mg in 1 study, 1 hour before surgery or intraoperatively right after delivery of the fetus. Pain scores 24h postop were only collected in 1 study. Morphine mg equivalents were similar with or without acetaminophen. 1 study showed lower postoperative pain scores at 4 hours after IV acetaminophen in a cohort that did not receive long acting neuraxial opioids. There is not data to support use of IV acetaminophen 1h before surgery or immediately at the time of delivery during CD. Further studies evaluating timing of acetaminophen for ERAC, more sensitive follow-up of pain, uniformly giving long-acting intrathecal opioid, and likely oral noninferiority to IV acetaminophen are warranted.

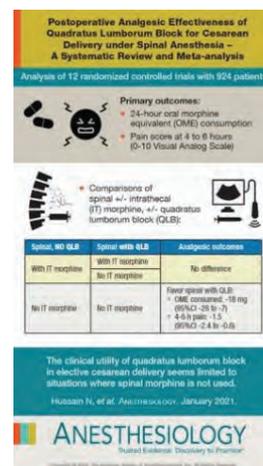
**131. Guevara J, Carvalho JCA, Downey K et al. Predicting pain after cesarean delivery: pressure algometry, temporal summation, 3 item questionnaire. Can J Anesth. 2021 Dec; 68(12):1802-10.**

This prospective cohort study on women undergoing CD under spinal anesthesia evaluated the previously validated 3-IQ, along with pressure algometry (PA) and mechanical temporal summation (TS) response for an enhanced ability to predict severe postoperative pain. 195 women were studied to demonstrate that addition of the PA and TS to the 3-IQ model

performed no better than the 3-IQ model alone. Further work in this area is warranted since severe postsurgical pain is known to be associated with the development of chronic pain.

132. Hussain N, Brull R, Weaver T et al. **Postoperative analgesic effectiveness of quadratus lumborum block for cesarean delivery under spinal anesthesia.** *Anesthesiology* 2021; 134:872-87.

A 2020 network meta-analysis demonstrated that TAP blocks provide better analgesia than control when neuraxial opioids are not used. However, QLBs were not included in the analysis. This systematic review and meta-analysis evaluated the effectiveness of the QLB under spinal anesthesia with three comparisons: ITM plus or minus QLB; ITM vs. QLB; no QLB vs. no ITM (no post-delivery analgesia). 924 patients were identified within 12 full-text RCTs. There were two primary outcomes: cumulative postoperative opioid consumption and VAS rest pain scores 4-6h after surgery. QLB conferred no benefit when ITM was used, nor when QLB alone was compared to ITM. When no analgesic (no QLB, no ITM) was compared to QLB, QLB offered a statistical benefit with a 17 mg difference in opioid consumption and 1.5 cm lower VAS.



133. El-Boghdady K, Desai N, Halpern S et al. **Quadratus lumborum block vs. transversus abdominis plane block for caesarean delivery: a systematic review and network meta-analysis.** *Anaesthesia* 2021 Mar; 76(3):393-403.

This network meta-analysis of RCTs compared TAP to QLB or to controls and identified 31 trials with 2199 patients with the primary outcome of cumulative morphine equivalent consumption at 24h (12 trials). TAP and QL blocks were equivalent and better than controls in the absence of morphine. However, with ITM, they were no better than control. TAP and QLBs appear superior to control only in the absence of ITM. The clinical utility of such blocks is limited to cases in which ITM is not used, and neither TAP or QLB appear superior. Authors comment that cumulative studies to date are limited, and results should be interpreted as such. Further studies to explore QLB and TAP utility for patients with chronic pain or opioid use disorder are warranted. In addition, further study on anterior, posterior, or lateral QLB, medication concentration and use of catheters require further assessment.

134. Habib AS, Nedeljkovic SS, Horn JL et al. **Randomized trial of transversus abdominis plane block with liposomal bupivacaine after cesarean delivery with or without intrathecal morphine.** *J Clin Anesth*. 2021 Dec; 75:100527.

This multicenter open-labor RCT evaluated women having elective CD under spinal anesthesia randomized 1:1:1 to receive LB TAP block alone, ITM 50 mcg then LB TAP block, or ITM alone. Multimodal postsurgical pain control was standardized. 153 patients were enrolled between March 2019 and January 2020. The LB TAP alone group had statistically noninferior postsurgical opioid consumption through 72h compared with the ITM alone group (least squares mean, 19.2 vs. 16.4 morphine equivalents; LSM treatment ratio, 1.17 [95% CI, 0.74-1.86]; noninferiority P < 0.0034 as did the ITM + LB TAP group (LSM, 14.6 vs. 16.4 morphine equivalents, LSM treatment ratio, 0.89 [95% CI, 0.55-1.44]; noninferiority P < 0.0001). The ITM alone group had higher pruritus severity scores. The authors conclude that the LB TAP block with or without ITM resulted in statistically noninferior postsurgical opioid consumption through 72h with reduced pruritus and a favorable safety profile compared to ITM alone for women undergoing CD.

135. Landau R, Romanelli E, Daoud B et al. **Effect of stepwise opioid-sparing analgesic protocol on in-hospital oxycodone use and discharge prescription after CD.** *Reg Anesth Pain Med* 2021; 46:151-6.

This retrospective cohort evaluated the impact of implementing a stepwise multimodal opioid-sparing analgesic computerized order set and provider education at 2 academic hospitals vs. no intervention in 2 alternate hospitals, all within a large metropolitan area. The primary outcome was proportion of women not using oxycodone during hospitalization, with secondary outcomes of total oxycodone dose in-hospital, time to first oxycodone dose, proportion of opioid-free prescription, and number of oxycodone pills prescribed. Post intervention, proportion of non-oxycodone users increased from 15 to 32%. The proportion of oxycodone-free prescriptions increased from 4.4 to 8.5% and number of pills prescribed decreased from 30 to 18 pills. At control hospitals, there was no change in any of these outcomes over the study period. This demonstrates an impactful opioid-sparing initiative for women undergoing CD in an urban hospital setting. Such initiatives can be tracked for their impact on prevention of unused opioids in households and associated persistent opioid use risk.

136. Potnuru PP, Patel SD, Birnbach DJ et al. **Effects of state law limiting postop opioid prescription in patients after CD. *Anesth Analg.* 2021 Mar 1; 132(3): 752-60.**

The Florida State law House Bill 21 (HB21) restricted the duration of opioid prescriptions for acute pain after CD. This retrospective cohort study assessed whether the HB21 passage was associated with discharge opioid prescription practices with a before-after study design. 8 months after HB 21 implementation, mean duration of opioid prescriptions decreased by 2.9 days and mean total opioid dose decreased. There was no concomitant increase in additional opioid prescriptions or emergency department visits.

137. Schiff DM, Nielsen TC, Hoepfner BB et al. **Methadone and buprenorphine discontinuation among postpartum women with opioid use disorder. *Am J Obstet Gynecol* 2021 Oct; 225:424.e1-12.**

This population-based retrospective cohort study used administrative data from 211,096 deliveries in Massachusetts between 2011 and 2014 to examine adherence to medications for OUD. 2314 women who received OUD at delivery were identified; 64.1% continued receiving OUD medications for 12 months postpartum. It was only 34% for women started 1 month prior to delivery up to 80% if the medications had been used throughout pregnancy. Additional associated features with lower compliance were non-White ethnicity and incarceration during or after delivery. This statewide analysis through the continuum of pregnancy to 1 year postpartum identifies areas of focus to improve adherence with medications for OUD.

### **UNIT SAFETY, SIMULATION, and COMMUNICATION**

138. Dillon SJ, Kleinmann W, Seasey A et al. **How personality affects teamwork: a study in multidisciplinary obstetrical simulation. *Am J Obstet Gynecol MFM.* 2021 Mar; 3(2): 100303.**

This prospective observational study of 22 obstetrical simulations including 270 staff including obstetricians, anesthesiologists, midwives, and nurses evaluated teamwork and communication. Personality testing was performed prior to simulation using the Big Five Inventory. Each team was scored using the Clinical Teamwork Scale. Communication and teamwork scores along with personality traits were evaluated for association. Teamwork was associated with communication for each team. Neuroticism was negatively associated with teamwork when coupled with communication. Increased neuroticism was associated with increased communication that was detrimental to overall teamwork.

139. Liberati EG, Tarrant C, Willars J et al. **Seven features of safety in maternity units: a framework based on multisite ethnography and stakeholder consultation. *BMJ Qual Saf.* 2021 Jun; 30(6): 444-56.**

It's a priority to reduce avoidable harm on L&D units. Rigorous descriptions of "what good looks like" are impactful. This multisite ethnography involved 401 hours of non-participant observations, 33 semi-structured interviews with staff across 6 maternity units, and stakeholder consultation involving 65 semi-structured telephone interviews and one focus group. Seven features of safety were identified within a framework called For US (For Unit Safety): (1) involve everyone in a commitment to unit safety and improvement at all levels; (2) formal training and informal learning for technical competence; (3) teamwork and positive working relationships; (4) constant reinforcement of safe, ethical, and respectful behavior; (5) multiple problem-sensing systems as a basis for action; (6) processes designed for safety with regular review and optimization; and (7) effective coordination to mobilize quickly. Worth posting and perpetuating.

140. Blumenthal EA, Hooshvar N, Tancioco V et al. **Implementation and evaluation of an electronic MEWT tool to reduce maternal morbidity. *Am J Perinatol.* 2021 Jul; 38(9): 869-79.**

This is a before-after study comparing maternal morbidity and clinical care 1 year before and 1 year after electronic implementation of a MEWT tool at 3 hospitals. The morbidity rate ratio increased from 1.6 to 2.06 per 100 deliveries in the post-MEWT period but various specific outcomes – sepsis, antibiotic timing, HTN morbidity, antihypertensive within 60 minutes – improved. MEWT trigger rates were 2.3% and sensitivity for morbidity was 50%. MEWT had highest sensitivity for detecting hypertension morbidity (82%) and lowest for detecting hemorrhage (30%). The lack of reduction in overall morbidity was attributed to annual differences in trends. Using metrics around sepsis, HTN, and cardiopulmonary morbidity are useful to track MEWT efficacy.

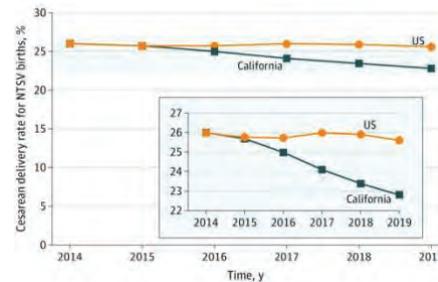
141. Benson AE, Metcalf RA, Cail K et al. **Transfusion preparedness in the L&D unit. An initiative to improve safety and cost. *Obstet Gynecol.* 2021 Nov; 138(5): 788-94.**

This quality improvement initiative at one academic center looked before and after implementation of a risk-based type and screen instead of universal type and screen based on risk-stratified alignment from CMQCC recommendations ("hold clot" for low- and medium- risk; type and screen and crossmatch for high-risk patients or positive antibody screen). Patient outcomes, safety and cost data, compliance and resource utilization metrics were collected. The change did not

increase emergency-release transfusion events (4 vs 3,  $p > 0.99$ ) or rate of hysterectomies or ICU admissions. Type and screen costs were substantially lower, for a projected annual savings of \$181,000 at an institution with 4,000 deliveries per year. Appropriate blood management can be safe as well as cost-saving. This validation of a similar 2011 study by Goodnough LT et al is important to reinforce patient blood management in obstetrics.

142. Rosenstien MG, Chang SC, Sakowski C et al. **Hospital QI interventions, statewide policy initiatives, and rates of cesarean delivery for nulliparous, term, singleton vertex births in California.** *JAMA.* 2021 Apr 27; 325(16): 1631-9.

Safe reduction in the rate of CD is a global priority. This observational study of CD rates from 2014 to 2019 included 7,574,889 nulliparous, term, singleton, vertex births in the US including 914,283 among 238 hospitals in California. Multiple initiatives to lower CD rates were launched from 2016 to 2019 by the CMQCC and Smart Care California. Hospitals with CD rates of 23.9% or higher (n = 149) were eligible and 91 (6150) joined 1 of 3 cohorts for the 18-month QI collaborative. The primary outcome was change in CD rates in California and difference-in-difference analysis for California vs. the US. CD rate in California decreased from 26 to 22.8% while the overall US rate stayed at 26%. Other states should follow suit – this is the template.

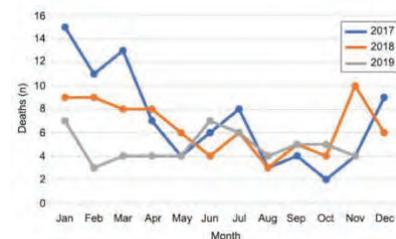


With an editorial by Nelson DB and Spong CY. **Initiatives to reduce CD rates for low-risk first births.** *JAMA.* 2021 Apr 27; 325(16): 1616-7.

**GLOBAL HEALTH**

143. Rulisa S, Ntihinurwa P, Ntirushwa D et al. **Causes of maternal mortality in Rwanda, 2017 -2019.** *Obstet Gynecol.* 2021 Oct 1; 138(4): 552-6.

The risk of maternal death is 120x higher in LRCs. In 2017, the MMR in the US was 17.3 per 100,000 live births compared to 542 per 100,000 live births in sub-Saharan Africa. Further efforts to define causes of maternal mortality in LRCs is a critical piece to shape future initiatives. This retrospective cross-sectional study from 2017-19 assessed causes of maternal mortality at the largest referral hospital in Rwanda, University Teaching Hospital of Kigali. Of note, women who died from pregnancy-related or associated morbidity during pregnancy or within 42d of delivery were included, though those who were dead upon arrival to the hospital were excluded. 217 women were identified out of 11,308 admissions; 86, 78, and 53 in 2017, 2018, and 2019, respectively. 50% of deaths were from sepsis, followed by hemorrhage (19%) and hypertension (15%). Seasonal variation coincided with lower numbers at times of medical staffing increases and altered referral patterns. A focus on sepsis, PPH and HTN and increased staffing is needed to lower MMR to the sustainable development goal target of < 70 per 100,000 live births.



144. Lonnee HA, Taule K, Sandvand JK et al. **A survey of anesthesia practice at all hospitals performing caesarean sections in Sierra Leone.** *Acta Anaesthesiol Scand.* 2021 Mar; 65(3): 404-19.

Sierra Leone is one of the poorest countries in the world with a CD rate of only 2.9% and an MMR of 1,360 per 100,000 live births. This report surveyed 1 anesthesia provider in 2016 at each of 36 hospitals in Sierra Leone that performs CDs to assess type of anesthesia used for these cases. Spinal was the most common anesthetic (63%) then ketamine without intubation. 33% of anesthesia providers were not qualified to provide anesthesia independently, and 50% expressed confidence in handling OB emergencies. Essential medications, recovery space, and blood products were not consistently available at every site. Of note, the CD mortality rate in this cohort was 18% and associated with predelivery anemia, PPH, and inadequate blood bank supplies. Outreach efforts in low-resource environments can use such data to create impactful initiatives. There is work to be done, and OB anesthesiologists can impact change.

145. Thayyil S, Pant S, Montaldo P et al. **Hypothermia for moderate or severe neonatal encephalopathy in low- and middle-income countries (HELIX): a randomized controlled trial in India, Sri Lanka, and Bangladesh.** *Lancet Glob Health.* 2021 Sep; 9(9): e1273-85.

Therapeutic hypothermia lowers death and disability after neonatal HIE in high income countries but its safety and effectiveness in LMICs is unknown. This multi-country, open label, RCT in 7 tertiary NICUs in India, Sri Lanka and Bangladesh enrolled 404 infants 36 weeks or more with moderate-severe neonatal HIE to receive whole body hypothermia 33.5°C for 72h or usual care, within 6h of birth. All centers had NICU resources including ventilation, cardiovascular support, and MRI scanners. The primary outcome of death or moderate-severe disability at 18-22 months was 50% vs. 47% in cooled vs control newborns, respectively. 42% vs. 31% in the cooled vs. control groups died during hospitalization. Based on these findings, therapeutic hypothermia at LMIC sites was discouraged. However, as per the editorial, further studies for selection of HIE newborns who may benefit from hypothermia are warranted, in conjunction with improved prenatal care and hospital births to prevent delays in therapy.

*With an editorial by Aneja S and Sharma S. Hypoxic ischaemic encephalopathy in low resource settings – time to stop cooling?* Lancet Glob Health. 2021 Sep; 9(9): e1187-8.

146. Drzymalski D, Guo JC, Qi XQ, et al. **The effect of no pain labor and delivery global health initiative on CD and neonatal outcomes in China: An interrupted time-series analysis.** Anesth Analg. 2021 Mar 1; 132(3): 698-706.

The CD rate in China is as high as 62.5%, and global health initiatives to reduce CD rate are a priority. A No Pain Labor & Delivery-Global Health Initiative was established in a rural Chinese hospital, and its impact on the CD was evaluated. A 1-week program including problem-based learning, bedside teaching, simulation drills, and multidisciplinary debriefings were implemented. After implementation of this program, a decrease in CD rate occurred (estimated OR 0.87; CI 0.78-0.98) and odds of monthly CD reduction an estimated 3% (1-5; P < 0.001) in the post vs. pre-intervention period. An increase in LEA utilization and reduction in NICU admission was also noted. This international educational initiative had a favorable impact on maternal and neonatal outcomes that warrants follow-up and replication in other areas with high baseline CD rate.

*With a comment in: Schober P, Vetter TR. Segmented regression in an interrupted time series study design.* Anesth Analg. 2021 Mar 1; 132(3): 696-7.

## **DISPARITIES IN MATERNAL OUTCOMES**

147. Siddiqui A, Azria E, Egorova N et al. **Contributions of prepregnancy obesity to racial and ethnic disparities in severe maternal morbidity.** Obstet Gynecol. 2021 May 1; 137(5):864-72.

Racial disparities in severe maternal outcomes are not well understood, and potential contributing risk factors warrant study. This retrospective population-based cohort study evaluated birth records linked with hospital discharge data in NYC. They found that pre-pregnancy obesity was a limited driver of racial-ethnic disparities in overall SMM. Black race remained associated with SMM after adjusting for covariables among subgroups of women with normal and obese BMI, with an aOR of 3.02. In other words, it only accounted for a small proportion of disparate SMM outcomes. Structural or health system factors are likely more contributory to disparities than modifiable individual-level factors.

148. Guglielminotti J, Wong CA, Friedman AM, Li G. **Racial and Ethnic disparities in death associated with SMM in the United States: Failure to rescue.** Obstet Gynecol. 2021 May 1; 137(5):791-800.

This retrospective cohort study of administrative data evaluated SMM at the time of delivery by patient race and ethnicity, with the primary outcome of failure to rescue. 73,934,559 delivery hospitalizations were identified, and 993,864 had SMM. Death occurred in 4,328 and failure-to-rescue rate ratio was 1.79 for black women, 1.39 for other race and ethnicity, and 1.08 for Hispanic women using non-Hispanic White women as a reference. These data indicate that failure to rescue from SMM has improved somewhat but continues to be a contributing factor to excess mortality among racial and ethnic minorities.

149. Kern-Goldberger AR, Arditi B, Wen T et al. **Risk of disparities in critical care during delivery hospitalizations.** Am J Obstet Gynecol MFM. 2021 Jul; 3(4): 100354.

OB anesthesiologists are increasingly called upon to provide peripartum critical care, and therefore can focus on mitigating disparities in this context. This cross-sectional study of the 2000-2014 NIS characterized the risks and disparities in critical diagnoses and interventions during delivery hospitalization. 45.8 million deliveries were identified, with 0.21% having a critical care procedure or diagnosis. The critical care composite was present in 75.8% of maternal deaths, increased from 17.9 to 30.3 per 10,000, and mechanical ventilation and intubation and respiratory failure the most common diagnoses.

Non-Hispanic Black women were 32.4% higher risk than non-Hispanic White women to die after critical care diagnosis but were 162% more likely to have a critical care diagnosis. Taken together, disparities may come from risk of conditions that require critical care rather than care received once the condition has developed.

150. Chambers BD, Arega HA, Arabia SE et al. **Black women's perspectives on structure racism across the reproductive lifespan: A conceptual framework for measurement development.** *Matern Child Health J.* 2021 Mar; 25(3): 402-13.

A series of focus groups with 32 Black women across the reproductive lifespan (5 preconception, 13 pregnant, and 14 postpartum) were performed to explore structural racism impact on maternal and infant health. Nine domains emerged: negative societal views, housing, medical care, law enforcement, hidden resources, employment, education, community infrastructure, and policing of black families. Better understanding the interplay between these components and their impact on Black women's reproductive health will enable more comprehensive care, including how the anesthesia team interfaces with Black patients to establish respect, trust, and communication and appropriate counseling.

151. Hamilton JL, Shumbusho D, Cooper D et al. **Race matters: maternal morbidity in the military health system.** *Am J Obstet Gynecol* 2021 May; 224:512.e1-6.

This retrospective cohort study captured data on 23,728 deliveries from April 1, 2018, to March 31, 2019, within the military healthcare system that includes universal access to healthcare. SMM in the context of race and ethnicity was evaluated. Compared to their White counterparts, Black women had a higher rate of CD (31.7 vs. 23.6%); were more likely to be admitted to the ICU (0.49 vs. 0.18%) and were more likely to experience overall SMM (2.66 vs. 1.66%). Given equal access to healthcare and similar socioeconomic status among patients in this military healthcare system, systemic racism from implicit and explicit medical biases is postulated as a factor that should be explored. Identifying disparities in the delivery of healthcare is an important area of research, and whether protocol-based care delivery can mitigate it.

152. Grobman WA, Sandoval G, Rice MM et al. **Prediction of VBAC in term gestations: a calculator without race and ethnicity.** *Am J Obstet Gynecol.* 2021 Dec; 225(6): 664.e1-7.

Should race and ethnicity be part of risk assessment tools? This secondary analysis of the Cesarean Registry of the MFMU Network repeated the original study from which the VBAC prediction tool was derived, but without including race and ethnicity. 11,687 patients met criteria as live singleton cephalic fetus at labor and delivery admission for TOLAC with history of 1 previous LTCD, 8636 (74%) had successful VBAC. A model was created by backward elimination variable selection. The model had excellent calibration and similar AUC as the previous model. This is a high-impact example of rethinking past approaches to strive for equity. Removing socially defined constructs race and ethnicity and instead using physiologic factors such as HTN should help to mitigate disparities. Evaluating whether this is the case, and other determinants of inequitable CD rates between Black vs. non-Black patients is important.

## **PATIENT EXPERIENCE AND POSTPARTUM RECOVERY**

153. Ende HB, Dwan RL, Freundlich RE et al. **Quantifying the incidence of clinically significant respiratory depression in women with and without obesity class III receiving neuraxial morphine for post-cesarean analgesia: a retrospective cohort study.** *Int J Obstet Anesth.* 2021 Aug; 47: 103187.

Obesity raises concern for respiratory depression following neuraxial morphine for post-CD analgesia, but studies are limited. This single-center, retrospective chart review (2006-2017) identified OB patients with clinically significant respiratory depression after neuraxial morphine, which was defined as (1) opioid antagonist administration; (2) rapid response team activation; (3) tracheal intubation due to a respiratory event. The incidence of this composite outcome was compared between women with a BMI  $\geq 40$  kg/m<sup>2</sup> or  $< 40$  kg/m<sup>2</sup>. 11,327 women received neuraxial morphine, with 1945 with BMI  $\geq 40$  kg/m<sup>2</sup>. While this subset of women had higher rates of sleep apnea, HTN, and magnesium administration, the incidence of respiratory depression was not higher in this group. Significant respiratory depression was reassuringly rare, only occurring in 16 cases. Larger studies can confirm these results for this very rare outcome.

154. Sultan P, Ando K, Sultan E, Hawkins JE et al. **A systematic review of patient-reported outcome measures to assess postpartum pain using Consensus-Based Standards for the Selection of Health Measurement Instruments (COSMIN) guidelines.** *Br J Anaesth.* 2021 Aug; 127(2): 264-74.

This systematic review identified 19 studies using 7 PROMs (capturing 3511 women) for the evaluation of postpartum pain. The Short-Form Brief Pain Inventory (SF-BPI) was the only PROM with adequate content validity and low-level evidence for sufficient internal consistency. This finding is important to facilitate research on postpartum pain, with the SF-BPI best choice for multidimensional PROMs to assess postpartum pain.

155. Green LJ, Pullon R, Mackillop LH et al. **Postpartum specific vital sign reference ranges.** *Obstet Gynecol.* 2021 Feb 1; 137(2): 295-304.

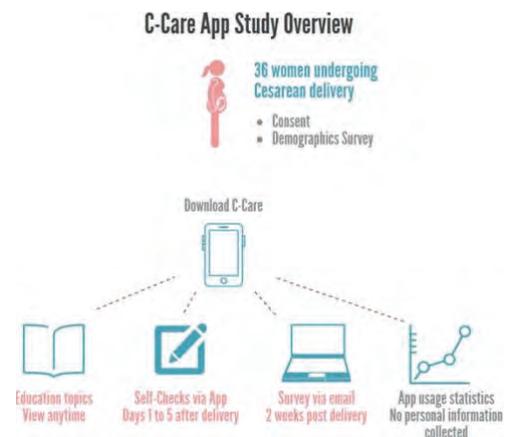
This was a multicenter prospective longitudinal cohort study in the UK of healthy women recruited before 20 weeks' gestation. Women recorded their own BP, heart rate, O<sub>2</sub> saturation, and temperature daily for 2 weeks postpartum and a trained midwife did it on days 1, 7, and 14. They established relevant vital sign baseline values that may help facilitate the detection of deterioration postpartum.

156. Martinez-Vasquez S, Rodriguez-Almagro J, Hernandez-Martinez A et al. **Obstetric factors associated with postpartum post-traumatic stress disorder after spontaneous vaginal birth.** *Birth.* 2021 Sep; 48(3): 406-15.

Perceived mistreatment during vaginal birth may be higher than realized. This cross-sectional study of 839 women in Spain used the perinatal PTSD Questionnaire and relationship between PTSD and intrapartum complications. PTSD (PPQ score  $\geq 19$ ) was identified in 8.1% of women with associated features of concerning intrapartum FHR tracing (OR 2.24); receipt of an enema (aOR 7.01), requirement to lay down through labor and birth (aOR 5.75), AROM without consent (aOR 2.28), fundal pressure during pushing (aOR 3.14), repeated vaginal exams by different people (aOR 4.84) and manual removal of the placenta without anesthesia (aOR 3.45). Patients need to be a part of their care process, to be respected and empowered, and to not feel dehumanized. With maternal anxiety, depression, and PTSD on the rise, understanding the causes of traumatic birth will enable patient-centered care that prevents traumatic birth experiences and delivers care that is trauma-informed.

157. Ke JXC, George RB, Wozney L, Munro A. **Perioperative mobile application for mothers undergoing Cesarean delivery: a prospective cohort study on patient engagement.** *Can J Anesth* 2021 Apr; 68(4):505-13.

C-care is a mobile application previously developed for patients undergoing CD and focuses on perioperative education and self-monitoring for potential anesthetic complications. This prospective cohort sought to gain feedback on patient experience using C-Care. 36 patients having CD were oriented to C-Care, and their usage data recorded for 30 days. All but one participant visited the app after orientation, for a median of 15 times over 30 days and completed 3 out of 5 self-monitoring questionnaires. The most viewed education topics were about pain control and what to expect right after surgery. 83% would recommend C-Care to other women. This is a good example of application of technology for patient engagement and potentially, patient safety. Such platforms could be tailored for longer-term follow-up of specific anesthesia-related complications such as PDPH.



158. Toscano M, Royzer R, Castillo D, Li D, Poleshuck E. **Prevalence of depression or anxiety during antepartum hospitalizations for obstetric complications: A systematic review and meta-analysis.** *Obstet Gynecol.* 2021 May 1; 137(5): 881-91.

39 studies were included for systematic review, and 18 for meta-analysis. Cross-sectional, cohort, case-control, quasi-experimental, and RCTs were included. The authors used a random effects meta-analysis model, I<sup>2</sup> tests for heterogeneity, and funnel plots for publication bias. The prevalence of depression was estimated to be 34% and anxiety 29%. One in 3 women hospitalized during pregnancy for OB complications has twice the reported prevalence of antenatal depression or anxiety. This must be explored, and supportive care anticipated.

## **UTERINE TRANSPLANTS, BASIC SCIENCE, AND ANIMAL MODELS**

159. Putman JM, Zhang L, Gregg AR et al. **Clinical pregnancy rates and experience with in vitro fertilization after uterus transplantation: Dallas Uterine Transplant Study.** *Am J Obstet Gynecol.* 2021 Aug; 225(2): 155.e1-15.

This observational cohort study of 20 women who had a uterine transplant over 3 years reported on clinical pregnancy rates for absolute uterine factor infertility after IVF with good-quality, blastocyst-stage, euploid embryos. 14 had successful transplants and were followed a median of 14 months. Clinical pregnancy resulted from first embryo transfer in 71.4% of those with successful transplants. A total of 13 live births occurred in 12 subjects. This study illustrates a successful pathway for fertility after uterine transplant, with focus on reducing the time interval from uterine transplant to clinical pregnancy (median time 4.5 months), which decreases maternal exposure to immunosuppressant therapies.

Uterine transplant is a plausible option for women with absolute uterine factor infertility who desire to carry their own pregnancy and experience childbirth.

160. Yuki Y, Hagsiawa K, Kinoshita M et al. **Efficacy of resuscitative infusion with hemoglobin vesicles in rabbits with massive obstetric hemorrhage.** *Am J Obstet Gynecol.* 2021 Apr; 224(4) 398.e1-11.

This study describes a rabbit model of MOH including severe anemia, coagulopathy, and lethal hemorrhagic shock at late gestation. The effectiveness of resuscitation with hgb-based oxygen carriers (hgb vesicles) vs. red blood cells was evaluated. Rabbits received 1 of 3 isovolemic resuscitative regimens after sustaining iatrogenic hemorrhagic shock: 5% serum albumin (n = 6); RBCs with plasma (1:1, n = 5); or hgb vesicle with 5% albumin (4:1, n = 5) with hemostasis restored at 60 minutes and survival a subsequent 24 hours evaluated. Both PRBCs and Hgb vesicles prevented hemorrhagic shock, but albumin did not, with low MAPs and elevated plasma lactate. All animals in the PRBC or Hgb vesicle group survived 8 hours or more, vs. none in the albumin group. As a preliminary animal study, hgb vesicles hold promise for synthetic RBC alternatives. More studies are warranted.

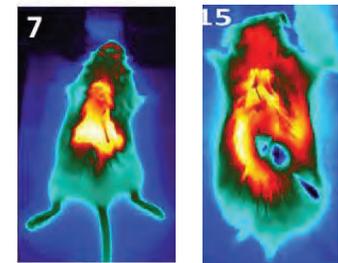
161. Stolk RF, Naumann F, van der Pasch E et al. **Phenylephrine impairs host defense mechanisms to infection: a combined laboratory study in mice and translational human study.** *Br J Anesth.* 2021 Mar; 126(3): 652-64.

Phenylephrine infusion is now standard of care for the prevention of post-spinal hypotension during CD. This basic and translational science study evaluates the impact of phenylephrine on host defense. Human leukocytes were stimulated with LPS with or without phenylephrine. C57BL/6J mice received phenylephrine infusion vs. saline before LPS administration or cecal ligation. 20 male mice were randomized to 5h infusion of phenylephrine or saline before receiving LPS. In vitro, phenylephrine enhanced LPS-induced anti-inflammatory cytokine IL-10 and attenuated release of pro-inflammatory mediators. Plasma IL-10 was higher in LPS-challenged mice infused with phenylephrine. Phenylephrine infusion increased bacterial counts after cecal ligation. Phenylephrine enhanced LPS-induced IL-10 response. Taken together, phenylephrine appears to exert potent anti-inflammatory effects that may be mediated by the beta adrenoreceptor. Impairment of host defense should be considered, particularly on those with impaired immune systems on prolonged or high-dose phenylephrine infusion.



162. Xu Z, Agbigbe O, Nigro N et al. **Use of high-resolution thermography as a validation measure to confirm epidural anesthesia.** *Int J Obstet Anesth* 2021 May; 46:102981.

Sensory level to evaluate epidural efficacy is an impactful assessment tool in humans, but not in mice. This study in 20 C57Bl/6 mice utilized infrared thermography to demonstrate selective segmental warming of the lower extremities after epidural anesthesia. Mice were anesthetized with isoflurane then an epidural catheter placed under direct surgical microscopy. A thermal camera then recorded baseline temperature, and 2,5,10,15 minutes after epidural bolus with bupivacaine vs. saline control. Thermal images were recorded and analyzed using FLIR software. Epidural bupivacaine caused progressive warming of lower extremities; thus, thermography may be useful to confirm epidural analgesia in animals who are nonverbal.



163. Jayasooria GS, Carvalho JCA, Luca A, Balki M. **The effects of nitroglycerin on the oxytocin dose-response profile in oxytocin desensitized and naïve human myometrium: An in vitro study.** *Anesth Analg* 2021 Jan; 132(1): 231-9.

TNG can be used for acute uterine relaxation and prolonged oxytocin exposure causes desensitization of oxytocin receptors, but does TNG exposure impact oxytocin effect after oxytocin desensitization? Myometrial samples from 117 women having CD were divided into 1 of 4 groups: oxytocin desensitized with no TNG; oxytocin and TNG; oxytocin naïve and TNG; and oxytocin naïve with no TNG. TNG-induced relaxation was not different between oxytocin desensitized or oxytocin-naïve human myometrial strips in vitro. TNG exposure did attenuate oxytocin-induced contractility, suggesting that oxytocin-augmented labors along with TNG may exacerbate uterine atony.

Abstract #: SAT-CP – Room 1 - 01

**Sustained Vasovagal Response Requiring Transvenous Pacing after Bakri balloon placement: A Case Report.**

**Presenting Author:** Won Lee, MD

**Presenting Author's Institution:** University of California - San Francisco

**Introduction:** Vasovagal responses can create circulatory collapse through bradycardia and paradoxical vasodilation. Procedure such as neuraxial anesthesia and abdominal insufflation have all been associated with vasovagal response via pain, anxiety, or stretch of tissues. With circulatory support and resuscitation, most vasovagal responses terminate quickly.[1] Here, we present an unusual case of sustained vasovagal response requiring transvenous pacing following Bakri Balloon placement for postpartum hemorrhage.

**Case:** A 33-year-old G1P0 patient at 37-week gestation with di-di gestation on flecainide for fetal tachyarrhythmia (last dose 100mg two hours prior to delivery) underwent spontaneous vaginal delivery with epidural analgesia. The course was complicated by postpartum hemorrhage of 1.3 liters due to uterine atony requiring Bakri Balloon placement, with later development of severe bradycardia. At a sustained nadir of junctional rhythm at 20 bpm, systolic blood pressure decreased to 60s. The patient had minimal heart rate response to glycopyrrolate or atropine. Initiation of dopamine infusion increased blood pressure without affecting HR. Given recent hemorrhage and unclear etiology of bradycardia, trial of Bakri Balloon deflation was deferred until pacing was obtained and hemodynamics had stabilized. After transfer to ICU, a right internal jugular introducer was placed and transvenous pacing was initiated with significant improvement in her heart rate and hemodynamics, allowing for cessation of dopamine. Bakri Balloon deflation was trialed after stabilization, 4 hours after hemorrhage, and upon deflation bleeding was minimal and patient shortly returned to normal sinus rhythm.

**Discussion:** Uterine and cervix tissues have vagus nerve innervation and insertion of intrauterine devices has triggered vasovagal shock.[2] Bakri Balloons, designed to temporize postpartum hemorrhage by inducing intrauterine tamponade can trigger the vagal afferent system, which can lead to increased parasympathetic activity at the sinoatrial and the atrioventricular (AV) nodes with profound bradycardia and circulatory collapse. Unlike typical vasovagal response, this patient experienced sustained hemodynamic instability requiring transvenous pacing. Although never been previously reported, it is possible that flecainide may have potentiated the vasovagal response. Flecainide is a sodium channel blocker with greatest effect on the His-Purkinje system. It can prolong atrial, AV nodal and ventricular refractory periods, and increase the endocardial pacing threshold.[3] Patients taking sodium channel or AV nodal blockade medications may warrant careful obstetric anesthesia evaluation, especially if the risk of postpartum hemorrhage is increased.

Abstract #: SAT-CP – Room 1 - 02

## Reaction(R) Time prolongation on TEG in Parturients with Antiphospholipid Syndrome after discontinuation of Heparin

Presenting Author: Mohammed Idris, MD

Presenting Author's Institution: Beth Israel Deaconess Medical Center - Boston, Massachusetts

### Introduction:

Antiphospholipid Syndrome (APLS) is characterized by the presence of lupus anticoagulant and anticardiolipin antibodies (antibodies against phospholipids), which leads to an increased risk of recurrent venous and arterial thrombosis. APLS accentuates the hypercoagulable state of pregnancy and hence ACOG recommends these parturients be placed on heparin. These antibodies prevent the assessment of anticoagulation by interfering with assembly of prothrombinase complex on phospholipids in the aPTT assay leading to a false prolongation. Thromboelastography (TEG) assesses the effect of heparin by comparing coagulation with and without heparinase, thereby bypassing this error. We report two patients with APLS with prolonged Reaction (R) time, even in the kaolin TEG with heparinase channel, for up to 27 hrs after their last dose of heparin.

*Case 1:* A 36 y/o G2P0 at 37 weeks with APLS, Systemic Lupus Erythematosus, and h/o Deep Venous Thrombosis (DVT) and Pulmonary Embolus (PE) on 7500 U of subcutaneous heparin BID presented to the Labor and Delivery (L&D) in early labor. Her last dose of heparin was 6 hours prior. Since her baseline aPTT was prolonged, a TEG 6s global cartridge was used to monitor coagulation status. Several of her initial TEG values (Figure 1) were outside the reportable range at R>17.0 min, R with heparinase of 11.6 min, Kinetic Time>5.0 min, Alpha Angle< 43.8°. Her TEG was repeated four additional times with near normalization at 27 hrs.

*Case 2:* A 29 y/o G2P0 at 27 weeks with APLS, history of DVT/PE, epilepsy, and preeclampsia with severe features presents for cesarean delivery due to severe fetal growth restriction, abnormal dopplers, and fetal decelerations. Her heparin infusion was stopped 14 hrs prior. Initial TEG showed R of 11.2 min, R with heparinase of 9.1 min. Her TEG values normalized 22 hrs after discontinuation of the infusion.

Both patients received neuraxial analgesia/anesthesia safely.

### Discussion:

Parturients with APLS present a complex management challenge on L&D due to heparin administration and monitoring difficulties. Our patients had abnormally prolonged R values for about 22-27 hrs after their last dose of heparin and significantly longer than the current recommendations. Furthermore, the R values were only partially corrected in the heparinase channel of TEG 6s. This finding may represent prolonged activity of heparin or an unknown artifact affecting the TEG 6s assay. The normalization of these values over time would argue against the latter. Additional studies should be performed to better characterize these findings and their implications on the safe care of parturients with APLS.

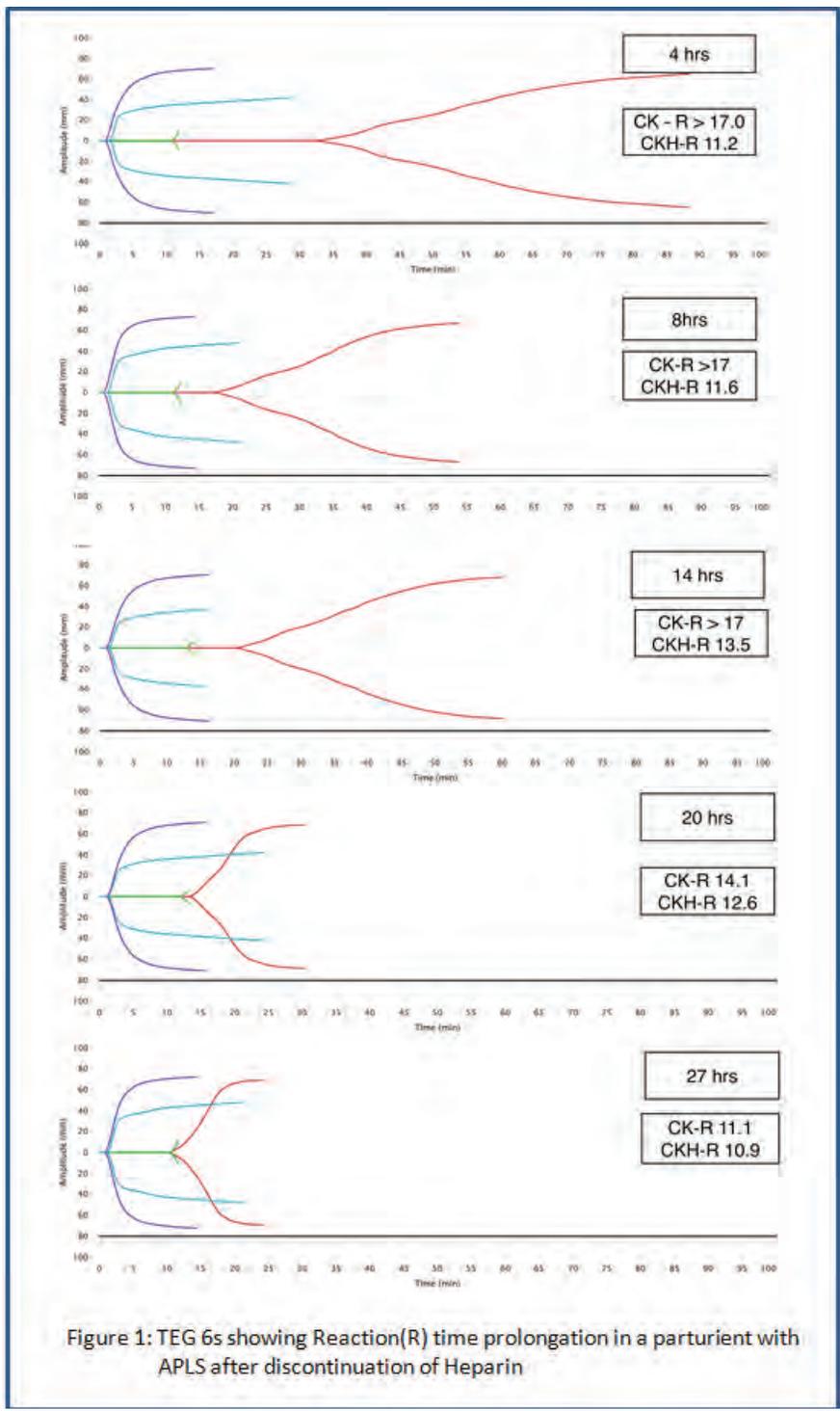


Figure 1: TEG 6s showing Reaction(R) time prolongation in a parturient with APLS after discontinuation of Heparin

Abstract #: SAT-CP – Room 1 - 03

## Cardiovascular Collapse, Multi-Chamber Intracardiac Thrombosis, and Disseminated Intravascular Coagulation Following Dilation & Evacuation in a Post-partum Cardiomyopathy Patient

**Presenting Author:** Hilary Gallin, MD/MBA

**Presenting Author's Institution:** Massachusetts General Hospital

**Co-Authors:** Marvin Chang, MD - Massachusetts General Hospital

Rebecca Minehart, MD - Massachusetts General Hospital-Anesthesia, Critical Care and Pain Medicine

### Cardiovascular Collapse, Multi-chamber Intracardiac Thrombosis, and DIC following D&E in a Post-partum Cardiomyopathy Patient

**Intro:** Peripartum cardiomyopathy (PPCM) is associated with 11% of maternal deaths<sup>1</sup>, both of which can be mitigated by performing a D&E in the highest risk patients. D&E are low risk procedures often performed in the office setting with low complication rates. We present a case of a patient with PPCM (EF 10%) who had cardiovascular collapse immediately following completion of a second trimester D&E procedure in the OR.

**Summary:** A 32yo female G4P3 at 16 weeks with PMH asthma and prior asymptomatic COVID was transferred from OSH where she presented with 4 months of worsening SOB. TTE revealed an LVEF 10%, moderately reduced RV function, moderate to severe MR, and RSVP of 60. Imaging was negative for PE, CAD, and DVT. She agreed to undergo a D&E to reverse her PPCM. Of note, she had tolerated a laparoscopic cholecystectomy under GA 3 weeks earlier. Her hemodynamics and volume status, as well as rhythm control of ventricular tachyarrhythmias was optimized by cardiology, and her prophylactic enoxaparin held the day before her D&E.

Her planned anesthetic for the D&E was MAC with a propofol infusion and ketamine. Initial vitals were BP 117/79, HR 115, and SpO<sub>2</sub> 100%, and were stable during the case. Immediately upon D&E completion, SpO<sub>2</sub> fell to the 70's despite no change in her spontaneous breathing. PPV was started and chest compressions were initiated. She was placed on peripheral ECMO. Differential diagnosis at the time included AFE, PE, or VAE. TEE was notable for a PFO and diffuse clots in all chambers of her heart including at the interface of the IVC and RA. Labs were notable for an INR 2.5, platelets 52, and Fibrinogen 177.

She was transferred to the ICU. She underwent surgical thrombectomy, biventricular assist device (BiVAD), and central ECMO cannulation. Her neurologic status deteriorated with imaging revealing significant embolic infarcts and was deemed not a candidate for heart transplant. Care was withdrawn by the family on POD 14.

**Discussion:** Our patient with cardiovascular collapse, multi-chamber intracardiac thrombosis, and DIC likely suffered an AFE, a rare complication of second trimester D&E<sup>2</sup>. Pregnant patients placed on extracorporeal life support (ECLS) have high survivability rates compared to other etiologies if the cause is primarily cardiac in nature<sup>3</sup>. In our patient, an embolic event may not have been preventable and likely decreased her survivability despite ECLS<sup>3</sup>.

Abstract #: SAT-CP – Room 1 - 04

## Cushing's Syndrome in Pregnancy: A Diagnostic Dilemma

Presenting Author: Caroline L. Thomas, Obstetric Anesthesiology Fellow

Presenting Author's Institution: Northwestern Medicine

### Background:

Cushing's syndrome is rare in pregnancy due to the association of hypothalamic-pituitary-adrenal axis dysfunction with infertility. Diagnosis in pregnancy is challenging as it can be confounded by normal symptomatology of pregnancy and by the overlapping diagnostic criteria between Cushing's and pre-eclampsia.

### Case:

A 36-year-old G4P2 female was admitted at 21w1d for hypertension and dyspnea. Her past medical history was significant for an adrenal mass without follow up. Review of systems was concerning for swelling in her legs, blurry vision, intermittent episodes of panic, irritability, palpitations, excessive hair growth, easy bruising, and weight gain. Laboratory evaluation revealed transaminitis, elevated UPC, hyperglycemia, and hypokalemia.

Despite her early gestational age, the patient met criteria for pre-eclampsia with severe features, but also had a constellation of findings suggestive of endocrine pathology. A CT abdomen showed a 3.5cm adrenal mass with interval growth. Given that the obstetric recommendations would differ significantly based on a diagnosis of pre-eclampsia versus secretory adrenal mass (pheochromocytoma or cortisol-secreting), an endocrine evaluation was pursued. Free urine cortisol returned markedly elevated (2186, normal < 50) and plasma metanephrines were undetectable.

Clinical deterioration requiring aggressive diuresis and antihypertensive management prompted an uncomplicated laparoscopic adrenalectomy at 23w3d under general anesthesia. She was managed with rapid sequence induction, pre-induction arterial line, large bore IV access and maintenance of anesthesia with sevoflurane for uterine relaxation. Intra-operative hydrocortisone was administered. Close perioperative monitoring of hemodynamics, volume status and electrolytes was required given abrupt cessation of cortisol. Pre- and post-procedural fetal heart tones were normal.

Post-operatively, she received a steroid taper. The patient's symptoms improved, hypertension resolved and she was discharged on post-operative day 7. Final pathology was consistent with diagnosis of a cortisol-secreting adrenal cortical adenoma.

### Discussion:

Multidisciplinary care between maternal fetal medicine, endocrinology, endocrine surgery, and anesthesia is required for diagnosis and management of Cushing's syndrome in pregnancy. While pre-eclampsia is common, a broader differential for hypertension and/or hypervolemia must be considered in a patient who presents at an early gestational age with co-morbid electrolyte disturbances, excessive hair growth, psychiatric complaints and palpitations. Treatment of hypertension for potential pre-eclampsia with beta-blockade could potentially lead to un-opposed alpha-agonism in the setting of yet-undiagnosed pheochromocytoma. Decisions regarding timing of delivery, fetal monitoring, and postpartum management should be shared to ensure optimal maternal and fetal outcomes.

## Ruling out an epidural arteriovenous malformation in a parturient with Hereditary Hemorrhagic Telangiectasia

**Presenting Author:** Jayne E. Manigrasso, M.D.

**Presenting Author's Institution:** Oregon Health and Science University - Portland, Oregon

**Co-Authors:** Emily J. Baird, M.D., Ph.D - Oregon Health and Science University

Mark S. Chesnutt, M.D. - Oregon Health and Science University

Gary M. Nesbit, M.D. - Oregon Health and Science University

Brandon M. Togioka, M.D. - Oregon Health and Science University

Hereditary Hemorrhagic Telangiectasia (HHT) is a disorder which causes the development of arteriovenous malformations (AVMs), most notably in the pulmonary and cerebral vasculature. AVMs are thought to enlarge during pregnancy due to an increase in cardiac output, venous congestion, blood volume, and plasma concentrations of progesterone and estrogen [1]. While most women with HHT deliver uneventfully, rare reports of peripartum complications exist including embolic events and hemorrhage due to a ruptured AVM [2].

Neuraxial labor analgesia is often requested for patients with HHT and a cerebral AVM in order to attenuate the hypertensive response to labor pain[1]. However, needle puncture of an AVM within the epidural space, albeit rare, has been associated with epidural or subdural hematoma formation and lower extremity paresis [3,4]. Epidural AVMs are generally considered a contraindication to neuraxial placement.

A 42-year-old nulliparous woman with HHT and a cerebral AVM underwent a lumbar spine MRI at 35 weeks gestation to exclude an epidural AVM in preparation for neuraxial labor analgesia. The standard supine MRI showed engorgement of the epidural venous plexus and dorsal displacement of the dural sac caudal to L2, interpreted as "likely epidural AVM". Interventional neuroradiology recommended an MRI in the right lateral position. This position change revealed a decrease in epidural venous engorgement and increased caliber of the IVC and aorta at the L3 disc level. Venous engorgement in the supine position was attributed to compression of the IVC by the gravid uterus, which diverts a portion of the pelvic and lower extremity venous return to the epidural venous plexus [5,6]. AVMs are not expected to change in size with position changes due to higher intraluminal pressure.

Reassured that the engorged epidural venous plexus had been misinterpreted as an AVM, an ultrasound-guided epidural was placed at the L1/2 interspace, which was used to successfully provide analgesia for spontaneous vaginal delivery without complication. This case highlights the utility of position changes to distinguish between an AVM and normal physiologic epidural venous plexus engorgement during pregnancy.

**Figure 1:** MRI of the lumbar spine in the supine (panels A, B) and right lateral position (panels C, D).

Panel A: engorged veins in the epidural venous plexus (straight arrows)

Panel B: compressed aorta and IVC (curved arrows) and engorged veins in the epidural venous plexus (straight arrows)

Panel C: reduced epidural venous engorgement (lack of dark flow voids).

Panel D: non-displaced dural sac and increased caliber of aorta and IVC.

[Figure 1- Manigrasso -HHT.pdf](#)

Abstract #: SAT-CP – Room 1 - 06

Serial ocular ultrasound as a surrogate of fundoscopic examination in a parturient with suspected elevated intracranial pressure.

**Presenting Author:** Adeeb Oweidat, MD

**Presenting Author's Institution:** Cleveland Clinic - Cleveland, Ohio

**Co-Authors:** Mohamad Ayoub, MD - Cleveland Clinic

Nour El Hage Chehade, MD - Cleveland Clinic

Justo Gonzalez, MD - Baylor University Medical Center

Arnold Chiari malformations (ACM) is associated with an impaired flow of cerebrospinal fluid (CSF) that has a risk for herniation of brain tissue<sup>1</sup>. Parturient with type I may manifest symptoms including headache and findings associated with increased intracranial pressure (ICP) such as papilledema. Anesthesiologists must determine if neuraxial anesthesia is safe. An unintentional dural puncture or perhaps even an uncomplicated spinal anesthetic might produce a CSF pressure gradient between brain and spinal cord with resultant cerebral herniation<sup>2</sup>. A fundoscopic exam can reveal papilledema yet often needs practice and precision often performed by an ophthalmologist. Point of care ultrasound of the eye has now shown to be useful in measuring raised ICP.

A 36-year-old preterm parturient with history of ACM I surgically decompressed (2013), pituitary microadenoma, and asthma was admitted with preeclampsia. Her symptoms were chronic headaches that recently worsened with valsalva maneuver. Bedside fundoscopic exam was notable for unclear disc margins bilaterally. MRI brain showed ACM with normal CSF flow. Neurosurgery was consulted with no relative contraindication to neuraxial anesthesia. The patient had baseline optic nerve sheath diameters (ONSD) using ultrasound (US) guidance with the average measurement in left and right eye were 5mm and 5.4mm respectively. Later in her hospital course, she developed severe preeclampsia requiring an urgent need for a c-section but without neurological changes thus not warranting a repeat ocular US. A 27G pencil point needle was used to perform spinal anesthesia without complications.

Ocular US is another modality that can be used in lieu of fundoscopic exam and has been shown to correlate well with invasive measurements of ICP. In the literature an ONSD >5.8 mm indicates increased ICP with a sensitivity of 90% and a specificity of 84%<sup>3</sup>. Performing a baseline ocular diameter followed by serial measurements will allow for comparison if any major neurological/headache change occurs and will thus determine if there is any increase in ICP. A noninvasive bedside method for recognizing cerebral edema and increased ICP could, therefore, be beneficial in the management of patients with ACM who has superimposed preeclampsia as both conditions can be associated with increased ICP. In conclusion, we suggest that ocular ultrasonography is a non-invasive and easy-to-learn technique that provide useful information about cerebral edema and intracranial hypertension in patients with ACM.



Abstract #: SAT-CP – Room 1 - 07

## Intracranial Abscess in a Primigravida: An Interdisciplinary Approach

**Presenting Author:** Lauren A. Blake, MD

**Presenting Author's Institution:** University of North Carolina at Chapel Hill - Chapel Hill , North Carolina

**Introduction:** An intracranial abscess is a potentially life-threatening complication that is rarely seen in pregnancy. Care, including time and route of delivery, requires a multidisciplinary approach with neurosurgery, perinatology, and anesthesiology.

**Case:** This is a case of a 28-year-old G1P0 at 38 weeks and 2 days who was transferred from an outside facility in the setting of acute encephalopathy and periorbital edema. The patient has a history of polysubstance abuse and her urine drug screen was positive for opiates, amphetamines, and cannabinoids on admission. A CT head without contrast was obtained at the outside facility and revealed a left frontoparietal subdural abscess, likely secondary to IV drug use. A CT venogram was ordered due to a clinical suspicion of cavernous sinus syndrome. This revealed left transverse and cavernous sinus thromboses, in addition to the left frontotemporoparietal abscess measuring 3.7 x 1.0 x 4.8 cm. With the cumulation of these findings and worsening encephalopathy, the decision was made to proceed with an emergent simultaneous cesarean section and burr hole evacuation. Due to the concern for increased intracranial pressure (ICP), a total intravenous anesthetic was planned. A rapid sequence intubation was necessary due to the patient's gravid uterus. Given the patient's extensive drug use, a bolus dose of 100 mcg of remifentanyl and 200 mcg of fentanyl were used on induction to prevent the hyperdynamic response to laryngoscopy. A 6.5 mm endotracheal tube and video laryngoscope were used to minimize intubation attempts. An infusion of remifentanyl and propofol were the primary anesthetic. The obstetric portion was performed first, delivering the fetus without complication. NICU was present to evaluate and transport the baby. While closing the abdominal incision, the patient was turned 90 degrees to prep for the burr hole evacuation. The patient was hyperventilated to reduce ICP. The intracranial abscess was drained and the fluid was sent for culture. The patient was kept intubated and transported back to the MICU. The patient remained intubated for nine days while being treated with broad spectrum antibiotics and a heparin drip. The patient did not suffer long-term neurological sequelae and was discharged on Suboxone and three months of anticoagulation.

**Discussion:** An intracranial abscess is a rare, but serious condition with significant morbidity and mortality. IV drug use is a known risk factor. An interdisciplinary approach can greatly improve outcomes. With the improvement in antibiotic guidance and neuroimaging, the mortality rate has decreased from 40 to 10% and full recovery has increased to 70%. Prompt diagnosis and treatment is key.

**Abstract #: SAT-CP – Room 1 - 08**

**Medically Challenging Case: Intracranial hemorrhage in a pregnant patient with HELLP syndrome**

**Presenting Author:** Mohammed A. Hussain, DO

**Presenting Author's Institution:** University of Texas Medical Branch at Galveston - Houston, Texas

**Introduction**

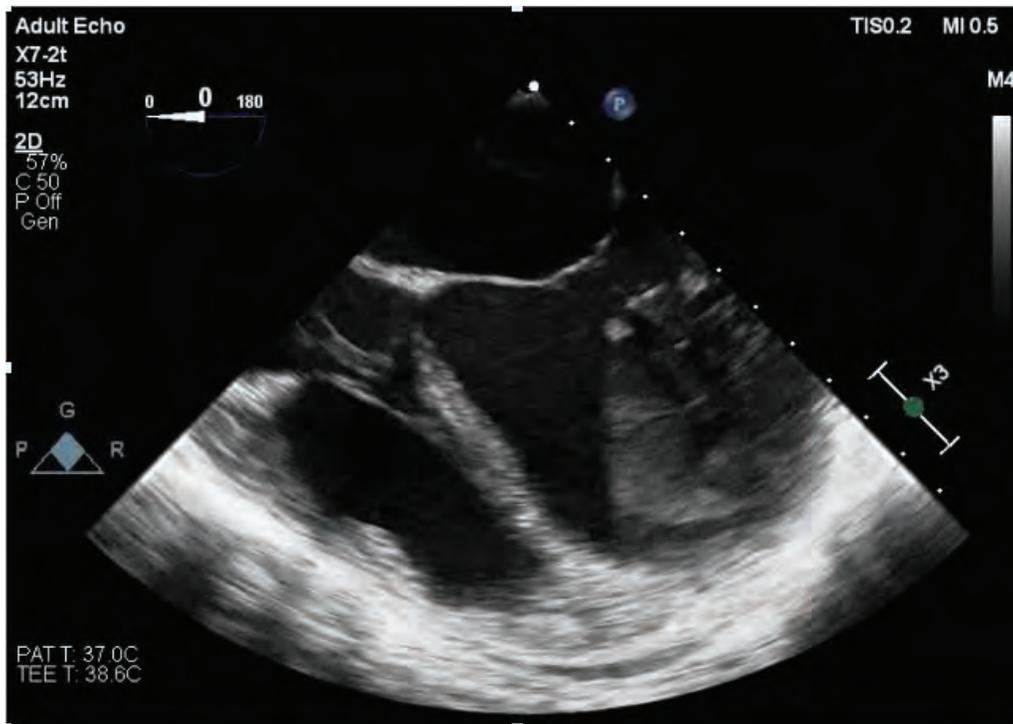
Intracranial hemorrhage (ICH) is relatively uncommon in pregnancy, with an estimated incidence of 0.01 to 0.05%, with vascular malformations as the most common cause of hemorrhagic stroke in this patient population [1-3]. Often, the presenting symptom is new onset tonic-clonic seizures. In contrast, the incidence of eclampsia is relatively higher at 0.08%, which also has a similar presentation of generalized tonic-clonic seizures in a woman with preeclampsia [5]. Treatment and diagnostics are very different for the two. The added urgency of fetal wellbeing, compounded by the diagnostic limitations associated with pregnancy, often pigeonholes providers into a narrower differential diagnosis that can lead to devastating morbidity and mortality.

**Methods (review of the case report)**

A 32-year-old and 26 weeks pregnant female was transferred to our institution for severe ranging blood pressures and seizures concerning for eclampsia. The patient arrived obtunded after administration of 55 mg valium by an outside institution and non-reassuring fetal heart tones. Shortly after arrival, and prior to labs resulting, she was taken for an emergent c-section under GETA. During surgery a coagulopathy was noted on labs, later diagnosed as HELLP syndrome. She was left intubated and sedated due to a poor neurologic exam, and admitted to the Surgical ICU. Despite sedation being stopped her neurological function did not improve, and she was further evaluated with an EEG and head CT. This revealed a large intraparenchymal hemorrhage with midline shift. Before any neurosurgical intervention, the patient's neurologic status abruptly worsened due to herniation. The family decided on a palliative extubation and autopsy, which noted her cause of death as ICH due to eclampsia.

**Conclusion**

This case of a parturient with ICH in the setting of HELLP syndrome demonstrates a few crucial points in managing high risk parturients with neurologic abnormalities. The medical team should seek to stabilize the mother prior to delivery if possible. While the seizures in this case were initially attributed to eclampsia, given the difficulty in treating the seizures compounded by HELLP syndrome, further investigation into an underlying etiology is warranted. Perhaps if cerebral imaging had occurred earlier in her presentation, the ICH would have been detected and acted upon prior to devastating neurologic injury.



Abstract #: SAT-CP – Room 1 - 09

## Pregnancy-associated Complement-mediated Thrombotic Microangiopathy: diagnostic dilemma

Presenting Author: Kate Balbi, DO

Presenting Author's Institution: Cedars-Sinai Medical Center

### Introduction

Complement-mediated Thrombotic Microangiopathy (C-TMA), also known as atypical hemolytic uremic syndrome (aHUS), is a severe inflammatory disease caused by uncontrolled activation of the complement system. Elevated terminal complement C5b-9 activates platelet and vascular endothelial-cells causing fulminant, systemic microvascular clotting. C-TMA is characterized and diagnosed by three defining features: hemolytic anemia, thrombocytopenia, and renal failure (1). The clinical presentation and laboratory features of HELLP syndrome, TTP and C-TMA are similar and cause diagnostic and management confusion. We report a case of C-TMA in a critically ill post-partum patient with prompt recognition and treatment with eculizumab resulting in rapid improvement.

### Case

34 y.o. G3P1 PMH rhabdomyolysis pre-pregnancy, TIA with PFO subsequently closed, prior NSVD without complications presented in labor. Admission CBC was normal and routine labor epidural placed. Fetal bradycardia required emergent cesarean delivery. Patient developed postpartum hemorrhage and DIC requiring massive transfusion in OR. Post-op patient had persistent thrombocytopenia (27k) and oliguric AKI requiring continuous dialysis. Labs revealed low C3/C4, evidence of hemolysis and rhabdomyolysis. ADAMTS13 activity was normal. A diagnosis of pregnancy-associated complement-mediated TMA was made and the terminal complement inhibitor eculizumab (monoclonal Ab to C5) started POD2. The clinical picture quickly improved. She was discharged on POD14, continued eculizumab for 6 months and received a brief period of outpatient dialysis. Genetic workup confirmed a missense variant in complement factor I, consistent with complement-mediated TMA.

### Discussion

Complement-mediated TMA more commonly presents in the postpartum period, often after a pregnancy complication, such as postpartum hemorrhage like in this case. These patients are often critically ill, and diagnosis may be delayed due to overlapping features with other TMA syndromes (TTP, HELLP, aHUS).(4) While all TMA syndromes are associated with thrombocytopenia, severe and prolonged thrombocytopenia is more often seen with TTP. TTP can also be confirmed with reduced ADAMTS13 activity. The presence of renal failure, more severe anemia and elevated LDH that persists after delivery often differentiate C-TMA from HELLP syndrome. In our patient the combination of hemolytic anemia, thrombocytopenia and renal failure contributed to the clinical diagnosis, later confirmed by complement genetic panel. Multidisciplinary collaboration with hematology, nephrology, maternal fetal medicine and anesthesiology was paramount in early recognition and treatment in this case.

Abstract #: SAT-CP – Room 1 - 10

### The High-Risk Hemorrhage Cesarean Section That Wasn't: Advanced Planning Meets Great Luck

**Presenting Author:** Kathryn M. Davis, MD

**Presenting Author's Institution:** Johns Hopkins University, School of Medicine

**Co-Authors:** David Berman, MD - Johns Hopkins University, School of Medicine

Anna Gabrielian, MD - Johns Hopkins University, School of Medicine

Lymphatic malformations are rare, non-malignant growths of abnormal lymphatic tissue, sometimes with significant vascular involvement. We present an unusual case of diffuse lymphangiomatosis (LAM) affecting pregnancy and perinatal anesthetic management.

A 33-year-old G0 was referred to our high-risk obstetric anesthesiology clinic as part of multidisciplinary preconception counseling for extensive LAM. Initially manifesting in infancy as a small birthmark, it had progressed to a large, multicompartmental mass involving her chest wall, pleura, mediastinum, abdominal wall, peritoneum, and retroperitoneum. She had undergone over 30 sclerotherapy treatments to slow its growth. We discussed the paucity of data on the behavior of LAM in pregnancy and the risk for high output cardiac failure. We counseled against neuraxial anesthesia given concern for both spinal involvement and risk of significant bleeding should the mass be violated during placement. Alternatives such as opioid PCA for labor and general anesthesia for cesarean delivery were offered. There was multidisciplinary discussion with maternal-fetal medicine and interventional radiology regarding mode of delivery, and concerns were raised about the ability to target potentially diffuse venous bleeding with IR embolization if the LAM was impacted by Valsalva or fetal descent during a potential vaginal delivery.

Upon becoming pregnant the patient maintained regular follow-up with MFM and underwent repeat third trimester MRI which demonstrated diffuse disease further extending into the thoracic epidural space and the left adnexa, pelvic sidewall, and lateral abdominal wall. When the patient unexpectedly presented in preterm labor at 36+0 weeks, a decision was collectively made to proceed urgently with cesarean delivery. After placing a rapid infusion catheter and an arterial line, we induced general anesthesia. She was intubated via video laryngoscopy and TIVA was used for maintenance with BIS monitoring. Crossmatched blood was immediately available in the operating room. A midline vertical skin incision allowed for avoidance of the pelvic sidewall with vacuum-assisted fetal delivery utilized to minimize pressure on the adnexa. Blood loss was within normal limits for a routine cesarean section and our patient was extubated uneventfully. As truncal blocks were not performed due to LAM invasion of the abdominal wall, post-operative pain was managed with IV PCA. She recovered well and was discharged on POD 4.

This case highlights the importance of multidisciplinary consultation and communication in the care of complex obstetric patients, especially in scenarios where existing literature is scant or absent. Experience with large lymphovenous malformations remains extremely limited without accepted guidelines for management. As a result, the careful coordination of multidisciplinary expertise and shared decision-making proved critical to crafting and executing a safe delivery plan.

## Management And Cesarean Delivery Of A Parturient With Refractory AF-RVR And Severe Peripartum Cardiomyopathy

**Presenting Author:** Benjamin Houseman, MD, PhD, FASA

**Presenting Author's Institution:** Envision Healthcare Services

**Co-Authors:** Tilman Chambers, MD - Memorial Hospital System Department of Anesthesiology

Sarah A. Dunn, MD - Envision Physician Services, Department of Anesthesiology

Maria Frosth, MD - Envision Physician Services, Department of Anesthesiology

Amy K. Pulido, MD - Envision Physician Services, Department of Anesthesiology

Chengcheng Zheng, BS - Florida International University College of Medicine

Xiwen Zheng, MD - Envision Physician Services, Department of Anesthesiology

### CASE REPORT

This case report outlines the peripartum management and cesarean delivery of a 35-year-old G2P0010 who presented with refractory AF-RVR and symptomatic peripartum cardiomyopathy (EF 10%) in her third trimester.

Prior to this pregnancy, the patient had a longstanding history of hypertension and AF-RVR managed with rivaroxaban. Echocardiography in 2016 and 2017 estimated an EF of 45-50% with no valvular or wall motion abnormalities. Past surgical history was significant for gastric sleeve surgery in 2016.

She was referred to our peripartum navigation team at 31 weeks EGA due to persistent AF-RVR (rate 180-200) and worsening physical status (NYHA Class II). TTE while in AF-RVR revealed an EF of 10% and severe MR but normal RV function. Her CARPREG 2 Score was 5, placing her at >41% risk of cardiac adverse event in the peripartum period (1). She underwent two cardioversions without success, and she was discharged home on oral diltiazem therapy.

At 36 5/7 weeks EGA she was admitted to the CV-ICU due to exacerbation of AF-RVR and worsening physical status (NYHA Class III). A decision was made to perform cesarean delivery following line placement and transition to heparin therapy. Cesarean section was performed under general endotracheal anesthesia with an ECMO team on standby. Invasive monitoring included an arterial line, transesophageal echocardiography, and a Swan-Ganz catheter. The latter was utilized to obtain a pulmonary artery pulsatility index (PAPi). Her PAPi was greater than one, indicating the need for right heart support with milrinone and epinephrine (2).

She delivered a healthy male infant with Apgar scores of 9 and 9. EBL was 500 mL and she was transferred intubated to the CV-ICU. Postpartum hypotension and AF-RVR were managed with epinephrine, amiodarone and milrinone infusions. She underwent successful TEE and cardioversion that day, and she was extubated on postpartum day 1. She was discharged home in sinus rhythm on postpartum day 7. A cardiac MRI eight weeks after delivery revealed her to be in sinus rhythm with an EF of 50%.

### DISCUSSION

Exacerbations of AF-RVR can be very difficult to manage in parturients, particularly in the setting of peripartum cardiomyopathy (3). Approximately 20% of parturients with supraventricular arrhythmias will experience an exacerbation during their pregnancy, and cardioversion is frequently unsuccessful if these exacerbations are precipitated by volume overload (4). As demonstrated in this case report, optimal outcomes for mother and baby are best achieved through early coordination of care by a peripartum navigation team.

[Management And Cesarean Delivery Of A Parturient With Refractory AF-RVR And Severe Peripartum Cardiomyopathy - Figure 1.pdf](#)

Abstract #: SAT-CP – Room 1 – 12

## Severe Factor XI Deficiency in a Jehovah's Witness Parturient

Presenting Author: Shradha D. Khadge, MD

Presenting Author's Institution: Cedars-Sinai Medical Center - West Hollywood, California

### Introduction:

Factor XI (FXI) deficiency, also known as Hemophilia C, is a rare, autosomal recessive disorder with a variable phenotype with bleeding diathesis in some, but not all. Factor level correlates poorly with bleeding risk, even with a prolonged PTT. A positive bleeding history is the strongest predictor of postpartum hemorrhage. Treatment is FXI replacement with FXI concentrate (UK, France) or fresh frozen plasma (FFP), activating intrinsic clotting pathway beyond FXI with recombinant Factor VIIa (rFVIIa) and prevention of clot lysis with tranexamic acid (TXA). Management may be further complicated by refusal of human blood products.

### Case:

37 y.o. G1P0 with PMH severe FXI deficiency and bleeding with: heavy menses, dental procedures, and gum bleeding with brushing. Prenatal FXI activity level < 1% (severe deficiency) and PTT 85. She was followed in Interdisciplinary Conference, including Hematology and Ethics for high-risk bleeding/refusal blood (Jehovah's Witness). Induced at 39 weeks. Admission FXI level 11%, PTT 67, and hematocrit 35. Our Jehovah's Witness refusal form lists for checkoff all specific components; she refused all human blood products, but accepted rFVIIa, cell salvage, and hetastarch. Per hematologist, the patient received TXA 1g Q6h and rFVIIa 15 mcg/kg Q6H initial prophylaxis. She received fentanyl PCA for initial pain control and continued as TEG was unavailable to evaluate adequacy of clotting for neuraxial in a timely fashion. She later went for cesarean delivery under general anesthesia. There were no issues with uterine tone or surgical site bleeding. She was continued on TXA and rFVIIa for 72h after delivery without bleeding nor thrombotic events.

### Discussion:

Homozygous FXI results in severe deficiency with activity level < 15% and for bleeding history prophylaxis or treatment replacement is with FFP 10-20 cc/kg (FXI concentrate not available USA). As an alternative to FFP (refusal), prophylactic TXA and low dose rFVIIa were used. Thrombotic risks may be increased, especially at higher doses (90 mg/kg) rFVIIa or replacement of FXI in addition to TXA. This case required multidisciplinary planning and consideration of many points including FXI deficiency in pregnancy, Jehovah's Witness blood refusal, use of rFVIIa, safety and alternatives to neuraxial anesthesia, FXI testing, and correlation of viscoelastic testing as a predictor of neuraxial anesthesia safety or other site bleeding. Preoperative optimization opportunities include Hb support, high-risk consultations, specialized coagulation testing and the balance between thrombin generation and clot lysis.

Abstract #: SAT-CP – Room 1 - 13

## Lymphangiomyomatosis (LAM) Complicated by Bilateral Pneumothorax in Pregnancy: A Case Report

**Presenting Author:** Michael Kim, MD

**Presenting Author's Institution:** New York Presbyterian - Columbia University Campus

**Co-Authors:** Jeanine D'Armiento, MD - Columbia University

Monica Goldklang, MD - Columbia University

Ruth Landau, M.D. - Columbia University

Katharine E. Thompson, M.D. - Columbia University

Daniel Tobes, MD - Columbia University Medical Center

### Background

Lymphangiomyomatosis (LAM) is a rare cystic lung disease seen in women of childbearing age.<sup>1</sup> Patients present with dyspnea and in addition to cystic disease on thoracic imaging, a workup may reveal pneumothorax (PTX), chylous effusion, or renal angiomyolipomas. The mTOR inhibitor sirolimus is the only FDA approved therapy.<sup>2</sup> Data suggests that most women with LAM may tolerate pregnancy, but cases in which LAM was diagnosed during pregnancy have a higher rate of respiratory complications.<sup>3-5</sup> LAM cells have estrogen and progesterone receptors that stimulate cell proliferation. LAM diagnosed during pregnancy may be a marker of more aggressive disease, and pregnancy itself may accelerate the rate of lung deterioration in LAM. We report a case diagnosed with LAM during 2nd trimester, managed by a multidisciplinary team, resulting in a successful induction of labor (IOL) with vaginal delivery at 36 weeks.

### Case

A 36 year-old G5P3013 presented to her local emergency room at 21 weeks' gestation, with progressively worsening dyspnea on exertion. PTX was diagnosed, and 1 week later she developed large bilateral PTX, requiring bilateral surgical chest tubes. Chest CT and lung biopsy confirmed the diagnosis of LAM. Sirolimus was started for active disease. At 32 weeks, she was transferred to our high-risk antepartum unit for LAM treatment, with 2 pigtail catheters. She had multiple acute hypoxic and dyspneic episodes, precipitated by chest tube malfunction. The pigtail tubes were upsized at 33 weeks to prevent tube clots, but this caused worsening pain. Escalating doses of hydromorphone were given for severe acute pain at her lung apices following each new PTX and lung re-expansion. At 34 weeks, mid-thoracic erector spinae plane (ESP) block catheters were discussed and offered, with good pain relief. She underwent IOL at 36 weeks with early combined spinal epidural analgesia and an assisted forceps vaginal delivery 6 hours later. A week later, she underwent a planned uncomplicated bilateral video assisted thoracoscopic pleurectomy and talc pleurodesis (under general anesthesia with a thoracic epidural for post-operative pain management).

### Discussion

Peripartum care of patients with LAM requires a multidisciplinary team able to coordinate LAM care, thoracic surgical care, analgesia for both labor and pain associated with chest tubes and PTX, and high-risk obstetric care. This patient's care for over 4 weeks required an immense amount of effort from each team involved, especially when dealing with unexpected complications related to PTX and pain management. The combination of continuous monitoring, specialized care teams (LAM treatment specialists, maternal fetal medicine, thoracic surgery, obstetric anesthesiology, acute pain), and shared decision making facilitated an optimal outcome for this patient.

## Delayed Postpartum Hemorrhage in a Parturient with Glanzmann Thrombasthenia

**Presenting Author:** Brian D. Taussig, MD

**Presenting Author's Institution:** Icahn School of Medicine at Mount Sinai - New York, New York

**Co-Authors:** Yaakov Beilin, MD - Icahn School of Medicine at Mount Sinai

Glanzmann thrombasthenia (GT) is a rare autosomal recessive bleeding disorder with an incidence of 1 in 1,000,000. Several subtypes exist, but they all result in either deficient or dysfunctional GIIb/IIIa glycoprotein, which manifests as impaired platelet aggregation.<sup>1</sup> Because clot formation is compromised, the parturient with GT presents several unique challenges to the anesthesiologist. Here, we present the peripartum management of a 23 year-old G2P0010 with GT.

The parturient initially presented for anesthesia consultation at 33 weeks gestation. History revealed significant bleeding including epistaxis and menorrhagia requiring platelet transfusion. ROTEM revealed prolonged clotting time and clot formation time and a reduced alpha angle. After interdisciplinary planning with obstetrics, blood bank, and hematology, cesarean delivery was planned for 37 weeks gestation with a 3-day course of PO tranexamic acid (TXA) prior to admission. On the day of the procedure, she received two packs of pooled HLA-matched platelets and 1 gram of IV TXA prior to skin incision. Recombinant factor VIIa and DDAVP were readily available in the event of refractory hemorrhage. Following placement of two large bore peripheral IVs and an arterial line general anesthesia was induced uneventfully. After delivery, carboprost and misoprostol were administered in addition to oxytocin. An additional pack of pooled platelets was administered for oozing with subsequent hemostasis and wound closure. The quantitative blood loss was 788 mL and the patient was extubated without issue. A prolonged postpartum hospitalization was planned given her increased risk of delayed PPH and she was discharged home on PPD7.

She represented on PPD15 with symptomatic anemia secondary to vaginal bleeding and was transfused two units of pRBCs and two packs of pooled platelets. Emergent uterine artery embolization was performed followed by placement of a Bakri balloon. She was transferred to the ICU postoperatively and extubated on POD1. She was placed on TXA and methylergonovine series at that time. On POD2, she received one pack of platelets, one unit of pRBCs, and DDAVP just prior to serial deflation of her Bakri balloon, and subsequently discharged home on POD4.

This case illustrates the importance of multidisciplinary pre-delivery planning and postpartum bleeding surveillance for the parturient with GT. Neuraxial anesthesia and transversus abdominis plane blocks were contraindicated in this patient, and prophylactic platelet and antifibrinolytic administration were critical in preventing hemodynamically significant hemorrhage in the immediate perioperative period. Despite these interventions, the patient suffered a PPH on day 15 requiring blood product resuscitation and surgical intervention, which ultimately resulted in sustained hemostasis and a full recovery.

Abstract #: SAT-CP – Room 1 - 15

## Neurocovid in the Peripartum Period

Presenting Author: Monique Osigbeme, MD

Presenting Author's Institution: Vanderbilt University Medical Center

### Introduction:

Although COVID-19 is conventionally represented as a febrile illness with respiratory involvement, unusual sequela such as sensory inhibition and vasculitis have also been reported.<sup>1</sup> In fact, up to 40%–88% of patients with severe COVID-19 are reported to present with neurological symptoms, such as neurodegeneration, neuroinflammation and demyelination signs.<sup>2</sup> The physiologic impacts of pregnancy may exacerbate the severity of these neurologic symptoms and presents diagnostic and therapeutic challenges in the parturient.

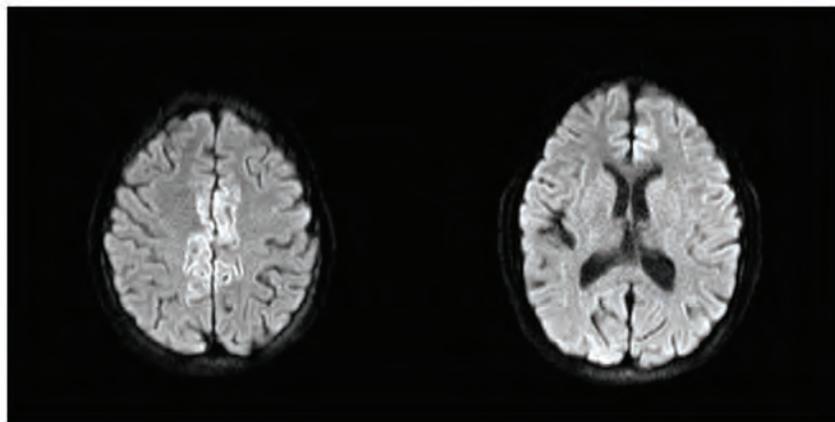
### Case:

A 16-year-old G1P0 at 30 weeks presented to the Intensive Care Unit with sepsis and respiratory failure secondary to COVID-19 with superimposed pneumonia. She was treated with remdesivir, steroids, antibiotics, and subsequently recovered and discharged home.

At 33w5d, she was readmitted with tonic-clonic seizures. Magnetic Resonance Imaging of the brain demonstrated symmetric cortical diffusion restriction of the frontal lobes, likely representing sequela of acute seizures, which was confirmed via electroencephalogram monitoring. Subsequent labs were unremarkable. Although eclampsia was strongly considered, the differential was broadened after the patient began to exhibit an unusual presentation of bilateral ascending paralysis that progressed to respiratory failure requiring intubation. Without a clear etiology, multiple specialties became involved to help assist in diagnosis, which ultimately was attributed to a neurologic presentation of COVID. On hospital day 6, a cesarean delivery was indicated due to worsening critical condition and nonreassuring fetal status. The delivery was uncomplicated, and the patient was able to wean toward extubation by the following day. Her clinical course postoperatively was complicated by frontal lobe infarct, continued weakness, delirium, and abnormal behavior requiring antipsychotic therapy. With some clinical improvement, she was discharged on hospital day 24 to an inpatient rehabilitation facility with aspirin, levetiracetam, and verapamil.

### Discussion points:

1. Review the most recent COVID data on its presentation and severity in parturients compared to the general population.
2. Discuss the expected course, treatment options, and recovery from neurologic COVID.
3. Consider the differential diagnoses for seizure and ascending paralysis in pregnancy.



## Successful Antepartum De-labelling of Local Anesthetic Allergy in a Parturient with a Self-Reported Allergy to Amide and Ester Local Anesthetics

**Presenting Author:** Eduardo Yamaguchi, MD

**Presenting Author's Institution:** BC Women's Hospital - Vancouver, BC - Vancouver, British Columbia

**Co-Authors:** Anthony Chau, MD FRCPC MSc - BC Women's Hospital, University of British Columbia

Robert Ffrench O'Carroll, MBCh BAO, MSc, FCAI - National Maternity Hospital, Dublin, Ireland

Roanne Preston, MD FRCPC - BC Women's Hospital - Vancouver, BC

**Introduction:** Obstetric anesthesiologists may be reluctant to offer neuraxial techniques in a parturient with history of possible local anesthetic (LA) allergy, for fear of precipitating an anaphylactic reaction. Here, we report a successful antepartum skin testing protocol in a pregnant woman with a self-reported allergy to amide and ester LA, who strongly desired neuraxial labor analgesia.

**Case Report:** A 30-year-old G1P0 healthy woman was referred at 32 weeks for antepartum anesthesia consultation for labor analgesia options in the context of a history of amide and ester LA allergy. The patient was told by her mother she had a childhood reaction, where she developed hypotension and shortness of breath after receiving lidocaine and procaine injections for dental procedures in another country. She did not recall developing angioedema or sudden onset of urticaria during these procedures. More details around the event could not be obtained. Given the unclear reaction history, the remoteness of the event, and the patient's strong desire for neuraxial anesthesia, we discussed the possibility for antepartum skin testing at 37 weeks gestation. The associated risks of the procedure were discussed and the patient was motivated to proceed. A protocol (Fig 1) was developed in consultation with an obstetrician and an allergist who perform routine penicillin skin testing for pregnant patients at our hospital.(1) Emergency resources in case of anaphylaxis, including an obstetrician and an operating room ready for emergency cesarean delivery were organized. Standard monitors and fetal heart monitoring were applied. Skin testing started in the contralateral forearm of the intravenous line, in two separate rows using a saline control, increasing the concentration of lidocaine every 15 min. (see Fig 1) The patient had a negative skin testing for lidocaine and was discharged home. At 38 weeks, the patient returned in active labor and delivered a healthy baby under epidural analgesia uneventfully. The patient reported high satisfaction as depicted by her own words: "I hope [reporting this experience] will be helpful and useful for others as the actual test was for me. Having an epidural gave me extra break, sleep and strength to go with the labor. Can't imagine now what I would do if I did not have it".

### Discussion:

True IgE-mediated allergy to LA is rare (< 1%).(2) Skin testing for allergy performed by anesthesiologists in the obstetric population remains controversial by the potential to expose the parturient to the risks of anaphylaxis and emergency delivery.(3) Conversely, under conditions in which the history suggest low likelihood of reaction and a motivated patient who understands the risks involved, intradermal skin testing by the anesthesiology team was feasible with an excellent patient outcome and satisfaction.

[AbstractFIGUREfinal03FEB2022.pdf](#)

Abstract #: SAT-CP – Room 1 - 17

**Acute right middle cerebral artery stroke and bilateral carotid artery dissection in a one-week postpartum patient with SARS CoV-2 infection.**

**Presenting Author:** Katelyn T. Scharf, MD

**Presenting Author's Institution:** University of Maryland School of Medicine

A 41-year-old Hispanic G8P2062 at 39 weeks 2 days gestation with a history of gestational diabetes, obesity underwent a spontaneous vaginal delivery with an uncomplicated epidural for labor and delivery analgesia and immediate postpartum tubal ligation.

On postpartum day seven, she presented to the emergency department with left upper and lower extremity weakness and a left-sided facial droop; vital signs were stable. She was incidentally found to be COVID-19+ during routine testing with mild cold-like symptoms. Notably, she had received two recent doses of the mRNA vaccine. Her laboratory studies were significant for elevated hemoglobin A1C of 5.8%, high cholesterol (278), high low-density lipoprotein (173), and borderline high triglycerides (159).

CTA head/neck revealed evidence of early ischemia at the M1 segment of the right middle cerebral artery (MCA) as well as luminal irregularity and greater than 90% stenosis of the right and left internal carotid arteries. These findings were thought to be secondary to vascular inflammation from COVID-19. She was administered intravenous alteplase and the decision was made to undergo interventional radiology guided thrombectomy with fluoroscopy under general anesthesia. A long segment embolic occlusion of the right MCA was successfully removed, yet there remained some areas that were not able to be completely revascularized. During her hospital course, she underwent a transthoracic echocardiogram with an agitated saline study that was normal with no evidence of a right to left shunt. She was discharged home on therapeutic anticoagulation after a one-week hospitalization with persistent left-sided weakness.

COVID-19 has been established to cause a hypercoagulable state that can increase a patient's risk for a venous or arterial thromboembolic event such as a stroke even in young patients<sup>1-2</sup>.

Multiple other case reports have described spontaneous carotid artery dissections in patients with COVID-19 thought to be caused by vascular endothelial dysfunction and coagulopathy<sup>1-2</sup>. A prior case report describes cerebral vasculitis seen in a woman at one-week postpartum<sup>3</sup>; however, there are no case reports of MCA thrombus/carotid artery dissection specifically in postpartum women with COVID-19. Prompt recognition and treatment is crucial to reduce the long-term morbidity in these patients.

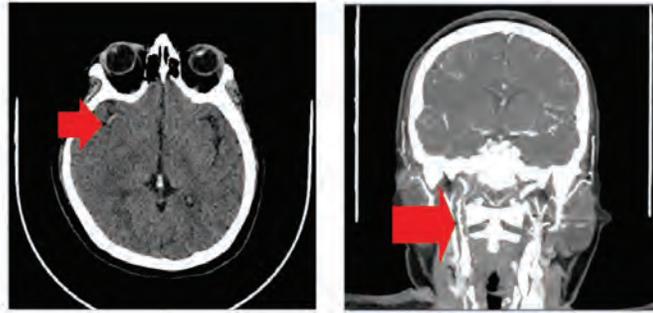


Image 1: On the left, CT head shows right MCA thrombus. On the right, CTA head and neck showing long segment non-calcified luminal irregularity and stenosis of the right internal carotid artery with greater than 90% luminal stenosis, and similar, though less severe findings in the left internal carotid artery.

**Abstract #: SAT-CP – Room 1 - 18**

**Early extra-corporeal membrane oxygenation cannulation for COVID-19 positive parturients**

**Presenting Author:** Maitri M. Shah, MD

**Presenting Author's Institution:** University of Arkansas for Medical Science - Little Rock, Arkansas

**Introduction**

Veno-venous extracorporeal membrane oxygenation (VV-ECMO) has played a significant role in the recovery of critically ill patients with COVID-19<sup>1</sup>. Although interim consensus guidelines have been released by the Extracorporeal Life Support Organization (ELSO) regarding the use of VV-ECMO in COVID-19 patients, little information is available about utilization in the COVID-19 positive pregnant population. As COVID-19 continues to evolve, resulting in a higher volume of critically ill parturients, we examine the outcomes and special considerations for these patients placed on VV-ECMO.<sup>2</sup>

**Case Series**

We present the management and outcomes of two pregnant patients presenting with acute hypoxic respiratory failure secondary to COVID-19 who were placed on VV-ECMO and survived to discharge.

The first patient is a 24-year-old G1P0 at 30 weeks and 1 day GA who presented 5 days after her initial COVID-19 diagnosis. She delivered a viable infant under neuraxial anesthesia on hospital day 1. She required intubation on hospital day 2 and was placed on VV-ECMO 3 hours after intubation. She had a 7-day ECMO run and was discharged home on hospital day 19.

The second patient is a 32-year-old G3P2002 at 26 weeks and 5 days GA who presented to our hospital one week after initial COVID-19 diagnosis. She required emergent intubation and cesarean delivery due to concern for fetal hypoxia in the setting of severe maternal hypoxia on hospital day 3. She delivered a viable infant under general anesthesia. Despite maximal ventilator support, she continued to deteriorate and was placed on VV-ECMO on hospital day 4. She had a 6-day ECMO run and was discharged home on hospital day 17.

**Conclusion**

Despite a lack of guidelines on the timing of cannulation and use of ECMO in the prenatal and postpartum patients, several case studies and case series have demonstrated positive outcomes for both cardiac and/or respiratory failure. The optimal timing for ECMO cannulation is crucial and early use as demonstrated by our single center experience led to positive maternal outcomes. Early referral to an ECMO center, with a dedicated ECMO team should be done as early as possible. A large multicenter retrospective cohort study is required to assess effectiveness of ECMO and delineate optimal cannulation time, anticoagulation and overall management of the pregnant COVID-19 patient.

Abstract #: SAT-CP – Room 1 - 19

**Bicuspid aortic valve with Aortopathy during pregnancy: coming soon to your L&D suite**

**Presenting Author:** Matthew Sikora, Fellow

**Presenting Author's Institution:** Cedars Sinai Medical Center - West Hollywood, California

**Co-Authors:** Katherine Gelber, Assistant Program Director - Cedars Sinai Medical Center

Shradha D. Khadge, MD - Cedars-Sinai Medical Center

Jatt Wichianson, Fellow - Cedars Sinai Medical Center

Mark Zakowski, Program Director - Cedars Sinai Medical Center

**Introduction:**

Bicuspid aortic valve (BAV) is the most common congenital cardiac anomaly (~1%) in newborns, with associated aortopathy in 33%, including dilatation of proximal aorta.<sup>1,2</sup> The cardiovascular stresses and hormonal changes of pregnancy increase the risk of progression of valvular diseases and aortic dilatation, with higher risk for aortic dissection and rupture, particularly in the 3rd trimester and peripartum period. Maternal BAV requires close interdisciplinary prenatal care with strict BP control and monitoring of the aortic valve and root.

**Case:**

31 y/o G1P0 with BAV Type 1, mild aortic regurgitation, and ascending aortic diameter of 4.7cm followed at high-risk interdisciplinary conference. Serial ECHOs during pregnancy showed unchanged aortic valve and root dimensions while on metoprolol 25mg QD. Functional status remained NYHA Class 1 and was intermediate risk for cardiac event per CARPREGII and ZAHARA scoring. Labor with early epidural and assisted vaginal delivery was allowed by cardiology; she desired elective cesarean. An a-line was placed prior to CSE for enhanced BP monitoring and control. Hemodynamic goals included SBP < 130 and HR < 60 to minimize shear stress. Cesarean and PACU course were routine. Echo POD#1 was unchanged, and discharged POD#3. On POD#5 she presented to ED with hypertension and pre-eclampsia was ruled out. A calcium channel blocker, amlodipine, was added for BP control. Echo at 3 months remained unchanged.

**Discussion:**

Of the 1% with BAV at birth, 91% of bicuspid valves have one raphe (line of fusion), but the aortic orifice is often asymmetrical, causing flow stress over time<sup>1</sup>. Aortopathy may include dilated root, aneurysm, aortic dissection and coarctation<sup>2</sup>. Surgery is indicated: a) aortic aneurysm is >4.5cm and patient symptomatic, b) asymptomatic and aneurysm is >5.0 cm or C) aneurysm grows >0.5 cm in one year.<sup>3</sup> Parturients with BAV and aortopathy require interdisciplinary consultation and close monitoring, especially in the 3<sup>rd</sup> trimester and post-partum, during the period of maximal hemodynamic stress and disease progression.<sup>4</sup> Most are on beta blockers to reduce cardiac contractility and aortic root shear forces to decrease chances for progression, aneurysm formation/dissection or rupture.

**Transfusion Exclusion with Dwindling Perfusion: Management of Postpartum Hemorrhage and Severe Anemia in a Jehovah's Witness Patient**

**Presenting Author:** Samantha Sohnen, MD

**Presenting Author's Institution:** Dartmouth-Hitchcock Medical Center

**Co-Authors:** Johanna Cobb, MD - Dartmouth-Hitchcock Medical Center

Wandana Joshi, DO - Dartmouth-Hitchcock Medical Center

Jonathan Weed, MD - Dartmouth-Hitchcock Medical Center

**Introduction:** Postpartum hemorrhage, defined as at least 1L blood loss within 24 hours of delivery, impacts 3-5% of obstetric patients and is a leading cause of maternal death, contributing to 25% of worldwide maternal deaths and 12% of American maternal deaths.<sup>1</sup> In the US, around 12% of deliveries result in blood transfusion.<sup>2</sup> We present a Jehovah's Witness (JW) patient who refused blood transfusion and experienced a postpartum hemorrhage with a subsequent hemoglobin (Hb) nadir of 2.2 g/dL.

**Case Report:** A 36-year-old G1P0 at 40w3d JW with no significant medical history, BMI of 28, and admission Hb 13.9 g/dL presented for induction of labor. She firmly objected to blood transfusion yet would accept albumin and cell saver. After two days of labor resulting in arrest of dilation and fetal intolerance, a cesarean section was performed under epidural anesthesia and a viable female infant was delivered. Uterine atony and hemorrhage was treated with oxytocin, tranexamic acid (TXA), and methergine with good effect. Estimated blood loss (EBL) was 1.4L and 200mL of cell saver was given.

Upon return to her room, the patient was persistently hypotensive and required IV pressors. Recurrent uterine atony with ongoing hemorrhage was identified but refractory to initial management, prompting the decision to return to the operating room. Clearly understanding the risks, the patient remained firmly against transfusion. General anesthesia was induced, additional access was established, and an emergent hysterectomy was performed. Intraoperatively, the patient received 500mL of 5% albumin and 2L crystalloid. EBL was 1.5L, yet not enough was recovered for cell saver transfusion. An urgent ethics consultation confirmed the team's duty to abide by the patient's wishes, despite her high risk of mortality.

Immediate postoperative labs included Hb 4.7 g/dL, INR 1.7, and fibrinogen 201 mg/dL. She was extubated within several hours and pressor requirements decreased. Her severe anemia, with a nadir of 2.2 g/dL, was managed with daily IV iron, erythropoietin, vitamin B supplementation, albumin, and minimizing phlebotomy. She was unable to tolerate hyperbaric oxygen therapy and declined hemoglobin-based oxygen carrier therapy. She received enoxaparin for venous thromboembolism prophylaxis. There was no evidence of end organ injury. She was ultimately discharged home on post-op day 13 with a Hb of 7.5 g/dL.

**Discussion:** The patient's ability to tolerate such substantial blood loss can be attributed to the prompt recognition and treatment of the underlying cause, the physiologic changes with pregnancy, her baseline health, and strategies implemented to mitigate her coagulopathy, including uterotonics, TXA, cell saver, and avoiding dilution of coagulation factors. Caring for a hemorrhaging JW patient involves ethical challenges such as preserving autonomy while clearly communicating the risks of blood refusal.<sup>3</sup>

**Abstract #: SAT-CP – Room 1 - 21**

### **Moyamoya Disease in Pregnancy**

**Presenting Author:** Cassie Wernke, D.O.

**Presenting Author's Institution:** The Ohio State University Wexner Medical Center - Grandview Heights, Ohio

**Co-Authors:** Teri Gray, MD - The Ohio State University

Leslie Matthews, MD - The Ohio State University - Wexner Medical Center

Moyamoya disease is characterized by bilateral chronic, progressive occlusion of the terminal internal carotid arteries and subsequent formation of abnormal collateral vessels. Patients are predisposed to cerebrovascular events such as transient ischemic attack, intracranial hemorrhage, and cerebral ischemia. Moyamoya disease predominantly affects young women, however, the rarity of the disease has limited the evidence regarding management of the disease in pregnancy.

A 35-year-old G2P0010 female at 35w3d gestation with a past medical history of Moyamoya disease, PFO s/p repair, gestational diabetes, and multiple TIAs presented to labor and delivery as a transfer from an outside hospital for induction of labor due to gestational hypertension with severe features. The patient was induced and epidural analgesia was initiated. Neurosurgery was consulted who recommended that although there was no contra-indication to vaginal delivery, maternal valsalva could decrease cerebral perfusion pressure and lead to ischemia. The patient was offered assisted second stage labor versus primary Cesarean section and elected to attempt vaginal delivery with assisted second stage. Throughout her labor course, she required multiple treatments for severe range blood pressures. Ultimately, the patient had complete cervical dilation without fetal descent for four hours, so the decision was made to proceed with primary Cesarean delivery due to risk of maternal valsalva and inability to assist second stage at 0 station. The patient underwent uncomplicated Cesarean delivery with epidural anesthesia and was discharged on POD 3.

While the optimal method of delivery for Moyamoya patients remains controversial, it is generally agreed that hypertension, hypotension, and hyperventilation should be avoided in order to maintain cerebral blood flow (CBF) (1, 2). Regardless of whether vaginal delivery with an epidural or cesarean section with spinal anesthesia is performed, evidence indicates that risk of cerebral ischemia is low if CBF remains stable and perfusion is maintained. This may prove even more difficult in patients such as our patient above who meet criteria for hypertensive disorders of pregnancy (HDP) (3). Elevated blood pressures in these patients present a risk of intracranial hemorrhage, which carries a poor prognosis. Alternatively, it is imperative to maintain normovolemia and limit blood loss in these patients to mitigate the risk of cerebral ischemia (2). Multidisciplinary delivery planning in these patients is essential and should include an in-depth discussion of risks and benefits and collaboration between the patient, anesthesiologists, obstetricians, and neurosurgeons.

Abstract #: SAT-CP – Room 1 - 22

## Placental Reninoma: an Atypical Case of Hypertension During Pregnancy

**Presenting Author:** Bosi Zhang, MD

**Presenting Author's Institution:** Northwell

**Co-Authors:** Madina Gerasimov, MD - Northwell Health

Gregory Palleschi, MD - Northwell Health

**Introduction:** Hypertension during pregnancy is a common presentation with a broad differential that has a significant impact on clinical decision-making.

**Case Report:** A 38 year-old female G1P0 at 14 weeks gestation with a history of asthma, hypothyroidism, and PCOS presented to the ED with a new onset hypertension (180/100). The patient was admitted with a diagnosis of chronic hypertension. Twenty-four hour urine protein was 189 mg, creatinine was 0.42 mg/dL, and AST/ALT were 17 and 13 U/L. She was treated with 60 mg of nifedipine BID and discharged a few days later with a blood pressure of 147/92.

At 21 weeks, the patient returned to the ED with a blood pressure of 170/93 and was readmitted. Platelets, creatinine, and liver enzymes were unremarkable. Electrolytes were notable for potassium of 2.8 meq/L. She was started on 80 meq oral potassium daily. The patient denied headache, visual disturbances and abdominal pain. Labetalol 800 mg TID and hydralazine 25 mg QID were added to her antihypertensive regimen. Further evaluation revealed elevated renin (144 ng/mL/hr, normal 0.2-5.4 ng/mL/hr) and aldosterone (141 ng/dL, normal < 23 ng/dL). Renin levels were significantly higher than typically observed in chronic hypertension (~5-8, SD 3.5-6.3)<sup>1</sup>. Urine microscopy revealed no dysmorphic red blood cells or casts. Serologic workup for glomerulonephritis was negative. Renal doppler and CT angiogram were negative for renal artery stenosis. MRI of the abdomen was negative for adrenal masses. Renal biopsy and genetic testing were negative for structural, immune-complex, and hereditary disease.

At 33 weeks 5 days, the blood pressure became resistant to ongoing therapy. Induction of labor was initiated. The patient's blood pressure remained elevated (194/91) despite nifedipine 10 mg IR x3 and hydralazine 10/20 mg IV pushes, and an emergent cesarean section was performed. Following delivery, the patient's blood pressure decreased to 100/60, and she was transferred to the ICU on phenylephrine infusion. The patient was discharged on postpartum day 4 with a blood pressure of 155/97 on nifedipine 60 mg BID, labetalol 600 mg TID, hydralazine 25 mg QID, enalapril 2.5 mg, and oral potassium.

One month after delivery, the patient was normotensive with normalizing levels of plasma renin (1.96), aldosterone (57.5), and potassium (5.3). By 6 weeks postpartum, the patient stopped her blood pressure medications, reporting blood pressures of 110s/70s. Although pathological evaluation of the placenta is pending, presumed diagnosis is placental reninoma.

**Discussion:** This case illustrates some of the challenges associated with managing atypical forms of hypertension during pregnancy. It also highlights a potential role of the renin-angiotensin-aldosterone system in resistant hypertension.

Abstract #: SAT-CP – Room 1 - 23

## Refractory hypothermia following neuraxial opiate administration in the peripartum population

**Presenting Author:** Taylor Branstool, MD

**Presenting Author's Institution:** The Ohio State University Wexner Medical Center

**Co-Authors:** Megan Cook, MD - The Ohio State University - Wexner Medical Center

Rose McGahan, MD - The Ohio State University Wexner Medical Center

Geoffrey Thomas, MD - The Ohio State University Wexner Medical Center

Yun Xia, MD, PhD - The Ohio State University Wexner Medical Center

### Intro

Thermoregulation is a multivariate and complex system in human physiology. It encompasses multiple organ systems and is one of the pillars of homeostasis. Disruption of this balance can have negative side effects on patient physiology and thereby worsen patient outcomes. As such, body temperature monitoring is recommended as standard monitoring by the ASA. Neuraxial anesthetics regularly disrupt this delicate homeostasis yet are often chosen in the parturient population. The administration of these anesthetics is not without potential complications. Here we discuss refractory hypothermia following neuraxial opiate administration for cesarean delivery.

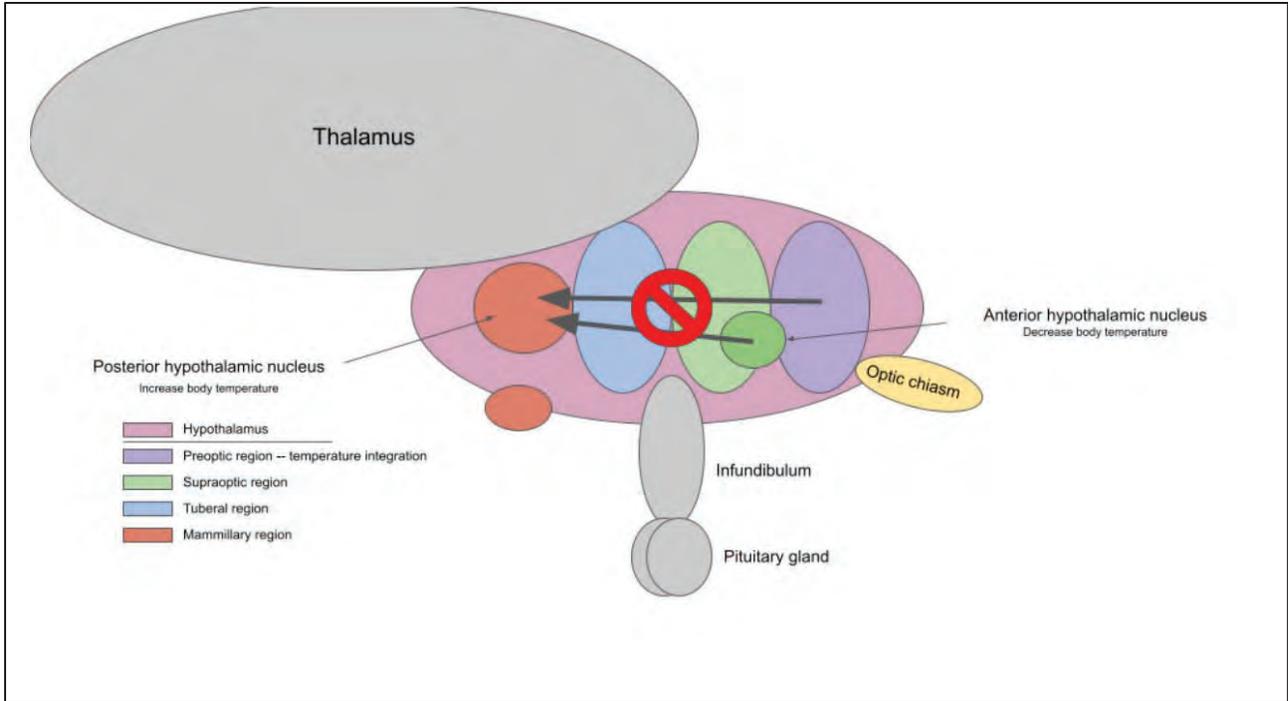
### Case

A 40 y.o. female G5P2022 at 34w0d with a past medical history of preeclampsia with severe features, gestational diabetes, chronic hepatitis B, obesity, and advanced maternal age presents for cesarean section. After appropriateness was assessed via pre-operative evaluation, a spinal anesthetic of 1.6 mL 0.75% hyperbaric bupivacaine with 0.1 mg morphine and 10 mcg fentanyl was chosen as the primary anesthetic for the case. The spinal was administered in the sitting position in the OR without difficulty. Intraoperatively the patient did not endorse any signs of hypothermia and declined warming measures when offered.

Post-operatively, the patient was taken to the post anesthesia care unit to recover. Her temperature was found to be 34.6 C sublingually upon arrival. Conservative warming measures including forced air warmer and warmed blankets were attempted for approximately 30 minutes without any significant change in body temperature. At this time 1 mg IV midazolam was administered, and conservative warming measures were continued. 15 minutes after administration of IV midazolam another sublingual temperature was checked and found to be 36.8 C.

### Discussion

While the exact mechanism of neuraxial opiate-induced hypothermia and its treatment have proven difficult to elucidate, it is postulated to involve the opiate receptors in the hypothalamus and its thermoregulatory pathways (1). Of interest, several pharmacologically distinct treatment options have been identified in the literature with varying mechanisms of action. First, IV naloxone represents a documented treatment for this type of hypothermia, likely antagonizing the opiate receptors in the hypothalamus and restoring homeostasis however at the cost of effective analgesia (2).. IV nalbuphine has also been documented as effective, likely by a similar mechanism (3). And finally PO lorazepam has been documented as being an effective treatment as well, although the mechanism remains not well understood (4). Here IV midazolam represents a pharmacologically similar treatment alternative to PO lorazepam.



Abstract #: SAT-CP – Room 1 - 24

## The Golden Hour: Intraoperative Preparation and Management for Neonatal Congenital Erythropoietic Porphyria

**Presenting Author:** Elliott C. Callahan, MD

**Presenting Author's Institution:** University of California, San Francisco - San Francisco, California

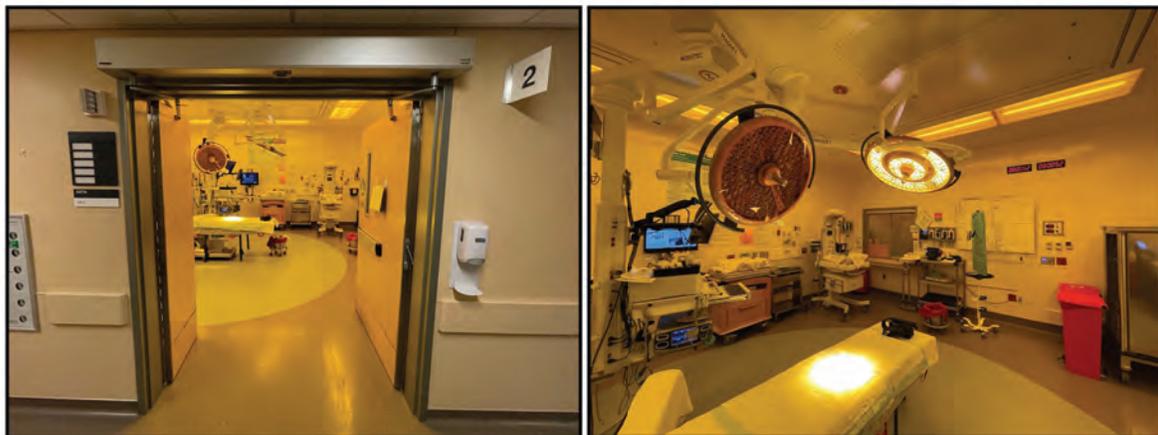
**Co-Authors:** Ronald B. George, MD FRCPC - UCSF

Won Lee, MD - University of California - San Francisco

**Background:** Congenital Erythropoietic Porphyria (CEP) is a rare autosomal recessive disorder of heme synthesis, which has multi-organ system manifestations including dermatologic sensitivity to wavelengths contained within fluorescent light.<sup>1</sup> We report a case of antenatal CEP diagnosis requiring unique, multidisciplinary peripartum coordination to avoid neonatal triggering light exposure.

**Case Presentation:** A 27-year-old G4P2 at 39-weeks gestation with prior history of cesarean delivery (CD) for breech presentation was referred to OB anesthesia clinic in preparation for repeat CD in the setting of fetal diagnosis of CEP. Given one of her previous children was diagnosed with CEP, she underwent amniocentesis in this pregnancy, which resulted with the same fetal CEP genotype. We collaborated with neonatology and maternal and fetal medicine to develop a delivery plan. Amber filters were installed over operating room (OR) fluorescent and overhead lights to facilitate skin-to-skin while ensuring safety of the newborn. The patient underwent an uncomplicated CD under spinal anesthetic. She and baby recovered from anesthesia in the operating room and were then admitted to the postpartum unit with appropriate light shielding.

**Discussion:** CEP is caused by an inherited defect in the enzyme uroporphyrinogen III synthase, resulting in accumulation of photoreactive porphyrin species in peripheral tissues, which—when exposed to light in the range of 400-410 nm (blue to near ultraviolet)—cause free radical formation and cellular damage.<sup>1</sup> This can lead to blistering and disfiguration. Previous case reports have described application of filters to fluorescent OR lamps,<sup>2</sup> covering patients with drapes, and recovery in dimly lit rooms.<sup>3</sup> We used yellow filters (Amber 81, Madico, Pinellas Park, Florida, USA) rated to block blue and near-ultraviolet light to 500 nm applied to fluorescent lights and OR overhead lights. Light emitted from anesthesia machines and monitors was deemed safe and remained unshielded. A shielded isolette was secured for neonatal transport, but the baby was transported to our postpartum unit protected with blankets.



Abstract #: SAT-CP – Room 1 - 25

## Differential Diagnosis and Management of Seizures During Cesarean Section

**Presenting Author:** Casey Cuccio, DO

**Presenting Author's Institution:** UCONN anesthesiology residency program - Glastonbury, Connecticut

**Co-Authors:** Joanna Ghobrial, DO - UCONN anesthesiology residency program

Vasilije Mijovic, MD - UCONN anesthesiology residency program

**Background:** Preeclampsia occurs in 2-6% of healthy nulliparous females in the United States, with eclampsia occurring in 0.3%. Eclampsia is defined as the new onset of seizures and/or unexplained coma during pregnancy or postpartum in patients with pre-eclampsia, but without pre-existing neurological deficit (1). Anesthetic management principles for eclampsia are similar to those for severe preeclampsia. However the distinguishing feature is seizure control, with particular attention to signs of increased ICP, focal deficits and airway protection (2).

**Case:** We present a case of a 34 year old female G3P0111 who presented at 31 weeks gestation to the ED after a witnessed tonic-clonic seizure. Her pregnancy was complicated with two episodes of loss of consciousness, both at 29 weeks gestation. On presentation she appeared to be in the postictal state, with a blood pressure of 160/90, and normal laboratory results including CBC, CMP, and coagulation panel. She was admitted to L&D and started on magnesium, including a bolus followed by a maintenance dose. Hypertensive episodes were treated with Labetalol and Hydralazine. Neurology was consulted to evaluate any underlying condition causing seizures. MRI and EEG were unremarkable. Eclampsia was established as the principal diagnosis and the patient promptly underwent a C-section. Given that platelets and a coagulation panel were within normal limits, the patient received a spinal anesthetic. Shortly after the block, the patient became unresponsive with unobtainable blood pressure. She was immediately intubated and an arterial line was placed. Magnesium-sulfate was discontinued, due to concern for possible toxicity. At the end of the case, the patient was transferred to the ICU given that her pH was 7.0 and she had an episode of SVT which resolved with vagal maneuvers. ICU labs were unremarkable, besides elevated prolactin which suggested a postictal state. She was extubated the next day and transferred to the medical floor. She was discharged on post op day 4 without complications.

**Discussion:** Differential diagnoses for this case included eclampsia, high spinal and underlying seizure disorder. Amniotic fluid embolism was less likely given that the seizure occurred before delivery of the baby. Since the patient presented with hypertension and neurological workup was negative, eclampsia was our leading diagnosis. Any patient seizing intrapartum should be considered to have eclampsia, however, other disorders must be ruled out. Early airway protection, aggressive blood pressure control and magnesium sulfate are essential interventions for successful recovery and prevention of irreversible deficit or death.

Abstract #: SAT-RFCP – Room 2 - 01

## Primary Mediastinal B cell lymphoma (PMBL) - Timing of Treatment and Contraception Counseling During Pregnancy

**Presenting Author:** Dhruv Choudhry, M.D.

**Presenting Author's Institution:** Ochsner Health - New Orleans, Louisiana

**Co-Authors:** Adrienne Ray, M.D., n/a - Ochsner Health

Melissa Russo, M.D. - Ochsner Health

### Introduction

The diagnosis of cancer during pregnancy is extremely distressing for a patient and her caregivers. The management of these patients is complex due to the time sensitive nature of treating life threatening disease yet minimizing harm to the fetus (1). Primary Mediastinal B cell lymphoma (PMBL) is a rare form of non Hodgkins Lymphoma that predominantly occurs in females.

### Case Presentation

Our patient is a 25 yo with history of PMBL. She initially received full treatment with R-CHOP. Prior to receiving radiation, a screening UPT was positive. She ultimately had a SAB and subsequently decided against radiation therapy. After three years in remission, an internal mammary mass was noted on CT. She was referred to CT surgery for a VATS, but again was pregnant. She initially decided to defer treatment until after the pregnancy, but at 24 wks she presented with cough and SOB. MRI showed progression of the mediastinal mass. Given her worsening of symptoms, the decision was made to proceed with urgent VATS. The procedure was managed by both OB and cardiac anesthesia and was completed without complication. The patient's health continued to decline and she was hospitalized with respiratory failure and pleural effusions. The patient and her husband rejected placement of a pleurex catheter and were hoping to proceed with cesarean section. During this hospitalization our patient went into preterm labor on the oncology floor at 29 4/7wks. Fortunately, the MFM attending physician was rounding on the patient and managed the spontaneous vaginal delivery of a viable infant. Our patient was discharged a few days after delivery, but she was ultimately re-hospitalized on more than one occasion and passed away secondary to hypoxic respiratory failure in the ICU approximately 3 mo postpartum.

### Discussion

The management of PMBL during pregnancy is complex involving ethical dilemmas and requiring multidisciplinary care. The goal of minimizing radiation and teratogens to the developing fetus often delays necessary treatment and may account for the high incidence of advanced disease in such patients. For women with cancer, counseling and contraceptive measures aiding in the postponement of pregnancy should be offered and individualized for each patient based on the progression of disease, prognosis, and treatment (3).

Abstract #: SAT-CP – Room 2 - 02

## Anesthetic Management for Cesarean Delivery of a Parturient with COVID-19 Infection while on Extracorporeal Membrane Oxygen Support

**Presenting Author:** Samantha Rubright, MD

**Presenting Author's Institution:** Duke University Medical Center - Durham, North Carolina

**Co-Authors:** Matthew Buck, MD - Duke University Medical Center

**Introduction:** COVID-19 infection can cause Acute Respiratory Distress Syndrome (ARDS), sometimes requiring ventilatory and circulatory support. With the physiologic changes of pregnancy, parturients are especially vulnerable to severe disease. Case reports have demonstrated that extracorporeal membrane oxygen (ECMO) support is effective in these patients but can lead to difficult medical and ethical decision-making regarding delivery planning and maternal and fetal well-being.

**Case:** A 25-year-old G1P0 with BMI of 53 kg/m<sup>2</sup> presented at 26 weeks gestation with acute respiratory failure due to COVID-19. Despite treatment, she required intubation and ECMO cannulation by hospital day seven. Her ICU course was further complicated by preeclampsia with severe features, requiring multiple infusions to control her blood pressure. On hospital day 15, given her tenuous respiratory status, ECMO requirement, and worsening preeclampsia, the multidisciplinary decision was made to proceed with urgent Cesarean delivery (CD). The patient was now at 28 weeks gestation and intermittent fetal monitoring was reassuring.

The patient was transported to the operating room where she was maintained under total IV anesthesia while on a portable ICU ventilator and ECMO support. Her starting hemoglobin was 7.1 g/dL, and she was transfused 3 units of red blood cells prior to incision. After delivery of the neonate, a high-dose oxytocin infusion was started and one gram of tranexamic acid was given. Hysterotomy was rapidly closed and a B-lynch suture was placed. A prophylactic Bakri balloon was inserted and left deflated in case of postpartum hemorrhage. She remained hemodynamically stable throughout the case.

After delivery, the patient's respiratory and hemodynamic parameters improved. She was decannulated from ECMO on post-operative day (POD) 5, and discharged home with tracheostomy on POD 15. The infant required chest compressions and intubation at delivery, but was ultimately discharged home at 48 days old.

**Discussion:** Even prior to the COVID-19 pandemic, ARDS was the most common indication for peripartum ECMO, with almost 80% of patients surviving<sup>1</sup>. It has also been shown that respiratory parameters in ventilated ICU parturients tend to improve after delivery<sup>2</sup>.

In our case, the patient's preeclampsia with severe features and respiratory status both improved after CD. However, the decision to proceed with delivery and potential maternal benefit must be balanced with the acute stress of surgery, hemodynamic changes, bleeding risk, and fetal well-being. Thus, a multidisciplinary team approach is necessary to best determine the timing of delivery and ensure the safety of these patients.

Abstract #: SAT-CP – Room 2 - 03

### Atrial Fibrillation as Maternal Presentation of Mirror Syndrome

**Presenting Author:** Alexander G. Samworth, MD

**Presenting Author's Institution:** McGaw Medical Center of Northwestern University

Mirror syndrome describes the rare phenomenon of fetal hydrops leading to maternal edema. Likely underdiagnosed, the true incidence of mirror syndrome is unclear.(1) Its pathophysiology is not well understood, though recent evidence suggests that altered placental function likely plays a role.(2) Common maternal symptoms include weight gain and edema, hypertension, and proteinuria.

A 36-year-old G2P1001 at 35 weeks gestation with no past medical history presented after minor abdominal trauma. Initial evaluation revealed new onset polyhydramnios and fetal hydrops. All prior fetal studies had been normal. She reported a ten-pound weight gain and new onset bilateral lower extremity edema that began a week prior to presentation. Imaging confirmed fetal hydrops with pericardial effusion, pleural effusions, and ascites. One day after admission, the patient experienced acute onset palpitations with worsening lower extremity edema. ECG revealed atrial fibrillation with a rapid ventricular response of 140-160 beats/min. Rate control was initiated with a beta-blocker. Blood work revealed an elevated B-type natriuretic peptide while other lab studies were normal. Maternal echocardiogram was obtained with evidence of intravascular overload, normal biventricular function, and a structurally normal heart. A CTA of the pulmonary arteries excluded pulmonary embolism.

Maternal optimization was accomplished with diuretic administration and further rate control was achieved with a diltiazem infusion. She then underwent a cesarean delivery under spinal anesthesia which proceeded uneventfully. Upon delivery, the newborn required intubation, paracentesis, and was taken to the NICU in stable condition. On post-operative day one our patient reverted to normal sinus rhythm. She was discharged with a Holter monitor on post-operative day four.

This is the first case report with arrhythmia as a primary maternal symptom of mirror syndrome. Atrial fibrillation is uncommon during pregnancy and treatment options depend on hemodynamic stability, underlying cardiopulmonary pathology, and gestational age.(3) Volume overload leads to atrial wall stress and neurohormonal changes that can trigger atrial fibrillation. In this case with new onset fetal hydrops, maternal edema, and maternal atrial fibrillation related to hypervolemia, mirror syndrome was the most likely unifying diagnosis.

Care of patients with mirror syndrome focuses on managing maternal symptoms and treating the underlying fetal pathology. When fetal intervention is not an option, delivery of the fetus should be prioritized as it has been shown to improve fetal survival.(4) In this case, expedient optimization of maternal symptoms with ventricular rate control and diuretic administration facilitated a safe delivery leading to good maternal and fetal outcomes.

[POWERPOINT HANDOUTS WILL GO HERE]

Abstract #: SAT-RFCP – Room 2 - 04

## Thrombotic Thrombocytopenic Purpura in a Parturient Leading to Life Threatening Thrombocytopenia and Fetal Demise

**Presenting Author:** Amnon A. Berger, MD, PhD

**Presenting Author's Institution:** Beth Israel Deaconess Medical Center - Westwood, Massachusetts

**Introduction:** Thrombocytopenia complicates 12% of pregnancies.<sup>1</sup> Common causes include gestational thrombocytopenia, preeclampsia with severe features (sPRE), and immune thrombocytopenia. Although thrombotic thrombocytopenia (TTP) is rare, it is a life-threatening disease with multiple ischemic end-organ effects.<sup>2</sup> TTP is caused by a deficiency of ADAMTS13, a metalloprotease responsible for cleaving von Willebrand factor, and can be hereditary or acquired; the latter is usually immune-mediated and can be triggered by pregnancy.<sup>3</sup> The clinical overlap with sPRE can complicate the differential diagnosis. Prompt diagnosis and treatment is key to improving maternal and fetal outcomes.

**Case Report:** A 31 yo G3P1 at 26w3d gestation with history of Factor V Leiden and DVT on prophylactic enoxaparin presented to an outside hospital with new-onset bruising and blurry vision. Her platelet count (plt) was found to be 19,000/ $\mu$ L and she was transferred to our tertiary academic referral center. Due to thrombocytopenia and intrauterine growth restriction, an initial diagnosis of sPRE was made. Urgent cesarean delivery was recommended due to non-reassuring fetal heart rate, and OB anesthesia was consulted. In contrast to sPRE, she had mild elevation of blood pressures, normal LFTs and undetectable haptoglobin level. Two hours after admission, her plts decreased to 14,000/ $\mu$ L and peripheral blood smear demonstrated schistocytes (Figure 1a); hematology was consulted urgently and a presumptive diagnosis of TTP was made. Multidisciplinary discussion led to a shared decision with the patient to defer cesarean delivery given increased maternal risks and likely poor fetal outcome. She was started on 1 mg/kg prednisone and total plasma exchange (TPE) was initiated 12 hours after admission with an immediate increase in plts (Figure 1b). The diagnosis was later confirmed when undetectable ADAMTS13 levels resulted with positive antibodies. On her third hospital day, plts recovered to >150,000/ $\mu$ L and she delivered vaginally with, unfortunately, fetal demise. She was transitioned to rituximab, continues to receive care from hematology and remains in good health.

**Discussion:** Thrombocytopenia is common in pregnancy. OB anesthesiologists must be intimately familiar with the differential diagnosis and treatment. Signs of end organ ischemia, extremely low plts and rapid decline in plts must be recognized. There is significant overlap between TTP and sPRE; however, treatment modalities differ significantly. Platelet transfusion is contraindicated in TTP. Importantly in our case, these hallmark signs were recognized early during evaluation by OB anesthesiologists and a multidisciplinary team was formed, including hematology and ICU. This further highlights the improved outcomes in tertiary centers with multidisciplinary care. Early intervention was likely lifesaving.

[TTP CR Figure.pdf](#)

Abstract #: SAT-RFCP – Room 2 - 05

## Management of a Parturient with Russell Silver Syndrome, Cerebral Palsy, and HELLP Syndrome

**Presenting Author:** Amy Zheng, MD

**Presenting Author's Institution:** University of Maryland School of Medicine - Baltimore, Maryland

**Co-Authors:** Shobana Bharadwaj, MBBS - University of Maryland School of Medicine

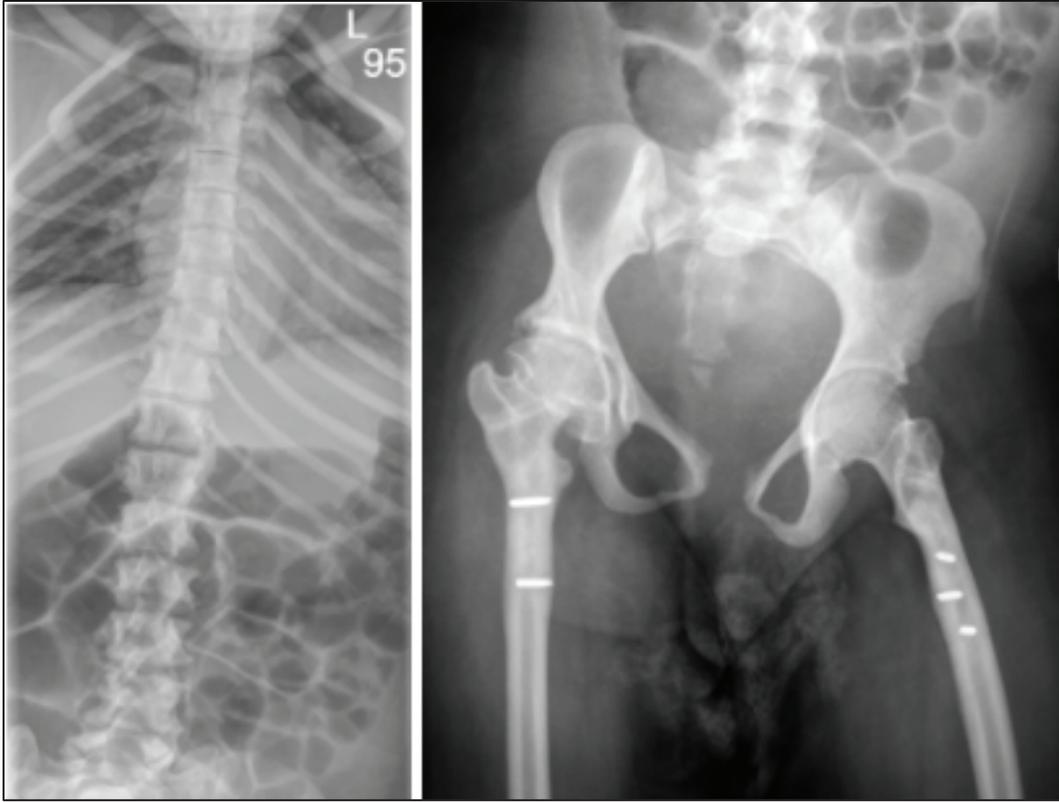
Ashlee V. Gourline, MD - University of Maryland School of Medicine

Bhavani S. Kodali, MBBS, MD - University of Maryland School of Medicine

Khang Lee, MD - University of Maryland School of Medicine

We present a 28-year-old G1P0 at 26 weeks with a past medical history of Russell-Silver Syndrome (RSS) and cerebral palsy. Physical features of her RSS included short stature, hypoplastic mandible, growth deficiency. Her cerebral palsy was characterized by lower extremity contractures and weakness, requiring a wheelchair for mobilization and deep venous thrombosis prophylaxis with enoxaparin. The patient presented for evaluation of preterm labor after a routine clinic exam revealed short cervix and preterm contractions. The contractions resolved after administration of intravenous fluids; however, her laboratory findings were significant for preeclampsia. Over the course of her hospital stay, new-onset pulmonary edema requiring supplemental oxygen, worsening thrombocytopenia, and transaminitis raised concerns for HELLP syndrome, prompting cesarean delivery. General endotracheal anesthesia was required in the setting of her coagulopathy that involved prudent airway management with video laryngoscope and rapid sequence induction with rocuronium- due to the risk of hyperkalemia with succinylcholine. Management necessitated awareness of judicious medication administration related to patient size, as well as recognition of endocrine/metabolic associated complications of RSS. The patient made an uneventful recovery and was discharged on postoperative day 5 while the premature neonate with APGAR Score of 4- 9 was admitted to the neonatal ICU.

Russell Silver syndrome is a rare congenital disorder associated with dwarfism, dysmorphic facial features, intrauterine growth restriction, postnatal growth impairment, and endocrine abnormalities. A comprehensive preoperative assessment requires recognition of several facial and laryngeal anatomic alterations that can contribute to airway management challenges- including mandibular hypoplasia, frontal bossing, relative macrocephaly, and subglottic stenosis. Recognition of nutritional deficiencies and endocrinologic complications associated with RSS allows for prevention of hypoglycemia. Neuraxial anesthesia is not contraindicated, but difficult patient positioning, level of conus termination, spinal deformity, and muscle spasms during placement are the concerns. Multidisciplinary planning for investigations and delivery is essential, given the risk of requirement for cesarean delivery in the setting of cephalopelvic disproportion. This case highlights the importance of appreciating chronic conditions with significant anesthetic implications while acknowledging and planning for new-onset, high-risk obstetrics comorbidities.



**Abstract #: SAT-RFCP – Room 2 – 06**

**General Anesthesia for a Cesarean in patient with Anterior Mediastinal Mass**

**Presenting Author:** Nathaniel Liu, DO

**Presenting Author's Institution:** Hosp of Univ of PA - Philadelphia, Pennsylvania

**Co-Authors:** John Kissko, MD - Hosp of Univ of PA

Jeremy Zuckerberg, MD - Hosp of Univ of PA

Anterior mediastinal masses are a rare pathology that pose significant challenges during the perioperative period. Cesarean delivery in symptomatic patients could cause significant morbidity associated with cardiovascular collapse. Previous literature focuses on the use of neuraxial anesthesia. This case demonstrates a successful delivery under general anesthesia after a sedated topicalized intubation.

A 31-year-old female, GP1011, at 35 weeks with anterior mediastinal mass presented for delivery. The patient initially presented with new onset chest pain for 3 weeks, productive cough, orthopnea, and shortness of breath. A COVID-19 test was negative and her cough was refractory to a course of antibiotics. Diagnostic imaging revealed a large mediastinal mass found to be diffuse B-cell lymphoma. A multi-disciplinary decision was made to proceed with delivery via c-section for timely initiation of chemotherapy. Pre-operative imaging demonstrated compression of the left main bronchus and pulmonary artery but no direct cardiac compression.

Several factors influenced the decision to use general anesthesia and maintain spontaneous ventilation for intubation. First, the patient had a history of multiple failed neuraxial attempts. Second, physical exam revealed a cough that was worse lying down with increasing oxygen requirement. The concern was that neuraxial anesthesia could lead to respiratory compromise in an already tenuous patient, ultimately necessitating emergent intubation.

An arterial catheter was placed pre-induction and cardiothoracic surgery placed groin access in case of emergency ECMO. The upper airway was topicalized with nebulized lidocaine and the superior laryngeal nerve was anesthetized via direct injection. The patient was then induced with 2mg/kg of ketamine and tolerated video laryngoscopy. The initial plan was for video laryngoscopy assisted fiberoptic intubation but, with a clear view of the vocal cords on video laryngoscopy, she was intubated without fiberoptic assistance. Final ETT placement was confirmed with bronchoscopy. Delivery was uncomplicated with Apgar scores of 8 and 9. The patient spontaneously ventilated throughout the case and was extubated without issue.

This case is illustrative of how a multi-disciplinary approach can lead to safe perioperative care in complex situations. Most commonly Cesarean delivery in patients with symptomatic mediastinal masses is performed under neuraxial anesthesia. However, this case demonstrates that general anesthesia is feasible with meticulous planning and emphasis on spontaneous ventilation and may be the safer option for some patients.



Abstract #: SAT-RFCP – Room 2 – 07

## Anesthetic Management of a Parturient with Fibrosing Mediastinitis

**Presenting Author:** Monique Osigbeme, MD

**Presenting Author's Institution:** Vanderbilt University Medical Center

**Co-Authors:** Kaitlyn Brennan, DO - Vanderbilt University Medical Center

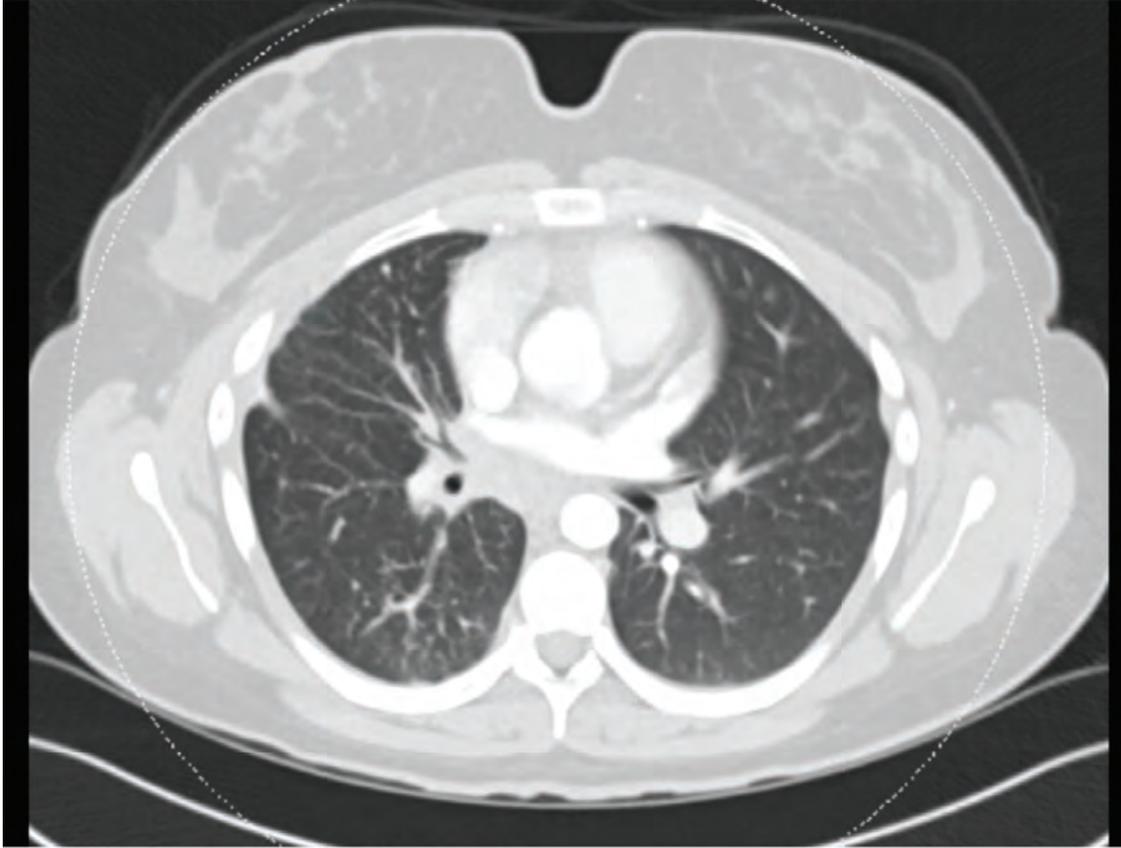
Britany L. Raymond, MD - Vanderbilt University Medical Center

**Introduction:** Fibrosing mediastinitis (FM) is a disorder characterized by extensive growth of fibroinflammatory tissue within the mediastinum and surrounding areas.<sup>1</sup> The disease process is unpredictable, with variable outcomes and controversial therapies.<sup>2</sup> FM is exceedingly rare, and information to guide anesthetic management during pregnancy is sparse. Therefore, we present our anesthetic approach to a parturient with severe bronchial and vascular involvement of FM as an example to assist future anesthesia providers caring for pregnant patients with this disease.

**Case:** A 26-year-old G1P0 with FM presented for scheduled cesarean delivery at 37 weeks. Recent CT scans showed right superior pulmonary vein obliteration and marked narrowing of her right upper pulmonary artery, resulting in complete lack of blood flow to her right upper and middle lobes. She also had significant narrowing of her left mainstem bronchus due to external compression (fig 1). Her third trimester trans thoracic echocardiogram (TTE) showed a mildly dilated right ventricle with normal biventricular systolic function.

A pre-induction arterial line was placed, followed by a low-dose combined spinal epidural with 7.5 mg of hyperbaric bupivacaine, 15mcg of fentanyl, and 0.15mg of morphine. Her anesthetic level was augmented to T4 with local anesthetic via her epidural catheter. A phenylephrine infusion was initiated, and milrinone and dobutamine were available for inotropy if clinically necessary. Her operative course was uncomplicated. However, on POD 0, she experienced a brief episode of hypoxia related to volume overload that responded well to a time-limited course of supplemental oxygen and diuresis with furosemide. She was discharged home on POD 3.

**Discussion:** Management of these patients requires a multidisciplinary team and should include anesthesiologists familiar with the management of critically-ill parturients. Recent chest imaging should be carefully reviewed, as mechanical compression of both vascular and bronchial structures can result in substantial V/Q mismatch and pulmonary hypertension (PH).<sup>3</sup> Serial TTEs are indicated throughout pregnancy to monitor for developing or worsening PH. Invasive monitoring with arterial access is reasonable, and central access can be considered, especially in patients with known PH where monitoring of right-sided pressures may be required. Inodilators such as milrinone are appropriate first-line agents to consider in the setting of developing heart failure due to autotransfusion after delivery. In extreme cases, some degree of intentional hemorrhage during this phase may also be appropriate. Common obstetric medications known to constrict the pulmonary vasculature (e.g. carboprost and methergonovine) should be avoided.



Abstract #: SAT-RFCP – Room 2 - 08

## Symptomatic Hemothorax Caused by a Ruptured Pulmonary Arteriovenous Malformation in Pregnancy

**Presenting Author:** James Damron, MD

**Presenting Author's Institution:** Vanderbilt University Medical Center - Nashville, Tennessee

**Co-Authors:**

**Introduction:** Pulmonary arteriovenous malformation (PAVM) is defined as an abnormal communication between the arterial and venous system in the pulmonary vasculature. This rare lesion is usually congenital and may be unmasked during pregnancy due to both increasing estrogen levels and increasing circulating blood volume, which in turn leads to increased blood flow through the pulmonary vasculature.<sup>1</sup> Mortality associated with symptomatic PAVM in pregnancy is as high as 11% and is mostly attributed to hemorrhage.<sup>2,3</sup> Importantly, PAVMs are sometimes associated with the presence of hereditary hemorrhagic telangiectasia (HHT).<sup>2</sup> Symptoms are non-specific and may include dyspnea, chest pain, and hypoxemia. This case highlights the clinical course of a patient with a ruptured PAVM.

**Case:** A 34yo G4P0 at 24w1d presented to the emergency department for evaluation of left upper quadrant pain. She was diagnosed with musculoskeletal pain after her obstetric workup was reassuring, however she returned 5 days later with worsening LUQ pain exacerbated by deep inspiration and palpation of her LUQ, new-onset dyspnea, and anemia. Her hemoglobin decreased from 12.5 gm/dL on initial presentation to 9.7 gm/dL on re-presentation. A chest x-ray revealed a left sided pleural effusion. A computed tomography (CT) scan of her chest revealed a 2.5cm left lower lobe AVM. A 6mm feeding artery and draining vein were noted as well as a moderate effusion with layering hypodensity consistent with an acute-on-chronic hemothorax. Her contained, ruptured pulmonary AVM was in communication with the pleural space. The lesion was embolized with a combination of coils and vascular plugs under general anesthesia with interventional radiology. (Fig 1) A surgical chest tube was placed on post-operative day (POD) 1 for residual hemothorax with 700 ml of blood immediately drained, and a thoracic epidural was placed for post-operative pain control. Her chest tube was removed on POD 3 and she was discharged home.

**Discussion:** The differential diagnosis for a patient with dyspnea in pregnancy is large and can range from commonly diagnosed conditions such as pulmonary embolus, infectious processes or simply normal dyspnea that can occur with pregnancy; to more rare causes, such as PAVM. Persistent or worsening symptoms require further evaluation. In a pregnant patient with PAVM, both increasing blood volume and estrogen levels increase the risk of rupture.<sup>2</sup> Co-existing hereditary disorders such as HHT may be present. Embolization is a reasonable treatment for PAVM during pregnancy, as risk of rupture increases as pregnancy progresses and can quickly lead to hemorrhagic shock. Recanalization after embolization can occur, and patients should be closely monitored by a multidisciplinary team for the duration of the pregnancy.<sup>1</sup>

[PAVM.pdf](#)

## Hypertriglyceridemia-Induced Acute Pancreatitis During Pregnancy: A Case Report

**Presenting Author:** Jamal Egbaria, Resident

**Presenting Author's Institution:** UAB Department of Anesthesiology

**Co-Authors:** Jared Bobulski, Resident - UAB Department of Anesthesiology

Hanna Hussey, Faculty - UAB Department of Anesthesiology

Peter Nagi, Faculty - UAB Department of Anesthesiology

**Introduction:** Hypertriglyceridemia-induced acute pancreatitis is a diagnosis characterized by severe epigastric pain often with radiation to the back, elevated amylase levels and multiple different metabolic derangements, as well as triglyceride levels greater than 500, but often times >1000. Here we report a case of a 33-year-old female who presented at 31.4 weeks gestation with an episode of hypertriglyceridemia-induced acute pancreatitis.

**Case report:** The patient is 33-year-old female at 31.4 weeks gestation who presented from an outside hospital with severe epigastric pain, triglycerides of 9294, and lab work notable for multiple metabolic derangements (sodium of 123, bicarbonate of 5, calcium of 5.6). The patient was aggressively resuscitated with IV fluids, started on an insulin infusion, and the baby was placed on a monitor and found to be in significant distress with recurrent late decelerations. Plasma exchange therapy was done urgently in hopes of improving the mother and baby's clinical state, however after therapy, the baby was still in significant distress. The decision was made to proceed with an expedited cesarean section. The most recent set of labs were notable for an INR of 1.65 (INR of 1.3 on admission), so the decision was made to forego neuraxial anesthesia and proceed with a general endotracheal anesthesia for the case. The surgery was uncomplicated, the baby had APGARs of 1 and 3 at 1 and 5 minutes, respectively, and the mother was extubated without issues. The patient was seen by the endocrinologists and had a variety of labs, including a genetic panel, drawn to assess the underlying cause for her severe hypertriglyceridemia. Ultimately, the genetic panel was negative and the patient was sent home with prescriptions for fenofibrate, niacin, icosapent ethyl and insulin for her newly diagnosed diabetes. Given the patient's desire to breastfeed, a statin was deferred upon discharge.

**Discussion/Conclusion:** Our case demonstrates that while plasma exchange therapy may be an acceptable treatment for the mother in the short term, it should not delay potential delivery if there is already evidence of late decelerations or fetal distress. The risks of delaying delivery of the baby may be too great when compared to the benefits that may come after one session of plasma exchange therapy. Additionally, it is imperative to obtain a current set of labs, including coagulation factors, as there may be alterations that significantly change the anesthetic management of the patient. Lastly, it is important for the mother to have close follow up with both the obstetrics and endocrine departments in hopes of determining the underlying cause for the elevated triglycerides and to assure appropriate medication management moving forward.

Abstract #: SAT-RFCP – Room 2 - 10

## Emergency Anesthetic Management for a Concurrent Subdural Hematoma Evacuation and C-Section in a Pregnant Trauma Patient

**Presenting Author:** Ellen G. Stallings, MD

**Presenting Author's Institution:** Vanderbilt University Medical Center - Nashville, Tennessee

**Introduction:** Trauma occurs in 1 of 12 pregnancies and is the leading cause of non-obstetric maternal mortality.<sup>1</sup> Intimate partner violence remains a primary contributor, affecting 3-9% of all parturients.<sup>1,2</sup> The presence of traumatic brain injury (TBI) in these women significantly increases the risks of morbidity and mortality.<sup>3</sup> Clinical management of TBI in this population presents unique considerations, such as the impacts of the physiologic changes of pregnancy, potentially teratogenic properties of the pharmacologic treatments for elevated intracranial pressure (ICP), and exposure to radiation or contrast during imaging, to mention a few.<sup>3</sup> Pregnant patients are a vulnerable population who are frequently excluded from TBI research; therefore, we present this case as an example to assist future anesthesia providers in the clinical management of pregnant patients with TBI and increased ICP.

**Case Report:** A 33-year-old woman with an unknown past medical history presented several hours after being found unresponsive at home as a victim of abuse. Upon arrival, her physical exam was notable for a Glasgow Coma Scale (GCS) of 3T, diffuse bruising over the torso and abdomen, burns to her left hand, and a gravid uterus. Bedside ultrasound showed positive fetal heart tones and an estimated gestational age of 28.1 weeks. Her traumagram was notable for a sternal body fracture, renal laceration, and concern for placental abruption with a thin retroplacental hematoma. Head imaging revealed a large subdural hematoma with midline shift, subarachnoid hemorrhage, and evidence of impending uncal herniation. She was taken emergently to the operating room for concurrent emergent Ceasaran delivery and left hemicraniectomy.

### Learning Objectives:

In the pregnant patient with TBI, be able to:

1. Identify aspects of maternal physiology during caesarean section that would impact a patient with elevated intracranial pressure.
2. Understand the effects of osmotic agents, temperature regulation, and use of hyperventilation as they relate to maternal and fetal morbidity and mortality.
3. Understand important factors in determining the sequence of intervention and timing as it relates to emergent delivery and craniotomy.
4. Review how intimate partner violence affects fetal and maternal outcomes.

Abstract #: SAT-RFCP – Room 2 - 11

## Management Of A Parturient With Congenital Fiber Type Disproportion Myopathy.

**Presenting Author:** Shibirath Velutha, MD

**Presenting Author's Institution:** Montefiore Medical Center

**Co-Authors:** Shamantha Reddy, MD, FASA, MD, FASA - Montefiore Medical Center

Erik B. Romanelli, MD, MPH - Montefiore Medical Center

Congenital Myopathies (CM) encompass a spectrum of inherited genetic disorders which affect muscle tone and contraction<sup>1</sup>. This case report describes a particular type of CM known as Congenital Fiber-Type Disproportion (CFTD). A 28-year-old primigravida with h/o CFTD was admitted for labor induction at 37 weeks for preeclampsia with severe features. PMH was significant for OSA on CPAP, mild asthma, chronic HTN, and sleeve gastrectomy for BMI 58.8. She reported generalized weakness, difficulty climbing down, and even combing hair. HR was 88/min, BP 160/92mmHg, RR 27/min and SpO<sub>2</sub> 93%. Airway exam revealed Mallampati class-III, adequate mouth opening, high-arched palate, TMD less than 3 fingerbreadths. Weakness of bilateral sternocleidomastoid, iliopsoas, and limitation in upward gaze was noted. CXR reported atelectasis and scoliosis. PFT demonstrated severe restrictive lung disease (FVC 1.11L) with reduced diffusion capacity. VBG reported a baseline CO<sub>2</sub> of 72.8 mmHg. ECHO revealed an EF of 65%. Levetiracetam was used instead of MgSO<sub>4</sub> for seizure prophylaxis because of concerns about respiratory depression. BiPAP was initiated with pressure support of 6 cm H<sub>2</sub>O and was titrated according to PCO<sub>2</sub> value and the patient's respiratory effort. ABGs were obtained every 2 hours. BP was managed with IV labetalol. Ultrasound-guided Dural puncture epidural was placed in a sitting position. The procedure was challenging due to her scoliosis, obesity, and bilateral iliopsoas weakness. Patient-controlled epidural analgesia was administered using 0.0625% Bupivacaine and Fentanyl 2mcg/mL at 12cc/hr. The patient received TXA and misoprostol for the risk of atony. She delivered vaginally and weaned off from BiPAP on postpartum day 1.

The incidence of CFTD is 1 in 50000. The condition is diagnosed with type 1 muscle fiber hypotrophy of at least 12% and clinical features of a myopathy<sup>2</sup>. Worsening of muscle weakness in the third trimester is attributed to rising progesterone on cellular potassium homeostasis. Severe symptoms include respiratory failure, ophthalmoplegia, dysphagia, dilated cardiomyopathy, and kyphoscoliosis<sup>3</sup>. CM patients are at risk of MH due to the possibility of RYR1 mutations, so succinylcholine and volatile anesthetics should be avoided, and an MH cart should be readily available<sup>4</sup>. Careful positioning is necessary as these patients are at higher risk of joint dislocation. Complications include; premature labor, preterm delivery, spontaneous abortion, prolonged first stage of labor, and uterine atony due to myopathy<sup>5</sup>. A multidisciplinary team approach is essential to discuss the route of delivery, method of analgesia, and anesthesia. FVC values above 1L can facilitate vaginal delivery even though there are no clear guidelines for a cut-off value.

[FVC Diagram for CFTD.pdf](#)

Abstract #: SAT-RFCP – Room 2 - 12

## Hereditary Angioedema in a Parturient who Presents for Induction of Labor

**Presenting Author:** Ioannis Angelidis, MD, MSPH

**Presenting Author's Institution:** The University of Chicago

**Co-Authors:** Jaspreet Bahia, n/a - University of Chicago

Chad Dean, MD - University of Chicago

**Introduction:** Hereditary angioedema (HA) is a rare autosomal dominant condition with an estimated prevalence of 1/50,000 to 1/100,000 individuals that results in episodes of subcutaneous and submucosal edema which can lead to life-threatening upper airway obstruction.<sup>1</sup> These episodes can occur spontaneously or be triggered by pain, stress, trauma, and estrogen.<sup>2</sup>

**Case:** 30 y/o G2P1011 female at 39 WGA who presented for induction of labor. The patient's medical history was significant for HA. During pregnancy she had increasing episodes, many of which included laryngeal edema. These were thought to be triggered by increased estrogen levels, so she was started on a pooled human plasma C1 esterase inhibitor, for prophylaxis. She was seen in our perioperative clinic to determine best management for labor. She was advised to take her C1 esterase inhibitor on the morning of induction, to bring her rescue medications with her, and to consider an early epidural. On the morning of her induction, she received a prophylactic dose of her medication and an early CSE was placed to prevent pain that could potentially trigger an episode. Labor was uneventful with a vaginal delivery of a healthy neonate.

**Discussion:** HA results from a deficiency of the C1 esterase inhibitor protein, causing unregulated activity of the complement cascade and overproduction of bradykinin that leads to edematous episodes that characterize the disease.<sup>1</sup> Treatments for the disease range from long- and short-term prophylaxis to rescue treatments for acute flares. The literature describes several cases of HA in pregnancy including two cases of uncomplicated vaginal deliveries where one received prophylactic medication and a case of uncomplicated cesarean delivery.<sup>2,3</sup> There is also a case series of 125 deliveries, where 14 received short-term prophylaxis at the time of delivery, however only 13 received prophylactic treatment prior to pregnancy.<sup>4</sup>

While there are no formal guidelines on management in patients with HA, prior evaluation and preparation by anesthesia providers is crucial, in addition to multidisciplinary delivery planning to minimize stressors. Early neuraxial analgesia should be advised, rescue treatments should be immediately available in the labor and operating rooms, and emergency airway equipment easily accessible. While the literature describes many cases of women successfully delivering without prophylactic treatment, an angioedema episode can have severe consequences in parturients whose airways may already be altered due to normal changes of pregnancy. Immediate availability of C1 inhibitor concentrates, bradykinin antagonists and kallikrein inhibitors could be lifesaving in case of an emergency.

Abstract #: SAT-RFCP – Room 2 - 13

## The Texas Heartbeat Act: Affecting the parturient one beat at a time

**Presenting Author:** Kendra Brown, MD

**Presenting Author's Institution:** McGovern Medical School at UTHealth - Houston , Texas

**Co-Authors:**

Senate Bill 8, better known as The Texas Heartbeat Act, has greatly impacted the obstetric community. This bill was passed during the 87th legislative session and went into effect September 1, 2021. Not only has this bill affected women's rights, and placed severe constraints on obtaining an abortion, it has significantly altered the medical management of the parturient.

Under this bill, physicians are prohibited from knowingly performing or inducing an abortion after approximately six weeks gestation, when a fetal heartbeat is detected. Performing an abortion after this set time period can have various legal implications for parties involved[1]. Exceptions are allowed if deemed as a "medical emergency." This includes, but not limited to cardiac disease with congestive heart failure, maternal malignancy with associated maternal symptoms, and pre-viable premature rupture of membranes (PPROM) with sepsis[2]. Here we will detail how the Heartbeat Act has influenced the obstetric and anesthetic management of the parturient. In the case described below an abortion could not be obtained until the patient began showing signs of a life-threatening infection.

34-year-old G2P1 female with Di-Di twin uterine pregnancy at 15 weeks gestation, presented with leakage of fluid, consistent with PPRM. The patient had no significant medical history and adequate prenatal care. Initial vital signs were stable and labs unremarkable. Fetal heart tones were detected on admission (Twin A: 148bpm and Twin: 154bpm).

On day two of hospitalization, she began having increased uterine tenderness, leukocytosis to 23, increased tachycardia, and was diagnosed with intra-amniotic infection in the setting of PPRM; a life-threatening infection. The appropriate documentation was made by the obstetricians, labor was medically induced with Misoprostol, with the possibility of proceeding with a dilation and curettage.

The consequences of this new bill can greatly impact the anesthesiologist's role in management of the parturient. A medical abortion was only justified as the patient started showing signs of a life-threatening infection. Infection can lead to bacteremia, affect coagulation, and potentially eliminate the ability to safely perform neuraxial anesthesia in the parturient. This case stresses the impact of legislation in management of the parturient, and the necessity for physician input and involvement early in the gestational course in order to safely provide and coordinate care.

Abstract #: SAT-RFCP – Room 2 - 14

### Severe Hyponatremia in Preeclampsia

**Presenting Author:** Ashlee V. Gourdine, MD

**Presenting Author's Institution:** University of Maryland School of Medicine - Baltimore, Maryland

**Co-Authors:** Shobana Bharadwaj, MBBS - University of Maryland School of Medicine

Bhavani S. Kodali, MBBS, MD - University of Maryland School of Medicine

Khang Lee, MD - University of Maryland School of Medicine

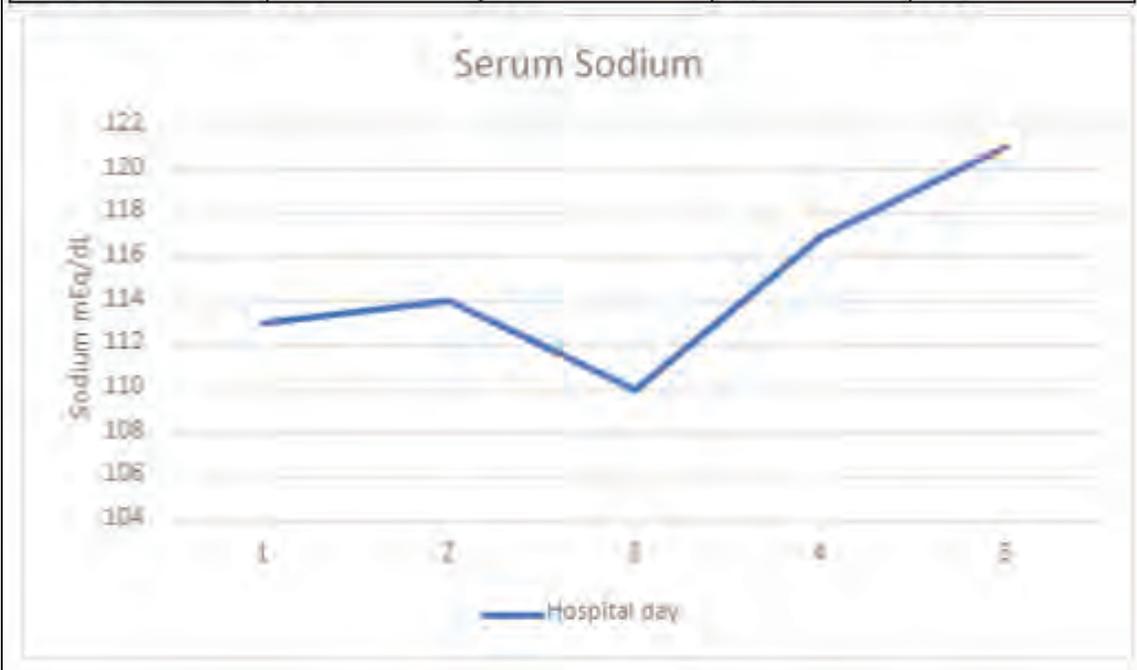
Megan McClain, MD - University of Maryland School of Medicine

We present a 35-year-old G4P0211 with a history of asthma and hypertension admitted at 31 weeks for worsening nausea, dyspnea and facial edema with a diagnosis of superimposed preeclampsia. The patient's obstetric history included two prior pregnancies complicated by preeclampsia and placental abruption- requiring cesarean delivery. The patient declined magnesium administration. Despite the administration of antihypertensives, her symptoms worsened to severe range blood pressures (170/102 mmHg), anasarca, and laboratory values significant for serum creatinine 1.42 mg/dl, sodium 110 mEq/L, and urine protein: creatinine ratio 0.823. Due to the evidence of acute renal failure and severe hyponatremia, the decision was made to deliver via cesarean delivery at 31 weeks gestation. Her intraoperative course was uncomplicated, and her infant was born with Apgar scores 8-9 and normal sodium levels.

Postoperatively, fluid restriction and measured correction of the patient's hyponatremia continued with isotonic sodium chloride, however, she soon displayed transient altered mental status. The differential diagnosis included posterior reversible encephalopathy syndrome (PRES), focal seizures, metabolic encephalopathy, and cerebrovascular accident. An emergent head computed tomography (CT) scan displayed normal anatomy without evidence of intracranial hemorrhage, infarct, cerebral edema, or mass effect. Metabolic encephalopathy in the setting of severe hyponatremia was suspected, and the patient was transferred to the intensive care unit for further management. With continued correction, the patient's severe hyponatremia improved and her management was subsequently transitioned to outpatient care.

Preeclampsia (PE) induces a multisystemic maternal syndrome that exhibits a myriad of symptoms correlated to disease severity and onset. Effective management of preeclampsia requires knowledge of associated diagnostic criteria and care guidelines as it correlates to disease progression. Mild hypovolemic hyponatremia is an expected physiologic change in pregnancy secondary to the release of human chorionic gonadotropin and oxytocin-mediated atrial natriuretic peptide secretion. Severe hyponatremia, however, is a medical emergency that is a rare complication of preeclampsia. Severe hyponatremia of preeclampsia is commonly associated with a hypervolemic state, nephrotic syndrome, and decreased inactivation of circulating anti-diuretic hormone by vasopressinase. Evaluation and management of this unique case highlights a critical comorbidity of PE, providing perioperative anesthetic considerations in multidisciplinary evaluation and treatment.

Hospital Day	Admission	Preoperative	POD 0	POD 1
Na	113	114	110	117
K	3.6	3.7	4.3	3.3
Creatinine	1.01	1.38	1.83	1.10
AST	77	80	125	131
ALT	39	41	45	44
Albumin	2.5	2.5	2.4	2.3
Serum Osmolality	237	--	--	--
Urine Osmolality	481	--	--	--
Glucose	93	78	86	108



Abstract #: SAT-RFCP – Room 2 - 15

## Anesthetic Planning for Delivery for a Patient with Titin-Truncating Variant Mutation Complicated by Complex Arrhythmia

**Presenting Author:** Elliott C. Callahan, MD

**Presenting Author's Institution:** University of California, San Francisco - San Francisco, California

**Co-Authors:** Kiana C. Nguyen, BS - University of California, San Francisco

Peter Yeh, MD - University of California, San Francisco

### Background

The protein Titin (TTN) is critical for sarcomere organization and striated muscle function. TTN-truncating variants (TTNtv) have been associated with early-onset arrhythmias.<sup>1</sup> While TTNtv have incomplete penetrance, they are the most common known genetic cause of dilated cardiomyopathy (DCM) and may be present in 10% of cases of peripartum cardiomyopathy (PPCM).<sup>2</sup>

### Case

We describe anesthetic planning and management of delivery in a patient with history of complex arrhythmia, found to have a TTNtv c.87852G >A (p.Trp29284\*).

A 27 yo G3P0 at 33w3d was referred to anesthesia clinic for history of ventricular fibrillation with sudden cardiac arrest. She was status post ICD placement and optimized on a regimen of metoprolol, quinidine and cilostazol. Her antepartum transthoracic echocardiography (TTE) was unremarkable.

A multidisciplinary team planned for induction of labor (IOL) at 39w with neuraxial anesthesia. Due to the anti-platelet effects of cilostazol, we planned to discontinue the medication 48 hours before IOL and neuraxial anesthesia, and monitor in the intensive care unit. Breakthrough arrhythmias would be managed with isoproterenol.

She presented with spontaneous rupture of membranes at 38w4d. Due to an insufficient window off cilostazol, neuraxial was eschewed in favor of remifentanyl with pudendal block for second stage analgesia. The patient had an uncomplicated delivery with no episodes of arrhythmia.

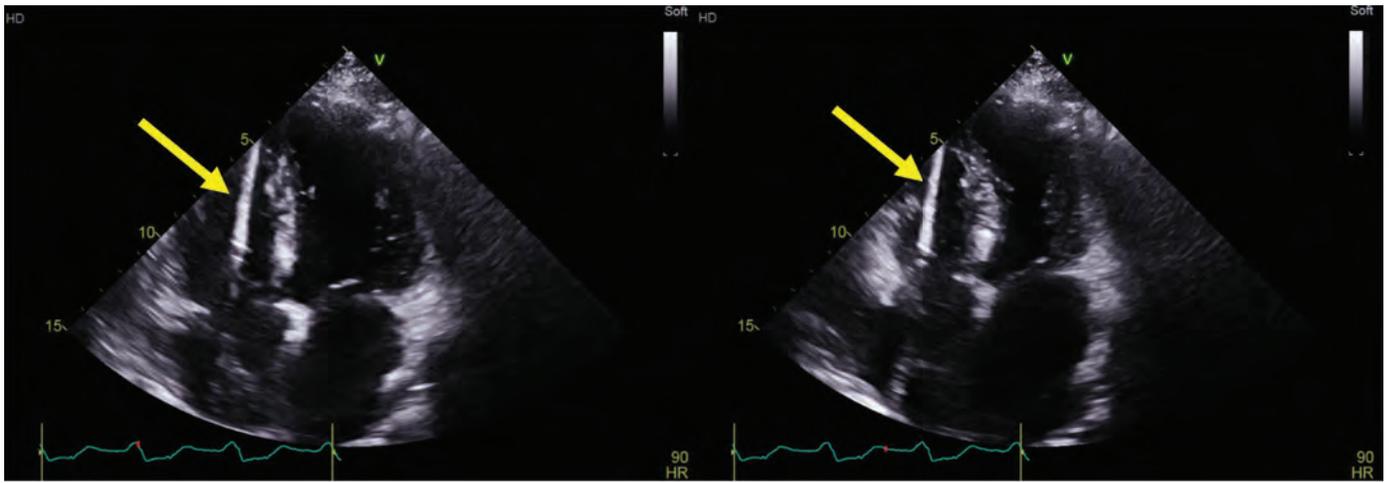
### Discussion

Pregnancy is a cardiac stressor and may constitute a "second hit" in TTNtv patients at risk for PPCM and malignant arrhythmias. They require multidisciplinary planning. In the future, cardiac magnetic resonance imaging for midwall fibrosis may help risk stratify, as it is a known predictor of arrhythmic events and device therapy in DCM.<sup>3</sup>

Cilostazol, an uncommonly encountered medication on L&D, is a phosphodiesterase III inhibitor with both anti-arrhythmic and anti-platelet aggregation effects. It is a relative contraindication to neuraxial procedures. While early epidural may be beneficial to blunt sympathetic surges for patients with history of arrhythmia, it is important to have contingency plans for management of complex patients given the unpredictability of labor.

Figure 1

30w TTE, apical 4 chamber view. End-diastole (L) and end-systole (R). Pacer/ICD lead indicated with arrow.



Abstract #: SAT-RFCP – Room 2 - 16

## Management Of Refractory Thrombocytopenia In A Parturient With Twin Gestation, Asymptomatic SARS-CoV-2 And Mild Pre-eclampsia

**Presenting Author:** Benjamin Houseman, MD, PhD, FASA

**Presenting Author's Institution:** Envision Healthcare Services

**Co-Authors:** Tilman Chambers, MD - Memorial Hospital System Department of Anesthesiology

Maria Frosth, MD - Envision Physician Services, Department of Anesthesiology

Stephan Mouhanna, BS - Florida International University College of Medicine

Amy K. Pulido, MD - Envision Physician Services, Department of Anesthesiology

Neeti Sadana, MD - Envision Physician Services, Department of Anesthesiology

Xiwen Zheng, MD - Envision Physician Services, Department of Anesthesiology

### CASE REPORT

This case report describes the peripartum management of severe, refractory thrombocytopenia in a parturient with twin gestation, mild pre-eclampsia and SARS-CoV-2 infection.

A 30-year-old G2P1001 was admitted for elective cesarean section at 37 1/7 weeks EGA due to dichorionic diamniotic twins in vertex / transverse presentation. Medical history included well-controlled asthma, HSV infection, and one prior vaginal delivery. Laboratory assessment on admission showed severe thrombocytopenia (30,000/ $\mu$ L compared to 101,000/ $\mu$ L two days before admission), mild hypertension, and proteinuria (Figure 1). She also tested positive for SARS-CoV-2 infection but had no symptoms. She had not received a SARS-CoV-2 vaccine.

The patient's thrombocytopenia did not respond to multiple platelet transfusions, multiple doses of intravenous immunoglobulin (IVIG), or stress dose steroids. Her platelet count reached a nadir of 22,000/ $\mu$ L on hospital day 2. Platelet, steroid, and IVIG administration were continued until hospital day 4, when she developed mild respiratory symptoms consistent with SARS-CoV-2 infection. To assist with management of her coagulation status, rapid thromboelastogram (TEG) analysis was performed (1). This study showed hypercoagulability with increased maximum amplitude and alpha angle.

A decision was made to perform cesarean section under general endotracheal anesthesia due to patient preference. An additional two units of platelets and a bolus dose of aminocaproic acid were administered prior to cesarean section. A healthy male (Apgar 6/8) and female infant (Apgar 7/8) were delivered with an EBL of 670 mL. The infusion of aminocaproic acid was continued for twenty-four hours. Examination of the two placentas revealed signs of systemic inflammation, gestational hypertension, and pre-eclampsia.

The patient's thrombocytopenia improved to 276,000/ $\mu$ L on postpartum day 3, and she was discharged home on postpartum day 7 following completion of remdesivir therapy.

### DISCUSSION

Both mild pre-eclampsia and SARS-CoV-2 infection likely contributed to this patient's profound thrombocytopenia and hypercoagulability (2). While a preoperative platelet count of 62,000/ $\mu$ L and TEG data supported the use of spinal anesthesia, the patient preferred general anesthesia. SARS-CoV-2 infection during pregnancy is associated with a 2.2% increase in odds ratio of developing pre-eclampsia and has been associated with ITP (3). The exact mechanism of ITP associated with COVID-19 remains a topic of debate but is thought to involve reduced production and increased destruction of platelets (4).

[Management Of Refractory Thrombocytopenia In A Parturient With Twin Gestation, Asymptomatic SARS-CoV-2 And Mild Pre-eclampsia - Figure 1.pdf](#)

Abstract #: SAT-RFCP – Room 2 – 17

## Anesthetic Considerations in a Parturient with Neurofibromatosis Type 1; A Case Report

**Presenting Author:** Candice Cuppini, MD

**Presenting Author's Institution:** The University of Chicago - Chicago, Illinois

**Co-Authors:** Ioannis Angelidis, MD, MSPH - The University of Chicago

**Background:** Neurofibromatosis type 1 (NF-1) is an inherited single gene disorder manifested by plexiform neurofibromas in a variety of locations including both the spinal cord and the larynx<sup>1</sup>. These tumors are often highly vascularized with the potential to change in size and location, generating anesthetic implications for the obstetric patient<sup>1</sup>.

**Case:** We present a case of a 29-year-old G1P0 patient with NF-1 who initially presented at 22 weeks gestation in our preoperative anesthesiology clinic for evaluation. Her past medical history also included hydrocephalus due to stenosis of aqueduct of Sylvius and she had undergone endoscopic third ventriculocisternostomy and ventricular catheter device placement for intracranial pressure (ICP) monitoring. She had plexiform cutaneous neurofibromas located in the lumbar area. Review of her MRI scans of the spine did not reveal any spinal cord neurofibromas. We recommended a repeat MRI of the spinal cord closer to delivery to evaluate for any new neurofibromas. The patient presented again at 35 weeks with premature rupture of membranes. She had not undergone the recommended imaging and the decision was made to proceed with general anesthesia. She had an uncomplicated cesarean delivery.

**Discussion:** The anesthetic management of patients with neurofibromas is varied given the multiple locations and sizes of neurofibromas. Hormonal changes in pregnancy are associated with an increase in symptoms and severity of NF-1. Puncture of these highly vascularized tumors in the spinal cord can lead to epidural hematoma, and so spinal cord imaging prior to performance of neuraxial procedures is recommended<sup>2</sup>. Neuraxial anesthesia is not a contraindication in the absence of tumors in the spinal cord<sup>2</sup>. Some of the most dangerous unrecognized conditions related to NF-1 are pheochromocytoma, vascular aneurysms and obstruction to the outflow of the right ventricle<sup>3</sup>. Hypertension is the most common consequence of these pathologies, and several deaths due to aneurysm rupture have been reported<sup>2-3</sup>. General anesthesia in NF-1 can be challenging as neurofibromas in the oropharynx or the larynx can create an unanticipated difficult airway and life threatening hypoxemia<sup>3</sup>. The majority of cases are uncomplicated; however, careful pre-operative assessment is imperative to prevent any fatal consequences<sup>2</sup>.

Abstract #: SAT-RFCP – Room 2 - 18

## Shoulder pain as an early sign of uterine rupture

Presenting Author: Preshita Date, MD

Presenting Author's Institution: Montefiore Medical Center

### Background:

Cesarean section rates worldwide have been rising (1). Concomitantly, the risk for uterine rupture has been rising as women with prior C-sections have a higher risk for uterine rupture. It is important to recognize the serious risk that uterine rupture poses and the various ways it can present. Typically, patients present with hemodynamic instability, abdominal pain, and fetal distress. We present an atypical case of a patient with uterine rupture who reported transient shoulder pain as her primary symptom.

### Case description:

27-year-old G2P1000 at 38w0d with a history of asthma, gestational diabetes on insulin, SGA fetus, presented for induction of labor (IOL) in the setting of TOLAC and prior IUFD. IOL started with oxytocin and cervical foley. Combined spinal epidural was placed uneventfully. Twelve hours into her induction, the patient reported sudden sharp, severe, non-radiating bilateral shoulder pain that lasted 10 min and subsided without intervention. She remained otherwise hemodynamically stable, without a change in FHR or cervical exam. Given the concern for uterine rupture, and that she was still in latent labor, the decision was made to proceed for repeat cesarean. Upon entry into the peritoneum, copious fluid was encountered, concerning for amniotic fluid. Uterine rupture was then diagnosed with the fetal head presenting through the rupture site along the prior hysterotomy incision. Fetus was delivered atraumatically and rupture site was closed. The patient remained hemodynamically stable throughout and had an uncomplicated recovery.

### Discussion:

The typical presentation of uterine rupture includes hypotension, tachycardia, nausea, vomiting, lightheadedness, and anxiety, as well as severe abdominal pain, fetal bradycardia, and loss of station (2). Uterine rupture was considered in the differential diagnosis for our patient but was lower in consideration given her hemodynamic stability, no abdominal pain, no change in fetal tracing, and no loss of station. It is important to consider sudden onset shoulder pain as a marker of uterine rupture.

Abstract #: SAT-RFCP – Room 2 - 19

## Undiagnosed Dilated Cardiomyopathy Complicating Severe Pre-Eclampsia

**Presenting Author:** Mickael Khouzami, MD

**Presenting Author's Institution:** Mount Sinai Hospital Icahn School of Medicine - New York, New York

**Co-Authors:** Julio Marengo, n/a - Mount Sinai Hospital Icahn School of Medicine

This is a 38 year old female G1P0 with known past medical history of chronic HTN, GDM type A2, morbid obesity status post bariatric surgery and a history of pelvic and LE surgery secondary to a mva in the past, who is admitted to L&D with the diagnosis of pre-term labor and pre-eclampsia with severe features. The patient had previously consulted the MFM service (10 days earlier) with pre-term contractions without cervical changes and went home.

The patient complained of shortness of breath, chest tightness and orthopnea; family history was significant for a brother who died from an unspecified "heart condition" in his early twenties. The patient underwent a gastric bypass four years prior to this pregnancy and the pre-operative work-up at the time was normal.

**Physical exam:** BP 172/103 mmHg, HR 129x', SP02 98% ra, RR18x', temp 37.1C, weight 99.8Kg, height 1.63m, BMI 37.74. EKG showed new LBBB not present in prior EKG, labs were significant for elevated LFTs and a K+ of 5.4mmol/L; the remaining values were normal.

Due to the patient's current condition, EKG findings and history, cardiology was consulted. TTE showed: LVEF of 15%, dilated LV, moderate MR and normal RV function. Because of the patient's worsening pre-eclampsia, OB and MFM teams agreed on an urgent delivery and considering her history of pelvic surgery an urgent cesarean delivery was decided.

In the OR, an a line was placed prior to induction, neuraxial block (CSE) was decided as the anesthetic technique. The patient's spinal anesthetic included 20mcg of Fentanyl, 200mcg of Morphine PF and 0.5ml of 0.75% hyperbaric Bupivacaine (3.75mg). Subsequently Lidocaine 2% was administered via epidural catheter in increments of 5ml/5min completing a total of 10ml, obtaining a T4 level. The surgical procedure was tolerated uneventfully.

Currently there is little evidence suggesting the anesthetic management in this setting for patients with peripartum cardiomyopathy, fluid restriction and the use of beta blockers is recommended, reduced stroke volume and increased afterload in the setting of severe pre-eclampsia is considered to be deleterious.

The option of neuraxial anesthetic (CSE), with an initial small intrathecal dose and posterior slow induction of the epidural block, allowed the development of a surgical anesthetic level (T4) in a gradual and safe way without sudden and drastic reductions of the SVR also avoiding unnecessary increases in myocardial O2 demand.

To ensure a good outcome it is important to assess the capabilities of your institution in terms of resources, additional staff and services.

Abstract #: SAT-RFCP – Room 2 - 20

### Consideration for Spinal Anesthesia in a Thrombocytopenic Patient

Presenting Author: Ashley N. Lewis, MD

Presenting Author's Institution: Medical College of Wisconsin - Milwaukee, Wisconsin

Current SOAP guidelines support the safety of proceeding with neuraxial analgesia and anesthesia in thrombocytopenic patients with platelets counts as low as  $70,000 \times 10^6/L$  barring other risk factors for coagulopathy. There is little evidence to guide clinicians when the platelet count is below  $70,000 \times 10^6/L$ , and some have questioned if the SOAP guidelines may be too restrictive in patients with more severe isolated thrombocytopenia. The ultimate decision matrix for the clinician is to weigh the risks of possible spinal epidural hematoma versus the elevated risks of airway management in a pregnant patient.

We present the case of a parturient with thrombocytopenia of an unknown origin, believed to be a combination of congenital thrombocytopenia compounded by gestational thrombocytopenia whose pregnancy was complicated by severe intrauterine growth restriction (IUGR) and breech presentation. The patient had no other history, or findings concerning for coagulopathy. At the time of her scheduled cesarean delivery, she was at 37w2d gestational age. She had an unremarkable physical exam: the patients' Mallampatti score was a II and she had no predictors of a difficult mask or a difficult intubation. The platelet count was abnormally low at  $37,000 \times 10^6/L$ , however her INR was 0.9 and fibrinogen 396 mg/dL. It was extremely important to the patient that she be awake for the delivery of her child. After careful discussion with the patient about possible risks of spinal epidural hematoma and difficult airway management, through shared decision making the patient decided to proceed with a spinal anesthetic for cesarean delivery. She underwent an uneventful spinal anesthetic followed by a successful caesarian delivery without complication. Neurologic checks were performed every two hours for the first twenty-four hours and every four hours for the second twenty-four hours. The patient was discharged on post-operative day two. At her two subsequent follow-up visits the patient was doing well without any neurologic complications. Platelets normalized without intervention.

With the combination of information obtained through labs, patient history, physical exam, urgency and nature of the surgery, a decision on patient management can be reached. At the moment, there remains a paucity of information regarding the incident of severe complication of neuraxial anesthesia in parturients with asymptomatic thrombocytopenia likely due to a combination of the rarity of the complications as well as patient population.

## Anesthetic Management for Cesarean Section in Morbidly Obese Parturient with History of Multiple Sclerosis & Scoliosis Surgery

Presenting Author: Renjith Maracheril, D.O.

Presenting Author's Institution: Maimonides Medical Center

### Introduction

Neuraxial anesthesia is typically the preferred mode of anesthesia for a parturient undergoing Cesarean section. However, comorbid conditions like scoliosis surgery with hardware insertion and morbid obesity can make the placement and functioning of this modality challenging, highlighting the importance of careful evaluation and understanding of anatomic anomalies for successful utilization. Other systemic processes like multiple sclerosis (as in our patient) can further complicate the anesthetic management in these patients. Consequently, it becomes imperative to consider all facets of the patient's history prior to undergoing an anesthetic technique.

### Case Summary

A 39-year-old female, G5P004, at 39+ weeks gestation with present medical history of morbid obesity (BMI ~49) and multiple sclerosis with baseline tremors and urinary incontinence (stable on current medical regimen), as well as surgery for scoliosis with Harrington rods in place, presented from the perinatal unit with variable fetal heart decelerations on non-stress testing. The patient had a late initiation of prenatal care with noted intra-uterine fetal growth restriction. Patient desired an elective primary Cesarean section and was assessed for potential neuraxial anesthesia placement. Due to inaccessibility of prior records, lumbar x-ray imaging was ordered. Neurology was also consulted for evaluation. Upon assessment of the patient, imaging, and neurology recommendations, spinal anesthesia was planned. Associated risks and the possibility of general anesthesia, should neuraxial anesthesia be unsuccessful, was also discussed with the patient. Patient underwent successful spinal anesthesia with 0.75% bupivacaine, fentanyl, and preservative-free morphine with an uneventful intraoperative course.

### Discussion

Anesthetic considerations for successful management in such patients include:

- Multiple sclerosis: Thorough pre-operative evaluation should include a baseline neurological history and exam. Spinal cord involvement may hinder placement of neuraxial anesthesia. In the event of general anesthesia, succinylcholine should be used judiciously as there is a possibility of demyelination and denervation in these patients, increasing the risk for induced hyperkalemia. Intra-operatively, temperature monitoring should be performed as minimal increases in temperature can lead to an exacerbation of symptoms.
- Scoliosis: Rotation of uncorrected scoliosis can distort the superficial anatomy, reducing the reliance of palpation for evaluation. Following correction, hardware insertion often involves vertebral decortication and spinous process removal, which can impede neuraxial block placement. It is often recommended to orient the needle towards the convexity of the curve, where the inter-laminar spaces are usually larger. Ultimately, it is beneficial to have imaging prior to placement to assess the extent of fusion and determine if safe neuraxial block placement is possible.

Abstract #: SAT-RFCP – Room 2 – 22

### Delivery of Mother and Child with Osteogenesis Imperfecta

**Presenting Author:** Benjamin Ten Eyck, MD

**Presenting Author's Institution:** The University of Texas Medical Branch at Galveston

**Co-Authors:** Allison Mullins, MD - The University of Texas Medical Branch at Galveston

Michelle Simon, MD - The University of Texas Medical Branch at Galveston

**Introduction:** Osteogenesis imperfecta (OI), is a rare autosomal dominant connective tissue disorder. Improper collagen I formation affects bones and other organs. Phenotype and severity vary. Parturients present multiple anesthetic challenges for their skeletal deformities, decreased pulmonary reserve and fracture risk. We present the case of a primigravida with OI who underwent a cesarean delivery of an affected fetus.

**Case Presentation:** A 27 year old G1P0 at 37w2d with OI type III, asthma and multiple remote preexisting fractures and skeletal deformities presented for delivery. Her BMI was 49.9, 3 feet and 3 inches and she was wheelchair bound. She underwent a planned primary c section for fetal and maternal OI and breech presentation. Two ultrasound guided large bore IVs were placed with gentle tourniquet application. A combined spinal and epidural was performed with ultrasound assistance, using 27G spinal and 17G epidural needles, with coload of fluid. Spinal medications used were 5.25 mg of hyperbaric bupivacaine, 15 mcg Fentanyl and 150 mcg preservative free morphine at the L4-5 interspace. After placement, severe hypotension with T3 level occurred, prompting significant vasopressor use. The fetus delivered via vertical skin incision with gentle traction, apgars of 6 and 9. The fetus had multiple in utero fractures with no new fractures from delivery. Epidural catheter activated to maintain comfort during surgery. Estimated blood loss was 500 mL. She tolerated delivery well and was discharged on postpartum day 4.

**Discussion:** The incidence of osteogenesis imperfecta in pregnancy is 1 in 250,000 to 300,000 [1]. Parturients with osteogenesis imperfecta present unique anesthetic challenges including poor respiratory reserve with a gravid uterus, short stature, scoliosis, hypermetabolism, hyperthermia, platelet dysfunction, difficult intubation and fragility of bones, blood vessels and skin [2, 3]. Type III is the most severe type of OI. Early multidisciplinary approach is crucial. Cesarean sections have been under general and neuraxial anesthesia. Risks and benefits of each must be individualized.

[Day of delivery and Postpartum Day 1.pdf](#)

## Mast Cell Activation Syndrome and Analgesic Management in the Parturient

**Presenting Author:** Kaila R. Nicolson, MD

**Presenting Author's Institution:** Ochsner Medical Center - New Orleans, Louisiana

**Introduction:** Mast cell activation syndrome (MCAS) is a disorder in which mast cells are inappropriately stimulated and release abnormal amounts of chemical agents resulting in multiorgan symptoms, generally inflammatory and allergic in nature. Mast cells are known mediators of acute and chronic pain [2]. Stressors, including labor and delivery, increase the activation of mast cells leading to increased pain and potentially life-threatening anaphylactic symptoms. We report a case of a parturient with suspected MCAS that underwent vaginal delivery with neuraxial labor analgesia complicated by hyperalgesia to explore the role of anesthetic management and pain control. The present review aims to discuss the diagnosis of MCAS, the importance of minimizing triggers, and the current state of analgesic drug therapy options in patients with mast cell disorders.

**Case Presentation:** We present a 19-year-old G1P0 at 39w1d female with history of postural orthostatic tachycardia syndrome with dysautonomia, Ehlers-Danlos syndrome, and suspected mast cell activation syndrome who was admitted for scheduled induction of labor secondary to pre-eclampsia. Given her multiple comorbidities, she was evaluated prior to her scheduled induction by obstetric anesthesia to optimize medical therapy. It was advised that she receive neuraxial analgesia early in her labor to decrease the stress response associated with labor and delivery. Two epidurals were placed due to a positive test dose with her initial epidural. She had an uneventful delivery, however, developed acute, non-radiating, back pain around her initial epidural site. Physical examination was significant for point tenderness around epidural site and negative for sensory or motor deficits. She was educated on typical post-epidural pain and was prescribed multimodal drug therapy. Her pain continued to worsen leading to the performance of an MRI to rule out an epidural hematoma which was negative. Further evaluation of potential causes of pain was performed and it was determined that many of the medications being prescribed for pain control were potential mast cell triggers leading to hyperalgesia. Her medication regimen was adjusted along with consulting Neurology and Pain Management for further guidance.

**Discussion:** MCAS is a prevalent disorder that presents with multiorgan symptoms. Diagnosis is based on the symptoms, clinical exam, and specific laboratory testing. Review of literature demonstrated little guidance on the anesthetic management of patients with MCAS [1]. This case illustrates the importance of recognizing mast cell triggers in not only the parturient, but all patients with MCAS, and the role of proper drug therapy to control pain [2]. The use of neuraxial anesthesia along with post-delivery pain management is examined.

## Anesthetic Management of Postpartum Patient with Huntington's Disease

**Presenting Author:** Ludovic P. Pao, MD

**Presenting Author's Institution:** The University of Texas at Southwestern Medical Center - Dallas, Texas

**Co-Authors:** Kelechi B. Anyaehie, MD, MPH - UT Southwestern Medical Center

Huntington's Disease (HD), an autosomal dominant neurodegenerative disease, affects 10-15 per 100,000 people of European descent<sup>1</sup>. Psychiatric symptoms typically manifest first, followed by random jerky movements known as chorea<sup>2</sup>. Severe chorea can limit modes of anesthesia in peri-partum patients. There is little literature describing the anesthetic considerations for peri-partum patients with HD. We describe a case in which a patient with suspected HD was successfully managed for a bilateral tubal ligation (BTL).

32yo G3P3 with history of choreiform movements, likely HD, presented for open BTL after uncomplicated spontaneous vaginal delivery without anesthesia. She had a strong family history of chorea in her father who passed at 35yo and in 6 of 9 siblings. She refused referrals for genetic counseling and testing. Neurology noted worsening symptoms 2 months prior. On exam she demonstrated dysarthria, flycatcher's tongue, wide based, unsteady gait, and diffuse chorea in head, trunk, and all extremities.

Although BTLs are commonly done under spinal at our institution, the patient's involuntary movements were concerning for risk of injury. A plan was made for GETA. In the OR, she was positioned on the operating bed with safety straps to limit her chorea and prevent fall. She was oxygenated, and a RSI was performed with 100mcg fentanyl, 50mg lidocaine, propofol (2 mg/kg), and rocuronium (1.2 mg/kg). She was intubated with a 6.0 ETT using a Mac 3 blade. Anesthesia was maintained with sevoflurane and supplemented with dexamethasone, hydromorphone, and ondansetron. The procedure was uneventful, lasting 71 minutes. She was reversed with neostigmine (40 mcg/kg) and glycopyrrolate after 2 out of 4 twitches returned at the adductor pollicis. After 10 minutes, she had 4 twitches and sustained tetanus with adequate spontaneous tidal volumes and patient was extubated. Shortly after, the patient's head and limbs exhibited uncoordinated and non-purposeful movement. It was difficult to distinguish between baseline chorea versus a "floppy fish" appearance from residual neuromuscular blockade. The patient seemed weak and unable to phonate. An additional dose of neostigmine and glycopyrrolate was given with improvement. She was transported to PACU with supplemental oxygen and an uneventful postoperative course.

There are several physiological and pharmacological considerations for HD patients undergoing GETA. Case reports have shown an exaggerated response and prolonged apnea following succinylcholine<sup>2</sup>. As in our case, return of chorea on emergence may confound adequate neuromuscular blockade reversal. Since dysphagia is often present, adequate reversal should be confirmed to reduce risk of aspiration and ensure airway protection.

Abstract #: SAT-RFCP – Room 2 - 25

### Anesthetic management of term parturient with congenital hypofibrinogenemia for repeat cesarean delivery

**Presenting Author:** Maitri M. Shah, MD

**Presenting Author's Institution:** University of Arkansas for Medical Science - Little Rock, Arkansas

**Co-Authors:** Waseem Athar, MD - University of Arkansas for Medical Sciences

A 33 year-old G2P1 female at 40 weeks gestation presented to labor and delivery for an elective repeat cesarean section with a past medical history of asymptomatic idiopathic intracranial hypertension. Previous cesarean section was due to placental abruption and was undertaken emergently under general anesthesia without anesthetic complications. Patient has allergies to lysine which results in anaphylaxis, latex and amoxicillin.

At 27 weeks gestation, the patient tripped and fell onto her hands and knees without hitting her abdomen. Non-stress test following the fall was reactive and reassuring with fetal heart rate baseline of 150 bpm with moderate variability and accelerations, without decelerations or contractions. She reported good fetal movement and no vaginal bleeding or loss of fluid. Labs were significant for fibrinogen of 87 mg/dL. Fibrinogen was repeated at 29 weeks gestation and was 87 mg/dL. The day before admission for delivery fibrinogen was 89 mg/dL with hemoglobin of 13.4, platelet count of 258k, PT 11.9, PTT 26.7 and INR 1.0. Rotational thromboelastometry was collected prior to cesarean section and was normal. Hematology was consulted and recommended cryoprecipitate transfusion only in the event of significant bleeding.

Neuraxial anesthesia was obtained using a 25g 3.5 inch Pencan spinal needle in the midline, palpated at the L3-4 interspace, with clear CSF. Intrathecal injection of 1.6 ml bupivacaine 0.75% with dextrose 8.25% created a T4 level of anesthesia which was adequate throughout surgery. Blood pressure was supported with phenylephrine and was titrated off by the end of surgery. There was an estimated blood loss of 800cc and patient remained hemodynamically stable without significant blood loss postoperatively. The patient did not receive any blood products during her stay. Postoperatively fibrinogen was 81 mg/dL and the following day was 85 mg/dL. ROTEM was not repeated as there were no clinical signs of bleeding or coagulopathy. Patient was discharged on post-operative day 2 without complications.

Hypofibrinogenemia in pregnancy creates a complex situation that the anesthesiologist must be aware of. The risk of peripartum hemorrhage, placental abruption, and epidural or spinal hematoma must be considered when caring for these patients. Clinical signs of acute blood loss, lab values demonstrating hypofibrinogenemia in pregnancy, availability of cryoprecipitate, and abnormal coagulation studies, such as viscoelastic tests to guide management. Neuraxial anesthesia was considered favorable over the well-known risks of general anesthesia in pregnancy, as the patient's fibrinogen was consistently low throughout pregnancy combined with normal coagulation studies.

[ROTEM.tif](#)

**Abstract #:** SAT-RFCP – Room 3 - 01

**Surgical abortion during the second trimester in a patient with plasminogen activator inhibitor type 1 deficiency**

**Presenting Author:** Joanna Ghobrial, DO

**Presenting Author's Institution:** UCONN anesthesiology residency program

**Co-Authors:** Casey Cuccio, DO - UCONN anesthesiology residency program

Vasilije Mijovic, MD - UCONN anesthesiology residency program

**Background:** Second trimester abortions account for 10-15% of abortions performed worldwide. Dilation and evacuation (D&E) is the preferred method of second-trimester abortion in the majority of developed countries (1). Plasminogen activator inhibitor type 1 (PAI-1) is an important component of the coagulation system that down-regulates fibrinolysis in the circulation. Reduced PAI-1 levels may result in increased fibrinolysis and an associated bleeding diathesis (2).

**Case:** A 22 year old G3P1011 at approximately 14 weeks, with history of PAI-1 deficiency, asthma and sickle cell trait presented for a surgical abortion. Her pregnancy was complicated by headaches associated with blurry vision and peripheral vision loss requiring ICU admission with concerns for pituitary apoplexy. MRI findings indicated a complex glandular cystic lesion within the pituitary gland, with signal characteristics reflecting proteinaceous content or subacute blood products. Patient was evaluated by the neurosurgical, endocrine and ophthalmology teams, and no acute intervention was indicated. She was subsequently discharged from the ICU and following this, desired termination of the pregnancy. Since the patient had a significant bleeding history, hematology was consulted and recommended fresh frozen plasma (FFP) and tranexamic acid (TXA) administration at the start of the procedure, followed by administration of aminocaproic acid postoperatively. Prior to beginning of the procedure, two large bore IVs and radial arterial line placement were performed. General anesthesia was then induced with Propofol, Rocuronium and Fentanyl, and maintained with Propofol infusion. Strict blood pressure control was maintained due to concerns for an intracranial process. Patient received 4 units of FFP and 1 gram of TXA as recommended. Hemodynamics remained stable and the procedure was done with minimal blood loss. The patient recovered in PACU, where she received additional TXA and misoprostol. She was discharged the next day with a two week course of aminocaproic acid.

**Discussion:** Surgical abortion is associated with an increased risk of bleeding, which is exponentially increased in patients with concomitant coagulation disorders. A multidisciplinary approach is essential to establish an optimal plan for intraoperative care and recovery. Obstetric anesthesiologists play a major role in maintaining HD stability and guide transfusion management so the risks of preoperative complications are minimized.

**PERSISTENT INADEQUATE ANALGESIA AS IDENTIFIER OF UTERINE WINDOW IN NULLIPAROUS PARTURIENT: A CASE REPORT**

**Presenting Author:** Eleanor Kenny, MD

**Presenting Author's Institution:** McGaw Northwestern Feinberg School of Medicine

**Co-Authors:** Jessica Kruse, MD - McGaw Northwestern Feinberg School of Medicine

Kaitlyn Neumann, MD, MEd - McGaw Northwestern Feinberg School of Medicine

Uterine rupture is a rare, but morbid complication of pregnancy that is primarily diagnosed by obstetric identifiers such as fetal bradycardia, loss of station, and vaginal bleeding in the setting of continuous abdominal pain. Risk factors include exposure to uterotonics, multiparity, multiple gestation, dystocia, and uterine anomalies or surgeries. We present the case of a nulliparous parturient presenting for induction of labor for pre-eclampsia who was found to have a uterine window manifesting as inadequate analgesia.

Upon desire for neuraxial labor analgesia, a combined spinal epidural was performed without complication. She was noted to be comfortable, with a T6 analgesic level bilaterally. Six hours later, the patient developed constant 10/10 pain in suprapubic and vaginal areas which worsened with contractions. Multiple interventions were taken to manage the patient's pain including increasing the volume and density of the neuraxial blockade with supplemental dosing of the epidural with 0.125% bupivacaine, 75mcg clonidine, and 100mcg of fentanyl. Despite these interventions and an unchanged cervical exam of 7cm dilation, the patient continued to have 10/10 pain in the suprapubic and vaginal areas with a bilateral T7 level without sacral sparing.

Given concern for an anesthetic window, the epidural catheter was replaced – an uncomplicated dural puncture epidural was performed with the goal of confirming midline placement by obtaining CSF return and coverage of assumed window with dosing of the epidural catheter. She received 10cc 1% epidural lidocaine; however, the pain did not improve.

To determine the etiology of the patient's pain, a bedside uterine ultrasound performed, coagulation studies were sent, and urinary catheter was replaced. There was no evidence of uterine rupture, abruption or concealed abruption. Continuous fetal heart tone monitoring remained reassuring. Ultimately, the decision was made to proceed with a cesarean delivery due to pain out-of-proportion of the clinical scenario. Her epidural was dosed with 3% chloroprocaine to achieve a T4 anesthetic level. After an uneventful cesarean delivery, inspection of the uterus revealed a lower uterine segment window.

Uterine rupture in the unscarred uterus is rare, though associated with higher maternal and neonatal mortality when compared to rupture in a scarred uterus. Identification and diagnosis of a uterine window or rupture occasionally requires a multidisciplinary approach. Anesthesiologists must recognize that when incomplete labor analgesia persists past standard troubleshooting, the patient may require further investigation by both the anesthesia and obstetric teams to rule out an obstetric etiology for breakthrough pain. This case emphasizes the importance for anesthetic providers to have high suspicion for uterine window or rupture in a patient with uncontrolled pain, regardless of risk factors or additional clinical manifestations of traditional uterine rupture.

**BLOOD RETURN IN AN EPIDURAL CATHETER, FOLLOWED BY DISSEMINATED INTRAVASCULAR COAGULATION:  
A CASE REPORT**

**Presenting Author:** Eleanor Kenny, MD

**Presenting Author's Institution:** McGaw Northwestern Feinberg School of Medicine

**Co-Authors:** Joseph B. Bavaro, n/a - McGaw Northwestern Feinberg School of Medicine  
Caroline Thomas, n/a - McGaw Northwestern Feinberg School of Medicine

**Background:** Although rare, disseminated intravascular coagulation (DIC) is a major cause of maternal morbidity and mortality and occurs in 12.5 per 10,000 deliveries.<sup>1</sup> We present a case of a nulliparous parturient whose clinical course was complicated by fetal bradycardia resulting in emergent cesarean, DIC (first presenting as spontaneous bleeding from the epidural catheter), and cardiac arrest.

**Case:** A 43 year old otherwise-healthy G1P0 presented at 39w4d for induction of labor for advanced maternal age. She underwent an uncomplicated combined spinal epidural for labor analgesia. Her labor course was complicated by multiple late fetal decelerations that were initially responsive to fluid boluses, cessation of oxytocin, and repositioning. However, prolonged fetal bradycardia to the 50's resulted in the decision to proceed to emergency cesarean delivery. 20cc of 3% chloroprocaine was administered via the epidural catheter to achieve a surgical level. On arrival to the operating room, the bed sheets were noted to be saturated with blood. In addition, approximately 4mL of passive blood return was observed filling an empty chloroprocaine syringe connected to the epidural catheter. After delivery (1- and 5-minute Apgar scores of 2 and 7), the patient experienced profound blood loss from surgical site bleeding and uterine atony. There was profuse vaginal bleeding and bleeding into the surgical field with a rapid blood loss of 3L. Uterotonics and tranexamic acid were administered without improvement. In the setting of ongoing bleeding and hemodynamic instability, the decision was made to proceed with a hysterectomy. The patient was induced with etomidate and succinylcholine and intubated without difficulty. Shortly after initiating positive pressure ventilation, the patient became hypotensive and then pulseless. She underwent one round of chest compressions and 1mg epinephrine was administered, after which a strong carotid pulse was palpated. Just prior to cardiac arrest, coagulation labs were notable for a fibrinogen of 130, INR of 1.7, and platelet count of 50, consistent with DIC. Intraoperatively, she received a total of 21 units of blood products with an estimated 5L of blood loss. After successful resuscitation and hysterectomy, she was transferred to the surgical intensive care unit and extubated. An unremarkable neurologic exam was reassuring for lack of developing epidural hematoma. She was discharged home on post-operative day 6.

**Discussion:** In cases of overt DIC, patients may present with oozing from catheter sites, most commonly at IV or mucosal sites such as urinary catheters. While not documented in other case studies, it is possible that blood noted in the epidural catheter may have been an early sign of DIC and subsequent abruptio. Differentiating between coagulopathic and surgical bleeding can be challenging; however early identification of DIC is critical to minimize blood loss related morbidity.

## Near Fatal Asthmatic Exacerbation in Pregnancy

**Presenting Author:** Marshal Lu, MD

**Presenting Author's Institution:** Montefiore Medical Center

**Co-Authors:** Preeti Anand, MD - Montefiore Medical Center

Mehwish A. Mirza, MD - Montefiore Medical Center

Shamantha Reddy, MD, FASA, MD, FASA - Montefiore Medical Center

### Introduction

Asthma is one of the most common comorbidities complicating pregnancy, affecting up to 8.8% of parturients<sup>1</sup>. Pregnancy can increase asthmatic exacerbations requiring intervention and poorly controlled asthma can increase risk of low birth weight, preterm delivery<sup>2</sup>. Pregnant patients with critical asthma syndrome require careful management by the ED, obstetric, intensive care, anesthesiology, and neonatology teams.

### Case Presentation

A 34-year-old female at 32 weeks gestation with moderate-persistent asthma presented with shortness of breath and stable vital signs, reassuring fetal heart tracing but severely restricted peak flow of 150L/min. She failed treatment with inhaled beta-2 agonists and oral steroids, developed near fatal exacerbation over next two hours, with desaturation to 60% on room air and 80% on non-rebreather mask associated with tachycardia, hypotension and altered mental status. The ICU team placed an interosseous line and unsuccessfully attempted orotracheal intubation using etomidate and succinylcholine with a size 7.5 endotracheal tube. The obstetric anesthesia team subsequently intubated with a smaller-sized orotracheal tube. Ventilatory support improved oxygen saturation to 95% but she required an emergent cesarean section under general anesthesia for fetal bradycardia. Ventilation was challenging due to persistent high peak airway pressures and inability to achieve adequate tidal volume with frequent desaturation to low 80s. Bronchoconstriction did not respond to beta 2 agonists, steroids and magnesium, and arterial blood gas demonstrated a pH of 6.93, pCO<sub>2</sub> of >100 mmHg, and pO<sub>2</sub> of 400, on FiO<sub>2</sub> of 1 and pressure-controlled ventilation. An epinephrine infusion was initiated with improvement of tidal volumes. Post-operatively in the ICU, the epinephrine infusion was stopped with improvement in bronchoconstriction, and she was extubated after 2 days. On delivery, the neonate had poor respiratory effort and muscle tone necessitating neonatal intensive care admission, and was discharged home after 22 days.

### Discussion

This case demonstrates a "near-miss" situation which could have resulted in maternal and fetal mortality. Unfamiliarity from the critical care team regarding treatment in the context of pregnancy resulted in delayed intubation, progressive hypoxia, and terminal fetal bradycardia that led to a preterm emergent cesarean section under general anesthesia. Root cause analysis demonstrated several opportunities for improvement, including the need for multidisciplinary simulation and education of all personnel involved in the care of obstetric patients. Of particular importance was management of the obstetric airway, recognition of respiratory emergencies, prompt identification of the rapid response leader, and availability of obstetric code carts.

**Abstract #: SAT-RFCP – Room 3 - 05**

**Awake fiberoptic intubation and tracheostomy for a parturient with submandibular abscess**

**Presenting Author:** Jessica Yeh, MBBS

**Presenting Author's Institution:** University of Arkansas for Medical Sciences

**Co-Authors:** Waseem Athar, MD - University of Arkansas for Medical Sciences

There are multiple physiologic changes in pregnancy that contribute to a higher risk of difficult airway including increased airway edema and weight gain. This case involves a non-laboring parturient with a difficult airway secondary to a facial abscess requiring a multidisciplinary team approach to airway and obstetric management.

21 year old G3P2 female presented with 1 week of left sided facial pain and swelling. She reported self-dating of approximately 37 weeks gestation without any prenatal care. On examination, severe trismus was noted and CT neck demonstrated a left submandibular necrotic abscess.

Discussion between the patient, Obstetrics, ENT, Neonatology and Anesthesia teams lead to the decision to proceed with urgent incision and drainage of facial abscess and tracheostomy. Intraoperative continuous electronic fetal monitoring was performed with the Obstetric team on stand-by if stat Cesarean delivery was indicated.

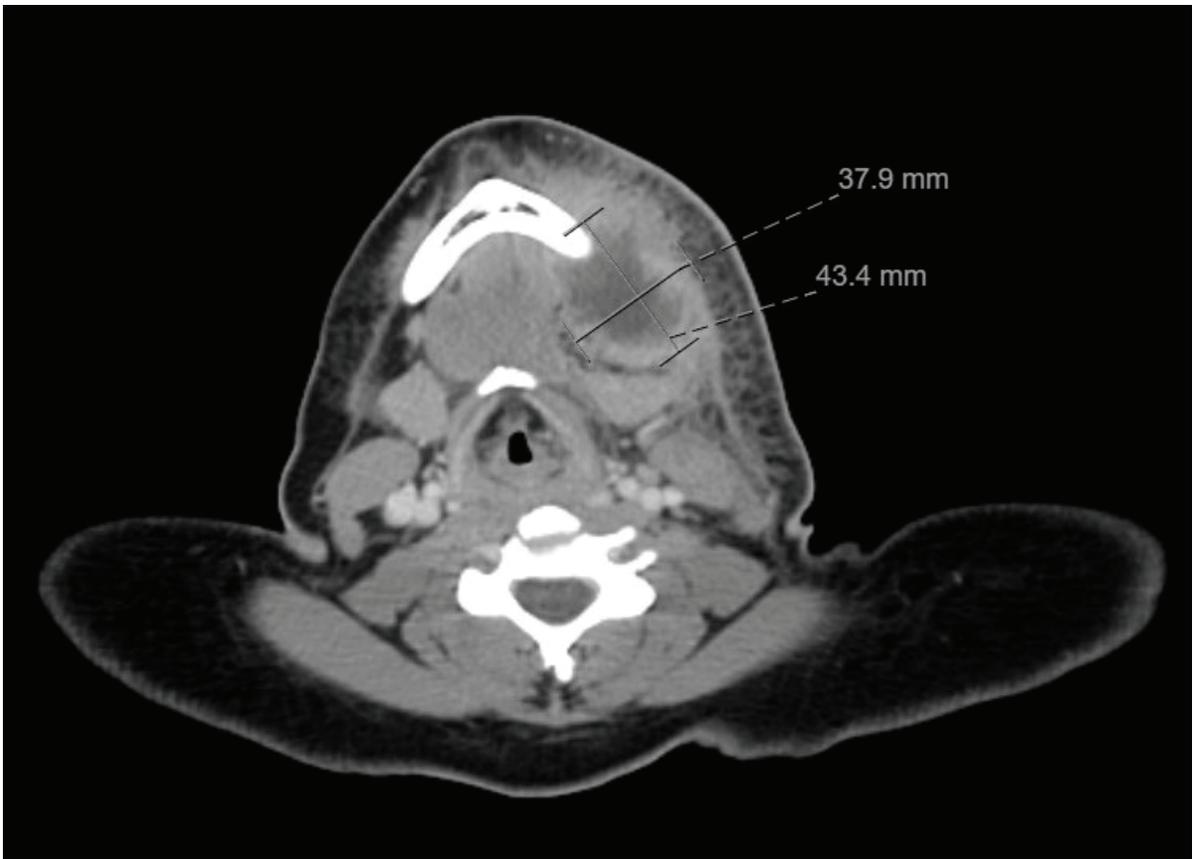
Midazolam 2 mg, metoclopramide 10 mg, dexamethasone 8 mg and glycopyrrolate 0.2 mg were given as premedication. The airway was anesthetized with nebulized and topical lidocaine. With the patient in semi-sitting position, a 5.0 cm cuffed nasal endotracheal tube was placed using a flexible fiberoptic endoscope. Once the airway was confirmed, general anesthesia was induced and surgery proceeded.

The patient was transferred to the intensive care unit postoperatively for tracheostomy management. Induction of labor for gestational hypertension and subsequent uncomplicated vaginal delivery occurred on post-op day (POD) 5 with dural puncture epidural placement for labor analgesia.

Repeat CT neck demonstrated no evidence of residual drainable fluid collection. Tracheostomy was decannulated on POD 7 and the patient left against medical advice thereafter.

The approach to a difficult airway in a parturient involves the consideration of multiple factors. This patient had a complex social situation with no prenatal care and uncertain gestational age. The decision to perform an awake nasal fiberoptic airway and tracheostomy allowed time for the patient to progress in gestation and for prenatal testing to optimize the patient and fetus for delivery while also maintaining a secure airway in the event of emergency Cesarean section. The patient was able to obtain a labor epidural in a controlled environment and have an uncomplicated vaginal delivery. The tracheostomy allowed for the airway edema to improve until decannulation without airway compromise at the end of her hospital stay.

Complex cases with anticipated difficult airways should be performed in centers with expertise in high risk obstetric anesthesia care and availability of maternal fetal medicine and ENT teams. The successful outcome of this case is attributed to multidisciplinary planning and management.



Abstract #: SAT-RFCP – Room 3 - 06

## CHLOROPROCAINE EPIDURAL ANALGESIA IN LOCAL ANESTHETIC RESISTANCE

Presenting Author: Kevin Beitz, DO

Presenting Author's Institution: MCW - Wauwatosa, Wisconsin

A 38-year-old G1P0 female at 39w0d presented for labor induction due to preeclampsia without severe features. The patient stated that during several prior dental and emergency room procedures she was uncomfortable, because she was a "fast metabolizer of lidocaine and hydromorphone". At the patient's request a combined spinal and epidural was performed using bupivacaine and fentanyl. The initial spinal anesthetic provided excellent analgesia for 1 hour, but the subsequent epidural provided inconsistent analgesia over the following 10-hour period. Supplemental epidural boluses of bupivacaine would provide transient pain relief, with an increased epidural level to ice, but quickly disappear over 15-minutes. Several adjustments were made, including replacing the epidural, with no effect. Because of the patient's self-reported experience with lidocaine (another amide anesthetic), bolus doses of 2% epidural chloroprocaine (an ester anesthetic) were tested, which resulted in more persistent and effective analgesia. The epidural pump was changed to a 1.5% chloroprocaine infusion, and the patient's comfort and epidural level improved. Bupivacaine is primarily metabolized by the p450 enzyme CYP3A4, which is known to have significant variability, both genetically and due to environmental factors.<sup>1</sup> One explanation for the improved analgesia in this patient when using an ester anesthetic is that she possessed a hyperactive CYP variant, and is therefore a fast-metabolizer of local anesthetic and opiate medications. Although chloroprocaine is commonly used to provide surgical anesthesia, use for labor analgesia has been limited to a few case reports in the context of amide allergies.<sup>2,3</sup> The case presented here suggest that in patients who demonstrate resistance to amide-based local anesthetics, switching to an ester-based local anesthetic may be beneficial.

**Abstract #: SAT-RFCP – Room 3 - 07**

**Cesarean delivery in a patient with severe aortic stenosis secondary to bicuspid aortic valve in need of concomitant aortic valve replacement**

**Presenting Author:** Kendra Brown, MD

**Presenting Author's Institution:** McGovern Medical School at UTHealth - Houston , Texas

Bicuspid aortic valve (BAV) is a cardiac malformation that occurs in 1-2% of the population with aortic stenosis being the most common associated valvulopathy[1]. Parturients with severe aortic stenosis (AS) will certainly have declining cardiac function in the 3rd trimester and are at risk for preterm delivery. Pregnancy related changes will exacerbate this underlying condition often requiring intervention.

27-year-old G1 with congenital AS secondary to BAV, coarctation of the aorta, history of balloon angioplasty of her aortic valve at 18w due to shortness of breath (SOB), presented with worsening dyspnea on exertion and SOB at 32w. TTE revealed LVEF of 48-50% and severe AS. Controlled elective cesarean delivery (CD) and concomitant aortic valve replacement (AVR) was immediately scheduled with cardiac surgery, CV and OB anesthesiology, MFM, and perfusion in the cardiac OR.

The patient expressed a strong desire to be awake during the CD knowing her risks of morbidity and mortality with cardiac surgery. It was decided to perform the CD under an epidural and no spinal, due to severe AS. An epidural was placed 24 hours prior to CD in order to not risk traumatic placement the day of surgery. Plain normal saline was infused through the catheter to keep it patent. If placement was traumatic we would be outside of the 24h ASRA window for full heparinization required for the AVR. If surgical anesthesia could not be obtained for the CD, GETA would be planned to avoid concerns with heparinization.

In the OR, an awake arterial line was placed. The epidural catheter was slowly infused with 2% lidocaine without epinephrine until surgical anesthesia was obtained. The CD was performed and appropriate uterine tone was achieved. The patient did endorse chest pain after delivery and her blood pressure dropped with surgical blood loss. This was treated along with her anxiety, and symptoms improved. The cardiac surgeons were readily available if she decompensated requiring an immediate AVR. She was observed in the cardiac ICU after delivery and underwent an uncomplicated AVR six days later.

Cardiovascular disease and valvulopathies are a major contributor to morbidity and mortality in the obstetric population. In cardiothoracic surgery it is desired to have postoperative epidurals for pain control and reduced risk of pulmonary complications[2]. A similar practice can be applied in the high risk cardiac obstetric patient. To balance the risk of epidural hematoma, it is important for anesthesiologists to consider placing epidurals 24 hours prior for inpatients.

**Abstract #: SAT-RFCP – Room 3 - 08**

**To cannulate or not— that is the question: a multidisciplinary team approach to prophylactic ECMO cannulation in a morbidly obese patient with cardiomyopathy**

**Presenting Author:** Joe E. Bryant-Huppert, M.D.

**Presenting Author's Institution:** New York Presbyterian - Weill Cornell Medicine, New York

**Introduction:** In developed countries, the leading cause of maternal death is cardiac disease. Close antepartum follow up allows for optimization, and therefore, improved outcomes. Cardiomyopathy, for example, may be exacerbated by pregnancy; patients who are symptomatic and have reduced exercise tolerance prior to conception are at higher risk of complications due to increases in heart rate and blood volume. Careful management of pregnant patients with cardiac disease by a multidisciplinary team is best practice to optimize outcomes, especially as urgent situations arise.

**Case:** A 35-year-old G8P1243 with history of peripartum cardiomyopathy (EF 20%), morbid obesity (BMI 50), APLS on lifelong anticoagulation, and concern for placenta accreta presented at 25 weeks' gestation with fatigue and dyspnea. She was also found to have severe intrauterine growth restriction and intermittent reversal of umbilical artery end-diastolic flow for which urgent cesarean delivery was recommended. Upon admission, a multidisciplinary meeting that included Obstetrics, Maternal-Fetal Medicine, Gynecologic Surgery, Obstetric Anesthesia, Cardiac Anesthesia, Cardiothoracic Surgery, Cardiac Critical Care, Neonatal Intensive Care, Hematology, and nursing was planned. Due to the patient's body habitus, the decision was made for prophylactic ECMO cannulation in order to guarantee successful catheter placement in the event of a cardiopulmonary emergency during delivery. The patient was brought to the operating room, where a pre-induction arterial line was placed followed by induction of general anesthesia (as patient was unable to lie flat awake). Both TEE and a pulmonary artery catheter were used to monitor cardiac function. Cardiothoracic surgery remained on stand-by throughout the cesarean section. The fetus was delivered without event, and the placenta separated easily. The patient remained hemodynamically stable (without the need for vasopressor or inotropic support) and was extubated at the end of the procedure. She was brought to the cardiac intensive care unit in stable condition. The rest of her postpartum course was uncomplicated, and she was discharged to home on postoperative day #8.

**Discussion:** A multidisciplinary team approach is the best way to ensure safe intrapartum and postpartum course, especially in high-risk obstetric patients such as those with cardiomyopathy. Using this approach allows for not only optimal planning, but better communication – an important factor in obstetric emergency outcomes. The decision to use prophylactic ECMO cannulation, informed through risk stratification and thoughtful planning by a high-functioning multidisciplinary team, was well tolerated by the patient and led to a good maternal outcome in a complex cesarean with high risk for complication.

**Abstract #: SAT-RFCP – Room 3 - 09**

**Family Member Mishaps on Labor and Delivery: How Close is Too Close?**

**Presenting Author:** Jose L. Gallardo Vega, MD

**Presenting Author's Institution:** LSU HSC New Orleans - Kenner, Louisiana

**Co-Authors:** Julie Gayle, MD - LSU HSC New Orleans

Corinne Weinstein, MD - Anesthesiologist

**Introduction:**

Family support is paramount during the labor and delivery experience. Occasionally, anesthesia staff are confronted with situations in which a family member presents a safety concern or obstructs care of the parturient. We present a case of accidental connection of epidural tubing to an intravenous (IV) fluid line by a family member in the labor and delivery suite.

**Case presentation:**

Our patient is an otherwise healthy 20 yo G2P1 at 40+6 EGA who presented for elective induction of labor. Once requested a CSE was performed uneventfully, and adequate labor analgesia was obtained with 0.2% Ropivacaine and 2mcg/mL Fentanyl solution administered via PCEA and a continuous rate of 10mL/hr. A few hours after placement, the patient reported inadequate pain control. Successful epidural catheter troubleshooting was completed by the covering anesthesiology resident. At shift change approximately four hours later, the anesthesiology resident noted and promptly addressed an epidural catheter observed to have been connected and actively infusing into IV tubing. Upon further investigation, it was discovered the epidural tubing became disconnected throughout the night, and the patient's husband connected the IV tubing without notifying labor and delivery staff. The occurrence was reported to our hospital safety committee, and the patient delivered a healthy infant without further complications or symptoms consistent with local anesthetic toxicity.

**Discussion:**

Labor support offers many benefits to the parturient and is overall unlikely to result in harm (1). Recognition of the labor and delivery unit as a complex environment that requires prompt and effective communication is vital to anesthesiology resident training (2). This communication between labor and delivery providers, nursing staff, and the patient and supporting family member is key in ensuring safety on the labor and delivery unit (2).

Abstract #: SAT-RFCP – Room 3 - 10

## Neuraxial Anesthesia in a Patient with a Chronic Epidural Cerebrospinal Fluid Collection

**Presenting Author:** Hilary Gallin, MD/MBA

**Presenting Author's Institution:** Massachusetts General Hospital

**Intro:** Management of CSF leaks following neuraxial anesthesia is well-studied; however, there is little precedent for neuraxial anesthesia management of a patient with a large CSF collection. We describe a case of a parturient with a large chronic CSF collection who desired neuraxial anesthesia for labor.

**Summary:** A 36 yo G1P0 at 30w5d PMH MS and epidural CSF leak presented for anesthesia consult. The patient had routine imaging for MS surveillance and had a stable “[anterior] epidural fluid collection [that] extended from the level of C6 through L1.” Etiology was unknown, but it was thought to be due to a traumatic LP in 2017 for MS diagnosis due to positional headaches and evidence of CSF collection shortly thereafter. CSF collection volume appeared stable on MRI and the patient denied active symptoms. She and her obstetrician were planning a vaginal delivery and requested a labor epidural.

We convened a multidisciplinary team with Neurology, Neuroradiology, and Obstetric providers. Her Neurologist noted that “in some ways, it is really not known” the optimal management with regards to neuraxial anesthesia for labor, but did not think she was at greater risk for a dural puncture due to labor epidural placement. She noted that, while unlikely, the fluid collection may expand or become infected following neuraxial anesthesia placement. She has “~4 thoracic spinal cord lesions with a comorbid myelopathy making potential future symptoms difficult to disaggregate.” The Neuroradiologist reviewed the scans, but felt equivocal whether there was an open communication between the intrathecal and epidural spaces without obtaining a myelogram with ionizing radiation. He thought it was most consistent with a non-healing dural tear.

After consulting with additional OB Anesthesiologists, the consensus was that a labor epidural would be appropriate. The risk of infection did not appear to be significantly greater than other patients. The collection spanned many levels, but did not appear to be a high volume or show signs of mass effect. While the labor epidural would deposit more volume into this circumferential space, the risk for cord compression appeared low. It was thought that the epidural mix would be equally effective based on the small volume of the CSF collection. The team would monitor the patient for signs of cord compression or high spinal such as increasing sensory deficits and/or motor blockade. The patient is a healthcare professional and highly motivated to communicate with the team. At the time of this report, the patient has not yet delivered.

**Discussion:** In the setting of neurological complications in planning for pregnancy, most emphasis is placed on intrinsic spinal cord lesions or intracranial lesions; epidural fluid collections are rarer with unclear management. Multidisciplinary discussions were useful to delineate the potential risks from different clinical perspectives. We will update this case report with her management and outcome.



Abstract #: SAT-RFCP – Room 3 - 11

## Management of a 62 Year Old Parturient with Severe Preeclampsia

**Presenting Author:** Lana Glantz, MD

**Presenting Author's Institution:** Maimonides Medical Center

**Co-Authors:** Kalpana Tyagaraj, MD - Maimonides Medical Center

### INTRODUCTION:

Remarkable advances in artificial reproductive technologies and egg donation in the last two decades have enabled perimenopausal, and even postmenopausal women aged 50 years and above to conceive and deliver. Extreme advanced maternal age (age >45) has been shown to significantly increase rates of gestational diabetes mellitus, preeclampsia, preterm birth, postpartum hemorrhage, placenta previa, blood transfusion, low birth weight, low Apgar scores and perinatal death.

### CASE SUMMARY:

A 62 year old P1 at 35+4 weeks, presented to triage for elevated BP readings. The pregnancy was facilitated by IVF with donor egg and had been otherwise uncomplicated. Patient's first pregnancy was at age 58 and delivery was performed via C-section for arrest of dilation. Blood pressure readings ranged from 150s-170s/80s-90s. Patient denied fatigue, headache, vision changes, chest pain, dyspnea, cough, or nausea/vomiting. Ultrasound revealed fetus in frank breech position. The Patient was admitted to L&D for suspected pre-eclampsia and started on a magnesium infusion. Pre-eclamptic labs were within normal limits. The patient required several labetalol pushes to keep BP readings below the severe range. A multidisciplinary decision was made to proceed with urgent C-section because of severe range BPs and category 2 FHR tracing. Spinal anesthesia was performed with 1.6 ml of 0.75% hyperbaric bupivacaine, 15 mcg of fentanyl, and 0.1mg of duramorph. A female, 2265 gm fetus was delivered with APGARs of 7 and 9. A post-op TAP block with liposomal bupivacaine was performed for pain management. The patient was continued on magnesium infusion post operatively. The patient was discharged on post-op day 3 on PO antihypertensives and was closely followed by the OB care providers.

### DISCUSSION:

While it has been established that pregnancy outcomes in women above 45 are generally poorer than those of women in their third or fourth decade of life, there is scarce data regarding the difference between pregnancy outcomes in the sixth and seventh decades of life. Current data on pregnancies in women above 50 is mainly restricted to relatively small cohorts and study designs that lack comparison groups. It is imperative to provide pre-conception counseling and closely monitor patients of extreme maternal age due to the significant risks to both mother and fetus.

Abstract #: SAT-RFCP – Room 3 - 12

## Successful Labor Neuraxial Analgesia in Parturient with Suspected Bernard-Soulier Syndrome

**Presenting Author:** Michael Hart, MD

**Presenting Author's Institution:** University of North Carolina

**Co-Authors:** Ben Cobb, MD - University of North Carolina

Christine P. McKenzie, MD - University of North Carolina

Thrombocytopenia occurs in up to 10% of pregnancies. We present a case of a rare qualitative platelet disorder who received labor neuraxial analgesia without complication.

This is a 27-year-old G1P0 at 39w0d presenting for induction of labor due to thrombocytopenia. The pregnancy was uncomplicated except for thrombocytopenia (80-100  $10^9/L$ ) diagnosed in the first trimester, reaching a nadir of 70  $10^9/L$  one week before induction. Apart from post-tonsillectomy bleeding at 8 years of age, mild gum bleeding and easy bruising, she denied any additional clinically significant bleeding history. She has a maternal grandfather with a similar medical history. One month before induction, she had a consultation with Hematology who suspected an autosomal dominant mild form of Bernard-Soulier syndrome based on macro thrombocytopenia (genetic testing not available until post-partum). Hematology recommended pre-neuraxial transfusion with platelets, complete blood counts every 6 hours during labor, one gram of tranexamic acid (TXA) at delivery as well as another transfusion with platelets. Upon admission, her platelet count was 97  $10^9/L$ , she was transfused with one unit of platelets with a rise to 124  $10^9/L$ , and oral TXA was started. An epidural was placed prior to Pitocin initiation. Before delivery, the platelet count was 129  $10^9/L$  and at delivery she received a unit of platelets and one gram of intravenous TXA. The delivery was complicated by a first-degree laceration and her quantitative blood loss was 306 ml. Post-delivery, the platelet count was 176  $10^9/L$ . Serial lower extremity neuro checks were performed for 24 hours post epidural removal, which occurred 2 hours post-partum.

Bernard-Soulier Syndrome (BSS) is a rare inherited platelet disorder with an estimated prevalence of 1/1,000,000. Over 30 mutations have been identified and it is usually inherited in an autosomal recessive pattern, but more mild forms can demonstrate an autosomal dominant inheritance. It is characterized by impaired platelet aggregation caused by a defect within the membrane glycoprotein Ib-IX-V complex. Systematic reviews and case reports have covered BSS in around 30 pregnancies with modes of delivery being split 50/50 between cesarean and vaginal. Primary post-partum hemorrhage occurred in a third of all cases with two leading to hysterectomies. Neuraxial anesthesia was not utilized in any of the cases, but platelet counts were typically below 80  $10^9/L$ . Currently, no guidelines exist regarding optimal mode of delivery and treatment is focused on supportive measures including platelet transfusions, TXA administration, and consideration for recombinant factor VIIa. Mild forms, such as the autosomal dominant subtype, may have a lower risk of bleeding as evidenced by the patient's clinical history and diagnosis in adulthood.

**PREGNANCY AND COVID 19: CESAREAN DELIVERY ON ECMO**

**Presenting Author:** Dorene J. Hinton

**Presenting Author's Institution:** Medical College of Wisconsin - West Allis, Wisconsin

**Background:** COVID 19 in pregnant females is associated with preterm birth, preeclampsia, Cesarean delivery, and perinatal death along with higher rates of ICU admission, mechanical ventilation, and extracorporeal membrane oxygenation (ECMO) when compared to nonpregnant females with COVID19. We present a case of severe COVID 19 during second trimester pregnancy which led to an emergency Cesarean delivery while being on ECMO.

**Case:** 38 y.o. G2P1 female with past medical history significant for polycystic kidney and liver disease, renal transplant recipient, was admitted with COVID 19 pneumonia at 25 weeks gestation. Patient was unvaccinated, declined the use of remdesivir and convalescent plasma. Obstetric history was significant for invitro fertilization pregnancy, placenta previa, preeclampsia and fibroids. Due to worsening of respiratory status, patient required mechanical ventilation and ECMO. At 28 weeks gestation, patient developed hemorrhagic shock. CT imaging demonstrated a large hepatic cyst with active hemorrhage and hemoperitoneum. Patient required Cesarean delivery, abdominal exploration, resection of hepatic cyst and hemorrhage control. Total blood loss was 2 L for which patient received 6 units of pRBCs, 2 units of platelets and 2 units of FFP. Postoperative course was complicated by additional 13 open abdominal surgeries, and embolization of uterine artery due to the bleeding from hysterotomy site, acute kidney injury and numerous infections. Patient was in the ICU for 7 weeks and on ECMO for 4 weeks but was eventually transferred in stable condition to the medical floor.

**Discussion:** Parturients on ECMO present a unique challenge for Obstetric Anesthesiologists and highlights importance of multidisciplinary approach including Cardiac and Critical care Anesthesiologists to establish plan for Cesarean delivery. According to literature, pregnancy does not increase susceptibility to COVID infection, but it appears to worsen clinical course in comparison to nonpregnant females. Pregnant females with comorbidities and older pregnant patients appear to be at particular elevated risk for adverse maternal outcomes.

Abstract #: SAT-RFCP – Room 3 - 14

## Awake Craniotomies In Pregnancy: To Use Dexmedetomidine Or Not To Use Dexmedetomidine

Presenting Author: Pamela Huang, MD

Presenting Author's Institution: University of California, San Francisco

### Background:

Depending on the location of a brain tumor, an awake craniotomy may allow for greater resection while optimally preserving a patient's delicate and profound language and sensorimotor function. Anesthetic goals are to ensure that the patient is alert, comfortable, and able to participate in real-time neurocognitive testing during the surgery's brain mapping phase. In non-pregnant patients, short-acting and titratable drugs like propofol, remifentanyl, and dexmedetomidine are commonly used for a sleep-awake-sleep approach. However, this technique and drugs like dexmedetomidine have not been extensively studied in the parturient.

### Case Descriptions:

We describe two awake craniotomies in pregnant patients. The first case was a 41-year-old G1P0 at 17 weeks gestation who presented with word finding difficulties and the second case was a 36-year-old G2P1 at 27 weeks gestation who presented with right sided facial weakness, aphasia, and focal seizures. Both women were found to have cortical lesions concerning for glioma. Both anesthesiology teams elected to use propofol and remifentanyl for the cases, and the surgeries were completed successfully. Notably, the first case had periods of respiratory depression with resultant hypercarbia and increased cerebral blood volume (as evidenced by taut dura) as well as anxiety with prolonged cognitive testing. The second case was notable for focal seizure activity, but re sedation was not required.

### Discussion:

Several case studies have reported the benefits and successes of awake craniotomies in different stages of pregnancy, and many utilized a dexmedetomidine infusion. Dexmedetomidine offers unique and desirable properties in awake craniotomies including anxiolysis and lack of respiratory depression, but it is currently classified by FDA as pregnancy category C. Theoretical concerns include maternal hypotension, decreased uteroplacental perfusion, and unknown fetal toxicities as have been seen in animal studies. For pregnancy category C drugs, physicians must decide case-by-case if the risk of the drug outweighs its benefits, and if there isn't a more suitable alternative. We discuss the preparation, challenges, and adaptations made in these particular cases without the use of dexmedetomidine. We also review the current literature on anesthesia practices in awake craniotomies for pregnant women. Until more studies are available in the parturient, we emphasize a multidisciplinary approach to elucidate specific needs and concerns for each case.

Abstract #: SAT-RFCP – Room 3 - 15

## Not All Maternal Seizures are Eclamptic: A Case of Acute Maternal Water Intoxication

Presenting Author: Stephanie M. Kierstead, MD

Presenting Author's Institution: University of Colorado

### Background:

Parturients are often encouraged to stay hydrated during parturition and may consume excessive amounts of water to meet this goal. For most, the medical team is not following strict ins and outs and may not be aware of the excessive intake. Here we present a case of maternal and neonatal seizures secondary to acute water intoxication resulting in severe hyponatremia.

### Case Description:

A 24-year-old primigravid at 41w2d presented to our hospital for elective induction of labor. The patient had a history notable for asthma and convulsive vasovagal syncope, for which neurology recommended she stay hydrated in stressful situations to prevent syncopal episodes. She had appropriate prenatal care and her pregnancy was uncomplicated.

The patient's induction was uneventful and she did not require oxytocin for labor augmentation. After pushing for two hours, she made little progress and desired an epidural. Thirty minutes after epidural placement, the patient complained of worsening headache and became somnolent. Her vitals were only exceptional for a new, severe-range blood pressure. Within minutes, she had a tonic-clonic seizure and required emergent bedside intubation for airway protection. A 6 g magnesium bolus was administered for a presumed eclamptic seizure. Fetal bradycardia occurred and did not resolve with maternal resuscitation, so she was taken to the OR for emergent cesarean. Laboratory tests revealed a serum sodium of 115 mmol/L.

After surgery, further workup demonstrated diffuse cerebral edema on head CT and maximally dilute urine. Further conversations with family members revealed excessive water intake during labor which was consistent with a diagnosis of primary polydipsia resulting in hyponatremic encephalopathy. The patient's neurologic status returned to baseline after slow correction of her sodium and she was extubated with repeat head CT showing improved cerebral edema.

The infant also demonstrated seizure-like activity at birth and his serum sodium was also 115 mmol/L. He received active cooling for neuroprotection and his MRI brain and EEG were normal. His follow up visits have noted normal development with no neurologic sequelae.

### Discussion:

Maternal hyponatremia has been shown to cause both maternal and neonatal seizures as sodium concentration rapidly equilibrates across the placenta.<sup>1</sup> Parturients are susceptible to water intoxication due to increased extracellular volume, increased ADH secretion during labor, desire to stay hydrated, supplemental IV fluids, and high-dose oxytocin protocols.<sup>1,2</sup> Hyponatremic seizures may mimic eclamptic seizures, but should be treated with water restriction vs. hypertonic fluid replacement with frequent sodium monitoring. Overall, acute water intoxication has a favorable prognosis for both mothers and infants.<sup>3</sup>

Abstract #: SAT-RFCP – Room 3 - 16

**Perioperative management of a parturient with untreated bilateral pheochromocytomas.**

**Presenting Author:** Dean Thorsen, DO, PhD

**Presenting Author's Institution:** Kaiser Permanente - Vallejo, California

MEN2a syndrome is a rare condition characterized by development of tumors in the thyroid, adrenal and parathyroid glands. The infrequency with which MEN syndrome with untreated pheochromocytomas are encountered in parturients makes perioperative management a potentially formidable challenge.

A 28 year old female, G4P1 at 39 weeks, with history of MEN2a, status post prophylactic thyroidectomy, untreated bilateral pheochromocytomas, presented to labor and delivery with 1 day of severe intermittent headaches, diarrhea and tremors. In triage she presented with malignant hypertension and found to be positive for COVID-19. Her previous pregnancy two years earlier was delivered via cesarian section; at that time she was not diagnosed with pheochromocytoma nor complications of blood pressure.

After a joint discussion with the patient, maternal-fetal medicine, the obstetrician and anesthesiologist, a decision to proceed with emergent cesarean section was made. The patient was quickly brought back to the operative room where two large bore IV's, an arterial line and central line were placed. Vasoactive medications including phentolamine, nicardipine, nitroglycerin, nitroprusside and phenylephrine were readily available. An epidural was placed in the operating room and slowly bloused to achieve surgical analgesia while carefully monitoring hemodynamics. Fluids, including a bolus of albumin was administered at the start of the case and CVP was monitored throughout. Delivery of baby was uneventful. The patient received several doses of IV phentolamine in the operating room toward the end of the case when hemostasis was achieved and her neuraxial anesthesia was beginning to wear. The epidural was left in place and the patient was transported to the ICU where she was monitored overnight. Additional doses of IV phentolamine were given within the first two hours of admission to the ICU. The epidural was run at a continuous rate with plain 0.125% Bupivacaine overnight and discontinued the next morning. The patient left AMA from the ICU without analgesics or alpha blockade treatment or prescriptions. Two days later she returned to the emergency room with complaints of headache and abdominal pain. Her blood pressure and heart rate appeared stable and headache was attributed to COVID and inadequate pain control following discharge from the hospital for her cesarian section. Endocrinology was consulted and recommended starting doxazosin. The patient was given analgesic and Doxazosin prescriptions along with outpatient follow-up before being discharged home.

This case report highlights and discusses the care of a non-compliant parturient with bilateral pheochromocytomas presenting for delivery, the potential perioperative complications and management. Anesthetic plans and delivery recommendations are discussed.

## Sudden Onset of Severe Headache with Emesis in Postpartum Woman with Corrected Chiari I Malformation

**Presenting Author:** Alyssa Streff, MD

**Presenting Author's Institution:** Vanderbilt University Medical Center

**Co-Authors:** Jeanette Bauchat, MD - Vanderbilt University Medical Center

Monique Osigbeme, MD - Vanderbilt University Medical Center

Laura L. Sorabella, MD - Vanderbilt university Medical Center

### Introduction:

Chiari type I is the most common Chiari malformation with an estimated incidence of 1 in 1000 (1). The overall management of Chiari I malformation during pregnancy is complex and is primarily determined by patient symptomatology ranging from asymptomatic to severe headache, vision changes and syncope related to increased intracranial pressure. We present the labor and postpartum management of a patient with corrected Chiari I malformation who experienced acute neurologic changes postpartum.

### Case:

A 31-year-old G2P1001 35.6 wks with diamniotic-dichorionic twins presented for an elective induction of labor. She had autoimmune hepatitis and Chiari 1 malformation with suboccipital decompression craniotomy and C1 laminectomy two years prior. The patient's post-craniotomy course was uncomplicated, and she reported all symptoms resolved immediately after repair.

MRI showed patent basilar cisterns and CSF space without restricted diffusion or hydrocephalus. Neurosurgery was consulted and agreed she could undergo vaginal delivery with neuraxial analgesia. A dural puncture epidural technique with a 25G spinal needle was performed without complications. The patient developed a new left-sided posterior headache that was associated with the timing of the maintenance epidural programmed intermittent boluses. Epidural maintenance was reset to continuous infusion leading to resolution of symptoms.

Shortly after vaginal delivery, the patient developed a severe throbbing headache, she said was identical to her prior Chiari headaches with associated nausea, vomiting, photophobia, phonophobia and eye pain. The symptoms worsened while laying down and improved sitting up. High blood pressures were noted and treated with intravenous labetalol. Neurosurgery and neurology were consulted, and a stat CT arterial and CT venous imaging were unremarkable. A newly elevated protein:creatinine ratio of  $>.5$  was found and a diagnosis of pre-eclampsia was made. The patient was started on magnesium infusion as well as a headache cocktail for diagnosed occipital neuralgia by Neurology with resolution of symptoms PPD 2.

### Discussion:

Women with Chiari I malformation can deliver safely with an obstetric and anesthetic plan that is customized to their specific needs, despite the theoretical risk of brainstem herniation from distorted anatomy and reduced CSF drainage (2). The differential diagnosis of a new and sudden onset severe headache in the postpartum period in a patient with Chiari malformation should remain broad, including worsening of the Chiari malformation, pre-eclampsia, post-dural puncture headache, acute intracranial bleed, vasospasm, tension headaches and complex migraine. Potential catastrophic causes should be ruled out first, specialist consultation should be sought early and the more common causes of headache in the postpartum period should remain on the differential diagnosis.

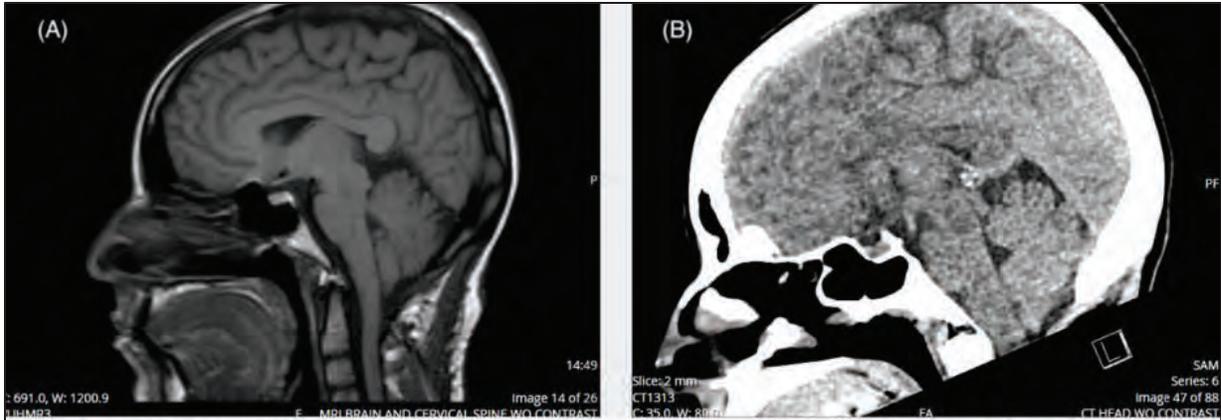


Fig 1. Peg like formation of cerebellar tonsils, below foramen magnum. Prior suboccipital decompression with patent basilar cisterns and CSF space. (A) Pre-delivery MRI (B) Post-partum CT.

## Delivery Considerations for the Parturient with Conjoined Twins and Postnatal Palliative Care

**Presenting Author:** Alyssa Streff, MD

**Presenting Author's Institution:** Vanderbilt University Medical Center

**Co-Authors:** Monique Osigbeme, MD - Vanderbilt University Medical Center

Taylor Ziga, MD - Vanderbilt University Medical Center

### Introduction

Conjoined twins are a rare occurrence with an estimated incidence of 1 in 50,000 births. Unfortunately, 40-60% are stillborn, with a true incidence of approximately 1 in 200,000 live births and another 30% do not survive the first day of life (1). The extent of organ sharing determines the possibility and prognosis of a separation procedure, and sharing of heart or brain virtually excludes separation (1). We outline a case of a parturient presenting for a cesarean delivery for conjoined twins without planned separation.

### Case

A 25-year-old G2P1001 at 32w4d presented for scheduled cesarean delivery for dicephalic thoraco-omphalopagus conjoined twins. The twins shared a single liver and 4 ventricle heart. Diagnosis of the conjoining was made during a 17 week ultrasound. Due to the extent of shared vital organs, separation was not feasible. With the aid a multidisciplinary team, the family decided to deliver as close to term as possible with palliative care including non-invasive respiratory support but no invasive measures. The neonatology team planned for comfort measures at any sign of distress and to prioritize bonding time between the parents and twins.

At time of delivery, an uncomplicated cesarean delivery was performed under spinal anesthesia. The babies were immediately brought to radiant warmer for evaluation. APGAR scores were 2 and 6 for Baby A and 6 and 8 for Baby B. Twin A was cyanotic with low oxygen saturations and was started on PPV from 1.5 to 3 minutes of life. At 3 minutes, both babies were started on vapotherm 5LMP at 1.0 FiO<sub>2</sub>. Infants were brought to family for immediate bonding. The patient and infants were brought directly to the NICU after the c-section, where she was able to recover. Post-surgery, the patient required high dose vasopressor support, which was appropriately managed and weaned by OB anesthesia providers in the NICU. The NICU team delivered buccal morphine to both twins when they began to show signs of distress. Ultimately, the infants passed away simultaneously at 12 hours of life from cardiac failure.

### Discussion

Perinatal management of conjoined twins is complex and often requires multidisciplinary care. Goals for the anticipated neonatal demise include ensuring the family has time and space to spend with family, make memories, and process their loss. Neonatal resuscitation can play a big role in achieving these goals. Alterations to airway management, placement of monitors, location of venous access and dosing of medications should be discussed before delivery as these can vary based on the fetal anatomy. The obstetric anesthesiologist should be aware of fetal resuscitation limitations and be an active member in helping the patient through this difficult time. Recognizing and addressing the family's values and goals as well as their concerns can help improve overall experience.

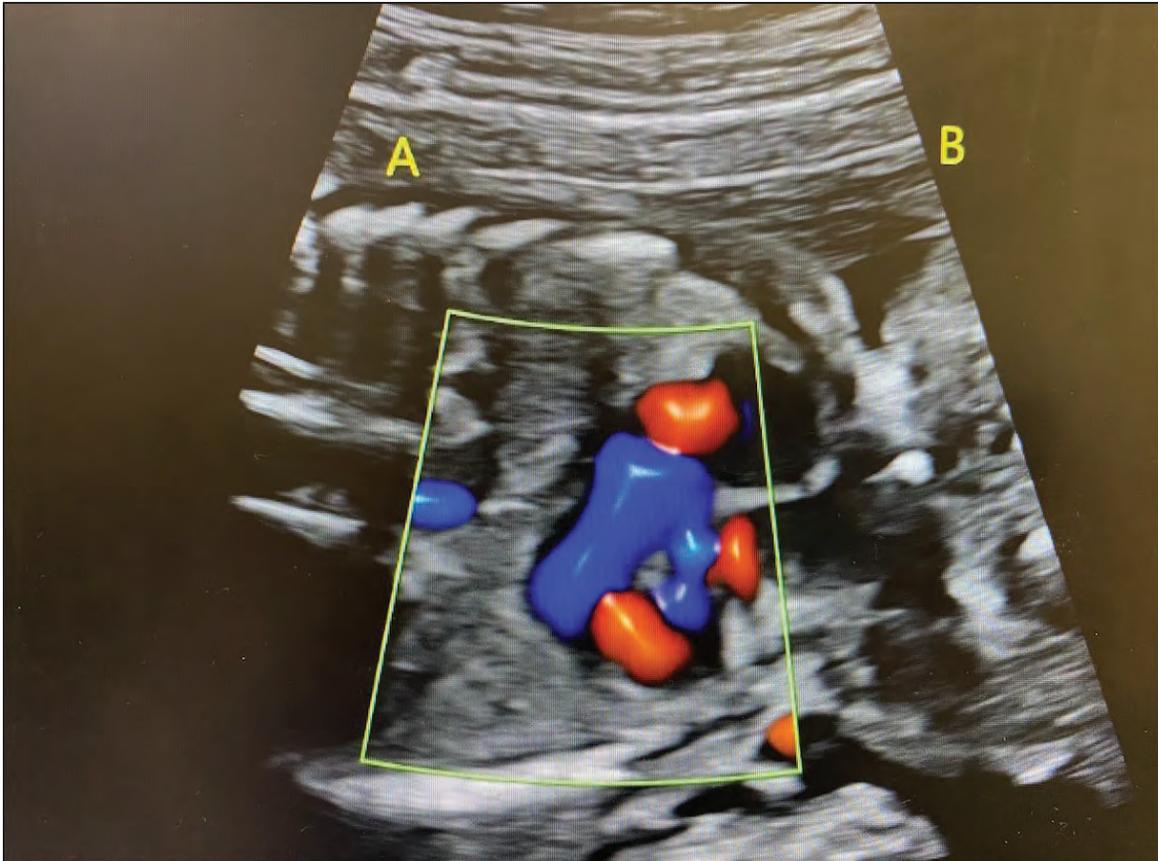


Fig 1. Dicephalic thoraco-omphalopagus conjoined twins

## Delivery Planning in a Parturient with End Stage Systemic Sclerosis: When a General Anesthesia is Not an Option

**Presenting Author:** Pedro Acevedo-Rodriguez, MD, JD

**Presenting Author's Institution:** Yale University

**Co-Authors:** Antonio Gonzalez-Fiol, MD - Yale University

Jessica Miranda, MD - Yale University

Nayema K. Salimi, MD - Yale University

### Introduction

Systemic sclerosis (SS) is a chronic rare autoimmune connective tissue disorder characterized by cutaneous and multiple organ-base fibrosis resulting in progressive end-organ dysfunction. The incidence is approximately 13.9/1,000,000 with a female to male ratio of 9.7:1 in the United States.<sup>1</sup> It is rarely seen in the pregnant population.<sup>2</sup>

### Case

37 year old G7P1 at 34+4weeks with severe systemic scleroderma and failure to thrive admitted for induction of labor and care coordination. Manifestations of her SS include: paroxysmal supraventricular tachycardia (SVT), mitral valve prolapse, tricuspid regurgitation, apical aneurysmal dilation of her heart, recurrent pericardial effusions (including a history of tamponade requiring pericardiocentesis), interstitial lung disease, eosinophilic esophagitis, and significant cutaneous involvement including difficult IV access and contractures. Her anesthetic history was notable for a D&C performed with oral versed and a paracervical block after IV access was attempted for two hours to no avail. Her pregnancy was notable for worsening SVTs, including a cardiac care unit admission at 30+4weeks complicated by pre-term labor. Based on her exam (see Figure 1), it was uncertain if intubation or even mask ventilation would be possible. Maternal-fetal-medicine (MFM) was concerned that if emergent c-section was needed, it would have to be with topical local anesthesia. It was also unclear if she had enough laxity in her vaginal tissue to allow for a vaginal delivery, yet, if she went for a c-section, surgical closure would be difficult due to the limited laxity.

Multiple meetings were held between MFM, nursing and obstetric anesthesiology. Given her previous difficult IV access, an IR-guided triple lumen catheter was placed prior to her induction. An ultrasound assisted epidural was placed prior to starting any labor medications. Positioning for neuraxial was challenging, but an L3-4 epidural was uneventfully placed. Advanced airway equipment, including pediatric indirect laryngoscopes of multiple sizes, medications for airway topicalization, and a flexible bronchoscope was available on the labor floor and plans were made to call a hospital difficult airway code if she needed a general anesthetic. She progressed quickly once her induction was started and brought to the operating room to push where she has a vacuum assisted vaginal delivery of a 1750gm baby.

### Discussion

This case illustrated the importance of multidisciplinary communication and risk identification and mitigation in patients with severe SS. Open communication regarding obstetric and anesthesiologic concerns were key to developing a safe delivery plan along with appropriate contingencies. Neuraxial anesthesia is safe in patients with SS, particularly with ultrasound guidance.<sup>1</sup>

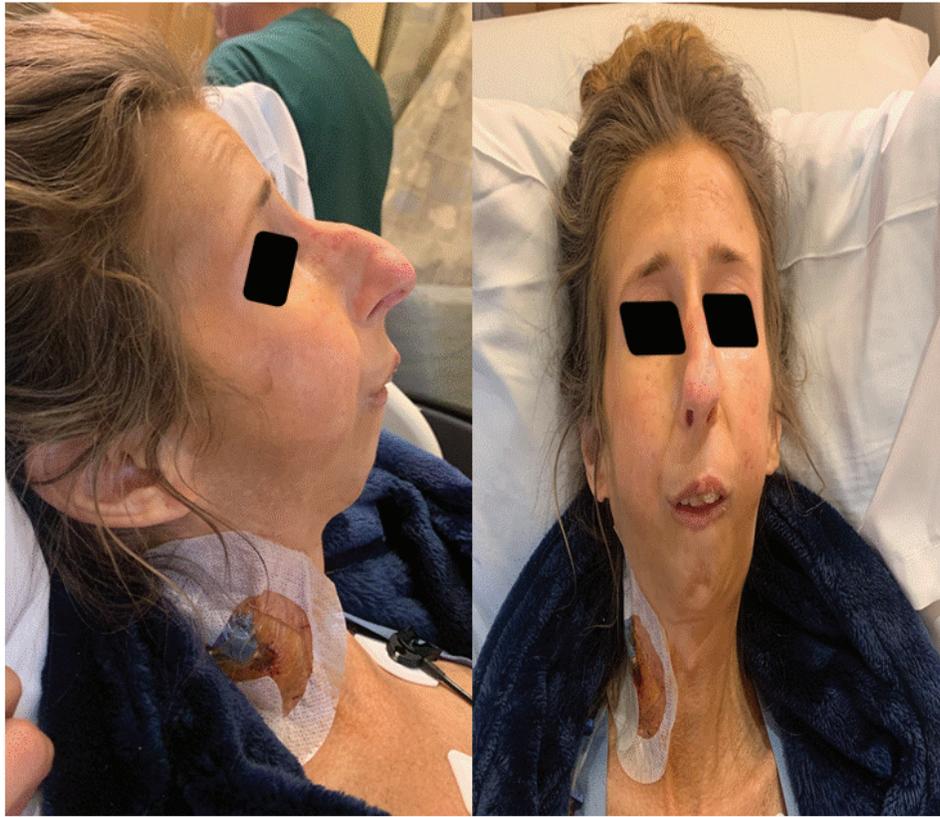


Figure 1.

Abstract #: SAT-RFCP – Room 3 - 20

## Pregnancy complicated by Subdural Hematomas: A case report

Presenting Author: Johns Rochelle, MD

Presenting Author's Institution: NYCHHC

### Introduction

Subdural hematoma (SDH) is caused by venous bleeding into the subdural space. Limited data exists on the incidence and prevalence of SDH due to the failure to diagnose this condition during mid trimester imaging. While the underlying cause of SDH is often unidentified, maternal injury, maternal use of anticoagulants, maternal and or fetal autoimmune thrombocytopenia and maternal Vitamin K deficiency, are among the more common causes. We present a case of monochorionic diamniotic twins with abnormal neuroanatomy consistent with SDH

### Case Description

A 25 year old G3P1 presented for an anatomical survey @18w5d. Prenatal care was complicated by frequent admissions for hyperemesis gravidarum, and an abnormal maternal Quad screen for borderline ONTD. All other prenatal labs were normal. Sonographic findings noted a monochorionic diamniotic twin pregnancy. Twin B was noted to have massive ventriculomegaly. Patient was referred for a higher level of care for management. Upon transfer, @20w5d, repeat ultrasound, MRI and genetic amniocentesis were undertaken; karyotypic analysis revealed two genetically normal males. MRI revealed Twin A had a large bilateral supratentorial/ infratentorial SDH causing enlarged BPD and suspected hypertelorism; Twin B with severe ventriculomegaly and enlargement of the BPD. There is abnormal heterogeneity of the posterior fossa structures c/w SDH in the region with suspicion for cerebellar hypoplasia and hemorrhage. The patient underwent extensive counseling and elected termination. She delivered the twins breech vaginally and declined autopsy.

### Conclusions

Fetal intracranial hemorrhage is a complication associated with significant fetal mortality and morbidity. Fetal subdural hematoma is a type of intracranial hemorrhage where blood collects between the dura and arachnoid matter and is extremely rare. While the underlying cause of SDH is often unidentified, maternal injury, maternal use of anticoagulants, maternal and or fetal autoimmune thrombocytopenia and maternal Vitamin K deficiency caused by hyperemesis gravidarum, are among the more common causes.

Currently, ultrasound is the initial and principal screening imaging modality for detection and diagnosis of intrauterine subdural hematoma. MRI is used to aid in a more detailed imaging of cerebral architecture, showing more distinct boundaries between tissues of different echodensities compared to that obtained from ultrasound.

Abstract #: SAT-RFCP – Room 3 - 21

## Penicillin Infusion Through Epidural Catheter: A Case of Wrong Drug Administration

Presenting Author: Brittni Lanoux, MD

Presenting Author's Institution: LSUHSC New Orleans - METAIRIE, Louisiana

### Introduction:

Medication errors are a significant cause of morbidity and mortality, ranking in the top 5 instances of death around the world (1). Current obstetric anesthesia literature leaves much to be desired regarding erroneous administration of medication into the epidural space. Of the described cases, there have been three involving antibiotic administration into the epidural space.

### Case Presentation:

A 20 yo G3P2 at 39+3 EGA presented for elective IOL and promptly requested epidural labor analgesia. CSE was administered. Neuraxial medication consisting of 0.2% Ropivacaine and 2mcg/mL Fentanyl was started at 10mL/hr through the epidural catheter with patient-controlled analgesia boluses allowed. After one hour, the patient experienced intense itching and was given ondansetron, diphenhydramine and Nalbuphine. She reported no relief therefore fentanyl was removed from the epidural solution. 0.2% Ropivacaine was sent from Pharmacy to the labor and delivery unit and arrived in the hospital medication tube system. The anesthesiology resident changed the epidural solution and the infusion was resumed. Two hours after changing the epidural medication, the patient endorsed pain with contractions despite appropriate troubleshooting including manually bolusing and increasing the infusion rate. Shortly after, the labor and delivery nurse noted Penicillin was hanging in place of Ropivacaine on the epidural pump. The bag was changed immediately to Ropivacaine, and the epidural infusion was continued with adequate pain relief obtained. The patient was informed of the error. Neurology was consulted and found no neurological deficits. Close monitoring was recommended. The patient delivered without complications.

### Discussion:

Reported examples of wrong drug administration through an epidural catheter and its consequences range from no effect detected, to pain on injection, to respiratory depression requiring intubation and death with a variety of approaches to treatment. In addition to practicing the tenants of "right patient, route and medication" in our daily practice as anesthesia providers, The Institute for Safe Medication Practices (ISMP) has released suggestions to prevent further epidural medication errors. These include distinguishing features of epidural bags including different size and/or color with distinctly colored labels and epidural tubing. Other safe practices include: medications that require scanning before administration, a timeout before initiating epidural infusions, and use of neuraxial specific bags, tubing and ports which are incompatible with typical Luer-type connectors (2). Many factors contribute to the causes of medication error, but the best solution to this problem is prevention.

## Considerations for Surgery in Cirrhotic Patients with Subacute Hepatic Decompensation During Pregnancy

Presenting Author: Leilani J. Sampang, MD

Presenting Author's Institution: Loyola University Health System - Oak Park, Illinois

### Introduction

Patients with non-pregnancy-specific liver disease have an increased risk of worsening liver function during pregnancy affecting viability of both mother and baby. The incidence is rare, comprising 0.01% of pregnancies (1). We present a case of a post-orthotopic-liver-transplant (OLT) parturient who required an urgent cesarean delivery due to subacute worsening of hepatic dysfunction.

### Case Report

Ms. E. is a 28 year old G1P0 female with a history of autoimmune hepatitis status post OLT complicated by recurrent cirrhosis who presented at 30.5 weeks gestation for worsening abdominal distension, leg edema, and shortness of breath. She developed portal hypertension with esophageal varices, hepatic hydrothorax, and massive splenomegaly. Her symptoms persisted despite diuretic therapy. Due to concern for decompensated cirrhosis and a MELD score of 23, she was scheduled for a cesarean delivery at 31 weeks gestation. Significant preoperative laboratory data included: platelets 32 K/mcL, Hgb 9.3 g/dL, INR 1.7, and fibrinogen 122 mg/dL. Prior to induction, a 7 Fr rapid-infusion catheter, 16G peripheral IV, and arterial line were placed with cell salvage available. She was given platelets, cryoprecipitate, and fresh frozen plasma to counteract her coagulopathy. Intraoperatively, she received stress-dose steroids, tranexamic acid, and additional fresh frozen plasma. Her delivery was uncomplicated with a total estimated blood loss of 500 mL (quantitative blood loss was incalculable due to large volume ascites) without need for additional blood products. She received carboprost in addition to the standard prophylactic oxytocin dose for uterine atony. Her postoperative course was uncomplicated with liver function studies and MELD score improved prior to discharge. She continues to be active on the liver transplant list.

### Discussion

Although the majority of liver transplant patients deliver via cesarean, it should be reserved for obstetric indications. Concerns related to labor include worsening portal hypertension and constant valsalva maneuvers leading to variceal hemorrhage (2); pre-emptive planning for assisted-vaginal delivery may reduce this risk. For those with indications for cesarean delivery, it is important to remember that decompensated cirrhotic patients undergoing surgery have an increased risk of intraoperative hypotension from severe hemorrhage due to coagulopathy and varices (3). In pregnant patients, there is special concern for fetal demise from transient hypotension with massive hemorrhage. Care must be taken to plan for massive bleeding in pregnant patients with large collateral circulation and known coagulopathy secondary to pre-existing liver disease, including the possible need for emergent liver transplantation.

Abstract #: SAT-RFCP – Room 3 - 23

**A super morbid obese patient with Wolff-Parkinson-White Syndrome and supraventricular tachycardia in need of a cesarean delivery**

**Presenting Author:** Kendra Brown, MD

**Presenting Author's Institution:** McGovern Medical School at UTHealth - Houston , Texas

Wolff-Parkinson-White (WPW) Syndrome is a condition of an accessory electrical pathway due to a band of atrial tissue that connects the atria and ventricles, allowing electrical activity to bypass the traditional pathway through the atrioventricular node. WPW is a major cause of paroxysmal supra-ventricular tachycardia (SVT) in the obstetric population and may induce detrimental fetal and maternal outcomes during a cesarean delivery [1].

A 26-year-old G1 with WPW diagnosed as a child via electrocardiogram, mild aortic root dilation (4.0cm) with LVEF of 60-65%, and super morbid obesity with a BMI of 80kg/m<sup>2</sup> was planned for cesarean delivery (CD) at 37 weeks. At 33w6d, the patient had a HR > 200bpm detected incidentally by a screening Holter monitor with a diagnosis of SVT. A loop recorder was then placed, with further interventions including WPW ablation deferred for after delivery.

The patient presented three days prior to planned CD with mildly worsened shortness of breath. Her loop recorder showed occasional episodes of SVT while asymptomatic.

During a multidiscipline meeting it was decided to schedule her CD in the cardiac operating room under combined-spinal epidural (CSE). Intraoperatively we used standard ASA monitors, and a ClearSight system, which allowed for advanced hemodynamic monitoring including systemic vascular resistance and mean arterial pressure. CSE was easily performed. The spinal dose included 1.4ml of 0.75% hyperbaric bupivacaine, 15mcg of fentanyl, and 150mcg of duramorph. Defibrillator pads were placed as precaution, and phenylephrine infusion was immediately started. Sensory blockade was achieved at T6.

Hemodynamic parameters were stable throughout the CD. The ClearSight system showed appropriate decrease in SVR and allowed for close titration of phenylephrine and fluid administration. No arrhythmias were observed. Intraoperatively, we gave through the epidural catheter 3ml of 2% lidocaine for the test dose, and then a total of 25mg of 0.25% bupivacaine for postoperative pain control. Phenylephrine infusion was weaned off at completion of the CD and no additional pressors or anti-arrhythmic drugs were required. She underwent an uncomplicated WPW ablation two days later.

Patients with WPW can be successfully managed under CSE and regional techniques to avoid sympathetic stimulation are beneficial [2]. Extensive preoperative evaluation, close hemodynamic monitoring, and careful titration of neuraxial anesthetic, can allow for favorable outcomes.

**Abstract #: SAT-RFCP – Room 3 - 24**

**Hemorrhagic Shock in an Obstetric Patient Secondary to Ruptured Couvelaire Uterus Resulting in Emergent Cesarean Hysterectomy with Massive Transfusion Protocol.**

**Presenting Author:** Radhika Chalasani, MD

**Presenting Author's Institution:** The Ohio State University - Wexner Medical Center - Delaware, Ohio

**Co-Authors:** Megan Cook, MD - The Ohio State University - Wexner Medical Center

Blair H. Hayes, MD - The Ohio State University - Wexner Medical Center

Leslie Matthews, MD - The Ohio State University - Wexner Medical Center

**Case:** A 34-year-old G4P3003 at 31w6d with PMH of obesity (BMI 38.8), chronic HTN, and gestational DM initially presented to the ED at 30w6d with extremity swelling and chest pressure. Diagnosis of preeclampsia with severe features was made and patient was admitted to antepartum with a plan to deliver at 34 weeks' gestation. She left AMA on HD4 and re-presented 3 days later at 31w6d with severe constant abdominal pain and bright red vaginal bleeding. No fetal cardiac activity was noted on ultrasound. She was admitted for augmentation of labor in the setting of IUFD. An epidural was placed for labor analgesia. Patient had acute hypotension 3 hrs after epidural placement. Initial resuscitation was started (IV fluid bolus, arterial and venous access) while the obstetrician performed bedside ultrasound. The fetal head could no longer be palpated on cervical exam. Given concern for uterine rupture, she was taken to the OR emergently and massive transfusion protocol was initiated. Large volume hemoperitoneum was encountered and a demised male infant was delivered en caul from the upper abdomen. Couvelaire uterus with vertical uterine rupture extending from lower uterine segment to the cornua was noted despite no history of uterine surgery. Hysterectomy performed for hemorrhage control. Transfused 10 u PRBC, 9 u FFP, 2 u cryoprecipitate, and 1 pool of platelets intraoperatively. She was transferred to the SICU intubated. Extubated on POD1 and discharged on POD4.

**Discussion:**

Antepartum hemorrhage is a significant cause of both fetal and maternal morbidity and mortality. Management ranges from expectant to immediate delivery depending on the fetal wellbeing and maternal stability. Complications include hemorrhagic shock, consumptive coagulopathy, IUFD, and organ failure. Couvelaire uterus or uteroplacental apoplexy is a rare complication of concealed abruptio placentae. It is caused when hemorrhage from placental blood vessels seeps into the decidua basalis causing placental separation, followed by infiltration in the lateral portions of the uterus and occasionally, into the peritoneal cavity leading to uterine rupture (1). Diagnosis is made surgically by visually noting dark purple patches with ecchymosis and indurations on the uterus (2).

Postpartum hemorrhage (PPH), is a leading cause of mortality in obstetric patients (3). Uterine rupture is a risk factor for PPH (4). Early identification is essential and multidisciplinary management of ante and postpartum hemorrhage is paramount to ensure patient safety.

Abstract #: SAT-RFCP – Room 3 - 25

## Consideration for Early ECMO Cannulation in the Pregnant Patient with Severe COVID Disease: A Case Report

**Presenting Author:** Erin Dengler, MD MBA

**Presenting Author's Institution:** University of North Carolina

**Co-Authors:** Kathryn Cobb, MD - University of North Carolina

Kathleen Smith, MD - University of North Carolina

A 37-year-old G4P3 female at 24 weeks gestation was admitted to the ICU with COVID pneumonia. Despite maximal empiric therapy, she acutely decompensated on hospital day 13 requiring intubation. Extracorporeal membrane oxygenation (ECMO) was considered at that time, however the decision was made to observe for clinical improvement following intubation. The patient continued to be hypoxemic on maximal ventilator settings, and the team decided to proceed with emergent cesarean delivery (CD) due to late decelerations in the setting of deteriorating maternal status. CD took place in the main operating room, with the plan to cannulate for ECMO immediately following delivery. Due to mild improvement in PaO<sub>2</sub> and concern for bleeding with heparinization following CD, ECMO cannulation was not performed. She remained intubated without clinical improvement over the next 12 days at which time ECMO was reconsidered; however it was determined the patient was no longer a candidate due to length of disease. She died on hospital day 28.

The optimal timing for ECMO cannulation in pregnancy complicated by COVID pneumonia is unclear. ECMO in pregnancy creates unique challenges, such as optimal anticoagulation regimen. Management is made more complex when ECMO cannulation and anticoagulation follow major abdominal surgery, such as CD. Administration of an antifibrinolytic such as tranexamic acid (TXA) to prevent bleeding with cannulation increases the risk of thrombosis in this hypercoagulable patient population.<sup>1</sup> As with any clinical decision, one must balance the risks of the procedure with the potential benefits. ECMO in pregnancy is associated with a 75% survival rate, whereas 13% of patients experience severe bleeding requiring surgical intervention.<sup>2</sup> Cannulation early in the course of COVID infection prior to CD may decrease risk of competing coagulation changes associated with surgery, pregnancy, COVID, and ECMO.

The Society for Maternal and Fetal Medicine endorses ECMO for peripartum females under 32 weeks with hypoxemia refractory to standard measures to facilitate in utero development.<sup>3</sup> Therefore, in peripartum women who have maximized empiric COVID treatment, early cannulation for ECMO could be more effective for both mother and fetus, allowing for oxygenation and ventilation to support fetal development, potentially avoiding morbidity and mortality associated with emergent CD. While ECMO should not be initiated prior to exhausting all treatment options, our case highlights the potential benefits of consideration of ECMO early in the course of infection in pregnant patients with severe COVID disease.

Abstract #: SAT-RFCP – Room 4 - 01

## Severe Fetal Brain Damage as a Complication of Acute Maternal Hypoxemia in Covid-19

Presenting Author: Eve Bishop, MD

Presenting Author's Institution: Massachusetts General Hospital

Maternal respiratory failure and hypoxemia can lead to inadequate oxygen supply to the placenta and cause fetal distress.<sup>1</sup> We report a case of Covid-19 acute respiratory distress (ARDS) in pregnancy with associated fetal brain damage.

A 41F G11P7 presented to a local hospital with Covid-19 symptoms. B-hCG was positive, and fetal ultrasound showed a gestational age of 27 weeks and fetal ascites. The patient was hypoxic to SpO2 83% and admitted to the ICU for high flow nasal cannula (HFNC) oxygen therapy. By hospital day 4, the patient was intubated and transferred to our hospital for extracorporeal membrane oxygenation (ECMO) consideration for insufficient oxygenation on maximal respiratory support. The patient's arterial blood gas showed pH 7.21, PaCO2 55, PaO2 66 on VCV with Vt 365, RR 36, Pplat 31, PEEP 14, FIO2 100%, iNO 40ppm, and in prone position on a paralytic infusion.

A multidisciplinary team of intensivists and maternal fetal medicine specialists discussed management options and decided to initiate VV-ECMO. Urgent delivery was considered but deferred due to limited patient benefit given her cardiac stability and risks of surgical stress and fetal prematurity. The patient underwent uncomplicated ECMO cannulation via the internal jugular and femoral veins, and her blood gas improved to pH 7.41, PaCO2 32, PaO2 95.

Following clinical improvement, complete fetal ultrasound showed resolution of ascites, but findings consistent with intracranial hemorrhage. Fetal MRI confirmed severe brain injury from hypoxic ischemic injury and hemorrhagic infarction. The family was counseled on fetal disability and decided against fetal resuscitation at delivery.

The patient remained on ECMO for 14 days and in the hospital for 60 days with a course complicated by tracheostomy placement, acute renal failure requiring renal replacement therapy, pulmonary hemorrhage and pulmonary emboli. She had rupture of membranes at 36 weeks, underwent cesarean delivery with general anesthesia, and the neonate received palliative care.

Our case of fetal brain injury associated with maternal hypoxemia demonstrates the importance of sufficient oxygenation (SpO2 >95%)<sup>2</sup> in pregnant women with Covid-19. The early finding of fetal ascites in our case suggests that fetal injury occurred prior to ECMO initiation in the setting of fetal acidosis and anemia. Earlier ECMO initiation may have altered the course of fetal injury and should be considered as an early intervention in pregnant women with refractory hypoxemia. Maternal outcomes following ECMO for Covid-19 are favorable compared to the general population with survival rates nearing 80% and further support ECMO consideration for pregnant patients.<sup>3</sup>

**Abstract #: SAT-RFCP – Room 4 - 02**

## **Labor Epidural in a Parturient with a Lumboperitoneal Shunt**

**Presenting Author:** Carolina Blotte, MD

**Presenting Author's Institution:** Boston University Medical Center, Massachusetts

**Co-Authors:** Rachel Achu, MD - Boston University Medical Center

### **Introduction:**

Idiopathic intracranial hypertension (IIH) is a syndrome of increased intracranial pressure without evidence of structural intracranial abnormalities. Treatment with lumboperitoneal (LP) shunts may be necessary in severe disease. The provision of neuraxial anesthesia in parturients with LP shunts is controversial. We present a case of the successful administration of epidural anesthesia in a parturient with a LP shunt.

### **Case presentation:**

A 29-year-old woman, G1P0, was admitted at 37 weeks, 6 days for induction of labor for chronic hypertension. Other past medical history included obesity, obstructive sleep apnea and IIH complicated by blindness, treated with a LP shunt placed in 2008, which required multiple revisions.

A multidisciplinary team composed of maternal fetal medicine, obstetric anesthesia, and neurosurgery discussed the importance of providing neuraxial anesthesia in this patient with multiple comorbidities. Imaging was obtained, which confirmed the presence of a LP shunt with the catheter entering the spinal canal at the L2-3 level, with ascension to the lower thoracic region.

With the initiation of induction, an epidural was placed prior to the start of contractions. The epidural catheter was easily placed below the surgical scar using a midline approach at the L4-L5 interspace. A test dose of 3ml lidocaine 1.5% with 5 mcg/ml epinephrine was negative. An intermittent epidural bolus infusion of 16ml/h of 0.0625% bupivacaine with 2 mcg/mL fentanyl was resulted in a T8-9 sensory blockade bilaterally. With the progression of labor, the infusion was changed to 0.125% bupivacaine with 2 mcg/mL fentanyl for better pain control. She had an uncomplicated vaginal delivery and the epidural catheter was easily removed. After an uneventful postpartum course, the patient was discharged home two days later.

### **Discussion:**

LP shunts can be used in the treatment of IIH unresponsive to conservative management. Damage to the shunt, altered epidural anatomy and knotting of the epidural catheter remain theoretical concerns regarding epidural placement in these patients, with some recommending against neuraxial blockade. Currently there is no consensus on the requirement for imaging prior to providing neuraxial anesthesia in patients with LP shunts. Due to multiple shunt revisions, we decided to perform imaging to accurately confirm shunt location.

This case highlights the importance of a multidisciplinary approach in the successful evaluation, management, and provision of neuraxial anesthesia for labor analgesia in a parturient with a LP shunt with multiple revisions.

## ACUTE SYSTOLIC DYSFUNCTION DURING EMERGENT CESAREAN DELIVERY

**Presenting Author:** Andrew Davis-Sandfoss, MD

**Presenting Author's Institution:** McGaw Medical Center of Northwestern University

**Co-Authors:** Ian Gaston, MD - McGaw Medical Center of Northwestern University

Emery H. McCrory, MD - Northwestern University Feinberg School of Medicine

**Introduction:** Studies have shown women who develop preeclampsia during pregnancy are twice as likely to develop heart failure later in life, increasing to a four-fold risk when preeclampsia complicates an additional pregnancy. While peripartum cardiomyopathy can be secondary to known risk factors such as advanced age, black race, preeclampsia, hypertension, multiple gestations, and anemia, other causes remain idiopathic. We present a case of acute, profound peripartum systolic dysfunction in a parturient undergoing emergent cesarean delivery.

**Case:** Our patient was a 31-year-old female, G4P0030 with a BMI 25 at 24 weeks gestation with a past medical history significant for chronic hypertension and obstetric history of two prior miscarriages who presented with pre-eclampsia with severe features and evolving HELLP (Hemolysis, Elevated Liver enzymes, and Low Platelets) syndrome. Physical exam was notable for ascites and laboratory data was significant for nephrotic-range proteinuria, elevated aspartate aminotransferase (AST), and normal platelet count. Fetal distress prompted emergent cesarean delivery under general anesthesia with endotracheal intubation using propofol and succinylcholine for induction. The patient subsequently developed profound, refractory hypotension requiring high dose phenylephrine, norepinephrine, and vasopressin infusions. Invasive blood pressure monitoring and central venous access were obtained. Point-of-care (POC) transthoracic echocardiography (TTE) demonstrated depressed left ventricular (LV) function with an ejection fraction (EF) of approximately 30% and septal hypokinesis, so inotropic support was initiated. Transient uterine atony resolved with uterotonics and tranexamic acid. Despite only one Liter blood loss, persistent hypotension prompted transfusion of two units of packed red blood cells. Upon transfer to the intensive care unit, the patient's systolic dysfunction and pressor requirement resolved. Post-extubation, a Computed Tomography with angiography (CTA) of the chest revealed an acute pulmonary embolism in the right lower lobe with extension to proximal subsegmental branches.

**Discussion:** In patients with pre-eclampsia, recognition and treatment of cardiovascular pathology is imperative to provide effective, safe, and life-saving treatment as this is a known risk factor for peripartum cardiomyopathy. In addition to induction and maintenance of general anesthesia with the use of inhaled anesthetics, and acute blood loss anemia associated with delivery, other confounding factors can contribute to hypotension in the peripartum period. Early use of transthoracic echocardiography can help aid in both diagnosis and additional management and should be used with a low threshold in patients with known risk factors for peri-partum cardiomyopathy.

Abstract #: SAT-RFCP – Room 4 – 04

### Can chronic aortic dissection and preeclampsia coexist?

**Presenting Author:** Jennifer Hoayek, MD

**Presenting Author's Institution:** The University of Texas Health Science Center in Houston

**Co-Authors:** Barbara Orlando, MD - The University of Texas Health Science Center in Houston

**Background:** Spontaneous aortic dissection is the most common fatal aortic condition. In pregnancy, it manifests mostly during the third trimester due to the hyperdynamic state and hormonal effects on vasculature<sup>1</sup>. Although aortic complications have been reported in women with genetic diseases or congenital aortic malformations, the majority of cases in parturient occur without any known risk factor.

**Case Presentation:** We present the case of a 37-year-old primipara with a history of uncontrolled Type 2 Diabetes, chronic hypertension and an incidentally diagnosed aortic dissection. Magnetic resonance angiography (MRA) in 2018 showed chronic short segment dissections within the infrarenal abdominal aorta. Cardiac echocardiogram showed no valvular abnormalities, EF 55-59%, aortic root 2.4 cm, ascending aorta 2.5 cm. The patient was managed conservatively. Repeat MRA on admission showed similar findings; the dissection flap appeared to extend 5.3 cm from the infrarenal abdominal aorta without evidence of aneurysm. The echocardiogram was unchanged. The patient was followed in the fetal center for fetal anomalies. At 33+4 weeks, she was found to have blood pressure (BP) of 174/89 and was diagnosed with Pre-Eclampsia with severe features. She was admitted to Labor and Delivery and treated with a 20mg bolus of esmolol and was initiated on metoprolol. A multidisciplinary meeting was held, and she was scheduled to deliver via cesarean delivery (CD) at 34 weeks, with the vascular team on standby, to minimize the risk of worsening dissection in the setting of pre-eclampsia. Anesthesia management included delivery in the cardiac operating room (OR) in case of aortic rupture, tight BP control with labetalol, cardene and esmolol drips, and a low dose Combined Spinal-Epidural (CSE) placed to avoid reflex tachycardia. Upon arrival to the OR, defibrillator pads and EV 1000 were attached. Her initial BP was 180/90 and she was given 10mg of labetalol. An arterial line was placed and esmolol drip was started at 150mcg/kg/min. A CSE was placed with intrathecal bupivacaine 0.75% (9.75mg), Duramorph (0.15 mg) and fentanyl (10 mcg), which contributed in controlling BP intraoperatively. The BP goal during CD was 140/80, achieved by titrating all drips to effect. The patient was hemodynamically stable throughout. She was recovered in the cardiac intensive care unit, where she was kept on IV medication for BP control. She was discharged home on day 6, on Hydralazine and Labetalol with a target BP below 140/80.

**Discussion:** This case illustrates an unusual presentation of a stable aortic dissection of unknown origin in a parturient, carefully managed intraoperatively in order to keep her dissection from extending to a type B dissection requiring immediate surgery. Judicious preparation and management led to a 34-week successful CD.

Abstract #: SAT-RFCP – Room 4 – 05

**Combined Spinal Epidural for an Intrauterine Term Therapeutic Fetal Paracentesis in a Multiparous Parturient with Substance Use Disorder**

**Presenting Author:** Lauren P. Newhouse, MD

**Presenting Author's Institution:** University of Illinois Hospital - Chicago, Illinois

**Co-Authors:** Jacqueline M Galvan, M.D. - UT Southwestern Department of Anesthesiology and Pain Medicine

**Introduction:** Intrauterine fetal procedures are becoming more prevalent with advancements in obstetrics<sup>1</sup> and require a new set of considerations for the obstetric anesthesiologist. Optimizing procedural conditions for the obstetrician while minimizing complications for a term fetus is a delicate balance requiring multidisciplinary planning. There is limited guidance for choice of anesthetic, ranging from general anesthesia to neuraxial. Metrics to consider are broad but might include projected feasibility of procedure, hospital resources, fetal and maternal wellbeing, and anticipated mode and timing of delivery. In this abstract we present a case of a successful intrauterine term therapeutic fetal paracentesis in a multiparous parturient followed by an induction of labor (IOL) utilizing a neuraxial anesthetic.

**Case:** 36 year old G7P3 with a PMH chronic hypertension, and substance use disorder presented at 35 wga for prolonged monitoring after a nonreactive stress test and oligohydramnios. Pregnancy was complicated by known fetal abdominal ascites and scalp edema consistent with fetal hydrops secondary to a known GLB-1 mutation. Abdominal circumference was 356.0 mm (>99 percentile). The increased fetal abdominal circumference raised concerns for decreased fetal lung compliance and abdominal dystocia during vaginal birth or cesarean section. Further, the patient began to have painful contractions. In order to maximize the success of a vaginal delivery and optimize fetal lung performance (especially if resuscitation would be required), the decision was made to perform a therapeutic intrauterine fetal paracentesis and then undergo an IOL. Intrauterine fetal paracentesis procedural concerns included identification of needle insertion point, avoiding fetal or placental trauma, aiding maternal comfort, and facilitating vaginal delivery. A low dose CSE catheter-based technique was chosen for reliable catheter performance and for its ability to provide either surgical anesthesia or analgesia. After the CSE block was placed and maternal- fetal well-being was confirmed, 251 mL of fluid was removed from the fetal abdomen. Fetus and mom tolerated the procedure well. IOL was performed and baby was delivered vaginally under the same CSE catheter.

**Discussion:** Successful intrauterine fetal procedures can minimize maternal and fetal morbidity in carefully selected patients. Multidisciplinary discussion and shared decision making with the patient of goals, objectives and risks of the procedure was critical. Optimizing chance for vaginal delivery in a multiparous patient with fetal increased abdominal girth was the goal. Coordination of care and selection of a versatile anesthetic was paramount to the outcome of this case. This case is an example of a successful intrauterine procedure on a term fetus with subsequent IOL done with CSE catheter based technique.

**Abstract #: SAT-RFCP – Room 4 - 06**

## **Disc Herniation During Labor Requiring Emergent Surgery**

**Presenting Author:** Alex D. Pham, MD

**Presenting Author's Institution:** Department of Anesthesiology, LSUHSC - New Orleans - Slidell, Louisiana

**Co-Authors:** Corinne Weinstein, MD - Anesthesiologist

### **Introduction:**

Nearly half of parturients experience low back pain during pregnancy, making this an unfortunate albeit common complaint during pregnancy (1). Although there are a variety of causes of acute low back pain during the peripartum period, disc herniation as a main cause is rare, occurring in 1 out of every 10,000 parturients (1). Furthermore, it is estimated less than 15% of those parturients with disc herniation experience alarming symptoms requiring immediate surgical intervention (1).

### **Case Presentation:**

Our patient is a 31yo G5P0 at 37+6 EGA with PMH of morbid obesity (BMI 53.5), hypertension, bipolar d/o, gestational diabetes (GDM), and lumbar spinal stenosis with L4/L5 disc herniation and L5 nerve root compression admitted for induction of labor (IOL) 2/2 GDM. She endorsed chronic left-sided low back pain with radiculopathy prompting an L4-5 lumbar laminectomy at 24 weeks EGA. Her symptoms persisted several weeks post-surgery, and it was jointly decided by neurosurgery and her OBGYN to perform a repeat discectomy after delivery. The patient also received extensive counselling regarding her options for labor analgesia by OB anesthesia. She insisted on neuraxial analgesia and during her admission for delivery, requested an epidural. An early dural puncture epidural was performed. Ultrasound guidance was used for confirmation of L3-4 interspace located above her previous surgical scarring. During the course of her prolonged IOL, she was placed in various seated positions. Emergent cesarean delivery under neuraxial anesthesia was performed for fetal intolerance to labor without any complications.

On post-operative day 1, the patient experienced decreased sensation to her left lateral thigh without bowel or bladder incontinence. As a precaution, neurology and physical therapy were consulted. Several hours later she reported worsening low back pain, radiculopathy and difficulty voiding. MRI revealed worsening disc herniation with "partial cauda equina syndrome". Neurosurgery was consulted and emergently performed a microdiscectomy. Her exam continued to improve postoperatively until discharge.

### **Discussion:**

Parturients with complex patient factors and neurologic histories require complex medical decision making. Recognition that hormones accompanying pregnancy alter joints of the pelvis is paramount particularly in these complex parturients (1). Worsening neurologic symptoms should trigger immediate work up to avoid patient injury. This case stresses the importance of pre operative counselling, proper positioning of the parturient during labor, post operative follow up, multidisciplinary care, and anticipation of complications in order to improve our approach to treating these patients.

Figure 1: Preoperative MRI L spine w/o Contrast



**Abstract #: SAT-RFCP – Room 4 – 07**

**Pregnant patient with intracranial hypertension secondary to brain abscesses undergoing an emergency cesarean section: A Case Report**

**Presenting Author:** Carolina Rincón, MD MSc

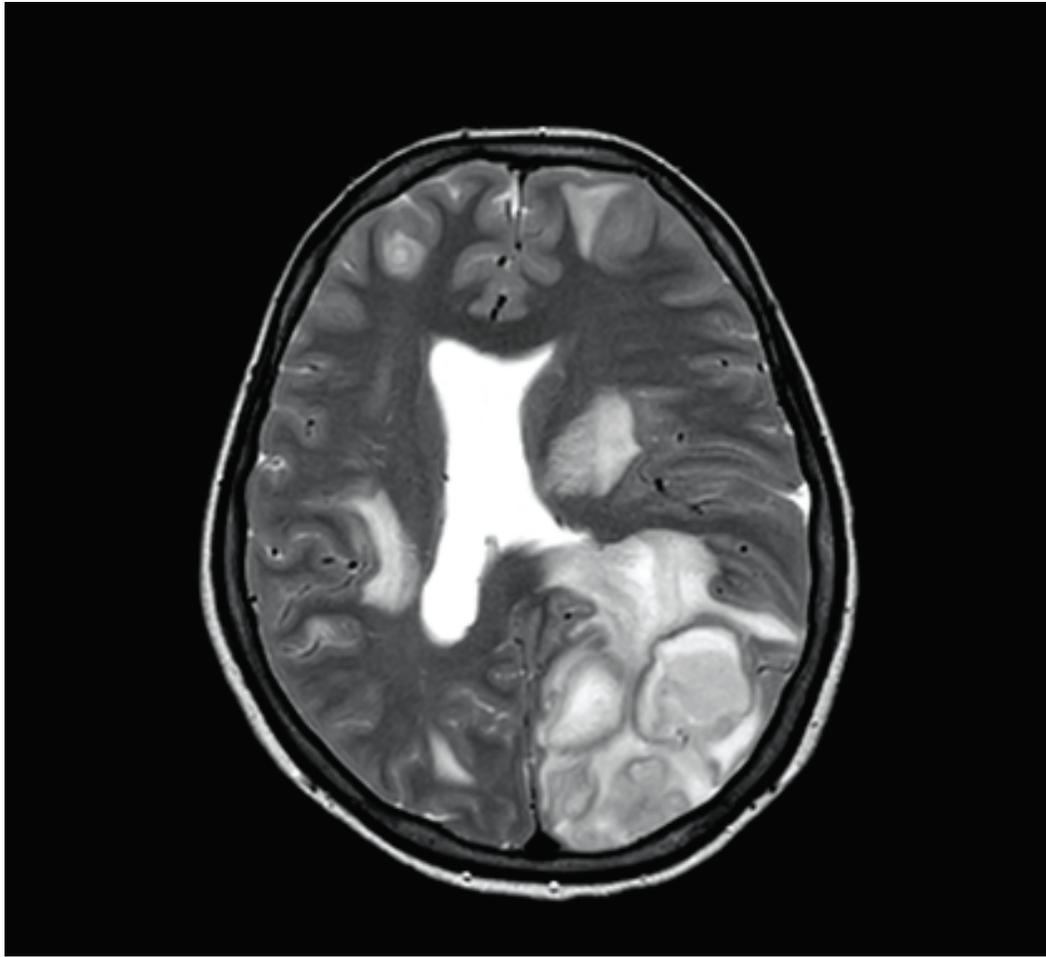
**Presenting Author's Institution:** Hospital Universitario San Ignacio, Distrito Capital de Bogota

An intracerebral abscess is a rare but life threatening infection that is extremely rare in pregnancy and presents several management dilemmas (1).

A 35 years old, G2P1 25 week pregnant woman with unremarkable history was admitted for IV antibiotic treatment of a community acquired pneumonia, during which she developed visual disturbances and altered mental status. MRI demonstrated increased intracranial pressure due to brain abscesses. After transfer to the ICU, she experienced rapid deterioration. Hypertonic saline, mannitol and dexamethasone provided no improvement. After multidisciplinary consultation it was decided to deliver the baby by cesarean. She was transferred to the OR, and an arterial line was placed. Anesthesia was induced with propofol 120mg, succinylcholine 100mg, lidocaine 100mg and fentanyl 200mcg. Hyperventilation, hypertonic saline, mannitol and furosemide were used to manage intracranial pressure. Anesthesia was maintained with a propofol infusion for neuroprotection. The patient remained hemodynamically stable and a live 840g baby, with Apgar 6-7-7, was delivered.

After the cesarean, the patient was transferred to the neurosurgical OR for an uneventful left decompressive craniectomy and drainage of intracerebral abscess. The patient then recovered with only mild right hemianopsia. The neonate enjoyed an uncomplicated course in the neonatal ICU and was discharged at 40 weeks of age.

Brain abscess is a rare but life threatening infection and an extremely rare complication during pregnancy (1), it has been associated with head trauma preeclampsia, mechanical cardiac valves, dental abscesses and thrombophilia (3). Bacterial invasion can be through contiguous spread, hematogenous spread from pulmonary or cardiac infections or unknown mechanisms (2). Early detection and diagnosis can be challenging, as the symptoms can be unspecific. Management requires consultation between multiple specialties, as possible management strategies include: delivery before decompression, decompression followed by delivery at a later date or conservative treatment with antibiotics and progression of pregnancy. Due to the severe clinical status of this patient it was decided that death was imminent and a rapid delivery was chosen. The route of delivery is also an important factor to consider as both labor and cesarean delivery have implications on neurologic and neonatal function (3). Anesthesia for both labor and cesarean section must take into consideration the possibility of raised ICP, and appropriate measures for reduction should be taken.



Abstract #: SAT-RFCP – Room 4 – 08

## Coronary Artery Embolus-Induced Peripartum Myocardial Infarction in Parturient with Fontan Physiology

Presenting Author: Damon Wallace, MD

Presenting Author's Institution: University of North Carolina - Durham, North Carolina

Anesthetic management of patients with corrected congenital cardiac disease can be challenging, to say the least. The addition of complicating factors like pregnancy and precarious anticoagulation status contributing to perioperative myocardial infarction does nothing but make these cases more complex. We present the case of a 24yo G1P0101 mother at 17 weeks with history of palliated tricuspid atresia with lateral tunnel Fontan physiology who presented with concerns for acute myocardial infarction in the setting of anticoagulation discontinuation following diagnosis of a placenta previa. She was normally maintained on prophylactic aspirin therapy and was also started on prophylactic enoxaparin while pregnant. She previously presented to the L&D triage center with painless vaginal bleeding and was diagnosed with placenta previa. Her anticoagulation was discontinued at that time, but she returned 10 days later with evidence of myocardial infarction thought to be secondary to coronary artery embolism. This occurred in the setting of anticoagulation cessation, venous stasis and altered flow dynamics associated with her Fontan surgery, and hypercoagulability of pregnancy. Given her complicated coagulation profile and high morbidity risk with continuing her pregnancy, she elected to proceed with D&E that was accomplished under general anesthesia.

Patients with Fontan circulation have altered blood flow dynamics associated with the Fontan baffle and venous circulation that puts patients at risk for systemic and intra-cardiac thromboses. In general, patients with palliated tricuspid atresia are treated with prophylactic aspirin assuming low-risk Fontan circulation. However, pregnant patients with Fontan physiology typically receive LMWH in addition to aspirin for prophylaxis, although the current data is not conclusive regarding the best strategy (1). Thus anticoagulated parturients are also at an increased risk of obstetric hemorrhagic complications. In terms of thrombotic complications, acute myocardial infarction secondary to coronary artery embolism is extremely rare in patients with tricuspid atresia as the most common complications of thromboembolism with Fontan physiology are baffle thrombosis, strokes, and pulmonary embolisms. However, there are case reports regarding coronary artery embolism in the setting of thrombus formation in the baffle (2). Care of these patients for whom the respective treatments of dual conditions are contraindicated for the other presents significant challenges and benefits from a multidisciplinary approach to medical, surgical, and anesthetic management.

Abstract #: SAT-RFCP – Room 4 – 09

## Anesthetic management of a high risk primigravida patient with brugada syndrome

**Presenting Author:** Tim Cai, MD

**Presenting Author's Institution:** Metrohealth Medical Center - Cleveland, Ohio

**Co-Authors:** Marcos Izquierdo, M.D. - Case Western Reserve University - MetroHealth

**Introduction:** Brugada syndrome is an inherited sodium channelopathy characterized by right bundle branch block and ST-segment elevation in V1-3 associated with increased risk of ventricular fibrillation and sudden cardiac death. The incidence is 1:2000. Given the devastating potential consequences, it is crucial for anesthesiologists to be familiar with detecting the ECG pattern and provide a safe anesthetic plan.

**Case Report:** We present a 20 year old G1P0 female at 28w4d gestation with di/di twins and cervical insufficiency who was genetically diagnosed with Brugada syndrome at 14 years old after a syncopal episode. She had been asymptomatic since that time, was not on any medications, nor did she have an ICD.

The patient presented for an unscheduled cesarean section because of vaginal bleeding due to prolapsed membranes and fetal malposition. A recent 12-lead ECG showed non-type 1 Brugada EKG pattern. A tetracaine spinal anesthetic was chosen as it has a reduced cardiotoxic profile when compared to bupivacaine. Prior to the induction of anesthesia, defibrillation pads were applied along with standard ASA monitors. ACLS medications and isoproterenol were immediately available. An uneventful spinal with 10mg of hyperbaric 1% tetracaine was placed with a T4 spinal level bilaterally. She was maintained on a phenylephrine infusion to maintain blood pressure. The patient delivered male infants with APGARS of 5/7 and 9/9. The remainder of her surgery was anesthetically uneventful. She was recovered in the high-risk unit with EKG monitoring throughout. She regained full motor and sensory function of her lower extremities eight hours after her spinal was placed.

**Discussion:** Fortunately, our high-risk OB team requested an anesthesiology consult as it allowed for proper planning for a safe anesthetic given several potential scenarios. Although most general anesthetics have been shown to be safe to use, we opted for a tetracaine spinal anesthetic to avoid the known risks of general anesthesia in parturients. The safety of bupivacaine spinals is conflicted in Brugada patients (1, 2). Despite the longer duration of action associated with tetracaine, we opted to avoid the bupivacaine risk altogether.

This case illustrates the anesthetic management of a high-risk patient with Brugada syndrome, with a focus on communication and preparation, leading to an optimal patient outcome.

[brugada 2 2021.pdf](#)

Abstract #: SAT-RFCP – Room 4 – 10

## Post Partum Transfusion-Related Acute Lung Injury and atypical Hemolytic Uremic Syndrome

Presenting Author: Omar El Masri, n/a

Presenting Author's Institution: Ochsner Health

### Introduction

Transfusion-related acute lung injury (TRALI) is a rare clinical diagnosis which presents with acute respiratory failure and noncardiogenic pulmonary edema during or within six hours of a blood product transfusion<sup>1</sup>. Hemolytic uremic syndrome (HUS) is a thrombotic microangiopathy characterized by intravascular hemolysis, thrombocytopenia, and acute kidney failure<sup>2</sup>. Atypical HUS (aHUS) is usually caused by uncontrolled complement activation. Pregnancy has been reported to be a trigger in about 10% of all patients with aHUS. However, aHUS remains ill-defined and is often difficult to diagnose and manage appropriately<sup>3</sup>. We present a case of TRALI and aHUS following postpartum hemorrhage (PPH).

### Case Presentation

A 37 y.o. G2P1001 woman at 39w6d presented for a scheduled cesarean delivery (CD). PMHx was significant for failed IOL due to fetal intolerance, PPH, advanced maternal age, endometriosis, & fibroids.

Patient underwent a CD complicated by 1.5L EBL for which she received 1unit of pRBC intra-op. In recovery, she had recurrent hemorrhage and sustained 750 ml blood loss. While receiving a second unit of pRBC, she became hypoxic, desaturating to 70% and hypotensive at 90/60. CXR showed bilateral diffuse pulmonary edema. POCUS exam showed B lines and no signs of cardiac strain. The transfusion was stopped, she was intubated, started on pressor support, and transferred to the ICU. TRALI was the clinical diagnosis and was later confirmed by serologic testing. She remained in ICU for 7 days and her course was complicated by resultant lactic acidosis, transaminitis, AKI and hyperkalemia- requiring CRRT. Subsequently, her anemia worsened, and she developed thrombocytopenia, consistent with aHUS. She was given 2u pRBCs and treated with eculizumab. Her anemia and thrombocytopenia improved, and her kidney function returned to baseline.

Respiratory failure resolved, and she was extubated on POD 4. She was discharged home on day 9 with Heme/Onc, ID, and OB outpatient follow up.

Her lab showed ADAM TS13-18%, normal coagulation studies, and her complement genetic markers were negative. TRALI workup revealed a donor anti-HLA antibody to an antigen our patient had.

### Discussion

TRALI has an incidence of 1 per 5 000-10 000. aHUS occurs in 1 out of every 25,000 pregnancies, mostly in postpartum, and it is associated with poor maternal outcomes<sup>4</sup>. It is known that post- partum bleeding, chorioamniotic infections, and the passage of fetal cells into the maternal circulation with induction of anti-HLA antibodies (particularly in a subsequent pregnancy) can activate alternative complement pathway and trigger HUS in congenitally predisposed patients<sup>5</sup>. But concomitant incidence of TRALI and aHUS is not well understood. Complement dysregulation is implicated in both disease states. A question this case raises is what link exists between both conditions if any.

**Labor analgesia in a patient with reported lidocaine allergy**

**Presenting Author:** Andrew Kolomensky, MD

**Presenting Author's Institution:** Ochsner Clinic Foundation

Adverse reactions to local anesthetics (LAs) are rare and often misreported as allergic reactions. Patients presenting in labor with documented allergy to LA present a particular clinical challenge. We describe a case of a primigravida with a reported history of lidocaine allergy requesting epidural analgesia for labor.

A 36 year old G1P0 at 40 weeks gestation presented to our facility for induction of labor. On chart review it was noted that the patient had a documented allergy to lidocaine. Per the patient, she previously had experienced several episodes of chills, rigors, and 'anxiety' following injection of lidocaine for dental procedures, with at least once instance necessitating rescheduling of the procedure. Of note, the patient had presented at 11 WGA with acute appendicitis and underwent laparoscopic appendectomy. No LA was administered for the procedure and she was advised to see an allergist prior to delivery, however the patient declined allergy testing.

The patient strongly desired epidural analgesia for her labor and was very anxious about any alternative options. Given the lack of previous allergy testing, the patient was counseled and offered chloroprocaine as an alternative to amide LAs. The patient received a dural puncture epidural with chloroprocaine used to both anesthetize the skin and for initial bolusing. An infusion of chloroprocaine 0.3% with fentanyl 2mcg/mL was started at 10mL/hr. The infusion concentration and rate were titrated to patient comfort and appropriate level of analgesia, which eventually required increasing the chloroprocaine concentration to 0.6% and the rate to 14 mL/hr. The patient delivered via forceps-assisted vaginal delivery. Despite again being advised to follow up with an allergist, the patient has not done this to date.

Non-allergic reactions to LAs are far more common than true allergy, with psychomotor and vasovagal reactions being among those seen in the former category. Cross-reactivity within amide LAs is common, however cross-reactivity between amide and ester groups is not generally observed. Given this, ester group LAs offer a potentially suitable alternative to amides for epidural analgesia. Few case reports exist reporting the use of chloroprocaine for this purpose with the concentration utilized varying to a high degree. Epidural chloroprocaine labor analgesia may offer a safe and effective alternative in the parturient presenting with reported amide LA allergy.

Abstract #: SAT-RFCP – Room 4 – 12

### Syrinx and Symptomatic COVID in Pregnancy

Presenting Author: Robert P. Schroell, III, MD

Presenting Author's Institution: The Ohio State Wexner Medical Center - COLUMBUS, Ohio

**Case:** A 31yo F G3P0111 at 34w2d presented with headache and severe range blood pressures(BPs) and was diagnosed with pre-eclampsia with severe features. She had an additional history of prior cesarean(CD) with difficult spinal placement, scoliosis, temporary paraplegia after motor vehicle crash, and T8-T9 spinal fusion complicated by syringomyelia with sensory deficits below this level. She also presented with recent onset cough, congestion, fatigue, and shortness of breath and tested positive for COVID-19. An outpatient MRI prior to pregnancy showed two syrinx; one at C7-T1 and one extending from T2 to the filum terminale, so a neurosurgery consult was placed to discuss risks of neuraxial anesthesia. On exam she was Mallampati 3, with good neck movement. She had chronic paresthesia to bilateral fingers and toes but was otherwise neurologically intact without symptoms of weakness or other paresthesia. Neurosurgery cautioned that significant alterations in CSF fluid dynamics can occur as a result of syrinx which increased the risk of injury to the spinal cord and nerve roots, increasing the risk of herniation with intrathecal injection. The patient had persistently elevated BP and worsening headache, so prompt CD was indicated before repeat spine imaging was able to be completed. Despite symptomatic COVID-19 infection after a multidisciplinary discussion with the neurosurgical, OB, and anesthesia teams, the decision was made to proceed with general anesthesia given lack of updated imaging to better characterize her syringomyelia, and risks of neurologic injury with neuraxial anesthesia and known syrinx. Rapid sequence induction and ETT placement was uncomplicated(grade 1 view with McGrath Mac3). After an uneventful CD, she was successfully extubated, without respiratory events. She was discharged home POD3 with routine follow-up.

**Discussion:** Syringomyelia is a rare spinal cord pathology that results in damage to tissues due to formation of a syrinx, or cyst. There is limited data regarding management of parturients with syringomyelia. Anesthetic management of parturients with syrinx present several unique challenges due to changes in CSF flow dynamics seen in pregnancy, potential for difficult block placement, and risk of additional syrinx formation following purposeful or accidental dural puncture during epidural or intrathecal injection.

Neuraxial anesthesia has several advantages in patients with COVID-19 infection. In addition to excellent post-operative analgesia, maintaining spontaneous ventilation and avoiding aerosolizing procedures such as intubation is also advantageous in a patient with active respiratory symptoms due to COVID-19 infection. (2)

The risk of devastating neurological consequences due to herniation from shifts in CSF flow dynamics outweighed the risk of instrumenting the maternal airway in a term parturient with a high risk of pulmonary complications from symptomatic COVID-19.

[RPS-Syrinx-Covid Abstract image.pdf](#)

Abstract #: SAT-RFCP – Room 4 – 13

### Anesthetic Management of a Parturient with a Syringo-pleural Shunt

Presenting Author: Karim Shuaib, MD

Presenting Author's Institution: Stony Brook University Hospital

Syringomyelia is a slowly progressive neurological condition characterized by the formation of a fluid-filled cavity (syrinx) within the spinal cord. Shunt placement through a syring is indicated for patients who failed decompression due to syring enlargement or persistent symptoms. A 29-year-old woman with a repaired Arnold Chiari Type II malformation that required multiple neurosurgeries, and bilateral syringo-pleural shunt placement for residual syringomyelia, presented for emergent cesarean delivery under general anesthesia for fetal bradycardia and maternal hypoxia initially thought to be secondary to increased shunt drainage into the pleural space. Following delivery, the patient was persistently hypoxic and found to have a bilateral multifocal pneumonia. The patient had no exacerbation or worsening of her neurological function. Here we report the safe use of general anesthesia for emergent cesarean delivery in a parturient with syringomyelia and bilateral syringo-pleural shunts. There are few reports on pregnancies with syringo-pleural shunts, especially those that may be the cause of an underlying infection or fluid collection. It is imperative to employ a multidisciplinary approach in managing these patients as the physiologic changes in pregnancy can make the delivery of these patients' complex. Fortunately, it appears that anesthetic complications occur infrequently regardless of anesthetic technique and mode of delivery.



## Local Anesthetic Systemic Toxicity after Transversus Abdominis Plane Block in the Parturient: Early Recognition and Treatment

**Presenting Author:** Christian R. Tilley, MD

**Presenting Author's Institution:** New York-Presbyterian/Weill Cornell Medicine - New York, New York

**Co-Authors:** Sharon E. Abramovitz, M.D. - New York-Presbyterian/Weill Cornell Medicine

John Brumm, M.D. - New York-Presbyterian/Weill Cornell Medicine

Joe E. Bryant-Huppert, M.D. - New York Presbyterian - Weill Cornell Medicine

**Introduction:** Local anesthetic systemic toxicity (LAST) is a known and potentially fatal complication of regional anesthesia occurring in 0.27 episodes per 1,000 peripheral nerve blocks<sup>1</sup>. While factors such as local anesthetic dose and location are the most obvious risk factors for LAST, parturients are not well-studied and may be at higher risk. The transversus abdominis plane block (TAP) is becoming an increasingly popular technique to provide post-operative analgesia after cesarean delivery. Increased utilization of TAP blocks requires proper LAST education and training, and necessary resources to be available in centers to care for this complication.

**Case:** A 29-year-old 75kg G7P2143 with past medical history of prior cesarean sections and anaphylactic reaction to morphine presented for scheduled repeat cesarean delivery. The anesthetic plan was spinal bupivacaine 1.6cc with 15mcg fentanyl, plus post-operative bilateral TAP block with 40cc 0.25% bupivacaine given the contraindicated use of spinal morphine. The delivery was uncomplicated, and the patient was taken to PACU after ultrasound guided TAP block. Twenty minutes later, the patient experienced a grand-mal seizure which resolved without pharmacologic intervention. Although the patient required supplemental oxygen for hypoxia (O<sub>2</sub> 95%), she was otherwise hemodynamically stable and regained mental status after seven minutes. Fat emulsion (Intralipid™) 100cc bolus was given, followed immediately by an additional 200cc over the next 20 minutes for the presumed diagnosis of LAST in the setting of bupivacaine administration. The patient did not have any additional seizures or signs of LAST such as arrhythmia or cardiovascular collapse. The remainder of her course was uncomplicated, she was discharged on post-partum day 2.

**Discussion:** LAST has been recognized as a potential cause for maternal morbidity and mortality. The incidence of LAST may become more common given the increasing use of TAP blocks for post-cesarean section pain. Parturients are at an increased risk for LAST due to increased neuronal sensitivity to and decreased protein binding of local anesthetics, as well as anatomic changes that lead to vascular engorgement and increased tissue blood flow. Implementation of acute lipid resuscitation helps facilitate reduction in morbidity and mortality in these cases. Providers must anticipate this potential complication and initiate timely and appropriate intralipid intervention of 100cc bolus for patients >70kg, and 1.5cc/kg for patients < 70kg, as well as support hemodynamics and aim to break seizure activity<sup>5</sup>. The use of cognitive aids and checklists will help facilitate rapid responses to these emergency situations.

## Undiagnosed Mitral Stenosis Presenting with Arrhythmia and Pulmonary Edema in Peripartum Care: A Case Report

**Presenting Author:** Joe E. Bryant-Huppert, M.D.

**Presenting Author's Institution:** New York Presbyterian - Weill Cornell Medicine, New York

**Introduction:** Mitral stenosis (MS) is the most common valvular lesion in pregnancy and is associated with significant maternal morbidity and mortality. Specifically, undiagnosed MS during pregnancy can lead to unexpected complications such as atrial tachyarrhythmias, thromboembolic events, heart failure and fluid overload. Prompt diagnosis and acute management of these symptoms is crucial in mitigating further cardiovascular risk.

**Case:** A 31-year-old female, G6P1132, with rheumatoid arthritis presented at 40 weeks gestation for induction of labor. At baseline she was noted to be mildly tachycardic with heart rate (HR) in the 110's, but otherwise reported to be at her baseline, unimpaired functional status. Labor analgesia was initiated with a combined spinal epidural and maintained with a standard patient-controlled epidural infusion. Hours later during active labor, she became acutely dyspneic with HR 160's and associated hypoxia and bilateral crackles on lung exam for which furosemide 10mg IV was empirically given. Labor rapidly progressed and she quickly had a spontaneous vaginal delivery. Immediately postpartum, an arterial line was placed for close hemodynamic monitoring as pressors were initiated for hypotension. Work up showed bilateral infiltrates on chest radiograph and transthoracic echocardiogram suggested moderate mitral stenosis, severe pulmonary hypertension and right ventricular overload. Point-of-care ultrasound revealed A-lines and B- consistent with flash pulmonary edema. Cardiology and cardiothoracic surgery were consulted and her condition was optimized on a regimen of beta blockers and diuretics. At 6 weeks postpartum, the patient underwent mechanical mitral valve replacement and was placed on long term anticoagulation.

**Discussion:** Parturients with MS can safely receive neuraxial anesthesia for labor. Telemetry should be available and invasive hemodynamic monitoring considered. Anesthetic goals include maintaining adequate preload/afterload and avoiding tachycardia. Triggers of pulmonary hypertension such as hypercarbia, hypoxia and severe pain should also be prevented. Clinical signs of acute heart failure and fluid overload should be quickly addressed with diuresis and beta blockade. Echocardiography can assess severity of valvular disease. Surgical options for MS such as percutaneous valvuloplasty, commissurotomy, mitral valve repair or replacement should be tailored to the patient. Overall management of MS in a parturient involves appropriate diagnosis, early intervention and multidisciplinary care to improve maternal outcomes.

Abstract #: SAT-RFCP – Room 4 – 16

### Spontaneous liver rupture in parturient in the absence of preeclampsia or HELLP syndrome

**Presenting Author:** Andrew Gallagher, M.D.

**Presenting Author's Institution:** University of Vermont Larner College of Medicine

**Co-Authors:** Lydia S. Grondin, M.D. - University of Vermont Larner College of Medicine

Bridget Marroquin, M.D. - University of Vermont Larner College of Medicine

**Abstract:** Spontaneous liver rupture is a rare complication of pregnancy, generally associated with preeclampsia or hemolysis elevated liver enzymes low platelets (HELLP) syndrome. We describe a case of 28-year-old G2P0010, admitted with acute abdominal pain, who developed spontaneous liver rupture, in the absence of a diagnosis of preeclampsia or HELLP.

**Introduction:** Spontaneous liver rupture during pregnancy has an estimated incidence of 1 in 45,000 live births, with maternal mortality ranging from 15 to 59 percent.<sup>1,2</sup> The vast majority of cases are associated with preeclampsia or HELLP syndrome; however, the hypertensive component may be subtle.

**Case:** A 28-year-old G2P0010 female at 33 weeks 4 days gestation, presented to Labor and Delivery (L&D) for elevated blood pressure readings at home and mild headaches. Past medical history notable for sporadic elevated blood pressure readings, without a formal diagnosis of HTN and no medications. Her preeclampsia labs were normal. She was discharged and represented three days later with sharp abdominal pain and fetal bradycardia. She was brought to the OR for an emergency cesarean section, where she became hypotensive. Two liters of blood were discovered in the abdomen. Massive transfusion protocol was initiated. The baby was rapidly delivered and Acute Care Surgery was paged. A capsular tear at the inferior edge of the left lobe of the liver was found, and controlled with cautery and packing. Both patient and neonate survived and were discharged post op day 10.

**Discussion:** In addition to hypertensive disorders, case reports indicate that spontaneous liver rupture in pregnancy is also correlated with pre-existing liver disease states such as hepatocellular carcinoma, hepatic adenoma, hepatic abscess, acute fatty liver of pregnancy.<sup>3</sup> In our case, the patient had a history of sporadic elevated blood pressure readings, yet no diagnosis of chronic hypertension, preeclampsia, HELLP syndrome, nor elevated labs. Her presentation outside of the context of these is rare. However, similar to other patients with spontaneous liver rupture, she presented vague signs and symptoms with abdominal discomfort and hypotension. Once recognized, expeditious actions by her care team led to delivery, surgical hemostasis, and resuscitation. In summary, hepatic rupture of pregnancy can be difficult to diagnose, yet carries a high rate of maternal mortality, and may present without formal diagnoses.

Abstract #: SAT-RFCP – Room 4 – 17

## Cardio-obstetric management of mitral cleft with LVOT obstruction in a rural center

Presenting Author: Leigh C. Hickerson, MD

Presenting Author's Institution: Dartmouth-Hitchcock Medical Center - Lebanon, New Hampshire

### Introduction

A patient presented at 21 weeks gestation to a rural center with congenital mitral cleft and left ventricular outflow tract (LVOT) obstruction. Congenital cleft mitral defects occur in 1 in 1340 patients.<sup>1,2</sup> Chordae malinsertion with LVOT obstruction occurs in 13% of cases. The competing hemodynamic goals for mixed cardio-obstetric lesions provide an anesthetic challenge.

### Case

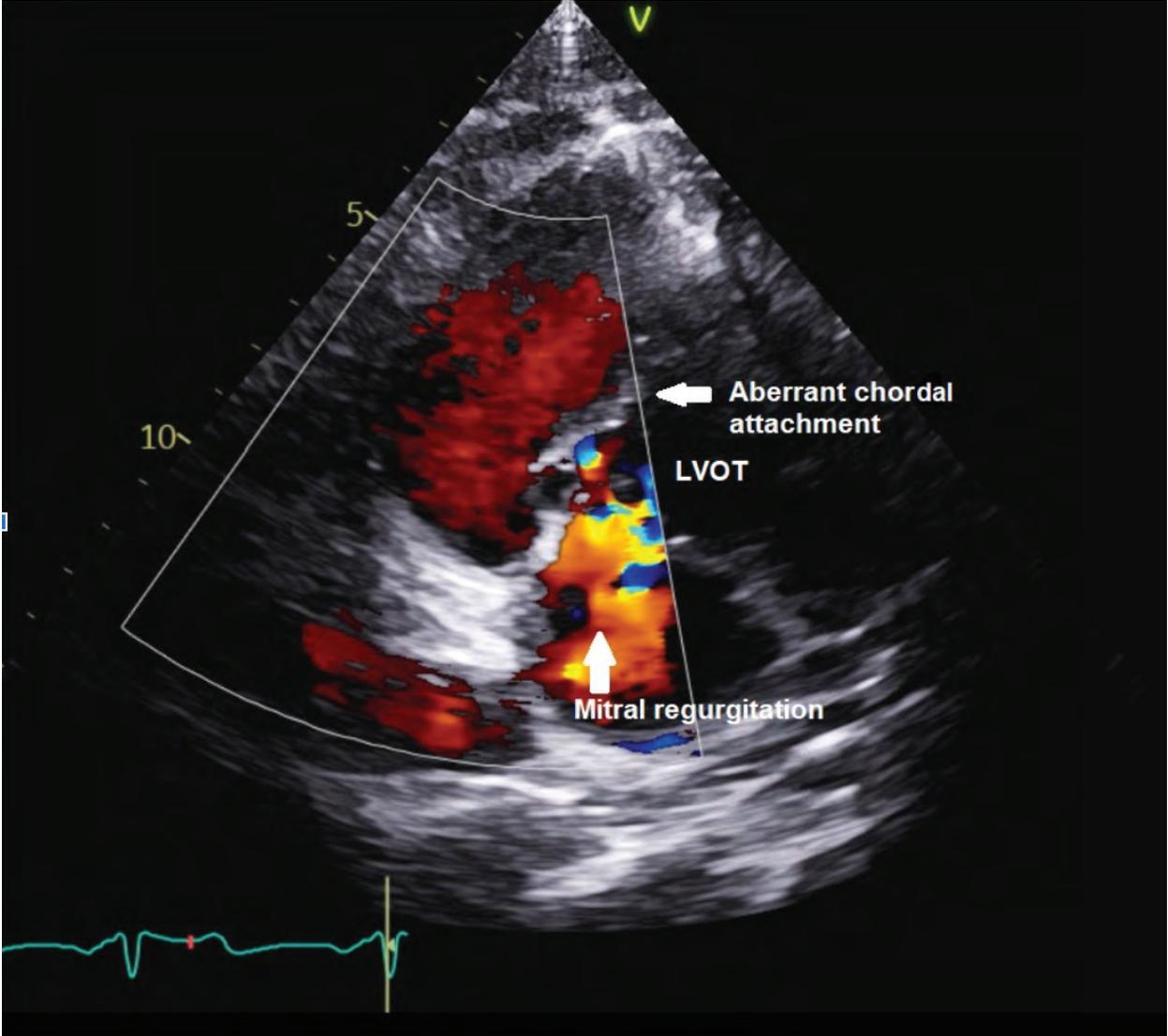
A 26 year old female presented at 21 weeks gestation to cardio-obstetrics. Her history included severe mitral regurgitation (MR) due to congenital anterior cleft and anomalous chordal attachment resulting in fixed LVOT obstruction.(Fig 1) Repeat echocardiography at 36 weeks showed a fixed peak gradient of 17mmHg. She remained New York Heart Association class I but developed a breech presentation. External cephalic version (ECV) was performed hospital day (HD) two under dural puncture epidural with 100mcg fentanyl and 12.5mL 3% chloroprocaine in 2.5mL increments without fluid bolus. Hypotension was avoided with vasopressin. After successful ECV, induction was initiated. Her epidural was replaced twice due to reduced efficacy. Labor arrested after 19 hours and cesarean section was arranged.

For cesarean delivery, an arterial line was placed prior to bolusing the epidural with 100mcg fentanyl and 17.5mL 3% chloroprocaine in divided doses. Vasopressin and esmolol were used to avoid tachycardia and offset vasodilation. After delivery of a viable male infant, tranexamic acid was pre-emptively administered due to the potentially severe hemodynamic consequences of postpartum hemorrhage. Estimated blood loss was 700mL. Vasopressin was weaned soon after during a two hour PACU stay. She was discharged HD seven.

She presented day eight with worsened lower extremity edema, blood pressure of 117/70, and creatinine 0.67mg/dL. Platelets were not measured. She was prescribed furosemide for five days with daily weights. On day 19, she presented to an outside facility with seizure-like activity with normal platelets and electrolytes and treated with magnesium and levetiracetam.

### Discussion

The deciding factor for unassisted trial of vaginal delivery was low LVOT gradient with no dynamic obstruction. Her CARPREG II score of three conferred a 15% risk of cardiac event. The cause of her postpartum edema and seizure is unclear. It is possible her seizure-like activity was post-syncopal in the setting of aggressive diuresis versus supraventricular arrhythmia, or perhaps due to eclampsia. Coordination of obstetric care for complex congenital heart disease is critical in rural centers with maternal morbidity odds ratio of 1.61 as compared to major city centers.<sup>3</sup>



## Neuraxial Anesthesia Affected by a Sacral Tarlov Cyst

**Presenting Author:** Ashlee V. Gourdine, MD

**Presenting Author's Institution:** University of Maryland School of Medicine - Baltimore, Maryland

**Co-Authors:** Shobana Bharadwaj, MBBS - University of Maryland School of Medicine

Nicolas Dorsey, MD, PhD - University of Maryland School of Medicine

Bhavani S. Kodali, MBBS, MD - University of Maryland School of Medicine

A 37-year-old G3P1011 at 23 weeks presented for dilation and evacuation secondary to fetal anomalies. Her medical history included intermittent headaches and previous chronic low back pain with rare lower extremity radiculopathy. A subsequent MRI was significant for a small perineural cyst within the sacral spinal canal at the S2 level measuring 1.2 x 0.8 cm. She reported alleviation of her lumbar back pain with physical therapy and denied significant weakness or radiculopathy after time of diagnosis.

The patient selected neuraxial anesthesia for the procedure. The anesthetic plan was to place spinal anesthesia above the L5 level with hyperbaric bupivacaine 0.75%. A 25-gauge spinal needle was utilized with an introducer. Gravity flow of clear cerebral spinal fluid was observed prior to administration of the intrathecal dose. The patient's sensory and motor block was assessed with the perception of pain to pinprick and strength of hip flexion and extension, respectively. Loss of sensation was observed at dermatome levels T7 to S3, with dense motor block bromage 2 on the left and T10 to L1 and no motor block on the right. The subsequent neurological assessment demonstrated an unchanged sensory and motor exam, with no improvement in sensory or motor blockade in the upper thoracic dermatomes or her right lower extremity. The decision was made to convert to general endotracheal anesthesia (GETA). The procedure proceeded uneventfully without complication, and the patient recovered successfully in the post anesthesia care unit with a return of baseline neurological status after resolution of the neuraxial block.

Our case provides a unique presentation and clinical course involving neuraxial anesthesia in a patient with a perineural cyst. Despite appropriate neuraxial technique and post procedural positioning after spinal, block assessment demonstrated abnormal intrathecal spread of local anesthetics and inadequate surgical block-requiring conversion to GETA. Located between the endoneurium and perineurium, perineural cysts of the spinal nerve roots are more commonly found in the sacral region of the spinal column. Since their discovery, several case reports and studies have described the surveillance and surgical management of asymptomatic and symptomatic perineural cysts. There is notably a paucity of studies regarding neuraxial anesthesia in this subset of patients. This case suggests there is a higher risk of neuraxial failure in patients with asymptomatic and symptomatic perineural cysts and provides clinical considerations for their identification and management.

**To get pregnant or not to get pregnant: Post-Fontan parturient**

**Presenting Author:** Jennifer Hoayek, MD

**Presenting Author's Institution:** The University of Texas Health Science Center in Houston

**Co-Authors:** Barbara Orlando, MD - The University of Texas Health Science Center in Houston

Mitesh Thakkar, MD - The University of Texas Health Science Center in Houston

**Background:** Congenital heart disease (CHD) affects approximately 0.6% of all live births. With the advancements in cardiac surgery, the number of women reaching child-bearing age after Fontan procedure is increasing the unique circulation combined with the hemodynamic alterations during pregnancy require special anesthetic considerations.

**Case Presentation:** This is the case of a 23-year-old primipara with a history of a repaired single ventricle (Glenn, Fontan) during childhood. Clinically, her baseline saturation was > 90% on room air, with good functional capacity (New York Heart Association class I). Echocardiogram showed preserved single ventricular systolic function, ejection fraction of 60-65% and unobstructed Glenn and Fontan pathways on cardiac CT angiogram.

A multidisciplinary meeting led to her being scheduled for a cesarean delivery (CD) at 34 weeks with the pediatric cardiac team on standby in the cardiac OR; to minimize the risk of arrhythmias or worsening heart failure in the setting of major fluid shift. During her follow up appointment, she was found to have fetal growth restriction and went for an emergent CD at 31 weeks.

Upon arrival to the operating room, defibrillator pads were attached. A radial arterial line and a right internal jugular central venous catheter were placed for BP and central venous pressure (CVP) monitoring. A CSE was placed with low dose intrathecal bupivacaine 0.75% (6 mg), Duramorph (0.15 mg) and fentanyl (10 mcg) to avoid significant decrease in systemic vascular resistance (SVR). Femoral arterial and venous access were secured by the Heart failure team in case of an emergent ECMO. To preserve SVR and cardiac output, we slowly titrated the epidural with 10 mL of 2% lidocaine administered over 25 minutes in 3 mL increments. Left lateral tilt was also used to avoid aortocaval compression. The initial CVP reading was 14 mmHg and blood pressure was in the 150/80 mmHg range; maintained with the titration of both a phenylephrine infusion and labetalol boluses. These measures all successfully contributed to the hemodynamic stability observed in our patient throughout the CD.

She was recovered in the cardiac ICU for 24 hours. She was followed by cardiology and required Lasix boluses and 2L of oxygen via nasal cannula to keep her saturation >90%. She was discharged on day 6 after weaning her off oxygen.

**Discussion:** Successful management of women with CHD repair reaching childbearing age is facilitated through coordinated efforts of a multidisciplinary team to adequately anticipate the increased risk of complications such as arrhythmias or hemorrhage throughout the perioperative course.

**Abstract #: SAT-RFCP – Room 4 - 20**

**Managing Labor in the Cardiac Intensive Care Unit; a Patient with Congenital Ebstein Anomaly**

**Presenting Author:** Benjamin Hyers, MD

**Presenting Author's Institution:** Icahn School of Medicine at Mount Sinai

**Co-Authors:** Joshua Hamburger, MD - Icahn School of Medicine at Mount Sinai

Poor outcomes are associated with not providing timely care for pregnant patients with cardiac disease<sup>1</sup>. Many factors contribute to caring for these patients safely including arranging for delivery in an appropriate location, planning with multiple teams, and preparing for all possible scenarios related to the patient's delivery.

A 36 year old female G2P1001 at 34 weeks 5 days gestation presented to the hospital with PPRM and intermittent contractions. Her medical history was significant for Ebstein anomaly with multiple prior surgeries including tricuspid valve repair then replacement, atrial flutter with MAZE procedure, and insertion of a PPM. Her echocardiogram showed moderate to severe tricuspid valve stenosis with an average gradient of 16 mmHg and right ventricular dysfunction. She endorsed dyspnea on exertion with minimal activity. Immediate plans were made for admission to the cardiac intensive care unit (CCU) for continuous telemetry monitoring and induction of labor.

An operating room near the ICU was prepared in advance for the possibility of an urgent cesarean delivery. A dedicated anesthesiology team assumed care in the CCU overnight. Prior to induction of labor, an arterial line was placed, defibrillation pads were applied, and an epidural was inserted at the L4-L5 interspace. A PCEA infusion of 0.0625% bupivacaine and 2ug/mL fentanyl was initiated. Labor progressed with oxytocin augmentation and heart rate was controlled with metoprolol. The neonatal team was informed when stage 2 was imminent. Maternal heart rate was maintained below 85 bpm with an esmolol infusion and boluses by the anesthesiology team. A healthy baby was delivered after 30 minutes of pushing.

Post-delivery, the patient remained in the CCU for monitoring. Metoprolol was continued and furosemide was started. She had two episodes of asymptomatic NSVT on postpartum days 2 and 3. Her pacemaker was interrogated and her metoprolol dosage was increased. She was discharged home on postpartum day 5 with obstetric and cardiology follow-up.

Managing pregnant patients with congenital heart disease is becoming more common because these patients are surviving to adulthood and proceeding with pregnancy<sup>2</sup>. The patient presented above required a hospital with emergency cardiac intervention capability and a delivery location with adequate monitoring. A dedicated anesthesiology team was deployed to the CCU given the CCU's distance from the labor suite and complexity of the case. A large multi-disciplinary team with careful planning, delineation of roles, and close communication successfully managed this patient's labor and delivery even though each individual practitioner was outside of their normal practice areas. This planning took place weeks before in cardiology clinic with cardiology, obstetrics, and anesthesiology teams.

Abstract #: SAT-RFCP – Room 4 - 21

## Anesthetic Management of a parturient with Moya Moya Syndrome and Sickle cell Disease

**Presenting Author:** Teshi Kaushik, MD

**Presenting Author's Institution:** Emory University - Decatur, Georgia

**Co-Authors:** Erica M. Johnson, MD - Emory University

Moyamoya disease is characterized by chronic progressive stenosis of the terminal portion of the internal carotid arteries and the formation of collateral circulation of abnormal net-like blood vessels. Parturients with this disease have a higher risk of hemorrhagic and ischemic stroke due to physiologic vasodilation, hypervolemia, and hypercoagulability changes of pregnancy. During labor hyperventilation can induce ischemic attack due to cerebral vasoconstriction and, pain and bearing down can induce intracranial hemorrhage due to hypertension.<sup>1</sup> Sickle cell disease in pregnancy is associated with exacerbated anemia and cardiac stress due to hypervolemia, vasculopathy affecting placental health, and hypoxemia due to increased oxygen demand.<sup>2</sup>

22 yr. G1P0 at 37 weeks with pregnancy complicated by a history of sickle cell disease (SCD) (HgbSS), multiple CVAs/TIAs, Moyamoya syndrome, history of DVT, and partial complex seizures presented in active labor and newly diagnosed pre-Eclampsia. She had undergone two encephalo-duro-arterio synangiosis (EDAS) procedures for her Moyamoya syndrome and was getting monthly exchange transfusions to keep her level of Hb SS < 30% for her Moyamoya disease. After much multidisciplinary discussion, it was decided to proceed with vaginal delivery. An epidural was placed, maintained with bupivacaine 0.125% and fentanyl infusion. Later the patient underwent urgent cesarean section (CS) secondary to fetal intolerance to labor. Bupivacaine 0.5% was given in the epidural space to achieve anesthesia with no complication. Hemodynamics were controlled with titrated doses of metoprolol and using invasive monitors to monitor blood pressure and volume status. The c-section and postpartum period were uncomplicated.

Historically, the CS has been preferred for delivery in Moyamoya; however higher blood loss and VTE risk are associated with CS. Recent data suggests VD under epidural anesthesia with vacuum extraction is helpful to avoid the Valsalva maneuver. The goal is to maintain hemodynamic stability and normocapnia.<sup>1</sup> Surgical treatment of Moyamoya disease is intracranial bypass grafting after which successful labor and delivery have been reported.<sup>3</sup> For SCD parturient no specific anesthetic is recommended. Regardless of the choice of anesthetic, it is important to avoid hypothermia, hypoxemia, hypovolemia, acidosis, and hypotension.<sup>2</sup>

Abstract #: SAT-RFCP – Room 4 - 22

## Massive Obstetric Hemorrhage Complicated by Submassive Pulmonary Embolism - A *Massive* Case Report

Presenting Author: Roy Lei, MD

Presenting Author's Institution: The University of Texas Health Science Center in Houston - McGovern Medical School

Postpartum hemorrhage (PPH) is responsible for 25% of maternal deaths each year. While PPH is a major complication of cesarean delivery, the risk of thromboembolism during and after pregnancy is increased. Our case report highlights these complications occurring during the same hospital course.

Patient is an otherwise healthy 32-year-old G1P0, admitted for induction of labor for A1GDM and Pre-E w/o SF. The labor course was complicated by chorioamnionitis and NRFHT which led to cesarean delivery. An adequate level of anesthesia was achieved via pre-existing epidural. After delivery, the OB noted pulsatile bleeding and called for backup with concern for uterine artery laceration. Patient was hypotensive with MAPs ~50s with increasing somnolence. This was communicated to OBs. An arterial line was placed, patient positioned in steep Trendelenburg, central access was obtained, MTP and pressors were initiated. Patient was intubated for airway protection. The OBs reported hemorrhage control despite suboptimal MAPs. Patient remained intubated and was transferred to ICU.

In the ICU, patient remained hemodynamically unstable, and was soon taken back to the OR for an ex-lap. A source of bleeding was not found, so ultimately the OBs decided to perform a hysterectomy. Patient remained unstable, so IR was consulted. Hemostasis was achieved after embolization of the left internal iliac artery.

Patient was extubated on POD3. During an examination under anesthesia and vaginal packing removal on POD4, she acutely desaturated and became hypotensive upon induction. Manual ventilation via the ETT was initiated with minimal improvement. Imaging revealed submassive pulmonary embolism of the right main pulmonary artery. TTE revealed severely depressed LVEF at 20-25% with RVSP of 38. Heparin infusion was initiated. She was extubated on POD6 and repeat TTE showed improvement of EF to 50-55%. The remaining hospital course was uneventful, and she was eventually discharged on POD14.

EBL is often undercalculated, and most parturients can lose up to 1000 mL of blood with minimal hemodynamic changes. Due to maternal changes in cardiac output, substantial blood volumes can be lost very quickly, so there needs to be a prompt decision for transfusion/resuscitation and definitive therapy when significant blood loss is recognized.

PPH is a risk factor for thrombosis, especially if transfusion occurs. Must consider mechanical thromboprophylaxis; pharmacologic prophylaxis should be postponed until coagulation has normalized.

Lastly, communication is key. Massive obstetric hemorrhage necessitates a multidisciplinary effort. Early involvement of teams outside of L&D is also important to coordinate perioperative care and stabilization.

Abstract #: SAT-RFCP – Room 4 - 23

### Stranger Things: COVID Vaccine Induced ITP in a Parturient

Presenting Author: Meredith Shaw, MD

Presenting Author's Institution: LSUHSC Anesthesiology - New Orleans

#### Introduction:

With the continuation of the COVID-19 pandemic, the impact of the virus and implementation of vaccinations will continue to effect previously routine obstetric care. As thrombocytopenia is a known rare complication of COVID-19 vaccination, benefits and potential complications from vaccination are important to highlight to patients but should also be discussed in the context of the novelty of the current pandemic experience (1).

#### Case Presentation:

A 34yo G1P0 at 39 WGA with no PMHx presented for induction of labor (IOL) 2/2 gestational diabetes. Initial admission lab work demonstrated new thrombocytopenia (TTP) with a platelet count of 94 K/uL. Her last normal platelet count was one month before presentation for delivery. Repeat labs the following morning showed a further decrease in platelet count to 88 K/uL. She had no clinical or laboratory signs suggesting preeclampsia and denied symptoms of coagulopathy. PT, PTT, and INR remained in normal range. She endorsed an uncomplicated first and second COVID-19 vaccine and had received a Moderna COVID booster shot 6 days prior to presentation. Considering the characteristics of her TTP, our Obstetric Anesthesiology and OBGYN care teams discussed possible etiologies including immune thrombocytopenia (ITP) vs gestational TTP and management options including discharging the patient with a course of oral steroids for IOL at a later date. The patient elected to continue with induction, and neuraxial labor analgesia was administered after confirmation of stable platelet count. At approximately 36 hours post induction, the patient underwent cesarean delivery 2/2 failure to progress. She was discharged on PPD#3 without complication and with a final platelet count of 99 K/uL.

#### Discussion:

The more common etiologies of thrombocytopenia in parturients include gestational thrombocytopenia, ITP and thrombocytopenia due to hypertensive disorders of pregnancy (2). This case suggests a potential need to exercise caution in performing neuraxial procedures in parturients recently vaccinated for COVID-19 prior to obtaining a platelet count. Discussions involving the risks and alternatives for all possible outcomes with a multidisciplinary care team is essential for quality patient care, and consideration should also be given to availability of consultant services such as Hematology if time allows.

**Abstract #: SAT-RFCP – Room 4 - 24**

**Coagulation Assessment and Anesthetic Concerns after Plasmapheresis in a Parturient with Familial Hyperlipidemia Type III and Preeclampsia**

**Presenting Author:** Priyanka Shetty, DO

**Presenting Author's Institution:** University of Connecticut

**Background:** Familial hyperlipidemia type III is an autosomal recessive genetic condition caused by a mutation in the APOE gene (1). Patients with this disease typically present with hyperlipidemia and hypertriglyceridemia, responsive to dietary modifications, statins, and fibrates. Noncompliant patients may require plasmapheresis in order to manage elevated triglyceride levels. Anesthetic management of a patient undergoing plasmapheresis treatment requires particular attention to the patient's platelet count, function, and coagulation studies (2).

**Case:** A 31 year old female G4P0121 at 32 weeks gestation presented to labor and delivery with elevated blood pressures and epigastric pain. Her medical history was significant for familial hyperlipidemia type III and HELLP syndrome in a prior pregnancy. On admission, her lab work demonstrated significantly elevated triglyceride and lipase levels. Because the initial preeclampsia work up was negative, hypertriglyceridemia induced pancreatitis was established as the principal diagnosis. Patient underwent plasmapheresis as per cardiology recommendation, followed by transfusion of 2 units of fresh frozen plasma. Triglyceride and lipase levels improved, but she continued to have elevated blood pressures (153/86). The next day, the patient developed new onset thrombocytopenia with significant downtrending of platelets. At that time, preeclampsia workup was repeated, and her protein:creatinine ratio was elevated. In the setting of new onset of thrombocytopenia and recent plasmapheresis, a thromboelastogram (TEG) and coagulation panel were performed to assess the patient's coagulation status. Both tests were unremarkable. The patient underwent a c-section under neuraxial anesthesia for a new diagnosis of preeclampsia with severe features. She had an uneventful procedure and recovery, and was discharged on post operative day 4 without complications.

**Discussion:** Parturients undergoing plasmapheresis may be at increased risk of depletion coagulopathy. Fresh frozen plasma administration following plasmapheresis may replete coagulation factors and prevent subsequent bleeding diathesis. Coagulation panel and TEG are useful tools, and should be performed to assess coagulation status of this patient population prior to attempting neuraxial anesthesia. Multidisciplinary approach is key to minimize maternal morbidity and prevent devastating complications associated with significant hemorrhage.

Abstract #: SAT-RFCP – Room 4 - 25

**Ketamine Dart in a Acutely Psychotic, COVID+ Patient in Preterm Labor**

**Presenting Author:** Melanie Wood, MD

**Presenting Author's Institution:** Yale School of Medicine

**Co-Authors:** Phil Rubin, MD - Yale School of Medicine

23 year-old G3P0 at 27 weeks, CoVID+, presented in preterm labor with PMH of substance-induced psychosis, intermittent explosive disorder, suicide attempt, and psychogenic seizures. She was admitted voluntarily, but the next day, she developed an acute psychotic episode, wandering the labor floor hallways naked, agitated, and combative. The patient pushed a security guard and kicked nursing staff, aggressively screaming at anyone who approached her.

She was restrained by security and OB team, and psychiatry administered lorazepam 2mg IM and diphenhydramine 50mg IM without any significant effect. She has an allergy to haloperidol and the psychiatrist did not want to administer olanzapine due to concerns for cardiorespiratory depression.

Due to emergent nature of the situation with potential to harm others, and public health concerns given CoVID+, patient was deemed unable to make rational decisions in this context by 2 attending physicians. In concert with OB, psychiatry, and anesthesia, we administered ketamine 100mg IM with good effect. She was brought back to her room and 2 peripheral IVs placed. Her SpO2 remained above 95% on RA, and she continued to be monitored by our team.

Management of acutely psychotic patients can be difficult especially in the context of pregnancy. Pregnancy in such patients introduces concerns pertaining to sudden changes in medication compliance, medication metabolism, elimination, and fetal concerns. Consent in emergency situations can be impossible to obtain but when patient, fetus, and others are at risk, timely intervention is critical and may call for emergency consent. IM haloperidol is commonly used to sedate psychotic patients but haloperidol allergy/intolerance presents unique challenges in acute situations.

COVID+ patients force additional consideration for the safety of staff when intervening on disruptive patients. The acutely psychotic non-pregnant patient is typically admitted to a designated area more adept to handle such patients such as a psychiatric floor or an emergency department. Staff on a labor floor are unfamiliar with and untrained to treat actively psychotic patients, which can lead to both patient and staff harm, thus transfer to such a department after medical clearance is essential.

Abstract #: SAT-RFCP – Room 5 - 01

## A Post-Partum Acute Type A Aortic Dissection without Known Connective Tissue Disease

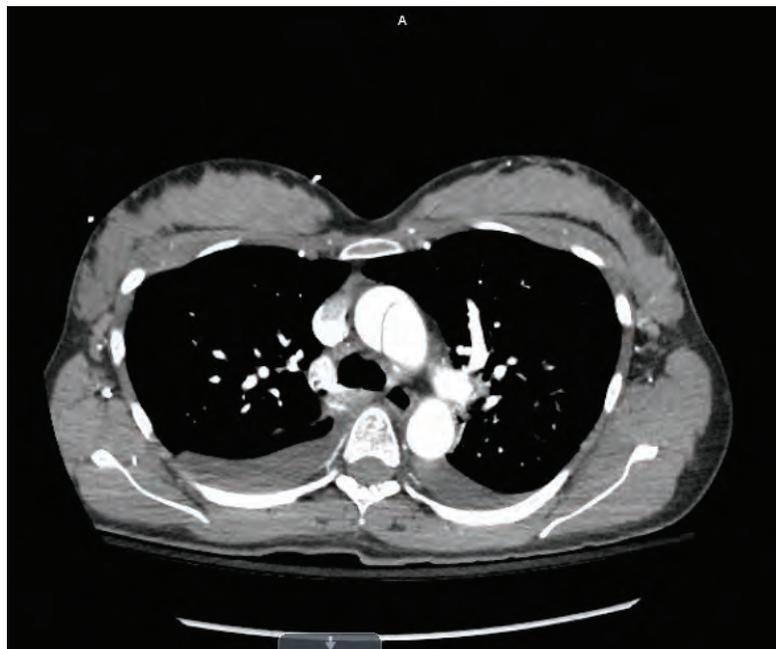
Presenting Author: Regine Goh, MD

Presenting Author's Institution: University of California, San Diego

**Introduction:** Type A acute aortic dissection is a rare but life-threatening event with increased risk during pregnancy, typically in the 3<sup>rd</sup> trimester or early post-partum period<sup>1</sup>. Here, we describe a case of a type A aortic dissection discovered two days post-partum in a pre-eclamptic woman without known aortopathy or connective tissue disease.

**Case Presentation:** A 35 year old woman presented to L&D triage at 34w5d with mild range blood pressures, headache, and substernal chest pain radiating to her jaw and back. Her medical history included chronic hypertension, pre-eclampsia in a prior pregnancy, prior C-section (CS), and no known connective tissue disease. Prior echo showed no aortic pathology or aortic root dilation. At that time, EKG was normal and symptoms improved. She was diagnosed with pre-eclampsia with severe features and underwent an uneventful repeat CS with spinal anesthesia. On POD1 she complained again of chest pain with mild range blood pressures and mild troponin elevation. Cardiology was consulted and initially attributed her symptoms to demand ischemia from hypertension, but ordered a transthoracic echo completed on POD2 which showed an acute aortic type A dissection. An emergent CTA of the chest confirmed the diagnosis and the patient was rushed to the OR for repair. Ultimately, genetic testing for underlying aortopathy was inconclusive.

**Discussion:** Pregnancy-related aortic dissection, although rare, represents 19% of aortic dissections in women < age 35 internationally<sup>1</sup>. Diagnosis is often delayed, on average up to 18.5 hours, with 85% of all cases initially being misdiagnosed<sup>2</sup>. Maternal mortality increases 1-3% per hour after presentation and reaches 25% in the first 24 hrs<sup>3</sup>. While pregnancy itself increases risk for acute aortic dissection, women with connective tissue disease such as Marfan's, aortic root diameter of >40mm, previous dissection, aortic coarctation, hypertension and drug abuse have considerably increased risk<sup>4</sup>. Our patient lacked these risk factors but had chronic hypertension and severe pre-eclampsia. During pregnancy, hormonal changes occur in the aorta including loss of elastic fibers, which predisposes to aortic dissection<sup>5</sup>. In pregnant women with chest pain and hypertension, aortic dissection should remain on the differential.



Abstract #: SAT-RFCP – Room 5 - 02

## Surgical Consequences of Intraoperative Nausea and Vomiting during Cesarean Section

**Presenting Author:** Rachel Gray, M.D.

**Presenting Author's Institution:** Albany Medical Center

**Co-Authors:** Lindsay Gennari, M.D. - Albany Medical Center

Manju Prasad, M.D. - Albany Medical Center

### **Background:**

Key concerns associated with intraoperative nausea and vomiting (IONV) during cesarean section (c-section) include aspiration risk and maternal discomfort. However, we present a case where IONV presented challenges to the surgical team and may have contributed to adverse surgical events for the patient.

### **Case Report:**

The patient is a G3P1 with history of gestational hypertension who presented for trial of labor after c-section. She developed a category 2 fetal heart tracing requiring c-section. She had a functional labor epidural in situ which was converted into a surgical block. Upon arrival to the operating room, she experienced severe nausea and vomiting and was given ondansetron, diphenhydramine, and dexamethasone. A phenylephrine drip was initiated to maintain her blood pressure. Her symptoms improved at that time. After delivery she suffered a postpartum hemorrhage and received tranexamic acid (TXA) and carboprost. She continued to have retching episodes, and the surgical team complained about the inability to continue the surgical closure. It was poorly communicated that the expulsion of the bowels was complicating her closure. Reassessment by the anesthesia team didn't feel there was a need for conversion to general anesthesia as the patient again appeared to be improving. The patient then experienced another episode of bilious emesis in which her bowels ballooned into the surgical field. Subsequently, a 10cm serosal tear that was 75% of the circumference of the transverse colon was noted requiring an urgent transverse colectomy under general anesthesia.

### **Discussion:**

Management of IONV has been shown to be successful with a wide array of anti-emetics. This patient's IONV was refractory to treatment.

There are many factors that put a patient at risk for IONV during c-section. Hypotension and unopposed vagal tone following neuraxial analgesia can contribute. In this case, the phenylephrine infusion kept her blood pressure close to baseline. Further, the use of additional medications such as carboprost and TXA, both of which carry the risk of associated nausea and vomiting may have worsened her symptoms. In this case methergine was avoided given her history of gestational hypertension. However, the patient was not hypertensive and methergine may have been a better choice given the severe nausea and vomiting the patient was experiencing.

This highlights the importance of communication between the surgical and anesthetic teams. A discussion regarding the expulsion of the bowels into the surgical field may have made the anesthesia providers more inclined to put the patient to sleep.

### **Conclusion:**

This case demonstrates that IONV may contribute to surgical complications secondary to movement of intra-abdominal contents. Careful consideration must be given to which postpartum hemorrhage drugs are used. Finally, communication between the surgical team and anesthesia team is key to creating the safest approach for the case.

Abstract #: SAT-RFCP – Room 5 - 03

## Interdisciplinary Management of a Parturient with Spinal Cord Stimulator and Intrathecal Pump for CRPS During Labor and Delivery

**Presenting Author:** Leon N. Grinman, DO

**Presenting Author's Institution:** Thomas Jefferson University Hospital

### Introduction:

Complex regional pain syndrome (CRPS) describes an array of painful conditions characterized by chronic pain seemingly disproportionate in time or degree to the usual course of any known trauma or lesion. The overall incidence rate of CRPS is 26.2 per 100,000 person years, with females three times more affected than men. Treatment can be complex, employing medications and device therapy such as intrathecal pump or spinal cord stimulation. Existing CRPS in a pregnant patient can make labor and delivery a particularly challenging experience.

### Case:

A 35 y/o G3P0101 female with history of CRPS in her right upper extremity and left lower extremity presented for interdisciplinary predelivery planning. Current treatment included intrathecal (IT) morphine (6.3 mg/day)/bupivacaine (2.52 mg/day) pump, spinal cord stimulation (SCS) to levels T12-L1, extended-release gabapentin, oral hydromorphone, tizanidine, and trazodone. She intermittently receives high-dose (150 mg), short-duration (2 hours) outpatient ketamine infusions. Medical history included obesity (BMI 45), hypertension, GERD, gastroparesis, anxiety/depression, and recent COVID-19. Obstetric history included previous cesarean section and gestational diabetes during this second pregnancy, managed with insulin pump.

The patient requested epidural analgesia for TOLAC as in her previous pregnancy, during which her SCS was in place. Her IT pump was placed at L4-5 after that delivery. After consultation with multiple specialists including acute pain management, chronic pain management, interventional radiology, OBGYN, maternal fetal medicine, and neonatal ICU, epidural and spinal were deemed prohibitive due to risk of damaging implanted hardware and risk of infection. Plans were made for IV analgesia and pudendal block for vaginal delivery as we do not offer nitrous oxide outside the OR. Repeat cesarean section would require general anesthesia. Ketamine infusion in either scenario would be started postpartum.

Patient was admitted for induction of labor for preeclampsia at 37 weeks and was managed with fentanyl PCA by OB service. She ultimately required cesarean section for arrest of labor, necessitating general anesthesia. Postoperative pain was managed with TAP blocks, IV hydromorphone, and IV ketamine infusion. Though initially comfortable, the patient grew unsatisfied with her analgesia due to continued disagreement over safe dosing and requested discharge home on postoperative day two.

### Discussion:

CRPS in the pregnant patient can be challenging, especially for delivery planning. Management includes interdisciplinary coordination, individualized plan, and clear understanding of expectations.

## Allergic Contact Dermatitis to Mastisol Adhesive Used for Labor Epidural Dressing: A Case Report

**Presenting Author:** Mingchun Liu, MD

**Presenting Author's Institution:** Washington University School of Medicine - St Louis, Missouri

**Co-Authors:** Amber C. Benhardt, MD - Washington University School of Medicine

Nicole Durko, MD - Washington University School of Medicine

### Introduction

Skin adhesives such as Mastisol are commonly used in obstetric anesthesiology to aid in the fixation of epidural catheters and prevent catheter dislodgment. Mastisol has been reported to have rare incidences of allergic skin reactions compared to other commercial adhesives (1). We report a case of severe allergic contact dermatitis (ACD) to Mastisol use during placement of a routine labor epidural.

### Case

Patient is a 30yo G2P0 who presented at 38 weeks and 4 days gestation with spontaneous rupture of membranes. Her medical history was notable for anxiety and gestational hypertension. Patient reported no history of allergies. Her labor was augmented with oxytocin, and a routine labor epidural was placed by an experienced anesthesiologist. The epidural catheter was dressed with Mastisol adhesive and large Tegaderm transparent dressings. During her labor course, patient was unable to make appropriate cervical change and ultimately underwent a primary cesarean section for arrest of dilation. On postoperative day 1, she reported doing well without any anesthesia complications but later noticed persistent itching of her back without any appreciable skin changes. On postoperative day 2, she was found to have a large geometric, erythematous rash with seeping clear thick fluid and blistering on her back (Fig. 1). The rash extended to her sacrum, bilateral buttocks, and sides of her abdomen. Patient had difficulty lying flat due to significant discomfort. She was started on PO diphenhydramine and IV methylprednisolone followed by a prednisone taper. The wound team was consulted, and topical ointment was added for patient comfort. Due to persistent symptoms, ID was consulted on postoperative day 4 with a possible diagnosis of superimposed cellulitis. Patient was started on IV vancomycin and transitioned to PO cefdinir at discharge on postoperative day 6 after noticeable improvement.

### Discussion

The exact etiology of this patient's rash is unclear, though it is highly suspected to be ACD secondary to Mastisol. Mastisol is a liquid adhesive consisting of ethanol, acetone, methyl salicylate, gum mastic, styrax, and water. There have been few case reports describing Mastisol-related ACD (2). ACD is a Type IV (delayed) hypersensitivity reaction that can present with erythema, edema, dermatitis, and blistering of the affected area (3). Other characteristics such as timing, geographic configuration of the skin eruption, pruritis, and lack of tenderness may support the diagnosis. Treatment is largely supportive including diligent wound care, topical and/or oral steroids, and oral antihistamines (3). In addition, patients should be closely monitored for secondary wound infections.



Abstract #: SAT-RFCP – Room 5 - 05

## Previously Undiagnosed Methemoglobinemia in a Parturient with Pre-eclampsia Presenting with Dyspnea

**Presenting Author:** Leslie Matthews, MD, PharmD

**Presenting Author's Institution:** The Ohio State University - Columbus, Ohio

**Co-Authors:** Teri Gray, MD - The Ohio State University

A 23 year old G1P0 at 36w4d presented to labor and delivery with lower extremity edema, elevated blood pressure, and shortness of breath. She had pitting edema up to the torso, and had pulse oximetry readings in the 80s. Chest CT was negative for pulmonary embolism but showed pulmonary edema and bilateral pleural effusions. Echocardiogram demonstrated LVEF of 50% and no evidence of shunt or other abnormalities. She was admitted for induction of labor due to preeclampsia with severe features.

Her pulse oximetry continued to read in the low 90s on oxygen. An arterial blood gas was obtained which showed a PaO<sub>2</sub> of >100 mmHg, but an elevated methemoglobin level of 14.8% (reference range of < 1.5%). Her blood itself had the classic chocolate brown appearance of methemoglobinemia. Pulmonology was consulted and recommended that methylene blue not be used unless methemoglobin levels trended upwards closer to 30%.

Given unreliable pulse oximetry readings in the setting of pulmonary edema and dyspnea, an arterial line was placed so that blood gases with co-oximetry could be obtained. Epidural analgesia was recommended to avoid IV opioids and general anesthesia given this patient's respiratory status and high risk of Cesarean delivery. Methemoglobin levels were monitored frequently and stayed stably elevated without intervention. She underwent an uncomplicated C-section for failure to descend, and was discharged at her baseline respiratory status.

Methemoglobinemia is a congenital or acquired condition in which hemoglobin has been oxidized and cannot bind oxygen normally, leading to tissue hypoxia. The acquired form is associated with exposure to antibiotics, nitrites, and local anesthetics (especially benzocaine and prilocaine). Lidocaine has also been associated with methemoglobinemia<sup>1</sup>, with no definitive risk associated with bupivacaine or ropivacaine. Cases of increasing methemoglobin levels have been described with bupivacaine administration, however.<sup>2</sup> Symptoms of methemoglobinemia include headache, fatigue, cyanosis, dyspnea, and hypoxia. Severe cases can manifest with neurologic symptoms such as altered mental status and seizures. Interestingly, many symptoms of methemoglobinemia overlap with those from pre-eclampsia. Co-oximetry testing analyzes many different waveforms of light, thus identifying not only oxyhemoglobin and deoxyhemoglobin, but also dyshemoglobins such as methemoglobin. Co-oximetry is a reliable way to differentiate various causes of hypoxia.<sup>3</sup>

Abstract #: SAT-RFCP – Room 5 - 06

### A Case of Autoimmune Hepatitis and Cesarean Delivery

**Presenting Author:** Mercedes Meuli, DO

**Presenting Author's Institution:** University of California San Diego

**Co-Authors:** Lawrence Weinstein, MD - University of California- San Diego

Autoimmune hepatitis (AIH) is a rare disease that occurs more commonly in females. Historically, woman with AIH were commonly infertile, but advances in immunosuppression treatment and medical care have enabled more patients to conceive and maintain pregnancies. AIH carries a high risk of morbidity and mortality, as it can lead to cirrhosis, coagulopathy, thrombocytopenia, or thrombotic events. Optimal care of the parturient with AIH requires a multidisciplinary approach amongst specialties throughout pregnancy and at time of delivery.

We present a case of a patient with AIH scheduled for a repeat cesarean section. The patient is a 24-year-old G2P1 at 37w6d with history of cirrhosis secondary to AIH with portal hypertension, splenomegaly, Crohn's disease, thrombocytopenia, cholestasis of pregnancy, obesity, asthma, and chronic steroid use. Her prior cesarean delivery was performed under general anesthesia, as thrombocytopenia prevented safe neuraxial anesthesia. During the current pregnancy, the patient expressed a desire to be awake for delivery.

On the day of surgery, the platelet count was 76,000. Coagulation panel was significant for an INR of 1.2 and fibrinogen for 217 mg/dL. A thromboelastogram was significant only for MA of 47mm. After thorough discussion about the possibly elevated risk of bleeding with neuraxial versus general anesthesia, the decision was made to proceed with spinal anesthesia with a 27g needle. The case was complicated by hemorrhage due to bleeding without atony. She was treated with TXA, 2U FFP and 1U platelets. Post-operatively, the patient did well and was ambulating later that day. The rest of the hospital course was unremarkable, with no signs of epidural hematoma.

This case highlights the need for multidisciplinary care for parturient with cirrhosis and thrombocytopenia as well the difficulty the anesthesiologist faces regarding the use of neuraxial for a cesarean delivery. Neuraxial anesthesia is increasingly performed in thrombocytopenic patients and can be done safely given stable platelets, normal PT/INR and a reassuring TEG. In this case, it was determined that the overall benefits of spinal anesthesia outweighed the *possibly* small increased risk of a bleeding complication.

**Abstract #: SAT-RFCP – Room 5 - 07**

**A Case of Placental Abruption Complicated by Maternal Fontan Physiology**

**Presenting Author:** Mercedes Meuli, DO

**Presenting Author's Institution:** University of California San Diego

**Co-Authors:** Anne Shapiro, MD - University of California- San Diego

Fontan physiology has been associated with poor placental perfusion and is a cause of high preterm birth rate. Case reports have shown that these patients have successfully undergone neuraxial anesthesia for delivery with careful multidisciplinary planning. However, we discuss a challenging case of a patient requiring emergent cesarean section due to placental abruption and non-reassuring fetal status with a history of Fontan physiology and Fontan associated liver disease. The patient ultimately delivered with a pre-induction arterial line followed by general anesthesia with RSI. Intraoperatively, she had a 1300mL blood loss which was secondary to uterine atony and improved with discontinuing volatile anesthetic. She received concentrated Pitocin without the use of any other uterotonic. On post-operative day one, the patient had a hemoglobin of 7.5gm/dL which was significantly decreased from admission hemoglobin of 10.5g/dL. She received one unit of packed red blood cells, otherwise her postoperative course was uncomplicated, and she was discharged on post-operative day four without requiring an ICU admission.

Patients with Fontan physiology are unique and complex and require a perfect balance of preload, pulmonary vascular resistance and cardiac output which can be challenging due to the physiologic changes of pregnancy. These patients are at high risk for developing arrhythmias, heart failure, cardiac arrest, thromboembolic events, and postpartum hemorrhage. Understanding physiologic changes with Fontan circulation is imperative to providing a safe anesthetic to both the parturient and fetus.

**Delayed diagnosis of disseminated intravascular coagulation after vaginal delivery due to laboratory systems issue – a case report and root cause analysis**

**Presenting Author:** Leziga T. Obiyo, MD, MPH

**Presenting Author's Institution:** Stanford University - Chicago, Illinois

**Co-Authors:** Jessica R. Ansari, MD - Stanford University

Kelly Fedoruk, MD FRCPC - Stanford University

Cedar J. Fowler, MD PHD MPH - Stanford University

Elizabeth Ozery, MD - Stanford University

**Introduction:** Disseminated intravascular coagulation (DIC), a catastrophic complication with high morbidity and mortality, requires prompt recognition and treatment<sup>1,2</sup>. We present a case with delayed recognition of DIC due to laboratory systems processes involving grossly abnormal coagulation results. A formal root cause analysis (RCA) identified actionable changes.

**Case Description:** A previously healthy 36yo G3P1 delivered via spontaneous vaginal delivery with combined spinal-epidural (CSE) analgesia. Shortly after delivery, excessive bleeding was recognized and methylergonovine was given for presumed uterine atony. When bleeding failed to improve despite firm fundal tone, the patient was taken to the operating room (OR) for better visualization. Upon arrival, the OB team reported a 4-cm cervical laceration and ruptured posterior vaginal hematoma with over 1L quantitative blood loss (QBL). Massive transfusion protocol was initiated. A 16-G peripheral IV and arterial lines were placed. Complete blood count (CBC) and coagulation labs were sent multiple times over the following hour, and several units of blood products were administered while the surgical team repaired lacerations. General endotracheal anesthesia was induced due to continued bleeding and transfusion. Despite follow-up with laboratory personnel, the first coagulation labs resulted 74 minutes after collection, yielding fibrinogen < 30, INR 7.4, and platelets 48. Thromboelastogram demonstrated delayed clot activation, decreased clot strength, and profound fibrinolysis. At this point, the diagnosis of DIC was communicated to the surgical team, who retrospectively noted maroon-stained amniotic fluid concerning for placental abruption. Given this new information, the vagina was packed rather than persisting with laceration repairs. The patient received 8U pRBC, 7U FFP, 2U platelets, 7g fibrinogen concentrates, 1U cryoprecipitate, and 1g tranexamic acid for a total of 4.7L QBL. She recovered in the ICU and was eventually discharged home.

**RCA Description:** RCA is a tool to learn from adverse events and near-misses<sup>3</sup>. A formal RCA including staff from the clinical lab, transfusion, and anesthesia found that the unit's super-stat laboratory worksheet included D-dimer and thrombin time in coagulation panels. These labs, not used in clinical decision-making, required significant time, independent assays, and protocolled repeats for abnormal values, thus delaying results of all coagulation parameters. As a result, these labs were removed from super-stat lab requisitions at this institution (Fig 1).

**Discussion:** Management of DIC requires aggressive and expedient replacement of coagulation factors and fibrinogen, which were delayed in this case due to systems error. Our RCA led to changes to avoid similar diagnostic delays of obstetric DIC and may be relevant at other institutions as well.

[SOAP 2022 - ObiyoRCAimage.pdf](#)

Abstract #: SAT-RFCP – Room 5 - 09

## Anesthetic Management in a Parturient with Uterine Rupture

Presenting Author: Olaide Sode

Presenting Author's Institution: UT Southwestern Medical Center

Uterine rupture is a life-threatening peripartum event that can lead to maternal-fetal morbidity and mortality. Risk factors for uterine rupture include grand multiparity, fetal macrosomia, induction of labor and chronic hypertension. We present a parturient with history of macrosomia and subsequent uterine rupture and the anesthetic challenges of her management.

A morbidly obese 33 yo G6P3A2 at 39 weeks gestation with history of poorly controlled chronic hypertension, macrosomia, and short interval pregnancy was admitted from clinic for elevated blood pressure and oligohydramnios. She underwent induction of labor with vaginal misoprostol and a labor epidural was placed without issue. Two hours later, an episode of deep variable decelerations with tetanic contractions was noted. With good analgesia on board, she was artificially ruptured, and internal monitors were placed. Subcutaneous terbutaline was given with reduction in contractions and improvement in fetal heart tones. After two hours, recurrent, and persistent decelerations to the 60s were noted. Repeat cervical exam revealed loss of station from prior cervical exam of 10cm dilation. A STAT C-section was called for presumed uterine rupture. In the OR, three minutes after dosing her labor epidural with 20mLs chloroprocaine 3%, she was disoriented and complained of abdominal pain. Due to the urgency and concerns of the surgeons, general anesthesia with rapid sequence induction was started. Initially, noninvasive blood pressures were difficult to obtain as she was significantly hypotensive with systolic pressures in the 50s. As a radial arterial line was placed for closer hemodynamic monitoring, phenylephrine boluses were given, and a subsequent infusion was started to maintain mean arterial pressure in the 60s. Upon entry of the abdomen, the fetus and placenta were free-floating with meconium. A 10cm posterior lateral uterine defect involving the right uterine artery and broad ligament was in active hemorrhage. MTP was activated and she underwent a hysterectomy with 4L EBL. She received 6 units of packed RBCs and 2 units of fresh frozen plasma intraoperatively. Her postpartum course was complicated by acute asymptomatic blood loss anemia with stable hematocrit, and she was discharged home 5 days later. The infant was discharged home after 2 weeks in the NICU for management of moderate hypoxic ischemic encephalopathy, status post hypothermic cooling and seizures.

In the setting of uterine rupture, cesarean delivery is indicated, and if severe, hysterectomy is the definitive treatment. In hemodynamically stable mothers with abnormal fetal heart rate patterns, epidural anesthesia may be appropriate. In hemodynamically unstable mothers with fetal compromise, general anesthesia is preferred. Early recognition of uterine rupture with a team-based multidisciplinary approach is crucial to ensuring a positive outcome for mother and baby.

## Delayed neurological sequelae due to retained epidural catheter fragment

Presenting Author: R. Jeanne Tong, MD

Presenting Author's Institution: New York Medical College/Westchester Medical Center

Epidural catheter breakage resulting in a retained catheter fragment is a rare but underreported complication of neuraxial analgesia for labor.<sup>1</sup> Cases of foreign body reaction, lumbar stenosis, and radicular nerve root impingement have been attributed to retained fragments.<sup>2</sup> We present a case of broken epidural catheter which resulted in delayed neurological symptoms ultimately requiring surgical intervention.

A 32-year-old G1P0 with no significant past medical history presented to labor and delivery at 39 weeks following spontaneous rupture of membranes. She requested epidural analgesia. An ArrowFlexTip epidural catheter was placed with the patient in sitting position at the L3-L4 level using a right paramedian approach. The catheter was secured at 15cm at the skin. Effective labor analgesia was achieved, and the patient had a vaginal delivery 2.5 hours after epidural placement. An hour after delivery, her catheter was removed by her nurse, which is standard practice at our institution. Resistance was noted on the 1<sup>st</sup> attempt, and removal was halted before attempting again. On 2<sup>nd</sup> attempt the catheter immediately broke at the 14cm mark. On examination of her back she had mild tenderness at the insertion site and no catheter fragment was visible at the skin. She had a normal neurological exam. Neurosurgery was consulted and CT demonstrated the catheter remnant within the epidural space. The patient was offered surgical removal prior to discharge but opted for outpatient follow up. At her appointment 4 weeks later, she reported bilateral low back pain with radiation down her left leg to the anterior thigh. 3 weeks later, the retained fragment was removed under general anesthesia. This was achieved by dissecting down the L3 spinous process to the lamina where the catheter was identified in the interlaminar space. The catheter, about 8cm in length, was then easily removed without a laminectomy. Her radiculopathy symptoms have since resolved.

Retained epidural catheter fragment due to breakage during removal is rare; consequently, few guidelines exist, including how long to surveil asymptomatic cases. Catheters reinforced with coiled stainless steel wire like the Arrow are more vulnerable to breakage.<sup>2</sup> Most cases require CT imaging to localize the fragment and some interval follow-up to identify complications. Recent case reports continue to suggest that minor fragments may be left in place if they do not cause symptoms.<sup>2</sup> In our case a very long fragment was retained, and there was a theoretical concern that if the opening was near enough to the skin puncture site, the fragment could be a nidus for infection into the epidural space. However, antimicrobial prophylaxis was deferred, and she developed radicular symptoms after 1 month, without signs of infection.



Abstract #: SAT-RFCP – Room 5 - 11

## Cesarean Section in a COVID Positive Patient for Non-Reassuring BPP

**Presenting Author:** Colin Beals-Reid, MD

**Presenting Author's Institution:** Yale University School of Medicine - Milford, Connecticut

**Co-Authors:** Aymen Alian, MD - Yale University

Jae Lee, MD - Yale University School of Medicine

### Introduction:

Recent studies have shown that COVID infection in pregnancy increases risk of preterm birth, cesarean birth, and stillbirth.<sup>1</sup> There are case reports of COVID infection and acute coagulopathy in pregnancy.<sup>2</sup> Here, we present a case of a pregnant patient in her third trimester that sustained a COVID infection which was followed by fulminant DIC and fetal distress requiring urgent cesarean section.

### Case Report:

32 yo G2P0 with PMH of Hgb C trait, active COVID who presented for primary cesarean delivery at 30+1 for urgent caesarean for 2/10 BPP. Triage vital signs were unremarkable. Patient's labs were significant for drop in platelets from 294 (4 months prior) to 72. Stat coags and fibrinogen were sent and Rotem performed which revealed significant coagulopathy (fig 1A)

In the operating room the FHR was reassuring. The OB and Anesthesia teams decided collaboratively to start resuscitation prior to incision. Three 18g IVs were placed and MTP initiated. Patient was given 2 of cryo, 2 of FFP, 1 of platelets, 1g of TXA and 5.5 g of fibrinogen concentrate. Induction was a straightforward RSI with propofol and succinylcholine and followed by arterial line placement. Delivery was 3 minutes after induction. Infant required intubation and transfer to NICU. Patient was given additional 2 of cryo, 2 of FFP 1 of platelet and 3 units RBCs. Patient received methergine, carbaprost intrauterine, and misoprostol. EBL was 2L and patient was extubated in OR. ROTEM results during the case improved (1B)

Post-op patient was diuresed for new O2 requirement and given 2g fibrinogen concentrate. Labs drawn 5 hours after the case showed normalization of most values (1C). Post-operative TAP blocks were performed without issue.

Patient was discharged home on POD #3 after an uneventful postoperative course. Infant was extubated first to HFNC and then to RA over extended NICU stay for prematurity.

### Discussion:

This challenging case required coordination between obstetric and anesthesia teams for management of a critically ill mother and a fetus in distress. ROTEM testing allowed for rapid assessment of patient's coagulation; testing which was triggered by the patient's drop in platelets and active COVID. Even with resuscitation prior to incision the patient had significant blood loss and it is likely that immediate incision would have been disastrous. The case shows the effects of COVID and pregnancy status on coagulation, an interaction which is still being explored.

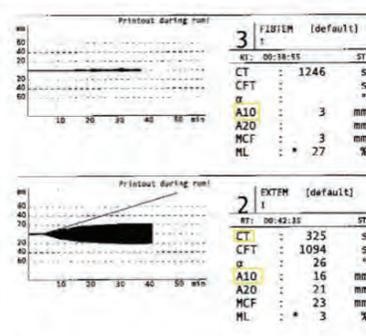
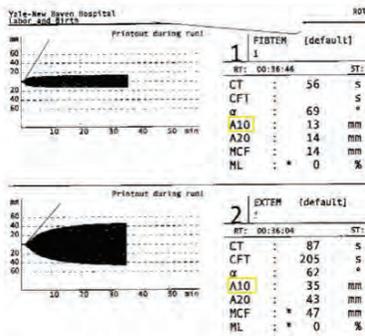
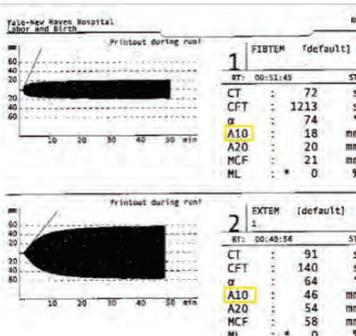
A: Initial	B: During Case	C: Post-op
		
<p>Hgb 12.6  <b>Platelets 72</b>  <b>INR 1.54</b>  <b>PTT 49.1</b>  <b>Fibrinogen &lt;50</b></p>	<p>Hgb 7.9  <b>Platelets 63</b>  <b>INR 0.97</b>  <b>PTT 35.0</b>  <b>Fibrinogen 267</b></p>	<p>Hgb 12.8  <b>Platelets 81</b>  <b>INR 0.92</b>  <b>PTT 30.9</b>  <b>Fibrinogen 387</b></p>
<p>Resuscitation given pre-incision:</p>	<p>Resuscitation given after incision:</p>	<p>Recommended values for pregnant women:</p>
<p>2 units of cryoprecipitate  2 units of FFP  1 pool of platelets  5.5g fibrinogen concentrate  1g bolus TXA</p>	<p>2g fibrinogen concentrate  2 units of cryoprecipitate  2 units of FFP  1 pool platelets  3 units RBCs</p>	<p>Fibrem A10 &gt;16mm  Extrem A10 &gt;45mm  Extrem CT &lt;82seconds  Fibrinogen ≥ 250-300</p>

Figure 1: Lab values and resuscitation

Abstract #: SAT-RFCP – Room 5 - 12

## Local Anesthetic Systemic Toxicity after Transversus Abdominis Plane Block in the Parturient: Early Recognition and Treatment

**Presenting Author:** Joe E. Bryant-Huppert, M.D.

**Presenting Author's Institution:** New York Presbyterian - Weill Cornell Medicine, New York

**Introduction:** Local anesthetic systemic toxicity (LAST) is a known and potentially fatal complication of regional anesthesia occurring in 0.27 episodes per 1,000 peripheral nerve blocks<sup>1</sup>. While factors such as local anesthetic dose and location are the most obvious risk factors for LAST, parturients are not well-studied and may be at higher risk. The transversus abdominis plane block (TAP) is becoming an increasingly popular technique to provide post-operative analgesia after cesarean delivery. Increased utilization of TAP blocks requires proper LAST education and training, and necessary resources to be available in centers to care for this complication.

**Case:** A 29-year-old 75kg G7P2143 with past medical history of prior cesarean sections and anaphylactic reaction to morphine presented for scheduled repeat cesarean delivery. The anesthetic plan was spinal bupivacaine 1.6cc with 15mcg fentanyl, plus post-operative bilateral TAP block with 40cc 0.25% bupivacaine given the contraindicated use of spinal morphine. The delivery was uncomplicated, and the patient was taken to PACU after ultrasound guided TAP block. Twenty minutes later, the patient experienced a grand-mal seizure which resolved without pharmacologic intervention. Although the patient required supplemental oxygen for hypoxia (O<sub>2</sub> 95%), she was otherwise hemodynamically stable and regained mental status after seven minutes. Fat emulsion (Intralipid) 100cc bolus was given, followed immediately by an additional 200cc over the next 20 minutes for the presumed diagnosis of LAST in the setting of bupivacaine administration. The patient did not have any additional seizures or signs of LAST such as arrhythmia or cardiovascular collapse. The remainder of her course was uncomplicated, she was discharged on post-partum day 2.

**Discussion:** LAST has been recognized as a potential cause for maternal morbidity and mortality. The incidence of LAST may become more common given the increasing use of TAP blocks for post-cesarean section pain. Parturients are at an increased risk for LAST due to increased neuronal sensitivity to and decreased protein binding of local anesthetics, as well as anatomic changes that lead to vascular engorgement and increased tissue blood flow. Implementation of acute lipid resuscitation helps facilitate reduction in morbidity and mortality in these cases, and providers must anticipate this potential complication and be comfortable with timely and appropriate intralipid intervention of 100cc bolus for patients >70kg, and 1.5cc/kg for patients < 70kg, as well as supporting hemodynamics and aiming to break seizure activity<sup>5</sup>. The use of cognitive aids and checklists will help facilitate rapid responses to these emergency situations.

## Successful use of Combined Spinal Epidural Anesthesia (CSEA) for Cesarean Section in Patient with Severe Mitral Regurgitation/Stenosis and Severe Pulmonary Hypertension

Presenting Author: Alexander Hunter, DO

Presenting Author's Institution: Geisinger Medical Center

### Introduction

Severe mitral stenosis carries a significant risk of morbidity and mortality during pregnancy. Hemodynamic shifts include increased cardiac output of up to 50% above pre-pregnancy values and increased heart rate.<sup>1</sup> Patients with severe mitral stenosis are often unable to maintain these demands, which can result in pulmonary hypertension (pHTN) and pulmonary edema. This poses specific anesthetic challenges perioperatively and makes hemodynamic management essential. This report conveys a patient with severe mitral stenosis and pHTN with a term pregnancy requiring C Section.

### Case

Our patient is a 38-year-old G3P1 at 37 weeks gestation who presented for a scheduled C section. While pregnant, she had NYHA Class 3 symptoms of heart failure, including orthopnea and dyspnea on exertion. Due to her cardiac history, both CSEA and general anesthesia were considered. Following discussion with obstetrics and cardiology, we elected for CSEA.

Arterial line and two IVs were placed pre-operatively. CSEA was performed in sitting position and 20mcg fentanyl and 150mcg morphine were given intrathecally. Patient was placed supine with left uterine displacement. Epidural was bolused with 1cc/minute of 2% lidocaine for a total of 20cc until appropriate anesthesia was obtained.

Vasopressin infusion was used to maintain mean arterial pressure >65 and systolic blood pressure >100. Nasal cannula was used for supplemental oxygen. Patient received 3 liters of plasmalyte and 10mg IV furosemide with an estimated blood loss of 1 liter. Patient tolerated procedure well and was escorted to the ICU before being discharged on post-op day 4.

### Discussion

Women with severe mitral stenosis are often unable to tolerate the physiologic changes of pregnancy. Tachycardia decreases left ventricular filling and, combined with increased volume, can lead to pHTN and edema. Severe pHTN is known to increase risk of morbidity/mortality and is often considered an absolute contraindication to pregnancy. Maternal death is greatest during labor and immediately post-delivery due to autotransfusion from the uterus.<sup>2</sup> For this reason, our patient required careful anesthetic management. General anesthesia was deferred to avoid the hemodynamic shifts associated with induction. CSEA allowed for a slow, controlled increase in neuraxial anesthesia. Prior studies have described success with different anesthetics in similar situations. Krenz et al presented a patient with severe pHTN who underwent C section using epidural anesthesia.<sup>1</sup> Despite this success, more research is needed to establish a gold standard in peripartum anesthesia in these patients.

## ***Adult Transthoracic Echocardiography Report***

### **Interpretation Summary**

- The qualitative LV ejection fraction is 55-59% (normal)
- The right ventricular cavity is moderately dilated
- The right ventricular systolic function is mildly reduced
- The left atrium is severely enlarged
- The mitral valve abnormalities are due to rheumatic heart disease
- Severe mitral stenosis is present. Mean MV gradient is 13-15 mmHg at heart rate of 68 bpm
- Severe mitral regurgitation is present
- The estimated pulmonary artery systolic pressure is 68mm Hg
- Dilated IVC with reduced collapsibility with sniff indicates an elevated right atrial pressure of 15mmHg

**Abstract #: SAT-RFCP – Room 5 - 14**

**Cesarean delivery in a parturient with severe mitral regurgitation from Libman-Sacks endocarditis and recurrent deep vein thromboses**

**Presenting Author:** Neva P. Lemoine, MD

**Presenting Author's Institution:** McGovern Medical School at UT Health - Houston, Texas

**Co-Authors:** Kendra Brown, MD - McGovern Medical School at UTHealth

**Introduction:**

Libman-Sacks endocarditis is a type of non-bacterial endocarditis that may be associated with inflammatory conditions and can affect valve function. Regurgitant valvular lesions are generally well tolerated in pregnancy and can safely be managed with neuraxial anesthesia [1]. However, this management can be complicated by anticoagulation requirements.

**Case Presentation:**

A 30-year-old G6P6 with a history of systemic lupus erythematosus (SLE) complicated by Libman-Sacks endocarditis and severe mitral regurgitation (MR), antiphospholipid antibody syndrome with recurrent deep vein thromboses on therapeutic low molecular weight heparin (LMWH), splenic infarct, and 3 prior cesarean deliveries (CD) presented for CD at 33w2d due to worsening shortness of breath. Transthoracic echocardiography demonstrated LVEF 60-65%, severe MR, and diffusely thickened mitral leaflets. CD was scheduled due to the worsening clinical status and for anticoagulation management. A heparin infusion was started to allow for a shorter interval off anticoagulation and for neuraxial anesthesia to be performed for CD. Day of surgery labs revealed a falsely elevated activated partial thromboplastin time (aPTT) as a result of SLE, but a normal heparin anti-factor Xa level [2].

A lumbar epidural was placed and slowly dosed with 15ml of 2% lidocaine with epinephrine, and 100mcg of fentanyl, until a T4 sensory block was achieved. Continuous non-invasive blood pressure monitoring via a ClearSight system also allowed for close monitoring of systemic vascular resistance and mean arterial pressure. These indices were stable throughout the CD. The CD was uncomplicated and the patient was restarted on a heparin infusion two hours after delivery and transitioned to therapeutic LMWH the following day.

**Discussion:**

Parturients with cardiac disease can often be delivered utilizing carefully dosed neuraxial anesthesia. However, careful planning must be performed in parturients with coexisting thromboembolic disease on therapeutic anticoagulation to allow for safe neuraxial placement, reduce time off anticoagulation, and minimize bleeding complications. Continuous non-invasive blood pressure monitoring can be utilized to tightly control hemodynamics while minimizing tissue trauma in a patient expected to be restarted on therapeutic anticoagulation.

## Combined Spinal Epidural Anesthesia for Labor Analgesia in a patient with Mast Cell Activation Disorder

**Presenting Author:** John E. Rouck, MD

**Presenting Author's Institution:** New York Presbyterian - Columbia University Campus

**Co-Authors:** Michael Kim, MD - New York Presbyterian - Columbia University Campus

Suzanne Mankowitz, MD - Columbia University Medical Center

Mast Cell Activation Diseases (MCAD) are a rare family of disorders characterized by accumulation of pathologic mast cells and associated release of mast cell mediators. Mast cell degranulation can be triggered by environmental allergens, stress, preservatives, dyes, and medications. (1). MCAD symptoms include organomegaly, severe osteoporosis, cutaneous involvement, respiratory effects, tachycardia, blood pressure fluctuations, pain, and anaphylaxis. (1). One study showed a miscarriage rate between 25-30% for patients with mastocytosis (2). We present a case report of Combined Spinal Epidural (CSE) analgesia for a laboring mother (34 G3P0020 at 38+2) with known MCAD.

The patient was diagnosed with mastocytosis as a teenager and her symptoms included pruritic skin lesions, nausea, diarrhea, and 3 syncopal episodes. An evaluation for bone marrow involvement was negative and her tryptase levels were normal. At time of labor the patient's symptoms were well controlled on Omalizumab, Cetirizine, Ranitidine, and montelukast. She was also taking Sertraline for anxiety and depression. One day prior to scheduled induction the patient's platelet count was 220. The patient desired labor analgesia and CSE was offered. The patient was premedicated 1 hour prior to CSE with oral diphenhydramine 25 mg and prednisone 50 mg as suggested by her hematologist. CSE was performed without complication using spinal bupivacaine and fentanyl. Continued epidural analgesia was provided for approximately 31 hours via intermittent epidural bolus with bupivacaine 0.0625% mixed with fentanyl 2 mcg / mL. This was supplemented with two physician boluses of bupivacaine and fentanyl.

Management of MCAD during labor requires the obstetric anesthesia team to navigate various challenges. Our patient presented for labor well optimized but had prior episodes triggered by stress. Therefore analgesia was of the utmost importance. If symptoms develop during pregnancy the management plan consists of mostly supportive care using H1 and H2 antagonists (3). Anaphylactoid reactions can occur spontaneously despite meticulous preventative measures. The anesthesia team must prepare for this complications by having epinephrine, antihistamines, and corticosteroids readily available (4). This report adds to a small but growing body of literature that patients with MCAD can tolerate neuraxial analgesia / anesthesia (2,4).

Abstract #: SAT-RFCP – Room 5 - 16

## Anesthetic Management and ECMO Cannulation for Cesarean Delivery in Patient with Compressive Anterior Mediastinal Tumor

**Presenting Author:** Hannah W. Burcham, MD

**Presenting Author's Institution:** University of Texas at Southwestern Medical Center - Dallas, Texas

**Co-Authors:** Julie Mani, MD - University of Texas at Southwestern Medical Center

A 45-year-old, 6-foot tall, G1 patient presented at 31 weeks with chest pressure and hemoptysis. Workup revealed stage IV neuroendocrine carcinoma with a primary lung mass obliterating the right middle lobe bronchus, abutting the right atrium, and compressing the right superior pulmonary vein and right middle lobe artery. Primary cesarean section was performed at 34 weeks to expedite initiation of chemotherapy. The patient received low-dose combined spinal-epidural anesthesia (CSEA) and placement of femoral sheaths to allow for rapid initiation of extracorporeal membrane oxygenation (ECMO). Other immediately available equipment included a fiberoptic bronchoscope, TEE probe, reinforced endotracheal tube, cardiac resuscitation drugs, and a stretcher for prone rescue positioning.

An anterior mediastinal mass presents a unique challenge to the obstetric anesthesiologist. The risk for airway obstruction and cardiovascular collapse is further complicated by peripartum physiologic changes and potential for rapid and profound desaturation. All efforts should be made to avoid a high spinal, hemodynamic instability, and unanticipated conversion to general anesthesia. Preoperative ECMO cannulation can be employed to ensure oxygenation and perfusion in patients at highest risk for complications.

Preoperative risk assessment is paramount in patients with AMM, as complications are associated with severity of symptoms at presentation.<sup>1</sup> Considerations for ECMO include tracheal compression greater than 50%, severe postural symptoms, SVC syndrome, and pericardial effusion. Cannulation should occur *prior* to induction of anesthesia if other salvage techniques are unlikely to be successful.<sup>2</sup> Additional peripartum considerations include fluid shifts, autotransfusion of the placenta, aortocaval compression, and potential for massive hemorrhage.

CSEA can be used to avoid an unsatisfactory sensory block that can occur with epidural anesthesia.<sup>3</sup> A need for strict hemodynamic control does not obviate the use of spinal or combined spinal-epidural anesthesia with appropriate planning and safeguards in place. CSEA has been safely performed for Cesarean deliveries in parturients with AMM and significant tracheal compressive effects.<sup>4</sup>

<b>LOW RISK</b>	Asymptomatic or mildly symptomatic; without postural symptoms or radiographic evidence of significant compression of structures
<b>INTERMEDIATE RISK</b>	Mild to moderate postural symptoms, tracheal compression < 50%
<b>HIGH RISK</b>	Severe postural symptoms, stridor, cyanosis, tracheal compression > 50% or tracheal compression with associated bronchial compression, pericardial effusion, or SVC syndrome

Abstract #: SAT-RFCP – Room 5 - 17

## Venous Air Embolism during a Cesarean Delivery in the Parturient

Presenting Author: Waquas Yaqoob, M.D.

Presenting Author's Institution: University of Connecticut Health Center

### Introduction

Venous air embolism (VAE) during pregnancy can be a catastrophic condition that could cause hemodynamic collapse. VAE occurs when there is entrainment of gas into the venous system that embolizes to the right ventricle and/or pulmonary artery. While well described and documented in neurosurgical procedures, the incidence of VAE in cesarean deliveries varies greatly.

### Case Presentation

34 year old female G4P2012 with a history of asthma presents for repeat elective cesarean section. Standard monitors were placed. A lumbar epidural in the 3-4 interspace was placed and dosed once a negative test dose was confirmed dose with 9 mL of local anesthetic which resulted in adequate surgical anesthesia.

The course of the surgery was unremarkable up until delivery of the neonate and manual extraction of the placenta the patient began endorsing sudden difficulty breathing and subsequent loss consciousness. The airway was secured with rapid sequence intubation. A junctional rhythm was noted on ECG. Pulse was lost and ACLS was initiated. Return of spontaneous circulation was achieved within 4 minutes and return to sinus tachycardia on ECG. Given suspicion for amniotic fluid embolism (AFE) patient was treated with atropine, ondansetron, and ketorolac. Obstetric team noted good uterine tone with oxytocin and was able to close patient's abdomen. Patient was bridged to an epinephrine drip.

She was transferred to ICU where she was extubated on post operative day two. An echocardiogram showed normal findings with no intracardiac shunt. Patient was discharged on postoperative day eight.

### Discussion

Diagnosis of VAE is based on clinical suspicion, symptoms, and invasive and noninvasive tests. Patients complain of chest pain, shortness of breath. This is associated with decreased oxygen saturation and hypotension. Gas analysis shows an increase in end-tidal nitrogen and decrease in end-tidal carbon dioxide pressure (ETCO<sub>2</sub>). Transesophageal echocardiogram shows air in the right side of the heart and is the most sensitive detector. Precordial doppler shows an increased in audible difference with the presence of air. Placement of pulmonary artery catheter would show elevated pulmonary artery pressures.

Diagnosis can be challenging when other differentials complicate the picture relating to the obstetric population (local anesthetic systemic toxicity, AFE, etc.). Our case illustrates the requirement for a high index of suspicion to initiate prompt treatment for VAE.

## Separating from the Pack: Preeclampsia-Induced Liver Dysfunction

**Presenting Author:** Drew Michael S. Donnell, MD

**Presenting Author's Institution:** Ohio State University - Columbus, Ohio

A 24-year-old G1P0 at 40w1d with BMI 33 presented for IOL. The pregnancy was uncomplicated beyond LGA and first trimester COVID-19 infection. Initial evaluation was significant for new-onset HTN, Hg 9.9, Plt 270, Cr 0.81, UCR 0.277, ALT 868, AST 543, and Alk Phos 262. Given HTN and transaminitis, a diagnosis of preeclampsia with SF (PESF) was made and magnesium was initiated. A labor epidural was uneventfully placed given stable platelet count and normal INR of 1.1. LFTs, BPs, and Cr continued to rise as labor progressed (ALT 1058, AST 543, SBP > 160, Cr 1.0). Vaginal delivery was complicated by PPH necessitating transfusion of 2 PRBCs. Post-delivery labs were significant for INR of 2.3 and LDH 822 with persistently elevated LFTs. Serial labs showed resolved coagulopathy and LFTs declined linearly over the ensuing 4 days prior to discharge.

PreE is a well-known disorder of pregnancy, affecting up to 7% of gestational courses and is responsible for more than 70k maternal deaths yearly [1]. An estimated 25% of cases involve end-organ damage to the liver [2]. While isolated PreE is the leading cause of hepatic dysfunction in obstetric patients, it is essential to consider the other PreE-associated conditions: HELLP and acute fatty liver of pregnancy (AFLP). Early identification is essential given the associated morbidity; however, the extent of overlap among these states proves management difficult during the initial stages of disease.

HELLP syndrome is a variant of PESF with a prevalence of 0.5% amongst all pregnancies. Diagnostic criteria include microangiopathic hemolytic anemia with schistocytes on peripheral smear, platelets < 100k, AST > 2 normal limits, LDH > 600 I/U, and total bilirubin > 1.2 mg/dL. AFLP, a catastrophic illness of the third trimester characterized by hepatic microvesicular steatosis and an incidence of 0.01%, is frequently diagnosed using the Swansea Criteria [Table 1] [3]. AFLP distinguishes itself with elevated alkaline phosphatase 3-10x baseline, hypoglycemia, and encephalopathy in later stages. In both disease states treatment involves delivery, particularly beyond 34w GA.

In any parturient with elevated LFTs, we must not fail to rule out acute liver failure (ALF) based on the presence of enzymes greater than 10x normal level, encephalopathy, and coagulopathy with an INR > 1.5. Diagnosis of ALF mandates consultation of MFM and a transplant evaluation. Among parturients meeting criteria for ALF, an estimated 16% will require transplant and another 11% will die. [4]

In conclusion, liver dysfunction during pregnancy is prevalent. ALFP, HELLP, and PreE exist on a spectrum of end-organ disease processes that are associated with significant perinatal morbidity and mortality. Multidisciplinary efforts, with a focus on timely recognition and recruitment of consultants as needed, are essential to high value care.

Symptoms	Abdominal pain Encephalopathy Polydipsia/ polyuria Vomiting
Laboratory	Coagulopathy Elevated ammonia Elevated bilirubin Elevated transaminases Elevated urate Hypoglycemia Leukocytosis Renal impairment
Imaging Pathology	Ascites on ultrasound Microvesicular steatosis on liver biopsy
Diagnosis requires 6 or more features in absence of other liver disease <i>Adapted from Gut. 2002; 51:876-880.</i>	

**Table 1.** Swansea Criteria for Diagnosis of Acute Fatty Liver of Pregnancy

General Anesthesia for Cesarean Delivery in Two Critically Ill Parturients with COVID-19

Presenting Author: Bradley Kaminski, MD

Presenting Author's Institution: University of Toronto, Department of Anesthesiology and Pain Medicine - Toronto, Ontario

**Purpose:** Despite an increasing global caseload of critically ill parturients with COVID-19, there is a general lack of information regarding the anesthetic management and maternal outcome following CD in such cases. Accordingly, our purpose is to describe the anesthetic technique and postoperative outcomes of two critically ill parturients with COVID-19 and provide the evidence base for our clinical decisions.

**Clinical Features:** Two pregnant patients presented to our hospital with severe COVID-19 ARDS in their 3rd trimester of pregnancy. Although currently, COVID-19 is not an indication for delivery prior to 34-weeks gestation due to neonatal morbidity, an SpO2 cut-off of < 93% indicates that mechanical ventilation may be necessary. Severe hypoxemia and precipitous clinical decline served as the basis for managing our cases under general anesthesia. Oxygenation and ventilation did not improve immediately following delivery in any patient, obviating the need for post-operative transfer to ICU. Requirements for hemodynamic support varied between patients. Post-partum hemorrhage was encountered in one case, requiring a combination of oxytocin, ergometrine, hemabate, tranexamic acid, and red blood cell transfusion. Worsening respiratory status observed in this patient was likely multifactorial - a combination of ARDS, ventilator-associated pneumonia, and fluid redistribution. Prone positioning, iNO and ECMO were considered and utilized as temporary measures to improve oxygenation.

**Conclusion:** The critically ill parturient with COVID-19 presents a unique challenge for optimal anesthetic management, combining considerations for ARDS, multi-system critical illness, and concurrent pregnancy. The potential for respiratory and hemodynamic decline should be anticipated, particularly where post-partum hemorrhage is observed, and post-operative ICU admission is necessary.

**Table 1:** Overview of patient characteristics including COVID-19/ ARDS management and intra-operative management.

Demographics	Comorbidities	COVID Species	Medical Management	Anesthetic Management/blood loss	Neonatal outcome	Timeline/ Complications
<b>Patient 1:</b> Age: 26 years G1 P0 Gestational age at delivery: 36 <sup>wk</sup> weeks	Preeclampsia	SARS-CoV-2 N501Y S Gene Mutation (Beta variant - B.1.351)	Dexamethasone 6 mg IV x10 days; Tocilizumab 8 mg/kg IV x1 dose; Enoxaparin 40 mg sc	<b>GA maintenance:</b> MAC (Sevoflurane)= 0.4, Propofol 100 mcg/kg/min <b>Ventilation:</b> VCV, FiO <sub>2</sub> 1.0 <b>Hemodynamic Support:</b> Labetolol 10 mg <b>EBL</b> = 800 ml <b>PPH Management:</b> Oxytocin 3U IV, Oxytocin (20U/L) 125ml/h infusion	<b>Weight:</b> 2.61 kg <b>APGAR</b> scores: 1, 6 and 8 at 1, 5, and 10 minutes, respectively	<b>Symptom day at CD:</b> 12 <b>ICU LOS:</b> 5 days (4 days intubated) <b>Total LOS:</b> 8 days
<b>Patient 2:</b> Age: 33 years G1 P0 Gestational age at delivery: 36 <sup>wk</sup> weeks	Morbid obesity (BMI 62 kg/m <sup>2</sup> )	SARS-CoV-2 N501Y S Gene Mutation (Beta variant - B.1.351)	Dexamethasone 6 mg IV x10 days; Tocilizumab 8 mg/kg IV x1 dose, Ceftriaxone 1 g; Enoxaparin 40 mg sc	<b>GA maintenance:</b> MAC (Sevoflurane)= 0.8-1.0 <b>Ventilation:</b> PCV switched to manual ventilation, FiO <sub>2</sub> 1.0 <b>Hemodynamic Support:</b> Ephedrine 10 mg IV, Epinephrine 20 µg IV, Norepinephrine 6 µg IV x 9 doses <b>EBL</b> = 800 ml <b>PPH Management:</b> Ergometrine 250 µg IM x 2 doses, Oxytocin (20U/L) 125ml/h IV infusion, pRBC x1 unit	<b>Weight:</b> 2.58 kg <b>APGAR</b> scores: 5, 9 and 9 at 1, 5, and 10 minutes, respectively	<b>Symptom day at CD:</b> 4 <b>ICU LOS:</b> 9 days (8 days intubated) <b>Total LOS:</b> 16 days <b>Complications:</b> cardiomyopathy, AKI

Abstract #: SAT-RFCP – Room 5 - 20

## Radiographic Image Suggesting Broken Epidural Catheter: A case report

**Presenting Author:** Eleanor Kenny, MD

**Presenting Author's Institution:** McGaw Northwestern Feinberg School of Medicine

**Co-Authors:** Jessica Kruse, MD - McGaw Northwestern Feinberg School of Medicine

Samantha Lu, MD - McGaw Northwestern Feinberg School of Medicine

### Introduction

The true incidence of epidural catheter breakage or fracture is not known. Likely a rare phenomenon, catheter shearing has been reported to be 1 in 60,000 or 0.002%.<sup>1</sup> Catheters are most likely to break at the time of removal and is seen most frequently with difficult extraction.

### Case:

A 35-year-old G4P2012 at 33 weeks 6 days gestation presented for scheduled repeat cesarean delivery and possible hysterectomy for presumed placenta accreta spectrum disorder under combined-spinal epidural anesthesia. The patient was morbidly obese with a body mass index of 41. She has a history of two prior cesarean deliveries and this pregnancy was complicated by placenta previa. She underwent uneventful placement combined-spinal epidural with no redirections with loss of resistance at 7 cm. After delivery of the neonate, hysterectomy was deemed necessary and the patient was converted to general anesthesia with endotracheal tube. An abdominal radiograph was taken prior to incisional closure to ensure no instruments remained per institutional policy. The final read of the xray reported "a very small focus of catheter discontinuity in the medial aspect of the left upper quadrant." The patient's back and catheter were immediately inspected. The location of the catheter finding corresponded with the small radiolucent portion of the epidural catheter, which was tucked in the patient's skin fold. This made the catheter appear convincingly discontinuous on imaging. The epidural catheter was uneventfully removed on postoperative day 0 after it was no longer needed for postoperative analgesia; the catheter and tip were intact.

### Discussion:

Though epidural catheters are usually broken with traumatic removal, there was concern that the catheter may have been broken during the movement of the patient from the surgical bed to the hospital bed or when the radiographic image was being obtained. Our institution makes use of wire-reinforced catheters; as such, there is a small translucent window without wire reinforcement on the epidural catheter through which one may view the aspirated fluid. This case serves as a reminder that these small windows will appear radiolucent in contrast to the remainder of the catheter on radiographic imaging and may appear discontinuous. Furthermore, this case provides the anesthesiologist an opportunity to explore the likelihood, management strategies, and differential diagnosis of a broken epidural catheter.

[Image suggesting broken epidural catheter.pdf](#)

Abstract #: SAT-RFCP – Room 5 - 21

## Anesthetic Management of a Parturient with Congenital Factor VII Deficiency

**Presenting Author:** Morgane Factor, MD

**Presenting Author's Institution:** Stony Brook Medicine

**Co-Authors:** Tiffany Angelo, MD - Stony Brook University Hospital

Bahaa Daoud, MD - Stony Brook University Hospital

Victoria Nguyen, MD - Stony Brook Medicine

### **Introduction:**

Congenital factor VII deficiency (FVIIID) is a rare autosomal recessive bleeding disorder. Clinical manifestations vary from asymptomatic to life-threatening bleeding, and labor and delivery may increase the latter in pregnant women with this condition. Recombinant factor VIIa is the most common replacement therapy, however, there has yet to be established a definitive prophylaxis or treatment plan for parturients with congenital FVIIID.

### **Case Presentation:**

We report a case of a 29-year-old woman with congenital Factor VII deficiency who presented for Cesarean section for breech presentation. Recombinant Factor VIIa was administered due to elevated INR. We proceeded with spinal anesthesia and the patient successfully delivered a live infant without major issues or hemorrhagic complications.

### **Discussion:**

Peripartum prophylaxis with recombinant factor VIIa should be considered to reduce the incidence of postpartum hemorrhage among pregnant women with congenital FVIIID.

Abstract #: SAT-RFCP – Room 5 - 22

**A Case of Placental Abruption and Takotsubo Cardiomyopathy After Epidermoid Tumor Resection**

**Presenting Author:** Shanthi V. Shaver, MD MPH

**Presenting Author's Institution:** Augusta University Medical Center

**Co-Authors:** Augusta Riveros Perez, MD MBA - Medical College of Georgia. Augusta University

A 27 year old female G2P1001 at 27 3/7 weeks with no significant past medical history was admitted for an urgent two-stage resection of a 7.2 x 6.2 x 7.0 cm epidermoid tumor. The patient initially presented with gait instability, right sided weakness, dysphagia, diplopia, and dysarthria. MRI showed severe mass effect on the pons and brainstem with encasement of the internal carotid and basilar arteries. She was taken for stage one decompression of the cranial nerves in the left lateral decubitus position. A pulmonary artery catheter was placed through a 9 Fr. Cordis for hemodynamic monitoring. The patient developed a neurogenic fever during stage one which worsened her already hyperdynamic cardiac output of pregnancy. Hypoxemic respiratory failure ensued and she was reintubated post-operative day zero. During stage two resection in the supine position, the patient again developed a neurogenic fever, and was maintained on 100% FiO2 throughout the case due to her acute onset pulmonary edema. Pulmonary artery catheter readings for stage two showed reduced cardiac output and index. Fetal heart monitoring occurred throughout both stages. Shortly after the conclusion of stage two resection, fetal heart tones demonstrated bradycardia which was confirmed by ultrasound. The patient was taken for emergency cesarean delivery and was found to have a placental abruption. Transthoracic echocardiography afterwards revealed Takotsubo cardiomyopathy with an ejection fraction of 20%.

[Shaver\\_Abstract\\_photo.pdf](#)

Abstract #: SAT-RFCP – Room 5 - 23

## Robotic Adrenalectomy for the Treatment of Pheochromocytoma in a Parturient

Presenting Author: Olivia J. Vetter, MD

Presenting Author's Institution: University of Illinois at Chicago - Chicago, Illinois

**Introduction:** Pheochromocytomas in the parturient are exceedingly rare (incidence < 0.007%), compared to hypertension in pregnancy (5-10%). There is little guidance regarding the exact management of pheochromocytoma in pregnancy, although early treatment significantly reduces maternal and neonatal mortality. Ideally, medical management of the HTN is followed by tumor resection in the 2<sup>nd</sup> trimester. To achieve this, a multidisciplinary team must consider the risk of catecholamine surges and their impact on maternal cardiac function and fetal uteroplacental perfusion and risk of abruption. We present a case of a 24wk GA patient undergoing robotic adrenalectomy for a medically pretreated pheochromocytoma.

**Case:** 29yoF G5P3, BMI 27 kg/m<sup>2</sup> with PMHx of pheochromocytoma and HTN presenting for single port left robotic adrenalectomy. OB Hx included 3 prior CDs and PreEx in two prior pregnancies, one complicated by HELLP. Pheochromocytoma was diagnosed at 7wks GA at an OSH with HTN emergency complicated by globally depressed LV diastolic dysfunction, EF of 45-50% and septal wall motion abnormalities on echo. Cardiac cath was negative for CAD. MRI showed an adrenal mass (4.3x3.8cm) and 24-hr urine was positive for nor/metanephrines. Selective  $\alpha$ -1 blockade with doxazosin and metoprolol tartrate for reflex tachycardia were started. She was lost to follow up, and at an initial visit at 22wks GA echo showed an EF of 55-60% and normal BPs. After multidisciplinary optimization, at 24wks GA (14 days of medical treatment) an epidural catheter was placed preoperatively for postoperative pain control and general anesthesia was utilized for surgery. An arterial line and EJ IV were placed. The left adrenal gland was resected without hemodynamic instability. Pre- and postoperative FHTs were reassuring. Her recovery was uneventful without metanephrines in the urine and she is awaiting delivery via CD.

**Discussion:** Management of the parturient with pheochromocytoma requires timely multi-disciplinary care to optimize outcomes of mother and baby. While surgery is the definitive treatment, timing and approach (robotic, laparoscopic, or open) remain controversial. Elements unique to each case including gestational age, clinical response to medical treatment, and presence/absence of fetal distress affect these decisions. In this patient, her initial depressed cardiac status may have represented a sensitivity to demand ischemia; thus large changes in hemodynamics had to be avoided. Robotic approach facilitated visualization and dissection in an inherently smaller operative space and possibly less risk of PTL in a 24wks parturient.

Abstract #: SAT-RFCP – Room 5 - 24

## Anesthetic management of the morbidly obese, anticoagulated parturient with a spinal cord stimulator

**Presenting Author:** Marshal Lu, MD

**Presenting Author's Institution:** Montefiore Medical Center

**Co-Authors:** Fadi Farah, M.D. - Montefiore Medical Center

Yelena Spitzer, MD - Montefiore Medical Center

### Introduction

Spinal cord stimulators (SCSs) are used in the treatment of refractory chronic neuropathic pain by delivering electrical current to neurons to modulate sensations of pain. SCSs usage has been increasingly utilized in women of childbearing age who subsequently become pregnant. Since SCS involves an electrical device placed epidurally, precautions should be taken to ensure successful parturient anesthesia and avoid damage to the SCS.

### Case Presentation

A 29 year old female in her second pregnancy at 33 weeks and 4 days with morbid obesity, history of pulmonary embolism taking 10,000U heparin subcutaneously twice daily, with severe intrauterine growth restriction with intermittent absent end-diastolic flow and a non-reactive non-stress test presented for urgent cesarean section. She had a back injury as a consequence of a motor vehicle accident and subsequently had a SCS placed one year ago. She received a single shot spinal anesthetic and delivered uneventfully. She was discharged home on postoperative day 4; her baby was discharged 1 month later.

### Discussion

Neuraxial anesthetics are commonly used in obstetric anesthesia for labor and cesarean delivery, and are not contraindicated by the presence of a SCS. The components of a SCS include wires placed in the epidural space on target neurons and an internal pulse generator (IPG) which provides energy to the wires, typically placed subcutaneously in the flank or buttock. To avoid damaging the SCS, neuraxial anesthetics should be attempted above or below the level of SCS wires. Imaging and records should be obtained prior to delivery to identify the location of the epidural leads and their method of placement. There is a risk of incomplete epidural anesthesia due to the presence of a fibrous encapsulated sheath that forms around the epidural wires. Strict sterile technique should be maintained to avoid infection of SCS hardware.

During cesarean section, electrocautery may result in thermal injury to the patient or loss of function of the SCS, and should be minimized. Bipolar is preferred over monopolar electrocautery. However, if monopolar electrocautery is necessary, the SCS must be evaluated beforehand to ensure it has normal impedances, reprogrammed to the lowest setting, and turned off. A grounding pad should be placed as far as possible from the SCS and IPG. SCS deactivation should be ensured during labor due to lack of research on its effects on labor progress. Postoperatively, the SCS should be interrogated to ensure normal function and reprogrammed to the settings prior to surgery.

Abstract #: SAT-RFCP – Room 5 – 25

## Postpartum Myonecrosis in a Patient with VLCAD - The Epidural Blame Game Continues...

**Presenting Author:** Marshal Lu, MD

**Presenting Author's Institution:** Montefiore Medical Center

**Co-Authors:** Erik B. Romanelli, MD, MPH - Montefiore Medical Center

Yelena Spitzer, MD - Montefiore Medical Center

### Case Presentation

A 36 year old presented to the labor and delivery floor for induction of labor of her third pregnancy. She had a genetic mutation in the ACADVL gene implicated in VLCAD. Before her pregnancy, she had exercise intolerance and frequent muscle cramping. A pregnancy 7 years ago was complicated by rhabdomyolysis with a creatine kinase of 5,596 U/L, and severe pain to the left thigh and buttocks. MRI and CT of the left gluteus and proximal vastus lateralis was suggestive of a compressive injury with possible myonecrosis.

Provisions were made for frequent glucose monitoring, intake of dextrose, avoidance of hypovolemia, and frequent positional changes. A baseline creatine kinase was 187 U/L. A combined spinal epidural was performed and the patient labored for 48 hours, after which she proceeded to an uneventful cesarean section for arrest of labor. During recovery on the postpartum unit, she developed left hip and thigh pain not associated with increased creatine kinase levels. Her symptoms improved and she was discharged home with her child.

### Discussion

In the adult-onset myopathic form of VLCAD, patients are at risk for rhabdomyolysis due to the inability to catabolize fatty acids for energy. Risk factors include increased metabolic demand such as exercise, muscle cramps, pain, and hypoglycemia.

Epidural analgesia can decrease maternal stress during labor, but may cause lower extremity numbness and therefore increased risk of muscular injury. Frequent turning should be implemented once neuraxial analgesia has been initiated. General anesthesia warrants additional considerations. Lipid-containing medications such as propofol and formulations of etomidate should be avoided. Succinylcholine may induce myalgia and increase creatine kinase which mimics symptoms of VLCAD. Recommendations on volatile anesthetics are mixed; guidelines recommend avoidance but cases of safe use have been reported.

Abstract #: SAT-RFCP – Room 6 - 01

## Use Of Thromboelastography To Aid In Clinical Decision-making For Epidural Catheter Placement In A Patient With Von Willebrand Disease Type 2

**Presenting Author:** Benjamin T. Houseman, MD, PhD, FASA

**Presenting Author's Institution:** Memorial Hospital System Department of Anesthesiology, Envision Physician Services  
Department of Anesthesiology

**Co-Authors:** Tilman Chambers, MD - Memorial Hospital System Department of Anesthesiology

Veronica Montes-Berrios, MD - Envision Physician Services, Department of Anesthesiology

Amy K. Pulido, MD - Envision Physician Services, Department of Anesthesiology

Kiesha Raphael, MD - Envision Physician Services, Department of Anesthesiology

Isaac Schultz, BA - Florida Atlantic University College of Medicine

### CASE REPORT

This case report illustrates the use of thromboelastography (TEG) to aid in clinical decision-making for epidural catheter placement in a patient with Willebrand Disease (vWD) Type 2 and thrombocytopenia.

A 33-year-old G1P1 with a longstanding history of thrombocytopenia and a diagnosis of vWD type 2 was admitted for induction of labor at 39 1/7 weeks. Prior to her pregnancy, she had normal menstrual bleeding and no history of bleeding diathesis. At 32 and 35 weeks EGA, the patient had completed courses of steroids with little improvement in her platelet count. Admission labs revealed thrombocytopenia (68,000/ $\mu$ L) and anemia (Hg 8.6 g/dL). PT, PTT, and INR were normal, and levels of Factor VIII and von Willebrand Factor were elevated (Figure 1).

The patient desired an epidural catheter for pain management. To facilitate safe placement, she received two units of platelets, resulting in an increase of her platelet count to 84,000/ $\mu$ L, as well as intravenous desmopressin 0.3 mcg/kg. Rapid TEG assessment indicated normal coagulation function, and an epidural catheter was placed uneventfully at the L3-4 interspace. A healthy male infant with Apgar 8 and 9 was delivered 5 hours later with EBL 600 mL. She had no significant parturient bleeding, and her platelet count three hours later was 90,000/ $\mu$ L, at which point the epidural catheter was removed. She remained thrombocytopenic but had no bleeding issues until she and her infant were discharged home on postpartum day 2. To our knowledge, the infant has no bleeding disorders.

### DISCUSSION

Consensus guidelines for neuraxial procedures do not provide detailed guidance on the management of less common coagulation disorders that present with thrombocytopenia (1-4). Placement of an epidural catheter in patients with a diagnosis of vWD type 2 is particularly challenging because this disease state has multiple subtypes with a wide range of clinical presentations. TEG provides a useful tool for cases such as ours because it measures the ability of whole blood to form a clot (5).

In this case report, rapid TEG demonstrated adequate platelet function, intact fibrin cross linking activity, and good clot integrity. These results, along with elevated vWF / Factor VIII levels and normal PT / PTT / INR, suggested that her thrombocytopenia was best managed with platelet transfusion and desmopressin rather than vWF – Factor VIII concentrate.

[Use Of Thromboelastography To Aid In Clinical Decision-making For Epidural Catheter Placement In A Patient With Von Willebrand Disease Type 2 - Figure 1.pdf](#)

Abstract #: SAT-RFCP – Room 6 – 02

## Use of Protamine to Reverse Therapeutic Heparin Infusion in a Patient with Postoperative Hemorrhage After Cesarean Delivery

**Presenting Author:** Richard Smiley, MD, PhD

**Presenting Author's Institution:** Columbia University Vagelos College of Physicians and Surgeons - New York, New York

**Co-Authors:** Chung-Jen Z. Chen, MD - New York Presbyterian - Columbia University

### Introduction

Venous thromboembolism (VTE) is an important cause of maternal morbidity and mortality during the peripartum period. Consequently, anticoagulation (AC) has increased significantly in the obstetric population. However, AC guidelines are inconsistent as to when to restart AC after delivery. There are emergency reversal agents for some AC (e.g. protamine for heparin, andexanet alfa for factor Xa inhibitors), but there is a paucity of research demonstrating safety in the obstetric population.

### Case

A 36 year old G3P0020 at 39 0/7 weeks gestation presented for induction of labor after PROM. Her antepartum course was complicated by a VTE involving the left common femoral, superficial femoral, and external iliac veins diagnosed at 32 2/7 weeks gestation, for which she was started on therapeutic enoxaparin.

On admission, enoxaparin was held and an epidural catheter was placed. Due to non-reassuring fetal tracing and chorioamnionitis, she underwent uncomplicated low transverse cesarean delivery (CD). The catheter was removed after surgical wound closure, and therapeutic heparin infusion was restarted 3 hours later.

Over the next 12 hours she developed worsening hypotension, abdominal distension/pain, and pallor concerning for intraabdominal bleeding. Hgb had declined from 10.5 to 7.6. Bedside FAST scan revealed ~4cm fluid in Morrison's pouch. The patient was given 2 units PRBCs and a phenylephrine infusion was started. The heparin infusion (aPTT 84.2) was stopped and 50mg protamine given in 10mg increments over 10 minutes. Repeat aPTT after reversal was 28.8. Her condition improved significantly after heparin reversal and transfusion, with decreasing pain and serial FAST scans showing unchanged fluid volume. Enoxaparin was restarted on POD 3 and gradually up-titrated to therapeutic doses by POD 6.

### Discussion

There are few published guidelines on resumption of therapeutic AC after CD. SOAP guidelines recommend waiting more than 1 hour after a neuraxial block or pulling a catheter before resuming heparin infusion.<sup>1</sup> Other guidelines have recommended waiting 12-24 hours after delivery before resuming heparin infusion.<sup>2,3</sup> In this case, therapeutic AC may have been resumed too early, contributing to postoperative intraabdominal hemorrhage. Although it is well known that protamine reverses heparin, few case reports have shown its effective use in the obstetric population. We thus opted to give 50mg, the maximum dose recommended for reversal outside of cardiac surgery.<sup>4</sup> We think this dose would be sufficient for reversal in most cases due to heparin's short half-life and current recommendations to give 0.5mg-0.75mg per 100u of heparin given. This case demonstrates the successful and safe use of protamine to reverse therapeutic heparin infusion in a post-CD patient.

**Abstract #: SAT-RFCP – Room 6 – 03**

**Awake Fiberoptic in Spanish-Speaking Parturient for Submandibular Abscess**

**Presenting Author:** Christy Henderson, MD

**Presenting Author's Institution:** VUMC

**Co-Authors:** Calvin Gruss, MD - VUMC

Stephanie Woodward, MD - VUMC

**Introduction:** During pregnancy, intubation efforts can be more challenging than the general population due to airway edema<sup>2</sup>. Oropharyngeal infections increase the risk of respiratory compromise with induction, which may necessitate an awake fiberoptic intubation.

**Case:** Ms. O is a 23-year-old Spanish-speaking G2P1 female at 35w2d gestation who presented to the ED with severe tooth pain. She reported chills and drainage from her mouth. Exam was notable for low grade fever, maternal tachycardia, mild respiratory distress, and significant submandibular swelling with trismus. WBC was elevated to 13. CT illustrated a right submandibular abscess with urgent I&D recommended by OMFS. While in the ED, the patient experienced preterm labor contractions; she was found to be 3/50/-2 on examination, which progressed to contractions every 5 minutes and cervical dilation to 4cm. OMFS, OB anesthesia, general anesthesia, and the OB team met to coordinate care. The patient desired an epidural, which was quickly placed for labor pain prior to transport to the OR. The decision was made to monitor the fetus intraoperatively; EFM and tocometry were used. Given her trismus and limited mouth opening (10mm), the decision was made to perform an awake oral fiberoptic intubation. She received nebulized lidocaine, and a viscous lidocaine jelly was applied to her tonsillar pillars. ENT was called to bedside for emergency airway. A dexmedetomidine infusion was started, and a transtracheal block performed. Due to limited mouth opening and significant oral edema, an oral fiberoptic pediatric scope was unable to pass the uvula, and the team transitioned to a nasal fiberoptic approach. Despite Afrin administration and serial nasal dilation, moderate epistaxis was noted. The patient tolerated the nasal approach, and a 6.0 ETT was passed, followed by induction of general anesthesia. Ms. O tolerated the procedure well and was extubated successfully in the OR. Postoperatively, her preterm labor contractions stopped, and the epidural was removed. She was discharged home on POD#3. She returned to the hospital with uterine contractions at 37w6d and underwent a CSE where she had a spontaneous vaginal delivery of a healthy baby girl.

**Discussion:**

- How preterm labor can affect the OR plan for other indicated procedures
- Identifying patient factors contributing to difficult airway <sup>1</sup>
- Indications, risks, and preparation prior to fiberoptic attempt in near-term parturient <sup>2,3</sup>

Abstract #: SAT-RFCP – Room 6 – 04

## TRANSFUSION MANAGEMENT IN IMMUNOGLOBULIN A DEFICIENT PARTURIENTS WITH POST-PARTUM HEMORRHAGE

Presenting Author: BO-CHIH PAN, MD

Presenting Author's Institution: MEDICAL COLLEGE OF WISCONSIN

**Background:** Immunoglobulin (Ig)A deficiency is the most common primary immunodeficiency with prevalence ranging from 1:100 to 1:20,000 depending on ethnicity and having a male predominance. In certain sensitized patients, exposure to blood products containing IgA antibodies can trigger a life-threatening anaphylactic reaction. We present the case of an IgA deficient patient who underwent Caesarean delivery for twins complicated by massive post-partum hemorrhage requiring blood transfusion.

**Case:** A 28 y.o. G1P0 parturient at 38 weeks and 1 day gestation, with past medical history significant only for IgA deficiency, presented for scheduled Caesarean delivery of twins. Her baseline hemoglobin and hematocrit were 10.0 and 34, respectively. After twin delivery, uterine tone was noted to be firm, and the initial quantitative blood loss (QBL) was approximately 1 liter. However, with initial fundal exam in the operating room, the patient had return of numerous large clots and brisk bleeding was noted. CBC and DIC panel were obtained, and an order was placed to prepare 2 units of washed RBCs. Tranexamic acid, misoprostol, methylergonovine, and carboprost were administered with improvement in hemostasis. Overall QBL was approximately 3 liters. The patient was brought to recovery and transfused with 1 unit of RBCs due to a drop in hemoglobin. She was monitored overnight, and the bleeding was noted to have significantly improved. However, due to further drop in hemoglobin to 6.7, as well as orthostatic hypotension accompanied by dizziness and lightheadedness, the patient was transfused with 2 additional units of washed RBCs the next day. By postoperative day 2, she experienced resolution of all symptoms and was ultimately discharged home on postoperative day 4. Although this patient did not require transfusion of other blood products, we did consider the scenario in which she would require platelets, fresh frozen plasma, or cryoprecipitate. In such a case, we would ideally administer products from IgA deficient donors. If that was not available, we would pretreat with steroid and diphenhydramine. In an emergent situation, the benefit of administering products from non-IgA deficient donors likely outweighs the remote chance of an anaphylaxis reaction.

**Discussion:** Various institutions have established protocols involving the transfusion of blood products from IgA-deficient donor pools or red blood cells that have been washed of IgA with buffered saline. Considerations addressed by such protocols include the length of preparation time and the length of time before expiry of the product. This case demonstrated that familiarity with such protocols allows providers to be better prepared for urgent transfusion of IgA deficient patients in the post-partum period.

Abstract #: SAT-RFCP – Room 6 – 05

## Caesarean Delivery in a Parturient with Autoimmune Hepatitis and Cirrhosis

**Presenting Author:** Jake Rachiele, MD

**Presenting Author's Institution:** Columbia University Medical Center

**Co-Authors:** Suzanne Mankowitz, MD - Columbia University Medical Center

Daniel Tobes, MD - Columbia University Medical Center

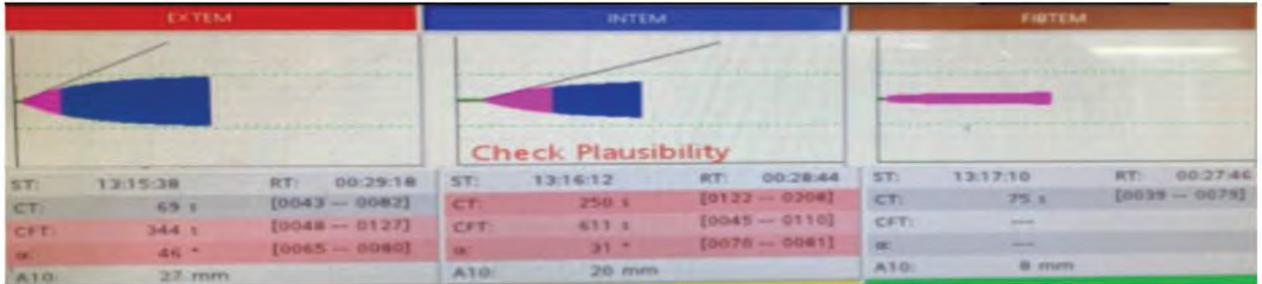
33 year old G1P0 at 37w4d with autoimmune hepatitis, cirrhosis with portal hypertension, esophageal varices with a MELD-Na of 6 and severe thrombocytopenia presenting for urgent Cesarean delivery due to worsening thrombocytopenia. Antepartum care for thrombocytopenia included a steroid course that was unsuccessful and she was subsequently started on tacrolimus. Platelet count on admission was 35, she received 2 units of platelets that did not respond with a count of 35 post-transfusion. IVIG was then administered and it was ineffective as well. Subsequently, the platelet count decreased to 26 and the decision to perform a cesarean section was made.

A multi-disciplinary meeting took place including OB, hepatology, hematology and anesthesia prior to proceeding to the OR. Intraoperative plan included transfusion of 2 units of platelets during line access placement and loading of tranexamic acid at the beginning and end of the surgery. A ROTEM was done and showed a multifactorial coagulopathy.

Patient was brought to the OR, a pre-induction radial arterial line was placed and an 18g PIV was in situ. A LIJ CVC was placed without issue. 2 units of platelets were given. A unit of cryoprecipitate and 2 units of FFP were given slowly afterwards. A rapid infuser was prepared. The patient was then preoxygenated and general anesthesia was induced with 200mg of propofol, 120mg of succinylcholine, 100 mcg of fentanyl, 60 mg of lidocaine and 120 mcg of phenylephrine. A 7.0 ETT was placed via a GlideScope 3. Anesthesia was maintained with 50% nitrous and a propofol drip of 120 mcg/kg/min. The baby was delivered 7 min after induction of anesthesia. Oxytocin was started and carboprost was given for uterine atony which improved significantly. Persistent oozing was noted from one site of the uterine incision which was oversewn and pressure held for about 10 minutes with resolution. Oozing was also noted when closing the skin but resolved with pressure. QBL was 1200ml and 2L of crystalloid was given. The patient was extubated uneventfully and brought to high risk postpartum unit on nasal cannula.

On arrival to high risk, patient's SpO2 was 92% on 4 liters nasal cannula. A chest xray was completed which showed bilateral infiltrates suggestive of vascular congestion. Differential included hypervolemia, transfusion associated cardiac overload and transfusion related lung injury. 20mg of lasix IV was given with resolution of hypoxia. Patient was discharged home 4 days later.

Cirrhosis is a rare condition to be encountered during pregnancy. Multifactorial thrombocytopenia in the setting of cirrhosis makes these cases even more challenging. Preoperative evaluation of autoimmune hepatitis with optimization is important. Other modalities such as IVIG and plasma exchange should also be considered. ROTEM can be a very useful in a complicated multifactorial coagulopathy and can guide treatment. Methergine should be avoided in cases of portal hypertension and uterine atony.



Abstract #: SAT-RFCP – Room 6 – 06

## Labor Anesthesia in Marfan Syndrome, An Interesting Case

**Presenting Author:** Tobias Robinson, MD

**Presenting Author's Institution:** UVMMC - Burlington, Vermont

**Co-Authors:** Dan Crowder, MD - UVMMC

### Introduction:

Dural ectasia (DE), as defined by De Paepe et al, is a dilation of the dural sac anywhere along the spinal column, and can be found in 63% to 92% of individuals with Marfan syndrome (MS). [1,2,3] These are often overlooked but, can influence anesthetic management dramatically, such as unpredictable intrathecal anesthetics and inadvertent dural puncture.

### Case:

A 34 year old G2P1001 female at 38 weeks and 6 days presented for induction of labor in the setting of gestational hypertension, with a known diagnosis of MS (FBN1 32 mutation). She has a history of prior vaginal delivery with epidural labor analgesia, mild mitral regurgitation, aortic root dilation, and mild dextroscoliosis.

During her induction, an epidural was placed at the L3-L4 level using standard techniques, with aid of ultrasound for assessment of anatomic landmarks. Assessment at 60 minutes demonstrated no level of analgesia despite repeat boluses of 0.125% bupivacaine (bupi). Decision was then made to replace epidural. The second attempt at L3-4 level resulted in accidental dural puncture and a spinal catheter was placed and used for analgesic control. However, no discernable analgesic level was obtained. The spinal catheter was then removed and a 3rd attempt was made to replace the epidural. A combined spinal-epidural was placed at the L4-5 level. Ultrasound guidance was once again used, and litmus paper identified the fluid return as CSF. An intrathecal dose of 1ml 0.25% bupi with 50mcg of fentanyl was delivered and the epidural catheter threaded easily. The patient continued to have significant pain at 20 minutes following placement, so an epidural bolus dose of 7ml of 0.25% bupi was administered, achieving a therapeutic T10 dermatomal level of analgesia. She delivered unassisted one hour later and the epidural catheter was removed.

The following day she developed a postural headache consistent with a post dural puncture headache. She elected for conservative management and was discharged home the following day.

### Discussion:

As discussed by Yang et.al and Lacassie et.al, DE often result in unpredictable spinal anesthesia, require variable local anesthetic doses, and have high failure rates. Though this patient did not have a formal diagnosis with imaging demonstrating a DE, the high prevalence in MS and her unpredictable response to intrathecal anesthetics, makes this diagnosis likely.

**Abstract #: SAT-RFCP – Room 6 – 07**

**When an AFE isn't just an Amniotic Fluid Embolism: AFE and Massive Pulmonary Embolism during Cesarean Delivery**

**Presenting Author:** Mohammed Idris, MD

**Presenting Author's Institution:** Beth Israel Deaconess Medical Center - Boston, Massachusetts

**Introduction:**

AFE occurs in 2-8 per 100,000 deliveries and is responsible for approximately 10% of maternal mortality in the United States. The diagnosis of AFE is often made on clinical grounds with sudden onset of cardiorespiratory arrest, hypotension, mental status changes, signs of DIC, onset within 30 min of delivery and absence of fever. We report a case of a patient undergoing an elective cesarean delivery who developed sudden loss of consciousness (LOC), severe bradycardia, hypotension, coagulopathy, inferior vena cava (IVC) clot and pulmonary embolism.

**Case Report:**

A 33 y/o G2P1 parturient at 36 weeks' gestation with h/o rheumatoid arthritis on etanercept presented for an elective CD due to placenta previa. Antenatal history was complicated by episodes of vaginal bleeding which required hospital admissions. Combined spinal epidural was performed which achieved a T4 sensory level bilaterally. She was hemodynamically stable until immediately after delivery when she lost consciousness, became bradycardic and hypotensive. Epinephrine 100mcg was given IV three times with return of spontaneous circulation, but the patient did not regain consciousness. She was intubated and invasive monitoring was started. Severe hypoxemia with PaO<sub>2</sub> 97 mmHg on FiO<sub>2</sub> 1.0 was noted and a repeat blood gas analysis after 30 min showed an improved PaO<sub>2</sub> at 297 mmHg (FiO<sub>2</sub> 1.0). Coagulation studies showed a drop in fibrinogen to 93 mg/dL, INR 1.8 and platelet 49,000/mm<sup>3</sup>. Transthoracic echo showed good left and right ventricular function with no RV dilatation and a normal TAPSE. A TEE showed depressed LV function, good RV function and a 5 cm mobile clot at the junction of the IVC and RA (Figure 1). Blood loss intraoperatively was 1600 ml. Heparin infusion was started in the ICU but she continued to be hemodynamically unstable. CT angiogram of the chest and the abdomen showed a PE in the left main pulmonary artery (Figure 2) and rectus sheath hematoma. The patient was taken to IR for embolization of the left inferior epigastric and uterine arteries. The subsequent ICU course was uneventful.

**Discussion:**

AFE with varying degrees of severity is seen in pregnant women. We report a case of AFE complicated by PE and bleeding into the rectus sheath. The differential diagnosis for the patient's initial collapse included vasovagal syncope, bleeding from placenta previa or AFE. Her evolving clinical picture of hypoxemia, hemodynamic instability and coagulopathy were more suggestive of AFE. The freely mobile 5 cm clot in the IVC could be the result of activation of coagulation cascade in the initial phase of AFE or from an undetected DVT (due to her repeated hospitalization).

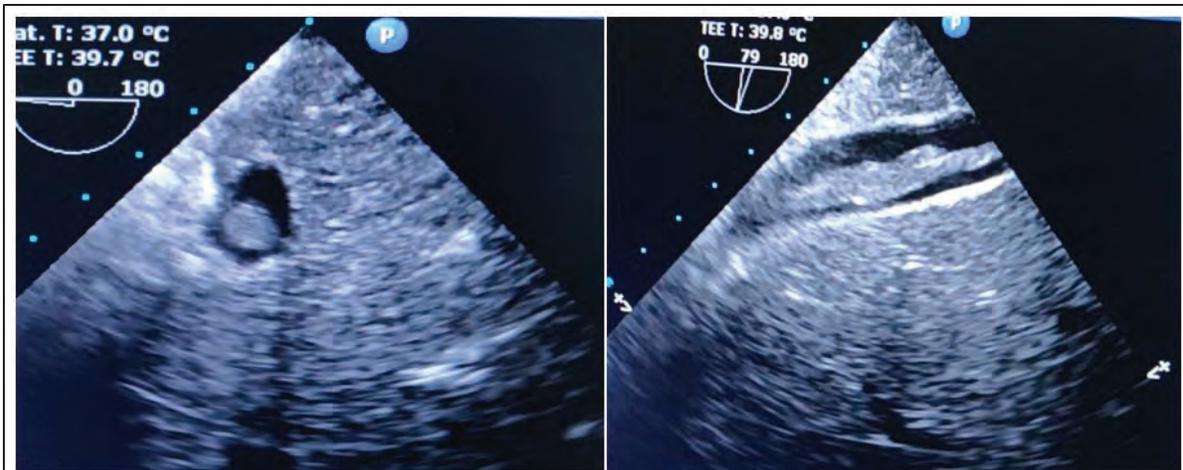


Figure 1: TEE showing clot in IVC

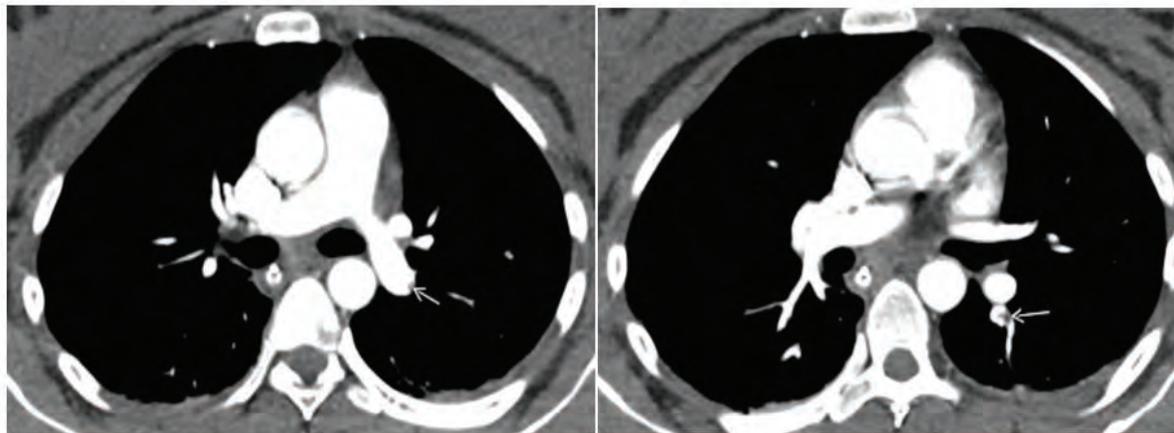


Figure 2: CT Angiogram showing pulmonary embolus in main pulmonary artery

Abstract #: SAT-RFCP – Room 6 – 08

**Management of Anesthesia and Anticoagulation in a Parturient with COVID Pneumonia, Thrombophilia and Heparin-Induced Thrombocytopenia**

**Presenting Author:** Mehwish A. Mirza, MD

**Presenting Author's Institution:** Montefiore Medical Center - Yonkers, New York

Prothrombin G20210A mutation is the second most common thrombophilic disorder in the general population, after Factor V Leiden. Prothrombin G20210A mutation increases prothrombin, which increases susceptibility for deep vein thrombosis and pulmonary emboli. Here, we present the case of a parturient with a history of prothrombin G20210A mutation on fondaparinux for history of heparin-induced thrombocytopenia, who presented for urgent cesarean section with respiratory distress in the setting of COVID pneumonia. While hospitalized, anticoagulant was transitioned from fondaparinux to intravenous argatroban given its shorter elimination half-life. Coagulation studies were done to assess safety of and potential for neuraxial anesthesia. She was found to have elevated PT in the setting of normal PTT, which may be explained by argatroban use or by a COVID coagulopathy seen in patients diagnosed with COVID pneumonia. Cesarean section was ultimately performed under general anesthesia given the unclear nature of the patient's anticoagulation status. Fondaparinux and argatroban are newer anticoagulants and additional studies are required to further elucidate the safety profile of these agents with neuraxial anesthesia. COVID-19 infection can also complicate the interpretation of laboratory values for coagulation status, especially in a patient on novel anticoagulation agents without guidelines for neuraxial anesthesia administration. The aim of this report is to discuss management of anesthesia and anticoagulants in the setting of COVID-19 infection during labor and delivery.

Abstract #: SAT-RFCP – Room 6 – 09

### Urgent Cesarean Section for Parturient with Acute Decompensated Heart Failure

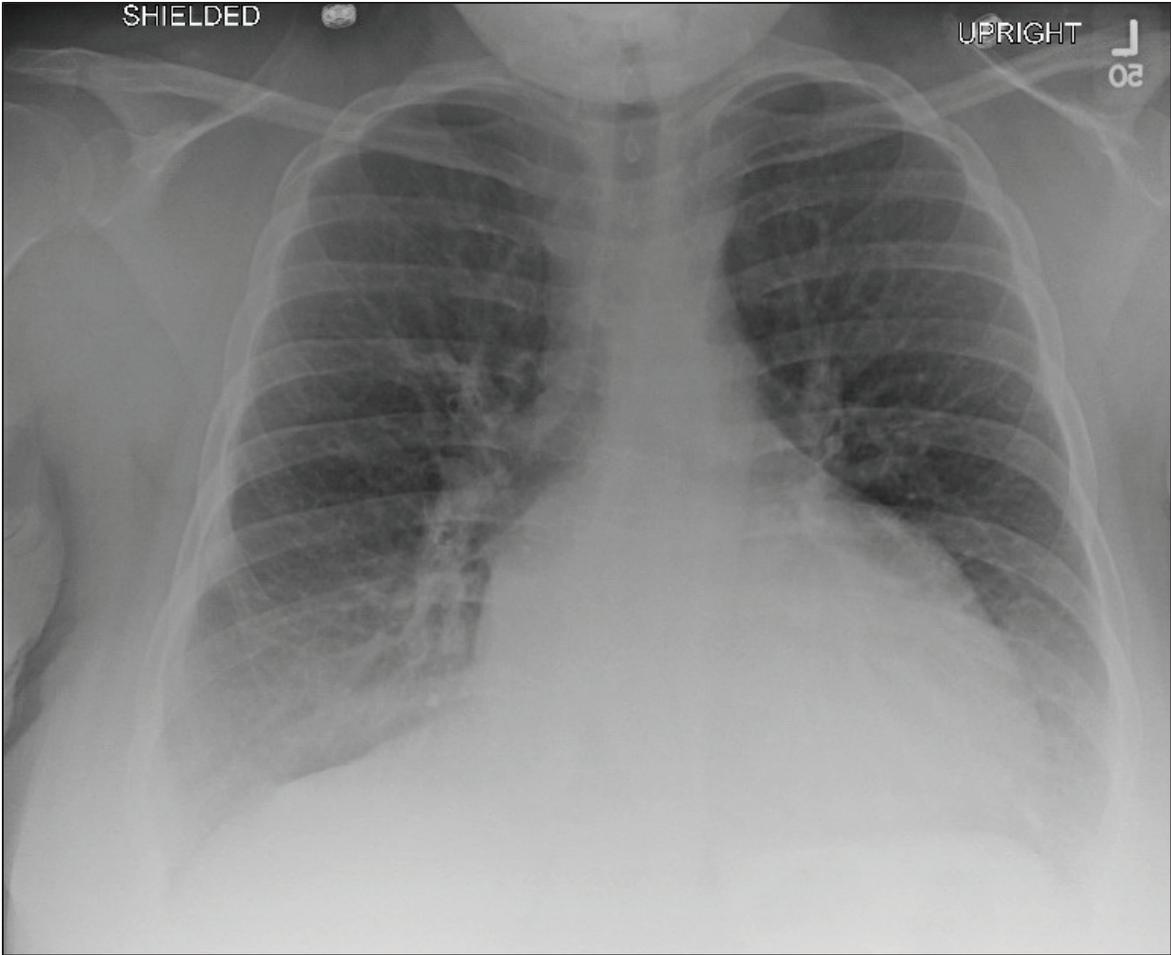
**Presenting Author:** Kyle Sullivan, MD

**Presenting Author's Institution:** University of Texas Health Science Center at San Antonio - SAN ANTONIO, Texas

**Co-Authors:** Matthew D. Read, MD - University of Texas Health Science Center at San Antonio

Taylor Watkins, MD - University of Texas Health Science Center at San Antonio

Cardiomyopathy secondary to ischemic heart disease prior to pregnancy provides a unique anesthetic challenge in the setting of a cesarean section. A 30 year-old female G2P1 at 30 weeks and 6 days with history of ischemic cardiomyopathy with reduced ejection fraction (30%, NYHA class 2) presented for urgent cesarean section in the setting of acute decompensated heart failure with superimposed pre-eclampsia. Other pertinent medical history included coronary artery disease with 6 prior myocardial infarctions status post multiple drug eluting stents (most recent 10 months prior to presentation) on aspirin and clopidogrel, morbid obesity (BMI 49), and hypertension. Due to concern for additional episodes of acute decompensated heart failure, secondary to continuing pregnancy related cardiovascular changes, a multidisciplinary team decided to proceed with cesarean section with bilateral salpingectomy. The patient was diuresed with furosemide and antenatal steroids were administered. General anesthesia was planned due to urgency of the procedure and continued dual-antiplatelet use making neuraxial anesthesia contraindicated. The patient had a favorable airway exam. A preinduction arterial line was placed followed by induction of anesthesia with boluses of lidocaine, esmolol, propofol, remifentanyl, and initiation of a low dose epinephrine drip. Remifentanyl was chosen to minimize respiratory depression for the baby post-delivery while providing a hemodynamically stable induction. Rapid sequence induction was avoided in favor of a controlled induction for hemodynamic stability. Intubation with video laryngoscope proceeded without complication. Post-induction, a central venous introducer and Swan-Ganz catheter were placed. The ECMO team placed sheaths in the groin in case of emergent need of venoarterial ECMO. Transesophageal echocardiography was used to monitor ventricular function and volume status. The procedure proceeded without complication requiring only carboprost and oxytocin for uterine atony. The baby required intubation after delivery, but quickly improved afterwards likely due to exhalation of anesthetic gases. The patient remained hemodynamically stable throughout the case and was extubated prior to being transferred to the post anesthesia care unit. While neuraxial anesthesia may be preferable for cesarean section, general anesthesia was necessary and provided tight control of cardiac parameters while mitigating the risk of acute decompensated heart failure.



**Abstract #: SAT-RFCP – Room 6 – 10**

**General anesthesia for cesarean delivery in parturients with clinically-significant intracranial lesions: a case series**

**Presenting Author:** Patrick Ahern, M.D.

**Presenting Author's Institution:** UTSW - Dallas, Texas

**Co-Authors:** Laylee Clare, D.O. - UTSW

The incidence of comorbid intracranial neoplastic & vascular pathology in pregnant patients is rare but strongly associated with serious adverse outcomes. Pregnancy's complex physiologic & hormonal changes precipitate intracranial tumor growth and subsequently worsen mass effect, while increasing the risk of intracranial arteriovenous malformation destabilization. These lesions present risks to both mother and neonate – requiring a coordinated management approach between neurosurgery, obstetrics, neonatology and anesthesiology. On the same day in 2021, we performed general anesthesia on two parturients with significant intracranial lesions.

The first was a 33-year-old G4P3 at 35 weeks gestation with a previously diagnosed foramen magnum meningioma that caused significant brainstem compression and worsening neurologic deficits. Her history was further complicated by chronic hypertension, asthma, anemia & tobacco use. Neurosurgery deferred tumor resection to the postpartum period. General anesthesia was performed given the risks of tonsillar herniation, CSF leak and masking of worsening or new neurologic symptoms with spontaneous vaginal delivery & neuraxial anesthesia.

The second was a 21-year-old G3P1 at 37 weeks 4 days gestation with a history of a minimally-symptomatic yet untreated ruptured left frontal AVM during a prior gestation. Neurosurgery saw the patient earlier in her gestation, however deferred neurovascular intervention as they felt exposing patient and neonate to the associated surgical risks did not outweigh her clinical status. Despite being originally scheduled for elective cesarean delivery at 39 weeks, she presented to the emergency department at 37 weeks 4 days in active labor. She was urgently admitted for primary cesarean section. General anesthesia was performed given the risks of further AVM rupture with spontaneous vaginal delivery & neuraxial anesthesia.

Both patients were induced via rapid sequence induction and maintained on inhaled anesthetic and remifentanyl infusion. Our goals of maintaining adequate depth of anesthesia, limiting fluctuations in intracranial pressure, maintaining hemodynamic stability & providing appropriate postoperative pain coverage were successfully achieved in both cases. The postoperative neurologic status of both patients remained unchanged and they were discharged, respectively, on postoperative days 4 & 3.

Abstract #: SAT-RFCP – Room 6 – 11

## Chronic Pulmonary Embolus and Pulmonary Hypertension in a Primigravida with Protein S Deficiency

**Presenting Author:** Danielle Esnard, MD

**Presenting Author's Institution:** Ochsner Medical Center

**Co-Authors:** Anne McConville, MD - Ochsner Medical Center

### Introduction

Protein S deficiency is an autosomal dominant thrombophilia that can cause venous thromboembolism. It is associated with miscarriage, late fetal loss, abruption, and pre-eclampsia<sup>1</sup>. We present a case of group 4 pulmonary hypertension (PH) caused by chronic pulmonary embolus (PE) in a primigravida with protein S deficiency.

### Case Presentation

A 20 year old G1P0 at 16 weeks estimated gestational age (EGA) with a past medical history of protein S deficiency complicated by acute saddle PE status post open embolectomy 6 months prior and strong family history of premature death due to blood clots initially presented for hemoptysis in setting of enoxaparin noncompliance. Transthoracic echocardiogram (TTE) revealed moderate right ventricular (RV) dysfunction, an immobile calcified mass attached to the right atrial inferolateral wall measuring, chronic distal PE, and pulmonary artery pressure (PAP) of 67 mmHg. Due to the mass' chronicity, cardiothoracic surgery deferred intervention and patient was discharged on therapeutic enoxaparin.

At 36 weeks EGA, patient was admitted with concern for placental abruption and fetal distress. General anesthesia was induced and arterial line placed for emergent cesarean section. A viable infant was delivered, and patient transferred to the ICU for post-operative care. Patient was diuresed with intravenous furosemide, anticoagulated with enoxaparin, and discharged home in stable condition.

The post-operative course was complicated by multiple bouts of pneumonia and a new right main stem PE with multiple bilateral segmental and subsegmental emboli. Patient was deemed too high risk for open embolectomy, so interventional radiology attempted catheter directed thrombolysis. General anesthesia induced and arterial line placed. The removal of clot burden from the bilateral pulmonary arteries caused hypotension and PEA arrest. Unfortunately, the patient could not be resuscitated.

### Discussion

Pregnancy is considered contraindicated in patients with severe pulmonary hypertension due to its 30-50% mortality rate<sup>2</sup>. The hemodynamic changes associated with pregnancy, labor, and delivery worsen the PH and subsequent RV dysfunction. After placental extraction, cardiac output and systemic vascular resistance increase dramatically and may take up to 6 months to return to normal<sup>3</sup>. All accepted modes of delivery and anesthetic aim to eliminate hemodynamic compromise. The most common practices include vaginal delivery with slow oxytocin and low dose epidural and scheduled cesarean with incremental epidural dosing. Standard practice includes monitoring with electrocardiography, pulse oximetry, invasive blood pressure monitoring, and post-operative ICU admission for volume control<sup>4-6</sup>. Coordination between cardiology, maternal fetal medicine, and obstetric anesthesia have proven instrumental to successful outcomes.

Abstract #: SAT-RFCP – Room 6 – 12

## Neuraxial anesthesia in patient with preeclampsia with severe features and possible ventriculoperitoneal shunt malfunction

**Presenting Author:** Gabriel Fregoso, MD

**Presenting Author's Institution:** Massachusetts General Hospital-Anesthesia, Critical Care and Pain Medicine

**Co-Authors:** Hilary Gallin, MD - Massachusetts General Hospital-Anesthesia, Critical Care and Pain Medicine

Erin E. Haggerty, MD - Massachusetts General Hospital-Anesthesia, Critical Care and Pain Medicine

Rebecca Minehart, MD - Massachusetts General Hospital-Anesthesia, Critical Care and Pain Medicine

### INTRO:

Neuraxial anesthesia for delivery is generally safe for idiopathic intracranial hypertension (IIH); however, safety evidence is limited in parturients with concurrent concern for ventriculoperitoneal shunt (VPS) malfunction [1,2]. We present a case of a parturient with preeclampsia with severe features and concern for malfunctioning VPS.

### CASE SUMMARY:

A 30 yo G5P1031 at 38w3d with history of prior cesarean delivery, IIH status post VPS, BMI of 48, gestational hypertension, and gestational diabetes presented with intractable headaches similar to those associated with her IIH. Workup showed grade 1 papilledema and CT revealed interval dilation of lateral ventricles concerning for VPS failure with increased ICP. Obstetrically, she was diagnosed with preeclampsia with severe features by headache criteria, magnesium was initiated, and the decision was made to proceed with repeat cesarean delivery. However, the safety of neuraxial anesthesia was questioned given concern for VPS failure. Initial consultation with both neurology and neurosurgical teams resulted in strong concern for performing neuraxial anesthesia based on her history. However, after further discussion with the neurology team, they determined on CT imaging that there appeared to be open communication between her ventricles. The neurosurgery team then performed a VPS tap with an opening pressure of 7 cm H<sub>2</sub>O. After discussion with all teams, the patient underwent uneventful cesarean delivery under epidural anesthesia.

### DISCUSSION:

Determining the safety of neuraxial procedures for parturients with increased ICP and risk of cerebral herniation is essential. IIH typically poses minimal risk for herniation with dural puncture as there is typically no gradient for herniation with underlying physiology being a communicating type increase in ICP secondary to under-absorption of CSF [1]. IIH patients are commonly managed with VPS; however, pregnancy poses risk of VPS malfunction secondary to increased intraabdominal pressure from the gravid uterus [2]. An obstetric anesthesiologist must mechanistically understand the underlying pathology for which VPS was placed, particularly whether the intracranial pathology is causing communicating or non-communicating increases in ICP and interpret available data when determining safety of neuraxial anesthesia. In this patient, the VPS tap ultimately helped to assess her ICP within the context of her CT scan to determine whether she had communication between cerebral ventricles.

## Management of a Parturient with Lumbar Schwannoma

**Presenting Author:** Lana Glantz, MD

**Presenting Author's Institution:** Maimonides Medical Center

**Co-Authors:** Kalpana Tyagaraj, MD - Maimonides Medical Center

### INTRODUCTION:

Neuraxial techniques are the pain-relieving modalities of choice for labor analgesia. Women with spinal cord lesions, including tumors, present specific challenges during pregnancy. Schwannomas are among the most common benign neurogenic tumors in the spinal canal and represent approximately 25% of intradural spinal tumors in adults. In pregnant patients, the diagnosis of spinal schwannomas may be delayed because the early symptoms are similar to the normal changes of pregnancy. Although many anesthesiologists consider spinal cord pathology to be a relative contraindication to neuraxial anesthesia, successful neuraxial blocks placement has been reported in such situations. A multidisciplinary approach is critical to provide safe anesthetic care for these patients.

### CASE SUMMARY:

A 37-year-old female P2 at 35 weeks presented to triage for anesthesia consult. The patient reported history of L2/3 schwannoma diagnosed 1 year ago. The patient reported that she started having lower back pain and radiculopathy prior to pregnancy and was seen by a neurologist. The MRI showed a 3mm nodular structure on the posterior aspect of spinal canal at L2/L3 level, most likely benign schwannoma. Other lumbar levels did not show any stenosis or disc bulges. Patient reported that her symptoms are infrequent and usually occur when heavy lifting. She denied any lower extremity weakness or sensory loss. The neurologist had recommended non-operative conservative management, possible epidural placement at L4/5 and follow up MRI. An extensive multidisciplinary discussion was held including the patient regarding pain management options. Patient expressed understanding of the risks and benefits and plan made for epidural placement at L4/L5 interspace.

At 39+3 weeks, the patient was admitted to L&D for induction of labor because of oligohydramnios with no 2x2 pocket. As per patient request, an epidural was inserted in the L4-L5 interspace. The epidural was loaded with 8ml of 0.25% bupivacaine and 100mcg of fentanyl and infusion 0.1% Bupivacaine with fentanyl 2mcgs/ml at 10 ml/hour was initiated. The patient had an uncomplicated, normal spontaneous vaginal delivery of a male fetus with APGARs of 8&9.

### DISCUSSION:

A thorough pre-operative assessment must be performed to assess the extent of symptoms and neurological deficits associated with a spinal cord tumor. MRI imaging and input from a neurologist should be obtained when planning the anesthetic care. It is imperative to include the patient in multidisciplinary discussions regarding their obstetric and anesthetic care.

The decision to proceed with epidural anesthesia rather than spinal or general anesthesia for delivery was to avoid potential problems with spinal anesthetic in this patient which include rapid sympathectomy with possibility of resultant spinal cord ischemia, unreliable sensory level and creating dural puncture in the presence of an intradural tumor.

Abstract #: SAT-RFCP – Room 6 – 14

## Hydatidiform Molar Pregnancy with Co-existent Normal Fetus

**Presenting Author:** Jakayla Harrell, MD

**Presenting Author's Institution:** Ochsner Clinic Foundation - Kenner, Louisiana

**Co-Authors:** Roneisha McLendon, MD, MS - Ochsner Health

**Introduction:** Gestational trophoblastic disease (GTD) consists of pathologies that can result in malignant complications with 0.5% average development in complete molar pregnancies and 0.1% development in partial (1). These patients may present with irregular vaginal bleeding, hyperemesis, early failed pregnancy, excessive uterine enlargement with rarer signs of hyperthyroidism, early onset pre-eclampsia, or respiratory failure (2). Such potential catastrophic complications make early identification, diagnosis, and treatment of GTD vital. Molar evacuation may be accompanied by excessive bleeding and the risks of tumor embolization must be weighed against hemorrhage; however, during surgical evacuation prostaglandins and pitocin may be used after careful consideration (2). We describe a case of hydatidiform molar pregnancy with co-existent normal fetus that required understanding of the perioperative possible presentation and risks for adequate surgical planning.

**Case:** Our case involves a 28yo G4P3 at 13w0d with history of asthma and no PNC who presented with hyperemesis gravidarum. TVUS on initial presentation (1/24) with 7x3x9 cm consistent with subchorionic hemorrhage and further workup showed elevated AST/ALT and HCG >225,000. Further US imaging was concerning for twin gestation of a normal fetus with a coexistent molar pregnancy necessitating a quantitative HCG that returned 243,214 (equivocal) with patient opting to do CVS outpatient. At 13w5d patient presented with PPROM after CVS and was scheduled for D&E. Subsequent multidisciplinary discussion ensued with the decision to proceed with general anesthesia with preparation for hemorrhage. Management intra-operatively included 2 large bore IV access sites, 2U prbc typed and crossed in the operating room, pre-operative buccal cytotec, intra-op paracervical block with lidocaine with 1:200k epi, methergine, and pitocin infusion with the possibility of paracervical vasopressin and TXA administration. She had a general anesthetic with 1,200cc blood loss during the procedure. Patient discharged POD 1 with close OB follow-up for pathological specimen and HCG measurements.

**Discussion:** GTD is rare but serious antenatal pathology. Patients must be carefully managed intra-operatively to lower risk of embolization and followed when cured with contraception as the risk of subsequent molar pregnancy is 1% after 1 mole (3). Optimal follow-up following a molar pregnancy is continued for six months if the HCG has reverted to normal within 56 days of the pregnancy event, or six months after the normalization of HCG level. Close follow-up confirms successful treatment and identifies patients who require chemotherapy or surgery. Women should be advised not to conceive until their follow-up is complete.

Abstract #: SAT-RFCP – Room 6 – 15

### When recurrent T- cell lymphoma goes undiagnosed in a parturient

**Presenting Author:** Jennifer Hoayek, MD

**Presenting Author's Institution:** The University of Texas Health Science Center in Houston

**Co-Authors:** Barbara Orlando, MD - The University of Texas Health Science Center in Houston

**Background:** The incidence of non-Hodgkin's lymphoma (NHL) during pregnancy is about 0.8 cases per 100,000 women<sup>1</sup>. Patients present with a wide range of symptoms such as palpable lymphadenopathy or classic constitutional B symptoms, in addition to anemia and thrombocytopenia.

**Case Presentation:** This is the case of a 30 y/o gravida<sup>1</sup> para 0 parturient who initially presented in July 2019, with one week of constant epigastric pain radiating to her back. CT of the abdomen showed diffuse lymphadenopathy. Biopsy of her retroperitoneal lymph nodes showed Stage IVB peripheral T-cell lymphoma. She was given 8 rounds of chemotherapy, and received an autologous stem cell transplant in 5/2020, resulting in remission. In 10/2021, she presented to the hospital at 31+4 weeks due to constant high-grade fever. She had no palpable lymph nodes. Repeat CT scan done in March 2021 showed splenic LN enlargement, which had been followed medically. New onset pancytopenia made hemophagocytic lymphohistiocytosis (HLH) secondary to a viral infection, the most likely diagnosis. Normally, delivery should be avoided during a period of pancytopenia due to a high risk of sepsis and poor maternal outcome; however, the patient was deteriorating clinically due to her worsening pancytopenia. At 32 weeks, the decision was made to proceed with an emergent cesarean delivery (CD). Upon pre-operative assessment, platelets were found to be 29000 and INR was 2.8. General Anesthesia (GA) and neuraxial anesthesia contra-indications due to pancytopenia and coagulopathy were discussed with the patient, as well as the possibility of remaining intubated in case of hemodynamic instability. Anesthesia management included preoperative transfusion of platelets and fresh frozen plasma (FFP), CD under GA, massive transfusion protocol activation, and peripheral access with 2 large-bore peripheral intravenous (PIV) lines. Once the surgical team was ready to proceed, the patient was induced using rapid sequence intubation with a 6.0 cuffed ETT. An arterial line was placed for arterial blood gas and blood pressure monitoring. Hemodynamic stability was maintained with a phenylephrine infusion, the transfusion of 3 units of packed red blood cells and 2 units of FFP intraoperatively. A bone marrow biopsy was performed following CD. The patient was later extubated and taken to the medical intensive care unit for recovery. HLH treatment was started; however, bone marrow biopsy results confirmed relapse of her peripheral T cell lymphoma. She was then started on salvage therapy and continues to be treated.

**Discussion:** Timely diagnosis of NHL during pregnancy is challenging. While we want to offer optimal medical treatment to the mother, we have to think about the impact of this management on the fetus. Therefore, coordinated efforts of a multidisciplinary team including obstetric anesthesiologists is a must.

Abstract #: SAT-RFCP – Room 6 – 16

## Neuraxial Anesthetic Management for Tubal Ligation After Inadvertent Dural Puncture and Severe Post Dural Puncture Headache

**Presenting Author:** Eva Martinez, MD

**Presenting Author's Institution:** University of Illinois at Chicago

**Co-Authors:** Lauren P. Newhouse, MD - University of Illinois Hospital

Heather C. Nixon, MD - University of Illinois at Chicago

**Introduction:** Inadvertent dural puncture (IDP) is one of the most common complications of epidural placement and can lead to more complex neuraxial management as well as postdural puncture headache (PDPH). Following IDP, there is no consensus on whether an intrathecal (IT) or receded epidural catheter should be placed. We present a case of a patient who experienced IDP, severe PDPH, and required a subsequent tubal ligation. In this case, a newly placed epidural catheter was utilized for surgical anesthesia and a therapeutic EBP.

**Case:** A 31yo G3P1 in spontaneous labor requested labor analgesia complicated by intrathecal (IT) catheter placement during an attempted epidural catheter placement recognized by positive CSF aspiration. IT analgesia was utilized for six hours of labor and a healthy infant was delivered vaginally. Although a tubal ligation (TL) was planned, staffing and census at the time did not allow for immediate surgery and the IT catheter was removed to facilitate safe discharge of patient to the postpartum floor. Within eight hours of delivery, the patient complained of a postural occipital headache, photophobia and blurry vision consistent with a PDPH. As the patient was scheduled for a next-day TL, the patient consented to a surgical epidural and a therapeutic EBP following the TL. An epidural catheter was placed in the OR on first attempt and 2% lidocaine/epinephrine/bicarbonate was titrated to a bilateral T8 level. Surgery was performed without complication. Following sensory level recession in the PACU 3hrs later, 20mL of autologous blood was injected via the epidural catheter (5mL aliquots) until resolution of the headache (18mL total). Following discharge, the patient returned to the ER with a recurrent headache. An EBP was attempted but aborted due to R lower extremity pain during the procedure. The pain team was consulted for a fluoroscopically guided EBP which resulted in full treatment of symptoms.

**Discussion:** Ideally, this patient would have received a TL using the IT catheter placed during labor, but a census surge prevented this. Per protocol, the IT catheter was removed prior to transfer to the postpartum floor. As the patient manifested symptoms of a PDPH in the first 12 hours and needed a TL, an epidural catheter was used for dual-purpose surgical anesthesia and therapeutic EBP. Use of this epidural catheter for surgery allowed verification of placement in the epidural space and waiting until the patient's motor and sensory function were restored limited the amount of local anesthetic present in the epidural space during the EBP. Although a prophylactic EBP has not been supported in the literature, we were able to use a newly placed epidural catheter to perform a successful therapeutic EBP.

Abstract #: SAT-RFCP – Room 6 – 17

**Primary Pulmonary Hypertension in a Late Second Trimester Parturient Presenting with Hemoptysis and Dyspnea: A Role for Point of Care Ultrasound (PoCUS)?**

**Presenting Author:** Phillip Sholes, MD

**Presenting Author's Institution:** University of North Carolina, North Carolina

Primary pulmonary hypertension (PH) in pregnancy is a high-risk condition with reported maternal mortality rates between 9-25%.<sup>4,5</sup> Point of care ultrasound with transthoracic echocardiography (TTE) is a non-invasive method to evaluate pregnant patients presenting with critical illness.<sup>2,3,6,7</sup> Bedside focused ultrasound can be used for rapid assessment, preventing delayed recognition of cardiac conditions in pregnant patients which carry a considerable risk of maternal morbidity and mortality.<sup>3</sup>

A 25-year-old female G3P22002 at 26 weeks gestation presented to an outside emergency department (ED) due to an episode of hemoptysis and shortness of breath. She was noted to be tachycardic, normotensive and with a leukocytosis of 20. An EKG was obtained with concern for right sided heart strain. The patient underwent evaluation by computer tomography (CT) scan to rule out a pulmonary embolism, which was negative but showed a pulmonary arterial venous malformation (AVM) to which her symptoms were attributed. The patient was transferred to our tertiary care facility for interventional radiology and maternal-fetal medicine management. Initial pulmonology consultation recommended contrast echocardiography to assess right to left intracardiac shunting<sup>1</sup>. The TTE was significant for severe pulmonary hypertension as evidenced by significant right ventricular dilation with reduced systolic function, compressed left ventricle, and interventricular septal flattening. The cardiology consult team, upon further review concluded that pulmonary hypertension was likely present at time of admission due to review of her initial CT.

The constellation of this patient's symptoms on presentation coupled with her CT findings may have served as a red herring leading to the diagnosis of a pulmonary AVM and not pulmonary hypertension. The non-invasive technique of bedside point of care ultrasonography in the ED and/or on labor and delivery may have shortened the time to diagnosis of severe pulmonary hypertension. The patient underwent procedural sedation in the setting of severe pulmonary hypertension and was classified as an ASA II prior to consultation of the obstetric anesthesia team for multidisciplinary planning for peripartum care given the patient's desire to continue the pregnancy. This difficult case highlights the potential benefit of point of care ultrasound and specifically TTE in evaluating a gravid patient presenting with dyspnea. As anesthesiologists specializing in obstetric care, point of care TTE should be a skill applied to the evaluation of critically ill parturients in the ED and labor and delivery.

[Sholes.pdf](#)

Abstract #: SAT-RFCP – Room 6 – 18

## Anesthetic Management for Resection of a Rare, Large, Metastatic Brain Mass during Multiple Gestation Pregnancy

**Presenting Author:** Claire Spradling, MD

**Presenting Author's Institution:** Vanderbilt University Medical Center - Nashville, Tennessee

**Co-Authors:** James Damron, MD - Vanderbilt University Medical Center

Douglas Hester, MD - Vanderbilt University Medical Center

Britany L. Raymond, MD - Vanderbilt University Medical Center

### Introduction:

Primary and secondary tumors of the brain are rare in pregnancy, with only 379 cases reported out of nearly 20 million pregnancy-related admissions from a US Nationwide Inpatient Sample.<sup>1</sup> Thus, there are many unanswered questions for providers who are confronted with planning the optimal anesthetic for women presenting for neurosurgical tumor resection during their pregnancy. We present the clinical management of one such unique case to help future providers anticipate, prepare, and plan for anesthetic challenges.

### Case Report:

A 39-year-old healthy woman developed concerning, recurrent chest pain. Clinical workup demonstrated CT evidence of a right lung mass consistent with synovial sarcoma. This grave diagnosis was also accompanied by the exciting news that she was finally pregnant, with twins, after a long struggle with fertility. She elected to continue her pregnancy and undergo a right middle and lower lobe lung resection during her first trimester with hopes of complete removal of the cancer. The patient recovered well for four months after the resection, until she began to develop headaches, visual impairment, and word finding difficulties. Brain MRI demonstrated a 3cm x 4cm left superior posterior parietal brain mass. Due to her progressive symptoms, a multi-disciplinary plan was made to move forward with resection of her tumor. At 25.1 weeks gestation, the patient underwent resection of her tumor and was started on chemotherapy. Unfortunately, at 32.3 weeks, she underwent urgent cesarean delivery due to fetal distress while hospitalized for coronavirus. Her delivery was ultimately uneventful and she continues to undergo chemotherapy and radiation while raising her two healthy children.

### Learning Objectives:

In the pregnant patient undergoing invasive neurological surgery, to be able to:

1. Discuss the physiologic impacts of both increased intracranial pressure and pregnancy
2. Formulate a safe anesthetic plan that optimizes both maternal and fetal safety
3. Determine the implications of fetal monitoring during an intracranial surgery

[Tumor Pictures\\_SOAP 2022.pdf](#)

Abstract #: SAT-RFCP – Room 6 – 19

## Pregnancy complicated by Spina Bifida and Edwards Syndrome: A Case Report and Review of the Literature

Presenting Author: Rochelle Johns, MD

Presenting Author's Institution: HHC Lincoln - Bronx, New York

Neural tube defects (NTD) result from a disturbance in the neurulation process which forms the CNS. The prevalence of NTD is 1:1200 live births and constitutes the second most common congenital malformation after congenital heart malformations. Despite the use of folate supplementation, these defects still occur and have a multifactorial inheritance pattern. The two most common NTD are Spina Bifida Aperta and Spina Bifida Occulta. Studies have shown that 2-16% of isolated NTD have an associated chromosomal abnormality or single gene defect. We present a case of a singleton pregnancy complicated by Spina Bifida in conjunction with Edward's syndrome.

37 year old G4P2012 presented at 11wks gestation. Her prenatal history was uncomplicated; no history of genetic conditions or NTD were noted. Genetic evaluation with Maternal Serum Quad screen noted an increased risk for trisomy 18, open NTD/ventral wall defects. The patient was referred to Genetics and elected to have Non-invasive Prenatal Testing (NIPT), which suggested an increased risk for trisomy 18. Early anatomical sonogram at 17w3d revealed a multitude of anomalies: banana sign, lemon sign, enlarged ventricles with dangling choroids, myelomeningocele and talipes of the left foot, with suspicion of a cardiac anomaly. Patient underwent genetic consultation, and elected to have an amniocentesis at 19 weeks gestation, which revealed a male fetus with mosaic Trisomy 18. Fetal echocardiogram was also recommended. An interdisciplinary team, consisting of MFM Specialists, Neonatologists, and the Geneticist held multiple discussions with the patient, the result of which resulted in her electing termination. The etiologies of NTD's are quite complex and multifactorial. Folate supplementation has proven to decrease the incidence of NTD's, however despite adequate supplementation these anomalies still occur. Trisomies 13 and 18 typically have a paucity of associated defects involving the CNS. Studies show the most common aneuploidy associated with myelomeningocele is trisomy 18.

Technological advancements in sonography have made prenatal diagnosis of NTD's possible at earlier gestational ages. Once sonographic evaluation has been noted, full evaluation consisting of genetic consultation, amniocentesis for evaluation of aneuploidy, fetal echocardiography should be recommended. A multidisciplinary team, consisting of Neonatologists, MFM Specialists, Geneticists, and Pediatric Neurosurgeons should have a frank discourse with the parents to discuss options inclusive of termination, fetal surgery, postnatal surgery, and risk of recurrence in subsequent pregnancies.

## High Neuraxial Blockade in Unrecognized Intrathecal/Subdural Catheter during Emergency Caesarean Section

**Presenting Author:** Charles Shaller, Resident

**Presenting Author's Institution:** Maimonides Medical Center - Brooklyn, New York

**Co-Authors:** William Tyson, Attending - Maimonides Medical Center

### INTRODUCTION:

Total Spinal is a known complication of neuraxial blocks. A high neuraxial block is a sensorimotor block that has climbed to a spinal segment level higher than intended. Neuraxial block at T3 and higher has been associated with significant cardiovascular and respiratory compromise.

### CASE DISCUSSION:

34 years female G3P1 at 39+ weeks with gestational diabetes and morbid obesity, underwent CSE placement uneventfully. Catheter aspiration followed by test dose were negative. Infusion was started with 0.1% Bupivacaine with Fentanyl 2mcg/ml.

An hour later, called to evaluate for hypotension. Patient received boluses of phenylephrine and Ephedrine, BP and fetal HR recovered and stabilized transiently but became hypotensive again with nonreassuring FHR. Decision to go for stat cesarean section. In the OR, after negative aspiration, 10ml of 2% lidocaine with epi was administered. In a few minutes, patient complained of "numb all over", became unresponsive. Patient continued to have BP and HR readings, hypotensive and in respiratory arrest. Intubated with 7 ETT and mechanical ventilation and phenylephrine infusion initiated. Baby was delivered with APGARs 2 and 7, transferred to NICU. After procedure, withdrawal with 3cc syringe yielded CSF return. Patient initiating breaths but TV not appropriate. Patient transferred to SICU to allow more time for more time before safe extubation. Patient was extubated and phenylephrine infusion was weaned off later that day. Patient was transfused 1 unit of PRBC for excessive bleeding. Patient and baby were discharged on 3<sup>rd</sup> POD.

### DISCUSSION:

Possible etiologies for unanticipated high neuraxial block:

1. Estimation of local anesthetic dose, volume and baricity, required for appropriate level of anesthesia.
2. Positioning of patient during and after placement of the block.
3. Spinal after epidural: continuous epidural infusion and previous top offs can compress subarachnoid space and potentially increase chances of high block.
4. Accidental/Unrecognized intrathecal injection.
5. Accidental Subdural block- delayed onset, profound sensory and motor block, false negative aspiration and test doses, patchy block and accidental total spinal.
6. Accidental Intradural injection into substance of dura can cause possible localized swelling. Some local anesthetics can escape into epidural space and eventually cause acceptable epidural block, with repeated top offs an extensive block develops.

### PREVENTION AND MANAGEMENT

Vigilance, meticulous technique, awareness of the possible complications, careful assessment of the progression of the block and appropriate monitoring are all the key factors in prevention and early detection of these potential complications. Emergency airway intervention, vasopressors, rapid bolusing of fluids, sedate and ventilate the patient till the level comes down, immediate CPR and delivery of the baby if cardiac arrest occurs, are crucial interventions for successful outcomes.

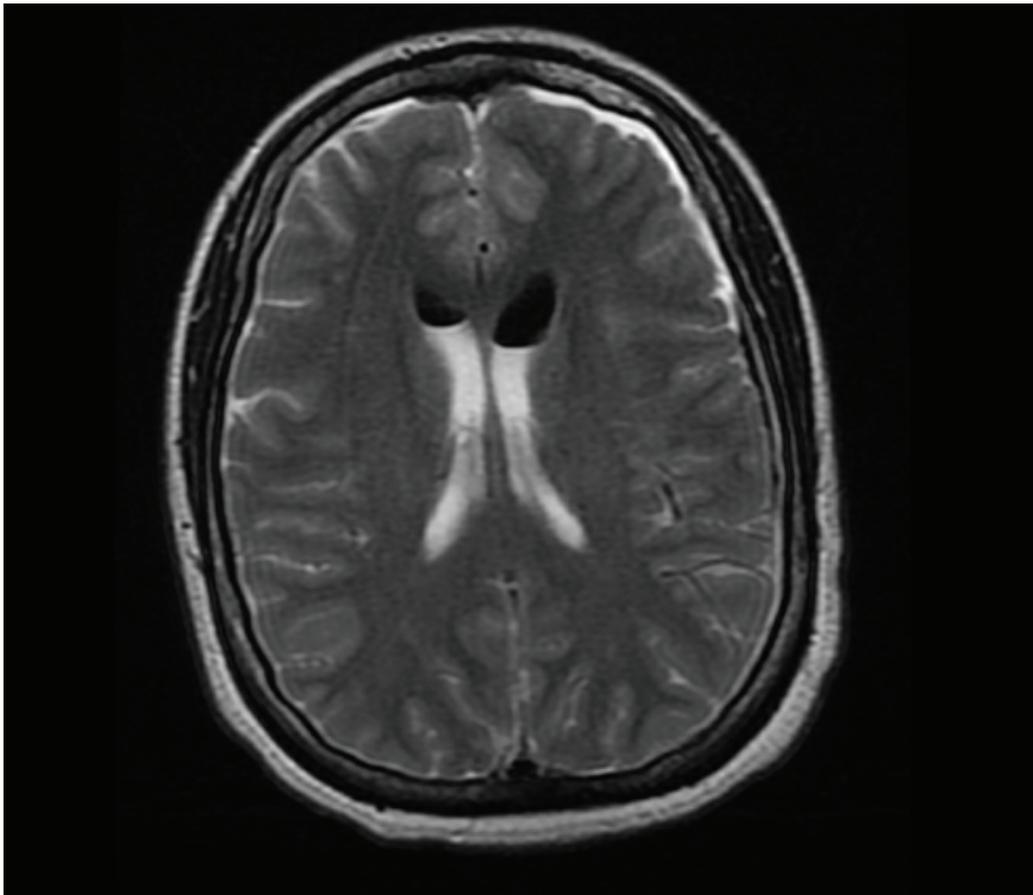
Abstract #: SAT-RFCP – Room 6 – 21

**Subdural hematoma and pneumocephalus after obstetric epidural anesthesia**

**Presenting Author:** Christopher Ching, MD

**Presenting Author's Institution:** Ochsner Medical Center

Epidural anesthesia is commonly used for labor analgesia in the parturient. Possible complications of epidural placement include inadvertent dural puncture, bleeding complications such as epidural or intracranial hematoma, pneumocephalus, infection and local anesthetic systemic toxicity. We present a rare case of a 37-year-old parturient who was found to have both pneumocephalus and a subdural hematoma following epidural anesthesia for a cesarean section. The patient developed symptoms of a post-dural puncture headache (PDPH) post-op day 1 and received an epidural blood patch on post-op day 2 but had persisting symptoms. Brain MRI was obtained and revealed pneumocephalus in the lateral ventricles and venous distension with a left frontoparietal subdural hematoma suggestive of intracranial hypotension. The patient had slow resolution of symptoms after conservative management with neurology consultation, head of bed restrictions and 100% O<sub>2</sub> therapy. Pneumocephalus and/or intracranial hemorrhage should be considered in patients with persisting headache following neuraxial anesthesia.



Abstract #: SAT-RFCP – Room 6 – 22

## Successful Labor Epidural Placement in a Parturient with a Spinal Cord Stimulator

Presenting Author: Lilliane R. Ernst, MD

Presenting Author's Institution: University of Tennessee Medical Center - Knoxville, Tennessee

### Intro:

Spinal cord stimulators (SCS) have emerged as an effective modality to treat refractory pain. Because these devices are present in the epidural space, they require additional consideration prior to performing neuraxial labor analgesia. We present the case of a labor epidural performed in a patient with an SCS.

### Case:

A 33-year-old G2P1 female with a past medical history of chronic back pain status post L5-S1 transforaminal lumbar interbody fusion (TLIF) and thoracic SCS placement presented to the pre-anesthesia testing (PAT) clinic at 27 weeks to discuss options for labor analgesia. The operative note from her SCS placement and a post-operative X-ray requested at PAT revealed that the SCS leads entered the epidural space at L1. Since neuraxial anesthesia could be placed inferior to the SCS leads it was determined that neuraxial anesthesia could be placed with minimal risk of damage to the SCS generator or leads, lead migration, or lead entanglement. The patient was counseled on the aforementioned risks. The patient subsequently presented to the labor and delivery floor at 37 weeks, and the risks mentioned at the PAT clinic were discussed again with the patient. Prior to epidural placement, neuraxial ultrasound was performed, and the SCS leads were not identified in the L3-L5 interspaces. An epidural catheter was successfully placed at the L4/L5 interspace. A T10 sensory level was achieved, and the epidural catheter was removed without incident after delivery.

### Discussion:

Spinal cord stimulators are an effective non-pharmacologic treatment for chronic pain. As SCS devices become more common, it is important to consider the implications of SCS placement in patients who could become pregnant. Spinal cord stimulators modulate pain signaling through electrical stimulation of the dorsal columns via leads placed into the epidural space. Consequently, the presence of the SCS leads in the epidural space necessitates certain considerations prior to neuraxial anesthesia. It is important to have documentation of SCS lead location if neuraxial anesthesia is planned. Furthermore, neuraxial ultrasound can help confirm SCS lead location. If SCS leads are placed cephalad to where labor analgesia will be performed, it is unlikely that the SCS leads will be damaged, and due to anchoring of the leads and lead fibrosis it is unlikely that the SCS leads will migrate with placement of neuraxial labor analgesia [1]. Even though the risks are low, patients should be counseled about the potential risk of SCS device damage, lead entanglement, and hardware infection. Ultimately, as long as the SCS leads and generator are cephalad to where neuraxial anesthesia will be placed, neuraxial anesthesia can be safely performed in patients with an SCS.

**Abstract #: SAT-RFCP – Room 6 – 23**

**Dwyer instrumentation for scoliosis, a challenge for Neuraxial Anesthesia**

**Presenting Author:** Mickael Khouzami, MD

**Presenting Author's Institution:** Mount Sinai Hospital Icahn School of Medicine - New York, New York

**Co-Authors:** Barbara Orlando, MD, PhD - University of Texas Health

Deborah Stein, MD - Mount Sinai Hospital Icahn School of Medicine

A 41 years old nulliparous woman was referred to the Obstetric Anesthesia division for a consultation prior to her delivery given her history of thoraco-lumbar scoliosis surgical repair. Review of her records revealed scoliosis treated surgically with a Dwyer Instrumentation in 1991 for lumbar scoliosis and Harrington rod placement in 1994 for the thoracic scoliosis. The patient was seen by the neurosurgery team as well prior to her delivery and neuraxial analgesia was deemed safe.

On admission, the patient's back was scanned using an ultrasound to better identify the instrumentation. The "Rivanna: Accuro" Ultrasound was used in the "spine mode" which provided a reconstructed real-time imaging revealing an adequate entry point at L3-L4 level, 3 cm left to the midline at a 20 degrees angle. Following sterile preparation, draping, and injection of 1% lidocaine subq, a 17-gauge Tuohy needle was inserted in the previously identified space with the patient in the sitting position. Loss of resistance to air was achieved, following only one redirection, at 7 cm. A combined spinal-epidural was attempted, but no CSF was noted. The epidural catheter was then threaded and secured at 13 cm following a negative aspiration and a test dose. The epidural was then loaded with 5 mL of 0.25% bupivacaine followed by a continuous infusion of Bupivacaine (0.0625%) with Fentanyl (2mcg/mL) at 12 mL/h and a demand dose of 8 mL at 10 min intervals. The patient was hemodynamically stable throughout epidural placement and labor.

At the time of the epidural placement, the patient's pain had reached a 10/10 on the VAS pain scale. Following the epidural bolus and infusion, the patient's pain was gradually relieved, except for a right-sided lower abdominal quadrant patch. The patient was repositioned and 5mL Bupivacaine 0.25% was administered through the epidural catheter. Her discomfort substantially decreased but the patient did note mild persistent discomfort in this location. The patient's labor progressed uneventfully and delivered vaginally a healthy 2860g female.

Scoliosis and instrumentation have been associated with an increased difficulty in administering neuraxial analgesia, as well as increased incidence of patchy or unilateral blockade. We had to consider the implications of a previous spinal surgery on the feasibility and effectiveness of an epidural catheter, because of the presence of instrumentation itself and the potential for epidural fibrosis post-repair.

Neuraxial ultrasound may, however, improve the technical performance of neuraxial blocks especially in patients with unidentifiable landmarks, patients with scoliosis and instrumentation.

**Abstract #: SAT-RFCP – Room 6 – 24**

**The use of 2-chloroprocaine for labor analgesia in a patient with lidocaine allergy**

**Presenting Author:** Mickael Khouzami, MD

**Presenting Author's Institution:** Mount Sinai Hospital Icahn School of Medicine - New York, New York

**Co-Authors:** Deborah Stein, MD - Mount Sinai Hospital Icahn School of Medicine

This is a 35 years old nulliparous woman with cHTN that was referred for consultation prior to her delivery given her history of lidocaine allergy.

Review of her records revealed exposure to lidocaine leading to hospitalization due to hives, periocular and perioral swelling, without respiratory compromise. Following a thorough history, the patient was counseled concerning her allergy and its implications on labor analgesia. Different analgesic modalities were discussed, and the patient opted for neuraxial analgesia with 2-chloroprocaine. A consultation with the Allergy/ Immunology division was requested but not obtained prior to delivery. On admission to the L&D Unit, an epidural catheter was placed successfully while disposing of all lidocaine containing products, and no test dose was given.

The pump was set to deliver 12mL/h 1% 2-chloroprocaine with a demand dose of 5 mL every 20 min. A bolus of 5 mL 1% was also given.

- At 10 hours, the patient started experiencing increased pain. Following examination, the patient's epidural catheter was replaced due to migration. Pain relief was achieved within 15 minutes.
- At 18 hours, the patient started feeling pain again. She was examined and no logistical issues were revealed: PCEA's settings were increased from 12 to 14 mL as a continuous rate, and 5 to 7 mL as demand. A bolus of 5 mL of 3% 2-chloroprocaine was given, which provided adequate pain relief.
- At 21 hours, the patient started feeling discomfort again. Following a complete exam, the concentration was increased to 1.5%. 100 mcg bolus of fentanyl epidurally helped attain adequate analgesia again until a decision was made to stop induction of labor (at 24 hours) and proceed with a cesarean section for arrest of dilation. The patient received a 20 mL bolus of 3% 2-chloroprocaine with bicarbonate for the surgical procedure and delivered a healthy 2870 g female.

2-chloroprocaine has been used to provide adequate pain relief for patients with a lidocaine allergy with concentration between 0.3 to 1.5%. There are no clear guidelines however on its use, so we implemented a protocol that averaged both concentrations, and started with a 1% mixture with fentanyl boluses, while also keeping room for escalation, if needed. Neuraxial analgesia remains the best modality to address pain associated with labor, with minimal side effects. Given the rarity of a true lidocaine allergy, guidelines and protocols for this subset of population remain scarce. Further research is still warranted in creating labor analgesic protocols for this small subset of patients.

Abstract #: SAT-RFCP – Room 6 – 25

## Minimizing Maternal and Fetal Morbidity in the Setting of Rapidly Evolving Placenta Percreta: A Multidisciplinary Approach

Presenting Author: Jatturong Wichianson, MD

Presenting Author's Institution: Cedars Sinai Medical Center

### Background:

Placenta percreta can lead to severe and even life-threatening hemorrhage. The optimal management strategy is to utilize a standardized and multidisciplinary approach to care.(1)

### Case Presentation:

A 37yo-F G3P1011 at 24w5d gestation was admitted to our Maternal-Fetal Care Unit after initial ultrasound at an outside facility suggested complete placenta previa and potential placenta accreta. PMH none, PSH prior spontaneous abortion and later primary c-section for breech presentation. She was added to our weekly interdisciplinary conference, with Gyn-Onc, NICU, MFM, nursing and OB anesthesiology contributing to planning her care and completing our multidisciplinary accreta checklist. She was initially scheduled for a combined c-section and hysterectomy per Gyn-Onc recommendation at 34w gestation under general anesthesia. However, she began having multiple episodes of vaginal bleeding shortly after her admission. Her pelvic exam revealed possible placental tissue extruding from her cervical os, and MRI demonstrated placenta percreta with invasion into the endocervix and through posterior uterine wall. At our weekly multidisciplinary meeting, delivery moved up to 28w5d gestation to provide a balance of maternal morbidity from rapid progression of accreta to percreta and fetal lung maturity, while ensuring availability of all specialty teams involved. Surgery proceeded as scheduled. Arterial and central lines were placed prior to induction of general anesthesia, Belmont rapid infuser and rapid sequence intubation and APGAR scores of 2/6/7. Intraoperative placenta percreta involved the right bladder wall. A total hysterectomy with removal of her cervix and bladder wall resected en bloc to reduce blood loss. Her intravascular volume was monitored with POCUS PSAV LV volume for goal directed fluid therapy, received 8U PRBC, 8U FFP, 1U platelet, 1 cryo for EBL of 3.2 L and remained hemodynamically stable. Postop course and labs were within normal and was discharged home on postoperative day 5.

### Discussion:

This case exemplifies the increased risk of placenta accreta spectrum(1) and percreta in setting of placenta previa and prior cesarean, which has an 11% risk of accreta.(2) One unique aspect was the very rapid progression from accreta to percreta at an early gestational age. MRI may add to the sensitivity and evaluation of placenta accreta spectrum disorders.(3) The report also highlights the importance of early planning and multidisciplinary approach to patient care in minimizing maternal and fetal morbidity in parturients with placenta percreta.(4) Using POCUS to guide goal directed fluid therapy can be very helpful.

Abstract #: SAT-RFCP – Room 7 – 01

## Anesthesia Management in a Parturient with Unresectable Astrocytoma and Opioid Use Disorder

Presenting Author: Brian Paoletti, MD

Presenting Author's Institution: Vanderbilt University Medical Center - Nashville, Tennessee

### Introduction

Astrocytomas are the most common brain tumors encountered in pregnant patients, and pregnancy can be associated with increases in tumor growth and malignant transformation.<sup>1,2</sup> When intracranial neoplasms cause elevations in intracranial pressure (ICP), anesthetic management for cesarean delivery must be tailored to avoid adverse neurologic events including brainstem herniation. In combination with opioid use disorder and chronic buprenorphine exposure, elevated ICP poses significant challenges for both operative management and postoperative analgesia.

### Case

A 30-year-old G5P3 at 22 weeks gestational age, with a history of polysubstance abuse on buprenorphine, presented with headache, agitation, and right-sided weakness. MRI revealed a left temporal lobe lesion with mass effect, and biopsy revealed a grade II astrocytoma. Levetiracetam and dexamethasone initially ameliorated symptoms; however, repeat MRI demonstrated increased tumor size and midline shift. The patient was transferred to the intensive care unit (ICU), and her tumor was deemed inoperable by the neurosurgery team. Following multidisciplinary discussions between obstetrics, obstetric anesthesiology, neurosurgery, neurology, and radiation oncology, the decision was made to deliver at 32 weeks via repeat cesarean delivery due to extent of tumor invasion.

### Anesthetic management

Given contraindication to neuraxial anesthesia in the setting of elevated ICP and mass effect, general anesthesia was planned. The patient was continued on buprenorphine perioperatively. Preinduction arterial line and large bore intravenous access were obtained. General anesthesia was induced with Propofol, Remifentanyl, and Rocuronium. Remifentanyl was chosen for induction and maintenance of anesthesia due to its rapid onset, short duration of action, and potency, in addition to its limited potential for neonatal respiratory depression. Despite large doses of remifentanyl, tachycardia and hypertension were noted during intubation and surgical stimulation. The patient was extubated at the end of the procedure and transferred to the ICU. The patient was discharged on POD6 with plans for 6 weeks of chemotherapy and radiation.

### Discussion

There are multiple case reports in the literature regarding astrocytoma management in pregnancy; however, there are no established clinical guidelines for the management of high-grade gliomas.<sup>3</sup> This patient's presentation was further complicated by chronic buprenorphine exposure, which contributed to opioid tolerance and hemodynamic instability perioperatively. The contraindication to neuraxial anesthesia posed a challenge for postoperative pain control, due to inability to administer neuraxial opioids. Optimal opioids in patients on buprenorphine are those with high mu-receptor affinity (hydromorphone and sufentanil); however, remifentanyl was chosen to minimize risk of fetal exposure and respiratory depression.

Abstract #: SAT-RFCP – Room 7 – 02

**Double intracranial trouble: Delayed diagnosis of postpartum intracranial hypotension after intrathecal catheter placement obscured by intracranial hemorrhage in the setting of pre-eclampsia**

**Presenting Author:** Samuel Pettigrew, MD

**Presenting Author's Institution:** University of Tennessee Medical Center Knoxville

**Co-Authors:**

**Introduction:** Intracranial hypotension (IH) is a rare complication by idiopathic or iatrogenic loss of cerebrospinal fluid (CSF). IH is characterized by a positional headache that mimics and is mistaken for a postdural puncture headache (PDPH) or in severe cases, subarachnoid hemorrhage (SAH) (1, 2). Additional symptoms include nausea, vomiting, blurred vision, phonophobia, photophobia, vertigo, and neck pain with flexion. Gadolinium-enhanced MRI findings of pachymeningeal enhancement are pathognomonic for IH. Due to inferior brain displacement after loss of CSF, patients can develop a transient unilateral or bilateral abducens nerve palsy as the brain matter droops. The headache can frequently be resolved or improved with epidural blood patch (EBP). (1)

**Case:** A 26 year-old G2P2 presented from an outside hospital after becoming unresponsive requiring intubation with stroke-like activity 24 hours after a cesarean section under general anesthesia. The pregnancy was complicated by pre-eclampsia with severe features requiring induction of labor at 35w2days. Incidental intrathecal catheter was placed. Cesarean section was performed under general anesthesia due to intolerance of labor and intrathecal catheter complications. 24 hours postop she developed severe headache, slurred speech and respiratory arrest with BP of 203/134. CT demonstrated SAH without aneurysm. On POD 2 CT angiogram demonstrated no aneurysm. Bilateral abducens palsy was discovered on POD 3. Brain MRI with contrast on POD 5 demonstrated pachymeningeal enhancement, mild venous sinus distention and cerebellar tonsil and corpus callosum drooping. EBP was performed on POD 6 with 20 mL of blood and the patient was extubated later that day. The patient's severe headache was reported to be positional in nature and on POD 7 a second EBP was performed with 20 mL of blood administered. Headaches were persistent despite the EBP. By discharge after 16 days, the patient had regained significant function and had full resolution of vasospasm and nerve palsy.

**Discussion:** The diagnosis of Intracranial Hypotension was dependent upon MRI visualized brain sag with pachymeningeal enhancement paired with findings of abducens nerve palsy. This diagnosis could have been missed in the setting of intracranial hemorrhage thought to be secondary to preeclampsia. While the diagnosis was delayed, dual EBP performed for PDPH likely hastened the resolution of postural headaches and CN VI palsy. Literature suggests treatment with EBP as the mainstay treatment for IH. Additional consideration to PDPH should be considered if symptoms are severe and neurosurgery consultation is of paramount importance.

Abstract #: SAT-RFCP – Room 7 – 03

Uterine incarceration in the third trimester complicated by bilateral hydronephrosis and inferior vena cava compression leading to severe tricuspid regurgitation necessitating delivery.

**Presenting Author:** TRUNG Q. PHAM, MD

**Presenting Author's Institution:** Duke University Hospital - MOORE, Oklahoma

**Co-Authors:** Fintan Hughes, MB BCh BAO - Duke University Hospital  
Cameron R. Taylor, M.D. - Duke University Health System

### Background

Incarceration of the gravid uterus is a rare but potentially morbid condition of pregnancy that has been described in literature. Although evidence-based practice for management of patients with this condition is limited, careful consideration of maternal factors and clinical status is important in the management, delivery, and anesthetic plan.

### Case Presentation

33-year-old G1P0 with uterine incarceration due to extensive adhesive disease resulting from a prior laparotomy following a motor vehicle collision. Patient had a successful manual uterine reduction at 23 weeks gestation under combined spinal epidural technique. However, she had recurrence of diagnosis 7 weeks later. Scans demonstrated acute retroflexion of the uterus with severe superior left lateral displacement of the uterine cervix behind the pubic symphysis. She had dyspnea on exertion from fluid overload likely secondary to inferior vena cava compression. Transthoracic echocardiogram demonstrated severe tricuspid regurgitation. The patient suffered from 3+ bilateral lower extremity edema and acute kidney injury secondary to severe bilateral hydronephrosis necessitating percutaneous nephrostomy tubes. Pro-brain natriuretic peptide labs peaked  $>1,700$  pg/mL and chest x-ray showed bilateral pleural effusions as pregnancy progressed. Balancing maternal morbidities with gestational age, the patient underwent a primary classical cesarean section at 31 weeks gestation under neuraxial technique with a thoracic epidural and lumbar combined spinal epidural. Point-of-care ultrasound along with cardiac output monitoring were used to monitor hemodynamic status intraoperatively. Immediately post-delivery, she had moderate tricuspid regurgitation with increased right ventricular systolic pressure and right ventricular size. Stroke volume decreased, but blood pressure was maintained successfully using phenylephrine. The patient was successfully weaned from vasopressors and had an uneventful recovery.

### Conclusion

Although gravid uterus incarceration has been well described in literature, there remains limited evidenced-based management strategies when it comes to providing anesthesia for reduction of the uterus and delivery of parturient. The anesthetic management of these patients may prove to be challenging and utilizing point-of-care ultrasound and cardiac monitoring may help guide anesthesiologists in the management of these complex cases.



Abstract #: SAT-RFCP – Room 7 – 04

## A Case of a High-Risk Parturient on Therapeutic Fondaparinux

**Presenting Author:** Pauline Ripchik, M.D.

**Presenting Author's Institution:** Northwestern University, Feinberg School of Medicine

**Co-Authors:** Mahesh Vaidyanathan, M.D., M.B.A. - Northwestern University, Feinberg School of Medicine

**Introduction:** Anticoagulation (AC) is frequently required during pregnancy and the postpartum period for a variety of clinical indications. AC choice is limited based on fetal teratogenicity and maternal comorbidities, and creates challenges based on societal recommendations for timing of safe neuraxial placement. Fondaparinux, an indirect Factor Xa inhibitor with no reversal agent, is often an AC choice of last resort in pregnancy due to its long half-life (17 to 21 hours) and concern for catastrophic hemorrhage in the event of unplanned delivery. Further, there is a paucity of data regarding safety of neuraxial placement in the setting of therapeutic fondaparinux.

**Case:** A 38-year-old, G3P0020 female presented for anesthesia consultation due to use of therapeutic fondaparinux (10mg daily). The patient had a history of antiphospholipid syndrome complicated by mesenteric vein thrombosis and multiple miscarriages. While she was initially started on enoxaparin, she developed heparin-induced-thrombocytopenia, which resolved after transitioning to fondaparinux. Warfarin was started for maintenance, but she developed a spontaneous subdural hematoma and was placed back on fondaparinux. Given the patient's recurrent pregnancy loss, she was increased to a therapeutic dose of fondaparinux and was able to conceive and carry to term. Her pregnancy was complicated by placenta previa with planned cesarean delivery at 37 weeks. The patient's antepartum course required multiple admissions for gestational hypertension. If admission for possible delivery was necessary, the AC plan was for transition to argatroban infusion, due to a more favorable half-life. Multidisciplinary planning with pharmacy and blood bank was crucial to ensure availability of activated prothrombin complex concentrate, factor VIII inhibitor bypassing agent, recombinant activated factor VII, and crossmatched blood products. The patient discontinued her fondaparinux 72 hours prior to her scheduled cesarean delivery. She underwent a general anesthetic, and her intraoperative and postpartum course were uneventful.

**Discussion:** Fondaparinux is indicated for AC in parturients at high risk of venous thromboembolism and history of heparin-induced-thrombocytopenia. Unlike first-line AC agents during pregnancy, enoxaparin and heparin, ASRA and SOAP recommend avoiding neuraxial placement in patients on fondaparinux. Many institutional protocols, in concordance with European Society guidelines, allow neuraxial placement, but only with prophylactic doses of fondaparinux ( $\leq 2.5$  mg daily). The long half-life of the drug poses concerns of catastrophic hemorrhage in the event of unscheduled and urgent delivery. Multidisciplinary planning is required when managing patients on fondaparinux to address early admission for transition to argatroban as necessary, availability of blood products, and efficacy of recombinant factors to bypass fondaparinux's mechanism of action.

Abstract #: SAT-RFCP – Room 7 – 05

## Cesarean Delivery in the Setting of Severe COVID-19 Pneumonia Requiring ECMO: A Case Study of Two Patients

Presenting Author: Joo Hyun Shin, MD

Presenting Author's Institution: UT Southwestern Medical Center - Irving, Texas

### Background:

The SARS-CoV-2 virus has presented unique problems in the obstetric patient population. Preliminary data suggests that pregnant patients may be more likely to have severe COVID-19 disease than nonpregnant patients, with some requiring long-term extracorporeal membrane oxygenation (ECMO). Since there is limited information about this patient population, we describe two cases highlighting the perioperative management and outcomes of two unvaccinated pregnant patients with severe COVID on ECMO undergoing cesarean deliveries.

### Cases:

Patient A, age 31 G5P2 with history of B-cell lymphoma in remission, presented at 26 weeks gestation, and patient B, age 30 G2P1, with no significant history, presented at 24 weeks gestation, both with acute hypoxemic respiratory failure, requiring intubation and admission to the intensive care unit (ICU) for COVID pneumonia. Eventually, they developed severe acute respiratory distress syndrome, requiring VV-ECMO cannulation.

Plans for delivery were initiated due to concerns of severe pre-eclampsia in patient A and ongoing coagulopathy needing multiple transfusions in patient B. At 30 weeks gestation, both patients underwent urgent cesarean deliveries. Patient A had been on ECMO for 18 days and patient B for 36 days. Both cases involved a large multi-disciplinary team for preparation and presence in the operating room, including OB-GYN, obstetric and cardiac anesthesiology, cardiothoracic surgery, cardiac ICU, respiratory therapy, and neonatal ICU. In the OR, the patients remained on their respective ICU ventilators and settings, and ECMO adjustments were made by the ECMO team. Induction doses of lorazepam and rocuronium were administered for incision. General anesthesia was maintained via total intravenous anesthesia with propofol, hydromorphone, and midazolam infusions continued from the ICU. Additional doses of ketamine, propofol, and rocuronium were given during the case. After successful deliveries of infants, both patients experienced major blood loss due to coagulopathy and received aggressive resuscitation.

They returned to the ICU ventilated and sedated, and postoperative course was complicated by hemoperitoneum, necessitating multiple OR visits and further resuscitation. Over the course of weeks, both patients were successfully decannulated from ECMO but remain hospitalized in the ICU for ventilator weaning.

### Conclusion:

The perioperative management of pregnant COVID patients on ECMO presents a unique challenge with the major complication being coagulopathy, requiring multiple trips to the operating room and aggressive resuscitation. Additionally, such cases highlight the importance of a multidisciplinary approach to patient care.

**Abstract #: SAT-RFCP – Room 7 – 06**

**Severe Delusional Disorder in a Parturient With History of Fetal Demise After Home Birth**

**Presenting Author:** Terry James Biel, MD MBA

**Presenting Author's Institution:** Oregon Health & Science University - Portland, Oregon

Estimates of diagnosable mental health disorders in pregnancy vary, perhaps affecting a quarter of patients.(1) We present a parturient with severe delusional disorder found to lack decision-making capacity regarding timing and method of delivery.

The patient is a G2P0100 whose history includes post-traumatic stress disorder, bipolar-type schizoaffective disorder, and suicidal ideation. She had a prior unattended preterm home delivery with the demised fetus subsequently discovered under her bed. No surrogate decision-maker or other advanced directives had been documented.

The patient's pregnancy was complicated by pre-eclampsia. An induction of labor at 37 weeks was recommended. In response, the patient asserted a new delusion: that she was a physician with 40 years of experience and disagreed with the recommendation. Subsequent attempts to reach the patient by phone and to visit her at home were unsuccessful.

At 37 weeks and 3 days the patient presented by ambulance, believing herself to be in labor. She soon attempted to leave the hospital and became combative. Psychiatry evaluation found she lacked decision-making capacity regarding leaving the hospital. A relative was identified to serve as her surrogate decision-maker and a multi-disciplinary ethics conference was held; the clinical teams and the patient's surrogate reached consensus that a Cesarean delivery aligned most with her underlying values.

Given continued difficulty in gaining the patient's participation, including establishing IV access, a staged approach was planned. The patient was administered an increased morning dose of her usual oral olanzapine. High-concentration ketamine and midazolam for intramuscular injection were prepared in the event she refused IV placement. However, the patient permitted IV start, and intravenous midazolam was administered. She received non-invasive ventilatory support with 100% inspired oxygen en route to the operating room. General endotracheal anesthesia was established. The Cesarean delivery proceeded uneventfully and she was successfully extubated.

Patient autonomy is a central value in medical ethics. Decision-making capacity in a parturient requires the same elements as in non-pregnant patients: demonstration of understanding the condition and the benefits, risks, and alternatives to treatment options; appreciation of potential consequences of a decision; logical reasoning; and the ability to communicate a choice clearly and consistently.(2) When patients are found to lack decision-making capacity, a surrogate decision-maker should be identified to represent their wishes and articulate their underlying values.

**Abstract #: SAT-RFCP – Room 7 – 07**

**Post-Partum Headache in Parturient with Difficult Epidural Placement, Preeclampsia, and COVID Positive**

**Presenting Author:** Jennifer Choi, DO

**Presenting Author's Institution:** Cleveland Clinic - Cleveland, Ohio

**Co-Authors:** Nour El Hage Chehade, MD - Cleveland Clinic

Justo Gonzalez, Physician - Cleveland Clinic

Adeeb Oweidat, MD - Cleveland Clinic

**Introduction**

Headache is a common chief complaint in the postpartum period. Many types of postpartum headaches features overlap with some occurring concurrently. Differentiation of the conditions that present with headaches in the postpartum period may be difficult.

We report a case of a healthy 37-year-old parturient G3P1 who presented in labor requesting epidural analgesia. She had history of previous difficult epidural placement. This epidural placement was difficult in finding loss of resistance and required 5 attempts total by 3 anesthesia care providers. Finally, epidural placement was achieved but with unintentional dural puncture suspected at the level of L3-4 at approximately 4 cm depth. Due to failure of labor progression she went for cesarean delivery under epidural anesthesia. Two days later, the patient complained of worsening positional headaches in the frontal and posterior area with no recovery with conservative treatment.

She was re-examined at day 6 and requested an epidural blood patch (EBP). Besides her headache and unremarkable thorough neurological physical exam, she had an elevated blood pressure thought to be anxiety driven.

For her EBP, the patient had difficulty sitting up due to worsening headache and was placed in the lateral position.

Ultrasound was used to find depth of epidural space at L3-4 and to assess the integrity of the posterior complex. For the midline approach, a strong hyperechoic line was not seen. Thus, a paramedian approach was taken and successful on first attempt. Interestingly prior to injection of autologous blood, she complained of a throbbing frontal headache which worsened with Trendelenburg. The blood patch was placed with improved posterior headache component, but the frontal headache continued with increased blood pressures.

She was diagnosed with pre-eclampsia with severe features based on blood pressure criteria and was treated with magnesium for 24 hours. Additionally, the patient was diagnosed with COVID-positive infection during this admission which has become a new association for causing headaches<sup>1</sup>. Headaches resolved after 48 hours and the patient was discharged home.

**Conclusion**

Secondary causes of post-partum headache can be confusing. It is important to rely on physical exam in the diagnosis and to remain vigilant to other causes when persistent. Based on our case, our patient had three possible different etiologies of headaches which warranted a complex treatment plan. The importance of ultrasound for treatment via blood patch can also not be underestimated as it was useful in ascertaining the depth and viewing integrity of the posterior complex. In addition, the paramedian approach has the advantage of using the lamina as an extra stoppage point, more laterally developed ligamentum flavum and increased space between ligament and dural sac.

Abstract #: SAT-RFCP – Room 7 – 08

## SUBDURAL HEMATOMA AFTER ACCIDENTAL DURAL PUNCTURE

Presenting Author: Anna Cholewa, MD

Presenting Author's Institution: Froedtert & The Medical College of Wisconsin - West Bend, Wisconsin

**Background:** Subdural hematoma is an extremely rare but serious complication of dural puncture. Diagnosing subdural hematoma can be challenging due to similarity of timing and presentation with post dural puncture headache (PDPH). We present a case in which the parturient experienced headaches for six weeks prior to the diagnosis of subdural hematomas.

**Case:** 31-year-old G1P0 female, BMI 29, without significant past medical history, was admitted for labor. Neuraxial anesthesia was complicated by multiple epidural placement attempts and an accidental dural puncture at the L3-4 level. The day after delivery, patient developed PDPH which was managed conservatively. After discharge, the obstetric anesthesia team continued to follow the patient's headache, which was fluctuating in severity. Eventually, patient was lost to follow up. Six weeks after delivery, the patient contacted the obstetric anesthesia team complaining of a two-day history of decreased hearing and persistent tinnitus in the right ear. The same day, the patient was evaluated in the emergency department, and was found to have a left chronic and right acute on chronic 6-7mm subdural hematomas, attributed to decreased intracranial pressure secondary to dural puncture. Patient was admitted to the neurology ICU and evaluated by the neurosurgical team that recommended an epidural blood patch (EBP). The following day, she underwent a successful EBP at the L4-L5 level with 11mL of autologous blood and experienced immediate resolution of headache as well as improvement in hearing and tinnitus. Half a year later, imaging showed complete resolution of subdural hematomas.

**Discussion:** Subdural hematoma is a life-threatening complication of accidental dural puncture. After this case, our institution created a protocol for PDPH follow-up. We recommend head imaging or EBP for all PDPH lasting more than two weeks. If a subdural hematoma is found on imaging, neurosurgery should be consulted to determine if EBP will suffice or if surgical intervention is required.

**Abstract #: SAT-RFCP – Room 7 – 09**

**Neuraxial anesthesia in a patient with a history of Chiari malformation type-1 (CM1)**

**Presenting Author:** Yen-Yen Gee, MD

**Presenting Author's Institution:** University of Chicago - Chicago, Illinois

**Co-Authors:** Ioannis Angelidis, MD, MSPH - The University of Chicago

Naida Cole, MD - University of Chicago

**Introduction**

With CM1 there is the possibility of decreased CSF outflow and increased ICP above the tonsillar herniation, which, with the possible transient rise in ICP after an epidural or rapid decrease in intrathecal pressure with dural puncture, could result in further herniation and neurologic deterioration.<sup>1</sup> Risk-benefit assessment of neuraxial techniques in patients with CM1 should consider symptoms, evidence of herniation, history of surgical repair, co-morbid conditions, and anticipated delivery course.

**Case report**

A 29-year-old G1P0 presented at 24+0 five years after suboccipital craniectomy and C1 laminectomy for decompression of tonsillar herniation and cervical syrinx complicated by persistent CSF drainage and dense paresis of the left upper extremity. Neurologic evaluation at presentation was notable for intermittent headaches with transient visual disturbances. Upper extremity weakness was not appreciable. Imaging revealed "continued diminished flow at the posterior aspect of the foramen magnum" compared to 2017.

Discussions involved experts in neurology, obstetrics, and anesthesiology. The patient was counseled on an epidural with the possibility of a shortened second stage if symptomatic with the progression of labor. She was admitted at 39+0 following an uncomplicated pregnancy in spontaneous active labor. There were no maternal or fetal features portending prolonged or difficult labor. A DPE was placed followed promptly by a vaginal delivery. She was discharged home two days later with no neurologic complications.

**Discussion**

Physiologic changes of pregnancy and labor decrease volume and increase pressure of lumbar CSF.<sup>2</sup> Those with baseline elevated ICP have a more pronounced transient increase in ICP after epidural injection and these increases displace CSF towards the head.<sup>1</sup> While increased ICP alone may not translate to increased risk or rate of herniation, additive changes in ICP with CM1, pregnancy, and neuraxial injection theoretically may.

No anesthetic for L&D is risk-free. CSF leak occurs with dural puncture, intentional or not. Even without known dural puncture, fatal herniation has occurred.<sup>1</sup> With GA, laryngoscopy can increase ICP and subsequent hyperventilation to then decrease ICP may have detrimental effects on fetal perfusion.

With symptoms thought to be consistent with more benign pathologies and preserved flow in the ventral brainstem and proximal cord, our patient received a small-gauge dural puncture and slowly titrated epidural safely.

**Key points**

- Symptoms and imaging should guide discussions regarding neuraxial techniques in patients with history of CM1.
- Symptoms may not correlate with imaging findings.
- In patients with no concerning features of CM1, a neuraxial technique may be offered.

Table 1. Features suggesting potential neurologic deterioration with neuraxial anesthesia. Adapted from Milhourat TH et al., 1999.

- Suboccipital headache
- Retro-orbital discomfort
- Floaters or flashing lights
- Blurred vision
- Photophobia
- Diplopia
- Visual field cuts
- Dizziness
- Disequilibrium
- Pressure in the ears
- Tinnitus
- Decreased hearing or hyperacusis
- Vertigo
- Hoarseness
- Cough
- Dysphagia
- Sleep apnea
- Tremors
- Weakness
- Muscle atrophy
- Lack of duraplasty

**Abstract #: SAT-RFCP – Room 7 – 10**

**Cesarean Delivery of Patient with Peripartum Cardiomyopathy and Pulmonary Hypertension**

**Presenting Author:** Carter K. Guice, III, MD

**Presenting Author's Institution:** Ochsner Clinic Foundation - New Orleans, Louisiana

**Introduction:** Cardiac disease is one of the leading causes of morbidity and mortality of parturients in the U.S. Although more likely to be encountered at a tertiary referral center, all anesthesiologists, even in community settings, may encounter parturients presenting with cardiomyopathies and other cardiovascular disease. Deliveries are increasing for women with conditions such as cardiomyopathies and pulmonary hypertension, which puts them at high risk for major adverse cardiac events.

**Case:** A 32 year-old female G3P0111 at 31 5/7 WGA presented as a transfer for obstetrical and heart failure management. Her medical problems included history of multiple VTE on therapeutic enoxaparin with a PFO, previous CVA in 2020 with residual left sided partial paralysis and ataxia with falls, peripartum cardiomyopathy with an ICD with HFrEF and pHTN on most recent TTE, and OSA with obesity.

On arrival, she was continued on furosemide and metoprolol for management of HF, continued on enoxaparin for anticoagulation and placed on continuous fetal monitoring. A TTE was performed which showed a decreased EF of 25% and SPAP of 49 mmHg with diastolic dysfunction suggesting worsening cardiac function. Decision made to transfer patient from the obstetrical hospital to the cardiac critical care unit for closer monitoring after episodes of SVT were observed. Enoxaparin was held for over 24 hours prior to planned C/S under neuraxial anesthesia on hospital day #6.

In the OR, patient given midazolam for anxiolysis. A radial arterial line was then placed. Access was a midline and peripheral IV. A dural puncture epidural was performed in sitting position. Before slow dosing epidural with 2% lidocaine with 1:200000 epinephrine, low dose epinephrine and vasopressin drips were started for inotropic and afterload support. Inhaled nitric oxide at 10 ppm was administered intraoperatively after epidural placement. A T4 level was achieved and incision was made, with delivery of singleton fetus 11 minutes later. Immediately after delivery, hypotension and uterine atony was noted and treated with a bolus of IV norepinephrine and IM carboprost. No blood products were required. Only epinephrine drip was needed during transport of patient to cardiac ICU. Patient was discharged 5 days later and lost to follow up.

**Discussion:** In patients with a severely reduced EF, carefully titrated epidural anesthesia is likely the safest method to perform a C/S. In addition, the use of nitric oxide should be considered in obstetrical patients undergoing C/S with severe pHTN. Optimal anesthetic management can likely mitigate risk of major adverse cardiac events in this high risk patient population.

**Abstract #:** SAT-RFCP – Room 7 – 11

**Delayed Hysterectomy After Cesarean Delivery for Placenta Accreta Spectrum: A Case Report and Update on the Literature**

**Presenting Author:** Courtney R. Hood, MD

**Presenting Author's Institution:** SAUSHEC - San Antonio, Texas

**Co-Authors:** Jordan Yokley, MD - SAUSHEC

Placenta accreta spectrum rates are on the rise in the U.S., and it is well established these patients are high risk for significant morbidity and mortality.<sup>1</sup> Current best practices on how to manage these patients relies on retrospective analyses comparing maternal and neonatal outcomes for immediate cesarean hysterectomy versus a more conservative, delayed hysterectomy approach.<sup>2-4</sup> Our case involved a 37 y.o. G3P2 at 33w5d with a history of SLE and Factor V Leiden syndrome presenting with suspected severe placenta percreta with possible bladder and anterior abdominal wall invasion. She underwent a planned cesarean delivery (CD) under GETA in August, followed by a successful delayed interval hysterectomy 28 days later. Her initial CD included a multidisciplinary approach with Maternal Fetal Medicine, bilateral ureteral stent placement by Urology, REBOA sheath placement (not utilized) by Trauma Surgery, Interventional Radiology on standby, and a pediatric intensivist present for immediate neonate intubation and care. The EBL for the initial CD was 100 mL and the patient and neonate experienced no sequelae. Following the delayed TAH/BLS 28 days later, the patient required one unit of packed red blood cells for EBL of 1000 mL, and developed a CAUTI from the indwelling foley; she otherwise recovered well and was discharged on POD5. This case highlights the anesthetic considerations and challenges for a classic case of planned CD with delayed hysterectomy, and will allow for a rich discussion of the state of current research on this topic.

Abstract #: SAT-RFCP – Room 7 – 12

### Anesthetic Management of a Parturient with History of Cardiac Stents

**Presenting Author:** Rhiannon Kelsh-Lasher, MD

**Presenting Author's Institution:** Albany Medical Center

**Co-Authors:** Margaret O'Donoghue, MD - Albany Medical Center

**Introduction:** Cardiovascular conditions are the leading cause of maternal death in the USA. It is becoming more common to care for women of childbearing age with cardiac disease, as risk factors such as advanced maternal age, obesity, diabetes and hypertension continue to rise. The safe management of delivery in women with heart disease requires a multi-disciplinary approach to anesthetic and obstetric care. Perioperative point-of-care echocardiography is an important tool that may be used to assess maternal cardiac function during the peripartum period [1,2].

**Case:** This is a 43 year old G1P1 admitted at 24+6 weeks gestation for preeclampsia with severe features by blood pressure. Her pertinent medical history included chronic hypertension, class III obesity, type II Diabetes, OSA, asthma, history of myocardial infarct s/p RCA stent with prior in-stent thrombosis and ischemic cardiomyopathy (EF 41-49% on recent echo). The fetus was eventually found to have absent end-diastolic flow and decision was made for primary cesarean section. Her anticoagulation had been held for 7 days prior. In the OR patient received an arterial line, a slowly dosed lumbar epidural and conservative fluid administration. Delivery of the fetus was uneventful. However, the patient developed dyspnea and O2 desaturation to the low 90's during closure due to presumed fluid overload. TTE was utilized both intra and postoperatively to assess cardiac function and fluid status. Her cardiac function was noted to be largely unchanged from baseline. Postop, the patient was placed on BiPAP and given IV Lasix. Her remaining hospital course was uneventful and she was discharged on day 20.

**Discussion:** Pregnancy and delivery have a huge effect on the cardiovascular system in the parturient, particularly in those with underlying cardiac disease. A slowly dosed lumbar epidural was utilized in this patient with history of cardiomyopathy as it provided the most stable hemodynamic profile by minimizing sympathetic response while providing surgical anesthesia. Given this patient's prior in-stent thrombosis and anticoagulation regimen, careful consideration was given by all teams regarding the timing of cessation of anticoagulation. Additionally, the use of TTE was utilized to assess real-time myocardial function and fluid status. The use of perioperative TTE in patients with underlying cardiac disease may allow for prompt detection and management of hemodynamic compromise [3].

## ANESTHETIC CONSIDERATIONS FOR SEVERE COVID-19 IN THE PERIPARTUM PERIOD

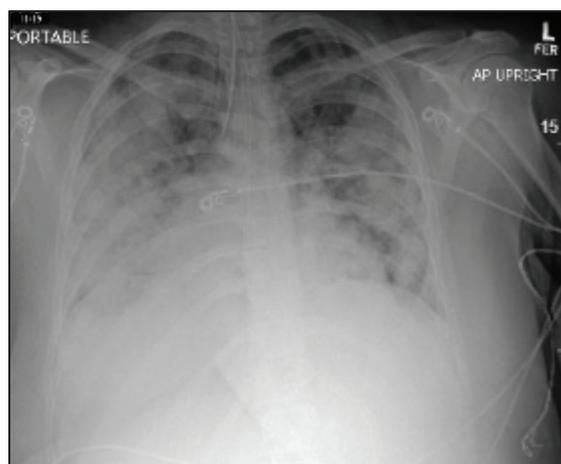
Presenting Author: Taylor Leathers, MD

Presenting Author's Institution: The University of Kansas Medical Center - Kansas City, Missouri

The COVID-19 pandemic has prompted health care professionals in all specialties to examine the way they deliver care to their COVID positive patients, and obstetric anesthesia is no exception. The physiological changes of pregnancy have rendered our parturients at an elevated risk for severe complications and thus require special considerations for peripartum care.

A 28 year old G3P1102 at 36w1d with a PMH of DMII, asthma, and obesity was diagnosed with COVID and presented to OSH for worsening dyspnea, cough and fevers. She was transferred to our institution for increasing oxygen requirements and a higher level of obstetric care. On arrival, she required 5L of oxygen by non-rebreather. The decision was made the high risk OB team to perform repeat c-section due to worsening maternal respiratory status. A CSE was placed for labor analgesia and the c-section was uncomplicated. Later that evening, the patient required 15L of oxygen and desaturated with any activity. On postoperative day one, the patient was continuing to deteriorate (ABG 7.36/40/57/23) and chest x-ray showed worsening multifocal pneumonia (Fig 1). She was transferred to the MICU and was intubated. Shortly after intubation with mechanical ventilation, the patient developed refractory hypoxia (ABG 7.27/50/68/20.2). Cardiothoracic surgery was consulted for ECMO and she was cannulated that day. Over the next several days, the patient was treated with a combination of steroids, antibiotics and diuretics. By POD9, she had been stable on minimal ECMO settings for >48 hours and the patient was decannulated. She was extubated on postop day 12 and unfortunately decided to leave AMA on POD 14.

Although the data is new and everchanging, the current evidence shows that pregnancy increases the risk for COVID infection and severe covid infection defined by ICU admission (aRR 1.5), mechanical ventilation (aRR 1.7), ECMO cannulation (aRR 2.4)<sup>3</sup>. It is the general consensus that neuraxial anesthesia for COVID patients undergoing c-section is superior to general anesthesia in terms of risk to the patient and healthcare team. However, in emergencies, general anesthesia has been done in COVID+ parturients without large differences in outcomes compared to non-COVID infected parturients<sup>1</sup>. There is more to be studied regarding COVID in pregnancy and the use of ECMO, but large observational studies have shown that ECMO is an effective and relatively safe salvage therapy for antepartum and postpartum patients with acute respiratory distress refractory to intubation with mechanical ventilation<sup>2</sup>.



Abstract #: SAT-RFCP – Room 7 – 14

## Management of Postpartum Hemorrhage in Patient with ITP and superimposed HELLP

**Presenting Author:** Sherry Liou, MD

**Presenting Author's Institution:** UCSF - San Francisco, California

**Co-Authors:** Won Lee, MD - University of California - San Francisco

Peter Yeh, MD - University of California, San Francisco

Our case describes a 33yo G2P1 at 36w4d who initially presented with a platelet count of 54 in her first trimester, but with unclear work-up and unknown follow-up. She re-presented in her third trimester with a platelet count of 9 on her routine lab work. Of note, her prior obstetric history was notable for a cesarean section 13 years earlier in a different country emergently under general anesthesia. Prior to transfer from an outside hospital, she was deemed to have presumed ITP and a course of steroids and IVIG was given without a significant elevation of her platelets. On admission, her labs suggested a hemolytic component given an elevation in her LDH. While her blood pressures were normal, she had quickly rising LFTs and the MFM team was concerned about atypical HELLP superimposed on her ITP. Given this indication for urgent delivery, she underwent a cesarean section with a preoperative transfusion of platelets. The patient's course was complicated by significant hemorrhage, requiring 2 units of PRBCs, 20 units of cryoprecipitate and 2 units of FFP throughout her cesarean section. Postoperatively, she was found to have an ongoing bleed and emergently return to the operating room. The abdomen was reopened and significant atony was noticed. There was initial discussion of hysterectomy for source control of the bleeding, but the atony improved with bakri and B-Lynch suture placement. In total, she received eight units of packed red blood cells, 6 units of FFP, 5 units of platelets, and 25 units of cryoprecipitate for a total estimated blood loss of 5 liters. She remained intubated after the exploratory laparotomy, but was quickly extubated, and had an otherwise unremarkable postoperative course, with improvement of her thrombocytopenia (PLT count of 118) by day two postpartum.

On literature review, there are few other case reports documenting the care of parturients with both ITP and HELLP, and an integral part of this patient's management was correctly diagnosing the underlying consumptive process. While the management of these different processes may overlap, there are also distinct therapies to consider for each. Regardless, the management of both hematologic processes involved minimizing the risk of maternal postpartum hemorrhage and being prepared to resuscitate in the case of postpartum hemorrhage. A patient's post operative care is also important as these patients may have prolonged thrombocytopenia, ongoing bleeding, and potential DIC and will need intensive monitoring postop. Ultimately, care of these patients require a multidisciplinary approach.

**Abstract #: SAT-RFCP – Room 7 – 15**

**The Outlier: A Case of Postpartum Piriformis Muscle Spasm**

**Presenting Author:** Chikezie Okeagu, M.D

**Presenting Author's Institution:** Louisiana State University Health Sciences Center

**Co-Authors:** Corinne Weinstein, MD - Anesthesiologist

**Introduction:**

Postpartum low back pain (LBP) is a common occurrence for new mothers, and pain intensity can vary from mild to debilitating. The potential etiologies are vast, ranging from pain resulting from stress of labor, biomechanical and hormonal changes related to pregnancy, physical demands of motherhood, or infection of bones and/or tissues in the back (1). It is helpful to consider a variety of diagnoses when evaluating a patient with complaints of LBP in the postpartum period.

**Case Presentation:**

A 37 y/o G8P0 at 37+3 EGA with PMH of recurrent pregnancy loss, morbid obesity, (BMI 51), polycystic ovarian syndrome, previous myomectomy, idiopathic intracranial hypertension, and chronic hypertension presented for scheduled cesarean delivery under spinal anesthesia. Moderate difficulty was encountered during the neuraxial procedure leading to multiple attempts before successful dural puncture and subsequent surgical anesthesia. The case proceeded uneventfully. On POD # 2, the patient complained of swelling and tightness to her right lower back and buttock which progressed through the evening to include radiation to the lateral/posterior knee. On physical exam, patient was afebrile with intact motor and sensory function. No erythema was noted overlying the neuraxial site. A very mild increase in tissue density and tenderness to palpation was noted to her right buttock compared to the left, however, no fluctuance was appreciated. Ultrasound evaluation of bilateral lower extremity veins showed no evidence of deep venous thrombosis. The patient was started on cyclobenzaprine for possible piriformis muscle spasm with continued monitoring for signs/symptoms of epidural complications. The patient's symptoms improved, and upon discharge on POD 4, she reported that her pain had resolved.

**Discussion:**

Piriformis syndrome is a known cause of LBP and sciatica resulting from entrapment of the sciatic nerve. The anatomical changes of pregnancy result in elongation and straining of the gluteal muscle group, especially deep, small muscles such as the piriformis. Piriformis syndrome is frequently underdiagnosed in the obstetric population and should be suspected with symptoms of hip or sciatic pain, especially after delivery (2). An appropriate assessment should be performed to rule out more sinister causes of LBP. To this end, MRI can be employed to provide evidence of piriformis syndrome and rule out other causes of LBP. While not performed in this case, MRI of patients with piriformis syndrome reveals asymmetrical thickening of the piriformis muscle (2). Treatment involves medications to reduce symptoms and physical therapy.

Abstract #: SAT-RFCP – Room 7 – 16

## Massive obstetric hemorrhage from an unanticipated uterine rupture

**Presenting Author:** Elizabeth Ozery, MD

**Presenting Author's Institution:** Stanford University

**Co-Authors:** Alexander J. Butwick, MBBS, FRCA, MS - Stanford University

**Introduction:** Uterine rupture is a rare complication in women without a prior cesarean delivery, with an incidence of 0.38 per 10,000.1 In this case report, we describe a case of life-threatening obstetric hemorrhage secondary to uterine rupture in a healthy woman with an uncomplicated pregnancy.

**Case report:** A healthy 34 year old G2P1 with a history of uncomplicated vaginal delivery and no prior uterine surgery presented in labor at 39 weeks. She was expectantly managed and had a CSE placed for labor analgesia. During the second stage of labor, an unexpected loss of fetal heart rate occurred. After fetal scalp electrode placement, the fetal heart rate was between 70-80 bpm, and an expeditious vacuum-assisted delivery was performed. Immediately after delivery, the patient experienced severe PPH (EBL=1.5L), presumed secondary to placental abruption and uterine atony. Methylergonovine and additional oxytocin were given. She was hemodynamically unstable (HR=130s, NIBP=undetectable). The anesthesia team and an MTG were activated, and the patient was transferred to the OR. Large-bore IV access and an arterial line were obtained, and aggressive volume resuscitation was initiated. An abdominal US (FAST scan) revealed no free fluid. The fundal tone was firm, and no external bleeding was present. However, the anesthesia team raised concern about intra abdominal hemorrhage due to worsening abdominal distension and deterioration of her hemodynamics. The patient was intubated, and an exploratory laparotomy was performed. Intraoperatively, the surgical team identified a large volume hemoperitoneum, with a very large uterine defect extending from the right lower uterine segment to the left side involving the left uterine vessels and vagina and a left pelvic sidewall bleed. An emergent hysterectomy was performed. Massive transfusion was necessary (34 PRBCs, 24 FFP, 5 plts, 7 g fibrinogen concentrate, and 1 g TXA), with a total estimated blood loss of 13L. Intraoperative hyperkalemia (K level up to 7.9 mEq/L) was treated with IV insulin and glucose. The pre-delivery, nadir/most extreme, and post-resuscitation laboratory results are presented in Table 1. To optimize surgical hemostasis, the vagina and abdomen were packed. She was transferred to the ICU and returned to the OR 2 days later for abdominal closure.

**Discussion:** In this case report, a patient without a history of prior cesarean delivery or uterine surgery experienced uterine rupture and life-threatening obstetric hemorrhage. Despite the negative FAST scan and absence of external bleeding, severe hemodynamic instability and increasing abdominal distension necessitated exploratory laparotomy and massive transfusion support. This case highlights why input from an experienced obstetric anesthesia team can be life-saving for patients with massive intra abdominal hemorrhage from unanticipated uterine rupture.

<b>Lab</b>	<b>Pre-delivery</b>	<b>Nadir</b>	<b>Post-resuscitation</b>
Hgb	10.5	6.7	17.9
Platelet count	189	37	87
Prothrombin time		19.5	13.9
Activated Partial Thromboplastin time		50.2	34.2
INR		1.7	1.1
Ionized Calcium		0.63	1.32
Fibrinogen level		140	288
<b>TEG indices</b>			
R time		2.9	7.7
Alpha angle		70	48.3
Maximum Amplitude		59.2	52.5
<b>ABGs</b>			
pH		7.138	7.394
pO2		171	238
pCO2		31.1	27.6
Base Deficit		17.2	7.5
HCO3		10.1	16.5

**Abstract #:** SAT-RFCP – Room 7 – 17

**Stuck between a rock and a hard place: anesthetic management of patient with a life threatening pregnancy complication, congenital hearing loss, and morbid obesity.**

**Presenting Author:** Jasmine Robinson, MD

**Presenting Author's Institution:** Tufts Medical Center - Dedham , Massachusetts

A 34-year-old G1P0 female with class III obesity, scoliosis requiring corrective surgery, congenital hearing loss requiring American Sign Language interpreter using plastic clear masks at the bedside, gestational diabetes, and hypothyroidism presented as a transfer from a community hospital with HELLP syndrome for cesarean delivery. Given worsening clinical picture, the history of corrective back surgery, and worsening thrombocytopenia with a platelet count of 47 K/uL, the decision was made to perform the surgery under total intravenous general anesthesia. Platelets were transfused immediately upon arrival in the operating room. Upon induction, it was difficult to pass an endotracheal tube despite Cormack-Lehane grade 1 view with a McGrath laryngoscope, and the patient's oxygen saturation fell. The patient was bag-mask ventilated, and once the oxygen saturation was within normal range again, an endotracheal tube was passed using a Bougie. The infant was delivered 2 minutes later with Apgars of 8 and 9 at 1 and 5 minutes, respectively. The patient had postpartum hemorrhage requiring blood transfusion and phenylephrine infusion. After emergence, the patient recovered well and was discharged during the normal timeframe.

### **Discussion**

The Society for Obstetric Anesthesia and Perinatology Interdisciplinary Consensus Statement on Neuraxial Procedures in Obstetric Patients With Thrombocytopenia recommends that patients with a platelet count of less than 50 K/uL should avoid a neuraxial procedure. Given that our patient also had the complicating factor of prior extensive back surgery, it was reasonable to proceed with general anesthesia. While the patient had risk factors for difficult airway, in today's population nearly all of the patients that we see at our institution have those risk factors, so it is our standard to use a video laryngoscope for intubation of the parturient. It is important to remember that general anesthesia for cesarean delivery significantly increases the risk of failed airway as well as postpartum hemorrhage.

## Second Trimester Uterine Rupture in a Parturient with Class 3b Placenta Accreta Spectrum

**Presenting Author:** Ashlee V. Gourdine, MD

**Presenting Author's Institution:** University of Maryland School of Medicine - Baltimore, Maryland

**Co-Authors:** Shobana Bharadwaj, MBBS - University of Maryland School of Medicine

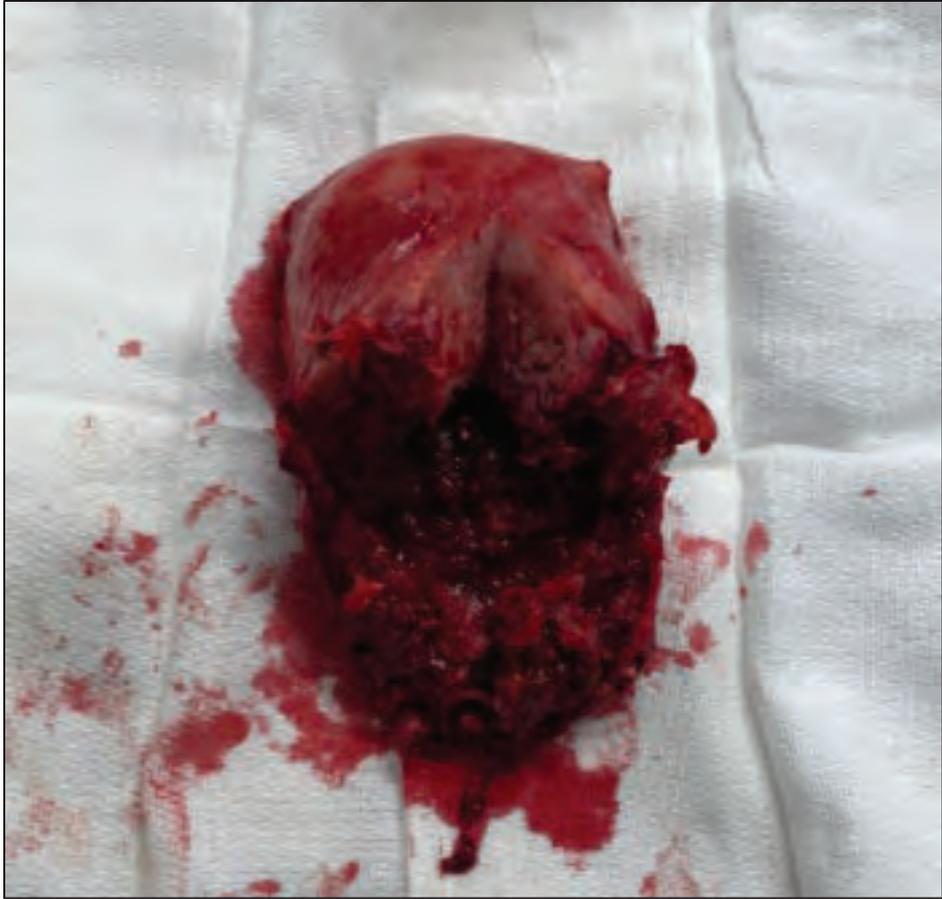
Jessica Galey, MD - University of Maryland School of Medicine

Bhavani S. Kodali, MBBS, MD - University of Maryland School of Medicine

We present a 31-year-old G4P2103 at 23 weeks with a past medical history of asthma, tobacco use, GERD who was admitted for vaginal bleeding in the setting of placenta previa. The patient's obstetric history was significant for a spontaneous vaginal delivery complicated by preeclampsia; a preterm cesarean delivery at 25 weeks secondary to cervical incompetence and abruption; and two subsequent cesarean deliveries. Her admission evaluation included a screening pelvic magnetic resonance imaging (MRI) and transvaginal ultrasound- significant for bulging of the placenta and increased signal suggestive of placenta accreta spectrum grade 3B with adjacent hemorrhage.

On hospital day three, the patient reported abrupt, brisk vaginal bleeding, approximating 1.3 liters of blood loss and prompting the decision for emergent operative management. Surgical intervention included exploratory laparotomy, supracervical cesarean hysterectomy, and bilateral salpingectomy. Placenta percreta and uterine rupture was identified under direct visualization at laparotomy. Operative management under general endotracheal anesthesia was challenging, with an estimated blood loss approximating 5900 ml, requiring vigilant resuscitative efforts with blood products and TXA. The newborn was emergently delivered and admitted to the neonatal intensive care unit for continued management. Her postoperative recovery course was uncomplicated allowing for hospital discharge on postoperative day four.

As the rate of cesarean deliveries and uterine surgeries continue to increase, placenta accreta spectrum (PAS) disorders have become a more prevalent disease, requiring prompt recognition and management. Early diagnosis of PAS with imaging modalities allows for the prevention of maternal morbidity and mortality associated with maternal hemorrhage. Risk stratification and vigilant surveillance after diagnosis are critical in avoiding complications from maternal hemorrhage. PAS with corresponding uterine rupture is a true obstetric emergency that requires anticipatory planning. Our patient's presentation of uterine rupture in the setting of PAS reflects the importance of recognizing the positive correlation of incidence in both placenta accreta and uterine rupture related to previous cesarean delivery. Continued surveillance of maternal-fetal hemodynamics, prompt hemorrhage identification and resuscitation, and recognition of synergistic risk factors of obstetric complications is essential during management of high-risk obstetric conditions.



Abstract #: SAT-RFCP – Room 7 – 19

## A Case of Symptomatic COVID in Pregnancy and Pre-Term Delivery

Presenting Author: Laura Ibdunni, MD

Presenting Author's Institution: Vanderbilt University Medical Center

### Introduction

Pregnant women have been identified as a high-risk population when infected with SARS-CoV-2 virus, a highly contagious virus with high morbidity and mortality. Unfortunately, data on the effects of Coronavirus disease (COVID-19) within parturients and newborns is still limited and growing, making evidence-based recommendations for the management of pregnant women challenging<sup>1</sup>. The purpose of this case report is to discuss the anesthesiologist role in multidisciplinary communication when caring for a parturient with COVID-19.

### Case

Ms. A is a G3P2002 at 30w5d who presented to an outside hospital for symptomatic COVID-19 infection, reporting nine days of myalgias, fatigue, nausea/vomiting, shortness of breath, and pleuritic chest pain. She was unvaccinated from the COVID-19 virus. Labs showed severe hypokalemia. She was then transferred and admitted to labor and delivery. The infectious disease team was consulted and she was started on Remdesivir and Dexamethasone. Ms. A's clinical course continued to worsen with increasing oxygen requirements with a reassuring fetal status. An interdisciplinary meeting was held between both the obstetric and anesthesia teams to discuss the patient and guide her clinical management. More specifically the meeting was to evaluate the risk/benefit of preterm delivery for maternal improvement, a difficult decision given the lack of data on maternal/fetal outcomes. It was subsequently decided to take Ms. A to the operating room for a cesarean delivery. Her cesarean delivery was uncomplicated, however, upon conclusion of the case, she required a phenylephrine infusion and increasing oxygen requirement. She was transferred to the surgical intensive care unit where she was later intubated. She was treated for viral pneumonia with antivirals, steroids, and diuretics and extubated after 7 days. She was discharged on post-op day 14 with a home oxygen requirement.

### Discussion

The data surrounding medical management and clinical outcomes in the treatment of a parturient with symptomatic COVID-19 remains limited<sup>2</sup>. The risks and benefits of preterm delivery versus intrauterine wellbeing in a decompensating mom make determining the timing of delivery difficult. Based on the high acuity of these patients, it is important for early collaboration between the anesthesia and obstetrics providers for the care and safety of mother and baby as we continue to work to advance maternal safety and outcomes during pregnancy<sup>2,3</sup>.

**ANESTHETIC MANAGEMENT OF CESAREAN SECTION IN A CRITICALLY ILL COVID-19 OBSTETRICAL PATIENT: CASE REPORT**

**Presenting Author:** Juliana A. Barrera Ramirez, MD, MSc

**Presenting Author's Institution:** Department of Anesthesia & Perioperative Medicine. Western University - London, Ontario

Current literature shows that COVID-19 infection in the obstetrical population is linked to severe disease status, increased maternal and fetal mortality, increased preterm delivery, and high rates of cesarean delivery [1]. Expert panel consensus recommends delivering the fetus at  $\geq 32$ -34 weeks gestational age (GA) among those with severe disease, to improve maternal oxygenation and provide high likelihood of neonatal survival [2]. To our knowledge, this is the first case report to address the anesthetic considerations, management, and challenges of a cesarean section in a critically ill COVID-19 parturient. Consent was obtained for publication.

**Case Presentation:** A 28-year-old G1 presented at 28+4 weeks GA with COVID-19 pneumonia and quickly deteriorated requiring invasive ventilation. She was transferred to the intensive care unit (ICU) at a tertiary care hospital and was diagnosed with severe Acute Respiratory Distress Syndrome ( $\text{PaO}_2/\text{FiO}_2$  ratio 81). Despite regular proning, recurrent desaturations (target  $\text{SpO}_2 > 95\%$ ) and hemodynamic instability led to a multidisciplinary team discussion and decision to perform an emergency cesarean section at 30+4 weeks GA in the ICU. High doses of sedation and paralytics, high ventilation requirements, hemodynamic instability requiring vasopressors, limited space and restricted help were some of the challenges faced by the anesthesia team. The patient received a total intravenous anesthetic (TIVA) that comprised pre-existing sedative infusions (Hydromorphone 30mg/hr and Midazolam 20mg/hr) in addition to Propofol (0.5mg/kg) and Rocuronium (50mg) boluses. Ventilation settings included: PCMV, 34 RR, PIP 35, PEEP 12, tidal volume 350mL and  $\text{FiO}_2$  1.0. Due to desaturation in supine position, the procedure was performed in the semi-recumbent position. The baby was delivered without maternal complications; however, prolonged neonatal resuscitation was required. The mother fully recovered and was discharged home 7 weeks later.

**Discussion:** This is the first case report to describe the anesthetic resources and logistical challenges of an emergent cesarean section in a critically ill COVID-19 obstetrical patient. This case highlights the need for additional anesthesia personnel, equipment, and effective communication to provide TIVA in an out-of-OR setting in a critically ill patient with high sedation requirements.

## Management of Von Willebrand Disease in an Intrapartum Patient

Presenting Author: Cecilia Kim, DO

Presenting Author's Institution: Maimonides Medical Center - Brooklyn, New York

Von Willebrand Disease (VWD) is an autosomal dominant disorder associated with abnormal coagulation. VWD is the most common bleeding disorder and affects males and females equally. VWD in parturient requires special consideration in the management of neuraxial blocks.

**CASE:** 26 yo G1P0 with history of Type 1 VWD and asthma presented in labor at 39+2. She was diagnosed with VWD 14 years ago when she had menorrhagia for 6 months for which she was prescribed nasal Desmopressin (DDAVP). In 2021 she presented to the ED after excessive bleeding s/p mole removal and required IV DDAVP. She reported 2 nosebleeds during pregnancy and frequent, easy bruising. Patient has been followed by hematology who recommended IV DDAVP infusion prior to delivery. A multidisciplinary huddle was held to formulate a plan for vaginal delivery and C-section if indicated.

### Plan for anticipated vaginal delivery:

- Obtain VW Factor (VWF) level and Factor VIII activity level, prior to epidural placement. On admission, labs were as follows VW activity 95.6 ( 40.3-163.4%), VW Antigen 129.8 (42.0-176.3%), Factor VIII 125 ( 50-150%), Factor Levels >50%
- Patient to be given DDAVP 0.3 mcg/ kg when she enters active labor
- Tranexamic acid (TXA) 1000 mg IV x1 immediately after delivery.
- Methergine in the room to ensure availability for immediate administration as needed.

### Plan for anticipated C-Section:

- DDAVP prior to skin incision if not already given within the past 12 hours
- TXA 1 g immediately after delivery and methergine as needed.
- After first dose of DDAVP the overnight team placed a straight epidural with no issues. Patient delivered via spontaneous vaginal delivery with estimated blood loss of 300 cc's. TXA 1 g was given immediately after and PO TXA 1300 mgs q8h for 7 days.

## DISCUSSION:

There are various forms of VWD:

In Type 1, the level of VWF in the blood is reduced and the level of factor VIII also might be reduced. This is the most common and mildest form of the disease. The symptoms might be so minor that the person isn't ever diagnosed. People with type I VWD usually do not bleed spontaneously but can have a lot of bleeding with menstrual periods, trauma, surgery, delivery or tooth extraction.

In Type 2, the level of VWF in the blood is normal, but abnormal functionally. Type has several subtypes, including:

- o Type 2A: The multimers are smaller than usual or break down too easily.
- o Type 2B: The factor sticks to the platelet leading to clumping, which can cause a low platelet number.

In Type 3, VWF and factor VIII levels are very low. Symptoms are severe and may include bleeding into joints and muscles.

The most common treatment is DDAVP. This causes a temporary increase in VWF and factor VIII levels. It can be given as an injection or a nasal spray. It may not be helpful in treating type 2. Women with VWD have the option of neuraxial anesthesia—either epidural or spinal—if their VWF levels are normal or corrected with treatment.

Abstract #: SAT-RFCP – Room 7 – 22

## Hemodynamic Instability in a Parturient following Dural Puncture Epidural

Presenting Author: John L. Parker, Doctor of Osteopathic Medicine

Presenting Author's Institution: Case Western Reserve University - MetroHealth - South Euclid, Ohio

### Introduction:

Neuraxial anesthesia has been used successfully by anesthesiologists to provide effective analgesia during labor. Dural Puncture Epidural (DPE) is a type of neuraxial technique that helps confirm correct epidural placement as well as provides a faster onset and better quality of analgesia than a lumbar epidural.<sup>1,2</sup> Since an intrathecal dose is not given – as opposed to a Combined Spinal Epidural (CSE) technique – DPE has a lower incidence of hemodynamic instability, fetal bradycardia, and respiratory depression.<sup>3</sup> However, complications during a DPE can occur. We present here a case of hemodynamic instability in a parturient following DPE.

### Materials and Methods:

As the case report is devoid of patient identifiable information, it is exempt from IRB review requirements as per Case Western Reserve University – MetroHealth policy.

### Case Report:

We present a case of hemodynamic instability in a parturient following DPE. Anesthesiology was called to provide analgesia for a healthy parturient (G2P1001 at 40w3d) having a scheduled External Cephalic Version (ECV). The patient received a DPE with no procedural complications. After bolusing the epidural catheter with 0.125% bupivacaine, the patient experienced a 30% decrease in mean arterial pressure with accompanying nausea and light-headedness. The patient was stabilized with intravenous fluids and vasopressors. She was monitored and treated until hemodynamically stable. Her labor epidural was then resumed at a reduced rate without further issue. Successful ECV was followed by vaginal delivery of a healthy baby. The patient remained asymptomatic during the postpartum period and was discharged home.

### Discussion:

Labor analgesia has revolutionized the field of obstetrics, but it is not without risk. DPE has better analgesic properties than a traditional epidural with less risk than a CSE. However, anesthesiologists should be ready to stabilize a patient while performing DPE should complications occur.

Abstract #: SAT-RFCP – Room 7 – 23

**Anesthetic considerations in a parturient with preeclampsia and recent myocardial infarction presenting for Cesarean section**

**Presenting Author:** Joe Salloum, MD

**Presenting Author's Institution:** Cleveland Clinic Foundation

**Co-Authors:** Adeeb Oweidat, MD - Cleveland Clinic

Myocardial infarction is quite rare during pregnancy (1), but when present, it is an important cause of morbidity and mortality for the parturient (1). A number of events around the time of delivery may require temporary suspension of dual antiplatelet agents. Performance of caesarian section and administration of neuraxial anesthesia are two such examples (2). The risk of developing epidural hematoma while performing neuraxial anesthesia is higher, especially when bridging with another short acting antiplatelet medication is needed (2). Nevertheless, general anesthesia also raises concern for airway complications in the parturient which are the most frequent cause of death among pregnant women who died was from a complication of general anesthesia(3). In this case report, we present a 39-year-old parturient (height: 165 cm, weight: 73.7 kg) G1P0 at 32 weeks 5 days presenting with a past medical history of chronic hypertension with superimposed preeclampsia with severe features, recent history of non-ST elevation myocardial infarction at 23 weeks 6 days gestational age (on dual antiplatelet therapy for a drug eluting stent), type 2 diabetes mellitus, asthma, obstructive sleep apnea, and gastroesophageal reflux disease. The plan of the obstetrician was to perform a Caesarian section rather than induction of labor. We had the option of performing either a neuraxial block or general anesthetic, each with its own risks. The patient was on therapeutic dual antiplatelet therapy with clopidogrel and aspirin which were discontinued five and three days before surgery, respectively. Bridging with cangrelor infusion was started three days before the surgery. Thromboelastography performed during the day of surgery was normal. A platelet aggregation test was also done showing partial therapeutic effect of cangrelor and clopidogrel. Despite the higher risk of mortality in performing general anesthesia in pregnant women, we felt the risk of epidural hematoma with our patient outweighed the risks of a general anesthetic (2). We highlight the successful use of general anesthesia in a patient who developed MI during her third trimester along with preeclampsia with severe feature necessitating urgent Caesarian section.

## Are Uterine Fibroids a Risk Factor for Placenta Accreta Spectrum Disorder?

**Presenting Author:** Ashley E. Vincent, B.A.

**Presenting Author's Institution:** Rutgers Robert Wood Johnson Medical School

**Co-Authors:** Alexander J. Butwick, MBBS, FRCA, MS - Stanford University

Elizabeth Ozery, MD - Stanford University

Andrea J. Traynor, MD - Stanford University

### Introduction

Placenta accreta spectrum (PAS) disorders are linked to devastating maternal outcomes including massive hemorrhage, hysterectomy, and death. Recent studies suggest an incidence of 1.7 per 10,000 maternities and 544 per 10,000 in women who have had a prior cesarean delivery (CD) and placenta previa<sup>1</sup>. Known major risk factors are advanced maternal age, two or more CD, placenta previa, previous uterine surgery, or IVF pregnancy<sup>1</sup>. However, some PAS cases are not associated with any known risk factors. We describe a case of unexpected focal accreta during elective CD.

### Case Presentation

A 34 year old healthy G1P0 at 39 weeks presented for elective CD for maternal request due to concern for fibroids. Her pregnancy was complicated by subchorionic hemorrhage, first trimester vaginal bleeding, a stable 9 cm posterior lower uterine segment fibroid, and a 3 cm anterior fibroid. The placenta was anterior. She had no history of myomectomy or other uterine surgery. All laboratory values were within normal limits. The patient received uncomplicated spinal anesthesia. Delivery was uneventful but the placenta did not separate easily despite gentle traction and a large amount of bleeding was observed. On intraoperative examination a small portion of the placenta was adherent to the fundus and was removed manually. Post-extraction, the uterus had moderate atony, which was treated with additional oxytocin and methylergonovine. The patient became hemodynamically compromised and general anesthesia was administered. Uterine tone improved after administration of uterotonics, yet bleeding persisted from a 2cm defect at the right cornua suspicious for focal placenta accreta. Labs were drawn, and a second IV and a radial arterial line were placed. The patient was resuscitated with: 4u PRBC, 4u FFP, 1u platelet, 1g fibrinogen concentrate, 500 ml albumin, and 4 L of crystalloid. Hemostasis was obtained after two absorbable compression sutures were placed over the area of the uterine defect. At the end of the case the patient was hemodynamically stable with Hct 25.6, plt 155, fibrinogen 239, and INR 1.2. Quantitative blood loss was 3,550 mL. Due to receiving large volume resuscitation, the patient remained intubated and was transported to the ICU for postpartum care and monitoring and had an uneventful recovery. Post-operative placental pathology confirmed a diagnosis of placenta accreta.

### Discussion

Uterine malformations and fibroids have been implicated in several cases of placenta accreta, with some placentas implanted directly over the fibroid<sup>2</sup>. For our patient, PAS was not observed on any prenatal ultrasounds. Due to the high morbidity and mortality associated with PAS and that a proportion of women with PAS may not have any established risk factors, future studies are needed to investigate a potential association between fibroids and PAS as well as risk factors for PAS among nulliparous women with fibroids.

# Program Material

## Sunday, May 15, 2022

---

### ASRA/SOAP Panel

Post Cesarean Delivery Pain Management: What do we know and how do we do it?"

Moderator: Pervez Sultan, MD

Panelists: Beth A. VanderWielen, MD – ASRA

Unyime Ituk, MD – ASRA

Ruth Landau, MD – SOAP

Ashraf Habib, MD – SOAP

### Sol Shnider Clinical Track #3

Moderator: Naida Cole, MD

Panelists: Nicole Higgins, MD; Emily Naoum, MD; Amy Lee, MD

### Faculty Case Presentations

Room 1 – Cardiac

Room 2 – Heme Preeclampsia

Room 3 – Neuraxial Labor Analgesia

Room 4 – Cesarean Delivery

Room 5 – PAS Postpartum Hemorrhage

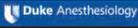
Room 6 – Post Dural Puncture Headache/Neuro

Room 7 – Rare Diseases



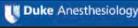
**Options and Evidence Surrounding Severe Post  
Cesarean Pain Management - Standards of Care and  
Emerging Evidence**

Ashraf S Habib, MBBCh, MSc, MHSc, FRCA  
Professor  
Chief, Division of Women's Anesthesia

 @ashrafhabib5    SOAP/ASRA Joint Panel    

**Disclosures**

- Research Support:
  - Haisco USA
  - Pacira Pharmaceuticals
  - Heron Therapeutics
  - Acacia Pharma
- Advisory Board:
  - Heron Therapeutics
  - Mdoloris

**Objectives**

- Components of MMA for uncomplicated CD
- Routine post CD analgesic regimens
- Management of unanticipated severe pain

**Objectives**

- Components of MMA for uncomplicated CD
- Routine post CD analgesic regimens
- Management of unanticipated severe pain

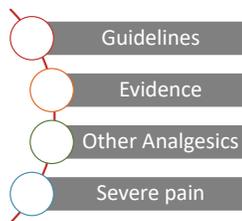
 

## Objectives

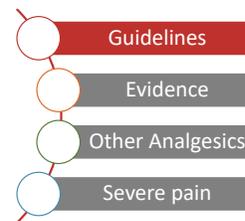
- Components of MMA for uncomplicated CD
- Routine post CD analgesic regimens
- Management of unanticipated severe pain

## Outline

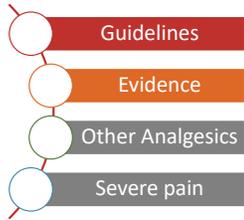
## Outline



## Outline



## Outline



Duke

Duke Anesthesiology

## Outline



Duke

Duke Anesthesiology

## Outline



Duke

Duke Anesthesiology

## Outline



Duke Anesthesiology

## Outline

Guidelines Evidence Other Analgesics Severe pain Duke Anesthesiology

### Guidelines

#### PROSPECT guideline for elective caesarean section: updated systematic review and procedure-specific postoperative pain management recommendations

E. Roothoof, <sup>1,2</sup> G. P. Joshi, <sup>3</sup> N. Rawal, <sup>4</sup> M. Van de Velde, <sup>5</sup> and on behalf of the PROSPECT Working Group\* of the European Society of Regional Anaesthesia and Pain Therapy and supported by the Obstetric Anaesthetists' Association

#### Society for Obstetric Anesthesia and Perinatology: Consensus Statement and Recommendations for Enhanced Recovery After Cesarean

Laurent Bollag, MD, <sup>1</sup> Grace Lim, MD, MS, <sup>1</sup> Pervez Sultan, MChB, FRCA, MD (Res), <sup>2</sup> Ashraf S. Habib, MBBCh, MSc, MHC, FRCA, <sup>3</sup> Ruth Landau, MD, <sup>4</sup> Mark Zakowski, MD, <sup>4</sup> Mohamed Tiourine, MD, <sup>6</sup> Sumita Bhamhani, MD, <sup>7</sup> and Brendan Carvalho, MBBCh, FRCA, MDChE

Roothoof. *Anaesthesia* 2021;76:665-680  
Bollag L. *Anesth Analg* 2021;132:1362-1377

Guidelines Evidence Other Analgesics Severe pain Duke Anesthesiology

### Guidelines

#### PROSPECT guideline for elective caesarean section: updated systematic review and procedure-specific postoperative pain management recommendations

E. Roothoof, <sup>1,2</sup> G. P. Joshi, <sup>3</sup> N. Rawal, <sup>4</sup> M. Van de Velde, <sup>5</sup> and on behalf of the PROSPECT Working Group\* of the European Society of Regional Anaesthesia and Pain Therapy and supported by the Obstetric Anaesthetists' Association

#### Society for Obstetric Anesthesia and Perinatology: Consensus Statement and Recommendations for Enhanced Recovery After Cesarean

Laurent Bollag, MD, <sup>1</sup> Grace Lim, MD, MS, <sup>1</sup> Pervez Sultan, MChB, FRCA, MD (Res), <sup>2</sup> Ashraf S. Habib, MBBCh, MSc, MHC, FRCA, <sup>3</sup> Ruth Landau, MD, <sup>4</sup> Mark Zakowski, MD, <sup>4</sup> Mohamed Tiourine, MD, <sup>6</sup> Sumita Bhamhani, MD, <sup>7</sup> and Brendan Carvalho, MBBCh, FRCA, MDChE

### Preoperative

- ITM 50-100 µg / 50-150 µg
- EM 2-3 mg/ 1-3 mg
- Oral Acetaminophen

### Intraoperative

- IV Acetaminophen
- IV NSAID
- IV Dexamethasone
- LA techniques (no IT/EM)

### Postoperative

- Oral/IV Acetaminophen
- Oral/IV NSAIDs
- Opioids (rescue)
- Adjuncts (TENS)

Roothoof. *Anaesthesia* 2021;76:665-680  
Bollag L. *Anesth Analg* 2021;132:1362-1377

Guidelines Evidence Other Analgesics Severe pain Duke Anesthesiology

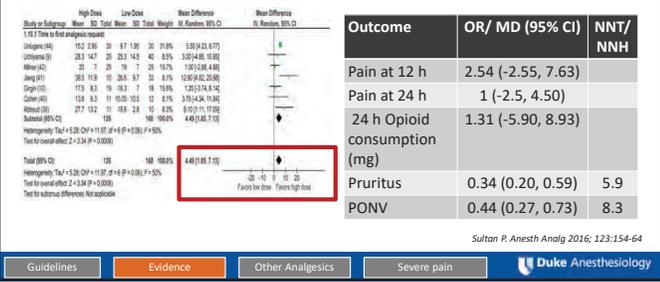
## Outline

Guidelines Evidence Other Analgesics Severe pain Duke Anesthesiology



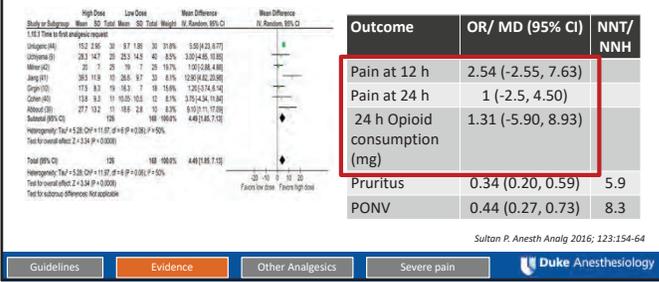
## Intrathecal Morphine

High dose (>100-250 µg) vs. Low Dose (50-100 µg)



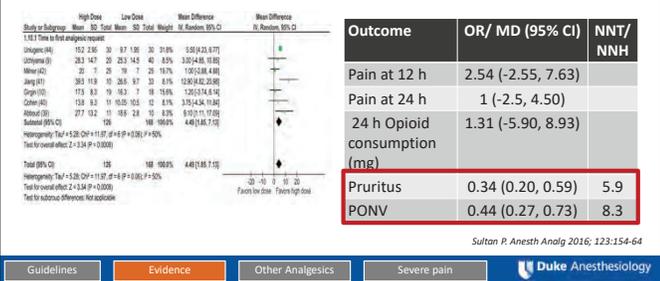
## Intrathecal Morphine

High dose (>100-250 µg) vs. Low Dose (50-100 µg)



## Intrathecal Morphine

High dose (>100-250 µg) vs. Low Dose (50-100 µg)



Guidelines

PROSPECT guideline for elective caesarean section: updated systematic review and procedure-aped **postoperative** pain management recommendations

**Society for Obstetric Anesthesia and Perinatology: Consensus Statement and Recommendations for Enhanced Recovery After Cesarean**

Preoperative

- ITM 50-100 µg / 50-150 µg
- EM 2-3 mg/ 1-3 mg
- Oral Acetaminophen

Intraoperative

- IV Acetaminophen
- IV NSAID
- IV Dexamethasone
- LA techniques (no IT/EM)

Postoperative

- Oral/IV Acetaminophen
- Oral/IV NSAIDs
- Opioids (rescue)
- Adjuncts (TENS)

Roofoothof. Anaesthesia 2021;76:665-680  
Bollig L. Anesth Analg 2021;132:1362-1377

## Systemic Adjuncts NSAIDs and Acetaminophen

- Synergistic Effect
- Scheduled rather than PRN
- Simultaneous rather than alternating
- Acetaminophen rather than combination
- Initiated preop/intraop rather than postop

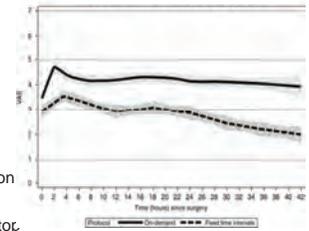
Combination  
 - > acetaminophen alone in 85% of studies  
 - > NSAIDs alone in 64% of studies

Ong CKS. *Anesth Analg* 2010;10:1170-9

## Systemic Adjuncts NSAIDs and Acetaminophen

- Synergistic Effect
- Scheduled rather than PRN
- Simultaneous rather than alternating
- Acetaminophen rather than combination
- Initiated preop/intraop rather than postop

Scheduled vs. PRN NSAIDs + Acetaminophen

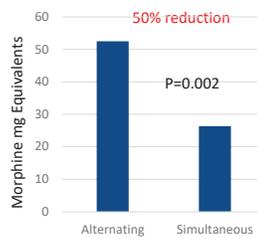


Yefet E. *BJOG* 2017; 124:1063-1070

## Systemic Adjuncts NSAIDs and Acetaminophen

- Synergistic Effect
- Scheduled rather than PRN
- Simultaneous rather than alternating
- Acetaminophen rather than combination
- Initiated preop/intraop rather than postop

Alternating vs. Simultaneous NSAIDs + Acetaminophen

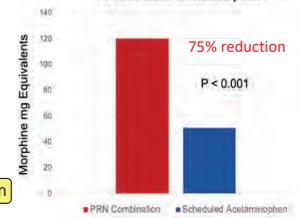


Forkin KT. *J Clin Anesth* 2022 (In Press)

## Systemic Adjuncts NSAIDs and Acetaminophen

- Synergistic Effect
- Scheduled rather than PRN
- Simultaneous rather than alternating
- Acetaminophen rather than combination
- Initiated preop/intraop rather than postop

PRN Acetaminophen/Oxycodone Combination vs. Scheduled Acetaminophen

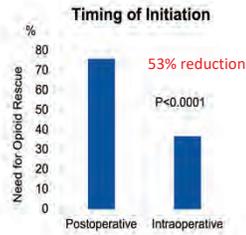


Smith AM. *Obstet Gynecol* 2019;133:700-6

## Systemic Adjuncts

### NSAIDs and Acetaminophen

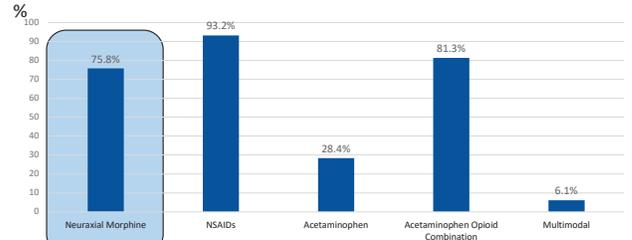
- Synergistic Effect
- Scheduled rather than PRN
- Simultaneous rather than alternating
- Acetaminophen rather than combination
- **Initiated preop/intraop rather than postop**



Herbert KA. *Matern Fetal Neonatal Med* 2021;3:1-7

## Multimodal Analgesia in the US 2008-2018

Premier Database

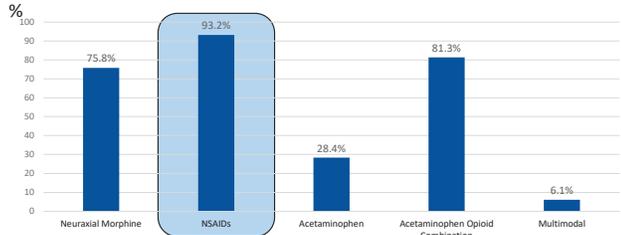


n=804,752

Reed S. *Anesth Analg* 2021;133:1550-1558

## Multimodal Analgesia in the US 2008-2018

Premier Database

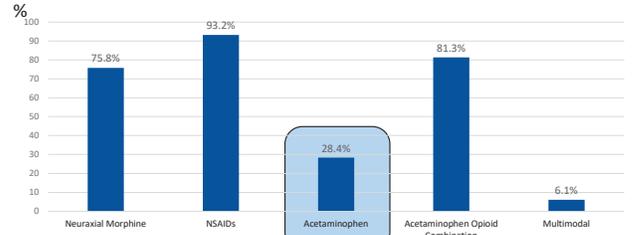


n=804,752

Reed S. *Anesth Analg* 2021;133:1550-1558

## Multimodal Analgesia in the US 2008-2018

Premier Database



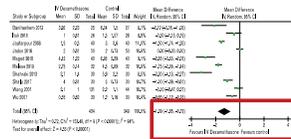
n=804,752

Reed S. *Anesth Analg* 2021;133:1550-1558

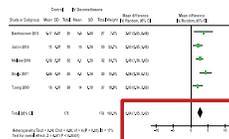


## Systemic Adjuncts Dexamethasone

### Early Pain Scores (4-6 h)



### Time to First Rescue



Singh NP. Eur J Anaesthesiol 2021 (Online ahead of print)

## Systemic Adjuncts Dexamethasone

### 12 h Pain Scores



### 24 h Opioid Consumption



Singh NP. Eur J Anaesthesiol 2021 (Online ahead of print)

### Guidelines

PROSPECT guideline for effective caesarean section: updated systematic review and procedure-specific, postoperative pain management recommendations

### Society for Obstetric Anesthesia and Perinatology: Consensus Statement and Recommendations for Enhanced Recovery After Cesarean

Lalorini B, et al. Anesth Analg 2012;115:1041-1047

#### Preoperative

- ITM 50-100 µg / 50-150 µg
- EM 2-3 mg/ 1-3 mg
- Oral Acetaminophen

#### Intraoperative

- IV Acetaminophen
- IV NSAID
- IV Dexamethasone
- LA techniques (no IT/EM)

#### Postoperative

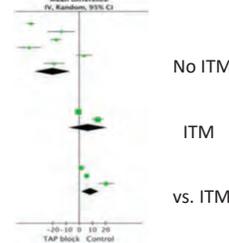
- Oral/IV Acetaminophen
- Oral/IV NSAIDs
- Opioids (rescue)
- Adjuncts (TENS)

Rooftoof. Anaesthesia 2021;76:665-680  
Bollag L. Anesth Analg 2021;132:1362-1377

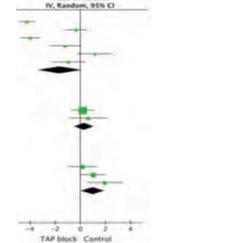
## Local Anesthetic Techniques

### TAP Block

#### Opioid Consumption



#### Pain on Movement



## Local Anesthetic Techniques

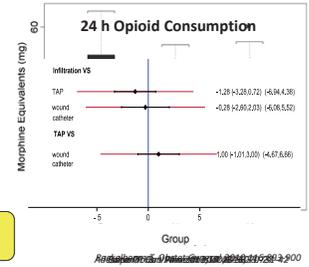
### Truncal Blocks

- Similar findings with QLB
  - Tan HS. *J Clin Anesth* 2020; 67:110003
  - El-Boghdady K. *Anaesthesia* 2021; 76:393-403
- QLB vs. TAP
  - Blanco R. *Reg Anesth Pain Med* 2016; 41:757-62
  - Verma K. *Indian J Anaesth* 2019; 63:820-26
  - El-Boghdady K. *Anaesthesia* 2021; 76:393-403
- Limited data for ESPB
  - Ribeiro Junior IDV. *Braz J Anesthesiol* 2021; S0104-0014(21)00374-2.

## Local Anesthetic Techniques

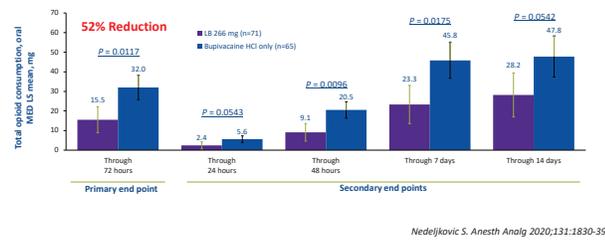
### Local Anesthetic Infiltration/Infusion

- Significant opioid sparing (no ITM)
  - Adesope O. *Eur J Anaesthesiol* 2016;33:731-42
  - Sultan P. *Can J Anesth* 2020;67:1070-27
- Below the fascia
  - Adesope O. *Eur J Anaesthesiol* 2016;33:731-42
- NSAIDs
  - Carvalho B. *J Pain* 2013;14:49-56
- Infiltration/wound catheter vs. TAP
  - Sultan P. *Can J Anesth* 2020;67:1070-27



## Local Anesthetic Techniques

### TAP Block with Liposomal Bupivacaine

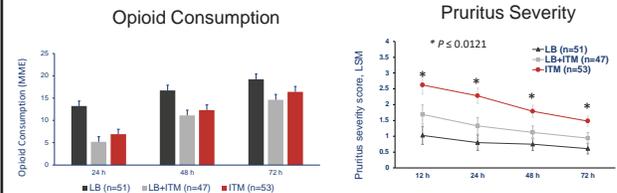


Nedeljkovic S. *Anesth Analg* 2020;131:1830-39

## Local Anesthetic Techniques

### TAP block Liposomal Bupivacaine + ITM

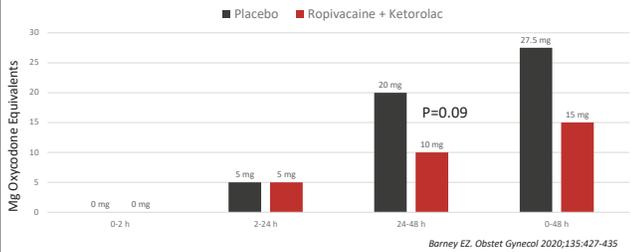
LB TAP vs. LB TAP + 50 µg ITM vs. 150 µg ITM



Habib AS. *J Clin Anesth* 2021; 75:110527

## Local Anaesthetic Techniques

Local NSAID + LA Infusion

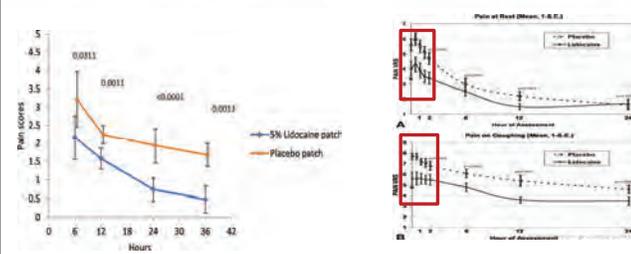


Guidelines Evidence Other Analgesics Severe pain Duke Anesthesiology

## Outline

Guidelines Evidence Other Analgesics Severe pain Duke Anesthesiology

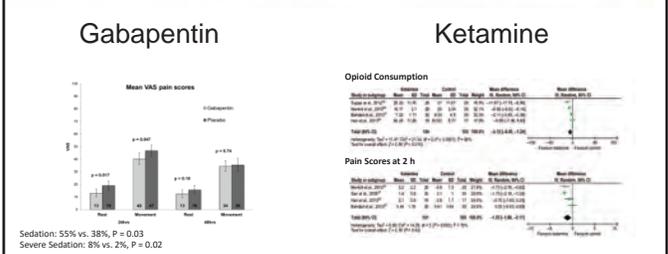
## 5% Lidocaine Patch



Guidelines Evidence Other Analgesics Severe pain Duke Anesthesiology

## Systemic Adjuncts

Gabapentin and Ketamine



Guidelines Evidence Other Analgesics Severe pain Duke Anesthesiology

## Neuraxial Adjuncts

Clonidine

Opioid Sparing	<ul style="list-style-type: none"> <li>MD=7.2 mg (95% CI: -11.4, -3.0 mg)</li> <li>21% reduction in opioid consumption</li> </ul>
Prolonged time to first rescue	• 135 min (95% CI: 102, 168 min)
Prolonged sensory blockade	• 128.2 min (95% CI: 81.7, 174.8 min)
Prolonged motor blockade	• 44.7 min (95% CI 8.7, 80.7 min)
Hypotension	• OR 2.849 (95% CI: 1.363, 5.957)
Sedation	• RR 3.92 (95% CI: 1.17 to 13.14)

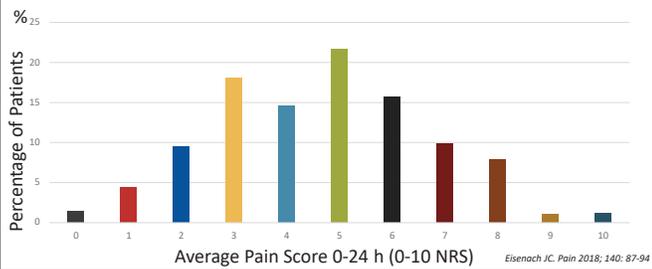
Allen TK. Br J Anaesth 2018; 120: 228-240  
Crespo S. Int J Obstet Anesth 2017;32: 64-76

Guidelines Evidence **Other Analgesics** Severe pain Duke Anesthesiology

## Outline

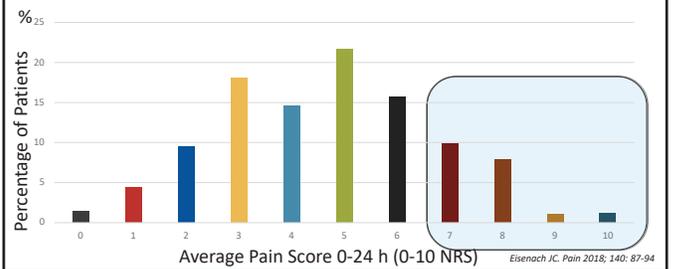
Guidelines Evidence Other Analgesics **Severe pain** Duke Anesthesiology

## Incidence of Severe Pain

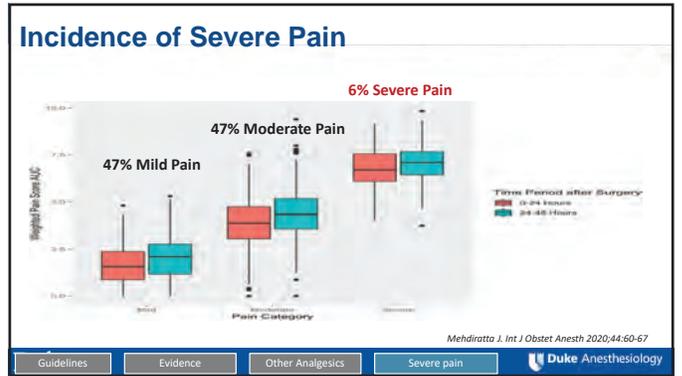
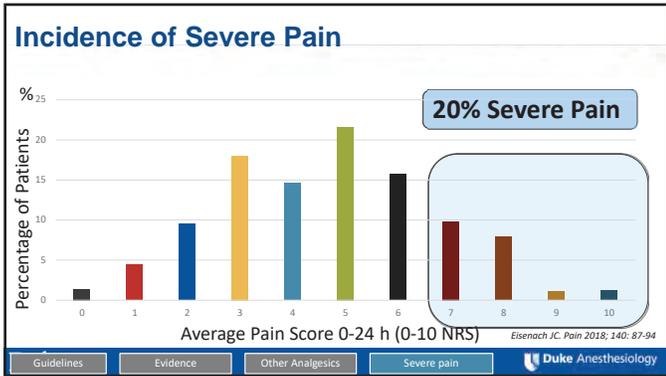


Guidelines Evidence Other Analgesics **Severe pain** Duke Anesthesiology

## Incidence of Severe Pain



Guidelines Evidence Other Analgesics **Severe pain** Duke Anesthesiology

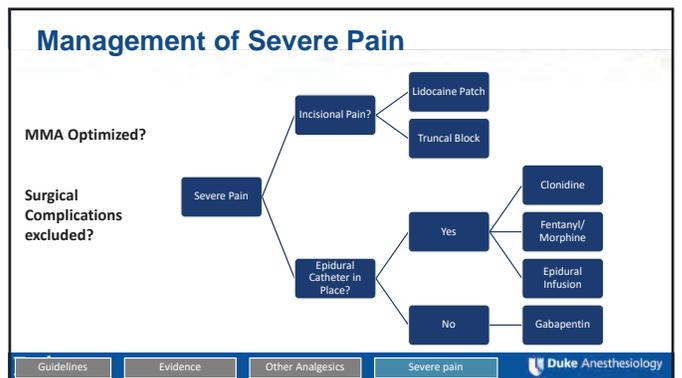


Transversus abdominis plane blocks for rescue analgesia following Caesarean delivery: a case series  
 Le bloc dans le plan de muscle transverse de l'abdomen pour l'analgesie de secours apres un accouchement par césarienne: une serie de cas

Fachon M, M, Boudra C, et al.

Mirza F. Can J Anesth 2013;60:299-303

Guidelines Evidence Other Analgesics Severe pain Duke Anesthesiology



## Conclusions

- ITM/EM + scheduled NSAIDS +scheduled acetaminophen
- Severe pain in 6-20% of patients
- Limited data on treatment of unexpected severe pain
- Truncal blocks, lidocaine patches, epidural infusion and gabapentin

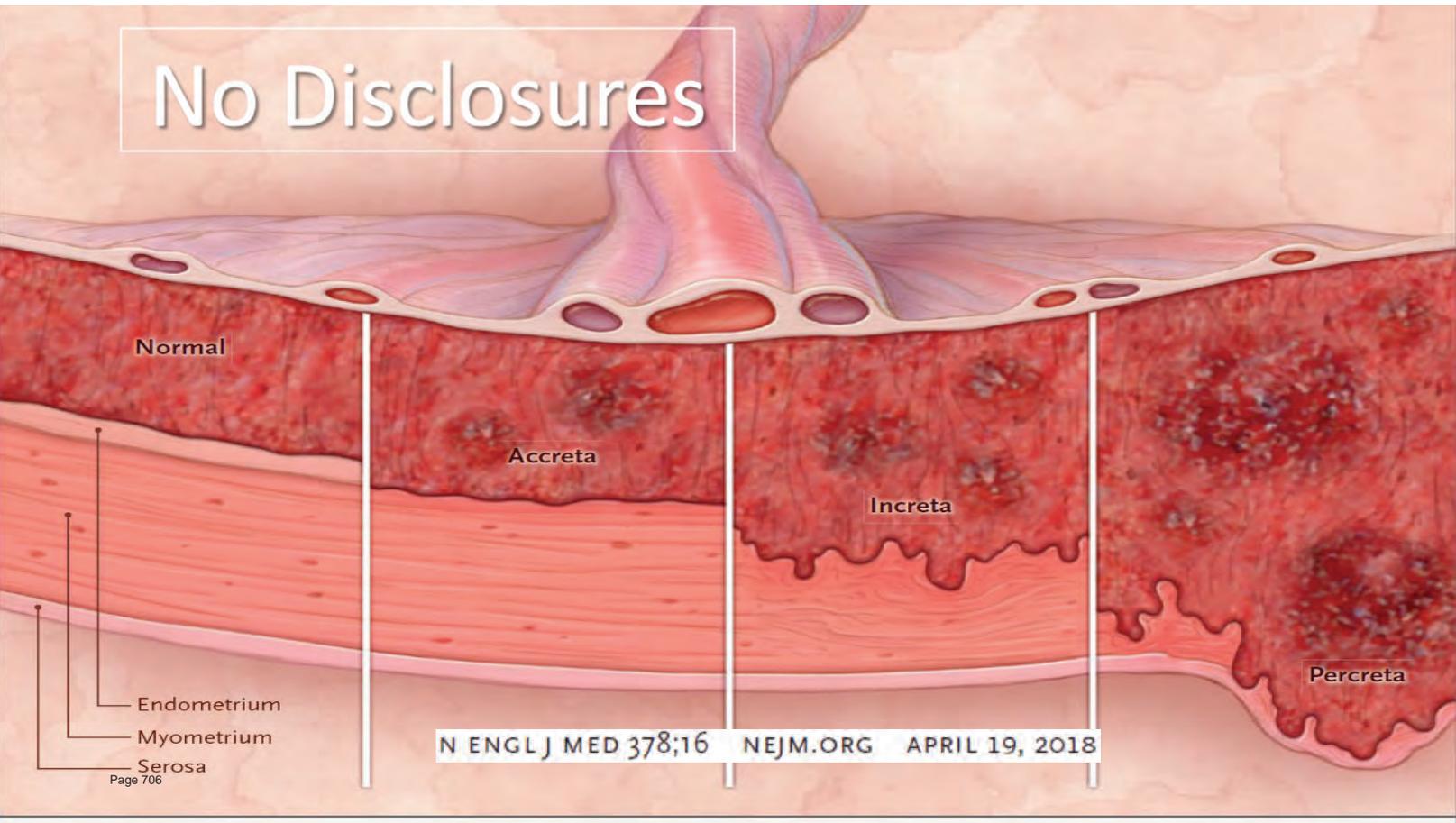


# PLACENTA ACCRETA SPECTRUM: NEW AND CUTTING EDGE

Nicole Higgins, MD, FASA  
Associate Professor  
Section Chief and Medical Director, Obstetric Anesthesiology  
Northwestern University Feinberg School of Medicine  
Chicago, Illinois  
[nicole.higgins@nm.org](mailto:nicole.higgins@nm.org)

SOAP 2022  
ANNUAL MEETING

No Disclosures



Normal

Accreta

Increta

Percreta

Endometrium  
Myometrium  
Serosa

Page 706

N ENGL J MED 378;16 NEJM.ORG APRIL 19, 2018

# ROADMAP

Review Risk  
Assessment

Know  
When to  
Transfer

Anesthetic  
Plan

Key  
References

What do  
you  
Need?

Postoperative  
Plan





ELSEVIER

Contents lists available at ScienceDirect

## International Journal of Obstetric Anesthesia

journal homepage: [www.elsevier.com/locate/ijoa](http://www.elsevier.com/locate/ijoa)



Key  
References

Review article

### Placenta accreta spectrum disorder: updates on anesthetic and surgical management strategies



B.D. Einerson<sup>a,\*</sup>, C.F. Weiniger<sup>b</sup>

<sup>a</sup> University of Utah Health Department of Obstetrics and Gynecology, Division of Maternal Fetal Medicine, Salt Lake City, Utah, USA

<sup>b</sup> Division of Anesthesia, Critical Care and Pain, Tel-Aviv Sourasky Medical Center, Tel-Aviv, Israel

#### ARTICLE INFO

**Keywords:**  
Accreta  
Hemorrhage  
Management  
Surgery

#### ABSTRACT

Placenta accreta spectrum (PAS) is a leading contributor to major obstetric hemorrhage and severe maternal morbidity in the developed world. In the United States, PAS has become the most common cause of peripartum hysterectomy. Over the last 40 years, clinicians have also witnessed a dramatic increase in the incidence of PAS. In the 1950s, the incidence of PAS was reported to be 0.03 per 1000 pregnancies. Recent epidemiological studies estimate that the PAS incidence is between 0.79 and 3.11 in 1000 pregnancies. As a consequence, obstetric anesthesiologists are increasingly likely to be called upon to manage women with suspected PAS for delivery. Given the increasing incidence and the morbidity burden associated with PAS, anesthesiologists play a vital role in optimizing maternal outcomes for women with PAS. This review will provide up-to-date information on nomenclature, pathophysiology, risk factors, antenatal detection, systemic preparations (includes timing of delivery, location of surgery, pre-operative evaluation and patient positioning), surgical and anesthetic approach, intra-operative management, invasive radiology and postoperative plans.

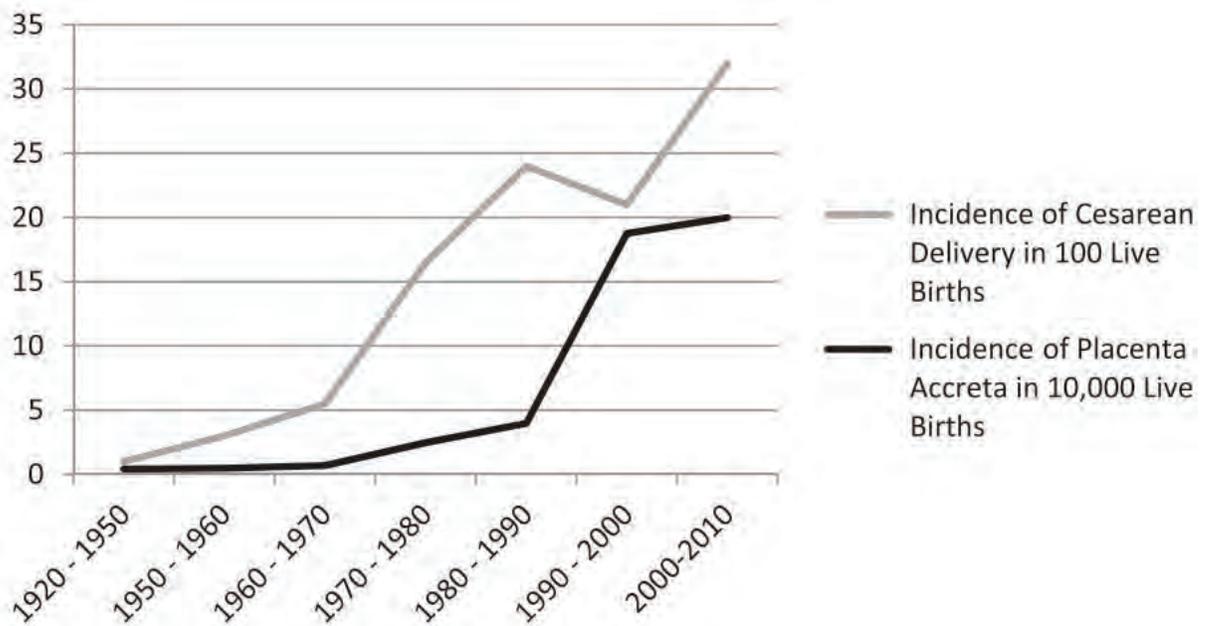


## Background

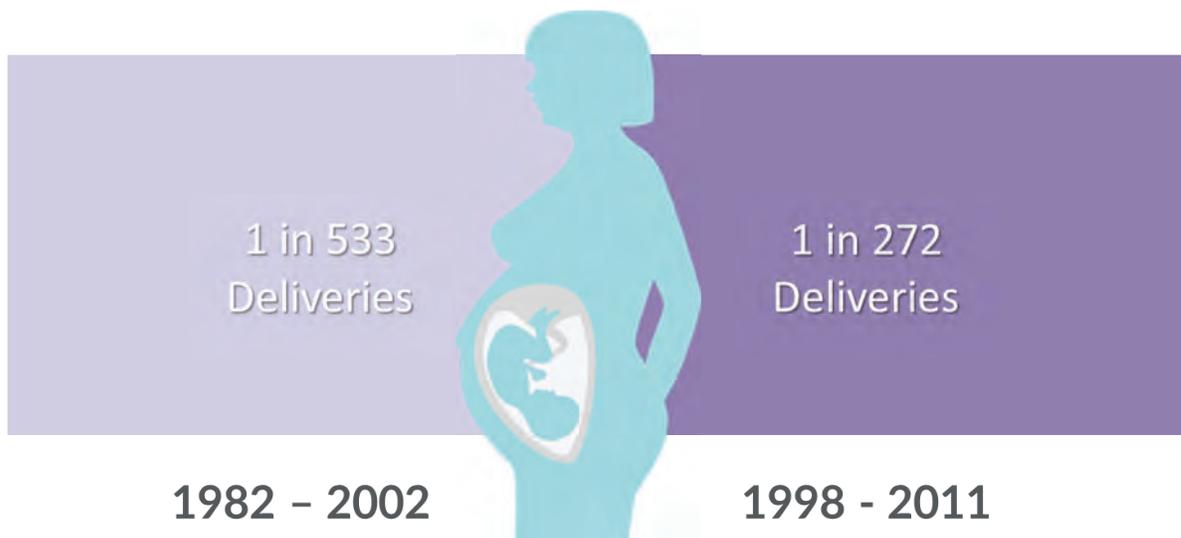
- Placenta Accreta Spectrum (PAS)
  - Accreta
  - Increta
  - Percreta
- PAS incidence is increasing



# Rising Incidence



## PAS Incidence Trend



## Background

- In the U.S., PAS is most common reason for
  - Cesarean hysterectomy
  - Peripartum hysterectomy
- Contributor to major maternal morbidity
- Although rare, also contributor to maternal mortality



## Risk Factors

- Prior cesarean delivery
- Uterine procedures
- Placenta previa
- AMA
- IVF
- History of retained products
- Parity



## Patient Case

- 38 yo G4P3 at 30 weeks with vaginal bleeding
- Visiting from another state
- 3 prior cesarean deliveries



# Maternal Morbidity Associated With Multiple Repeat Cesarean Deliveries

Robert M. Silver, MD, Mark B. Landon, MD, Dwight J. Rouse, MD, Kenneth J. Leveno, MD, Catherine Y. Spong, MD, Elizabeth A. Thom, PhD, Atef H. Moawad, MD, Steve N. Caritis, MD, Margaret Harper, MD, Ronald J. Wapner, MD, Yoram Sorokin, MD, Menachem Miodovnik, MD, Marshall Carpenter, MD, Alan M. Peaceman, MD, Mary J. O'Sullivan, MD, Baha Sibai, MD, Oded Langer, MD, John M. Thorp, MD, Susan M. Ramin, MD, and Brian M. Mercer, MD, for the National Institute of Child Health and Human Development Maternal-Fetal Medicine Units Network\*

**OBJECTIVE:** Although repeat cesarean deliveries often are associated with serious morbidity, they account for only a portion of abdominal deliveries and are overlooked when evaluating morbidity. Our objective was to estimate the magnitude of increased maternal morbidity associated with increasing number of cesarean deliveries.

**METHODS:** Prospective observational cohort of 30,132 women who had cesarean delivery without labor in 19 academic centers over 4 years (1999–2002).

**RESULTS:** There were 6,201 first (primary), 15,808 second, 6,324 third, 1,452 fourth, 258 fifth, and 89 sixth or

more cesarean deliveries. The risks of placenta accreta, cystotomy, bowel injury, ureteral injury, and ileus, the need for postoperative ventilation, intensive care unit admission, hysterectomy, and blood transfusion requiring 4 or more units, and the duration of operative time and hospital stay significantly increased with increasing number of cesarean deliveries. Placenta accreta was present in 15 (0.24%), 49 (0.31%), 36 (0.57%), 31 (2.13%), 6 (2.33%), and 6 (6.74%) women undergoing their first, second, third, fourth, fifth, and sixth or more cesarean deliveries, respectively. Hysterectomy was required in 40 (0.65%) first, 67 (0.42%) second, 57 (0.90%) third, 35 (2.41%) fourth, 9 (3.49%) fifth, and 8 (8.99%) sixth or more cesarean deliveries. In the 723 women with previa, the risk for placenta accreta was 3%, 11%, 40%, 61%, and 67% for first, second, third, fourth, and fifth or more repeat cesarean deliveries, respectively.

**CONCLUSION:** Because serious maternal morbidity increases progressively with increasing number of cesarean deliveries, the number of intended pregnancies should

\* For members of the National Institute of Child Health and Human Development Maternal-Fetal Medicine Units Network, see the Appendix.

From the Departments of Obstetrics and Gynecology at the University of Utah, Salt Lake City, Utah; Ohio State University, Columbus, Ohio; University of Alabama at Birmingham, Birmingham, Alabama; University of Texas Southwestern Medical Center, Dallas, Texas; University of Chicago, Chicago, Illinois; University of Pittsburgh, Pittsburgh, Pennsylvania; Wake Forest University School of Medicine, Winston-Salem, North Carolina; Columbia University,

Review Risk Assessment

Key References



Original Research

### Maternal Morbidity Associated With Multiple Repeat Cesarean Deliveries

Robert M. Silver, MD, Mark B. Landon, MD, Dwight J. Rouse, MD, Kenneth J. Leveno, MD, Catherine Y. Spong, MD, Elizabeth A. Thom, PhD, Atif H. Moawad, MD, Steve N. Caritis, MD, Margaret Harper, MD, Ronald J. Wapner, MD, Yoram Sorokin, MD, Menachem Miodovnik, MD, Marshall Carpenter, MD, Alan M. Peaceman, MD, Mary J. O'Sullivan, MD, Baha Sibai, MD, Odell Langer, MD, John M. Thorp, MD, Susan M. Ramin, MD, and Brian M. Mercer, MD, for the National Institute of Child Health and Human Development Maternal-Fetal Medicine Units Network\*

**Table 3. Odds Ratios With 95% Confidence Intervals for Placenta Accreta and Hysterectomy by Number of Cesarean Deliveries Compared With First Cesarean Delivery**

Cesarean Delivery	Accreta [n (%)]	OR (95% CI)	Hysterectomy [n (%)]	OR (95% CI)
First*	15 (0.2)	—	40 (0.7)	—
Second	49 (0.3)	1.3 (0.7–2.3)	67 (0.4)	0.7 (0.4–0.97)
Third	36 (0.6)	2.4 (1.3–4.3)	57 (0.9)	1.4 (0.9–2.1)
Fourth	31 (2.1)	9.0 (4.8–16.7)	35 (2.4)	3.8 (2.4–6.0)
Fifth	6 (2.3)	9.8 (3.8–25.5)	9 (3.5)	5.6 (2.7–11.6)
≥ 6	6 (6.7)	29.8 (11.3–78.7)	8 (9.0)	15.2 (6.9–33.5)

OR, odds ratio; CI, confidence interval.

\* Primary cesarean delivery.

Review Risk Assessment

Key References



## Patient Case

Review Risk  
Assessment

- 34 yo G4P3 at 30 weeks with vaginal bleeding
- Visiting from another state
- 3 prior cesarean deliveries
- Known placenta previa



Original Research

## Maternal Morbidity Associated With Multiple Repeat Cesarean Deliveries

Robert M. Silver, MD, Mark B. Landon, MD, Dwight J. Rouse, MD, Kenneth J. Leveno, MD, Catherine Y. Spong, MD, Elizabeth A. Thom, PhD, Atif H. Moawad, MD, Steve N. Caritis, MD, Margaret Harper, MD, Ronald J. Wapner, MD, Yoram Sorokin, MD, Menachem Miodovnik, MD, Marshall Carpenter, MD, Alan M. Peaceman, MD, Mary J. O'Sullivan, MD, Baha Sibai, MD, Odell Langer, MD, John M. Thorp, MD, Susan M. Ramin, MD, and Brian M. Mercer, MD, for the National Institute of Child Health and Human Development Maternal-Fetal Medicine Units Network\*

**Table 4. Placenta Previa and Placenta Accreta by Number of Cesarean Deliveries**

Cesarean Delivery	Previa	Previa*:Accreta <sup>†</sup> [n (%)]	No Previa*:Accreta <sup>†</sup> [n (%)]
First <sup>‡</sup>	398	13 (3.3)	2 (0.03)
Second	211	23 (11)	26 (0.2)
Third	72	29 (40)	7 (0.1)
Fourth	33	20 (61)	11 (0.8)
Fifth	6	4 (67)	2 (0.8)
≥ 6	3	2 (67)	4 (4.7)

\* Percentage of accreta in women with placenta previa.

<sup>†</sup> Increased risk with increasing number of cesarean deliveries;  $P < .001$ .

<sup>‡</sup> Percentage of accreta in women without placenta previa.

<sup>§</sup> Primary cesarean.

Review Risk Assessment

Key References



## What We Know...

Know  
When to  
Transfer

- Planned delivery of PAS patient during the 34<sup>th</sup> week in a specialist center with a multidisciplinary team:
  - ↓ hemorrhage morbidity
  - ↓ transfusion
  - ↓ operating time
  - ↓ ICU admissions
  - Better neonatal outcomes



# Care Consensus

Know  
When to  
Transfer

Key  
References

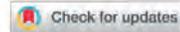


The American College of  
Obstetricians and Gynecologists  
WOMEN'S HEALTH CARE PHYSICIANS



Society for  
Maternal-Fetal  
Medicine

Obstetric Care Consensus  
(Replaces Committee Opinion No. 529,  
July 2012 and SMFM Clinical Guideline #1,  
November 2010) | #7  
[smfm.org](http://smfm.org)



## Placenta Accreta Spectrum

The Society of Gynecologic Oncology endorses this document. This document was developed jointly by the American College of Obstetricians and Gynecologists and the Society for Maternal-Fetal Medicine with the assistance of Alison G. Cahill, MD, MSCI; Richard Beigi, MD, MSc; R. Phillips Heine, MD; Robert M. Silver, MD; and Joseph R. Wax, MD.



### Recommendation:

Patients with suspected PAS, “*should be delivered at a level III or IV center with considerable experience whenever possible...*”



**Evidence-based guidelines for the management of abnormally invasive placenta: recommendations from the International Society for Abnormally Invasive Placenta**

[Check for updates](#)

Sally L. Collins, MD, PhD; Bahrin Alenadar, MD; Heleen J. van Bokkum, MD; Charline Berthold, MD; Thorsten Braun, MD; Pavel Galda, MD; Pierre Delorme, MD; Johannes J. Duvkot, MD; Lene Gronbeck, MD; Gilles Kayem, MD; Jens Langhoff-Ross, MD; Louis Marcelin, MD; Pasquale Martinelli, MD; Olivier Morel, MD; Mina Mhallem, MD; Maddalena Morlando, MD; Lonne N. Noyergaard, MD; Andreas Nonnenmacher, MD; Petra Patešky, MD; Philippe Petit, MD; Marcus J. Rijken, MD; Mariola Rospicka-Lesiak, MD; Dietmar Schlenker, MD; Lise Sentilhes, MD; Veerana Stefanovic, MD; Gita Strindfors, MD; Boris Tutschek, MD; Siri Vangem, MD; Alexander Weichert, MD; Katharina Weiszacker, MD; Frederic Chamtraine, MD; on behalf of the International Society for Abnormally Invasive Placenta (IS-AIP)



**TABLE 1**

**International Society for Abnormally Invasive Placenta (IS-AIP) criteria for what constitutes a specialist center for AIP**

1. A center that can provide a multidisciplinary team (MDT) with significant experience in managing abnormally invasive placenta (AIP) and that can provide antenatal diagnosis and preoperative planning. This team should be available 24 hours a day, 7 days a week, to ensure that expertise is available for emergency situations.  
This MDT should, as a minimum, include:
  - Imaging expert (fetal medicine specialist and/or radiologist)
  - Experienced obstetrician (often maternal-fetal medicine specialist)
  - Anesthesiologist with expertise in complex obstetric cases
  - Surgeon experienced with complex pelvic surgery (often a gynecological oncologist)
  - Urologist (with experience of open urological surgery especially ureteric re-implantation)
  - Neonatologist
  - Interventional radiologist<sup>a</sup>
2. There should be, *on site*, rapid access to the following in case of emergency:
  - Colorectal surgeon
  - Vascular surgeon
  - Hematologist
3. Adult intensive care facilities available on site
4. Gestational age–appropriate neonatal intensive care facilities
5. Massive transfusion facilities
6. Intraoperative blood salvage (cell salvage) services available<sup>b</sup>

<sup>a</sup> Although the IS-AIP do not recommend the routine use of prophylactic balloon occlusion, the availability of embolization in the event of massive hemorrhage remains important.; <sup>b</sup> Intraoperative blood salvage should be available for all elective procedures as a minimum.

Collins. IS-AIP guideline for management of abnormally invasive placenta. *Am J Obstet Gynecol* 2019.



## What We Also Know...

- Many PAS patients do not deliver at specialist center
  - Emergency
  - Missed diagnosis
  - No referral mechanism
  - Lack of access

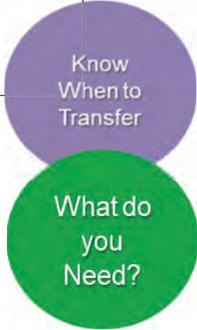


# What to Do?

Where and when to delivery will depend on many factors



- A** **Pt/fetus stable:**  
Consider transfer
- B** **Pt/fetus unstable:**  
Plan for Delivery
- C** **Emergency Preparation**



## Patient Case

Review Risk  
Assessment

- 34 yo G4P3 at 30 weeks with vaginal bleeding
- Visiting from another state
- 3 prior cesarean deliveries
- Known placenta previa
- Non-reassuring FHR Tracing



## Plan - Preoperative

- Delivery Location?
  - No data on ideal location
  - Should be based on individual center's resources
- Invasive radiology interventions?
  - Current evidence is low quality and conflicted
  - Several complications reported
  - Aortic balloon occlusion may hold promise
- Patient positioning?

What do  
you  
Need?

Anesthetic  
Plan



## Plan - Preoperative

- Resources available
  - Blood bank communication
  - Cell Salvage
  - Rapid infusion device
  - Vascular access
    - Arterial line
    - Central access
  - Medications
    - Tranexamic acid – **WOMAN** trial



What do you Need?

Anesthetic Plan

Key References



## Further Resources

What do  
you  
Need?

### CMQCC Obstetric Hemorrhage Toolkit



### Placenta Accreta Spectrum: Incidence, Risks, Diagnosis, Counseling and Preparation for Birth

Richard Lee, MD, Keck School of Medicine, University of Southern California  
Vineet K. Shrivastava, MD, MemorialCare™ Miller Children's and Women's Hospital, Long Beach and  
University of California, Irvine  
Kristen Terlizzi, National Accreta Foundation



# Resources

What do you Need?

- Checklists



**SMFM Preoperative Planning Form for Suspected Morbidly Adherent Placenta**



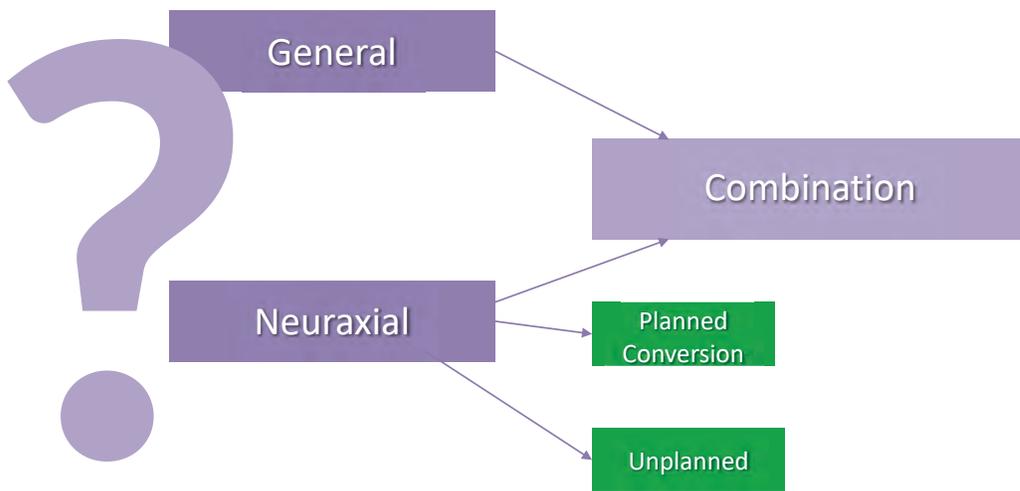
**SMFM Checklist for Unexpected Morbidly Adherent Placenta**

*Intended for use when morbidly adherent placenta is first encountered at the time of labor onset or delivery, and was not diagnosed antenatally.*



# Anesthetic Plan

Anesthetic Plan



# Anesthetic Plan

Anesthetic Plan

	Advantages	Disadvantages
General Anesthesia	Controlled intubation Hemodynamic stability Beneficial in coagulopathy Beneficial for prolonged surgery Patient preferences	Fetal exposure to anesthesia No intrathecal morphine or postop epidural analgesia
Neuraxial Anesthesia <ul style="list-style-type: none"> <li>• CSE</li> <li>• Epidural</li> </ul>	Allows patient to participate in birth Improved bonding Postoperative analgesia with intrathecal morphine or epidural infusion Can be extended	Sympathectomy during active hemorrhage Hemodynamic instability may require conversion to GA Coagulopathy is a potential concern
Combination GA and Neuraxial	Patient can participate in birth Postoperative analgesia Patient comfort during prolonged surgery	Potential airway manipulation in unstable patient or with unfavorable airway



# PLAN - intraoperative

- Vascular access
  - Arterial line: pre- vs. post-induction
  - Central access: should be individualized
- Cell Salvage and rapid infusion device is recommended
- POCUS
- Targeted blood product administration
  - Point of care devices (e.g., thromboelastometry)
  - Fixed ratio?
- Tranexamic Acid

Anesthetic  
Plan

What do  
you  
Need?



# PLAN - postoperative

- Location

- ICU
- Intermediate Care
- L&D

- Level of monitoring

- VTE prophylaxis

- Postop Analgesia

- Intrathecal morphine
- Epidural infusion
- Blocks (TAP or QL)
- Scheduled NSAIDs, acetaminophen
- IV or oral opioids for breakthrough

Anesthetic Plan

Postoperative Plan

What do you Need?



# New and Cutting Edge?

## *Areas for Improvement*

- Racial Disparities
  - Cesarean rates are 5-6% higher for Black women
  - Asian and Black women have higher rates of placenta previa
  - Black women have higher rates of PAS
- Mental Health Support
  - Impact of PAS
  - ACOG recommends screening



# New and Cutting Edge?

## *Future Areas*

- Abdominal aortic balloon occlusion
- Surgical approaches
- Conservative management
- Risk assessment improvements
- Ideal anesthesiology staffing models
- Promotion of vaginal birth



## SUMMARY

- Advanced planning for birth in Level III or IV
- Multidisciplinary team
- Tailored anesthetic plan
  - Type
  - Resources
  - Postoperative care
- Postpartum considerations





ELSEVIER

Contents lists available at ScienceDirect

# International Journal of Obstetric Anesthesia

journal homepage: [www.elsevier.com/locate/ijoa](http://www.elsevier.com/locate/ijoa)



## Review article

### Placenta accreta spectrum disorder: updates on anesthetic and surgical management strategies



**Table 3**  
Peri-operative and postoperative approaches for the management of women with placenta accreta spectrum at the University of Utah and Tel-Aviv Sourasky Medical Center.

	University of Utah, US	Tel-Aviv Sourasky Medical Center, Israel
Pre-operative multidisciplinary communication	Encrypted email and via electronic medical record routing	Via smartphone group messaging
Pre-operative multidisciplinary meeting	Yes, monthly treatment planning conferences	No
Pre-operative debrief	Yes	Yes
Place of surgery	Main operating room for all suspected cases of PASL & D operating rooms for cases with very low suspicion	Scheduled: hybrid operating room in main operating room Emergent/urgent: L & D operating rooms
Invasive radiology	Not routine. Post-delivery embolization on a rare case-by-case basis	Scheduled cases, internal iliac balloon placement, inflated after delivery, prior to placental manipulation
Primary anesthesia mode	Scheduled: Neuraxial (CSE) for cesarean with intra-operative conversion to general anesthesia after delivery Emergent/urgent: General anesthesia	Scheduled: Neuraxial (CSE) Emergent/urgent: General anesthesia

Intravenous lines	2 × 14-gauge peripheral cannulae	2 × 14-gauge peripheral cannulae
Rapid infuser device	Yes	Yes
Cell salvage	Not routine	Not routine
Arterial line placement	Yes	Yes
Central line placement	Not routine	Not routine
Pre-operative blood ordering before scheduled cesarean hysterectomy	6 units PRBC; 6 units plasma	8 units PRBC (4 units available in the operating room)
Point-of-care devices	Arterial blood gas machine and thromboelastometry	Arterial blood gas machine in operating room Thromboelastometry (in hematology laboratory)
Antony prophylaxis with oxytocin	Yes, after delivery of the fetus	Yes, after delivery of the fetus
Tranexamic acid	If actively bleeding after delivery of fetus	If actively bleeding
Postoperative disposition	Routine: Postoperative OB/GYN care unit (postpartum); Complicated: SICU	Routine: L & D postoperative care unit (staffed by intensive care trained nurses) Complicated: General ICU
Postoperative analgesia	Intrathecal morphine; TAP or QLB block; oral NSAIDs; oral oxycodone or IV hydromorphone for breakthrough pain	Intrathecal morphine; TAP or QLB block if no neuraxial block PACU: Intravenous acetaminophen, metamizole and ketorolac Department: oral acetaminophen, metamizole, NSAIDs, and tramadol for breakthrough pain



# Further Resources

What do you Need?





# THANK YOU



# Extracorporeal Membrane Oxygenation in Pregnancy



Emily Naoum, M.D.

## Objectives

- 1 Epidemiology of peripartum ECMO
- 2 Indications for ECMO in pregnancy
- 3 Pregnancy specific considerations
- 4 Outcomes of peripartum ECMO
- 5 Future directions

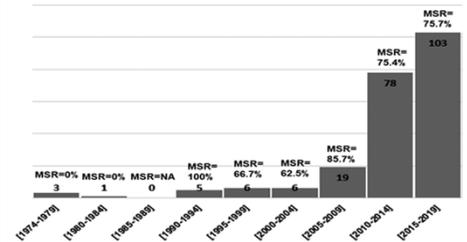


slide | 2

# 1 | EPIDEMIOLOGY

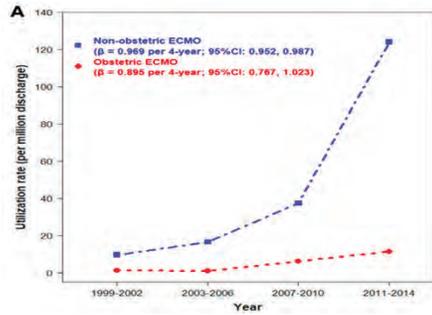
Peripartum ECMO

## Trends in peripartum ECMO



Naoum E, et al. JAMA 2020. slide | 4

## Trends in peripartum ECMO



Taha B et al. *Anesth Analg*. 2021. [link](#) | 5

## Patient characteristics

**Table 1. Comparison of Adult Obstetric ECMO and Nonobstetric ECMO Cases (United States, 1999–2014)**

Variable	Nonobstetric ECMO (N = 20,123)	Obstetric ECMO (N = 331)	P value
<b>Patient characteristics</b>			
Age (y)	53 (38–63)	26 (23–33)	<.001
Female sex	7538 (37.5%)	331 (100.0%)	<.001
<b>Race and ethnicity</b>			
Non-Hispanic White	11,865 (67.9%)	130 (47.3%)	.001
Non-Hispanic Black	2495 (14.6%)	96 (34.8%)	
Hispanic	1394 (8.2%)	20 (7.2%)	
Non-Hispanic Asian or Pacific Islander	399 (2.3%)	*	
Other	1184 (7.0%)	24 (8.9%)	
<b>Health insurance</b>			
Medicaid or Medicare	9093 (45.3%)	168 (51.0%)	.352
Private	9273 (46.2%)	149 (44.8%)	
Other	1713 (8.5%)	14 (4.2%)	
First quartile of median household income for the patient ZIP code of residence (or poorest)	5023 (25.7%)	111 (34.1%)	.118
Charlson comorbidity index	2 (0–3)	0 (0–3)	<.001
Comorbidity index for obstetric patient	NA	NA	NA

Taha B et al. *Anesth Analg*. 2021. [link](#) | 6

## Patient characteristics

	All pregnant or peripartum patients N = 100	All non-pregnant female patients N = 1080	p or OR [CI]
Median [IQR] or n (%)			
Age (years)	32.4 [28.4–36.8]	49.3 [40.6–57.6]	<0.001
Weight (kg)	85.0 [71.4–104.5]	92.0 [77.7–111.0]	0.02
Overweight or Obesity, n (%)	53 (53.0)	735 (68.1)	<0.01
<b>Race/Ethnicity</b>			
White	22 (22.0)	426 (39.4)	Reference
Hispanic	27 (27.0)	224 (20.7)	0.005
Black	19 (19.0)	180 (16.7)	0.03
Asian	13 (13.0)	91 (8.4)	0.01

O'Neill et al. *Am J Respir Crit Care Med*. 2021. [link](#) | 7

# 2 INDICATIONS

Peripartum ECMO

Current use of ECMO for ARDS

Efficacy and economic assessment of conventional ventilatory support versus extracorporeal membrane oxygenation for severe adult respiratory failure (CESAR): a multicentre randomised controlled trial

Sola F, Mouton RP, Anandakrishnan T, et al. *N Engl J Med*. 2018;378:1301-1311.



Extracorporeal Membrane Oxygenation for Severe Acute Respiratory Distress Syndrome

A. Combes, D. Hajage, G. Capellier, A. Demoule, S. Lassus, C. Guervilly, D. De Silva, L. Zafrani, P. Tite, B. Vabret, E. Maitry, S. Lemy, Y. Cohen, C. Richard, P. Kalfon, L. Bouadma, H. Mehdaoui, G. Badier, G. Lebreton, L. Brochard, N. D. Ferguson, F. Fan, A. S. Slutsky, D. Brodie, and A. Mercat, for the EOLIA Trial Group, REVA, and ECMONA<sup>1</sup>

slide | 9

Current use of ECMO for ARDS:

EOLIA

- International, randomized, controlled trial
- Inclusion criteria
  - P:F < 50 mmHg for > 3 hours
  - P:F < 80 mmHg for > 8 hours
  - Arterial pH < 7.25 with PaCO<sub>2</sub> > 60 mmHg for > 6 hours

slide | 10

Current use of ECMO for ARDS:

EOLIA

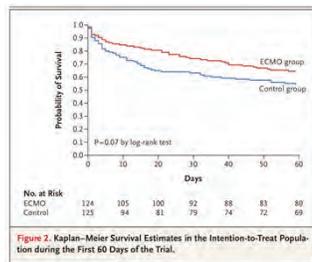


Figure 2. Kaplan-Meier Survival Estimates in the Intention-to-Treat Population during the First 60 Days of the Trial.

- Primary end point of 60-day mortality – no difference
- Considering crossover and treatment failure – ECMO has benefit

Indications for peripartum ECMO



Pulmonary

- ARDS
- Asthma
- Hypertensive disorders of pregnancy
- Fluid overload
- PE
- Cardiac disease



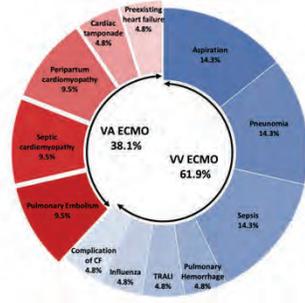
Cardiac

- Cardiac arrest
- Heart failure
- Peripartum cardiomyopathy
- PE
- AFE



slide | 12

## Indications for peripartum ECMO



Lanford A, et al. Anesth Analg 2021. slide | 13

## Timing of ECMO

Antepartum	Intrapartum	Postpartum
ARDS > heart failure > PAH	Cardiac arrest > cardiac failure > AFE	ARDS > PPCM > cardiac failure
Mostly VV	Mostly VA	Mostly VA
Medium duration (10.8 days)	Shortest duration (5.5 days)	Longest duration (17.9 days)
Higher survival (80.2%)	Highest survival (84.1%)	Lowest survival (67.5%)

SOAP

Nasiri E, et al. JAMA 2020. slide | 14

## 3 | SPECIFIC CONSIDERATIONS

Peripartum ECMO

## Pregnancy specific physiology

### Cardiovascular

↑ HR, SV, CO, EF  
↓ SVR, PVR, BP



### Pulmonary

↑ MV, TV, O<sub>2</sub> consumption, PaO<sub>2</sub>  
↓ FRC, ERV, PaCO<sub>2</sub>



SOAP

slide | 16

## Physiologic goals

### Flows

VV – oxygenation  
VA – end organ perfusion

PaO<sub>2</sub>  
slightly ↑

PaCO<sub>2</sub>  
slightly ↓

## Cannulation considerations

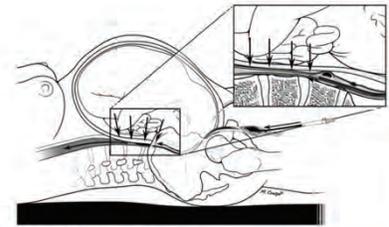


Figure 1: Vena cava compression avoiding the femoral cannula advancement.

Ngatchou W, et al. Interact Cardiovasc Thorac Surg 2012.

## Cannulation considerations

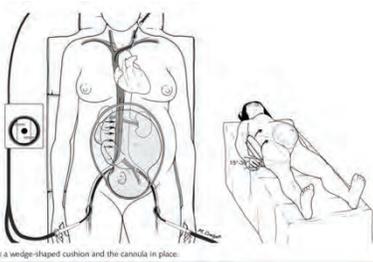
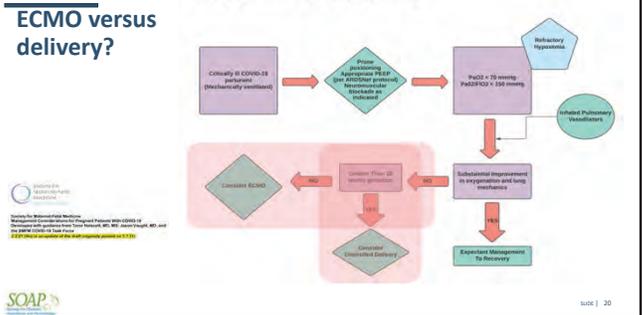


Figure 2: Left lateral tilt by a wedge-shaped cushion and the cannula in place.

Ngatchou W, et al. Interact Cardiovasc Thorac Surg 2012.

## ECMO versus delivery?

Figure 2. Algorithm for Refractory Hypoxemia



Adapted from: European Society for Intensive Care Medicine. Management of COVID-19: Practical Points. WHO (2020). <https://www.who.int/publications/m/item/management-of-covid-19-practical-points-16-05-2020>

SOAP

slide | 20

## Fetal heart rate monitoring



Individualized based on GA and maternal status

Daily versus continuous

Decision to deliver

SOAP

slide | 21

# 4 | COMPLICATIONS & OUTCOMES

Peripartum ECMO

## Complications in peripartum patients

### Hemorrhage

Slightly ↑

**30%** general

vs.

**40%** peripartum

### Thrombotic events

Essentially =

**7%** general

vs.

**5%** peripartum

SOAP

slide | 23

## Complications in peripartum patients

**Table 3. Complications Associated With Adult ECMO (United States, 1999–2014)**

Complication	Nonobstetric ECMO (N = 20,123) (%)	Obstetric ECMO (N = 333) (%)	P value	Crude OR (95% CI)	Adjusted OR* (95% CI)
Thromboembolic					
Ischemic stroke	1236 (6.1)	14 (4.2)	.50	0.69 (0.41–1.17)	0.82 (0.48–1.40)
Venous thromboembolism without associated pulmonary embolism	551 (2.7)	15 (4.5)	.40	1.62 (0.97–2.72)	1.83 (1.06–3.15)
Lower limb arterial embolism or thrombosis	481 (2.4)	0 (0.0)	.23	NA	NA
Hemorrhagic					
Hemorrhagic stroke	800 (4.0)	15 (4.5)	.85	1.12 (0.67–1.87)	0.88 (0.52–1.49)
Gastrointestinal bleeding	1180 (5.9)	24 (7.3)	.62	1.24 (0.83–1.86)	1.30 (0.86–1.98)
Nontraumatic hemoperitoneum	221 (1.1)	15 (4.5)	.01	4.12 (2.44–6.96)	4.32 (2.41–7.74)

Results are presented as weighted count (%).

Abbreviations: CI, confidence interval; ECMO, extracorporeal membrane oxygenation; NA, not applicable; OR, odds ratio.

\*Adjusted using a weighted logistic regression model with a Poisson distribution for the following variables: (1) age, (2) sex, (3) race and ethnicity, (4) quartile of median household income, (5) Charlson comorbidity index, (6) hospital census region, and (7) 4y time-interval.

SOAP

Taha B et al. *Anesth Analg*. 2021.

slide | 24

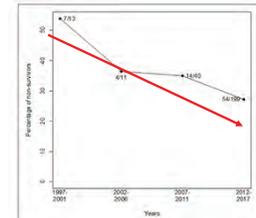
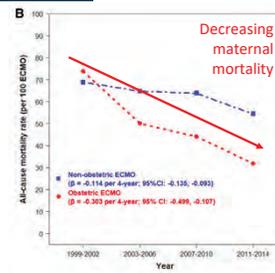
## Outcomes of peripartum ECMO



SOAP

slide | 25

## Outcomes of peripartum ECMO

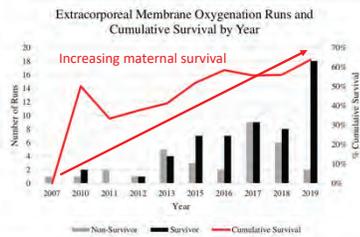


**Figure 1.** Overall mortality of peripartum patients on extracorporeal membrane oxygenation (ECMO) over a 20-yr period from 1997 to 2017. The number of patients who died during the 9-yr periods has also been represented against the total number of patients on ECMO during that period.

Taha B et al. Anesth Analg. 2021; Ramanathan K, et al. Crit Care Med. 2020;

slide | 26

## Outcomes of peripartum ECMO



**Fig. 1.** Graphic depiction of number of extracorporeal membrane oxygenation runs and cumulative survival by year in the study period.

Olson T, et al. Int J Cardiol. 2020; slide | 27

## Outcomes of peripartum ECMO

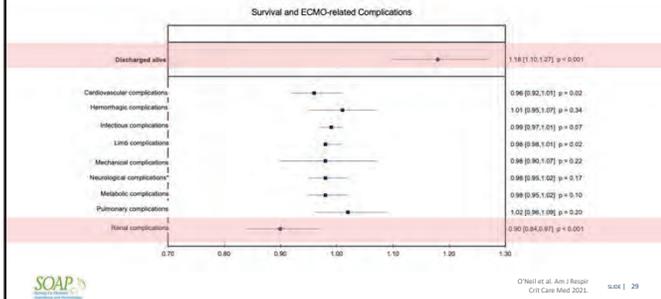
**TABLE 4. Multivariate Analysis Showing Risk Factors for Mortality in Peripartum Patients**

Risk Factors	OR (95% CI)	p	Overall p
<b>Pre-ECMO factors</b>			
<b>Indications</b>			
Pulmonary	1		<b>0.025</b>
Cardiac	1.634 (0.797–3.352)	0.18	
Extracorporeal cardiopulmonary resuscitation	3.074 (1.425–6.473)	<b>0.007</b>	
Hemofiltration	2.758 (0.857–8.878)	0.089	
<b>ECMO factors</b>			
<b>Duration of ECMO, hr</b>			
<66	1		<b>0.017</b>
66–128	0.281 (0.101–0.777)	<b>0.014</b>	
128–232	0.474 (0.191–1.174)	0.107	
> 232	1.084 (0.429–2.737)	0.864	
Renal complications	2.346 (1.203–4.572)	<b>0.012</b>	
Neurologic complications	2.345 (0.805–6.836)	0.118	

SOAP

Ramanathan K, et al. Crit Care Med. 2020; slide | 28

## Outcomes of peripartum ECMO & COVID19



## Indications based survival

Table 2. Extracorporeal Life Support Indications and Outcomes (Table view)

Indications	Total, n (%)	Survival, n (%)
Acute respiratory distress syndrome	177 (49.3)	141 (79.7)
Cardiac failure	67 (18.7)	52 (77.6)
Cardiac arrest	57 (15.9)	50 (87.7)
Peripartum cardiomyopathy	45 (12.5)	36 (78.3)
Pulmonary arterial hypertension	28 (7.8)	14 (50)
Amniotic fluid embolism	27 (7.5)	14 (51.9)
Pulmonary embolism	17 (4.7)	11 (64.7)
Heart disease	14 (3.9)	11 (78.6)
Septic shock	11 (3.1)	10 (90.9)

Naikem E, et al. JAMA 2020. slide | 30

# 5 | FUTURE DIRECTIONS

Peripartum ECMO

## Future directions

### Dedicated peripartum registries

- Cannulation location
- Mode of delivery
- Optimal anticoagulation regimen
- Neonatal outcomes



"ECMO Consult"

# QUESTIONS

## Thank you!

Emily Naoum, M.D.  
enaoum@mgh.harvard.edu



LAO



## Pregnancy Related Neurological Complications After Neuraxial Anesthesia

Amy Lee, MD  
Associate Professor  
Baylor College of Medicine  
Houston, TX  
May 15, 2022



 @AmyLeeMDAnes

 SOAP 2022  
ANNUAL MEETING

## Disclosures

- I have no financial disclosures.

LAO



 SOAP 2022  
ANNUAL MEETING

## Case Scenario

- Recently delivered 34 year old G1P1 is complaining of numbness, and pain and cannot walk after her delivery.
- Immediately visit with patient and what next?



 SOAP 2022  
ANNUAL MEETING

## Learning Objectives

- Incidence of neurological injury in pregnancy
- Intrinsic obstetric nerve injuries: Peripheral Nerve Palsies
- Anesthesia-related neurological deficits: Central Nervous System Lesions
- Evaluation of postpartum neurological deficits
- Medicolegal implications: risk mgmt and follow-up



 SOAP 2022  
ANNUAL MEETING

## Incidence

- True figure for anesthetic complications are difficult to measure
- Intrinsic Obstetric Peripheral Nerve Palsies: 0.6 – 92 per 10,000 (Wong prospective article)
- Serious Neurological Injury: 1 per 10,000 overall vs 1 per 35,000 anesthesia-related (SCORE project)

## 3 Important References

### Incidence of Postpartum Lumbosacral Spine and Lower Extremity Nerve Injuries

Cynthia A. Wong, MD, Barbara M. Scavone, MD, Sheila Dugan, MD, Joanne C. Smith, MD, Heidi Prather, DO, Jeanne N. Ganschiff, MD, and Robert J. McCarthy, PhD

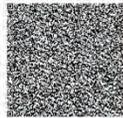


9

### Nerve injuries after neuraxial anaesthesia and their medicolegal implications

Cynthia A. Wong, MD, Professor and Vice Chair and Medical Director of Obstetric Anesthesia \*

Department of Anesthesiology, Northwestern University Feinberg School of Medicine, 251 E. Huron Street, FS-704, Chicago, IL 60611, USA



ORIGINAL INVESTIGATIONS IN EDUCATION

### Serious Complications Related to Obstetric Anesthesia

*The Serious Complication Repository Project of the Society for Obstetric Anesthesia and Perinatology*

Robert D'Angelo, M.D., Richard M. Smiley, M.D., Ph.D., Edward T. Riley, M.D., Scott Segal, M.D., M.H.C.M.



### Peripheral Nerve Palsies

SOAP 2022 ANNUAL MEETING

### 3 Common Peripheral Nerve Injuries

SOAP 2022 ANNUAL MEETING

### Lateral Femoral Cutaneous Nerve (L2, L3)

- Aka Meralgia Paresthetica
- Purely sensory
- Accounts for more than 30% of obstetric peripheral palsies
- Risk factors: compressive edema, increased abdominal pressure, pregnancy, obesity, diabetes, external pressure, or prolonged hip flexion
- S/Sx
  - Usually unilateral numbness, tingling, burning, or other paresthesias to anterolateral thigh
  - Mostly self-limiting, resolving soon after childbirth
  - Can occur during pregnancy after 30 wks gestation

SOAP 2022 ANNUAL MEETING

SOAP 2022 ANNUAL MEETING

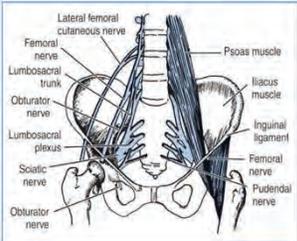
**Femoral Nerve Palsy (L2, L3, L4)**

- Vulnerable to stretch injury as it passes beneath the inguinal ligament (not compression of fetal head)
- Risk Factors: prolonged flexion, abduction, external rotation of hip, excessive lithotomy position
- S/Sx
  - Weakness of hip flexion – suggesting injury proximal to the inguinal ligament
  - Numbness of the anterior thigh and sometimes medial leg
  - Weakness of thigh flexion and knee extension
  - Decreased or absent patellar reflex



SOAP 2022 ANNUAL MEETING

**Obturator Nerve Palsy (L2, L3, L4)**

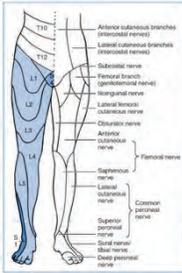


- Compression injury of the nerve btw the pelvis and fetal head, or forceps assisted delivery
- S/Sx: Numbness of medial thigh and abnormal gait (weakness of thigh adduction)

SOAP 2022 ANNUAL MEETING

**Lumbosacral Plexus (L1-L4, L5-S4)**

- Injury by compression of the plexus btw the pelvic brim and fetal presenting part, or instrumented vaginal delivery
- Risk Factors: cephalopelvic disproportion, macrosomia, malpresentation, prolonged labor and difficult vaginal delivery
- Most likely injuries is L4-L5 by the fetal head
- S/Sx: foot drop (loss of ankle dorsiflexion), sensory loss in L5 dermatome (common peroneal nerve involvement)



SOAP 2022 ANNUAL MEETING

**Sciatic Nerve Palsy (L5, S1-S4)**



- Risk Factors: hip wedge incorrectly placed under right buttock to displace the uterus in C/D, sitting in one position too long, stretch injury from lithotomy position ("candy cane" stirrups)
- S/Sx: variable
  - Foot drop is common
  - Loss of sensation below the knee sparing the medial leg
  - Loss of movement below the knee
  - Posterior cutaneous nerve and gluteal function are preserved, implying damage distal to the LS plexus
- DDX: LS plexus and peroneal nerve injury

SOAP 2022 ANNUAL MEETING

AG

## Common Peroneal Nerve Palsy



- Superficial peroneal nerve – sensory to the lateral leg and dorsum of the foot
- Deep peroneal nerve – motor innervation to foot dorsiflexion and eversion
- Risk Factors: prolonged external compression by the mother’s hands, stirrups, prolonged lithotomy position or maternal squatting (natural childbirth)
- S/Sx: Sensory deficits on the anterolateral calf and dorsum of the foot and foot drop (when peroneal nerve damaged at the knee) with steppage gait and weak ankle eversion, but preserved plantar flexion and ankle inversion

SOAP Society of Obstetric Anesthesiologists and Perinatology  
SOAP 2022 ANNUAL MEETING

## Neuraxial Analgesia/Anesthesia: An Indirect Contributor?

- Neuraxial analgesia/anesthesia may indirectly contribute to compression/stretch injuries because it may decrease the ability of a woman to perceive that her legs are in a position that contributes to compression/stretch-induced neuropathy. Practices that providers should observe to lessen the risk for compression-induced neuropathy.

SOAP Society of Obstetric Anesthesiologists and Perinatology  
SOAP 2022 ANNUAL MEETING

AG

## Anesthesia-Related CNS Neurologic Injury

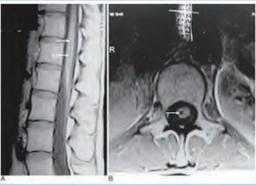
- Neurological Sequelae of Dural Puncture
  - Cranial Nerve Palsies : CN VI, VIII
    - CN VI: Abducens most vulnerable, diplopia
    - CN VIII: Vestibulochlear, hearing loss, tinnitus
    - Tx: Prompt EBP resolves headache
    - Recovery of neuropathy may be delayed, and even persistent
  - Subdural Hematoma
    - S/Sx: persistent headache after EBP (>80%), altered consciousness, seizures, or focal neurologic findings (speech difficulty, one sided weakness) (70%)
    - Tx: Imaging studies (CT) for diagnosis
    - Risk Factors: dural puncture (large bore and with small-gauge pencil-point needle)
  - Cortical Vein and Venous Sinus Thrombosis



SOAP Society of Obstetric Anesthesiologists and Perinatology  
SOAP 2022 ANNUAL MEETING

AG

## Direct Trauma



- Spinal cord, conus medullaris, and spinal nerve roots trauma can be by needles or catheters
- Syrinx or hematoma in the conus medullaris
- S/Sx: pain during needle insertion, unilateral paresthesia in L5-S1 dermatome, foot drop, urinary sx

SOAP Society of Obstetric Anesthesiologists and Perinatology  
SOAP 2022 ANNUAL MEETING

## Neuraxial Hematoma

- Risk Factors: difficult or traumatic epidural needle/catheter placement, coagulopathy or therapeutic anticoagulation at time of placement or catheter removal, spinal deformity, spinal tumor, continuous epidural higher rate over single shot spinal anesthesia
- Incidence: 1 per 500,000 (epidural hematoma)
- S/Sx: acute onset of back and radicular leg pain, lower extremity weakness and numbness, bladder and bowel dysfunction
- Dx: MRI and neurosurgical evaluation

## Infection: Epidural Abscess

- Risk Factors: prolonged catheterization (1-4 days), suboptimal aseptic technique, traumatic/difficult insertion, diabetic or immunocompromised patients (AIDS, steroids)
- Incidence: 1 per 200,000
- S/Sx:
  - Onset 4-10 days after catheterization, severe backache (with local tenderness), fever, catheter entry inflamed with fluid leak, neck stiffness, headache
  - Late findings: radicular pain, lower limb and sacral numbness, loss of reflexes and bladder dysfunction
- Labs: leukocytosis, increased C-reactive protein and erythrocyte sedimentation rate, blood cultures
- Organism: Staphylococcus aureus, skin likely source
- Tx:
  - Prompt MRI for diagnosis
  - Laminectomy (once neuro deficits present), surgical drainage
  - Conservative prolonged 4-6 wks antibiotic tx or percutaneous needle drainage with mild sx (without neuro sx), close monitoring

A0



## Infection: Meningitis

- Risk Factor: dural puncture, vaginal delivery, poor sterile technique (occurs in clusters)
- Incidence: 1 per 39,000
- S/Sx: 12 hrs to several days after delivery, fever, headache, photophobia, nausea/vomiting, neck stiffness, confusion, drowsiness, + Kernig's sign
- Labs: Lumbar puncture elevated CSF protein and WBC, CSF glucose lower than plasma glucose level, bacteria cultured in broth (avoid LP if epidural abscess suspected or increased ICP)
- Organism: Streptococci viridans type (*S. salivarius*), oral or vaginal flora
- Tx: Start antibiotics before culture results (usually Vancomycin and 3<sup>rd</sup> G cephalosporin and then adjusted based on culture and sensitivity)

## Comparison

	EPIDURAL ABSCESS	MENINGITIS
Incidence	1 in 200,000	1 in 39,000
Entry Point	Through epidural catheter	Via dural puncture
Organism	Staphylococcus aureus	Streptococcus salivarius (viridans type)
Source of Infection	Pt's skin, body fluids in the bed	Provider's oral/nasal cavity uncovered by mask, blood borne, vaginal flora
Onset of Sx	4-10 days, severe backpain with localized tenderness	12 hrs – few days, Kernig's sign
Risk Factors	Prolonged catheterization, poor aseptic technique, difficult neuraxial, immunocompromise	Dural puncture, labor, no face mask, manual removal of placenta, vaginal infection, bacteremia, immunocompromise

SOAP Society of Obstetric Anesthesiology and Perioperative Medicine  
SOAP 2022 ANNUAL MEETING

## Chemical Injury: Cauda Equina Syndrome & Arachnoiditis

- Nerves in the subarachnoid space are more vulnerable to toxic injury than spinal nerves in the epidural space
- Can cause cauda equina syndrome or arachnoiditis
- Neurotoxic substances: drug preservatives, high doses of local anesthetics



SOAP Society of Obstetric Anesthesiology and Perioperative Medicine  
SOAP 2022 ANNUAL MEETING

## Chemical Injury: Transient Neurologic Syndrome

- Aka Transient radicular irritation
- Like CES, follows spinal anesthesia, most commonly with lidocaine
- Same risk factors as those for CES, although TNS less dependent on lidocaine dose or presence of vasoconstrictor
- 4X more common with lidocaine than other local anesthetics
- Incidence ranges from 0 – 9%
- S/Sx:
  - 12 hrs after resolution of uncomplicated spinal anesthesia
  - transient pain in the lower back, buttock or lower extremities
  - Aching or cramping pain, worse at night
  - Improves with ambulation and tx with NSAIDs, last several days



SOAP Society of Obstetric Anesthesiology and Perioperative Medicine  
SOAP 2022 ANNUAL MEETING

Chemical Injury

TNS

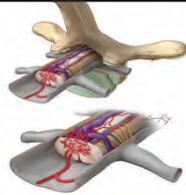
CES

Arachnoiditis

SOAP Society of Obstetric Anesthesiology and Perioperative Medicine  
SOAP 2022 ANNUAL MEETING

## Vascular Injury

- Ischemic injury to spinal cord
- Anterior artery syndrome – motor deficits with or without loss of pain and temperature sensation, bowel and bladder incontinence, and sparing vibration and joint sensations (posterior columns)
- Spinal canal arteriovenous malformations may increase risk of vascular injury during neuraxial placement.



SOAP Society of Obstetric Anesthesiologists and Perinatology  
SOAP 2022 ANNUAL MEETING

## Postpartum Neurological Deficit Evaluation

- Focused history and physical examination
  - Details of delivery
  - Specific symptoms
  - Timing of onset of symptoms
  - Progression of symptoms
  - Laterality?
  - Pain? Backpain, Paraspinous muscles pain? Suprapubic pain?
  - Thorough neurologic examination
- Complex symptoms, with motor or bilateral findings should prompt a consultation (neurology, neurosurgery, physiatrist)
- Immediate MRI is gold standard to rule out central neuraxial lesions
- Start antibiotics if infectious etiology



SOAP Society of Obstetric Anesthesiologists and Perinatology  
SOAP 2022 ANNUAL MEETING

## Medicolegal Implications

- Develop relationship with expert consultant
- Using non-incriminating language
- Refer to Physical Therapy prior to discharge

SOAP Society of Obstetric Anesthesiologists and Perinatology  
SOAP 2022 ANNUAL MEETING

## Risk Management and Follow-Up

- ASA Closed Claims Database
- Effective communication
  - Informed consent

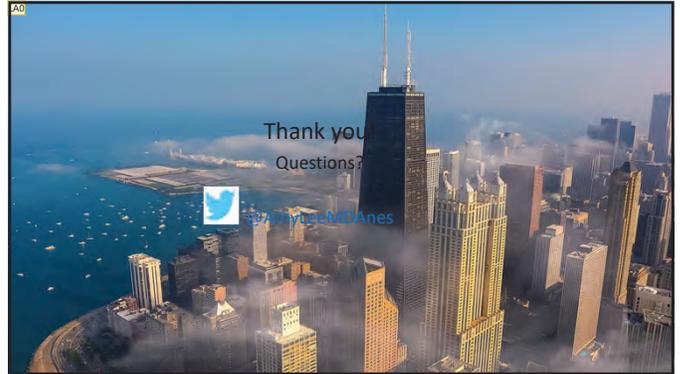


SOAP Society of Obstetric Anesthesiologists and Perinatology  
SOAP 2022 ANNUAL MEETING

## Take Home Message

- Serious and permanent neurological complications are rare
- Most are related to intrinsic obstetric peripheral palsies (<1%)
- Meticulous technique during neuraxial placement will decrease the risk of injury due to neuraxial procedures (CNS) – direct trauma and infection
  - Sterile technique
  - Proper drug ID and concentration injected
- Postpartum complaints requires prompt evaluation for early recognition, diagnosis, and treatment of neurologic injury, especially space-occupying lesions and infection are essential to prevent permanent injury or death

SOAP 2022  
ANNUAL MEETING



Abstract #: SUN-FCP – Room 1 Cardiac – 01

**Anesthetic Management of an Obstetric Patient with Severe Right Ventricular Outflow Tract Obstruction after Truncus Arteriosus Repair Undergoing an Elective Cesarean Section**

**Presenting Author:** Nour EL HAGE CHEHADE, MD

**Presenting Author's Institution:** Cleveland Clinic, Ohio

**Introduction:** Right ventricular outflow tract obstruction (RVOT) is the most common late complication of arterial switch operation for Truncus Arteriosus (TA). The anesthetic management of a pregnant patient who required an elective cesarean section suffering from severe RVOT obstruction remains controversial and inconclusive.

**Case:** We describe the case of a 25-year-old G3P2 patient known to have a history of truncus arteriosus with interrupted type B aortic arch status post-arterial switch. Her past medical history was also significant for gestational hypertension, type II diabetes mellitus, and morbid obesity. The patient required serial homograft replacement procedures at the age of 4 months and 7 years due to right atrial-pulmonary artery (RA-PA) conduit stenosis. By age 20, she underwent placement of a

Melody valve and stenting of the RVOT due to recurrent stenosis. At present, transthoracic echocardiography showed severe stenosis of the Melody valve. Throughout pregnancy, the patient was closely followed up by a multidisciplinary team including an anesthesiologist, cardiologist, and maternofetal medicine specialists. Therefore, our anesthetic goals during her elective cesarean section were to avoid tachyarrhythmias, maintain normal right ventricular preload and myocardial contractility to keep an adequate pulmonary blood flow. After connecting our patient to our ASA standard monitors and starting an arterial line to closely monitor our patient's hemodynamic parameters, we performed a sequential combined spinal-epidural anesthetic. We administered intrathecally 9 mg of hyperbaric bupivacaine, 20 mcg of fentanyl, and 100 mcg of morphine. A low-dose phenylephrine infusion was titrated immediately after the administration of the spinal anesthetic, to maintain normotension and preserve uterine blood flow. The case was successfully completed without any reported complications or need for inotropic support. The patient was then transferred to the general ward and discharged several days later.

**Conclusion:** RVOT obstruction may be produced by different pathologies, the treatment of this condition should be tailored to its main etiology.<sup>2</sup> The presence of congenital heart disease in parturients tends to complicate pregnancy and delivery outcomes. Our patient suffered from an RVOT obstruction due to stenosis post-surgical correction of her congenital cardiac disease, TA. Patients suffering from these conditions require a multidisciplinary approach and careful anesthetic planning. In our patient, the use of a combined spinal-epidural technique achieved successful surgical anesthesia and analgesia without producing hemodynamic instability that allowed us to obtain excellent neonatal and maternal outcomes.

Abstract #: SUN-FCP – Room 1 Cardiac – 02

## Anesthetic Management of A Parturient with a History of Ross Procedure Complicated by Pulmonary Valve Stenosis Undergoing Elective Cesarean-Section

Presenting Author: Nour El Hage Chehade, MD

Presenting Author's Institution: Cleveland Clinic - Cleveland, Ohio

### Introduction

Congenital aortic valvular stenosis in women at childbearing age is not common. The Ross procedure is used as a treatment modality in children and young patients with this condition. It consists of replacing the aortic valve with the patient's own pulmonary valve and has been shown to provide hemodynamic advantages, durability, and an opportunity to avoid anticoagulation use. However, the probability of developing pulmonary homograft stenosis at 10 years is estimated around 30%<sup>1</sup>. Considering its rarity, the optimal anesthetic plan for expectant patients with this condition is either inconclusive or controversial.

### Case

We report a case of a 29-year-old G2P1 parturient with pulmonary stenosis who presented at 37 weeks of gestation for a scheduled cesarean section. The patient underwent balloon valvuloplasty at 20 months of age for congenital aortic stenosis. At 26 years of age, the patient developed recurrent aortic stenosis with left ventricular dilation requiring a Ross procedure which was later complicated by gradual severe pulmonary homograft stenosis. Throughout pregnancy, the patient was being closely followed-up by a multidisciplinary team including an obstetric anesthesiologist, cardiac obstetric, and maternal-fetal medicine specialists. The patient had NYHA class II at the moment of delivery. Our anesthetic goals were to maintain right ventricular preload, right ventricular contractility, left ventricular afterload, and manage any arrhythmias. The primary anesthetic technique that we used was to perform lumbar epidural anesthesia at the level of L2-L3 that was slowly titrated to effect over 20 min with 2% Lidocaine. Invasive monitoring consisted of a pre-induction arterial line for continuous blood pressure monitoring. Phenylephrine infusion was used to maintain adequate hemodynamics. The case was uneventful with no requirements for inotropic support. The patient was admitted to the obstetrics ward and was discharged 5-days later.

### Conclusion

Some cardiac conditions tend to worsen throughout pregnancy<sup>2</sup>. Pulmonary homograft stenosis requires close follow-up during pregnancy and careful anesthetic planning. In this case, epidural anesthesia offered a safe approach for managing a parturient with this condition.

Abstract #: SUN-FCP – Room 1 Cardiac – 03

## Management of Labor Induction in a Parturient with Symptomatic Pericardial Effusion

**Presenting Author:** Jessica Sheeran, M.D.

**Presenting Author's Institution:** University of Virginia - Charlottesville, Virginia

**Co-Authors:** Edward Gillig, M.D. - University of Virginia

Emmarie Myers, M.D. - University of Virginia

Pericardial effusions may be caused by infections, autoimmune disorders, medications, malignancy, or be idiopathic. Acute idiopathic pericarditis, presumed to be of viral etiology, is most common [1]. Pregnancy does not appear to increase susceptibility to pericardial disease, and etiology reflects that in age-matched non-pregnant women, with acute idiopathic pericarditis the most frequent diagnosis. Approximately 40% of pregnant women have been found to have hydropericardium by the 3<sup>rd</sup> trimester, characterized by mild, benign pericardial effusion that is well-tolerated and typically resolves after delivery [2]. To minimize fetal exposure to radiation, transthoracic echocardiography (TTE) is the imaging of choice to diagnose effusions and evaluate for tamponade physiology. Cardiac tamponade is the most significant complication from pericardial effusions. During pregnancy, the normal increase in blood volume can delay tamponade physiology and larger effusions may be better tolerated [2]. We present a case of management of a patient with a symptomatic pericardial effusion during induction of labor (IOL).

A 30-year-old G1P0 female at 38w3d presented for IOL given worsening dyspnea in the setting of a known, large pericardial effusion diagnosed 3 months prior. TTE at admission showed a large effusion with early signs of tamponade physiology, including right ventricular diastolic collapse. Concerningly, the patient had recently developed dyspnea at rest. There was a multidisciplinary discussion with Cardiology regarding pericardiocentesis. Given the effusion location and chronicity, a drain would be required and she would have to labor in the Cardiac ICU for drain management. Cardiology did not feel this was an appropriate place to labor, thus she was managed on L&D with a critical care nurse and Cardiologist immediately available for pericardiocentesis if she decompensated. Prior to the induction, a radial arterial catheter and lumbar epidural were placed and large bore intravenous access confirmed. She had an uneventful vaginal delivery without hemodynamic compromise. On post-partum day 3, CT scan showed a large anterior mediastinal mass and Grade IV malignant thymoma was diagnosed by biopsy. She was treated with definitive chemotherapy and radiation.

This case demonstrates the importance of multidisciplinary planning and communication in patients with pericardial effusion. The autotransfusion from birth may be well-tolerated in parturient with pericardial effusions as maintaining adequate preload is a main goal of managing tamponade physiology. Invasive hemodynamic monitoring and adequate intravenous access are imperative in monitoring patients with tamponade physiology, as well as identifying and treating decompensation.

[SheeranPericardialEffusion.pdf](#)

Abstract #: SUN-FCP – Room 1 Cardiac – 04

**Delivery Management of a Parturient with Newly Diagnosed Double Chambered Right Ventricle**

**Presenting Author:** James Damron, MD

**Presenting Author's Institution:** Vanderbilt University Medical Center - Nashville, Tennessee

**Co-Authors:** Kaitlyn Brennan, DO - Vanderbilt University Medical Center

**Introduction:** Double Chambered Right Ventricle (DCRV) is a rare congenital heart anomaly that occurs in about 1% of patients with congenital heart disease. It is usually associated with a ventricular septal defect (VSD).<sup>1</sup> In DCRV, the right ventricle is divided by a muscular band into a proximal high-pressure chamber and distal low-pressure chamber. It is usually diagnosed in childhood concurrent with a VSD diagnosis, but rarely presents in adulthood.<sup>2</sup> This case report describes the management of a new diagnosis of DCRV in a parturient.

**Case:** A 20yo G1P0 at 12w0d presented to the emergency department with a chief complaint of near syncope, chest pain, and tachycardia. Her past medical history was significant for a supracristal VSD status post patch repair and right ventricular outflow tract (RVOT) myotomy. She had a residual small patch leak post-operatively. An EKG demonstrated sinus rhythm and her known right bundle branch block. A transthoracic echo (TTE) was performed which suggested the presence of a RVOT obstruction. She was discharged with an ambulatory cardiac monitor and plans for further evaluation with a cardiac MRI. Cardiac MRI revealed a double chamber right ventricle with muscle bundle hypertrophy and at least moderate intracavitary obstruction, and a subsequent focused TTE revealed an RV high-low pressure gradient of 51mmHg. (fig 1) Both her left and right ventricular systolic function were normal. She was initiated on beta blocker therapy with metoprolol and her symptoms improved slightly. She presented for delivery at 38w1d with spontaneous rupture of membranes and elected for neuraxial anesthesia. A dural puncture epidural was performed. Standard monitoring, consisting of continuous pulse oximetry and intermittent non-invasive blood pressure monitoring was used throughout her labor, with the addition of continuous telemetry. She had a vacuum assisted vaginal delivery which she tolerated without any recurrence of syncope, chest pain, or hemodynamic instability. She remained on continuous telemetry for 24 hours postpartum and was discharged on postpartum day 2.

**Discussion:** DCRV is a rare condition in the general population and there is scant data concerning management during pregnancy. Prognosis is related to both the degree of cavitory obstruction in the RV and the intercavitary pressure gradient. There is risk for RVOT obstructive physiology, arrhythmias, and RV systolic dysfunction. Cardiac MRI is an important diagnostic tool, as diagnosis with TTE is notoriously difficult, and was diagnostic in about 15% of cases in a small case series.<sup>3</sup> Beta blockade can assist in symptom management, and surgical correction outside of pregnancy is curative. These patients require interdisciplinary management with adult congenital cardiologists, maternal fetal medicine, and anesthesiologists experienced in the care of pregnant patients with complex cardiac lesions.

[Fig 1.pdf](#)

**Abstract #: SUN-FCP – Room 1 Cardiac – 05**

## **Case Series of Two Types of Successful Deliveries in Parturients With Shone's Complex Syndrome**

**Presenting Author:** Katherine Herbert, MD

**Presenting Author's Institution:** Medical University of South Carolina - Charleston, South Carolina

**Co-Authors:** David A. Gutman, MD, MBA - Medical university of South Carolina

Michael Marotta, MD - Medical University of South Carolina

Joel Sirianni, MD - Medical university of South Carolina

Cecelia Taylor, MD - Medical University of South Carolina

### **Introduction**

Shone's Complex Syndrome is a coexistence of anomalies including parachute mitral valve, supra-valvular left atrial ring, sub-aortic stenosis, and/or aortic coarctation (CoA).<sup>1</sup> As this complex is typically corrected in infancy, management of adult patients depends on residual symptoms. Post-repair patients may develop pulmonary hypertension (PH) due to hypoplastic left ventricles, aortic stenosis, mitral stenosis (MS), and left ventricle outflow tract lesions.<sup>2</sup> Few published reports of Shone Syndrome exist focusing on the anesthetic management of obstetric patients. We present 2 cases of successful delivery in patients with Shone Syndrome.

### **Case Series**

Case 1: A 26yo G2P0010 female presented at 38w0d with pre-mature rupture of membranes. Her past medical history included Shone Syndrome repaired in childhood. At initial evaluation of her G2 pregnancy she had stable MS, mild residual sub-aortic stenosis and normal ventricular function. A 3rd trimester multi-disciplinary meeting was held with obstetrics, anesthesia, and cardiology. In light of her clinical symptoms, a vaginal delivery under epidural was deemed appropriate. She presented with PROM and underwent combined spinal-epidural(CSE) placement with Fentanyl 25mcg intrathecally. She did not require vasopressors and remained hemodynamically stable throughout labor. She delivered a healthy infant and was discharged the next day.

Case 2: A 25yo G1P0000 female at 39w0d presented for schedule Cesarean. Her past medical history included Shone Syndrome repair (CoA, supra-mitral ring, subaortic membrane, bicuspid aortic valve, membranous Ventricular Septal Defect), with residual MS and a hypoplastic aortic arch. She was followed by cardiology who were concerned about her residual MS and hypoplastic aorta. At that time her ventricular function remained normal. A 3rd trimester multidisciplinary meeting noted she remained at high risk for PH given fixed obstructive lesions. A cesarean was scheduled and recovery in a cardiovascular intensive care unit(CVICU) was planned. For her cesarean, she received a spinal anesthetic with 15mcg fentanyl, hyperbaric bupivacaine 0.75% 1.6ml, and 0.1mg morphine. A phenylephrine infusion at 80mcg/min was immediately started and was discontinued prior to leaving the operating room.

### **DISCUSSION**

Here we present 2 cases of successful delivery in patients with previously repaired Shone's Complex Syndrome. They highlight the importance of a tailored anesthetic and advanced multidisciplinary planning. Our first patient was well compensated so we elected for a CSE. Our second case underwent Cesarean under spinal anesthesia due to cardiac indications. In each scenario, providers could construct an anesthetic plan that was tailored to residual comorbidities, thus facilitating safe delivery. Both patients were followed closely by congenital cardiologists, so our team could quickly review records and adjust delivery plans accordingly.

**Abstract #: SUN-FCP – Room 1 Cardiac – 06**

**Cardiovascular complications following severe COVID-19 infection during pregnancy: A case report**

**Presenting Author:** Sonal N. Zambare, MD

**Presenting Author's Institution:** Baylor College of Medicine - Pearland, Texas

**Co-Authors:** Andrew Nguyen, MD - Baylor College of Medicine

**Introduction:** Peripartum cardiomyopathy can contribute to significant morbidity and mortality<sup>1</sup>. Severe COVID-19 infection is associated with increased risk for myocardial injury and/or arrhythmias<sup>2</sup>. We report a case of cardiovascular complications following COVID-19 infection during pregnancy.

**Case:** A 33-year-old G2P1 was admitted at 39w4d for induction of labor. Her significant past history included an admission for SARS-CoV-19 infection at 31 wga at another hospital with ARDS from COVID pneumonia, dilated cardiomyopathy, and atrial fibrillation with rapid ventricular rate. TTE showed a reduced LVEF to 45-50% and mild pulmonary hypertension. During her admission, the patient was treated with remdesivir and dexamethasone. The patient's condition came close to requiring intubation and ECMO several times during her admission, however her condition improved without need for these interventions and was discharged on heparin due to a high risk of thromboembolism. She had no notable cardiac history prior to admission with SARS-CoV-19 and was asymptomatic on admission for induction.

A follow-up TTE a couple of weeks after her discharge demonstrated recovery of her LV function with LVEF 55-59% and evidence of concentric LV remodeling and sinus rhythm. The echocardiogram was also notable for persistent mild pulmonary hypertension and a suspected supravulvular Gerbode defect (specifically membranous septal LV to RA defect), which wasn't noted on prior TTE.

A multi-disciplinary approach with inputs from MFM, Obstetrics, Anesthesiology, and Cardiology was utilized during the peripartum period. The patient was admitted one day prior to her scheduled induction with planned start of induction overnight to facilitate a daytime delivery with all teams and support personnel readily available. An arterial line was placed prior to induction of labor and the hemodynamics were monitored closely. In-line filters were placed on all intravenous lines. Labor analgesia was provided with an epidural and use of saline for loss of resistance. The patient delivered vaginally but the delivery was complicated by uterine atony and postpartum hemorrhage, which was managed with uterotonics, tranexamic acid, Bakri balloon, and 1 unit of PRBCs. The remainder of the patient's postpartum course was uncomplicated and she was discharged on postpartum day 2.

**Conclusion:** Long-term complications of SARS-CoV-19 on various organ systems are slowly becoming apparent. Our patient was found to have cardiomyopathy, pulmonary hypertension, and arrhythmia after COVID infection, although demonstrated recovery from most of her cardiac complications. It is difficult to predict the long-term sequelae and prognosis for future pregnancies for patients after COVID-19 infection.

[Transthoracic echocardiography PSAX view demonstrating suspected abnormal jet from LVOT to right atrium.pdf](#)

Abstract #: SUN-FCP – Room 1 Cardiac – 07

## Anesthetic Management of Ebstein's Anomaly in the Advanced Maternal Age Parturient

Presenting Author: Alexander Brown, MD

Presenting Author's Institution: Henry Ford Hospital

**Introduction:** Ebstein's anomaly is a congenital malformation resulting in apical displacement of the septal leading to tricuspid regurgitation and atrialization of the right ventricle. Despite early treatment options, there is a subset of the adult population living with Ebstein's anomaly. Associated malformations seen in this subset include atrial septal defects (ASD), and atrial arrhythmias. Female patients with Ebstein's Anomaly can have successful pregnancies in the presence of adequate right heart function. Right heart function can be difficult to characterize in these patients, given the atrialization of the right ventricle [1].

**Case Presentation:** A 40 year old G5P4004 female with past medical history of Ebstein's anomaly (unrepaired), secundum ASD (unrepaired), Wolf Parkinson White syndrome s/p ablation, and gestational diabetes presents at 39 weeks for elective primary cesarean section and bilateral tubal ligation. Preoperative trans-thoracic echocardiogram (TTE) noted an ejection fraction of 61%, PA pressure of 29 mm Hg and severe tricuspid regurgitation. Preoperative planning included timing of anticoagulant therapy, type and screen, availability of both invasive monitors and cardiac anesthesia. Carefully titrated epidural anesthesia was administered preoperatively with 2% Lidocaine 1:200,000 epinephrine to a total of 10ml over 30 minutes. The patient remained hemodynamically stable and was transported to the OR. On arrival, BP remained close to baseline at 135/83 mm Hg. Sensory level was accessed at T6 after an additional 5ml epidural aliquot. 15 minutes later the patient's blood pressure fell to 101/57 mm Hg, with a decrease in SpO2 to 82%. Phenylephrine infusion and supplemental O2 was started with immediate recovery. Uterine incision to delivery of baby was within 1 minute. Oxytocin was slowly administered and excessive IVF was avoided. Phenylephrine infusion was weaned off successfully. Following surgical closure, 2mg of Morphine was given through the epidural prior to removal. Mother was monitored in PACU with no significant changes in hemodynamics. Point of Care TTE displayed findings similar to preop exam.

**Discussion:** Ebstein's anomaly, unrepaired, in a 41 year old female presenting at full term for elective cesarean section is rare. Unique challenges encountered during this case included placement of neuraxial anesthesia in a parturient sensitive to changes in afterload, providing adequate surgical anesthesia, attention to preload postpartum to ensure normal right heart function, and having appropriate post-operative follow-up. Despite careful titration of neuraxial anesthesia the patient experienced a reduction in systemic vascular resistance and afterload that led to a transient reversal of a left to right shunt and subsequent hypoxia.

**Abstract #: SUN-FCP – Room 1 Cardiac – 08**

**Anesthetic Management of a Parturient with Pulmonary Hypertension for Cesarean Delivery**

**Presenting Author:** Lawrence Weinstein, MD

**Presenting Author's Institution:** University of California, San Diego - San Diego, California

**Co-Authors:** Matthew Losli, MD - University of California, San Diego

Mercades Meuli, DO - University of California, San Diego

Pulmonary arterial hypertension during pregnancy is an extremely high-risk comorbidity, with mortality rates between 30 and 56%. Increased blood volume and cardiac output leads to worsening pulmonary pressures, as the underlying disease prevents the fall in pulmonary vascular resistance that normally accompanies pregnancy. The increased pressures and volume load can strain the right ventricle, putting the woman at risk for heart failure during labor and with postpartum uterine contraction.

The patient is a 25 year-old G1P0 with idiopathic vasoreactive pulmonary HTN chronically managed with amlodipine and sildenafil. At 9 weeks gestation, right heart catheterization and echocardiogram demonstrated moderate pulmonary HTN, with RV systolic pressure of 59 mm/Hg and mean PA pressure of 40 mm/Hg. Anticipating clinical deterioration with continued pregnancy, the patient was admitted for initiation of intravenous epoprostenol for further pulmonary vasodilation. She tolerated the infusion, which was eventually up-titrated to 20 ng/kg/minute. She was scheduled for controlled Cesarean delivery at 38 weeks gestation.

On presentation, the patient was cooperative, physical exam was unremarkable (height 4'10", weight 62 kg) and the airway was reassuring. It was decided to proceed with neuraxial anesthesia to minimize risk of aspiration, potential difficulty with airway management, and hypoxia or hypercarbia secondary to sedation.

The anesthetic goals for pulmonary HTN include avoiding increased pulmonary vascular resistance by avoiding hypercarbia, hypoxia, acidosis, and pain. It is vital to limit myocardial depression and maintain systemic vascular resistance and cardiac output to ensure myocardial and fetal perfusion. Additionally, it is important to mitigate the preload effect of autotransfusion following delivery and be prepared to provide inotropic support.

In the operating room an arterial line was placed followed by a combined spinal-epidural with bupivacaine 0.75% 0.8 cc, fentanyl 25 mcg, and morphine 0.1 mg. The patient remained seated for several minutes to minimize sympathetic block and a phenylephrine infusion was started to maintain blood pressure. A right internal jugular introducer was placed in case central inotropes or a PA catheter were needed postpartum. Epidural lidocaine 2%, 2 cc, was given to achieve a T-3 sensory level and the case proceeded smoothly. Following delivery concentrated oxytocin was slowly infused to minimize fluid administration and mitigate the effect of uterine contraction on preload. The patient had an uneventful post-op course and was discharged five days later on her baseline pulmonary HTN medications.

Abstract #: SUN-FCP – Room 1 Cardiac – 09

**Severe Mitral Regurgitation Complicates Risk of Pulmonary Edema in Severe Preeclampsia**

Presenting Author: Simone Sukhdeo, MA, PhD

Presenting Author's Institution: Rutgers Robert Wood Johnson Medical School

**Introduction:** Acute pulmonary edema is a life-threatening complication that occurs in 3% of preeclampsia cases, and represents the leading cause of maternal mortality from preeclampsia.<sup>1</sup> We report the management of a parturient with severe preeclampsia and mitral regurgitation who developed acute pulmonary edema requiring emergent cesarean section.

**Case:** A 31-year-old parturient patient, gravida 2, para 0, with fetal demise associated with severe preeclampsia presented at 24 weeks gestation with severe features of preeclampsia, including an episode of palpitations and dyspnea. Past medical history included hypertension and systemic lupus erythematosus (SLE). Clinical and laboratory findings were remarkable for BP 152/102, HR 131, proteinuria and elevated creatinine. Rapid progression to hypertensive crisis with severe headaches was stabilized on intravenous labetalol and magnesium sulfate infusion. A transthoracic echocardiogram was performed given history of lupus and palpitations, revealing severe mitral valve regurgitation. On hospital day 3, the patient developed acute respiratory distress, hypoxia with noted jugular vein distention and inspiratory crackles bilaterally. Despite interventions with furosemide and prior to non-invasive ventilation support, the patient had respiratory decompensation and fetal distress requiring emergent cesarean section. Rapid sequence induction and intubation was performed with etomidate and succinylcholine. General anesthesia was maintained with sevoflurane, propofol and rocuronium. The infant was delivered and intubated for low Apgar scores. The patient remained intubated postoperatively. She was successfully extubated the next day after extensive diuresis and ventilator weaning, and discharged home on postoperative day 4.

**Discussion:** SLE is an inflammatory autoimmune disorder that can result in valvular heart disease.<sup>2</sup> Preeclampsia is characterized by hemodynamic and fluid balance derangements.<sup>3</sup> Preeclampsia and severe mitral regurgitation of SLE can be a high risk interaction of complex and opposing disease processes that promotes the development of acute pulmonary edema and congestive heart failure. Early intervention by a multidisciplinary team may mitigate the severity of complications by focusing on stabilization of oxygenation, noninvasive ventilation, hemodynamic stabilization via preload and afterload reduction, and fluid restriction.<sup>1,3</sup> In the event of rapid decompensation, urgent delivery is the most effective therapeutic choice.<sup>3</sup>

Abstract #: SUN-FCP – Room 1 – Cardiac - 10

## Use of Transthoracic Echocardiography (TTE) for Intraoperative Monitoring during a Cesarean Section for a Patient with Unicuspid Aortic Valve

**Presenting Author:** Mohamed Eissa, MBBCh, MD

**Presenting Author's Institution:** The University of Ottawa - Ottawa, Ontario

**Co-Authors:** George Dumitrascu, MD FRCPC - University of Ottawa

Wesley Edwards, MBBS MPH FRCA - University of Ottawa

Elizabeth Miller, MD, FRCPC - The University of Ottawa

Leigh Nickerson, MD, FRCPC - The University of Ottawa

Hesham Talab, MD, FRCPC - The University of Ottawa

### Introduction

Cardiovascular diseases (CVD) complicate 1–4% of normal pregnancies and although infrequent, they are nevertheless the leading cause of maternal mortality.<sup>1</sup>

Aortic valve diseases (AVD) are often associated with poor maternal and fetal outcomes during pregnancy. These patients require a multidisciplinary approach for prenatal care and delivery.<sup>2</sup> Unicuspid aortic valve (UAV) is a rare congenital CVD, usually complicated by aortic stenosis (AS) as well as aortic insufficiency (AI). Aortopathies may also be associated.

### Case description

After obtaining consent, we report the case of an 18 year-old female with a UAV and dilated aortic root presenting for delivery. She became pregnant while awaiting surgical correction of her UAV and dilated root. Pre-delivery CT angiogram demonstrated a dilated aortic root and ascending aorta with no evidence of dissection. TTE revealed normal biventricular function, with a mildly dilated left ventricle, as well as a UAV with moderate to severe AS and moderate to severe AI (see images below). She was followed closely by a multidisciplinary team throughout her pregnancy, and finally a plan was made for elective cesarean section (CS) at 37 weeks.

In the operating room (OR) in addition to standard American Society of Anesthesiology monitors, an arterial line was placed. The anesthetic technique was a CSE with intrathecal opioids (Fentanyl 15 mcg, Epimorph 150 mcg) and a slowly titrated 2% lidocaine solution in the epidural catheter. The patient's initial systemic arterial blood pressure (BP) was 134/74 (mean 101) mmHg, heart rate (HR) 95 beats/min. BP and afterload were maintained by a phenylephrine infusion titrated with care to avoid excessive hypertension and minimize shear stress on the patient's dilated ascending aorta. Fetal HR monitoring was also performed from the time of entry into the OR until surgical site preparation. Before and after the neuraxial block, as well as immediately after delivery of the newborn, an Intraoperative TTE was performed to calculate the patient's stroke volume and cardiac output (CO) After delivery, Carbetocin 100 mcg was administered IV over 15 minutes. There were no intraoperative changes on patient's hemodynamics or TTE exam. No surgical complications occurred. Postoperatively, patient was admitted to the ICU for hemodynamic monitoring and was subsequently discharged home 2 days later.

### Discussion

To our knowledge, this is the 1<sup>st</sup> case of UAV presenting for a CS. TTE was successfully used for dynamic CO measurement during the onset of the sympathectomy and throughout the remainder of the procedure demonstrating the usefulness of such a non-invasive, safe technique.

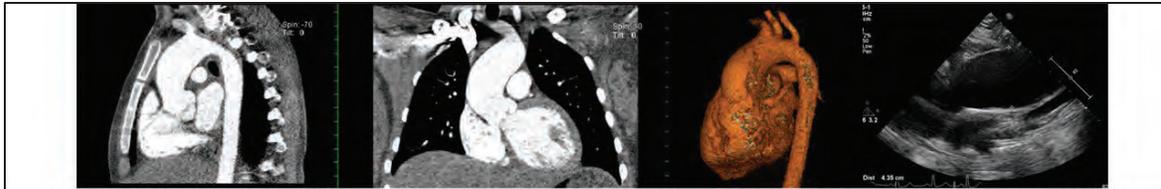


Figure 1: CT Angio showing dilated aortic root and ascending aorta with no evidence of dissection with the following parameters 34 x 39 x 30 mm, and 38 x 42 mm respectively which can be seen also by intraoperative TTE through the parasternal long axis view (4.35 cm)

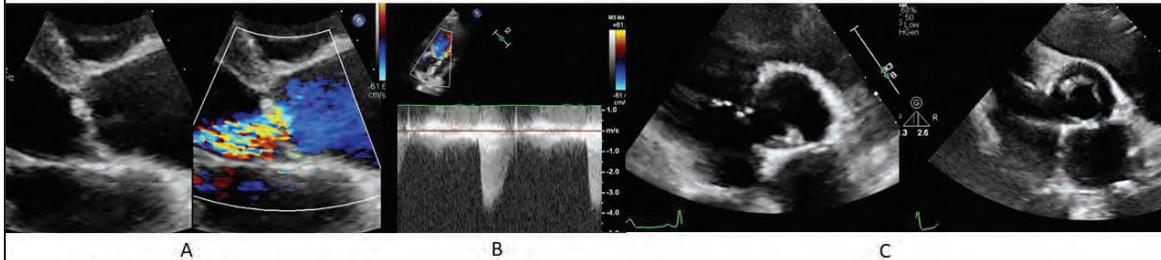


Figure 2: Intraoperative TTE:  
 A) Parasternal long axis view with color flow mapping showing severe AR with AR jet height/LVOT diameter >65%.  
 B) Apical 5 chambers view with CW doppler showing severe AS with peak velocity across the AV almost 4 m/sec (PPG 64 mmHg).  
 C) Parasternal short axis view AV showing UAV with single commissure attached posteriorly and an eccentric elongated opening of the AV during systole

Abstract #: SUN-FCP – Room 2 – Heme Preeclampsia - 01

## The Influence of Private Genetic Testing on the Peripartum Workup of Thrombocytopenia and Selection of Neuraxial Anesthesia for Cesarean Delivery

**Presenting Author:** Angus Royal, MBBS FRCA

**Presenting Author's Institution:** BC Women's Hospital, University of British Columbia

**Co-Authors:** Clare E. Burlinson, BSc MBBS FRCA - BC Women's Hospital, University of British Columbia

Anthony Chau, MD FRCPC MSc - BC Women's Hospital, University of British Columbia

Roanne Preston, MD FRCPC - BC Women's Hospital, University of British Columbia

**Introduction:** Bernard-Soulier syndrome (BSS) is a rare, autosomal recessive platelet function disorder that causes prolonged bleeding time and perioperative hemorrhage (1). Carrier status of BSS is usually undiagnosed when there are no known homozygous family members; however, heterozygous carriers can also have macrothrombocytopenia and bleeding diatheses have been described (2). Here, we report the decision making for the selection of neuraxial anesthesia and outcome in a thrombocytopenic patient diagnosed with heterozygous BSS by private genetic testing.

**Case:** A 32 year-old G1P0 with a twin pregnancy via in vitro fertilization was scheduled for cesarean delivery (CD) for malposition. Prior to conception she was found to be a carrier for BSS through private genetic screening (invitae.com) and was referred to Anesthesiology to assess for suitability for neuraxial anesthesia. She had a history of mild thrombocytopenia that worsened during pregnancy and Hematology posited this was due to the interplay of heterozygous BSS and pregnancy. Reassuringly, there were no bleeding episodes with daily aspirin 81mg for preeclampsia prophylaxis until 30th-week gestation. She also had prior uneventful dental extractions and tonsillectomy. Weekly platelet counts during the third trimester ranged from 66 to 81 x10<sup>9</sup>/L. Platelet aggregation studies were performed at 36 weeks and were normal. A pre-operative course of prednisone was attempted but had no effect. Extensive discussions with the patient and Hematology were conducted prior to CD date, including a risk/benefit analysis as per SOAP guidelines (3).

The platelet count was 68 x10<sup>9</sup>/L on the day of CD. Together with the patient and her partner, It was decided by the team to proceed with spinal anesthesia, performed by a senior obstetric anesthesiologist, with the condition that if the technique was difficult or if any bleeding was noted it would be abandoned. Prophylactic tranexamic acid 1g was given pre-incision. The estimated blood loss was 500mls. Recovery was uneventful and she was discharged home with her healthy babies on day 2.

**Discussion:** Obstetric anesthesiologists may increasingly encounter patients seeking consultation on anesthetic options when diagnosed with a condition by private whole-genome testing. In this patient, the diagnosis triggered additional hematological workup that might otherwise have been missed. In our case, additional platelet aggregation studies and hematology consultation aided in decision making for neuraxial placement. However, others may present the information at delivery without having previously been evaluated. This could generate a clinical dilemma when deciding on neuraxial techniques and thus women who seek private genetic testing should be encouraged to share their results with their obstetric providers as early as possible during prenatal visits.

**Abstract #: SUN-FCP – Room 2 – Heme Preeclampsia - 02**

**Management of Blood Transfusion in Parturients with Sickle Cell Disease**

**Presenting Author:** Mary K. Dierks, M.D.

**Presenting Author's Institution:** University of Chicago

A 34 yo G3P1011 with sickle cell disease (SCD) and baseline hemoglobin (Hb) 7.1mg/dL, >20 blood transfusions complicated by iron overload, pulmonary embolism in 2013 on enoxaparin, and chronic opioid use presented at 35w6d for cesarean delivery (CD) for nonreassuring fetal heart tracing. Obstetric history included a prior CD for fetal intolerance of labor, acute chest syndrome and postpartum exchange transfusion. Current pregnancy was complicated by admission at 25w4d for chest pain due to pneumonia, requiring antibiotics and a unit of packed red blood cells (pRBCs).

At 35w5d, immediate CD was recommended for biophysical profile 6/10. Admission Hb was 6.8mg/dL; 2 units of compatible pRBCs were prepared. The CD was performed under spinal anesthesia with hyperbaric bupivacaine, 150 mcg intrathecal morphine and 25mcg fentanyl. Quantitative blood loss was 455mL and 1 unit of pRBCs was given. SpO2 remained greater than 89% on 4L nasal cannula. Postpartum, home analgesics and Dilaudid PCA were given for uncontrolled lower extremity pain. On postpartum day 1 her reticulocyte count rose to 20% and Hb dropped to 6.5 mg/dL raising concern for vaso-occlusive crisis requiring 2 units of pRBCs. She was discharged on postpartum day 3 with Hb 8.6mg/dL on home pain medications.

SCD is a multi-organ disorder with maternal mortality up to 11.4%. (PMID 26672916). Pregnant women with SCD are at increased risk of venous thromboembolism, preterm labor, acute chest syndrome and pain crises. SCD anemia worsens in pregnancy due to physiologic dilution, therefore blood transfusion is key, but it must be balanced with the risk for iron overload, alloimmunization, and delayed hemolytic transfusion reactions. Currently no high-quality evidence exists to guide transfusion for SCD in pregnancy, with even less addressing the peripartum period.

For SCD in pregnancy, there is no consensus on the value below which transfusion should be considered. Prior to delivery patients should have an extended red cell antigen profile due to RBC alloimmunization rates up to 47% in SCD (PMID 30122266). The American Society of Hematology recommends prophylactic transfusion in pregnancy for history of severe SCD-related complications but prophylactic vs selective transfusion does not reduce mortality. In the case of severe SCD complications, exchange transfusion should be considered to lower Hb S to approximately 40% (to attenuate the risk of vaso-occlusion) and raise Hb A to 10mg/dL.

Management of SCD anemia in pregnancy and peripartum is complex, requiring a multidisciplinary approach and individualized plan to guide transfusion therapy.

**Abstract #: SUN-FCP – Room 2 – Heme Preeclampsia – 03**

**Paroxysmal nocturnal hemoglobinuria and pregnancy- two case reports**

**Presenting Author:** Borislava Pujic, MD, PhD

**Presenting Author's Institution:** Clinical Center Vojvodina, Clinic for Anesthesia, Intensive Care and Pain therapy, Novi Sad, Serbia; - Novi Sad, Vojvodina

**Co-Authors:** Sanja Milosev, MD - Clinical Center Vojvodina, Clinic for anesthesia, intensive care and pain therapy, Novi Sad, Serbia

Craig Palmer, MD - University of Arizona College of Medicine

We present two cases of paroxysmal nocturnal hemoglobinuria (PNH) in parturients delivered during 2021. PNH is acquired disorder, characterized with anemia, intravascular hemolysis, thrombotic events, thrombocytopenia and hemorrhage.

**Case report 1:** A 38y old, primip, 36+5 wks EGA was admitted with severe anemia and thoracic pain. PMH suggested anemia during last 15y and she had received symptomatic therapy. PSH included laparoscopic surgery twice for ovarian cyst and hysteroscopic removal of a uterine polyp. At 31 wks EGA she was diagnosed by hemathologist with PNH. Consultation among the multidisciplinary medical team (obstetrician/hematologist/internal medicine/anesthesiologist/neonatologist) resulted in a planned cesarean delivery near term. The patient received the recommended meningococcal vaccination, and two weeks later eculizumab IV the day before delivery. Because of high level of D-dimer (1.7mg/L, WNL < 0.5), she was started on LMWH twice daily at a therapeutic dosage. Cesarean delivery was performed at in 39 wks EGA under general anesthesia (GA), and a healthy baby girl 3120g and 48cm was born. APGAR scores were 10/10 at 1 and 5 minutes. The surgery and postoperative course were uneventful. The patient received a second dose of eculizumab on post-op day (POD) 6 and was discharged home on POD 7, with continuing LMWH managed by her hematologist.

**Case report 2:** A 35y old, primip at 36+1 wks EGA diagnosed with preeclampsia was admitted for delivery. She had been diagnosed with PNH 11yrs prior, and her PMH was significant for anemia, twice treated with blood transfusion. The patient had pancytopenia throughout pregnancy, and was actively managed by her hematologist. At 32 wks EGA she received meningococcal vaccination and at 34 wks a 1<sup>st</sup> dose of eculizumab, followed by a 2<sup>nd</sup> dose at 35 wks. On admission for delivery she received PRBC transfusion (admission Hgb was 8.7g/dl). Lab tests showed very low platelet level ( $38 \times 10^9/L$ ), d D-dimer level of 1.47 mg/L. She was on prophylactic LMWH dose at admission. Before delivery, she received a platelet concentrate transfusion, and cesarean delivery was performed under GA at 37 weeks EGA. A healthy baby boy, 3240g and 50cm was born with APGAR scores 5/8 at 1 and 5 minutes. The surgery and postop course were uneventful, but she received a 2<sup>nd</sup> PRBC transfusion on POD 1. Patient was discharged home in POD 7 under continuing care of her hematologist, with plans to receive a third eculizumab dose.

**Conclusion:** PNH is a rare medical condition due to a genetic mutation, affecting 1-1.5 individuals per million (1). Eculizamab, a monoclonal antibody, is the only approved treatment, though bone marrow transplant has also been used. Multidisciplinary management between obstetricians, anesthesiologists and hematologists is essential for successful pregnancy outcomes.

**Abstract #: SUN-FCP – Room 2 – Heme Preeclampsia -04**

**Labor Epidural Placement in a COVID-Positive Patient with Profound Thrombocytopenia**

**Presenting Author:** Thomas G. Avritt, MD

**Presenting Author's Institution:** University of Kentucky - Lexington, Kentucky

A 26-year-old G2P1001 woman presented to our hospital at 38w0d with regular contractions and was admitted for labor. Her history was significant for previous opioid use disorder (on suboxone), Hepatitis C, and symptomatic (fever, cough, nausea) COVID-19 infection diagnosed two days prior to presentation. She requested an epidural immediately upon admission. Her prenatal course was unremarkable, and she had no history of pre-eclampsia, HELLP, or other known cause of thrombocytopenia. Of note, she had a platelet count of 241,000 three months prior to presentation. After a discussion of risks and benefits, an epidural was placed (atraumatic on first pass) while awaiting the results of the patient's routine labs. Her initial platelet count later resulted at 27,000, with repeat of 19,000 (the remainder of the CBC was normal with both draws). Additional work-up ordered at this time was significant for aPTT 66, fibrinogen 89, INR 1.2. TEG further demonstrated coagulopathy with K time 9.7, alpha angle 26.4, maximum amplitude 33.1. Labs were checked serially q8h thereafter. Decision was made to continue using her epidural for labor analgesia with hourly neurologic checks performed to ensure that she could move her legs. She was transfused with multiple units of cryoprecipitate, fresh frozen plasma, and platelets throughout her labor course. Due to the unknown cause and course of her coagulopathy and thrombocytopenia, the obstetric team decided to augment her labor to deliver her baby as soon as possible. Delivery occurred roughly 14 hours after admission (evening of DOH1); excellent hemostasis was noted by the obstetric team. The epidural catheter was removed on the morning of DOH3, at which point her platelet count was 73,000. She had an uneventful postpartum course, was discharged on DOH4, and her platelet count and coagulation studies were normal at her two-week postpartum visit.

Given that no other likely etiology for this patient's condition was found, we propose that COVID-19 was the most likely cause of her condition. Hypercoagulability is a well-documented complication of COVID-19 infection, but coagulopathy and thrombocytopenia this profound appear to be rarer and be seen typically in patients more critically ill than ours.

## Using INTEM for Transfusion Guidance in a Parturient with Severe Factor XI Deficiency

**Presenting Author:** Sheeran Jessica, M.D.

**Presenting Author's Institution:** University of Virginia - Charlottesville, Virginia

**Co-Authors:** Louise Man, M.D. - University of Virginia

Emmarie Myers, M.D. - University of Virginia

Factor XI (FXI) deficiency in pregnancy remains a challenge as 20% of patients develop pregnancy related bleeding [1]. Clinical bleeding poorly correlates with baseline FXI activity levels with the most serious hemorrhage risk in the setting of hemostatic challenges like surgeries and trauma. To complicate care, there are no plasma-derived or recombinant FXI replacement products available in the United States so fresh frozen plasma (FFP) transfusions are needed [2]. We present a case of the management of a parturient with severe FXI deficiency using ROTEM guidance.

A 26-year-old G1P0 female at 39w with severe FXI deficiency presented for planned labor induction. Baseline FXI activity levels were < 1%, and INTEM was significant for prolonged clotting time (CT) of 359 seconds (ref range 122-308 sec) but otherwise normal parameters. Her care was discussed at a multidisciplinary conference and plan included FFP transfusions with a goal FXI activity level of 30% before delivery. Given poor correlation between FXI levels and bleeding risk, we also planned to follow serial INTEMs as an adjunctive guide. Epidural anesthesia was not offered due to bleeding risk and she used nitrous oxide for labor analgesia. At the start of her induction, she was transfused 3 units of FFP. Repeat FXI was still low at 14% but her CT on INTEM normalized to 208 sec. Her labor progressed quickly and she delivered a healthy son via uncomplicated vaginal delivery without additional transfusion. She was given 1 gram of IV tranexamic acid. Post-partum day 1, she received 2 additional units of FFP. Her FXI increased to only 17% but her INTEM CT remained normal at 209 sec. Roughly 24 hours after last transfusion, her FXI activity was 9% while INTEM showed still normal CT of 237 sec. She was discharged home less than 48 hours after delivery.

Given the rarity of FXI deficiency and little standardization for management, it was exceedingly important to have detailed multidisciplinary discussions both prior to and during delivery with frequent monitoring of bleeding. It was especially helpful to utilize global hemostasis assays such as ROTEM testing in addition to FXI activity testing, as ROTEM assays can be interpreted in real time while traditional FXI activity assays have longer turn-around times. Additionally, since her clotting times normalized on INTEM after only 3 units of FFP, ROTEM testing reassured us that she needed fewer FFP transfusions than expected with using only FXI activities. This prevented potential complications from additional FFP units and resulted in more judicious utilization of blood products.

[FXISheeran.pdf](#)

**Abstract #:** SUN-FCP – Room 2 – Heme Preeclampsia - 06

### **Subcapsular Hematoma Rupture in Pregnancy**

**Presenting Author:** Jakayla Harrell, MD

**Presenting Author's Institution:** Ochsner Clinic Foundation - Kenner, Louisiana

**Co-Authors:** Allison Clark, MD - Ochsner Clinic Foundation

**Introduction:** Subcapsular hematoma rupture is a rare complication of pre-eclampsia and HELLP syndrome which carries a high risk for maternal and neonatal morbidity and mortality. Herein we present a case of subcapsular hematoma rupture in a parturient with poor obstetric history.

**Case Presentation:** Our patient is a 38 year old G5P2 at 34 weeks EGA with history of chronic hypertension and poor obstetric history. Surgical history was pertinent for 3 prior cesarean deliveries. She presented to the OBED with complaint of acute right upper quadrant pain. On admit her vital signs included HR 73, BP 158/105, and SpO2 100%. Laboratory studies were pertinent for PCR 0.29, AST 37, ALT 31, and PLT 146K. RUQ ultrasound revealed a 2.7cm hypoechoic lesion in the right lobe of the liver consistent with hepatic hemangioma. She was admitted for observation and began contracting in the ED. The fetal heart rate became concerning for recurrent deep late decelerations, and repeat bedside ultrasound revealed free fluid in the abdomen. At that time the patient was emergently taken to the OR for cesarean delivery and a spinal was placed in the lateral position with continuous fetal monitoring. Upon peritoneal incision approximately 1.5L of blood was evacuated from the abdomen. The uterus appeared intact and a neonate with Apgars of 4 & 8 at 1 & 5 minutes was delivered. General surgery was consulted due to continued oozing from the RUQ. At that time the decision was made to convert to general anesthesia. The incision was extended superiorly by general surgery and a large subcapsular hematoma was encountered. The liver was packed and the abdomen was closed. The patient remained hemodynamically stable and repeat labs were pertinent for a drop in PLT to 91K, H/H 9/30, and fibrinogen 347. The patient was transported to the interventional radiology suite for embolization, however further bleeding was not identified. She required transfusion of 3 units pRBC, 2 PLT, and 1 cryoprecipitate over the first 12 hours. The patient had a complicated postoperative course including 2 subsequent exploratory laparotomies. She was discharged to home on POD #9. She required microlaryngeal surgery and resection of tracheal granulomas due to prolonged intubation 5 months after delivery, but otherwise did well.

**Discussion:** Subcapsular hematoma rupture is a rare complication of pre-eclampsia and HELLP syndrome which carries a maternal mortality of up to 20%. Aggressive management of hemorrhage and coagulopathy are pertinent to provide best outcomes. As our patient's presentation supports, pre-eclampsia and its complications can present as a wide spectrum of findings and providers must remain diligent regarding this potentially fatal complication.

**Abstract #: SUN-FCP – Room 2 – Heme Preeclampsia - 07**

**Posterior Reversible Encephalopathy Syndrome (PRES) and Pre-Eclampsia/Eclampsia: Anesthetic Implications and Management**

**Presenting Author:** Jordan Yokley, MD

**Presenting Author's Institution:** SAUSHEC, Texas

**Co-Authors:** Kurt Grathwohl, MD - Brooke Army Medical Center

James Parry, BS - Uniformed Services University of the Health Sciences

Andrea R. Trent, MD - Brooke Army Medical Center

Posterior reversible encephalopathy syndrome (PRES) was only recently described, and the association of PRES in pre-eclampsia/eclampsia is becoming increasingly recognized. While pre-eclampsia/eclampsia alone presents unique perioperative challenges, PRES further complicates anesthetic management. Unfortunately, the anesthetic management for these critically ill and complex patients is not well elucidated, and in some cases has been implicated as the cause of PRES. We describe two presentations of PRES with pre-eclampsia/eclampsia and their anesthetic management. Two patients presented with severe hypertension and neurologic disturbances and were diagnosed with pre-eclampsia/eclampsia and PRES. Both patients required cesarean delivery, one of which was carried out under spinal anesthesia and the other under general anesthesia. Both patients had an uncomplicated perioperative course and rapid resolution of symptoms. More information and an increasing number of reported cases are required to determine the safest anesthetic options in patients with PRES. Clinicians must be aware of PRES as the cause of neurological symptoms in pre-eclampsia and eclampsia. Second, the choice of anesthetic should be guided by careful risk/benefit analysis after consideration of confounding conditions, physical examination, laboratory testing, patient physiology, and expected responses to the anesthetic. These two unique cases add to the body of information and highlight the paucity of experience managing this condition during pregnancy.

Abstract #: SUN-FCP – Room 2 – Heme Preeclampsia - 08

## Post-Delivery Epidural Removal with Platelet Count of Thirty Two Thousand

**Presenting Author:** David A. Gutman, MD, MBA

**Presenting Author's Institution:** Medical university of South Carolina - Charleston, South Carolina

**Co-Authors:** Jafer Ali, MD - Medical University of South Carolina

Katherine Herbert, MD - Medical University of South Carolina

Michael Marotta, MD - Medical University of South Carolina

Joel Sirianni, MD - Medical university of South Carolina

### **Introduction:**

Caution must be applied when proceeding with neuraxial anesthesia in a parturient with thrombocytopenia. Gestational thrombocytopenia is the most common type of thrombocytopenia in parturients, but there exists gradations in this pathology and it may progress. We present a patient with known gestational thrombocytopenia for induction of labor (IOL) who rapidly developed severe thrombocytopenia and postpartum HELLP (hemolysis, elevated liver enzymes, low platelet count) syndrome.

### **Case Report:**

A 22 year old G1P0 female at 37 weeks presented for IOL due to severe fetal growth restriction and elevated uterine artery dopplers. Past medical history includes gestational hypertension and gestational thrombocytopenia with platelets ranging from a high of  $145 \times 10^3$  over the previous 5 months to  $105 \times 10^3$  on admission. Quickly after arrival she requested an epidural and one was placed without issue. As the labor progressed, she developed severe range blood pressures, and was diagnosed with preeclampsia with severe features. This was treated with magnesium and antihypertensives. Three hours after epidural placement she delivered vaginally with vacuum assistance. A second degree laceration was repaired, hemostasis obtained, and uterine tone adequately treated with oxytocin and rectal misoprostol.

The epidural was removed directly following laceration repair and 2 hours later, the repeat labs showed an elevated hemoglobin with a platelet count of  $189 \times 10^3$ . The following morning she coughed up some bloody sputum and labs showed a platelet count of  $32 \times 10^3$ . Additional workup showed elevated liver enzymes, lactate dehydrogenase of 1290 U/L, and leukocytosis with otherwise normal coagulation lab work. The diagnosis of HELLP syndrome was made and she was started on intravenous dexamethasone 10 mg every 12 hours until her platelets began to rise. It took 3 days for her platelet count to go from a nadir of  $32 \times 10^3$  to  $70 \times 10^3$ . The aberrant platelet count of  $189 \times 10^3$  was thus thought to be a lab error and neuro checks were conducted for 3 days straight due to concern for having removed the epidural with a platelet count near  $32 \times 10^3$ . She was discharged in 4 days later in stable condition with an intact neurological exam.

### **Discussion:**

Thrombocytopenia can develop rapidly during labor. Lab work must be done prior to neuraxial anesthesia in a patient with known preeclampsia to avoid potentially causing a devastating epidural hematoma. How frequently to check platelet levels before placement and how often to check after placement is not well defined. "How low is too low?" remain debated topics as discussed recently in Anesthesia & Analgesia.<sup>1,2</sup> For simplicity and standardization, our institution recently agreed upon checking platelet levels every 6 hours in laboring patients with preeclampsia until neuraxial is placed. Checking levels prior to epidural removal is done on a case by case basis, but perhaps should also be standardized.

Abstract #: SUN-FCP – Room 2 – Heme Preeclampsia - 09

## Acute and Profound Immune Thrombocytopenia in Pregnancy– Are we Sure a Routine Platelet Count Isn't Necessary?

**Presenting Author:** David A. Gutman, MD, MBA

**Presenting Author's Institution:** Medical university of South Carolina - Charleston, South Carolina

**Co-Authors:** Katherine Herbert, MD - Medical University of South Carolina

Michael Marotta, MD - Medical University of South Carolina

Joel Sirianni, MD - Medical university of South Carolina

**Introduction:** Thrombocytopenia complicates as many as 10% of all pregnancies. The most common cause is gestational thrombocytopenia (GTP) at 75% and less common is immune thrombocytopenia (ITP) at 5%.<sup>1</sup> ITP is a diagnosis of exclusion, and should give clinicians pause for thought when juxtaposed with the official SOAP practice guideline of “a routine platelet count is not necessary in the healthy parturient.”<sup>2</sup>

**Case Report:** We present the case of a 27-year-old G1P0 at 39 weeks who was transferred from an outside hospital due to a platelet count of  $18 \times 10^3$ . The patient was otherwise completely healthy with no past medical problems not taking any medication and without allergies. She originally had planned a home birth, but upon going into labor she presented to the local hospital due to increasing labor pain and a desire for labor analgesia.

Upon admission to labor and delivery, the platelet count returned at  $18 \times 10^3$ , an unexpected result as her 3 prior platelet counts 12, 10, and 7 months prior were  $380 \times 10^3$ ,  $277 \times 10^3$ ,  $265 \times 10^3$ . She was immediately transferred for a hematology consult. All GTP causes were ruled out. Hematology reviewed the microscopy slides and reported no clumping or schistocytosis. They recommended dexamethasone 10mg x 1 dose and intravenous immunoglobulin (IV IGG) 1g/kg. By this time, she was 6 cm dilated, extremely painful and begging for an epidural.

Initially the patient was placed on PCA Fentanyl. Thrombocytopenia was confirmed with repeat platelet count of  $21 \times 10^3$ . Two units of platelets were transfused in anticipation of delivery with platelet improvement to  $58 \times 10^3$ . She was deemed an unsuitable candidate for an epidural. Instead she was given inhaled nitrous oxide along with aroma therapy and music therapy. She received a subcutaneous sterile saline injection in the L4 lumbar area and delivered a baby 3 hours later.

Post-delivery, the patient received IV IGG and had close hematology follow-up. Her platelets stabilized in the  $80 \times 10^3$  range several days after delivery and 1 month later relapsed into the teens ( $11 \times 10^3$ - $16 \times 10^3$ ). She continues to get close follow-up and is planning on having more children.

**Discussion:** While practice guidelines are set for a reason, unexpected exceptions and potential pitfalls do occur. Had the standards been followed, an epidural would have been inserted into this patient with a platelet count of  $18 \times 10^3$ . The vast majority of OB anesthesiologists would avoid such a situation having knowledge of that platelet count due to the potential harm of an epidural hematoma. Risks and benefits along with contingencies must be discussed and prepared for accordingly to facilitate the safe care of mother and fetus. Maternal ITP is sometimes associated with fetal intracranial hemorrhage. Unexpected maternal ITP is always a possibility. This case highlights that while being knowledgeable of practice guidelines is imperative, we must accept exceptions to the rule are always present.

**Abstract #:** SUN-FCP – Room 3 – Neuraxial Labor Analgesia - 01

**A Case of Total Neuraxial Anesthesia after Epidural Bolus for an Emergency Cesarean Section**

**Presenting Author:** Eve Cremers, D.O.

**Presenting Author's Institution:** San Antonio Uniformed Services Health Education Consortium - San Antonio, Texas

Total neuraxial block is a rare complication of spinal anesthesia and an even rarer complication of epidural anesthesia.<sup>1</sup> We present a case of complete neuraxial block that occurred after a lidocaine bolus delivered via a previously normally functioning epidural catheter for conversion to surgical anesthesia during an emergency cesarean section. Initial attempt at epidural placement five hours prior was complicated by an inadvertent dural puncture, followed by successful epidural placement at an adjacent interspace. Animal studies and select case reports in humans suggest local anesthetic crossover from the epidural to subarachnoid space via the dural tear as a mechanism for the unexpectedly high blockade that occurred after epidural bolus administration.<sup>2,3</sup>

**Abstract #: SUN-FCP – Room 3 – Neuraxial Labor Analgesia - 02**

**A Case of Unexplained Persistent Unilateral Block Following Epidural Anesthesia**

**Presenting Author:** Bhakti Chourasia, MD

**Presenting Author's Institution:** University of Florida College of Medicine Florida - Jacksonville, Florida

**Co-Authors:** Austin Govero, MD - Mayo Clinic Florida

Andrew Hong, MD - Mayo Clinic Florida

Igor Ianov, MD - University of Florida College of Medicine Florida

Panumart Manatpon, MD - University of Florida College of Medicine Florida

Kristen Vanderhoef, M.D. - University of Florida-Jacksonville

A 29-year-old woman G4P2012 at 39w4d presented in early labor. OB team planned for induction of labor for chronic hypertension. History was nonsignificant except for a positive COVID test. Patient requested epidural. All hematological laboratory values were within normal limits. Epidural was placed at L3-L4 without difficulty by loss of resistance with normal saline. Test dose was negative. An infusion of 0.125% bupivacaine with fentanyl 2mcg/ml was started at 10 ml/hr. Epidural level was later checked and found to be working only on the right side. Patient was feeling contractions only at left side, but was comfortable and delivered a healthy baby vaginally. Vital signs were stable and the catheter removed with tip intact. 12 hours later, patient complained of persistent numbness down her right leg. A level check with ice revealed complete loss of sensation in her entire RLE circumferentially from the hip down. LLE sensations were intact. Motor function of RLE showed minimal decrease motor strength (4/5). She reported a "static-like sensation" whenever she touches her right leg. She stated that these symptoms began after the delivery and had been constant in severity. Patient denied headache, fever, chills, saddle anesthesia, as well as urinary and bowel incontinence. Patient endorsed she had never before experienced these symptoms with her two previous epidurals. Neurology consult recommended a stat MRI. Imaging did not reveal any acute abnormality although possible small hemangiomas in the T12 and L1 vertebra were noted.

On post-partum day 1, she continued to report lack of sensation and motor weakness in her RLE. The patient endorsed a new sensation of paresthesia starting at her right foot that gradually increased in level throughout the day. On post-partum day 2, patient reported complete resolution of her symptoms and was discharged home.

In conclusion, this patient's presentation was both challenging and unusual, but it has been reported in previous case reports with a majority of cases having longer periods to sensory loss<sup>1</sup>. The differential includes possible undiagnosed neuropathy exacerbated by the epidural, a metabolism defect resulting in a persistent local anesthetic effect at the epidural space or malingering. The patient's recent diagnosis of COVID raises the possibility of an unknown interaction between COVID and epidural anesthesia resulting in prolonged duration of action.

**Abstract #: SUN-FCP – Room 3 – Neuraxial Labor Analgesia - 03**

**Epidural Abscess after Labor Epidural Analgesia**

**Presenting Author:** Jason J. White, MD

**Presenting Author's Institution:** Weill Cornell Medicine - New York, New York

**Co-Authors:** Grace Fong, MD - Weill Cornell Medicine

**Background:** Neuraxial-related infections were the most common cause of neuraxial injury in the ASA Closed Claims Project. Despite this, there is a very low incidence overall. The source of infection can be contamination or bloodborne. Most abscesses present within five days of placement, with back pain the most common symptom. Neurologic deficits may follow. Early detection is the key to recovery. Broad-spectrum antibiotics and surgical intervention is the gold-standard treatment.

**Case presentation:** A 25 yo G1P0 presented at 38 weeks with severe, painful itching over her body. Her past medical history was significant for obesity and eczema. She was noted to have increased blood pressure with proteinuria and admitted for induction secondary to preeclampsia. On exam, diffusely raised and erythematous papules on bilateral legs, back, and arms with excoriations were observed. She requested labor analgesia. A CSE was placed at L3/L4, using Povidone/Iodine skin prep due to concern over using an alcohol-based prep on broken skin. Placement required two attempts. Her labor progressed, and she delivered a healthy male infant. The epidural was removed one hour after delivery. Six hours later, she reported 10/10 back pain. On postpartum day #1, anesthesiology found tenderness to palpation and a mass at the epidural site. An MRI was obtained on postpartum day #2. The MRI showed a serosanguineous collection in the dorsal epidural space. Edema/enhancement consistent with needle trajectory were detected. Neurosurgery was consulted and diagnosed with an epidural hematoma, recommending conservative management. On postpartum day #3, purulent drainage was evident from the epidural site, and a repeat MRI was obtained. The fluid collection had increased in size extending from L5 to L2 with peripheral enhancement to the cutaneous surface with diffusion. Central canal compression was present. She was started on vancomycin/cefepime. Neurosurgery performed a laminectomy. She recovered quickly and was discharged home on postpartum day #8. A month later, she reported normal function, but some pain had returned. She also reported significant anxiety and was started on sertraline.

**Discussion:** This patient had several risk factors for infection: a long course of steroids, a superimposed skin infection, difficult epidural placement, and a change in the usual skin preparation. The presentation of severe back pain with erythema warranted immediate investigation. Broad-spectrum antibiotics and laminectomy led to a rapid recovery, but persistent pain and long-term psychological trauma elucidate the significance of this severe complication and the importance of prevention.

[Doc3.pdf](#)

**Abstract #: SUN-FCP – Room 3 – Neuraxial Labor Analgesia - 04**

**A Series of Upright MRI Images to Illustrate Optimal Positioning for Labor Epidural Placement**

**Presenting Author:** Julie Seavello, MD MPH

**Presenting Author's Institution:** Island Hospital - Mill Creek, Washington

**Case Report:**

Placement of a labor epidural proceeds most easily when the patient is able to flex her lumbar spine so as to maximally widen the distance between the spinous processes in the lower lumbar region. The patient is challenged in achieving this movement by her full-term gravid uterus which increases the natural lumbar lordosis. She needs move her spine from a concave position to a more convex position in order to present a broader pathway between the spinous processes for advancement of the Tuohy needle.

There are multiple coaching phrases (1) that are used by the labor nurse and the anesthesia provider to try to guide the patient towards optimal positioning. The most commonly used phrases focus on different areas of the spine and may not be helpful in opening up the lower lumbar spaces. For example, the instruction to "Tuck your chin and sag your shoulders" may only affect the upper thoracic region without making a change in the lower lumbar area. Similarly, the instruction to "Arch your back out like a mad cat" may affect only the lower thoracic area without making the needed change in the lower lumbar area. Since improper positioning results in failed attempts at needle advancement, which increases patient pain, frustration, and confusion, it is worthwhile to investigate which position changes result in the greatest increase in space between the lower lumbar spinous processes.

**Hypothesis and Findings:**

Our hypothesis was that the pelvic tilt would have the greatest impact on widening the space between the lower lumbar spinous processes. This pelvic tilt is assisted with placement of a footstool to support the patient.

A series of upright MRI images are presented which illustrate what happens to the lower lumbar spine when a patient responds to several different coaching phrases: 1 -Tuck your chin, 2 - Arch your back out, and 3 - Tilt your pelvis. Another image is presented to examine the change in the lumbar spine when the patient's feet are placed on a footstool.

A weighted pregnancy prosthesis is worn by the model to approximate the exaggerated lumbar lordosis that occurs in term pregnancy.

## Abstract #: SUN-FCP – Room 3 – Neuraxial Labor Analgesia - 05

### When In Doubt, Pull It Out

**Presenting Author:** Danielle White, MD

**Presenting Author's Institution:** McGovern Medical School

**Co-Authors:**

With the increasing size of the average American has come the increasing challenge of managing morbidly obese parturients. Morbidly obese parturients present a specific set of anesthesia related challenges including the placement of neuraxial anesthesia, IV access, and hemodynamic monitoring. This case documents a complication of neuraxial anesthesia and the management of a morbidly obese patient for cesarean section.

38 year old G4P2 with hypertension, diabetes & super morbid obesity(BMI 81) presented to OB triage 3 days prior to delivery to discuss anesthetic management for scheduled C-section. The decision was made to perform a combined spinal epidural for analgesia & place 2 large bore IVs and arterial line for blood pressure control. 2 IVs and an arterial line were place with ultrasound guidance preoperatively. Neuraxial anesthesia was challenging with multiple attempts made by the anesthesia resident, fellow and attending. All obtained convincing loss of resistance but failed to have CSF via the spinal needle. The decision was made to proceed with epidural anesthesia. The patient received 10cc 2%lidocaine with epinephrine via the epidural and achieved an adequate level of anesthesia. The blood pressure decreased significantly in correspondence with local anesthetic administration. A phenylephrine infusion was started for hemodynamic control. Given this response there was concern for an intrathecal catheter. The catheter was aspirated throughout procedure without return of CSF. 0.15mg preservative free Morphine was given through the catheter given the concern for intrathecal placement. The catheter was left in place for further pain management. On post op evaluation the patient reported 10/10 pain. As several hours had passed since initial dose of morphine and patient had not received adequate relief it was determined that the catheter was not intrathecal and 2mg of preservative free morphine was given through the catheter. The patient later became hypotensive with decreased respiratory frequency & increased somnolence. The patient was sent to the ICU for closer monitoring.

This case highlights the challenges of managing morbidly obese parturients. Preoperative assessment is integral for anesthetic planning and managing patients expectations. Hemodynamic monitoring is vital as increased incidence of hypotension and prolonged FHR decelerations following epidural anesthesia during labor at term have been shown in morbidly obese patients(1). This also warrants cautious & meticulous titration of epidural anesthesia. We hypothesize that the dura mater was violated during the neuraxial procedure leading to the accumulation of morphine in the intrathecal space. Ultimately, this case encourages anesthetic provider that in regards to challenging epidural placement "When in doubt, pull it out"

### Noisy Breathing in the Labor Suite

**Presenting Author:** Patricia L. Dalby, MD

**Presenting Author's Institution:** University of Pittsburgh School of Medicine - Pittsburgh, Pennsylvania

**Co-Authors:** Stephen Z. Frabitore, MD - University of Pittsburgh Medical Center

Sarah J. Kroh, MD - Allegheny Health Network

Stridor development in pregnancy is relatively uncommon. It is usually a consequence of associated pregnancy physiological changes which subside in the postpartum period. Pregnancy-induced Stridor may rarely require a tracheostomy or other surgical therapy.

Our patient was a 39 year old obese female with obstructive sleep apnea, and a known large multi-nodular goiter and hyperthyroidism previously treated with Methimazole. She had been hospitalized for several days for parenteral pain control due to a sickle cell vasoocclusive crisis. She was 35 weeks pregnant and had required percutaneous blood sampling and fetal transfusion procedures to maintain this pregnancy. She had a known isoimmunization disorder and had experienced recurrent miscarriages. The fifth hospital night the patient developed bronchospasms that partially resolved with bronchodilator administration. The patient admitted that she had wheezing and cough episodes since she had COVID 6 months earlier. Going forward in the hospital she had intermittent noisy respiration that was evaluated by an ENT who thought that she was having expiratory stridor. The stridor got progressively worse. Review of the patient's only Chest CT Angiogram from 5 years earlier revealed an enlarged thyroid gland with multiple nodules in the large retrosternal extension to the superior mediastinum with mass effect on the adjacent left brachiocephalic vein and aortic arch and great vessels. No further imaging since that time had been done other than a thyroid ultrasound which again confirmed the retrosternal /mediastinal extent of the goiter.

The next afternoon the fetus developed recurrent late heart rate decelerations and an urgent cesarean section called. She agreed to an epidural anesthetic. Thoracic surgery was consulted to be in the OR in case of the need for intubation or maternal airway deterioration. The urgent cesarean section (CS) proceeded uneventfully, with delivery of the preterm but healthy baby. The patient was positioned with her head/chest at 30 degrees upright for comfort but still had intermittent complaints of dyspnea.

This patient recovered well from the CS. A new CT of the head and chest revealed further extension of the goiter into the mediastinum with compression of adjacent vessels and trachea. She had a thyroidectomy performed by thoracic surgery one week postoperatively. Three months later she was readmitted for a sickle cell crisis and intermittent urticarial episodes. Another chest CT showed recurrence of an anterior mediastinal mass/ goiter.

**Abstract #: SUN-FCP – Room 3 – Neuraxial Labor Analgesia - 07**

**Platelet transfusion prior to neuraxial placement for term parturient on dual antiplatelet therapy**

**Presenting Author:** Jessica Merrill, MD

**Presenting Author's Institution:** University of Arkansas for Medical Science - Little Rock, Arkansas

**Co-Authors:** Nadir El Sharawi, M.D. - University of Arkansas for Medical Sciences

**Introduction**

While relatively rare, risk of pregnancy-related myocardial infarction (PAMI) is increasing with advancing maternal age and greater prevalence of traditional cardiovascular risk factors. When treated with PCI most patients will require dual anti-platelet therapy (DAPT) for a duration of time that includes delivery. This poses a unique challenge when planning labor analgesia as per ASRA guidelines most P2Y12 receptor antagonists should be held at least 5 days prior to placement of neuraxial anesthesia. There is some evidence in the surgical literature for use of donor platelets for reversal of antiplatelet effect to prevent bleeding. We present a case of successful epidural placement following pre-procedure platelet transfusion in a parturient on DAPT secondary to STEMI treated with DES.

**Case**

32-year-old woman (G3P2) 30 weeks pregnant with no prenatal care and multiple CAD risk factors (smoking pack/day, hypertension and obesity) suffered anterior MI 2/2 ruptured atherosclerotic plaque of proximal LAD for which she received 3 DES requiring DAPT. TTE showed EF 40%. Discharged on carvedilol, prasugrel, aspirin and furosemide. Subsequently lost to follow up.

Presented at 39 weeks complaining of chest pain, cough and orthopnea. Reported 100% compliance with DAPT regimen. No signs of active labor. Bedside ultrasound showed viable fetus in vertex position. No obstetric indication for operative delivery. Given evidence of acute heart failure exacerbation, morbid obesity (BMI 48) and continued tobacco use planned for repeat vaginal delivery with assisted second stage. Labor analgesia initially managed with IV opioids with moderate success. As labor progressed, pain became unbearable with accompanying hypertension and tachycardia. Given increased myocardial oxygen demand and concern for both fetal compromise and maternal respiratory depression with ongoing opioids, after shared decision-making about risk of epidural hematoma and stent thrombosis, patient elected for epidural following platelet transfusion. Platelet function assay draw pre and post transfusion suggesting adequate reversal of platelet inhibition. Patient underwent successful vaginal delivery. Second platelet transfusion given prior to removal of epidural catheter. Patient monitored closely for signs of epidural hematoma and myocardial ischemia. DAPT restarted 6 hours after catheter removal without any cardiac or neurologic sequela.

**Conclusion**

Patients with PAMI should have a labor plan that minimizes intrapartum hemodynamic fluctuations. This may require avoidance of operative delivery under general anesthesia. As these patients may present for urgent delivery, if risk of general anesthesia and/or operative is deemed too high platelet transfusion prior to neuraxial placement may mitigate risk of epidural hematoma in patients on DAPT.

[Platelet transfusion prior to neuraxial placement for term parturient on dual antiplatelet therapy figure.pdf](#)

**Abstract #: SUN-FCP – Room 3 – Neuraxial Labor Analgesia - 08**

**Facial itching to facial blisters: reactivation of herpes simplex virus after neuraxial opioids**

**Presenting Author:** Katherine Herbert, MD

**Presenting Author's Institution:** Medical University of South Carolina - Charleston, South Carolina

**Introduction:** Intrathecal morphine (ITM) is a widely administered component of neuraxial anesthesia in cesarean deliveries (CD) for postoperative pain control. Although typically well-tolerated, the use of ITM is not without risk. A common complaint is intense pruritis particularly in the trigeminal nerve distribution. We report a patient who presented postpartum with recrudescence of Herpes Simplex Virus -1 (HSV-1) following a CD.

**Case:** A 30-year-old gravida 2 para 0 at 39 weeks' gestation presented for self-requested primary elective CD. Her past medical history includes ulcerative colitis on infliximab and mesalamine, depression, anxiety, chronic pain, and Clostridium difficile status post treatment. Her medication allergies included oxycodone, vancomycin, and morphine. Her pregnancy had been complicated with antepartum admissions due to ulcerative colitis flares. She was in good health without complaint on the day of surgery. Her CD was performed under a single shot spinal anesthetic consisting of hyperbaric bupivacaine 0.75% 12 mg, morphine 100 mcg, and fentanyl 15 mcg. The decision to use morphine was made as the patient's reported drug interaction was drowsiness. The CD proceeded uneventfully except for the patient's complaint of facial itching. Her recovery in the immediate postoperative period was complicated by pain control and facial itching. The facial itching persisted throughout her hospitalization and was treated with diphenhydramine, which provided relief per the patient. She was discharged on postoperative day (POD)#3 and on POD #4 she communicated with her MFM physician that blisters had formed on her chin and upper lip. The MFM physician communicated with the obstetric anesthesiology team, and after reviewing a picture of the lesions, a diagnosis of HSV-1 was made (Fig 1). The patient reported no recollection of past history of HSV-1. The patient was prescribed valacyclovir 1 gram twice daily for 7 days. The patient's lesions considerably improved with 7 days of treatment (Fig 2).

**Discussion:** Postpartum presentation of perioral blisters in the setting of prolonged and persistent facial pruritis brings to attention a rare side-effect of intrathecal narcotics – recrudescence of HSV-1. Although the exact etiology is unknown, proposed mechanisms include trauma from persistent itching, immunosuppression, and stimulation of the trigeminal nerve ganglion caused by intrathecal opioid spread. Our patient on immunosuppression for her ulcerative colitis may have experienced a perfect storm for HSV-1 recrudescence in the setting of intense and prolonged facial pruritis. Providing effective anti-pruritis therapy both improves patient satisfaction and in susceptible patients the reactivation of HSV-1. This case highlights the importance of recognizing and treating this rare side-effect of neuraxial narcotics.

[HSV Figures Submission.pdf](#)

## **Abstract #: SUN-FCP – Room 3 – Neuraxial Labor Analgesia -09**

**Anesthetic management of an incarcerated gravid uterus on a knee chest position; A case report and a narrative review of literature of anesthetic management of incarcerated uterus from 1971 to 2021**

**Presenting Author:** Wesley Rajaleelan, MBBS MD DA

**Presenting Author's Institution:** University of Ottawa, Ontario

**Co-Authors:** George Dumitrascu, MD FRCPC - University of Ottawa

Wesley Edwards, MBBS MPH FRCA - University of Ottawa

Robert Jee, MD FRCPC - University of Ottawa

Jenny H. Nguyen, MD - University of Ottawa

Marc Stalder, MD FRCPC - University of Ottawa

### **Introduction**

Incarceration of the gravid uterus is a rare obstetric disorder that contributes to maternal and fetal morbidity and mortality. Anesthetic options to manually reduce an incarcerated gravid uterus are limited and thus pose a challenge, especially when the obstetricians prefer to position the patient in a knee chest position for the procedure. In this article, we present a case report and a narrative review of literature of anesthetic management of incarcerated uterus from 1971 to 2021 over a period of 50 years.

### **Case report**

A 41-year-old G3P2, otherwise healthy female presented with urinary retention and lower abdominal pain at 22+2 weeks gestational age. On manual examination, the cervix was difficult to assess, and the fetal head was felt low in the rectovaginal pouch. Retroverted incarcerated uterus with a very anterior cervix was diagnosed on an urgent targeted ultrasound scan. In the OR, a lumbar epidural was inserted at L3-4, and the patient was positioned on a knee chest position for manual reduction of the incarcerated uterus. One obstetrician attempted manual replacement of the uterus transabdominally while another simultaneously attempted intravaginally. An initial bolus of 15cc of 0.1% ropivacaine and 3mcg/ml fentanyl and an additional 8cc of 2% lidocaine with epinephrine via epidural were given to ensure patient comfort throughout the procedure. Manual replacement of the uterus was successful after a total of 3 attempts lasting 30 minutes.

### **Literature review**

We performed a thorough literature search of articles from 1971 to 2021 (50 years). We identified 73 articles involving 93 patients. The most common intervention was manual reduction followed by cesarean section at term, and in rare cases, a midline laparotomy was performed. Interestingly, only 10.8% of patients were placed in a knee chest position for manual reduction under an epidural similar to our case report. The majority of patients (83.8%) were placed in a supine lithotomy position for manual reduction. There was no significant correlation between the type of anesthetic used and success at manual reduction of the incarcerated uterus.

### **Conclusion**

There are limited treatment options for uterine incarceration, the most common being manual reduction. A well balanced and titrated epidural is beneficial for manual reduction of an incarcerated gravid uterus, especially when the obstetricians prefer to place the patient in an unorthodox knee chest position, as it ensures patient comfort whilst preserving motor function.

Abstract #: SUN-FCP – Room 4 – Cesarean Delivery - 01

### 3-D printing and holograms to facilitate EXIT airway management planning

**Presenting Author:** Ronald B. George, MD FRCPC

**Presenting Author's Institution:** UCSF - San Francisco, California

**Co-Authors:** Marla B. Ferschl, MD - UCSF

Hanmin Lee, MD - UCSF

**Introduction:** Congenital neck and airway lesions can be visualized on prenatal ultrasound. Severe anomalies may distort the anatomy of the upper airway and result in challenging postnatal airway management. The Ex-utero Intrapartum Therapy (EXIT) procedure allows the airway to be secured in a controlled fashion, while the fetus is maintained on placental circulation (1). Prenatal imaging cannot always precisely define the airway anatomy and possible obstructions to delivery of the fetus, which makes planning for these procedures particularly challenging. A three-dimensional (3-D) model can assist with preoperative preparation.

**Case:** A 33-year-old G3P1 patient presented in the second trimester for investigation of polyhydramnios that revealed a large complex fetal neck mass. Several large volume amnioreductions were required to control maternal symptoms. Radiological investigations highlighted a multiloculated cystic/solid facial and neck teratoma with an estimated volume of 4000 mL. Reaccumulating severe maternal polyhydramnios restricted fetal imaging quality on both ultrasound and MRI. Neither modality demonstrated convincing evidence of a complete trachea or the presence of a naso- or oropharynx. Due to the large size of the teratoma, delivery of the head and neck posed a challenge, and it was unclear if the nares, oropharynx or trachea would even be accessible for intervention. Our institutional biomedical imaging and printing team constructed a 3-D model of the fetus using MRI images to facilitate surgical planning. The 3-D model demonstrated a likely naso- and oropharynx as well as a distorted but intact trachea.(Figure 1) An EXIT procedure was done to secure the fetal airway. General anesthesia with high-MAC desflurane for uterine quiescence and a thoracic epidural for postoperative pain management were critical components of maternal care. The fetal airway was secured by a pediatric otolaryngologist and the fetus was subsequently delivered.

**Conclusion:** Though 2-D imaging may be useful, a 3-D airway model facilitates visualization and airway orientation in complicated cases (2). This technique has been used to determine appropriate airway sizing in pediatric patients (3). Harnessing this technological resource is an important consideration for multidisciplinary teams when confronted with a challenging airway.



**Abstract #: SUN-FCP – Room 4 – Cesarean Delivery – 02**

**Intraoperative Diagnosis and Management of Euglycemic Diabetic Ketoacidosis During Emergent Cesarean Delivery**

**Presenting Author:** Kelechi B. Anyaehie, MD, MPH

**Presenting Author's Institution:** UT Southwestern Medical Center

Euglycemic diabetic ketoacidosis (EDKA) is a form of DKA that is a life-threatening emergency but can be misleading on diagnosis due to normal glucose ranges. Common etiologies are pregnancy, infection and low calorie intake. Metabolic acidosis, ketosis and glucose < 200 mg/dL are typically found on presentation. We present a case of a parturient with type 1 diabetes mellitus (T1DM), found to be in EDKA under general anesthesia and the challenges to her management intraoperatively.

A 17 year old G1P0 with history of T1DM, presented to us as a STAT primary cesarean section for recurrent fetal bradycardia. She initially presented in OB triage with complaints of decreased fetal movement, cough, shortness of breath, nausea, vomiting and inability to tolerate oral intake for three days. On exam, she was tachycardic, hypertensive and breathing 24 times a minute. She reported intermittent compliance with insulin and had a history of multiple admissions for DKA.

Given the emergent nature of her delivery, history and physical, intravenous access, and labs were not obtained prior to the OR. After 5 minutes and multiple attempts, a right antecubital 20 gauge peripheral IV was established. Rapid sequence induction was performed and after connection to the anesthesia machine, end tidal CO<sub>2</sub> measured in the 20s. Hemodynamics, bilateral breath sounds, and tubing connections were assessed and confirmed. Ventilator settings were adjusted, without improvement. Patient's history was discussed with obstetricians and made her abnormalities suspicious for DKA. The infant was delivered with APGARs 1 and 7 at 1 and 5 minutes, with pH cord gas less than 6.79. A radial arterial line was placed and arterial blood gas revealed pH 7.07 pCO<sub>2</sub> 19, HCO<sub>3</sub> 5, base excess -24.9 and glucose 181 with calculated anion gap of 24. Given her significant acidosis, sodium bicarbonate and regular insulin were administered intravenously. MICU was consulted intraoperatively to assist with EDKA management. Recommendations included increasing respiratory rate and initiating dextrose and insulin infusions. Patient was transferred to MICU intubated for further management, and resolution of DKA. She was discharged home on post-operative day 4 with optimized insulin regimen and her infant remained in NICU for prematurity.

Early diagnosis of euglycemic DKA in pregnancy may be more challenging in emergent deliveries under general anesthesia as full history or lab values may not be known. Our patient presented with recurrent late decelerations likely reflecting the severity of acidosis. Pregnancy is a known cause for EDKA, therefore early recognition and aggressive management are important to avoid serious maternal and fetal complications.

**Abstract #: SUN-FCP – Room 4 – Cesarean Delivery - 03**

**Anesthetic Considerations During Prolonged Fetal Extraction; A Case Report**

**Presenting Author:** Michael Richter, MD

**Presenting Author's Institution:** University of Minnesota

**INTRO:** Impacted fetal head during cesarean section is a potentially devastating cause of difficult extraction occurring in 1.5% of all surgical deliveries.<sup>1</sup> Difficult extractions are associated with increased risk of maternal and fetal hemorrhage, traumatic injury, and fetal asphyxia. Risk factors include prolonged labor, malposition, macrosomia, obesity, and failed operative deliveries.<sup>2</sup>

**CASE:** We are reporting a case of a 23 year old female with prolonged fetal extraction secondary to impacted fetal head during cesarean section. The patient presented at 37 weeks gestation for induction of labor secondary to gestational hypertension with a pregnancy notable for suspected fetal macrosomia. A labor epidural was successfully placed after induction began. Urgent cesarean section was called 12 hours later for arrest of descent and category II fetal heart tracing. A fetal pillow was placed in anticipation of difficult extraction and incision was made under epidural anesthesia. Total extraction time of 14 minutes during which hand-push, reverse breech and extension of uterine incision was attempted by obstetricians. Anesthetic interventions included nitroglycerin (3 mins), followed by conversion to general anesthetic with inhalation agents and paralytics (9 mins). Estimated blood loss was 1700 and initial hypotension was managed with albumin and crystalloid infusions. Pain was well controlled with epidural morphine and postoperative transversus abdominis plane block.

**DISCUSSION:** Successful management of a difficult fetal extraction involves both surgical and anesthetic intervention. Tools utilized in difficult extractions such as the fetal pillow/head elevators as well as surgical approaches such as hand-push technique, and reverse-breech method are well described in obstetric literature.<sup>3,4</sup> Medication and anesthetic adjuncts aimed at uterine relaxation such as nitroglycerin, volatile anesthetics, and paralytics may provide more optimal conditions for extraction. Complications such as maternal hemorrhage and increased pain should be considered by any obstetric anesthetic provider.

Abstract #: SUN-FCP – Room 4 – Cesarean Delivery – 04

### Hypertriglyceridemia-Induced Acute Pancreatitis in Pregnancy

Presenting Author: Erik B. Romanelli, MD, MPH

Presenting Author's Institution: Montefiore Medical Center - New York, New York

**Case-** 35yo G6P5, no reported PMHx, prior CDx3, presented at 26-weeks GA for PPRM and found to have chronic abruption. Admitted to antepartum for expectant management, intermittently endorsing generalized abdominal pain and cramping. After a meal on HD#5, had intractable vomiting episodes and reported "burning" epigastric pain with radiation to back. Initial lab workup had to be resent because specimens noted to be lipemic. Subsequently ruled in for acute pancreatitis (AP) with elevated amylase (201) and lipase (277). LFTs normal, abdominal U/S only showed fatty liver, small gallbladder polyp, and normal appearing pancreas. Triglyceride(TG) and LDL-cholesterol levels were >5680mg/dl and >600, respectively, both outside reportable range. Though patient was euglycemic, an insulin drip (with concurrent D10) was initiated. Patient admitted to ICU on HD#8 as became toxic-appearing, noted increased maternal and fetal tachycardia, and lack of response to escalating doses of IV morphine PCA. Continuous EFM and a C-section tray were at ICU bedside. A RIJ trialysis catheter was placed, and a single round of plasmapheresis was performed. There was subsequently a rapid decrease in TG level and improved pain scores. She was initiated on fenofibrate, omega-3 fatty acids, and a strict low-fat diet once TG levels were < 1000. As clinical symptoms improved, she was transferred back to antepartum service for continued PPRM surveillance. Ultimately, delivery was expedited as MCA dopplers worsened shortly thereafter (PUBS not indicated in setting of chronic abruption) and she had quaternary CD at 29-weeks GA performed under combined spinal-epidural anesthesia (procedure uncomplicated). Postpartum course was significant for development of a LUE DVT provoked by a midline catheter, and she was started on therapeutic enoxaparin. Chest CT was negative for PE, however a pancreatic pseudocyst was incidentally found (GI did not recommend drainage while inpatient). The patient was discharged in stable condition.

**Discussion –** Hypertriglyceridemia-induced acute pancreatitis (HTGAP) is a rare complication in pregnancy (and in general population) that can portend maternal and/or fetal mortality in severe cases. Diagnosis can be difficult in pregnancy because of confounding obstetric etiologies (i.e. labor, uterine rupture, placental abruption, acute fatty liver of pregnancy) and other acute abdomen presentations. There are no strict guidelines for managing this condition in pregnancy, and most sources emphasize NPO, fluid resuscitation, pain control, and reduction of triglyceride levels (numerous case reports point to conflicting risks/benefits in utilizing insulin drip versus plasmapheresis). Clinicians must use best judgment in more severe presentations, ideally delaying delivery until triglyceride levels have returned to normal range and maternal condition has stabilized.

Abstract #: SUN-FCP – Room 4 – Cesarean Delivery – 05

## Acute Pancreatitis in Second Trimester Leading to IUFD and Multi-Organ Dysfunction

**Presenting Author:** Erik Romanelli, MD, MPH

**Presenting Author's Institution:** Montefiore Medical Center

**Co-Authors:** Shamantha Reddy, MD, FASA, MD, FASA - Montefiore Medical Center

Shibinath Velutha, MD - Montefiore Medical Center

### BACKGROUND

The incidence of acute pancreatitis in pregnancy (APIP) is estimated as high as 1 in 1000 pregnancies [1]. The disease process is commonly caused by gallstones, alcohol usage, infections, idiopathic causes, and hyperlipidemia. We report a case of triglyceride-induced pancreatitis in the setting of Apolipoprotein C2 (APOC2) deficiency and concurrent COVID-19 infection.

### CASE REPORT

38-year-old G13P1 admitted with complaints of acute abdominal pain, nausea, and multiple episodes of hematochezia. She was newly noted to be both 20-weeks pregnant and positive for COVID-19 infection. History was significant for severe persistent asthma, prior gastric bypass, cholecystectomy, D&C for ectopic pregnancy, recurrent miscarriages, and one prior cesarean delivery. Initial labs reported elevated lipase (289U/L). Initially, the patient was stabilized with intravenous fluids, potassium supplementation, proton-pump inhibitors, and patient-controlled analgesia with IV hydromorphone. A central line was placed in the right IJV due to difficult vascular access. On further investigation, TG, ALT, and AST were 1843mg/dl, 2622, 5284, respectively. Urgent MRI revealed edema of the pancreas with peripancreatic stranding and fluid compatible with pancreatitis. Chest X-Ray reported left lung atelectasis and infiltrates consistent with early ARDS. Despite initial interventions, her condition further deteriorated with the development of SIRS and a new-onset coagulopathy (INR rose to 4.4) and acute renal failure, requiring significant transfusion of blood products. Fetal demise was recognized on hospital day 13. She underwent D&E under general anesthesia (neuraxial contraindicated with persistent coagulopathy) and clinically improved shortly thereafter. She was discharged from the hospital in stable condition.

### DISCUSSION

There are a handful of case reports which attribute COVID-19 infection as the inciting etiology of acute pancreatitis in the non-pregnant population, suggesting that injury to the pancreas occurs in up to 17% of affected patients [2]. Two case reports attribute COVID-19 to development of APIP [3,4]. Our case is unique in being a case of triglyceride-induced APIP, which has not been reported in the setting of a concurrent COVID-19 infection. Hormonal changes associated with pregnancy alone can cause dyslipidemia from impaired activation of lipoprotein lipase, and in this case with co-existing APOC2 deficiency (and questionable impact of COVID-19 infection), triglycerides rose to a severely-elevated level. Treatment options for APOC2 deficiency include fresh frozen plasma (which contains APO-C2, plasmapheresis, lipid-lowering agents, and fat-free foods. An obstetric anesthesiologist's knowledge and skill in managing medically complex peripartum cases as a member of a multidisciplinary team are displayed in this case.

## Volume Management of a Critically Ill Pregnancy Patient with Chronic Renal Disease

**Presenting Author:** David Newhouse

**Presenting Author's Institution:** University of Pittsburgh School of Medicine - Pittsburgh, Pennsylvania

**Co-Authors:** Stacy Beck, MD - University of Pittsburgh Medical Center, Magee Women's Hospital

Grace Lim, MD MSc - Department of Anesthesiology & Perioperative Medicine, University of Pittsburgh School of Medicine

Kate Petty, MD - Department of Anesthesiology & Perioperative Medicine, University of Pittsburgh School of Medicine

**Introduction:** As the pregnant population continues to age, providers are challenged by increased co-morbidities associated with pregnancy including chronic kidney disease (CKD) and end-stage renal disease (ESRD). Women with renal disease who conceive, have an elevated risk of pre-eclampsia, fetal growth restriction and pre-term delivery<sup>1</sup> for which management requires a multi-disciplinary approach.

In ESRD, pregnant women are started on intensified intermittent hemodialysis dialysis (iHD) for volume and uremia management.<sup>1</sup> In this case report, we illustrate a critically ill pregnant woman started on continuous renal replacement therapy (CRRT) to manage volume status.

**Case Description:** SB, a 43-year-old G4P2 with a past medical history significant for morbid obesity, obstructive sleep apnea requiring nocturnal continuous positive pressure (CPAP), severe asthma requiring daily rescue inhaler, hypertension, diastolic heart failure, stage IV CKD and insulin-controlled diabetes mellitus initially was diagnosed in the emergency department with an intrauterine pregnancy estimated at 7 weeks gestation.

At 18 weeks and 5 days, SB required admission for decompensated heart failure and nephrotic range proteinuria. SB required aggressive volume management due to pulmonary edema requiring constant CPAP. In the setting of stage IV CKD, minimal clearance of urea, and significant volume overload she was started on iHD.

SB remained hospitalized for the remainder of her pregnancy due to volume overload. SB was managed with a strict fluid restriction, loop diuretic therapy and iHD with a 2L volume removal, six days a week. At 24 weeks despite an aggressive diuresis, SB remained significantly volume overloaded in respiratory distress and during iHD experienced an episode of significant hypotension. SB's oral anti-hypertensives were titrated, resulting in malignant hypertension the next day. This was determined to be severe pre-eclampsia for which MFM wished to deliver SB. Prior to an operative delivery, a multi-disciplinary collaboration with nephrology, MFM and anesthesia occurred. The night before her planned delivery, an arterial line was placed for blood pressure monitoring with initiation of rapidly titratable anti-hypertensive agents while removing ultrafiltrate with CRRT.

On the day of the caesarean, SB was able to lie flat without CPAP and was taken to the operating room. An epidural was placed and a T4 anesthetic level was achieved. The MFM team performed a classical incision to deliver the fetus. The procedure went without complication. On completion of the procedure, she was transferred to the ICU for postpartum management.

**Discussion:** As our pregnant population continues to age, we highlight the ever-growing need for critical care and anesthesia consultation for the critically ill pregnant patient.

## Abstract #: SUN-FCP – Room 4 – Cesarean Delivery – 07

### Intraoperative Cesarean Section During Robotic Inguinal Hernia Repair

**Presenting Author:** Migdalia H. Saloum, MD

**Presenting Author's Institution:** US Anesthesia Partners North Texas - Arlington Division - Southlake, Texas

**Co-Authors:** Babak Tavakoli, MD - US Anesthesia Partners North Texas - Arlington Division

This is a case of a 40 year old patient at 35 weeks of pregnancy that underwent a laparoscopic/robotic assisted inguinal hernia repair during which she had an intraoperative cesarean delivery.

- 40 yo G10P7 @ 35.4 weeks of pregnancy
- presented with fever/nausea and a mass in the left groin causing severe pain - CT scan showed incarcerated inguinal hernia
- patient has history of DVT on Enoxaparin therapy, MI with stent placement 8 years ago, asthma, smoker, and anxiety
- General surgeon determines patient needs emergent surgery - plans laparoscopic/robotic approach
- consultation with Obstetrician and MFM - plan to avoid immediate delivery of fetus and proceed with surgery with pre and post procedure fetal monitoring. patient is consented for possible emergency C section and bilateral tubal ligation. (pt desired sterilization)
- patient undergoes robotic assisted laparoscopic procedure under General anesthesia
- surgery is technically challenging with the gravid uterus. veress needle is inserted at costal margin above uterus. pressure is kept at 12mmHG throughout. 4 8mm trocars inserted across upper abdomen and one 5mm trocar in LUQ.
- surgeon finds incarcerated sigmoid colon with adherent small bowel with a fistula - cannot reduce or repair hernia
- 2 hours into surgery decision is made to convert to open and deliver fetus via cesarean to facilitate procedure
- Obstetrician performs cesarean delivery with low transverse incision and BTL. Baby is delivered depressed and is taken to NICU
- 1000ml EBL with cesarean delivery. 500ml EBL with general surgery. After delivery, uterus has adequate tone, but blood pressure is difficult to maintain and falls to 70/40 levels and blood transfusion is given intraop.
- surgery proceeds as open - sigmoid colectomy with end colostomy and resection of terminal ileum with anastomosis.
- POD #1 patient is in severe pain at pfannensteil incision site and receives TAP block. patient continues to complain of pain
- POD #3 diagnostic laparoscopy for repair of perforation at anastomosis site and incision and drainage of abscess
- Postoperatively patient to ICU - intubated, sepsis/acidemia, requiring pressor support
- POD #4 repeat diagnostic laparoscopy for leak at anastomosis site

This patient spent 13 days in the hospital with significant morbidity. several questions arise

- what are the considerations when deciding to proceed with surgery in the third trimester?
- should a 35 week preterm fetus be delivered prior to surgery? what are the risks to consider?
- laparoscopic vs. open?
- what are considerations for fetal well being when we don't have intraoperative fetal monitoring?
- what kind of complications can be anticipated?

**Abstract #: SUN-FCP – Room 4 – Cesarean Delivery – 08**

## **Anesthesia and the Decompensated Obstetric Patient**

**Presenting Author:** Brandon Leighton, MD

**Presenting Author's Institution:** Brooke Army Medical Center - San Antonio, Texas

**Co-Authors:** Elizabeth Guarisco, MD - University of Texas Health San Antonio- University Hospital

Alixandria Pfeiffer, DO - University of Texas Health San Antonio- University Hospital

Matthew Read, MD - Brooke Army Medical Center

A 30 yr old G2P1 patient at 31w0d with a history of HFrEF (EF 35%, NYHA III), presented to the ED with NYHA IV symptoms. Her history was significant for six previous MIs and a chronically occluded LAD. Physical exam was notable for volume overload with labs demonstrating significantly elevated troponin and BNP. She was subsequently admitted to the antepartum ward for management of acute decompensated heart failure.

On hospital day one it was noted that in addition to an acute worsening of her LVEF (now 20%), she had developed superimposed pre-eclampsia with severe features. A multidisciplinary team (obstetrics, anesthesia, neonatology, and cardiology) met for care planning. Given her clinical status, the team recommended proceeding with an urgent, repeat C-section. With heightened concern for an intrapartum/immediate postpartum cardiac event, the support of cardiothoracic anesthesia and the ECMO team were requested.

Though a slowly dosed epidural would have been ideal, her recent Clopidigrel use was an absolute contraindication for neuraxial anesthesia and necessitated a general anesthetic. To facilitate patient comfort during line placement and to minimize fetal harm, Remifentanyl was used for anxiolysis. Pre-induction lines included both an arterial line as well as venous and arterial femoral access to allow for the emergent transition to VA ECMO. A hemodynamically stable induction was obtained using an Epinephrine infusion and carefully titrated Propofol. As soon as her eyelid reflex was absent, Succinylcholine was administered to facilitate immediate RSI conditions. Following intubation, a MAC catheter was placed to allow for emergency resuscitation. Intraoperative TEE was notable for an LVEF of 15-20% and global hypokinesis to the LAD and LCx territory. Anesthesia was maintained using volatile anesthetic, with Rocuronium for paralysis, and the Epinephrine infusion was continued for inotropic support. The obstetricians were careful to avoid large blood loss and both Carboprost and Tranexamic Acid were administered during the case. The patient tolerated the case well, with her overall baseline cardiovascular status maintained throughout. She was extubated in the OR and brought to the ICU for close hemodynamic monitoring and recovery. She had an uncomplicated postop course and was transferred to cardiology for further optimization (discharged on POD5). Her infant had an uneventful NICU course.

This case highlights the significance of a 'Pregnancy Heart Team' as advocated by ACOG for a patient with a mWHO risk class of 4. Pregnancy is an absolute contraindication in patients like this due to the extremely high risk of Severe Maternal Morbidity and Mortality (SMM). Extensive preparation at an appropriate level hospital is needed to lower the risk of a catastrophic outcome for both the mother and the fetus. As the incidence of SMM cases increase, we hope that this case can be used as a template for both future education and collaboration.

Abstract #: SUN-FCP – Room 4 - 09

## Anesthetic management of pregnancy termination in a high-risk patient with genetic peripartum cardiomyopathy

**Presenting Author:** Alla Yarmosh, MD, MCR

**Presenting Author's Institution:** Stanford University, California

**Co-Authors:** Jessica R. Ansari, MD - Stanford University

Andrea J. Traynor, MD - Stanford University

### Introduction:

Peripartum cardiomyopathy (PPCM) is defined as new onset heart failure secondary to systolic dysfunction occurring in the peripartum or postpartum period.<sup>1</sup> The left ventricular ejection fraction (LVEF) at diagnosis is the most reliable predictor of adverse outcomes and long-term recovery.<sup>2</sup> Patients with a LVEF < 50% are at higher risk of relapse and approximately half show deterioration in subsequent pregnancy. As such, the European Society of Cardiology guidelines discourage subsequent pregnancies in patients with a LVEF < 50%.<sup>2</sup> We describe the anesthetic management of a parturient with genetic PPCM who underwent second trimester termination of her second pregnancy.

### Case:

In 2020, the patient experienced an uncomplicated first pregnancy and normal spontaneous vaginal delivery. Nine days postpartum, she was diagnosed with PPCM after presenting with chest pain and shortness of breath, troponin > 40, and LVEF 35%. Genetic testing revealed two mutations: a pathogenic variant in a desmoplakin (DSP) gene and a variant in Titin (TTN). Both DSP and TTN mutations are linked to sudden cardiac death, arrhythmia, and familial cardiomyopathy. Her serial echocardiograms showed persistently low EF, most recently an LVEF of 38%. Given this and her genetic predisposition to arrhythmia, cardiology recommended intracardiac defibrillator (ICD) placement, but she became pregnant prior to the procedure. After extensive counseling from a multidisciplinary team including maternal fetal medicine, genetics, and cardiology, she made the difficult decision to terminate the pregnancy.

At 14 weeks gestation, she underwent dilation and evacuation at the main hospital of our tertiary care center rather than an outpatient facility. The anesthetic plan included general anesthesia with a native airway using midazolam, fentanyl, and propofol infusion with phenylephrine as needed. A native airway was maintained to avoid potential sympathetic surges from airway instrumentation. In preparation for possible arrhythmias, esmolol and amiodarone boluses were prepared, defibrillator pads were in the room, and a cardiac anesthesiologist was also present. Intravenous fluids were restricted to 500 milliliters of crystalloid. Post operatively she was monitored on telemetry. There were no complications, and the patient expressed deep gratitude for her care.

### Discussion:

Recent literature supports the safety of intravenous anesthesia with a native airway for dilation and evacuation procedures up to 24 weeks gestation.<sup>3</sup> A native airway technique was selected to avoid sympathetic surges in a PPCM patient with reduced ejection fraction and risk for arrhythmia due to genetic cardiomyopathy. We combined knowledge of the latest literature on anesthesia for pregnancy termination with principles for high-risk cardio-obstetric patients to safely care for this patient.

Abstract #: SUN-FCP – Room 4 – Cesarean Delivery – 10

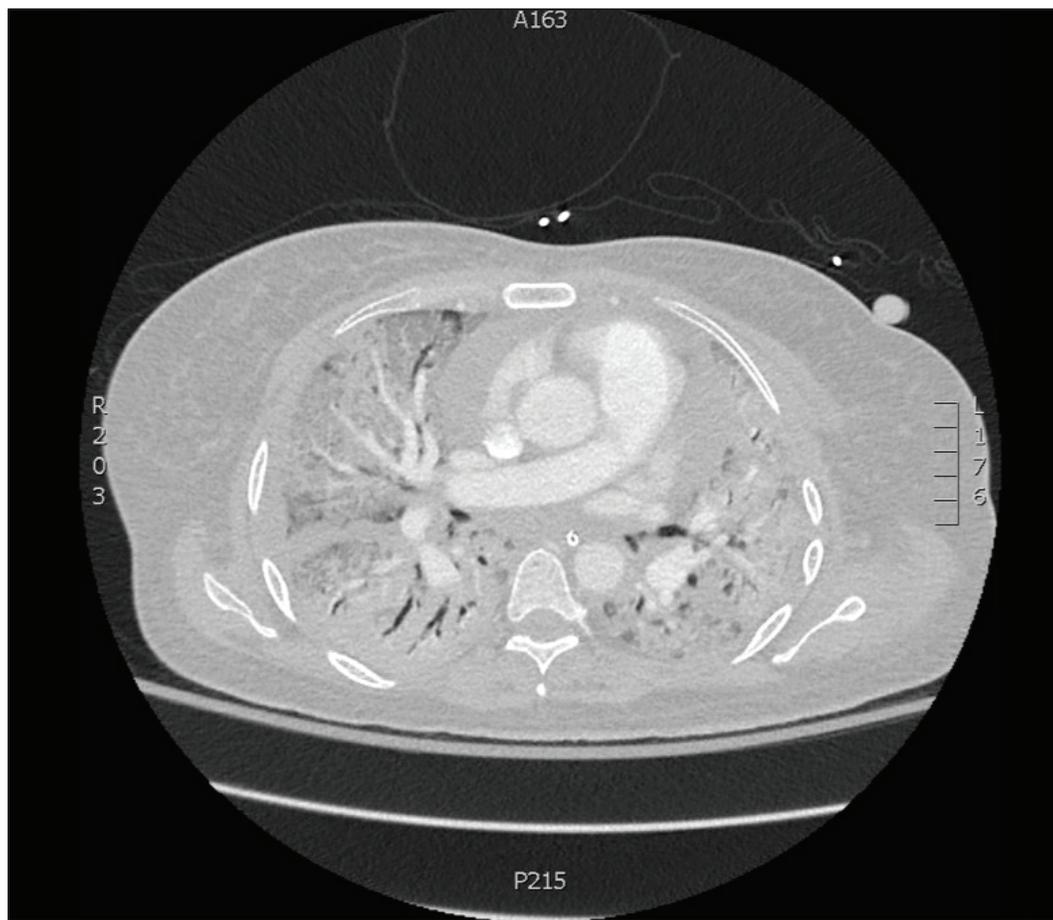
### ECMO Cannulation and Emergent Cesarean for a COVID Positive Mother

Presenting Author: Shyam Patel, DO

Presenting Author's Institution: Brooke Army Medical Center, Texas

Co-Authors: Christan Vernau, MD - Brooke Army Medical Center

Extracorporeal Life Support (ECLS) has become increasingly utilized to save patients. However, when the patient is pregnant and covid-positive, there is limited data and no proven protocols for care. A 36-year-old multi-gravid patient, pregnant at 29 weeks, presented with dyspnea and subsequently tested positive with covid. Within her hospital course she endured a rapid decline and progression to acute hypoxic respiratory failure secondary to her COVID pneumonia. A multidisciplinary approach between obstetrics, medical intensivists and anesthesiologists successfully executed extracorporeal membrane oxygenation (ECMO) cannulation and emergent cesarean section in the medical intensive care unit. This case report reviews the multidisciplinary approach used between obstetrics, medical intensivists, and anesthesiologists for the successful cannulation of the covid-positive patient and delivery of her 29-week-old child during the pandemic.



**Tailored Gentle Section For Best Maternal Bonding and Surgical Experience using a Multitude of Accommodations**

**Presenting Author:** Nour EL HAGE CHEHADE, MD

**Presenting Author's Institution:** Cleveland Clinic, Ohio

**Co-Authors:**

**Introduction**

The celebration of a new baby's birth can be distracted by the stressful process of undergoing Cesarean section. A wider selection of parturients requesting gentle c-section is seen and was associated with decreased anxiety, maternal satisfaction, and better bonding with the baby at the moment of delivery. Here we describe the special accommodations requested from a fellow OB physician colleague requesting an optimal delivery.

**Case**

A healthy 32-year-old parturient G2P1 at 39 of gestation presented for repeat c-section requesting a gentle or family-centered delivery. The care team's goal was to make the delivery as natural as possible, accommodate in a way to relieve patient anxiety, as well as improve maternal and baby outcomes. The patient had clear liquids up to 2 hours prior to surgery. An 18 g IV was placed in the nondominant forearm. EKG pads were placed on her back. We performed the neuraxial procedure in the lateral position to increase comfort. We used a 27G pencil tip spinal needle to reduce the risk of post-dural puncture headache at the level of L2-L3 and injected 12.5 mg of hyperbaric bupivacaine, 50 mcg of clonidine, 100 mcg of morphine intrathecally. The choice of clonidine was to reduce the occurrence of adverse events post-spinal anesthesia in cesarean section such as shivering, nausea, vomiting, and itching. Noninvasive blood pressure cuff and pulse oximeter were repositioned to lower extremities and set to every minute and SCDs placed. A new intravenous line (18G) was inserted in her lower extremities with microtubing attached to reduce dead space and upper IV capped. The patient was positioned on-ramp pillow to reduce dyspnea feeling, better birth viewing via clear drape, and to better hold her baby after delivery. Her husband and mother were also able to attend the surgery and after delivery, she was able to have her baby on her chest skin to skin with minimal distraction from anesthesia monitoring or surgical manipulation. Low dose propofol infusion (10 mcg/kg/min) and 10 mg of dexamethasone were also used intraoperatively to reduce the risk of intraoperative nausea and vomiting. Bilateral ultrasound-guided quadratus lumborum and transversalis fascia blocks using liposomal bupivacaine were performed at the end of the case. The patient had ketorolac and ibuprofen for postoperative pain control with minimal pain. The same day of the delivery, the patient was ambulating and eating which she said was unable to do after her first cesarean.

**Conclusion**

The tailored baby-friendly technique is a way to improve the surgical experience and make it the closest to the natural birth for early bonding with the baby at his "golden hour" by decreasing the risk of itch, nausea, shivering, PPDH, and improved control of post-operative pain. For the family, this is a once in the lifetime experience, and making all these small accommodations leads to the overall best experience.

Abstract #: SUN-FCP – Room 5 – PAS Postpartum Hemorrhage - 01

## Cesarean Section in a Parturient with Placenta Accreta Complicated by Uterine Torsion and Incarceration

**Presenting Author:** David A. Gutman, MD, MBA

**Presenting Author's Institution:** Medical university of South Carolina - Charleston, South Carolina

**Co-Authors:** Katherine Herbert, MD - Medical University of South Carolina

Alexandra Latham, MD - Medical University of South Carolina

Michael Marotta, MD - Medical University of South Carolina

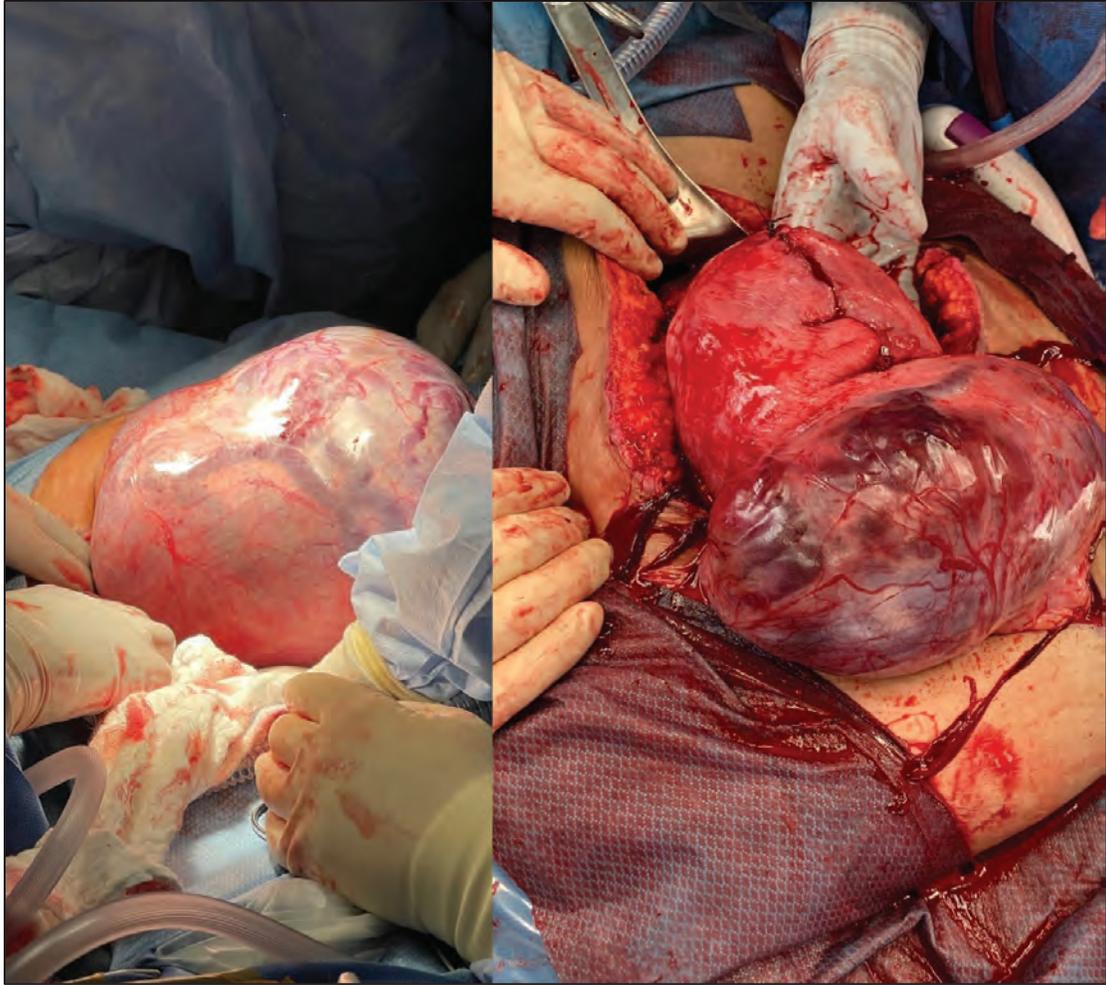
Joel Sirianni, MD - Medical university of South Carolina

**Introduction:** Morbidly adherent placentation is associated with increased maternal morbidity including increased risk of general anesthesia for cesarean delivery, massive blood loss, blood product transfusion, intraoperative hysterectomy, and prolonged hospitalizations. Risk factors include placenta previa, prior cesarean deliveries, advanced maternal age, in vitro fertilization, and previous uterine surgeries. Cesarean delivery is made even more technically challenging when there is uterine torsion and uterine incarceration in the pelvis, as mobilization of the uterus can be difficult and prolonged.

**Case Report:** We present the case of a 34-year-old G4P2 at 34 weeks who was scheduled for cesarean delivery and multiple advanced surgical contingencies due to the presence of placenta accreta complicated by uterine torsion and incarceration. The patient's past medical and surgical history were significant for morbid obesity (BMI 46), two prior cesarean sections, and placenta previa during the existing pregnancy. Routine ultrasound scans indicated anatomical irregularities which prompted a MRI of the pelvis. The official radiologic reading described the uterus as "[having] several findings concerning for abnormal placentation, uterine torsion, and incarceration" with "abnormal positioning of the fetal head between pubic symphysis and sacrum."

General anesthesia was induced followed by placement of a right internal jugular rapid infuser line and radial arterial line. Preoperative ureteral stents were placed, and the right femoral artery was accessed in anticipation of rapid endovascular balloon occlusion deployment. After extensive mobilization of the uterus, the baby was delivered, and the hysterotomy was closed. The plan was to observe and exit the abdomen with the intention of doing an interval hysterectomy after placenta involution. Unfortunately, the uterine torsion had rendered the dilated vessels friable leading to ongoing hemorrhage. The plan switched to performing an acute hysterectomy during which the patient experienced 3L EBL requiring activating the massive transfusion protocol with multiple blood products being given. At the end of the procedure, the patient was extubated, and both mother and baby had an uneventful postoperative course.

**Discussion:** With the rate of cesareans and maternal age increasing, we are seeing the rise in rates of morbidly adherent placentation. The cases are technically challenging enough without the added burden of uterine torsion and incarceration, which could lead to massive hemorrhage and worse maternal outcomes. This patient may not have required blood product transfusion if she were able to have an interval hysterectomy instead of an immediate one, decreasing her maternal morbidity. Initial preoperative planning may require rapid adjustments intraoperatively. The anesthesiologist must be vigilant, responsive, and a good communicator with surgical colleagues to ensure optimal outcomes for patients.



## Bronchoscopy and Laser Resection at 8 Months of Pregnancy for Proximal Subglottic Tracheal Stenosis

**Presenting Author:** David A. Gutman, MD, MBA

**Presenting Author's Institution:** Medical university of South Carolina - Charleston, South Carolina

**Co-Authors:** Katherine Herbert, MD - Medical University of South Carolina

Michael Marotta, MD - Medical University of South Carolina

Joel Sirianni, MD - Medical university of South Carolina

**Introduction:** Tracheal stenosis within the obstetrical population is fairly rare. Tracheal stenosis and associated stridor necessitating pulmonologist intervention in the 3<sup>rd</sup> trimester is even rarer. Facilitating this non-obstetrical intervention on a pregnant woman requires extensive planning to allow for the safe care of both mother and baby.

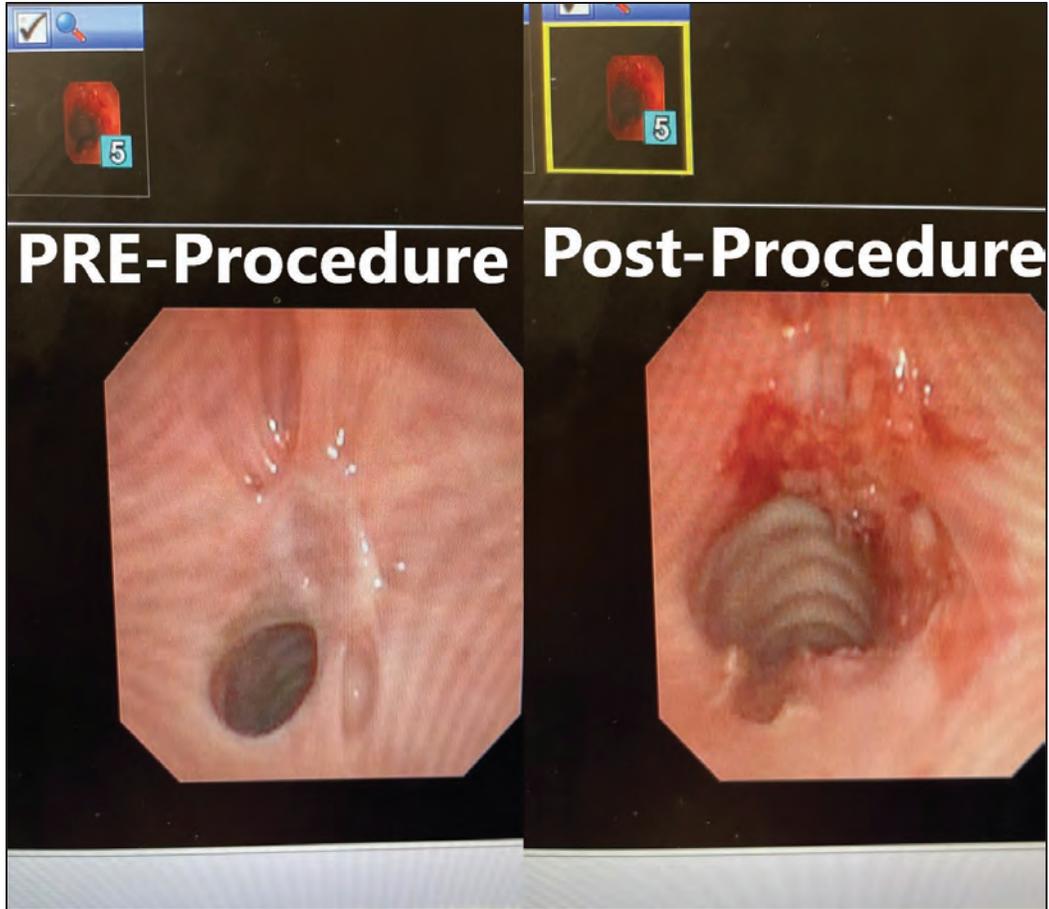
**Case Report:** We present the case of a 36-year-old G1P0 at 33 weeks who presented for bronchoscopy, balloon dilation, and laser resection of proximal subglottic tracheal stenosis. The patient's medical and surgical history was unremarkable other than report of a "nervous cough" while growing up. She required multiple cycles of IVF to achieve this pregnancy. She had a very strong desire to delivery vaginally and thus when she began to have worsening wheezing and stridor in the 2<sup>nd</sup> trimester, she was referred to a pulmonologist by her obstetrician.

Her initial CT of the neck demonstrated a sundrop shaped circumferential stenosis 1 cm below the cricoid. During an initial bronchoscopy at an outside hospital, a normal fiberoptic scope was unable to advance beyond the lesion, and she was referred to our tertiary academic institution. There was increased urgency for a therapeutic intervention due to elevating concern about her ability to tolerate labor with the worsening stridor. An extensive discussion occurred with maternal fetal medicine, OB anesthesia, and pulmonology surrounding the indication, timing, and execution of such a procedure during her 3<sup>rd</sup> trimester of pregnancy.

Preoperatively, the patient had a non-stress test (NST). Due to concerns for a full-stomach patient with an unsecure airway, she was given famotidine, metoclopramide, and sodium citrate. In the procedure room, she was placed in left uterine displacement with the head of bed elevated. She was induced and a size 4 LMA was inserted successfully. Anesthesia was maintained with propofol and remifentanyl with the patient breathing spontaneously. At the conclusion of the case, she was awakened and the LMA removed. NST was normal in PACU. She successfully delivered vaginally 4 weeks later with no wheezing or stridor.

Seven months later her repeat bronchoscopy demonstrated recurrence of the stenosis. Pulmonology's plan is to do serial balloon dilations or laser resections as needed prior to exploring tracheal resection.

**Discussion:** While every pregnant woman is considered a full stomach at 33 weeks gestation, it is sometimes impossible to secure the airway while facilitating tracheal explorations. Risks and benefits along with contingencies must be discussed and prepared for accordingly to facilitate the safe care of mother and fetus. Tracheal subglottic stenosis can be treated in "full-stomach" pregnant women in a controlled setting with appropriate advanced planning as well as thorough patient understanding and acceptance of the appropriate risks and benefits.



## Cesarean Section in a Parturient with Profound Tracheal Stenosis and Placenta Increta

**Presenting Author:** Katherine Herbert, MD

**Presenting Author's Institution:** Medical University of South Carolina - Charleston, South Carolina

**Co-Authors:** David A. Gutman, MD, MBA - Medical university of South Carolina

Michael Marotta, MD - Medical University of South Carolina

Joel Sirianni, MD - Medical university of South Carolina

### Introduction:

Morbidly adherent placentation present many challenges necessitating a large multidisciplinary team. An otolaryngologist is not usually part of this team. We present a parturient with significant glottic and subglottic stenosis requiring a cesarean section and hysterectomy for a suspected placenta increta.

### Case Report:

A 33 year old G5P3013 woman at 35 weeks presented to the anesthesia preoperative clinic in the setting of suspected morbidly adherent placenta. Past medical history was significant for cesarean section x 3, obesity with BMI 37, anemia, gastroesophageal reflux, childhood asthma, and a motor vehicle accident in 2004 necessitating pleurodesis for recurrent pneumothorax and temporary tracheostomy with tracheal stenosis. The patient was known to have 30% subglottic stenosis in 2013. She underwent general anesthesia in 2016 with failed intubation x 2 by an anesthesiologist and successful intubation by an otolaryngologist (ENT) using rigid bronchoscopy and a 5.0 endotracheal tube. She next had a cesarean section under combined spinal-epidural in 2019 but no further general anesthetics requiring airway manipulation. The patient was referred to ENT who performed flexible laryngoscopy finding 50% glottic stenosis and some degree of subglottic stenosis.

The airway plan was discussed in the operating room time-out prior to preoxygenation. The patient underwent rapid sequence intubation by the ENT team using a Dedo laryngoscope. The ENT resident was unable to intubate but the ENT attending was able to obtain a grade I view and pass a 5.0 microlaryngeal tube without resistance past the glottic stenosis. She noted "cartilaginous appearing deformity of the anterior right lateral tracheal" and only a couple millimeters of space around the 6.9 mm outer diameter tube in the anterior trachea. The case proceeded with placement of ureteral stents by urology and a femoral arterial sheath by trauma surgery for possible deployment of a resuscitative endovascular balloon occlusion of the aorta (REBOA) device. The baby was delivered uneventfully, the placenta increta was confirmed, and hysterectomy was performed. Total EBL was 5L and multiple transfusions were administered. The patient was hemodynamically stable at the conclusion of the case, breathing spontaneously with > 6 ml/kg tidal volumes, following commands, and had a positive cuff leak test. She was extubated uneventfully (six hours after intubation) without post-operative stridor, dyspnea, or hypoxia. She was discharged in stable condition with plans to finish a steroid taper.

### Discussion:

Cesarean hysterectomy for placenta increta in a parturient with tracheal stenosis requires careful consideration by a multidisciplinary team. The risk of aspiration and failed intubation must be considered prior to induction of anesthesia with appropriate contingency plans for establishing a secure airway.

## Anesthetic Management and Use of Point-of-Care Ultrasound in a Parturient with Symptomatic Goiter

**Presenting Author:** Maria N. Sheikh, M.D., M.P.H.

**Presenting Author's Institution:** Columbia University Irving Medical Center - New York, New York

**Co-Authors:** Suzanne Mankowitz, MD - Columbia University Medical Center

Katharine E. Thompson, M.D. - Columbia University

Laina Yu, M.D. - Columbia University

### Introduction:

Pregnancy is associated with formation of new thyroid nodules and increased size of existing nodules (1). Parturients with large multinodular goiter may have decreased neck movement and mouth opening, and tracheal compression and/or deviation. Physiologic changes to the airway can increase the risk of difficult intubation in pregnant patients, and a thyroid mass can create further challenges in the anesthetic management of parturients who already have pregnancy-related airway changes. We discuss the peripartum care of a patient with enlarging goiter, including use of point-of-care ultrasound (POCUS) for airway assessment.

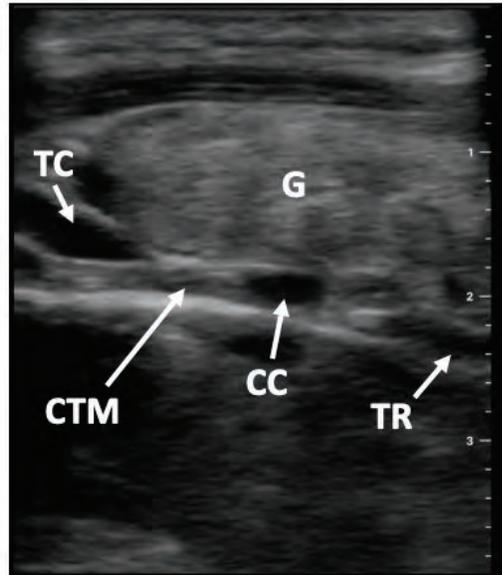
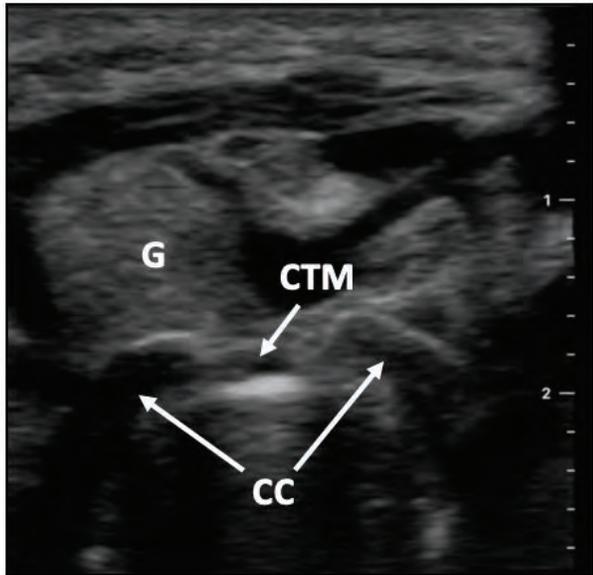
### Case:

42-year-old G5P3 with prior cesarean section (CS) and 7 years of enlarging goiter presented with oligohydramnios at 37 weeks. A neck CT from 2 years ago showed a 10.5 cm right thyroid lobe and 12.5 cm left thyroid lobe. Her goiter extended from the parapharyngeal space superiorly to the level of the aortic arch inferiorly and into the mediastinum, with tracheal narrowing and rightward deviation. The patient endorsed needing to sleep with 3 pillows and whistling in her voice with prolonged speaking. Otolaryngology colleagues advised that in the event of airway emergency, cricothyrotomy could be performed, however an emergent tracheostomy would be difficult due to the large goiter. Airway POCUS revealed the cricothyroid membrane (CTM) and tracheal rings (TR) were 2-2.5 cm deep under the goiter (Figure 1). Rightward tracheal deviation of 1 cm was also noted.

The patient desired a TOLAC, however after multidisciplinary discussion she agreed to a planned CS to avoid risks of emergent airway instrumentation, with ECMO standby. CSE was performed with hyperbaric bupivacaine 0.75% 12 mg, fentanyl 15 mcg, morphine 150 mcg, and clonidine 30 mcg. Intraoperatively, she was kept in slight recumbent position with O<sub>2</sub> via nasal cannula (2L) which kept her SpO<sub>2</sub> 99% throughout the CS. A male infant was delivered with Apgar scores of 9/9. The epidural catheter was kept in place for 24 hours to allow redosing of neuraxial morphine for post-cesarean analgesia.

### Discussion:

The use of awake fiberoptic intubation for urgent cesarean section in the setting of airway compression has been reported (2). In our case, careful planning and early involvement of a multidisciplinary team allowed a planned CS with neuraxial anesthesia and no airway compromise. POCUS can be utilized in conjunction with other imaging modalities to confirm severity of airway obstruction. Specifically, it can identify relevant anatomy and estimate distance to the CTM and TR in the event of failed intubation and need for cricothyrotomy or tracheostomy.



**Figure 1.** Linear, high-frequency transducer in transverse midline view (top) and midsagittal view (bottom).  
G = goiter, CTM = cricothyroid membrane, CC = cricoid cartilage, TC = thyroid cartilage, TR = tracheal ring

**Abstract #:** SUN-FCP – Room 5 – PAS Postpartum Hemorrhage – 05

### **Anesthetic Management of a Parturient with Pathologic Uterine Ring**

**Presenting Author:** Maria N. Sheikh, M.D., M.P.H.

**Presenting Author's Institution:** Columbia University Irving Medical Center - New York, New York

**Co-Authors:** Katharine E. Thompson, M.D. - Columbia University

#### **Introduction:**

Bandl's ring (BR), also known as a pathologic uterine ring, is a constriction at the junction between a woman's thick upper uterine segment and thinned lower uterine segment during parturition(1). This muscular band can entrap the baby's head and/or shoulders, leading to an inability to deliver the infant. We present the case of a woman with unexpected BR who underwent primary cesarean section (CS) complicated by postpartum hemorrhage (PPH).

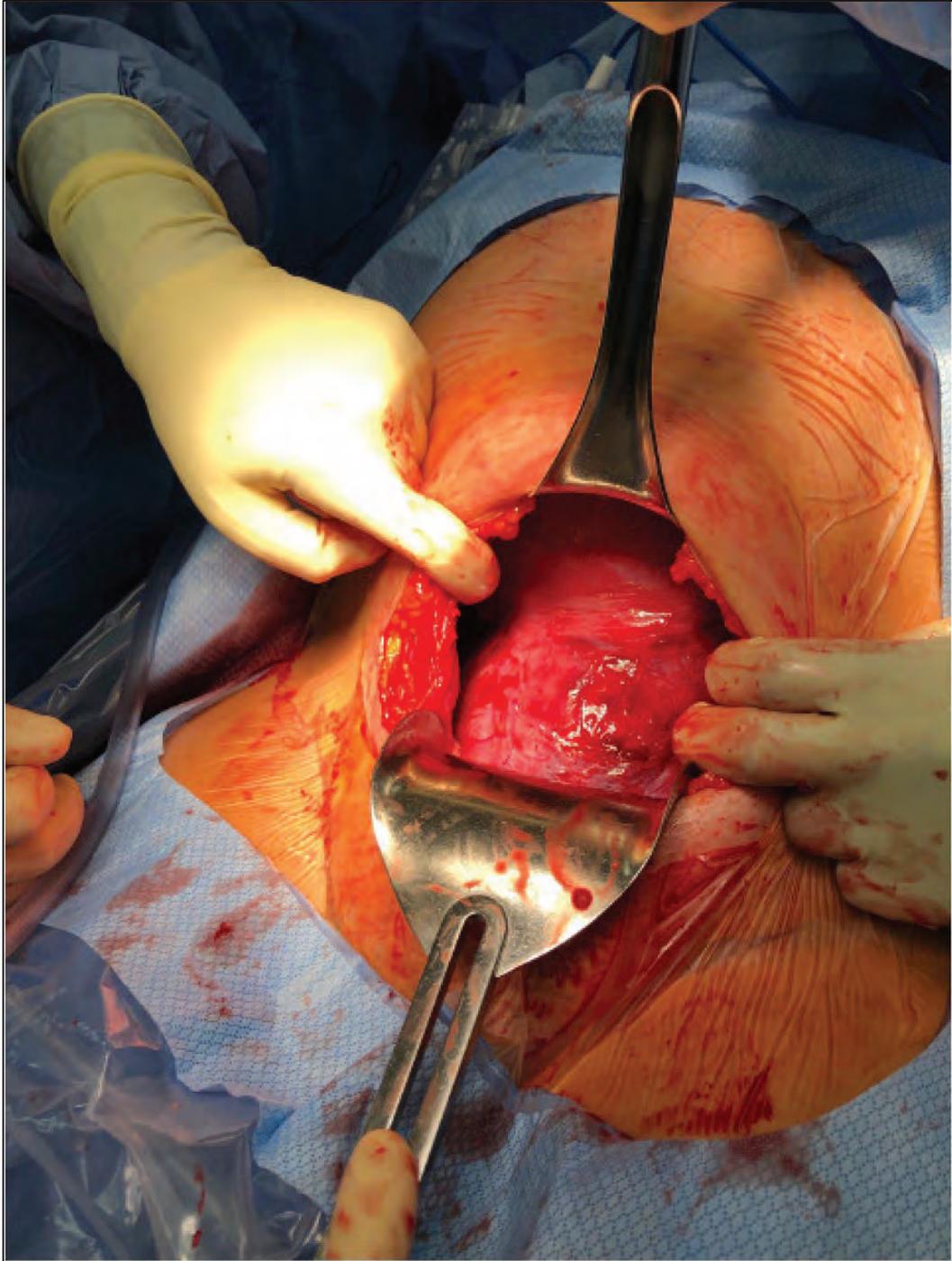
#### **Case:**

36-year-old G5P0221 at 39 weeks 2 days with no significant past medical history presented in labor. Analgesia was initiated with uncomplicated combined-spinal-epidural (CSE). She progressed to full cervical dilation however there was no change in fetal station for 1.5 hours and recurrent variable decelerations were noted on the fetal heart monitor. The obstetricians proceeded with CS for arrest of descent and non-reassuring fetal heart tones. CSE was incrementally loaded with 20 ml 2% lidocaine with 1:200,000 epinephrine and 100 mcg fentanyl, and a T4 sensory level was achieved.

On intraoperative inspection, a tight BR was noted to be separating the thin lower uterine segment from the body of the uterus. A low vertical incision was made across the uterine ring and extended superiorly. After delivery of a male infant with Apgar scores of 9 and 9, brisk bleeding and severe uterine atony were noted. The lower uterine segment appeared to have a horizontal extension creating a "T" shaped hysterotomy. Phenylephrine infusion was increased to 100 mcg/min while a second IV and arterial line were placed. The patient received 200 mcg IM methylergonovine, 250 mcg IM carboprost x 2, 1 gram IV tranexamic acid, 3 units packed red blood cells and 2 units fresh frozen plasma. A Jada System (intrauterine device) was placed to assist with contraction and control of postpartum hemorrhage. Quantitative blood loss was 2730 ml. She was weaned off vasopressors and transferred to the high-risk obstetric unit for observation. CSE was kept in place for two days postoperatively for pain control. Soon after birth, the infant was transferred to NICU due to seizure activity and found to have suffered a left middle cerebral artery stroke. The patient was discharged home on postoperative day 3 and her baby was discharged 2 weeks later with oxcarbazepine therapy.

#### **Discussion:**

The incidence of BR is 1 in 5000 deliveries(1) and its etiology is poorly defined. Duration of labor, fetal head position, rupture of membranes, and oxytocin use have not been found to be predisposing factors(2). BR is known to inhibit successful vaginal delivery and is associated with neurologic consequences for the fetus(2). Obstetric anesthesiologists should be vigilant of a possible increased risk of PPH due to a larger incision and subsequent impaired uterine contraction, and should consider keeping the epidural for at least 24-48 hours for postoperative pain control.



Delayed postpartum hemorrhage requiring massive transfusion including prothrombin complex concentrate

**Presenting Author:** Bryan Wakefield, M.D.

**Presenting Author's Institution:** University of North Carolina

**Co-Authors:** Michael Hart, MD - University of North Carolina

David C. Mayer, M.D. - University of North Carolina

Lacey Straube, MD - University of North Carolina

Postpartum hemorrhage (PPH) is frequently complicated by coagulopathy requiring transfusion of cryoprecipitate and fresh frozen plasma (FFP) during massive transfusion (MT). Factor replacement with prothrombin complex concentrate (PCC) is not well-studied and therefore is not currently recommended for routine use in PPH. However, it was used without complication in this case of massive PPH. Given its rarely reported use for this indication, its administration warrants discussion.

A 30-year-old 115 kg G6P5005 at 36 weeks and 4 days' gestation with a twin intrauterine pregnancy presented for her sixth repeat cesarean delivery (CD). An arterial line, 2 large-bore IVs, and a combined-spinal epidural were placed. Uterine atony was resolved with carboprost, and total quantitative blood loss (QBL) was 1100 milliliters.

Ten hours postpartum, fundal massage expressed one liter of vaginal bleeding. The MT Protocol was activated, and she was taken emergently to the operating room for dilation and curettage under general anesthesia. Retained placental fragments were discovered with continued brisk bleeding. Given the ongoing need for MT, a hysterectomy was performed.

The final QBL was 8 liters, and 20 units of packed red blood cells, 23 units of FFP, 2 units of platelets, 2 units of cryoprecipitate, 1 gram of tranexamic acid, and 36 units/kg (4248 units) of PCC were administered. There was a continuous delay in receiving thawed FFP from the blood bank that inhibited our ability to resuscitate in a 1:1:1 fashion. There was also a substantial delay in receiving coagulation lab values. Although viscoelastic testing (ROTEM) was utilized, it provided delayed information during our rapid administration of blood products. Given the continuous need for blood and factor replacement in the setting of intractable bleeding and largely unknown coagulation lab values, PCC was administered. The patient was transported intubated to the intensive care unit to recover and was extubated the following day. The remaining hospital course was uneventful, including lack of pro-thrombotic events.

PCC contains vitamin K-dependent factors (II, VII, IX and X). It was initially indicated for reversal of vitamin K antagonists and is often restricted to cases of congenital or acquired deficiencies of coagulation factors. Its safety has been questioned in postpartum patients given its pro-thrombotic mechanism. However, in the setting of intractable hemorrhage, avoiding exsanguination from surgical bleeding and coagulopathy was our top priority. Although PCC is not recommended for routine use in obstetric hemorrhage, we believe it aided in achieving hemostasis without the addition of thrombotic events in this patient.

**Abstract #: SUN-FCP – Room 5 – PAS Postpartum Hemorrhage – 07**

**Management of Ornithine Transcarbamylase Deficiency in a Parturient with Placenta Accreta**

**Presenting Author:** Jessica Sheeran, MD

**Presenting Author's Institution:** University of Virginia - Charlottesville, Virginia

**Co-Authors:** Sunny Chiao, M.D. - University of Virginia

Emmarie Myers, M.D. - University of Virginia

Christina Peroutka, M.D. - University of Virginia

Ornithine transcarbamylase deficiency (OTCD) is the most common urea cycle disorder. Ammonia (NH<sub>3</sub>) produced from breakdown of protein cannot be converted into urea resulting in hyperammonemia, which untreated, may lead to cerebral edema, neurologic damage, and death (1). Pregnancy involves a 47% risk of hemodialysis and 30% mortality (with postpartum days 7-14 of highest risk) (2). Maternal protein intake increases to support increased nitrogen demands from placental, uterine and fetal growth. Intra- and post-partum hyperammonemia occurs due to increased physiologic stress and catabolism from uterine involution and maternal weight loss. Lack of fetal nitrogen uptake after birth also contributes (3). Management of the parturient involves reducing protein intake, ensuring adequate calories and hydration with dextrose fluids, and providing nitrogen scavengers. We present a case of a parturient with OTCD who experienced rapid clinical improvement following cesarean-hysterectomy.

A 30 yo G4P1112 with medical history of OTCD and ulcerative colitis was admitted at 37w5d for repeat cesarean section. OTCD was diagnosed at 22w1d due to altered mental status from hyperammonemia, ultimately requiring prolonged ICU care with intermittent hemodialysis and IV arginine (Arg) and sodium phenylbutyrate-sodium benzoate nitrogen scavenger infusions to optimize nutritional status and fetal growth. Pre-operative NH<sub>3</sub> levels ranged 32-55 umol/L (goal < 75) on IV Arg and scavengers with D10NS at 200 ml/h. In the OR, spinal anesthesia facilitated uncomplicated delivery of a viable female infant. Rapid bleeding and instability ensued due to a densely adherent placenta with complete loss of planes (placenta accreta) necessitating conversion to general anesthesia and cesarean hysterectomy. The patient received 2 units packed red blood cells and 1 unit FFP for 4100 ml blood loss and was transferred to the MICU. NH<sub>3</sub> peaked at 160 umol/L. Daily plasma amino acids with q4h NH<sub>3</sub> allowed for rapid weaning off IV scavengers and fluids to a PO regimen without need for hemodialysis. The patient was discharged 10 days postpartum.

Pregnancy may unmask OTCD with life-threatening hyperammonemia. Our patient did well postpartum with rapid decline in NH<sub>3</sub> despite a prolonged surgery and blood transfusions. This may in part be due to her cesarean-hysterectomy given that uterine involution can lead to hyperammonemia. To our knowledge, this is the first case report of cesarean hysterectomy in a parturient with OTCD.

Abstract #: SUN-FCP – Room 5 – PAS Postpartum Hemorrhage – 08

**Fluoroscopy Free Intraaortic Balloon Occlusion in a Patient with Morbidly Adherent Placenta Accreta in Planned Caesarean Hysterectomy.**

**Presenting Author:** Dr Bhavdip V. Patel, FCAI

**Presenting Author's Institution:** Rotunda Hospital, Dublin, Ireland - Dublin, Dublin

**Introduction:** Placenta Accreta Spectrum (PAS) is increasingly common and is associated with severe morbidity or mortality due to haemorrhage. The optimum method of haemorrhage control is uncertain and some prophylactic interventions require radiation exposure. We present a case in which an Intra-aortic occlusion balloon (IAB) device was inserted prophylactically as part of a multidisciplinary approach to haemorrhage control in a case of morbidly adherent placenta undergoing caesarean hysterectomy.

**Case Presentation:** 38 year old G5P5 with 4 prior LSCS was diagnosed with placenta accreta with US and MRI. Following multispecialty meetings a caesarean hysterectomy via a midline laparotomy incision was planned at 31 weeks. She received steroid and MgSO<sub>4</sub> pre delivery. General anaesthesia, with invasive vascular access and a thoracic epidural was performed. Systemic vascular resistance was monitored using pulse contour analysis through left radial artery cannulation. Following induction of anaesthesia, IR accessed the right femoral artery and performed intravascular ultrasound (IVUS) evaluation of the aorta and iliac arteries to evaluate IAB landing zones. A suitably sized occlusion balloon was then advanced to the infrarenal aorta and secured into position. A test occlusion was performed and assessed by loss of oximetry signal in the toes. Post delivery, the occlusive balloon was inflated causing an increase in SVR of approximately 50%. Following hysterectomy the balloon was deflated. Total EBL was 900 ml, with 250 ml transfused back from cell saver with 2 L CSL. There was minimal hemodynamic instability throughout procedure, in particular no proximal hypertension or ischemia reperfusion related hypotension. There were no thrombotic or traumatic complications in relation to the device.

**Discussion:** Historically, Placenta accreta is associated with Massive hemorrhage. In this case IAB was used as a component of a multispecialty approach to haemorrhage prevention. The protocol outlined has the benefits of no radiation, no need for transfer to an angio suite, and excellent aortic hemostasis. Further research is needed in this area particularly in relation to scope of deployment and duration of balloon occlusion in abnormal placentation where robust collaterals from other systemic arteries can be present.

Abstract #: SUN-FCP – Room 5 – PAS Postpartum Hemorrhage – 09

## Two Parturients with Placenta Previa and Placenta Accreta Spectrum (PAS) Undiagnosed by Ultrasound

Presenting Author: Susanne S. Rupert, MD

Presenting Author's Institution: University of Minnesota - Minneapolis, Minnesota

**Introduction:** Placenta accreta involves abnormal adherence of the placenta to myometrium instead of the decidua. Abnormal placental adherence can result in severe maternal and neonatal morbidity and mortality. Ultrasound imaging, although helpful, does not identify a significant number of PAS patients. Thus, anesthesiologist and obstetricians must remain vigilant.

### Case Presentations:

**Case 1:** 39 yo G1P0000 at 35w1d risk factors for PAS: placenta previa, IVF, and AMA. Anesthetic for Cesarean was spinal which was converted to GETA for unplanned hysterectomy. After delivery, the placenta was unable to be delivered with gentle traction and uterine massage, resection with sharp dissection and cautery, oversewing the placental bed, and uterotonic and TXA were unsuccessful in controlling the profuse bleeding. Decision was made to proceed with hysterectomy. EBL 3100; 2-units PRBCs and 1-unit FFP.

**Case 2:** 31 yo G4P3003 at 36w3d, risk factors for PAS: placenta previa, previous D and C, and multiparity. Cesarean under spinal. After delivery, the placenta was attached to the anterior uterine wall, penetrating deep into the myometrium. Decision was made to proceed with hysterectomy under GETA. EBL 3105; 4 units PRBCs and 3 units FFP.

Both patients benefitted from delivery at a Centers of Excellence hospital, good team communication, prompt decision to perform hysterectomy, and a hemorrhage cart with all needed supplies.

**Discussion:** One theory of the etiology of placenta accreta spectrum is a defect of the endometrial myometrial interface leads to failure of normal decidualization in the area of a uterine scar which allows abnormally deep placental anchoring villi and trophoblast infiltration. Placenta previa and previous CS are the greatest risk factors for PAS. Risk of placenta accreta is 3%, 11%, 40%, 61%, and 67%, for the first, second, third, fourth, and fifth or more cesarean, respectively. The rate of PAS increases from 0.3% with one previous cesarean to 6.74% with five or more cesarean deliveries. Additional risk factors include prior uterine surgeries or curettage, Asherman syndrome, advanced maternal age, multiparity, and IVF.

Placenta previa is the most important ultrasound association with placenta accreta, present in 80%. Other abnormalities are multiple placental vascular lacunae, loss of normal hypoechoic zone, decrease retroplacental myometrial thickness, uterine serosa-bladder interface abnormalities, and extension of placenta into myometrium, serosa, or bladder. Doppler may facilitate diagnosis evaluating for turbulent lacunar flow, subplacental vascularity gaps, gaps in myometrial blood flow, and vessels bridging the placenta to the uterine margin. Ultrasound sensitivity (50-90%) and specificity (71-95%) for diagnosis of placenta accreta varies greatly.

Abstract #: SUN-FCP – Room 5 – PAS Postpartum Hemorrhage – 10

**Peri-Partum Venous-Arterio-Venous Extracorporeal Membrane Oxygenation as A Rescue Therapy for Cardiogenic Shock and Acute Respiratory Distress Syndrome.**

**Presenting Author:** Angelique M. Garay, DNAP, CRNA, ACNP-BC

**Presenting Author's Institution:** Yale New Haven Hospital - Milford, Connecticut

**Co-Authors:** Pedro Acevedo-Rodriguez, MD, JD - Yale University

Aymen Alian, MD - Yale University

Antonio Gonzalez-Fiol, MD - Yale School of Medicine

Rachel Rachler, DNAP, CRNA, DNAP, CRNA, APRN - Yale New Haven Hospital

ECMO emerged a crucial management for patients with severe heart and/or lung failure. Its uses and configurations have evolved significantly, including the use of triple cannulation strategies. Favorable maternal and fetal results have been reported with use of peri-partum veno-arterial or veno-veno ECMO for cardiac or pulmonary failure<sup>1-3</sup>, limited data exists for triple cannulation strategies in this population.

A 37 y.o., g1, p0 admitted at 40 wks for induction of labor. Medical history, asthma, chronic sinusitis, and in vitro fertilization, otherwise normal pregnancy. A cesarian delivery on day 2, for NRFHT. Immediate post-operative period, she became hemodynamically unstable due to acute uterine bleeding and returned to operating room for dilation and curettage, massive transfusion, and uterotonics. In setting of hemorrhage and instability, Ventricular fibrillation ensued requiring chest compressions and serial defibrillation. Supracervical hysterectomy, bilateral salpingo-oophorectomy and aortic compression were performed. TEE showed a fibrillating heart and excluded obstructive etiology of cardiovascular collapse, favoring a diagnosis of cardiogenic shock. After several defibrillation, the patient return of spontaneous circulation with compromised left ventricular function and normal right ventricular function. Given hypoxemia and tenuous hemodynamics post arrest, rapid femoral cannulation to start VA ECMO concluded. Hemodynamics and metabolic acidosis stabilized, remained hypoxic and difficult to ventilate. A third cannula was subsequently placed in right internal jugular vein to achieve VAV ECMO. POD 1, improvement of cardiac function allowed for change from VAV to VV ECMO. Ongoing respiratory aid in the setting of pulmonary edema due to transfusion-associated fluid overload. With reassuring gas exchange and respiratory dynamics, decannulation and extubation on POD 4. Post TEE showed improved biventricular function and discharged POD 8. Utility of TEE for guiding diagnosis and treatment in undifferentiated shock and value of multidisciplinary collaboration for institution of time-sensitive, life-saving therapies such as ECMO. It shows capabilities of diverse ECMO cannulation strategies in evolving clinical situations. Current management is based on observational data and clinical experience. No guidelines exist for prompt initiation, management, and termination of advanced life support therapy, particularly in parturient. More prospective studies are needed to asses various ECMO modes in unique peoples.

**Abstract #: SUN-FACP – Room 5 – PAS Postpartum Hemorrhage – 11**

**Preterm delivery in a patient with spontaneous hemoperitoneum in pregnancy and concurrent placenta accreta**

**Presenting Author:** Emily F. Nasser, MD

**Presenting Author's Institution:** University of California Los Angeles - Los Angeles, California

**Introduction:**

Spontaneous hemoperitoneum in pregnancy (SHiP) is a rare condition characterized by unprovoked intraperitoneal bleeding in pregnancy. SHiP is most commonly seen in women with endometriosis or ovarian hyperstimulation from artificial reproductive techniques, and is associated with adverse perinatal outcomes. We present a 38 year old G1P0 with endometriosis, open myomectomy for fibroids, and in-vitro fertilization (IVF) pregnancy transferred from an outside hospital (OSH) at 23w0d gestational age (GA) for SHiP.

**Case Description:**

The patient is a 38 year old G1P0 female with recurrent stage 4 endometriosis with multiple prior open laparotomies, fibroids requiring open myomectomy, and IVF pregnancy. She presented to an OSH at 22w4d gestation with abdominal pain and severe anemia (hemoglobin 6), and was found to have large hemoperitoneum requiring 3 liter drainage and massive transfusion. She was transferred to our institution at 23w0d gestation, at which time her clinical presentation was thought to be consistent with SHiP from ruptured endometrioma, now walled-off. Placenta accreta was suspected due to MRI finding of poorly delineated utero-placental interface in the left anterior uterus. At 25w3d, she suddenly developed preterm labor with fetal distress, oral intolerance, and acute kidney injury. New, enlarging retroplacental hematoma was noted on ultrasound concerning for placental abruption versus uterine rupture. Emergent cesarean delivery was performed in the main operating room with delivery of a live neonate under a combined-spinal epidural anesthetic. Dense bladder adhesions were noted, preventing uterine exteriorization (Figure 1a). The placenta was noted to be completely abrupted from the uterine wall, though without evidence of uterine dehiscence (Figure 1b). Patient-controlled epidural anesthesia with a bupivacaine 0.0625% fentanyl 2 mcg/mL mixture was used for postoperative analgesia until transition to oral analgesics. The patient was discharged home on postoperative day 11.

**Discussion:**

This case highlights the perinatal morbidity associated with SHiP, a rare condition, and concomitant placenta accreta spectrum. Though expectant management was pursued to allow pregnancy to progress to fetal viability, preparations were in place for emergency cesarean hysterectomy and massive intrapartum hemorrhage. Detailed multidisciplinary antepartum planning amongst the anesthesia, maternal-fetal medicine, and gynecologic-oncology teams were crucial to a favorable maternal and neonatal outcome in this complex, emergent delivery.

[Nasser - Preterm delivery of SHiP with placenta accreta images.pdf](#)

**Abstract #: SUN-FCP – Room 6 – Post Dural Puncture Headache/Neuro - 01**

**Arachnoiditis after Inadvertent Dural Puncture Requiring Epidural Blood Patch**

**Presenting Author:** Jason J. White, MD

**Presenting Author's Institution:** Weill Cornell Medicine - New York, New York

**Background:** Arachnoiditis can result from chemical contamination, local anesthetics, or blood breakdown. It is a known but rare complication of epidural blood patches. It has been defined as back and leg pain that increases with activity, an abnormal neurological examination, and MRI changes consistent with the disease. Only eight other cases of post-epidural blood patch arachnoiditis have been reported. There are few treatment options for arachnoiditis, and the most severe cases are likely to develop lasting disability.

**Case Presentation:** A 38 yo G2P0010 was admitted for an elective scheduled induction at 39.3 weeks. Soon after admission, a CSE was attempted at L4/L5 using loss of resistance to air, but an inadvertent dural puncture occurred. The CSE was reattempted at L3/L4 using loss of resistance to air with success. Eventually, a cesarean section was called for arrest of dilation. A female neonate was delivered with Apgars 9 and 9. On postoperative day #1, her headache had worsened, and the patient agreed to a blood patch. The blood patch was performed at L4/L5. 22mL of autologous blood was injected. She tolerated the injection well and was ambulating without any headache that evening. On postoperative day # 3, she denied headache. She was discharged that day. On postoperative day # 9, she presented to the ED with fever, back and leg pain, and knee-buckling when walking. An MRI of the lumbar spine demonstrated clumping of the cauda equina with associated mild enhancement consistent with infectious/inflammatory arachnoiditis. There was a small T2 hypointense material layering within the thecal sac, reflecting sequellae of prior blood patch and trace post-procedure blood. Neurology described coccygeal numbness and was concerned with her post-void residual bladder volume. His diagnosis was inflammatory arachnoiditis with radiculopathy. She was given one dose of IV solumedrol before leaving with prednisone po for six days and a proton pump inhibitor. On POD # 10, Neurology followed up with her outpatient, and she reported no change in symptoms, but a mild non-positional headache was now present. On POD # 12, she again saw Neurology, who also reported her symptoms were improving. Her prednisone was decreased, and a repeat lumbar spine MRI was ordered. The lumbar spine MRI showed the clumping of her cauda equina had some improvement, and her subdural collection of blood from T12 to L3/L4 was unchanged. On POD # 24, Neurology reported that her radicular pain increased. She was started on gabapentin. On POD # 41, her pain improved. She since has reached out to anesthesia, reporting resolution of symptoms.

## Management of a Parturient with Vein of Galen Malformation

**Presenting Author:** Kristen L. Fardelmann, MD

**Presenting Author's Institution:** Yale University

**Co-Authors:** Christina Ackerman-Banks, MD - Yale University

Aymen Alian, MD - Yale University

Katherine Campbell, MD - Yale University

Antonio Gonzalez-Fiol, MD - Yale University

Vein of Galen Malformations (VGAM) are rare congenital arteriovenous malformations that develop between 6- and 11-weeks gestation and are associated with cardiovascular and neurodevelopmental complications. Multidisciplinary (anesthesia, cardiology, MFM, and neurosurgery) collaboration was critical for this parturient with VGAM and severe left ventricular dilation (LVD).

**Case:** A 24-year-old G2P0 at 14 weeks gestation with history of obesity, depression, and a large, unrepaired VGAM presented with symptoms concerning for high output heart failure (HOCHF). Despite evidence of mild LVD in childhood and adolescence, the patient remained asymptomatic with stable echocardiogram (ECHO) findings until early pregnancy when she developed shortness of breath and palpitations. Given her clinical presentation and MRI findings of a large VGAM with multiple enlarged feeding vessels, sequential embolization was considered. However, conservative monitoring of symptoms, B-type natriuretic peptide, and ECHO was pursued with beta blocker therapy for ventricular ectopy (5.4% on holter) due to high risk of serial embolization in pregnancy. At 39 weeks gestation, the patient remained stable from a cardiac perspective and an induction of labor (IOL) with assisted second stage vaginal delivery was planned. Labor analgesia was achieved via epidural that was successfully converted for cesarean section in the setting of failed IOL. The patient safely delivered a liveborn neonate with weight 4196g and Apgars 9 and 9 at 1 and 5 minutes. Postpartum multimodal analgesia included acetaminophen, ibuprofen, oxycodone and bilateral transversus abdominis plane blocks. The patient had an uneventful postpartum course with telemetry monitoring for 24 hours and postpartum ECHO significant for mild depression of previous LV function at 55%.

**Discussion:** About 30% of VGAM cases are diagnosed prenatally via ultrasound and may be associated with findings of HOCHF. Most patients develop symptoms (HOCHF, seizure, subarachnoid hemorrhage, developmental delay, and macrocephaly) in childhood necessitating medical and surgical management. Prognosis is dependent on severity and timing of cardiovascular and neurodevelopmental complications. In the untreated patient, cardiac chamber dilation, pulmonary hypertension, arrhythmia, heart failure, and intracranial hemorrhage are of utmost concern intrapartum. Neuraxial anesthesia provides the benefit of continuous neurologic assessment, incremental dosing, minimization of pain and cardiovascular stress in labor, and avoidance of general anesthesia and its associated hemodynamic fluctuations with induction, laryngoscopy, surgical stimulation, and emergence. As demonstrated in our case, it is rare for a patient to reach adulthood with an untreated, but hemodynamically significant VGAM. Delivery at a Level IV Maternal Care Center with immediate access to neurosurgical intervention is critical.

[Sagittal View of Brain MR Venogram which notes large Vein of Galen Malformation and Associated Feeding Vessels.pdf](#)

## Unusual Reoccurrence of Postdural Puncture Headache and Subdural Hematoma After a Labor Epidural

**Presenting Author:** Taimoor Khan, MD

**Presenting Author's Institution:** Memorial Healthcare System - Pembroke Pines, Florida

**Co-Authors:** Grace Chalhoub, MD - Memorial Healthcare System

Benjamin Houseman, MD, PhD, FASA - Envision Healthcare Services

Marisol Perales, MD - Envision Healthcare Services

### Introduction:

Postdural Puncture headache (PDPH) is one of the most common complications of neuraxial anesthesia. Symptoms present most commonly within 12-48 hours of needle placement, but rarely beyond the first 5 days. Treatment begins with conservative therapy, followed by an epidural blood patch (EBP), the gold standard, if they do not resolve. <sup>[1]</sup>.

### Case Report:

A 27-year-old African American G1P0 with no significant past medical history presented at 38w6d in early labor. An epidural catheter was placed uneventfully at the L3-4 interspace using a 17-gauge Tuohy needle with loss of resistance to air. Successful analgesia was confirmed. A cesarean section was performed due to fetal bradycardia. Neuraxial narcotic was administered following delivery of a healthy male infant, and the epidural catheter was removed without incident.

On POD 1, the patient reported bilateral neck stiffness and occipital headache worsened with neck flexion or standing upright. Conservative management with caffeine, oral analgesics, and hydration led to some clinical improvement. An EBP was offered but refused in favor of conservative therapy. She was discharged on POD 3 and maintained close contact with the anesthesia department.

The patient reported on POD 17 a return of her postural headache, and was instructed to go to the emergency room. A head CT showed 6-8mm bilateral subacute to chronic subdural hematomas. After consultation with the neurosurgical team, an epidural blood patch was performed with improvement of her symptoms. The patient was discharged home, only to return with worsening of her postural headache on POD 21. A repeat CT showed slight progression of the subdural hematomas, and a second blood patch was performed with improvement of her headache and discharge.

On POD 31 the patient returned with recurrence and worsening of her headache. A CT scan showed progression of her subdural hematomas. She underwent fluoroscopically guided blood patch and middle meningeal artery embolization. Outpatient follow-up confirmed symptom resolution, and neuroimaging showed improvement of the hematomas.

### Discussion:

Subdural hematomas after epidural puncture are purported to be caused by sagging of the brain tissue and stretching of the subdural bridging veins, but it is unusual for these lesions to remain asymptomatic <sup>[2]</sup>. In this case, strong patient rapport and clear outpatient instructions helped identify the subdural hematomas. This case highlights the importance of follow-up contact with obstetric anesthesia patients as well as of a multidisciplinary team approach to eventually achieve symptom resolution.

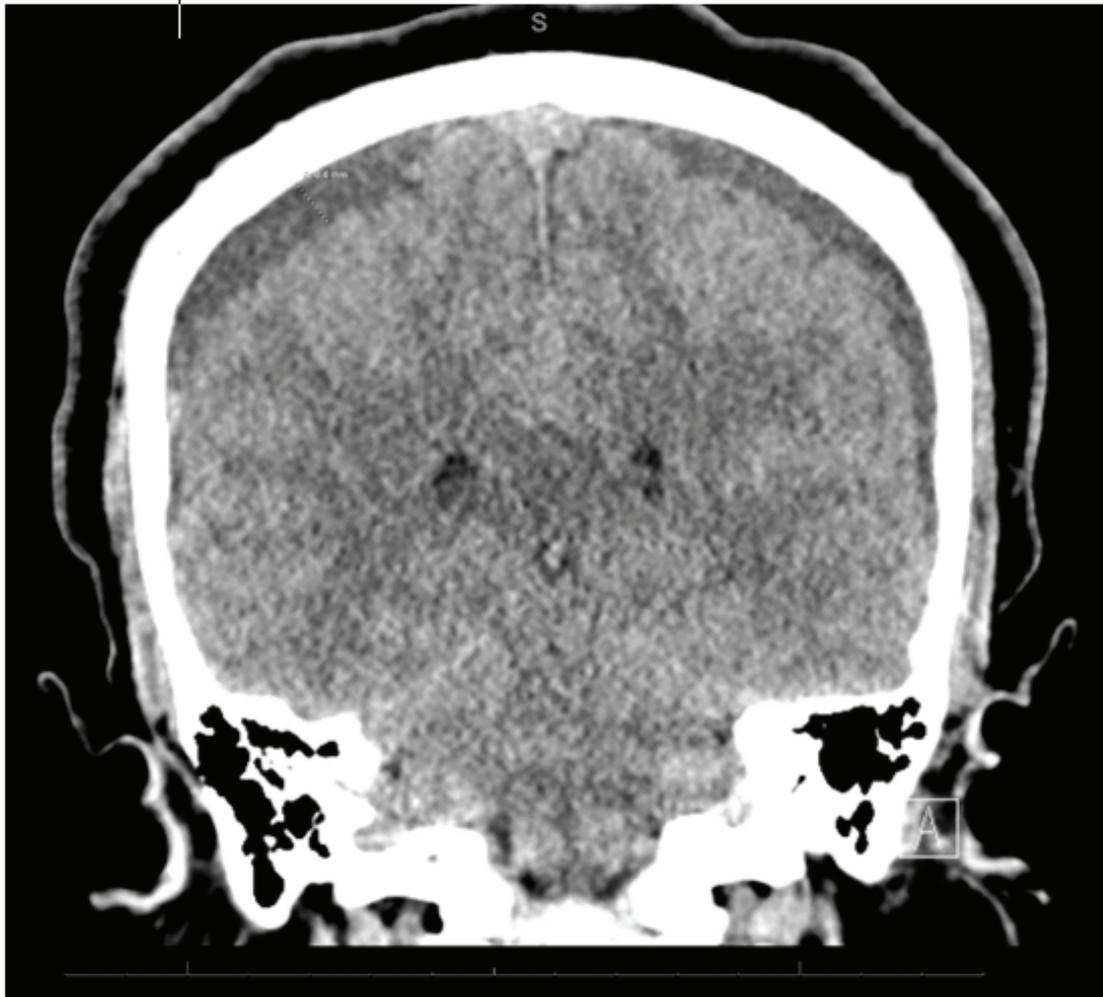


Figure 1: POD 17 Coronal CT showing bilateral subdural collections along the cerebral convexities, representing bilateral subacute to chronic subdural hematomas.

Abstract #: SUN-FCP – Room 6 – Post Dural Puncture Headache/Neuro - 04

## The Benefit of Neuraxial Ultrasound-Guided Mapping for Epidural Blood Patch Placement and Treatment of Lumbosacral Radiculitis Following Repeat Epidural Blood Patch

**Presenting Author:** Nour EL HAGE CHEHADE, MD

**Presenting Author's Institution:** Cleveland Clinic, Ohio

**Introduction:** Post-dural puncture headache (PDPH) is an unfortunate complication that can occur after accidental dural puncture (ADP) during epidural placement. Epidural blood patch (EBP) is the most definitive treatment of this condition but may have its own failure rates and complications.

**Case:** We present the case of a 28-year-old Japanese G1P0 full-term parturient BMI 22.58 kg/m<sup>2</sup> (152cm and 52kg) who presented in labor requesting epidural analgesia. The patient had an unexpected shallow epidural depth and during epidural insertion using a 17G Hustead needle, the procedure was complicated by two dural punctures with the second puncture recognized as an intrathecal catheter. The intrathecal catheter was kept for labor analgesia. On post-partum day 1, she developed an incapacitating PDPH warranting an EBP. The EBP was performed in lateral position by the most experienced provider using neuraxial ultrasound-guided mapping to measure the distance to the posterior complex, which was noted to be around 3.2 cm at the level of L3-L4 with 20 ml of autologous blood injected. On day 5 post-partum, the patient had a recurrence of the same incapacitating PDPH. During the second EBP, a total of 20 mL of autologous blood was injected into the two dural puncture sites with a backpressure limiting dose (15 ml at L2-L3 level, 5 ml at L3-L4). Six days later, the patient developed severe back pain. Physical examination was consistent with lumbosacral radiculitis without other etiologies including signs and symptoms of epidural hematoma and abscess were not found and imaging was not warranted and the patient was counseled to reach out if any changes occurred. Gabapentin was used for symptomatic treatment with completed resolution noted within a one-week period.

**Conclusion:** In patients with difficult epidural placement, the use of neuraxial ultrasound-guided mapping can be a useful<sup>1</sup> tool prior to EBP treatment and other neuraxial procedures. Cautious measurements are warranted prior to the procedure, especially in thin patients. Radiculitis post-repeat EBP is a known phenomenon and increased volume of EBP may increase the risk of meningeal irritation and hence radiculitis. Steroid use is controversial in radiculitis treatment and close follow-up is required to observe for other devastating complications.

**Abstract #: SUN-FCP – Room 6 – Post Dural Puncture Headache/Neuro - 05**

**Successful Epidural Placement and Vaginal Delivery In a Case of Arnold-Chiari Malformation type 1 and Ehler Danlos Syndrome with the Assistance of Point of Care Ultrasound and Epidural Needle Stopper**

**Presenting Author:** Nour EL HAGE CHEHADE, MD

**Presenting Author's Institution:** Cleveland Clinic, Ohio

**Introduction**

The association between Arnold-Chiari Malformation type1 (ACM-1)and Ehler’s Danlos Syndrome(EDS) has been described recently<sup>1</sup>. The anesthetic management of parturients needing labor anesthesia or anesthesia for cesarean section is a subject of discussion. When both diseases occur simultaneously, the decision is challenging and more complex.

**Case**

We report the case of 25-year-old G1P0 at 38 weeks of gestation with ACM1, EDS, POTS, and scoliosis. The diagnosis of ACM-1 was made at the age of 17 when brain imaging was performed for recurrent headaches. The patient had been symptomatic since and had been followed by the neurosurgery team who wanted to perform decompression but was postponed. During the anesthesia evaluation, the patient was suffering from persistent occipital headaches and worsening on Valsalva which warranted repeat imaging. A review of her brain MRI demonstrated ACM-1 with 0.7 cm transtonsilar herniation below the foramen magnum. In anesthesia consult, baseline ocular ultrasound showed normal optic sheath diameters, no retained food on baseline gastric ultrasound after a small meal 4 hours previously, and the neuraxial US showing scoliosis with depths measured. Materno-fetal Medicine specialist, neurosurgeon, neuro-ophthalmology, and obstetric anesthesiology specialists agreed on proceeding with normal vaginal delivery and epidural for labor analgesia. The anesthetic concerns were increased intracranial pressure (ICP) with possible herniation complication, possible increased risk of dural puncture in EDS leading to herniation, delayed gastric emptying, and autonomic dysfunction. The patient presented in labor requesting her epidural without any new neurologic changes. Due to POTS, she was placed in the right lateral position due to previous US showing deeper right articular process with repeat ultrasound locating L2-3 space with measurement showing depth to place epidural stopper and angle of needle trajectory noted. Successful lumbar epidural after one attempt for labor analgesia. The patient went on to have a normal vaginal delivery.

**Conclusion**

Concerns about increased ICP and herniation are present when managing a parturient case with ACM1 and connective tissue disorder among other comorbid disorders such as POTS, GI motility disorders, and scoliosis. The use of POCUS can be a powerful tool to take the best care of these patients. The use of neuraxial ultrasound can be especially beneficial in finding exact measurements to find the epidural space and prevent any possible catastrophic side effects.



**To Patch or Not To Patch?**

**Presenting Author:** Lisa M. Corbett, MD, CPE

**Presenting Author's Institution:** Oregon Health Sciences University - West Linn, Oregon

**Co-Authors:** Iryna C. Chugaieva - University of Minnesota

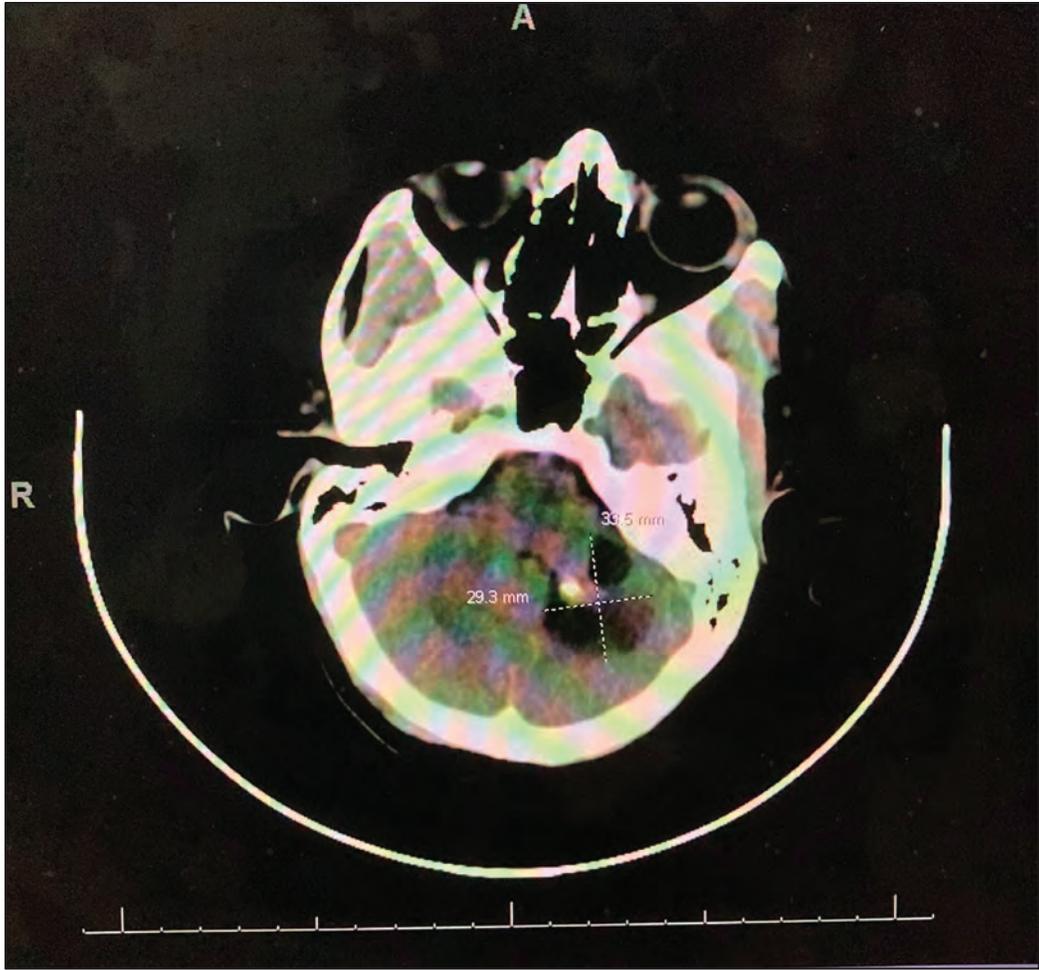
Iryna Chugaieva, MD, Lisa Corbett, MD

**BACKGROUND:**

Postdural Puncture Headache(PDPH) is a well known complication of neuraxial anesthesia. It can occur after spinal anesthesia or after unintentional puncture of dura during epidural placement(1). Incidence of inadvertent dural puncture during epidural is ~1.5% and more than 50% of these patients develop PDPH(2). Patient risk factors for PDPH include young age, pregnancy, female gender, h/o PDPH, low BMI. These factors put obstetric patients at increased risk of development of PDPH. PDPH usually occurs within 5 days after dural puncture. Headache significantly worsens with sitting or standing and improves with lying flat. It can be accompanied by neck pain, tinnitus, hearing changes, photophobia, nausea. Treatment options include hydration, bed rest, analgesic medications, caffeine, sphenopalatine block and epidural blood patch(EBP). EBP is considered a treatment of choice for moderate and severe PDPH(2). Although EBP has a high rate of success, it is not without risks. Before performing EBP, anesthesiologist has to exclude other potential causes of headache such as tension-like headaches, hypertensive disorders, cerebral venous thrombosis(3). We report the case of accidental finding of cerebellar tumor in patient with postpartum headache who was referred to anesthesia team for possible PDPH

**Case Report:**

We present a case of 32y.o. P4034 female with PMH of gestational DM, 2 cesarean sections, resolved COVID19 infection who presented to ED for evaluation of headache. She was day 3 after vaginal delivery for which she had an uncomplicated epidural. Patient (Pt) received IV fluids, Ketorolac, Tylenol, Acetaminophen and caffeine with minimal improvement. Anesthesiologist was consulted for possible PDPH. We found that pt's headache started ~48hrs after delivery and was localized to the middle of her posterior neck with radiation to the shoulders, upper chest and forehead. Headache was only modestly improved with lying flat. Pt denied nausea/vomiting, photophobia, focal deficits or vision changes. Physical exam and vital signs were unremarkable. We requested brain imaging to rule out intracranial pathology prior to proceeding with other treatment modalities as headache was not consistent with classic PDPH. MRI of head showed large cerebellar lesion. Neurosurgery and neurology teams were consulted and concluded that lesion likely didn't contribute to pt's symptoms. We didn't perform EBP as we didn't feel that risk of serious complications outweighed low likelihood of symptomatic improvement.



**Abstract #: SUN-FCP – Room 6 – Post Dural Puncture Headache/Neuro - 07**

**Delayed treatment of accident dural puncture in the setting of parturients with hypertensive disorders – perfect storm for PRES**

**Presenting Author:** Katherine Herbert, MD

**Presenting Author's Institution:** Medical University of South Carolina - Charleston, South Carolina

**Introduction:** Postpartum headaches (PPH) have multiple etiologies. Accidental dural puncture (ADP) during labor epidural placement and resulting PDPH is one of them. Untreated ADP complications include subdural hematoma, cerebral venous/sinus thrombosis, and chronic headaches. While hypertensive disorders of pregnancy are commonly associated with PPH, posterior reversible encephalopathy syndrome (PRES) is a rare cause of PPH in these patients. However, untreated ADP in the setting of postpartum hypertension appears to be synergistic for the development of PRES. We present a parturient with gestational hypertension who developed postpartum seizures and PRES after significant delay in definitive treatment of ADP.

**Case Report:** A 27 y.o G1P0 at 37 weeks' gestation had an elective induction of labor for gestational hypertension and fetal growth restriction. Following an ADP during initial labor epidural placement, a subsequent successful placement resulted in good pain relief. She underwent a cesarean delivery due to fetal intolerance of labor. 12 hours after ADP, the patient experienced a mild positional headache and opted for conservative management. At 24 hours she had worsening symptoms and received one dose of IV caffeine. 36 hours after ADP, patient complained of further worsening of symptoms and at 48 hours received an autologous epidural blood patch (EBP). The delay for the EBP was due to an overly busy labor and delivery deck. Of note, the patient's blood pressures were with 130-140s/80-90s with no concern for postpartum preeclampsia by the OB team. Three hours after EBP, patient suffered a seizure with noted blood pressures of 200s/100s. Magnesium and antihypertensive therapies were initiated. CT head was negative for acute intracranial hemorrhage, but the presence of vasogenic edema raised concerns for PRES. MRI confirmed PRES and intracranial hypotension. EEG showed mild diffuse slowing consistent with encephalopathy. Patient did not have a repeat seizure and did not require the initiation of antiepileptics. The patient continued to complain of a more manageable positional headache. After blood pressure control was obtained, she was discharged home POD #7 with ibuprofen, acetaminophen, and butalbital/acetaminophen/caffeine for her headache. On POD# 11 patient endorsed a mild intermittent headache without a positional component and at six weeks reported her headache had improved.

**Discussion:** Symptomatic and worsening PDPH's should be expeditiously treated with EBP to avoid rare yet devastating complications of ADP. Our patient's combination of untreated systemic hypertension with vasogenic edema and untreated intracranial hypotension due to CSF leak accelerated the development of PRES. This case underscores the importance of not delaying EBP in patients with worsening PDPH symptoms especially in the setting of hypertensive disorders.

## Neuraxial Labor Analgesia With Transverse Myelitis

**Presenting Author:** Fouzia Khalid, M.B.B.S

**Presenting Author's Institution:** University of Washington - Kirkland, Washington

**Co-Authors:** Laurant Bollag, MD - University of Washington

Emily Dinges, MD - University of Washington

Transverse myelitis (TM) is rare with an annual incidence of 1-8 per million.<sup>1</sup> TM is caused by focal inflammation and demyelination within the spinal cord causing dysfunction below the lesion. Etiologies include idiopathic, post infectious, post inflammatory, or in association with autoimmune diseases (multiple sclerosis, lupus, Sjogren's).<sup>1</sup> Symptoms can develop over hours to days and usually include bilateral motor weakness<sup>2</sup> and/or neuropathic pain/paresthesia<sup>3</sup> with an identifiable sensory level. Bladder, bowel and sexual dysfunction are common.<sup>1</sup> Observational studies suggest high dose corticosteroids may improve outcomes.<sup>3</sup> Plasma exchange is reserved for non-responders or acute severe symptoms.<sup>4</sup>

### CASE

An otherwise healthy 33-year-old G3P0 at 18 weeks developed back pain followed by paresthesia starting at the feet and extended symmetrically up to her breast over five days. Examination showed no motor weakness, cranial nerve palsies, or bowel/bladder dysfunction. Non-contrast MRI showed a normal brain with a demyelinating cord lesion at T1. Lumbar puncture showed oligo-clonal bands of immunoglobins. Steroids were initiated and she was discharged on day 4 without significant improvement. The etiology remained unknown.

Oral steroids and physiotherapy continued for 4 weeks. She had good recovery with strength 5/5 in her limbs and 2+ reflexes. Mild hypoesthesia of the legs remained. She was seen in the OBA high risk clinic to discuss labor analgesia where she expressed a strong desire for neuraxial. At 39 weeks she was induced and an L4-L5 epidural was placed and maintained on bupivacaine 0.0625% + fentanyl 2 mcg/ml PIEB 10 ml every 45 min with PCEA. Delivery was uneventful. She reported no new or deteriorating deficits at 6 weeks postpartum and a second MRI showed no changes. The feelings of leg numbness after hot showers and physical activity were unchanged.

### DISCUSSION

The TM with obstetric anesthesia literature consists of 8 case reports, summarized in Table 1. There were 3 epidurals, 1 spinal, 1 sedation, and 4 general anesthetics. Many authors consider neuraxial labor analgesia contraindicated in the acute phase as it may potentially worsen disease, but are silent about neuraxial after the acute phase. Our case was TM with a T1 lesion who insisted on neuraxial analgesia. It was successfully provided and did not cause clinical or radiographic worsening of her disease by 6 weeks postpartum. We used an epidural rather than CSE technique to avoid high spinal local anesthetic concentrations. Choice of anesthesia depends on disease course, lesion location, delivery plan, and patient consent. Provision of neuraxial analgesia may be considered after counseling regarding the risks, benefits, and lack of certainty regarding safety. Multidisciplinary planning with neurologist involvement is recommended. Further studies are warranted.

[TM Table 1 for SOAP ED Jan 26.pdf](#)

**Abstract #: SUN-FCP – Room 6 – Post Dural Puncture Headache/Neuro - 09**

### **Hemorrhagic Stroke in Pregnancy – A Case Report**

**Presenting Author:** Edward Gill, MBChB, MSc

**Presenting Author's Institution:** Barts Health NHS Trust - London, England

**Co-Authors:** Laszlo Agocs, MBChB - Barts Health

Laura Fulton, FRCA - Barts Health

Rodwan Husein, MBChB - Barts Health and The London School of Anaesthesia

Emamoke Oteri, FRCA - Barts Health NHS Trust

A previously fit and well 32-year-old primipara presented to the Emergency Department at 32 weeks with sudden onset right sided weakness and dysphasia. Physical examination demonstrated the right upper limb held in flexion with a MRC power score of 2, and a right lower limb MRC power score of 1. Mild hyperreflexia was also evident. Comprehension appeared intact, but there was marked dysphasia. Blood pressure was within normal limits and an ECG demonstrated sinus rhythm. Subsequent computed tomography and angiography of the head showed a left sided parenchymal bleed. Magnetic resonance imaging confirmed a large intra-axial hemorrhage centred on the left putamen, with no evidence of arteriovenous malformation or aneurysm.

The patient was discussed by a multi-disciplinary team comprising of consultants in Anaesthesia, Obstetrics, Stroke and Maternal Medicine, and seen in the high-risk anaesthetic clinic prior to labour. A plan was made for early epidural insertion and assisted second stage of delivery to minimise hypertensive episodes during labour. If a caesarean section was indicated then above knee thrombo-embolus deterrent stockings should be worn to avoid administration of prophylactic low-molecular weight heparin. Delivery was uneventful at 39 weeks, with epidural analgesia and Kiwi device assisted delivery. Subsequent postnatal imaging and Stroke physician review concluded the aetiology to be related possibly to micro-aneurysm.

This case presents a rare presentation of haemorrhagic stroke in pregnancy, particular with no identifiable risk factors. The incidence of stroke (ischemic or hemorrhagic) is estimated to be 25 cases per 100,000 deliveries.[1] Instigation of a multi-disciplinary derived birth plan minimises risk of morbidity to mother and foetus, with the aim of reducing the risk of further bleeding or extension of the intracranial haemorrhage

Abstract #: SUN-FCP – Room 7 – Rare Diseases - 01

## Case Report: Anesthesia and Peripartum Management of Alpha Gal Syndrome In Pregnancy

**Presenting Author:** Adam P. Dunmore, MD

**Presenting Author's Institution:** University of Pittsburgh Medical Center - Pittsburgh, Pennsylvania

**Co-Authors:** Grace Lim, MD MSc - Department of Anesthesiology & Perioperative Medicine, University of Pittsburgh School of Medicine

C. Tyler Smith, MD - University of Pittsburgh, Anesthesiology & Perioperative Medicine

### Intro

Alpha-gal Allergy or Alpha-gal Syndrome (AGS) is an acquired allergy caused by a bite from the lone star tick. The prevalence of AGS is increasing due to spread of this tick across the Southeastern United States. It results in an IgE mediated reaction to the oligosaccharide galactose- $\alpha$ -1,3-galactose ( $\alpha$ -Gal) which is expressed in the meat and tissues of mammals, including materials used in common medication production and sutures. In most cases, AGS diagnosis is made after delayed (2-3 hours) anaphylactic reactions to red meat and blood tests for IgE to  $\alpha$ -Gal<sup>1</sup>.  $\alpha$ -gal is an oligosaccharide found on the surface of mammalian cells<sup>2</sup>, produced by the enzyme  $\alpha$ -1,3-galactosyltransferase which is present in most mammals. The IgE mediated reactions seen in AGS requires previous exposure to the lone star tick in order to occur<sup>3</sup>. AGS introduces significant challenges to the anesthesiologist who will need to provide a detailed, 'mammalian-less' anesthetic and to manage perioperative medication plans.

### Case

A 47-year-old G1P0 female presented for prenatal anesthesia clinic with past medical history of AGS, mast cell activation syndrome, chronic lyme disease, moderate asthma, and chronic pain. She reported the ability to eat only 10 foods due to AGS as well as mast cell activation syndrome. A multidisciplinary discussion between maternal fetal medicine, pharmacy, allergy and immunology, and obstetric anesthesiology ensued and continued until delivery. All conceivable medications used in obstetric and anesthesia care, post delivery care, and operative delivery care, including multiple formulations of each drug, were individually assessed by the pharmacy team to determine if they contained mammalian products. Suture materials were verified for safety, should laceration or operative delivery be required.

An induction of labor was scheduled to minimize risks of emergent delivery. Multidisciplinary teams reviewed her plan every 12 hours at team safety rounds. Epinephrine, diphenhydramine, and hydrocortisone were available at bedside always. She requested epidural labor analgesia which was initiated using pre-specified pharmacy formulated medications including ropivacaine 0.1% + 2mcg/mL fentanyl. She had a successful spontaneous vaginal delivery without lacerations. There was no evidence of allergic reaction during labor and delivery. Postpartum course was uncomplicated, and she was discharged on day 2 in stable condition with routine postpartum follow-up.

### Conclusion

Patients with a history of AGS should have anesthesiology and pharmacy consultation and full review of medications which may contain mammalian product prior to the onset of spontaneous labor. Careful consideration must be taken when planning the mode of delivery and which medications are compatible for each in patient with this condition.

[figure Dunmore alpha gal.pdf](#)

Abstract #: SUN-FCP – Room 7 – Rare Diseases – 02

## A Case Report of Cesarean Section for a Parturient with Cantú Syndrome

**Presenting Author:** Mary Roberts, MD

**Presenting Author's Institution:** University of Cincinnati

**Co-Authors:** Andrea Girnius, MD - University of Cincinnati

Cantú syndrome is a rare autosomal dominant genetic disorder characterized by hypertrichosis, coarse facial features, cardiac abnormalities, and skeletal abnormalities (1) and can be associated with mutation of the ABCC9 gene (2). Given its low prevalence, few anesthetic case reports exist that involve this syndrome and it may be under-diagnosed. Nevertheless, this condition requires specific anesthetic considerations.

Our patient was a 25 year old G1P0 female with a known history of Chiari malformation type 1 with lumboperitoneal shunt, scoliosis status post spinal fusion, stable mild aortic root dilation and mild aortic insufficiency, and prior pericardial effusion. Cantú syndrome was first suspected during pregnancy given her cardiac and skeletal anomalies. Genetic testing confirmed ABCC9 mutations in both the patient and fetus consistent with Cantú syndrome.

She was followed in our multidisciplinary obstetric cardiac clinic during pregnancy. Transthoracic echocardiogram acquired around 35 weeks gestation showed no pericardial effusion, normal left ventricular ejection fraction, aortic root of 4 cm and mild aortic regurgitation. At 36 weeks and 1 day gestation the patient presented due to painful contractions. Her pain was poorly controlled with oral medications and she was admitted for monitoring with a plan to deliver at 37 weeks gestation. Painful contractions returned on hospital day 6 (36+6 weeks gestation) and the decision was made to deliver via Cesarean section for breech presentation. Her history of spinal fusion and lumboperitoneal shunt precluded neuraxial anesthesia; she therefore underwent general anesthesia with rapid sequence intubation and video laryngoscopy. The patient was extubated after an uncomplicated delivery; the baby was taken to the NICU due to prematurity and known Cantú syndrome, but did well and was discharged as expected. The patient had an uncomplicated recovery and was discharged on postoperative day 6.

The facial, cardiac, and skeletal abnormalities that arise in Cantú syndrome can impact anesthetic care. Broad nasal bridge and macroglossia can impair mask ventilation and direct laryngoscopy; video laryngoscopy may be considered for the first-pass attempt. Scoliosis and cranial malformations may complicate or prevent neuraxial anesthesia. Cardiac abnormalities should be considered, especially given the increase in cardiac output and blood volume in pregnancy which may exacerbate valvular disorders, cardiomyopathy and pericardial effusions. Overall, anesthesia can be delivered safely and effectively to patients with Cantú syndrome.

## Combined Spinal-Epidural Anesthesia for Cesarean Delivery of a Parturient with VACTERL Association

**Presenting Author:** Lawrence Weinstein, MD

**Presenting Author's Institution:** University of California, San Diego - San Diego, California

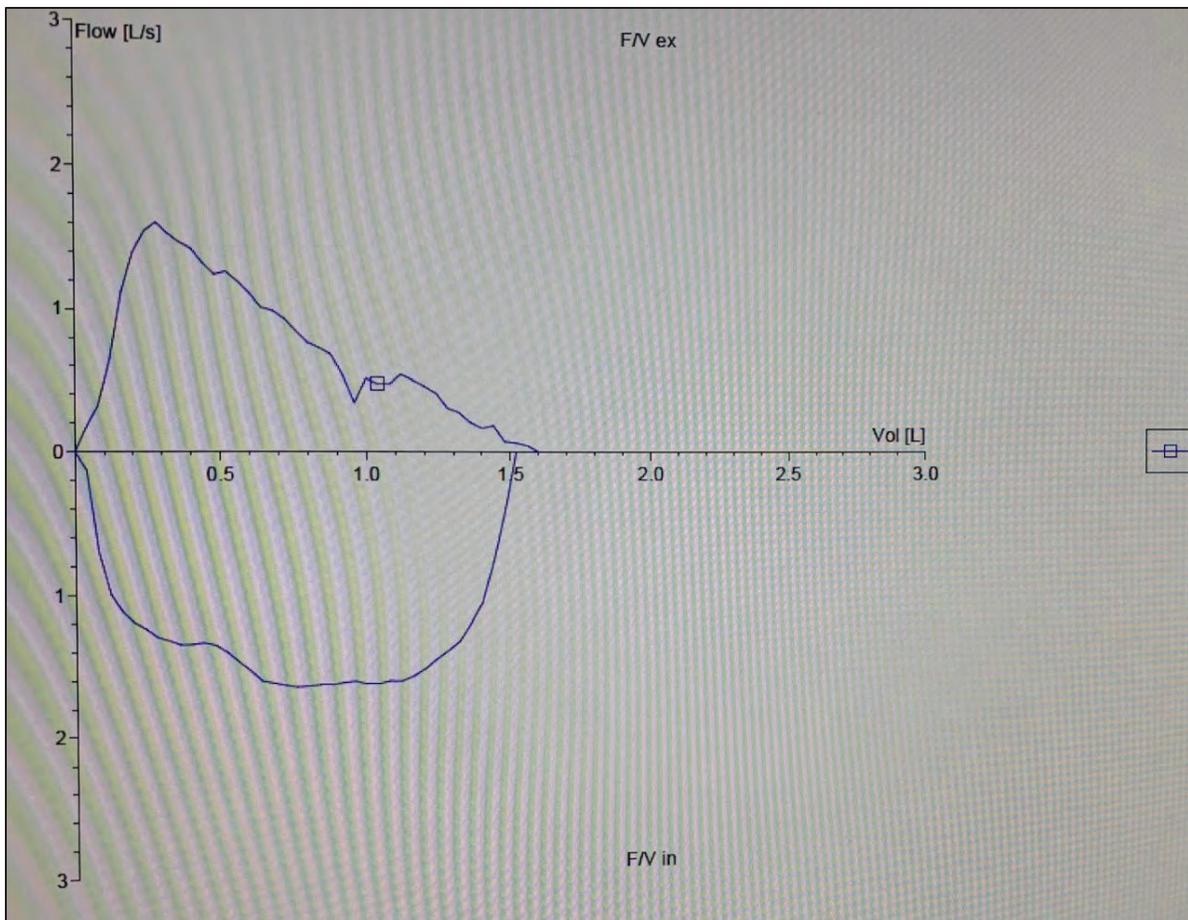
VACTERL association is a rare congenital disorder with an incidence of 1/10,000 – 1/40,000 births. The term is an acronym for **V**ertebral defects, **A**nal atresia, **C**ardiac defects, **T**E fistula, **R**enal and **L**imb abnormalities. Diagnosis is made when three or more of the features are present in the absence of other congenital abnormalities. With advances in care, particularly surgical correction of cardiac and TE abnormalities, more women with VACTERL are living to adulthood and having children. The features of VACTERL make pregnancy, delivery, and anesthesia more complicated, and safe care requires a multi-disciplinary approach.

The patient is a 20-year-old, G2P0 woman with a history of VACTERL diagnosed by severe scoliosis, atrial & ventricular septal defects, TE fistula, and hypoplastic right upper extremity. The VSD, ASD, and TEF were surgically corrected early in life. Echocardiogram demonstrated normal bi-ventricular function with RV enlargement and no residual ASD nor VSD. The patient's scoliosis was uncorrected and PFT's revealed both obstructive and restrictive lung disease, with severely decreased FVC, FRC, TLC, and RV. With the increased oxygen consumption in pregnancy, this was concerning should general anesthesia be needed. The patient was scheduled for a c-section secondary to small body habitus and a contracted pelvis.

On presentation, the patient was pleasant and cooperative. Exam was notable for extremely small stature (4'5", 35 kg), hypoplastic right UE, severe thoracic scoliosis, and diminished breath sounds. Airway exam was reassuring, with good neck motion and mouth opening. The lumbar spine was easily palpable and less scoliotic than the thoracic area. Neuraxial and general anesthesia were discussed, with the patient opting for attempted spinal anesthesia.

The patient was brought to the OR and a combined spinal-epidural was placed on one attempt at the L2-3 interspace. Given her short stature, the spinal dose was reduced to bupivacaine 0.75% 0.8 cc, with morphine 0.1 mg and fentanyl 15 mcg. She remained sitting for 2 minutes to prevent excessive cephalad spread and to allow for adequate saddle anesthesia for vaginal prep and foley placement. After positioning, the patient had a T3 sensory level to ice within several minutes. Complete motor block in the legs suggested adequate block density, and the c-section proceeded uneventfully.

Patients with VACTERL present unique anesthetic challenges. In this case, pregnancy and restrictive lung disease made general anesthesia riskier, while scoliosis and small stature may have complicated spinal anesthesia. Given her size, we opted for a very low-dose CSE to minimize the chance of high-spinal, while allowing for extension of the block via epidural catheter if needed. Thorough patient evaluation allowed for safe delivery with neuraxial anesthesia.



Abstract #: SUN-FCP – Room 7 – Rare Diseases – 04

**Intellectual disability, sexual abuse and scoliosis: coordinated cesarean section care for a patient with 22q11 deletion syndrome**

**Presenting Author:** Anna Swenson, MD

**Presenting Author's Institution:** University of Minnesota - Golden Valley, Minnesota

People with intellectual disability often have anesthetic challenges and are at higher risk of sexual abuse.<sup>1</sup> When abuse leads to pregnancy, multidisciplinary advance planning can help provide respectful care and informed consent for patients.

**Case report:**

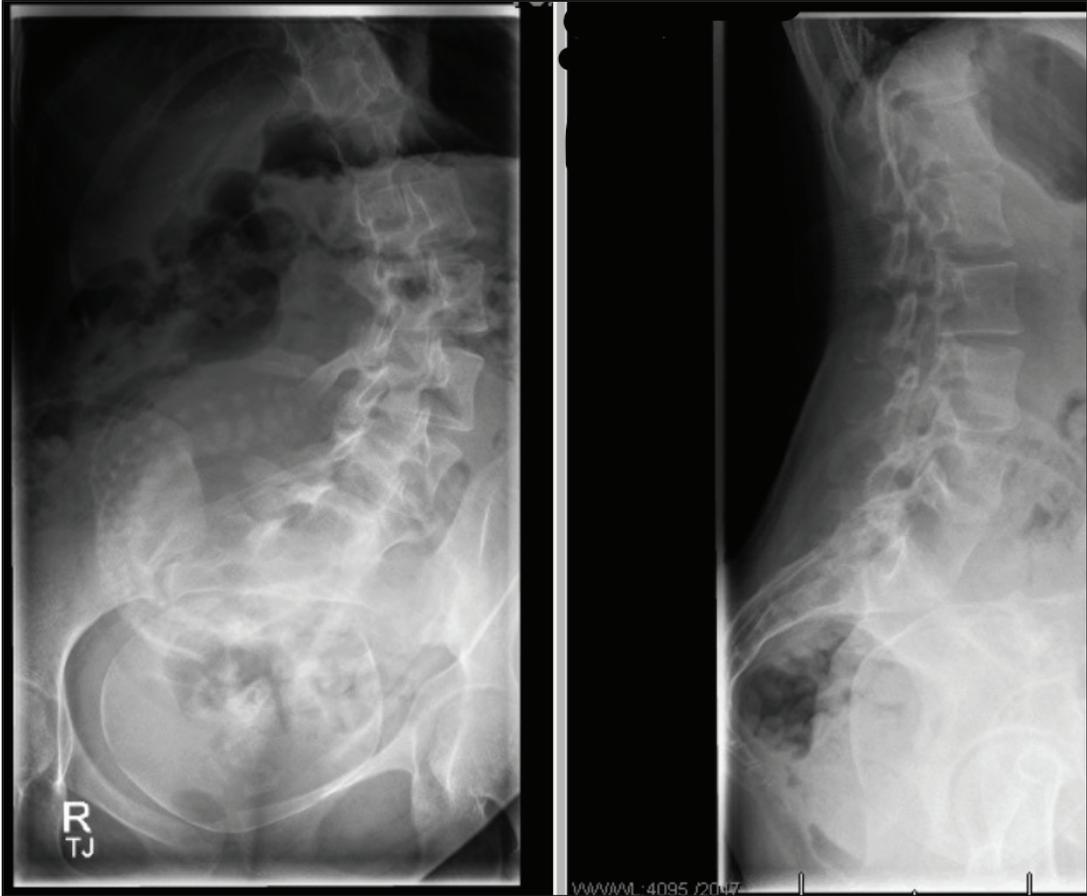
24 year old G1P0 parturient at 31 weeks gestation was referred for anesthesia consult. Records reported that she was pregnant from sexual abuse and had 22q11.2 deletion syndrome with developmental delay, scoliosis, congenitally fused cervical spine, velopharyngeal insufficiency, and hearing loss. She was scheduled to have a cesarean section at 38 weeks due to her small pelvis and anesthetic risks. She and her family speak Hmong.

With an interpreter, the patient, her mother and an anesthesiologist discussed spinal and general anesthesia, and made a plan for first attempting spinal anesthesia. She had a two centimeter mouth opening, limited neck extension, and marked scoliosis. She wore hearing aids, but could understand loud speech without them. It was agreed that the patient's mother could be present for spinal placement. An in person Hmong interpreter, second anesthesia staff, and ultrasound would be available for the cesarean section. To minimize re-traumatization, team members would have ongoing interaction about expected sensations during the cesarean section.<sup>2</sup> She would position herself supine and her arms would not be restrained. On the day of surgery, spinal placement was successful on second attempt, which the patient tolerated well. She remained hemodynamically stable and conversant through the procedure. She gave birth to a male infant and had skin-to-skin. The patient had an uneventful recovery, was visited by lactation and social work, and was discharged postoperative day three.

**Discussion:**

Our patient had significant risk factors for difficult airway, difficult neuraxial placement, and psychological distress. With her developmental delay, history of abuse, and language barrier, there was concern for how she would tolerate either awake intubation or spinal placement, but having a thorough conversation in advance helped the patient and her mother's anxiety. Having an in person interpreter was valuable to improve understanding with her hearing loss and developmental delay. The additional anesthesiologist and ultrasound helped the spinal placement efficiency.

They preferred to not have a legal guardian, but the patient was not able to repeat risks and benefits of procedures, so both she and her mother signed consent forms. Knowledge of her history allowed the medical team to coordinate our efforts to provide trauma informed care for this medically and socially complex patient.



## Cesarean Delivery in a Patient with Blue Rubber Bleb Nevus Syndrome

**Presenting Author:** Alexandra Kiers, MD

**Presenting Author's Institution:** Henry Ford Hospital - Detroit, Michigan

**Co-Authors:**

**Introduction:** Blue Rubber Bleb Nevus Syndrome (BRBNS) is a rare condition characterized by vascular malformations that present in varying locations throughout the body<sup>1,2,3</sup>. In the following case, we present an incident of successful cesarean delivery in a woman with BRBNS.

### Case Presentation:

A 21-year-old G1P0 female at 17w5d gestation with a medical history of BRBNS and chronic anemia complicated by anti-Kell isoimmunization presented to our hospital for Obstetric consultation. The patient was initiated on aspirin therapy and advised to follow up with a multidisciplinary team. She was seen by the Obstetrical Anesthesiology team approximately two months later at 26w6d gestation after presenting with dyspnea. At that time, the patient was evaluated by Otolaryngology, Gastroenterology, Hematology, and Dermatology services. Flexible laryngoscopy showed no pharyngeal or laryngeal lesions however, the subglottic airway was not examined. Magnetic Resonance Imaging (MRI) of the spine revealed multiple lesions in the lumbar region including a large lesion at approximately L4-L5 on the left and two lesions in the gluteal region without obvious connection to the spinal canal or lumbosacral plexus. Based on the results, the patient was to be offered neuraxial anesthesia under ultrasound-guidance. The patient later re-presented with symptoms of COVID-19 infection at 39w3d at which time she underwent induction of labor. The patient refused neuraxial anesthesia and eventually required urgent cesarean delivery under general anesthesia. The patient was intubated via video laryngoscope without incident and surgery was uncomplicated. The patient required one unit of packed red blood cells on the first postoperative day but otherwise had no significant complications.

### Discussion:

BRBNS is a rare condition of unclear pathogenesis with vascular malformations typically presenting early in life<sup>1</sup>. Depending on lesion location, patients may have significant symptoms and complications<sup>1,2,3</sup>. Given the rarity of the disease, there is an overall paucity of literature detailing anesthetic management of pregnant women with BRBNS. Available case reports describe success with both neuraxial and general anesthesia, with a multidisciplinary team being vital<sup>1,2,3</sup>. Here we present a case of successful cesarean delivery via general anesthesia in a woman with BRBNS.

Cesarean Section of a Patient With Fibrodysplasia Ossificans Progressiva

**Presenting Author:** Heewon Lee, MD

**Presenting Author's Institution:** Emory University

**Co-Authors:** Evesha Kenlyn, MD - Emory University

Bryan Nycz, MD - Emory University

Fibrodysplasia ossificans progressiva (FOP) is a rare autosomal dominant disease characterized by progressive ossification of tendons, ligaments, fascia, and skeletal muscle. Ossification can occur either spontaneously or as a result of tissue trauma beginning in childhood. Joints typically ankylose and patients frequently become immobile in their 20s. Patients frequently die before age 40 due to restrictive disease secondary to intercostal muscle failure. The temporomandibular joint (TMJ) and cervical spine also often ossify resulting in immobilization of the jaw and neck, making traditional airway management nearly impossible. There are very few case reports related to the anesthetic care of a parturient with FOP. Most case reports are in relation to anesthesia for dental procedures. Here, we describe our patient, an eighteen year old G2P0010 with history of FOP, hypertension, seizure disorder, GERD, and severe fetal growth restriction (EFW 6%ile, AC < 3%) who presented at 15 weeks for initial prenatal consultation. A multidisciplinary team consisting of obstetricians, obstetric anesthesiologists, otolaryngologists, a FOP specialist, and neonatologists devised a delivery plan for the patient. Given the COVID pandemic, the teams met virtually prior to the delivery date. The patient was admitted at 33 weeks and 4 days due to worsening functional status after a flare localized to her lumbar spine and increased work of breathing. She was managed and status optimized prior to delivery at 34 weeks and 3 days with general anesthesia following awake nasal intubation. During the entirety of her hospital stay, particular attention was made to prevent further trauma to avoid exacerbation of the disease.



Abstract #: SUN-FCP – Room 7 – Rare Diseases – 07

### Interdisciplinary management of a medically complex parturient with sarcoidosis and splenomegaly

**Presenting Author:** Margaret E. Smith, MD

**Presenting Author's Institution:** University of Chicago - Chicago, Illinois

**Co-Authors:** Chad Dean, MD - University of Chicago

**Case:** A 30y/o G4P1102 at 25 WGA with history of sarcoidosis presented to an outside hospital with fevers and abdominal fullness. She reported a history of splenomegaly diagnosed incidentally on routine OB ultrasound (US) earlier in pregnancy. Repeat US showed massive splenomegaly, with progression from 21 to 27cm in craniocaudal direction over a period of two weeks. Laboratory studies were significant for anemia and lymphopenia. She was transferred to our institution given concern for progressive splenic sequestration with risk of splenic rupture.

She was hemodynamically stable, with left-upper quadrant pain controlled on multimodal analgesia. The etiology of her splenomegaly was felt to be most consistent with sarcoidosis and she was initiated on infliximab and high dose corticosteroids. A multidisciplinary team was convened including MFM, general and vascular surgery, hematology, rheumatology, and OB anesthesia to discuss further management with the patient, who took part in shared decision-making.

The patient wished to proceed with pregnancy, and the rheumatology team felt that the patient's splenomegaly could stabilize with appropriate treatment of her sarcoidosis. We continued inpatient expectant management with serial abdominal US in an attempt to achieve fetal maturity. At 35 WGA, the spleen had decreased to 17cm in size, but the patient developed paroxysmal tachyarrhythmias and echocardiogram revealed mildly reduced ejection fraction. The decision was made to proceed with cesarean delivery at this time. She underwent an uncomplicated cesarean delivery under combined spinal epidural. Her recovery was uneventful and she was discharged home on POD #4.

**Discussion:** Massive splenomegaly is rare in sarcoidosis, seen in only 3% of patients.<sup>1</sup> With regards to splenomegaly in pregnancy, the literature is limited with no formal guidelines for management.<sup>2</sup> Changes related to pregnancy, including reduced peritoneal cavity volume and uterine contractions, increase the risk for spontaneous rupture in the setting of splenomegaly, especially in the third trimester.<sup>3</sup> Conversely, splenectomy late in pregnancy carries a substantial risk of maternal and fetal morbidity and mortality.<sup>4</sup> In our patient, if worsening splenomegaly or splenic rupture, we planned to proceed with cesarean delivery with concomitant splenectomy, which likely would have required aortic cross-clamping to control bleeding. Given her significant response to therapy, the decision was made to defer splenectomy at the time of delivery. The benefits of increased fetal maturity and improved management of her sarcoidosis outweighed the risk of spontaneous splenic rupture under careful monitoring and continuous reassessment. The presence of competing risks and benefits requires multidisciplinary communication and involvement of the patient in shared decision-making.

**Abstract #: SUN-FCP – Room 7 – Rare Diseases – 08**

**Case report: Peri-partum challenges in a parturient with systemic sclerosis & COVID-19 infection**

**Presenting Author:** Sonal N. Zambare, MD

**Presenting Author's Institution:** Baylor College of Medicine - Pearland, Texas

**Introduction:** The COVID-19 pandemic has added many challenges in care of pregnant women with pre-existing conditions. We present successful management of a pregnant woman with systemic sclerosis (SSc) with SARS-CoV-2 infection necessitating a preterm cesarean delivery.

**Case:** A 29 y-o G3P2 at gestational age of 30.6 weeks with history of systemic sclerosis, moderate dextro-scoliosis, severe restrictive lung disease, fetal growth restriction, difficult airway and difficult vascular access was admitted with shortness of breath, transaminitis and poor weight gain during pregnancy. She was SARS-CoV-2 positive on admission. She was 5' tall 35 kg with BMI 15 kg/m<sup>2</sup>. Patient had a history of tracheostomy complicated by a tracheo-cutaneous fistula at age 7 which had been subsequently decannulated at age 9. Her obstetric history included 2 vaginal births. Significantly, following an epidural for labor analgesia during her first pregnancy she developed a subdural hematoma immediately postpartum. During the second pregnancy she had opted not to have an epidural for analgesia.

Her pulmonary function was significantly worse compared to prior studies with a FEV1 and FVC 18% of predicted. TTE showed a mitral valve prolapse with no evidence of pulmonary hypertension and a normal cardiac function. She underwent a controlled primary cesarean delivery with a tubal ligation for increasing oxygen requirement and work of breathing in the setting of poor baseline lung function. There was concern that patient would not be able to tolerate induction of labor and stresses of labor/pushing with an unfavorable cervix for induction of labor and an emergent intubation for an emergent delivery needed to be avoided.

Intraoperatively, she had an epidural placed for her cesarean delivery so that the anesthetic level could be titrated slowly given her short stature and severe scoliosis. There was concern for a rapid and unpredictable spread of an intrathecal anesthetic so it was avoided. The sensory block after the epidural was patchy and the patient experienced pain during the cesarean. To assist with pain, sedation with dexmedetomidine and ketamine was used successfully during the surgery and intubation was avoided in this patient with a predicted difficult intubation. Post-operatively the patient and her newborn performed well.

**Discussion:** Patients with SSc present many challenges for the entire team with airway management, neuraxial placement, unpredictable spread of local anesthetic, cardiopulmonary compromise, renal disease, intravenous line placement, respiratory compromise and patient positioning<sup>1</sup>. Infection with the SARS CoV-19 virus altered the course of pregnancy in our patient significantly leading to a preterm cesarean delivery. Covid-19 pandemic has added to the challenges for these patients. Careful planning and close monitoring remain vital for management.

[Spine image.pdf](#)

**Abstract #: SUN-FCP – Room 7 – Rare Diseases – 09**

**Total Parenteral Nutrition in Pregnancy – A case Report**

**Presenting Author:** Rodwan Husein, MBChB

**Presenting Author's Institution:** Barts Health and The London School of Anaesthesia

**Co-Authors:** Laszlo Agocs, MBChB - Barts Health

Laura Fulton, FRCA - Barts Health

Wedisha Gankanda, Mbchb - Barts Health

Edward Gill, MBChB, MSc - Barts Health NHS Trust

Sanjeev Thunga, FRCA - Barts Health

Total Parenteral Nutrition in Pregnancy – A case Report

A 32-year-old lady presented to our obstetrics unit 37 weeks pregnant whilst on Total Parenteral Nutrition (TPN). Natural conception whilst on TPN is a very rare occurrence with only a handful of cases reported in the last 30 years. This lady had been on TPN for 19 months prior to conception and throughout pregnancy secondary to three major laparotomy procedures.

The patient also suffered from dumping syndrome, asthma, anaemia, deranged liver function and polycystic ovary syndrome. The pregnancy was further complicated with abnormal middle cerebral artery dopplers. In this case report we describe our experience and approach to this rare obstetric co-morbidity.

A multi-disciplinary team (MDT) involving obstetricians, general surgeons and anaesthetists discussed the merits of the different delivery and analgesic methods. The main concerns included surgical approach, presence of adhesions, bowel resection, spinal versus epidural versus general anaesthesia (GA). It was concluded that a vaginal delivery with an early epidural would be the safest and most effective route with the caveat of proceeding to top up for a caesarean section, and conversion to GA if a full laparotomy was required. This decision was taken in light of the patient's refusal for an elective caesarean section fueled by her previous surgical experiences

A lumbar epidural catheter was cited and the patient eventually had an induction of labour. Unfortunately, a meconium stained liquor was subsequently discovered and an emergency caesarean section declared. An epidural top-up was performed and a Pfannenstiel approach was taken to the abdomen with no significant adhesions found. The procedure was completed uneventfully with a healthy delivery and a pain free mother. This case highlights the increasing complexity of the obstetric anaesthetic demographic and the importance of an MDT approach.