SOAP
Society for Obstetric Anesthesia and Perinatology

SOAP 51st Annual Meeting

Improving Maternal Outcomes: High Impact Strategies for Change

May 1–5, 2019

JW Marriott Phoenix Desert Ridge Resort and Spa • Phoenix, Arizona

SYLLABUS

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

American Society of Anesthesiologists™

SOAP
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Welcome!

On behalf of the SOAP Board of Directors and the 2019 Annual Meeting Planning Committee, **we are delighted to welcome you to the Society for Obstetric Anesthesia and Perinatology (SOAP) 51st Annual Meeting at the J.W. Marriott Phoenix Desert Ridge Resort and Spa in sunny Phoenix, Arizona (May 1-5, 2019).**

Educational Program:

This meeting is dedicated to ***Improving Maternal Outcomes: High Impact Strategies for Change***, bringing you the latest techniques, guidelines and research.

Our pre-meeting workshops offer great opportunities for skill building for any level of training. Hands on workshops feature a wide array of ultrasound applications, professional development in leadership, and team training! Dr. Carolyn Weiniger will deliver the annual, highly anticipated "Gerard W. Ostheimer - What's New in Obstetric Anesthesia?" lecture and Dr. Jose Carvalho will be giving the always engaging Fred Hehre Lecture. Emerging research will be highlighted in our Gertie Marx Research Competition, Best Paper Session and oral poster presentations. New this year, we present several multi-disciplinary panels to discuss the coordination of care for some of the sickest patients. We will have a special guest appearance by Stephanie Arnold, bestselling author of the book *"37 Seconds"* about her personal experience with a near fatal amniotic fluid embolism.

For those looking for brief, clinically focused, refresher lectures, join us Saturday, May 4th for the ***Clinical Track***. These lectures feature 25-minute overviews of how to treat pregnant patients with Maternal Hemorrhage, Substance Use Disorders, Postdural Puncture Headache and Controversial Topics with Emerging Data.

Trainees can take advantage of our ***"Find a Mentor"*** program where residents can pair with more senior SOAP members to learn more about our wonderful specialty.

Lunch time offers several exciting options this year. Sign up for one of our ***Lunch and Learn*** sessions, where you can have a meal while engaging in case-based learning. If you are interested in networking with SOAP Board members and colleagues, sign up for the ***Lunch Around*** in the Stonegrill. Space is limited in these and the other organized lunch options, so be sure to sign up.

Recreational Offerings:

There will be plenty of time to enjoy the luxurious amenities of the J.W. Marriott Phoenix Desert Ridge Resort and Spa during our "free" (unscheduled) Friday afternoon and between sessions. There is something for everyone in the family! The hotel features five pools, including a lazy river and waterslide with food and drinks available within steps. Golf enthusiasts will enjoy the Wildfire Golf Club with its two professional golf courses (Palmer Signature Course and the Faldo Championship) and mountain views. Be sure to register for our Friday afternoon golf outing!

Visit the 28,000 square foot Revive Spa which boasts 41 treatment rooms, a private outdoor bistro and sanctuary pool area with a backdrop of the majestic mountains of the Sonora Desert. A state-of-the-art fitness center hosts classes in cycling, yoga, strength training and Tai Chi that will help you stay balanced and energized during your stay. Enjoy outdoor tennis courts, jogging, fitness trails and bike rentals or experience Pickleball, a sport that combines badminton, tennis and table tennis. In addition, the property has a **JW Kids Camp** daily that offers arts and crafts, desert adventures, sports and trivia for your little ones.

Lisa R. Leffert, M.D.
Chair, Scientific Program Committee
2019 SOAP Annual Meeting
SOAP President Elect

Heather C. Nixon, M.D.
2019 SOAP Annual Meeting Host

Explore local attractions in nearby Scottsdale or Cave Creek, where you can find western style goods with great dining options. The Desert Ridge Marketplace is also within walking distance from the hotel. Take some time to visit the amazing Musical Instruments Museum (MIM), which houses North America's largest collection of musical instruments just five minutes from the hotel.

Of course, don't miss our **Opening Reception at the J.W. Marriott Sunset Lawn on Wednesday, May 1st** (admission is included in the registration fees). Then join friends again on the **evening of Saturday, May 4th** at the local eatery **High and Rye** for a more relaxed and casual banquet featuring upscale comfort food, craft cocktails, beers and dancing with a DJ.

Come for the meeting, but save time to enjoy Phoenix at its best! We look forward to welcoming you to the 51st Annual Meeting - one you won't want to miss!

Sincerely,
Lisa R. Leffert, M.D. & Heather C. Nixon, M.D.

Thank you to the 2019 SOAP Platinum, Gold, Silver and Bronze Supporters:

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Program Committee

Lisa R. Leffert, M.D.
Program Chair, SOAP 51st Annual Meeting
Associate Professor of Anesthesia
Harvard University Medical School
Massachusetts General Hospital
Boston, MA

Heather C. Nixon, M.D.
Meeting Host, SOAP 51st Annual Meeting
Associate Professor of Clinical Anesthesiology
University of Illinois College of Medicine at Chicago
University of Illinois Health
Chicago, IL

Meredith A. Albrecht, M.D., Ph.D.
Associate Professor of Anesthesiology
Medical College of Wisconsin
Medical College of Wisconsin Affiliated Hospitals
Milwaukee, WI

Brendan Carvalho, M.B.B.Ch., F.R.C.A., M.D.C.H.
Professor of Anesthesiology, Perioperative and Pain Medicine
Stanford University School of Medicine
Stanford, CA

Philip E. Hess, M.D.
Associate Professor of Anaesthesia
Harvard University Medical School
Beth Israel Deaconess Medical Center
Boston, MA

Ruth Landau, M.D.
Professor of Anesthesiology
Columbia University
New York - Presbyterian Hospital
New York, NY

May C.M. Pian-Smith, M.D., M.S.
Associate Professor of Anaesthesia
Harvard University Medical School
Massachusetts General Hospital
Boston, MA

Paloma Toledo, M.D., M.P.H.
Assistant Professor of Anesthesiology
Northwestern University Feinberg School of Medicine
Prentice Women's Hospital
Chicago, IL

Mark I. Zakowski, M.D., FASA
Associate Professor of Anesthesiology
Cedars-Sinai Medical Center
Los Angeles, CA

Program Faculty

Jaime Aaronson, M.D.
Weill Cornell Medicine
New York Presbyterian Hospital
New York, NY

Meredith A. Albrecht, M.D., Ph.D.
Medical College of Wisconsin
Medical College of Wisconsin Affiliated Hospitals
Milwaukee, WI

Katherine W. Arendt, M.D.
Mayo Clinic College of Medicine
Mayo Clinic
Rochester, MN

Stephanie Arnold
Chicago, IL

Cristian Arzola, M.D., M.Sc.
University of Toronto
Mount Sinai Hospital
Toronto, ON

Ami Y. Attali, D.O.
Wayne State School of Medicine
Henry Ford Hospital
Detroit, MI

Mrinalini Balki, M.B., B.S., M.D.
University of Toronto
Mount Sinai Hospital
Toronto, ON

Jennifer Banayan, M.D.
Pritzker School of Medicine, University of Chicago
University of Chicago Medicine
Chicago, IL

Brian T. Bateman, M.D., M.Sc.
Harvard University Medical School
Massachusetts General Hospital
Boston, MA

Jeanette R. Bauchat, M.D.
Vanderbilt University School of Medicine
Vanderbilt University Medical Center
Nashville, TN

Melissa E. Bauer, D.O.
University of Michigan Health System
Ann Arbor, MI

Alan D. Bedrick, M.D.
University of Arizona College of Medicine – Tucson
Banner University Medical Center Tucson
Tucson, AZ

Sumita Bhambani, M.D.
Lewis Katz School of Medicine at Temple University
Temple University Hospital
Philadelphia, PA

Ricardo Bittencourt, M.D., M.B.A.
University of Alberta
University of Alberta Hospital
Edmonton, AB

Laurent A. Bollag, M.D.
University of Washington School of Medicine
University of Washington Medical Center
Seattle, WA

Joan E. Briller, M.D.
University of Illinois College of Medicine at Chicago
University of Illinois Hospital & Clinics
Chicago, IL

Alexander Butwick, M.B.B.S., M.S., F.R.C.A.
Stanford University School of Medicine
Stanford, CA

Stephanie I. Byerly, M.D.
University of Texas Southwestern Medical School
University of Texas Southwestern Medical Center
Dallas, TX

Arthur L. Calimaran, M.D.
University of Mississippi Medical Center
Jackson, MS

William R. Camann, M.D.
Harvard University Medical School
Brigham and Women's Hospital
Boston, MA

Brendan Carvalho, M.B.B.Ch., F.R.C.A., M.D.C.H.
Stanford University School of Medicine
Stanford, CA

Jose C.A. Carvalho, M.D., Ph.D., FANZCA, FRCPC
University of Toronto
Mount Sinai Hospital
Toronto, ON

Laurie A. Chalifoux, M.D.
Michigan State University College of Human Medicine
Anesthesia Practice Consultants, Spectrum Health
Grand Rapids, MI

Wei Chao, M.D.
University of Hawaii School of Medicine
Honolulu, HI

Anthony Chau, B.Sc., M.D., M.Sc., FRCPC
B.C. Women's Hospital & Health Centre
Vancouver, BC

Erik M. Clinton, M.D.
Harvard University Medical School
Massachusetts General Hospital
Boston, MA

Jaime Daly, M.D.
Harvard University Medical School
Massachusetts General Hospital
Boston, MA

Mateja De Leonni Stanonik, M.D., M.A., Ph.D.
Vita Medica Institute
Tucson, AZ

Carlos M. Delgado Upegui, M.D.
University of Washington Medical Center
Seattle, WA

Emily Dinges, M.D.
University of Washington
Seattle, WA

Thomas Drew, M.D.
University of Toronto
Mount Sinai Hospital
Toronto, ON

Guy Edelman, M.D.
University of Illinois College of Medicine at Chicago
University of Illinois Health
Chicago, IL

Michaela K. Farber, M.D., M.S.
Harvard University Medical School
Brigham and Women's Hospital
Boston, MA

Regina Y. Fragneto, M.D.
University of Kentucky College of Medicine
University of Kentucky Chandler Medical Center
Georgetown, KY

Robert R. Gaiser, M.D.
University of Kentucky College of Medicine
University of Kentucky HealthCare
Lexington, KY

Jacqueline M. Galvan, M.D.
University of Illinois College of Medicine at Chicago
University of Illinois Hospital & Health Sciences
Chicago, IL

Ronald B. George, M.D., FRCPC
Dalhousie University
IWK Health Centre
Haifax, NS

Program Faculty cont.

Ashraf S. Habib, M.B., B.Ch., M.H.Sc., F.R.C.A.
Duke University School of Medicine
Duke University Health System
Durham, NC

Joy L. Hawkins, M.D.
University of Colorado School of Medicine
University of Colorado Hospital
Aurora, CO

Philip E. Hess, M.D.
Harvard University Medical School
Beth Israel Deaconess Medical Center
Boston, MA

Nicole Higgins, M.D.
Northwestern University Feinberg School of Medicine
Northwestern Memorial Hospital
Chicago, IL

Alexandria J. Hill, M.D.
University of Nevada Las Vegas
University of Arizona
High Risk Pregnancy Center
Texas A&M Health Science Center
Las Vegas, NV

Jennifer E. Hofer, M.D.
Pritzker School of Medicine, University of Chicago
University of Chicago Medicine
Chicago, IL

Michael P. Hofkamp, M.D.
Baylor & Scott White Healthcare
Temple, TX

McCallum R. Hoyt, M.D., M.B.A.
Cleveland Clinic Foundation
Hillcrest Hospital
Mayfield Heights, OH

Alejandro Jankelevich, M.D.
Hospital Fach and Clinica Las Condes
Santiago, Chile

Gayani Jayasooriya, M.B.,B.S., B.Sc., F.R.C.A.
Imperial School of Anaesthesia
Hillingdon Hospital NHS Trust
London, United Kingdom

Ki Jinn Chin, M.B.B.S (Hons), MMEd, FANZCA, FRCPC
University of Toronto
Toronto Western Hospital
Toronto, ON

Rachel M. Kacmar, M.D.
University of Colorado School of Medicine
University of Colorado Hospital
Aurora, CO

Brinda B. Kamdar, M.D.
Harvard University Medical School
Massachusetts General Hospital
Boston, MA

Sarah J. Kilpatrick, M.D., Ph.D.
Cedars-Sinai Medical Center
Los Angeles, CA

Klaus Kjaer, M.D., M.B.A.
Weill Cornell Medical College
New York Presbyterian Hospital
New York, NY

Thomas T. Klumpner, M.D.
University of Michigan Health System
Ann Arbor, MI

Ruth Landau, M.D.
Columbia University
New York - Presbyterian Hospital
New York, NY

Elizabeth Lange, M.D.
Northwestern University
Feinberg School of Medicine
Northwestern Memorial Hospital
Chicago, IL

Allison J. Lee, M.D., M.B., B.S.
Columbia University
Columbia University Medical Center
New York, NY

Lisa R. Leffert, M.D.
Harvard University Medical School
Massachusetts General Hospital
Boston, MA

Grace Lim, M.D., M.Sc.
University of Pittsburgh School of Medicine
Magee-Women's Hospital of UPMC
Pittsburgh, PA

James Lozada, D.O.
Northwestern University Feinberg School of Medicine
Prentice Women's Hospital
Chicago, IL

Grant C. Lynde, M.D., M.B.A.
Emory University School of Medicine
Emory University Hospital
Atlanta, GA

Bryan P. Mahoney, M.D.
Mount Sinai West
New York, NY

Clarita B. Margarido, M.D., Ph.D.
University of Toronto
Sunnybrook Health Sciences Centre
Toronto, ON

Marie-Louise Meng, M.D.
Columbia University
New York - Presbyterian Hospital
New York, NY

Jill M. Mhyre, M.D.
University of Arkansas for Medical Sciences
Little Rock, AR

Jean M. Miles, M.D.
Memorial Healthcare System
Envision Physician Services
Miami, FL

Rebecca D. Minehart, M.D., M.S.H.P.Ed.
Harvard University Medical School
Massachusetts General Hospital
Boston, MA

Daria M. Moaveni, M.D., B.S.
University of Miami Miller School of Medicine
Jackson Memorial Hospital
Miami, FL

Richard C. Month, M.D.
University of Pennsylvania Perelman School of Medicine
Hospital of the University of Pennsylvania
Philadelphia, PA

Albert Moore, M.D., FRCPC
McGill University
Royal Victoria Hospital
Montréal, QC

Jamie D. Murphy, M.D.
Johns Hopkins University School of Medicine
Johns Hopkins Hospital
Baltimore, MD

Kenneth E. Nelson, M.D.
Wake Forest University School of Medicine
Forsyth Memorial Hospital
Winston Salem, NC

Hokuto Nishioka, M.D.
University of Illinois College of Medicine at Chicago
University of Illinois Health
Chicago, IL

Heather C. Nixon, M.D.
University of Illinois College of Medicine at Chicago
University of Illinois Hospital
Chicago, IL

Barbara Orlando, M.D.
Icahn School of Medicine at Mount Sinai
Mount Sinai West Hospital
New York, NY

Vilma E. Ortiz, M.D.
Harvard University Medical School
Massachusetts General Hospital
Boston, MA

Clemens M. Ortner, M.D., M.S.
Stanford University School of Medicine
Stanford University Medical Center
Stanford, CA

Cesar Padilla, M.D.
Brigham and Women's Hospital
Boston, MA

Quisqueya T. Palacios, M.D.
Baylor College of Medicine
Houston, TX

Arvind Palanisamy, M.B., B.S., M.D., F.R.C.A.
Washington University School of Medicine
Barnes Jewish Hospital
St. Louis, MO

Greg Palleschi, M.D.
North Shore University Hospital
Lattingtown, NY

Craig M. Palmer, M.D.
University of Arizona Healthcare Network
Tuscon, AZ

Feyce M. Peralta, M.D.
Northwestern University Feinberg School of Medicine
Northwestern Memorial Hospital
Chicago, IL

Cathleen Peterson-Layne, Ph.D., M.D.
University of Nebraska Medical Center
Omaha, NE

May C.M. Pian-Smith, M.D., M.S.
Harvard University Medical School
Massachusetts General Hospital
Boston, MA

Felicity Plaat, M.D.
Imperial College Healthcare NHS Trust
Queen Charlotte's Hospital, London
London, UK

Malavika Prabhu, M.D.
Women and Infants Hospital
Providence, RI

Stephen Pratt, M.D.
Harvard University Medical School
Beth Israel Deaconess Medical Center
Boston, MA

Britany L. Raymond, M.D., B.S.
Vanderbilt University School of Medicine
Vanderbilt University Medical Center
Nashville, TN

Mark D. Rollins, M.D., Ph.D.
University of Utah
Salt Lake City, UT

Philip A. Rubin, M.D.
Yale University School of Medicine
Yale New Haven Hospital
New Haven, CT

Barbara M. Scavone, M.D.
Pritzker School of Medicine, University of Chicago
University of Chicago Medicine
Chicago, IL

Scott Segal, M.D., M.S.
Wake Forest University School of Medicine
Forsyth Memorial Hospital
Winston Salem, NC

Emily E. Sharpe, M.D.
Mayo Clinic College of Medicine
Mayo Clinic
Rochester, MN

Grace H. Shih, M.D.
University of Kansas Health System
Kansas City, KS

Naveed T. Siddiqui, M.D., M.Sc.
University of Toronto
Mount Sinai Hospital
Toronto, ON

Program Faculty cont.

Richard M. Smiley, M.D., Ph.D.
Columbia University
New York - Presbyterian Hospital
New York, NY

Kathleen A. Smith, M.D., FASA
University of North Carolina Chapel Hill School of Medicine
University of North Carolina Hospitals
Chapel Hill, NC

Eliane C S Soares, M.D.
Universidade Federal de Minas Gerais
Mater Dei Hospital
Belo Horizonte, Brazil

Nicole Z. Spence, M.D.
Harvard University Medical School
Massachusetts General Hospital
Boston, MA

David Stahl, M.D.
The Ohio State University Wexner Medical Center
Columbus, OH

John T. Sullivan, M.D., M.B.A.
St. Clair Hospital
Pittsburgh, PA

Pervez Sultan, M.B., B.S., F.R.C.A.
University College London
University College London Hospitals
London, UK

Caitlin D. Sutton, M.D.
Baylor College of Medicine
Texas Children's Hospital
Houston, TX

Hans P. Sviggum, M.D.
Mayo Clinic College of Medicine
Mayo Clinic
Rochester, MD

Chiraag Talati, M.B.B.S, B.Sc. (Hons), F.R.C.A.
Homerton University Hospital NHS Foundation Trust
London, United Kingdom

Mohamed Tiouririne, M.D.
University of Virginia Medical School
University of Virginia Medical Center
Charlottesville, VA

Roulhac D. Toledano, M.D., Ph.D.
NYU Lange Medical Center
Brooklyn, NY

Paloma Toledo, M.D., M.P.H.
Northwestern University Feinberg School of Medicine
Prentice Women's Hospital
Chicago, IL

Ashley M. Tonidandel, M.D., M.S.
Wake Forest University School of Medicine
Forsyth Memorial Hospital
Winston Salem, NC

Lawrence C. Tsen, M.D.
Harvard University Medical School
Brigham and Women's Hospital
Boston, MA

Mahesh Vaidyanathan, M.D., M.B.A., B.S.
Northwestern University Feinberg School of Medicine
Northwestern Memorial Hospital
Chicago, IL

Manuel C. Vallejo, Jr., M.D., D.M.D.
West Virginia University School of Medicine
Ruby Memorial Hospital
Morgantown, WV

Anasuya Vasudevan, M.B., B.S., M.D., F.R.C.A.
Geisinger Commonwealth School of Medicine
Scranton, PA

Tracey M. Vogel, M.D.
West Penn Allegheny Health System
Pittsburgh, PA

Christine Warrick, M.D.
University of Utah
Park City, UT

Carolyn Weiniger, M.B., Ch. B.
Tel Aviv Sourasky Medical Center
Tel Aviv, Israel

Corinne C. Weinstein, M.D., B.S.N.
University of Illinois College of Medicine at Chicago
University of Illinois Health
Chicago, IL

Paul M. Wieczorek, M.D., FRCPC
McGill University
Jewish General Hospital
Montréal, QC

Cynthia A. Wong, M.D.
University of Iowa Carver College of Medicine
University of Iowa Hospitals and Clinics
Iowa City, IA

Edward A. Yaghmour, M.D.
Northwestern University Feinberg School of Medicine
Northwestern Memorial Hospital
Chicago, IL

Joshua Younger, M.D.
Wayne State School of Medicine
Henry Ford Health System
Detroit, MI

Mark I. Zakowski, M.D.
Cedars-Sinai Medical Center
Los Angeles, CA

Paul Zakus, M.D., FRCPC
University of Calgary
Foothills Medical Centre
Calgary, AB

Jie Zhou, M.D., M.S., M.B.A.
Brigham and Women's Hospital
Harvard University Medical School
Boston, MA

Planning Committee/Faculty Disclosures

Key

1.. Salary
2.. Ownership
3.. Royalties
4.. Equity Position
5.. Stock Options
6.. Funded Research
7.. Consulting Fees
8.. Honoraria
9.. Other Material Support

The following planning committee members and/or faculty have reported that they have the following relevant financial relationships with commercial interests to disclose:

Financial Relationships Disclosed

Ami Y. Attali, D.O.
6 - Pacira Pharmaceuticals

Brian T. Bateman, M.D., M.Sc.
6 - Baxalta
6 - GSK
6 - Lilly
6 - Pacira Pharmaceuticals
6 - Pfizer
7 - Aetion, Inc
7 - The Alosa Foundation

Alexander J. Butwick, M.B.,B.S., FRCA, M.S.
7 - Instrumentation Laboratory
8 - Cerus Corp.

Brendan Carvalho M.B.B.Ch., F.R.C.A., M.D.C.H.
6 - Pacira Pharmaceuticals

Michaela K. Farber, M.D., M.S.
9 - Gauss Surgical

Ashraf S. Habib, M.B.,B.Ch., M.Sc., M.S.N., FRCA
6 - BioQ Pharma
6 - Health Decisions
6 - Pacira
7 - Haylard Health
7 - Trevena, Inc.
8 - Acacia Pharma

Grant C. Lynde, M.D., M.B.A.
7 - Merck

Rebecca D. Minehart, M.D., M.Ed.
7 - Rivanna Medical, Inc.
8 - ASA Interactive Computer Based Editorial Board Member

Richard M. Smiley M.D., Ph.D.
Spouse - 4 - Abbott
Spouse - 4 - Abbvie
Spouse - 4 - Amgen
5 - Abbott

Mohamed Tiouririne MD
5 - Adial Pharmaceutical
Spouse - 5 - Adial Pharmaceutical

Carolyn Weiniger, M.B.,Ch.B
8 - Elsevier

Abstract Author Disclosures

Key

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6 - Pacira Pharmaceuticals

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6 - Baxalta
6 - GSK
6 - Lilly
6 - Pacira Pharmaceuticals
6 - Pfizer
7 - Aetion, Inc
7 - The Alosa Foundation

Alexander J. Butwick, M.B.,B.S., FRCA, M.S.
7 - Instrumentation Laboratory
8 - Cerus Corp.

Brendan Carvalho M.B.B.Ch., F.R.C.A., M.D.C.H.
6 - Pacira Pharmaceuticals

Michaela K. Farber, M.D., M.S.
9 - Gauss Surgical

Ashraf S. Habib, M.B.,B.Ch., M.Sc., M.S.N., FRCA
6 - BioQ Pharma
6 - Health Decisions
6 - Pacira
7 - Haylard Health
7 - Trevena, Inc.
8 - Acacia Pharma

Mario I. Lumbreras-Marquez, M.B.B.S.
9 - Gauss Surgical

Grant C. Lynde, M.D., M.B.A.
7 - Merck

Rebecca D. Minehart, M.D., M.Ed.
7 - Rivanna Medical, Inc.
8 - ASA Interactive Computer Based Editorial Board Member

Richard M. Smiley M.D., Ph.D.
Spouse - 4 - Abbott
Spouse - 4 - Abbvie
Spouse - 4 - Amgen
5 - Abbott

Mohamed Tiouririne MD
5 - Adial Pharmaceutical
Spouse - 5 - Adial Pharmaceutical

Carolyn Weiniger, M.B.,Ch.B
8 - Elsevier

Program Information

Mission Statement
The Society for Obstetric Anesthesia and Perinatology (SOAP) was founded in 1968 to provide a forum for discussion of problems unique to the peripartum period. SOAP is comprised of anesthesiologists, obstetricians, pediatricians, and basic scientists who share an interest in the care of the pregnant patient and the newborn.

The mission of this Society is to improve the pregnancy-related outcomes of women and neonates through the support of obstetric anesthesiology research, the provision of education to its members, other providers, and pregnant women, and the promotion of excellence in clinical anesthetic care.

A membership in SOAP is an opportunity to meet people who share your interests, and to stimulate improvements in health care for pregnant patients.

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 34.25 *AMA PRA Category 1 Credit*™*. Physicians should claim only the credit commensurate with the extent of their participation in the activity.

*This amount includes the optional workshops.

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This patient safety activity helps fulfill the patient safety CME requirement for Part II of the Maintenance of Certification in Anesthesiology Program (MOCA) of The American Board of Anesthesiology (ABA). Please consult the ABA website, www.theABA.org, for a list of all MOCA requirements.

Statement of Need
The SOAP Annual Meeting provides a forum devoted exclusively to obstetric anesthesia at which leaders in the field present the most current research, recent clinical updates and other relevant clinical information.

Target Audience
The SOAP 51st Annual Meeting is intended for anesthesiologists, obstetricians, neonatologists, obstetric medicine specialists, maternal-fetal medicine specialists, residents, fellows, medical students, Certified Registered Nurse Anesthetists (CRNA) and Certified Anesthesiologist Assistants (CAA). The Society supports the attendance by associate members in the educational sessions of the annual meeting. The program is generated from member requests and an assessment of need by the Program Committee. Attendance at this meeting does not guarantee competency or proficiency in the performance of any procedures which may be discussed or taught during the course.

Mission of SOAP Program Committee
The mission of the Society's Program 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 woman.

Participation in the SOAP 51st Annual Meeting
Attendance shall be open to all health practitioners, provided that they have registered for the meeting. CME credit will only be offered to M.D.s, D.O.s 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. Assess the risk factors, racial disparities and preemptive care related to pregnant women with major co-morbid cardiac, neurologic, and hematologic disease to design optimal peridelivery anesthetic care
2. Utilize the latest evidence on patient outcomes and novel regional anesthesia techniques to optimize the perioperative pain management after cesarean delivery
3. Analyze case management strategies of high risk parturients to develop optimal labor analgesia care strategies
4. Model interdisciplinary team approaches to the care of complex pregnant and postpartum patients that can be utilized in a variety of care settings
5. Inform one's home institution to undertake the broadest reasonable range of maternal and perinatal care given available resources and personell.

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 call the SOAP office at (414) 389-8611 and/or submit a description of your needs in writing to info@soap.org.

Commercial Support Acknowledgement
This CME activity is supported by in-kind donations.

- Laerdal Medical: Mannequins
- SonoSite: Ultrasound Systems, Mannequin and Block Model
- University of Arizona Health Sciences Arizona Simulation Technology & Education Center (ASTEC): Simulation Model

Disclosure Policy
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To abide by our new anti-harassment policy in all venues at the SOAP Annual Meeting, including ancillary events and official and unofficial social gatherings:

- Exercise consideration and respect in your speech and actions.
- Refrain from demeaning, discriminatory, or harassing behavior and speech.
- Be mindful of your surroundings and of your fellow participants.

Program Schedule

Wednesday, May 1, 2019

7:30 a.m. - 6:00 p.m.
Registration Hours
Grand Sonoran Foyer

8:00 a.m. - 12:00 p.m.
Make or Break Leadership Lessons for Labor and Delivery Workshop
Course Directors: Grant C. Lynde, M.D., M.B.A.; Robert R. Gaiser, M.D.; McCallum R. Hoyt, M.D., M.B.A.; Mahesh Vaidyanathan, M.D., M.B.A., B.S.
(Additional Registration Required)
Wildflower C

8:00 a.m. - 12:00 p.m.
The Use of Ultrasound in Obstetric Anesthesia Workshop: Vascular Access, Neuraxial Anesthesia, TAP Block, Airway and Gastric Assessment
Course Director: Jose C.A. Carvalho, M.D., Ph.D., FANZCA, FRCPC
(Additional Registration Required)
Wildflower A-B

1:00 p.m. - 5:00 p.m.
Focused Cardiac Ultrasound in the Management of the High Risk Parturient Workshop
Course Director: Laurie A. Chalifoux, M.D.
(Additional Registration Required)
Wildflower A-B

1:00 p.m. - 5:00 p.m.
Becoming the Best Version of Ourselves: Overcoming Challenges with Resilience and Connection Workshop
Course Director: Grace H. Shih, M.D.
(Additional Registration Required)
Wildflower C

1:00 p.m. - 5:00 p.m.
Obstetric Anesthesia Crisis Resource Management Course
Course Directors: Rebecca D. Minehart, M.D., M.S.H.P.Ed.; Erik M. Clinton, M.D.
(Additional Registration Required)
Grand Sonoran A-C

1:00 p.m. - 5:00 p.m.
Chinese Symposium on Obstetric Anesthesia
Course Director: Jie Zhou, M.D., M.S., M.B.A.
(Additional Registration Required)
Grand Sonoran J-K

6:00 p.m. - 8:00 p.m.
Welcome Reception
Sunset Lawn

Thursday, May 2, 2019

6:30 a.m. - 5:00 p.m.
Registration Hours
Grand Sonoran Foyer

6:30 a.m. - 7:45 a.m.
Continental Breakfast & Exhibits Open
Grand Sonoran Foyer

6:30 a.m. - 7:45 a.m.
Poster Viewing
Grand Sonoran A-D, H-I, Grand Canyon 10

7:30 a.m. - 7:45 a.m.
Welcome to the 51st Annual Meeting
Lisa R. Leffert, M.D.; Heather C. Nixon, M.D.; Mark I. Zakowski, M.D., FASA
Grand Sonoran E-G

7:45 a.m. - 9:15 a.m.
Gertie Marx Research Competition
Moderator: Philip E. Hess, M.D.
Grand Sonoran E-G

9:15 a.m. - 9:30 a.m.
Distinguished Service Award
Recipient: Richard M. Smiley, M.D., Ph.D.
Presenter: Ruth Landau, M.D.
Grand Sonoran E-G

9:30 a.m. - 10:15 a.m.
Coffee Break & Exhibits
Grand Sonoran Foyer

9:30 a.m. - 10:15 a.m.
Scientific Poster Session #1
Moderator Leader: Meredith A. Albrecht, M.D., Ph.D.
Grand Sonoran A-D, H-I, Grand Canyon 10

10:15 a.m. - 11:15 a.m.
Society for Maternal-Fetal Medicine (SMFM) - What's New in Obstetrics?
Introduction: Lisa R. Leffert, M.D.
Speaker: Alexandria J. Hill, M.D.
Grand Sonoran E-G

11:15 a.m. - 12:15 p.m.
Panel - The Role of Truncal Blocks to Optimize Cesarean Delivery Analgesia
Moderator: Ruth Landau, M.D.
Speakers: Brendan Carvalho, M.B.B.Ch., FRCA, M.D.C.H.; Ki Jinn Chin, FRCPC
Grand Sonoran E-G

12:15 p.m. - 1:15 p.m.
Lunch On Your Own

12:15 p.m. - 1:15 p.m.
Problem-Based Learning Discussion - Management of the Obese Parturient
Speakers: Jaime Daly, M.D.; Vilma E. Ortiz, M.D.
(Additional Registration Required)
Pinnacle Peak 1

12:15 p.m. - 1:15 p.m.
Rivanna Lunch Session: Neuraxial Placements in Challenging Patient Populations Using the Accuro® Handheld Spinal Navigation Device
(Non-CME Session)
Speakers:Brendan Carvalho, M.B.B.Ch., F.R.C.A., M.D.C.H.; Peter Pan, M.D., M.S.E.E.; Rebecca Minehart, M.D., M.S.H.P.Ed.
(Additional Registration Required)
Grand Sonoran J-K

12:15 p.m. - 1:15 p.m.
Lunch Around - *Sign up at Registration Desk, Space Limited to 20.*
Stonegrill Restaurant

1:15 p.m. - 2:55 p.m.
Scientific Poster Session #2
Moderator Leaders: Rachel M. Kacmar, M.D.; Elizabeth Lange, M.D.
Grand Sonoran A-D, H-I, Grand Canyon 10

1:15 p.m. - 2:55 p.m.
Visit Exhibits
Grand Sonoran Foyer

3:00 p.m. - 4:00 p.m.
Research Hour - Defining, Evaluating and Influencing Recovery After Cesarean Delivery
Moderator: Brendan Carvalho, M.B.B.Ch., FRCA, M.D.C.H.
Speakers: Ashraf S. Habib, M.B.,B.Ch., M.Sc., M.S.N., FRCA; Pervez Sultan, M.D., M.B.,Ch.B., FRCA
Grand Sonoran E-G

4:00 p.m. - 5:00 p.m.
Oral Presentations I
Moderator: Michaela K. Farber, M.D., M.S.; Grace Lim, M.D., M.Sc.
Grand Sonoran E-G

Friday, May 3, 2019

6:15 a.m. - 7:15 a.m.
Fitness Activity: Boot Camp
(Additional Registration Required)
Yoga Lawn, Outside of Revive Spa

6:30 a.m. - 5:00 p.m.
Registration Hours
Grand Sonoran Foyer

6:30 a.m. - 7:30 a.m.
Continental Breakfast & Exhibits Open
Grand Sonoran Foyer

6:30 a.m. - 7:30 a.m.
Poster Viewing
Grand Sonoran A-D, H-I, Grand Canyon 10

7:25 a.m. - 7:30 a.m.
Opening Remarks
Lisa R. Leffert, M.D.
Grand Sonoran E-G

7:30 a.m. - 9:00 a.m.
Best Paper Session
Moderators: Jill M. Mhyre, M.D.; Arvind Palanisamy, M.B., B.S., M.D., FRCA
Grand Sonoran E-G

9:00 a.m. - 10:30 a.m.
Scientific Poster Session #3
Moderator Leaders: Melissa E. Bauer, D.O.; Allison J. Lee, M.D., M.B., B.S.
Grand Sonoran A-D, H-I, Grand Canyon 10

9:00 a.m. - 10:30 a.m.
Coffee Break & Exhibits
Grand Sonoran Foyer

10:30 a.m. - 12:00 p.m.
Interdisciplinary Panel - Cardiac Disease
Moderator: Katherine W. Arendt, M.D.
Speakers: Joan E. Briller, M.D.; Alexandria J. Hill, M.D.; Marie-Louise Meng, M.D.
Grand Sonoran E-G

12:00 p.m. - 12:15 p.m.
American Society of Anesthesiologists (ASA) Update
Introduction: Mark I. Zakowski, M.D., FASA
Speaker: Linda J. Mason, M.D., FASA, ASA President
Grand Sonoran E-G

Program Schedule cont.

Friday, May 3, 2019 cont.

12:20 p.m. - 1:30 p.m.
SOAP Annual Business Meeting and Elections
Lunch will be provided in Grand Sonoran Foyer.
Grand Sonoran E-G

1:30 p.m.
Free Afternoon

5:00 p.m. - 7:00 p.m.
Resident/Fellow Case Presentations
Moderator Leader: Jacqueline M. Galvan, M.D.
Grand Sonoran A-D, H-I, Grand Canyon 10

7:00 p.m. - 9:00 p.m.
Fellows' and Residents' Reception
(By Invitation Only, Offsite Location)

Saturday, May 4, 2019

6:45 a.m. - 7:45 a.m.
Fitness Activity: Foam Rolling/Stretch
(Additional Registration Required)
Yoga Lawn, Revive Spa

7:00 a.m. - 5:15 p.m.
Registration Hours
Grand Sonoran Foyer

7:00 a.m. - 8:30 a.m.
Continental Breakfast & Exhibits
Grand Sonoran Foyer

7:00 a.m. - 8:30 a.m.
Poster Viewing
Grand Sonoran A-D, H-I, Grand Canyon 10

7:55 a.m. - 8:00 a.m.
Opening Remarks
Lisa R. Leffert, M.D.
Grand Sonoran E-G

8:00 a.m. - 9:00 a.m.
Scientific Poster Summaries
Moderators: Paloma Toledo, M.D., M.P.H.; Hans P. Sviggum, M.D.
Grand Sonoran E-G

8:00 a.m. - 8:25 a.m.
Obstetric Hemorrhage
Speaker: Alexander Butwick, M.B.B.S., M.S., F.R.C.A.
Grand Sonoran J-K

8:30 a.m. - 8:55 a.m.
Drug Shortages: What Can I Do For My Patients?
Speaker: Heather C. Nixon, M.D.
Grand Sonoran J-K

9:00 a.m. - 10:00 a.m.
Special Lecture: Patient Perspectives
Moderator: May C. Pian-Smith, M.D., M.S.
Speakers: Stephanie Arnold, Author and Amniotic Fluid Embolism Survivor; Tracey M. Vogel, M.D.
Grand Sonoran E-G

10:00 a.m. - 10:30 a.m.
Coffee Break & Exhibits
Grand Sonoran Foyer

10:00 a.m. - 10:30 a.m.
Poster Viewing
Grand Sonoran A-D, H-I, Grand Canyon 10

10:30 a.m. - 11:30 a.m.
Gerard W. Ostheimer Lecture
What's New in Obstetric Anesthesia?
Introduction: Ashraf S. Habib, M.B., B.Ch., M.H.Sc., FRCA
Speaker: Carolyn Weiniger, M.B., Ch.B.
Grand Sonoran E-G

11:30 a.m. - 12:30 p.m.
What's New in Neonatology?
Introduction: Joy L. Hawkins, M.D.
Speaker: Alan D. Bedrick, M.D.
Grand Sonoran E-G

11:30 a.m. - 11:55 a.m.
Management of Neuraxial Labor Analgesia
Speaker: Kenneth E. Nelson, M.D.
Grand Sonoran J-K

12:00 p.m. - 12:25 p.m.
Substance Use Disorder
Speaker: Britany L. Raymond, M.D., B.S.
Grand Sonoran J-K

12:30 p.m. - 1:30 p.m.
Lunch Lesson: Adjuncts in Postpartum Hemorrhage - How Do We Use Them?
Speakers: Alexander Butwick, M.B.B.S., M.S., F.R.C.A.; Jennifer E. Hofer, M.D.
(Additional Registration Required)
Pinnacle Peak 1

1:30 p.m. - 2:30 p.m.
Fred Hehre Lecture - Dogmas in Obstetric Anesthesia: The Balance Between Evidence, Common Sense, Habit and Fear
Introduction: Cristian Arzola, M.D., M.Sc.
Speaker: Jose C.A. Carvalho, M.D., Ph.D., FANZCA, FRCPC
Grand Sonoran E-G

2:30 p.m. - 3:00 p.m.
Coffee Break & Exhibits
Grand Sonoran Foyer

2:30 p.m. - 3:00 p.m.
Poster Viewing
Grand Sonoran A-D, H-I, Grand Canyon 10

3:00 p.m. - 4:00 p.m.
Oral Presentations II
Moderators: Emily E. Sharpe, M.D.; Cynthia A. Wong, M.D.
Grand Sonoran E-G

3:00 p.m. - 3:25 p.m.
Post Dural Puncture Headache
Speaker: Barbara M. Scavone, M.D.
Grand Sonoran J-K

3:35 p.m. - 4:00 p.m.
My Two Cents - Controversial Topics
Speaker: Lawrence C. Tsen, M.D.
Grand Sonoran J-K

4:00 p.m. - 5:15 p.m.
Why Should You Care About Maternal Levels of Care?
Moderator: Brian T. Bateman, M.D., M.Sc.
Speakers: Brendan Carvalho, M.B.B.Ch., FRCA, M.D.C.H.; Sarah J. Kilpatrick, M.D., Ph.D.; Jamie D. Murphy, M.D.
Grand Sonoran E-G

6:00 p.m. - 10:00 p.m.
Banquet
(Additional Registration Required)
(Offsite Location)

High & Rye
5310 E. High St. #100
Phoenix, AZ 85054

Sunday, May 5, 2019

7:30 a.m. - 11:45 a.m.
Registration Hours
Grand Sonoran Foyer

7:00 a.m. - 8:30 a.m.
Continental Breakfast
Grand Sonoran Foyer

7:55 a.m. - 8:00 a.m.
Opening Remarks
Lisa R. Leffert, M.D.
Grand Sonoran E-G

8:00 a.m. - 9:30 a.m.
Best Case Reports - You Did What?
Moderator: Klaus Kjaer, M.D., M.B.A.
Panelists: Jeanette R. Bauchat, M.D., M.S.; Laurent A. Bollag, M.D.; Jean M. Miles, M.D.
Grand Sonoran E-G

9:30 a.m. - 9:35 a.m.
2020 Annual Meeting Preview
Speakers: Ruth Landau, M.D., 2020 Program Chair; Ronald B. George, M.D., FRCPC, 2020 Meeting Host
Grand Sonoran E-G

9:35 a.m. - 10:00 a.m.
Coffee Break
Grand Sonoran Foyer

10:00 a.m. - 11:00 a.m.
It's All in Her Head: Approaches to the Anesthetic Management of Pregnant Women with Intracranial Disease
Moderator: Heather C. Nixon, M.D.
Speakers: Mateja De Leonni Stanonik, M.D., M.A., Ph.D.; Guy Edelman, M.D.; Lisa R. Leffert, M.D.
Grand Sonoran E-G

11:00 a.m. - 12:00 p.m.
Faculty Case Report Posters
Moderator Leader: Roulhac D. Toledano, M.D., Ph.D.
Grand Sonoran A-D, H-J

12:00 p.m.
Adjournment

Q&A time will be afforded at the end of each session.

Program Material

Thursday, May 2, 2019

- **Gertie Marx Research Competition**
  Moderator: Philip E. Hess, M.D.
- **Scientific Poster Session #1 Abstracts**
  Moderator Leader: Meredith A. Albrecht, M.D., Ph.D.
- **Society for Maternal-Fetal Medicine (SMFM) - What's New in Obstetrics?**
  Introduction: Lisa R. Leffert, M.D.
  Speaker: Alexandria J. Hill, M.D.
- **Panel - The Role of Truncal Blocks to Optimize Cesarean Delivery Analgesia**
  Moderator: Ruth Landau, M.D.
  Speakers: Brendan Carvalho, M.B.B.Ch., FRCA, M.D.C.H.; Ki Jinn Chin, FRCPC
- **Problem-Based Learning Discussion - Management of the Obese Parturient**
  Speakers: Jaime Daly, M.D.; Vilma E. Ortiz, M.D.
- **Scientific Poster Session #2 Abstracts**
  Moderator Leaders: Rachel M. Kacmar, M.D.; Elizabeth Lange, M.D.
- **Research Hour - Defining, Evaluating and Influencing Recovery After Cesarean Delivery**
  Moderator: Brendan Carvalho, M.B.B.Ch., FRCA, M.D.C.H.
  Speakers: Ashraf S. Habib, M.B.,B.Ch., M.Sc., M.S.N., FRCA; Pervez Sultan, M.D., M.B.,Ch.B., FRCA
- **Oral Presentations I**
  Moderator: Michaela K. Farber, M.D., M.S.; Grace Lim, M.D., M.Sc.

Abstract #:GM-01

The effect of carbetocin dose on transmural dispersion of myocardial repolarization in healthy parturients scheduled for elective cesarean delivery under spinal anesthesia - A prospective, randomized clinical trial

Presenting Author: Natasha Clunies-Ross MBBS BSc FRCA
Presenting Author's Institution: BC Women's Hospital, University of British Columbia
Co-Author: Thomas M Roston MD FRCPC - University of British Columbia
James Taylor BSc - BC Women's Hospital, University of British Columbia
Simon Whyte MBBS FRCA FRCPC - BC Children's Hospital, University of British Columbia
Matthias Görges PhD - University of British Columbia
Anthony Chau MD FRCPC MMSc - BC Women's Hospital, University of British Columbia

Introduction: QT prolongation is associated with torsades des pointes but remains a poor predictor of drug torsadogenicity. Increased transmural dispersion of repolarization, measured as the time interval between the peak and end of the T wave (Tp-e), is a more reliable predictor.[1] Carbetocin is recommended as an uterotonic in patients undergoing cesarean delivery (CD), but its effect on Tp-e is unknown.[2] We evaluated the effect of carbetocin dose on Tp-e and Bazett-corrected QT (QTc) intervals during elective CD under spinal anesthesia. We hypothesized that carbetocin would dose-dependently increase Tp-e intervals.

Methods: Upon patient consent, 40 healthy patients undergoing elective CD with a standardized spinal anesthetic and phenylephrine infusion were randomized to receive an IV bolus of carbetocin 50 mcg (C50) or 100 mcg (C100) via an infusion pump over 1 min. 12-lead ECGs were obtained at baseline, 5 min postspinal, then 5 and 10 min post-carbetocin. A cardiologist blinded to group and timing of ECGs measured QTc and Tp-e intervals using Emori's criteria.[3] Primary outcome was the change in Tp-e at 5 min postcarbetocin between and within groups, analyzed by mixed-effects linear regression. Secondary outcomes included occurrence of arrhythmias, changes in QTc at 5 min and 10 min post-carbetocin, changes in both QTc and Tp-e post-spinal compared to baseline between and within groups. P-values were adjusted for multiple comparisons.

Results: Between groups, at 5 min post-carbetocin, Tp-e in C100 was 4.0 msec longer compared to C50 (95%CI=0.3-7.8, p=0.03). Within groups, at 5 min post-carbetocin C50 did not significantly increase Tp-e compared to baseline (2.4 msec; p=0.25) but C100 did (4.9 msec; 95%CI=1.8-8.1; p=0.008). QTc increased significantly within C50 and C100 groups at 5 and 10 min post-carbetocin (all $p<0.001$), with no betweengroup differences. There were no arrhythmias. (see Fig)

Discussion: Tp-e was unaffected by carbetocin 50 mcg IV given post-CD in healthy parturients under spinal anesthesia, but slightly prolonged by 100 mcg. The increase in QTc post-carbetocin was significant, with no apparent dose-dependent effect. Although the minimal Tp-e prolongation at the higher dose is unlikely to be clinically significant, these findings suggest a lower carbetocin dose may be preferred in parturients with reduced repolarization reserve.

References:

1. Hume-Smith H, A&A 2008
2. Bruyere M, IJOA. 2014
3. Emori T, J Cardiovasc Electrophysiol. 2001

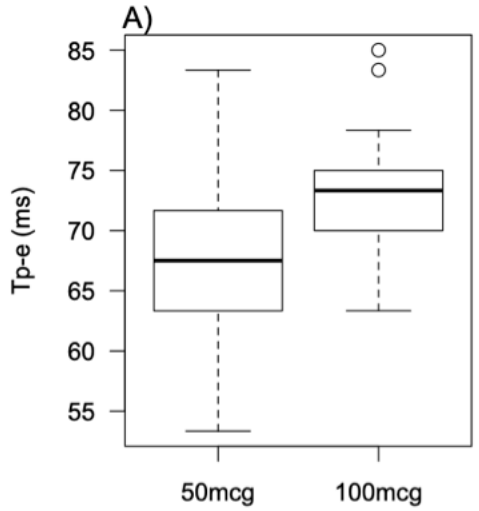
Abstract #:GM-01

Primary Outcome: Tp-e at 5 min post-carbetocin

A) Tp-e between groups – significant increase in C100 compared to C50 (p=0.03).

B) Tp-e within groups – significant increase in C100 compared to baseline (p=0.008).

A)



B)

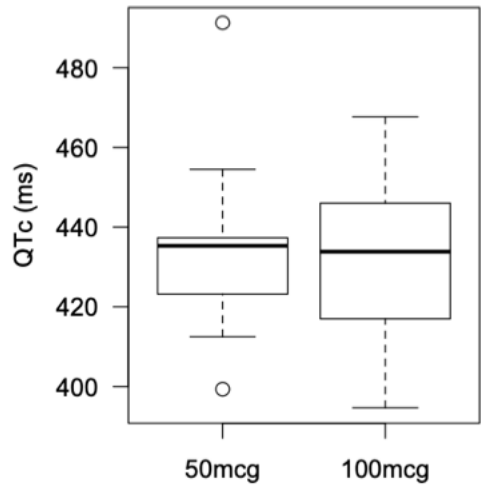
	Tp-e			
	50mcg mean (SD)	**p**	**100mcg** mean (SD)	**p**
Baseline	65.8 (8.1)	ref	68.6 (5.6)	ref
5 min post-carbetocin	68.2 (7.5)	0.25	73.5 (5.3)	**0.008**

Secondary Outcomes:

C) QTc between groups – no difference at 5 min post-carbetocin (p=0.78).

D) QTc and Tp-e within groups compared to baseline.

C)



D)

	QTc			
	50mcg mean (SD)	**p**	**100mcg** mean (SD)	**p**
Baseline	411.4 (10.4)	ref	407.9 (16.2)	ref
Post spinal	406.4 (19.8)	0.23	410.9 (17.0)	0.34
5 min post-carbetocin	434.1 (18.9)	**<0.001**	432.7 (18.1)	**<0.001**
10 min post-carbetocin	430.6 (17.9)	**<0.001**	429.5 (16.5)	**<0.001**

	Tp-e			
	50mcg mean (SD)	**p**	**100mcg** mean (SD)	**p**
Baseline	65.8 (8.1)	ref	68.6 (5.6)	ref
Post spinal	67.3 (7.7)	0.37	69.6 (6.5)	0.53
10 min post-carbetocin	68.1 (8.2)	0.25	70.5 (4.6)	0.38

All p-values are for pairwise tests from baseline and are Benjamini-Hochberg adjusted for multiple comparisons.

Abstract #:GM-02

The association of Shock Index (SI) and non-invasive Hemoglobin (SpHb) variation with blood loss after vaginal deliveries: A prospective cohort study

Presenting Author: Thomas Drew MD
Presenting Author's Institution: Mount Sinai Hospital
Co-Author: Jose Carvalho MD PhD - Mount Sinai Hospital, University of Toronto
Chandrasekaran Subramanian MD - Mount Sinai Hospital, University of Toronto
Kristi Downey MSc - Mount Sinai Hospital, University of Toronto
Barry Thorneloe MD - Mount Sinai Hospital, University of Toronto
Balki Mrinalini MD - Mount Sinai Hospital, University of Toronto

Background: Postpartum hemorrhage (PPH) is one of the leading causes of death during childbirth [1]. Substantial variation exists in the onset of clinical signs of PPH [2]. Shock Index (SI) (heart rate/systolic blood pressure [BP]) and continuous non-invasive hemoglobin monitoring (SpHb) (Masimo©, US) have both been proposed for the timely diagnosis of PPH. The objective of this study was to determine the association of SI and SpHb variation with blood loss after vaginal delivery. We hypothesized that both assessment tools are early indicators of PPH.

Methods: We conducted a prospective observational study in women ≥37 wks gestation undergoing vaginal deliveries. SpHb and heart rate were recorded continuously and non-invasive BP recorded every 10 min for 2 hrs after delivery. Actual blood loss (ABL) was measured at 30, 60 and 120 min postpartum by using calibrated drapes and weighing soiled pads. The primary outcome was the cumulative ABL during the study period. Linear mixed models were used to determine the association of SI and SpHb with ABL. Logistic regression was used to determine the area under the receiver operator curve (AUROC) and the optimal cut off-point for detecting ABL ≥1L.

Results: We recruited 67 women to the study. Both SI and SpHb demonstrated downward trend over time ($p=0.04$, $p<0.01$). However, the slope of this trend was not associated with ABL (SI $p=0.65$; SpHb $p=0.32$). Mean (SD) SI was higher in women with ABL ≥1L compared to those with ABL <1L (0.91 [0.17] vs. 0.80 [0.14], $p= 0.009$). Change in SpHb (g/dL) from baseline was not different in women with or without ABL ≥1L (-7.08 (8.98) vs. -3.83 (7.84), $p=0.18$). Maximum SI within the first hr of delivery was significantly correlated with ABL ($r=0.45$, $p <0.001$) and was a predictor of ABL ≥1L ($p=0.004$, AUROC 0.760) with a value of SI ≥0.9 demonstrating 91% sensitivity and 54% specificity (Fig 1). Maximum change in SpHb from baseline was not correlated with ABL ($r=0.23$, $p=0.057$) and was not a predictor of ABL ≥1L ($p=0.14$).

Conclusions: Higher SI values are associated with more blood loss after vaginal delivery and an SI ≥ 0.9 within the first hr after delivery may be a clinically useful tool for the early detection of PPH. SpHb variation does not accurately predict blood loss after delivery.

References:

1. www.who.int/reproductivehealth/topics/maternal_perinatal/pph
2. BMJ 2017;358:j3875

Abstract #:GM-03

The Effect of Combined Use of Dural Puncture Epidural and Programmed Intermittent Epidural Bolus for Labor Analgesia: A Randomized Controlled Clinical Trial

Presenting Author: Weijia Du MD
Presenting Author's Institution: Shanghai First Maternity and Infant Hospital
Co-Author: Yujie Song MD - Shanghai First Maternity and Infant Hospital
Zhendong Xu MD - Shanghai First Maternity and Infant Hospital
Zhiqiang Liu MD - Shanghai First Maternity and Infant Hospital

BACKGROUND: The dural puncture epidural (DPE) is a technical modification of combined spinal epidural (CSE), where the dura mater is punctured by a spinal needle, but without direct injection of drugs. The DPE has been found to improve block quality over the Epidural (EP) with fewer side effects than the CSE. Besides the initiation of neuraxial labor analgesia, using PIEB as the maintenance epidural analgesia method compared to continuous epidural infusion (CEI) is believed to reduce anesthetic consumption and fewer manual boluses. The aim of this study was to evaluate the analgesia onset, drug consumption and side effects of the combination of DPE and PIEB technique. Adequate analgesia was defined as visual numerical rating scale (VNRS) measurement ≤ 10 mm on a 100-mm scale during active contractions.

METHODS: Nulliparous women with VNRS >50 mm and cervical dilation <5 cm were randomly assigned to receive EP + CEI, DPE + CEI, DPE + PIEB. A 25G Whitacre needle (BD medical) was utilized to puncture the dural. Analgesia was initiated and maintained with a solution of 0.1% ropivacaine plus 0.3 μg·ml-1sufentanil. After a loading dose of 10 mL followed by an epidural test dose (lidocaine 45 mg), PIEB pump (8 mL every hour beginning 1 hour after epidural initiation) or CEI pump (8 mL/h, beginning immediately after epidural initiation) was connected to patients according to the group assignment. All pumps were set to deliver a 5ml patient-controlled epidural analgesia (PCEA) bolus with a lockout time of 20 minutes. Breakthrough pain was treated with PCEA initially, followed by a manual bolus of 5 ml of 0.125% ropivacaine plus 0.3 μg·ml-1sufentanil if necessary. The primary outcome was time to achieve adequate analgesia analyzed by Kaplan-Meier curves. Secondary outcomes included block quality, drug consumption, and maternal adverse effects.

RESULTS: We studied 116 subjects (EP+CEI=38, DPE+CEI=40, DPE+PIEB=38). The mean time [95% Confidence Interval] to adequate analgesia was 17 min [16-19 min] in group EP+CEI compared with 14 min [12-16 min] in group DPE+CEI and 14 min [12-16 min] in group DPE+PIEB (p=0.04). A significant difference was noted in the incidence of bilateral S2 blockade at 30 minutes between group EP+CEI, group DPE+CEI, and group DPE+PIEB (42.1%, 67.5% and 68.4% respectively, p=0.029). The hourly consumption of ropivacaine and sufentanil was significantly lower in group DPE+PIEB than those in group DPE+CEI or group EP+CEI (p all<0.001). There were no differences in the duration of labor, delivery mode, new born Apgar scores, the incidence of adverse effects or the satisfaction score of labor.

CONCLUSIONS: DPE with a 25G needle was associated with rapid analgesia onset and greater sacral spread. Combined use of DPE and PIEB reduced anesthetics consumption without additional side effects. The combined use of DPE and PIEB appears to offer a favorable paradigm of initiation and maintenance for labor analgesia.

Abstract #:GM-04

Pharmacokinetic modeling and placental transfer of gentamicin administered to peripartum women

Presenting Author: Amy E Judy MD MPH
Presenting Author's Institution: Stanford University School of Medicine
Co-Author: Pamela Flood MD MA - Stanford University School of Medicine
Cedar Fowler MD - Stanford University School of Medicine
Brendan Carvalho MBBCh - Stanford University School of Medicine

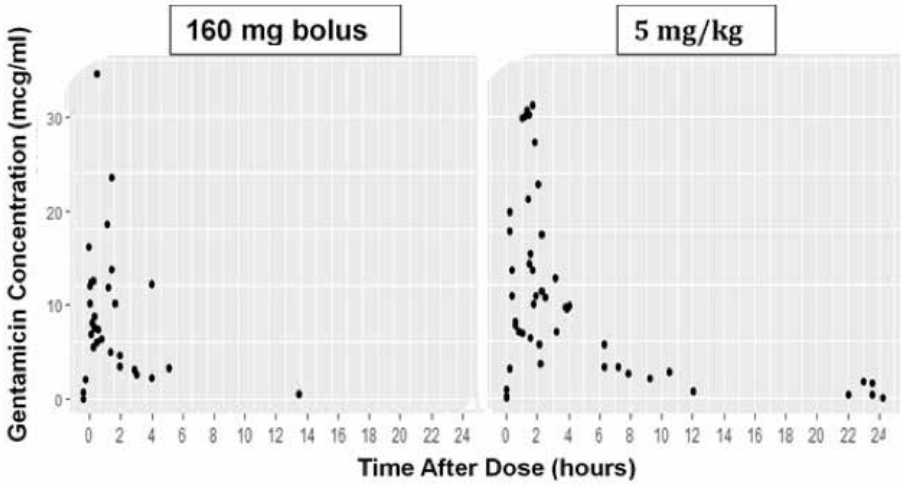
Background: Gentamicin is a commonly used antibiotic in pregnant and peripartum women, however pharmacokinetic (PK) data to guide appropriate dosing in this population is lacking. The study aim was to characterize the maternal PK profile and placental transfer of gentamicin administered peripartum, and to compare findings to existing PK data derived from non-pregnant adults.

Methods: We conducted a prospective cohort trial of intravenous gentamicin administered during 3rd trimester. Dosing was per clinical recommendations: 160 mg once for preoperative prophylaxis or 5 mg/kg every 24h for chorioamnionitis. Maternal blood samples were collected before treatment, 5, 15, 30-min, 3h, 6h, 24h after dosing, and at delivery (MV). PK properties were evaluated with a population approach using non-linear mixed-effect modeling. Umbilical arterial (UA) and venous (UV) blood were sampled at delivery, and UA:MV and UA:UV ratios determined.

Results: PK profiles of 20 pregnant women were analyzed. A two-compartment model provided the best fit. Analysis revealed a central volume of distribution (V1) of 0.7 L, clearance (Cl) of 14 L/h, intercompartmental CLRA of 0.05 L/h and peripheral volume of distribution (V2) of 13 L. Intraindividual portion of the variance was 0.1. A weight proportional model did not improve the model fit. Gentamicin concentrations over time are depicted in the Figure. The UV:MV(SD) and UA:UV(SD) ratios were 0.6(1.0) and 1.0(0.4) respectively. Our data show that current dosing paradigms may maintain the required minimum inhibitory concentration (MIC) for some obstetric pathogens (E. coli) but fall short for others, including Enterococcus faecalis (1)(Figure).

Conclusion: Our data demonstrate that gentamicin Cl is greater than published for non-pregnant women (14 L/h vs. 3.4 L/h)(2). These results are consistent with pregnancy physiology of greater renal clearance of hydrophilic drugs (3). However our two-compartment model did not find the V1 greater than in non-pregnant subjects using a one-compartment model (2), which would have been an expected in pregnancy. The results highlight the importance of studying drugs in the indicated population (pregnant vs. non-pregnant). Importantly, findings show that when pathogens with high MICs, such as Enterococcus faecalis are suspected, a shorter dosing interval may be indicated in pregnant women.

Figure: Gentamicin concentration over time after a) 160 mg dose or b) 5 mg/kg loading dose



Minimum inhibitory concentration (MIC) for E. coli is 0.5 mcg/mL and for Enterococcus faecalis is 32 mcg/mL

References:

1. Clin Obstet Gynecol 2008;51:498–506
2. J Clin Pharm Ther 2007;32:595-602
3. PLoS One 2017;12:e0177324

Abstract #:GM-05

Relative potency of noradrenaline vs. phenylephrine infusions in the prevention of hypotension after spinal anaesthesia for caesarean delivery

Presenting Author: Fatima Khatoon MBBS
Presenting Author's Institution: Arab Board in Anesthesia - Hamad Medical Corporation
Co-Author: Naz Amber MBBS, FCPS - Hamad Medical Corporation, Doha - Qatar
Khalid Fouzia MBBS, FCPS - Hamad Medical Corporation, Doha - Qatar
Abdalla Eynas MBBS, Arab Board - Hamad Medical Corporation, Doha - Qatar
Fernando Roshan MB Bch, FRCA - Hamad Medical Corporation, Doha - Qatar
Kocarev Mitko MD, DEAA - Hamad Medical Corporation, Doha - Qatar

Introduction: Noradrenaline has recently been introduced for preventing hypotension after spinal anesthesia for caesarean delivery. Compared to phenylephrine, noradrenaline is effective in maintaining blood pressure (BP), but may be superior at maintaining heart rate (HR) and cardiac output (CO). In a comparative doseresponse study, noradrenaline given as a single IV bolus was 13 times more potent than phenylephrine. It is uncertain if this potency ratio also applies to infusions. We aimed to determine the minimum infusion rates (MIR) (median effective rate, ER50) of both drugs needed to maintain maternal systolic BP within 20% of the baseline after spinal anesthesia for caesarean delivery and to derive the relative potency ratio.

Methods: Sixty ASA physical status 2 patients with a normal singleton pregnancy beyond 36 weeks gestation undergoing elective caesarean delivery with standardized spinal anesthesia (hyperbaric bupivacaine 0.5% w/v 12.5mg, with Fentanyl 15mcg) were randomized into two groups. The first patient in Group 1 received phenylephrine 1200mcg in normal saline 0.9% w/v 60 ml at 60ml/h infusion rate (20mcg/min). The first patient in Group 2 received noradrenaline 96mcg in normal saline 0.9% w/v 60ml at 60ml/h infusion rate (1.6mcg/min). The vasopressor dose for every subsequent patient was determined by the efficacy of the dose in preventing hypotension in the previous patient. If effective, the next patient received a dose reduced by 150mcg of phenylephrine or 12 mcg of noradrenaline. If ineffective, the dose for the next patient was increased by the same amount. The MIRs were determined according to the Dixon–Massey formula. Continuous stroke volume (SV), HR and CO were also measured using non-invasive hemodynamic monitoring system.

Results: The MIR was 12.7 mcg/min (95%CI 10.4 to 14.9) for phenylephrine and 1.0 mcg/min (95%CI 0.8 to 1.2) for noradrenaline, giving a potency ratio of 12.6 (95%CI 9.9 to 15.9). There was no difference in HR, SV and CO between the groups.

Conclusion: We determined MIR of phenylephrine and noradrenaline in prevention of hypotension after spinal anesthesia for caesarean delivery and confirmed a potency ratio of 12.6 (95%CI 9.9 to 15.9) for equivalence in blood pressure control. At the MIR, noradrenaline does not provide benefits of greater HR and CO.

Reference:

1. Ngan Kee WD. A Random-allocation Graded Dose-Response Study of Norepinephrine and Phenylephrine for Treating Hypotension during Spinal Anesthesia for Cesarean Delivery. Anesthesiology, 2017;127:934-941

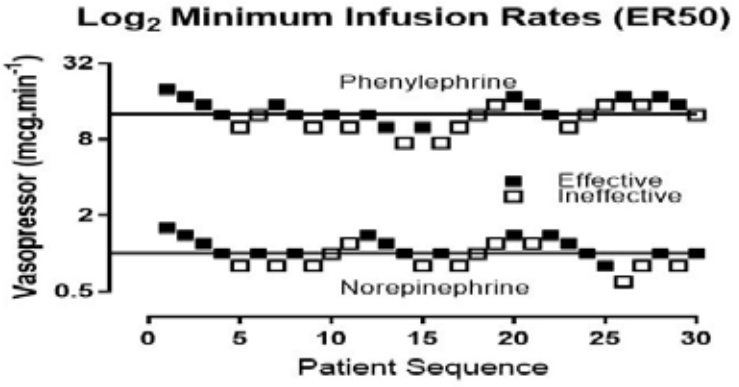


Fig 1. Up–down sequences for phenylephrine and noradrenaline representing effective and ineffective outcomes with MIR

Abstract #:GM-06

Uterine Exteriorisation Versus in Situ Repair for Elective Cesarean Delivery Using a Phenylephrine Infusion; a Randomized Controlled Trial

Presenting Author: Danny Mireault MD
Presenting Author's Institution: Maisonneuve-Rosemont Hospital, University of Montreal - Montreal, Quebec
Co-Authors: Valerie Zaphiratos MD, MSc - Maisonneuve-Rosemont Hospital
Pierre Drolet MD - Maisonneuve-Rosemont Hospital
Laurent Tordjman MD - Maisonneuve-Rosemont Hospital
Philippe Richebé MD, PhD - Maisonneuve-Rosemont Hospital
Christian Loubert MD - Maisonneuve-Rosemont Hospital

Introduction: During cesarean delivery (CD), the uterus can be repaired in situ within the peritoneal cavity or exteriorized from the abdomen. Neither of these two approaches have been deemed clearly superior.1–4 Only one randomized controlled trial (RCT) evaluated intraoperative nausea or vomiting (IONV) as a primary outcome with a standardized anesthetic technique.4 IONV is amongst the main concerns of women scheduled for elective CD.5 This study aims to compare the effect of these two uterine repair methods on maternal morbidity during elective CD.

Methods: This study was a prospective RCT of 180 healthy term parturients undergoing elective CD. Spinal anesthesia, uterotonics, infusion of phenylephrine and blood pressure management were all standardized. Patients were randomized to exteriorization (n=90) or in situ uterine repair (n=90). The primary outcome was postdelivery IONV assessed on a 4-point scale (0 none, 1 light, 2 severe, 3 vomiting) at the beginning of uterine and fascia repair as specific time points.

Results: From November 2015 through July 2018, 160 patients were included for analysis. Incidence of postdelivery IONV was 40.2% in the exteriorization group compared to 20.5% in the in situ group (P = 0.01). The severity of IONV was reduced with in situ repair (Chi-square test for trend, p = 0.005) (Figure). The exteriorization group required more phenylephrine boluses (Median [IQR]: 4 [1-6.25] vs 1.5 [0-4]; Mann-Whitney test, p = 0.0002). The duration of surgery (28.5 [24-35] vs 29 [25-34] minutes; p = 0.63), blood loss (Mean±SD: 669.5±133 vs 674.4±152 mL) and post-operative hemoglobin (103.1±14.7 g/L vs 103.1±12.4 g/L) were similar between groups.

Discussion: This is the first prospective randomized controlled trial studying uterine repair on IONV using a phenylephrine infusion. In situ uterine repair for elective CD significantly decreases IONV incidence and intensity, and causes less hemodynamic changes requiring intervention. In situ uterine repair minimizes maternal morbidity for elective CD.

References:

1. Can J Anesth. 2015;62(11):1209-1220
2. Am J Obstet Gynecol. 2009;200(6):625.e1-625.e8
3. Cochrane Database Syst Rev. 2004;(4):CD000085d
4. Obstet Gynecol Surv. 2008;63(1):7-8
5. Anesth Analg. 2005;101(4):1182-1187

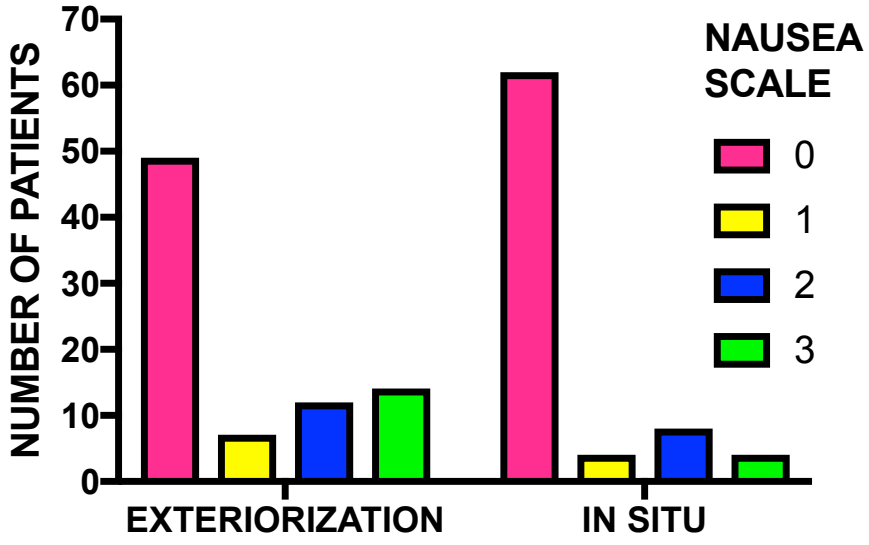


Figure 1. Intraoperative post-delivery nausea and vomiting severity in each intervention group. 4-point nausea scale where 0 is no nausea, 1 light, 2 severe and 3 being vomiting or retching.

Abstract #: T1A-55

Prospective study to investigate the reporting of comorbid diseases in a cohort of laboring women in a large tertiary medical center

Presenting Author: Carolyn Weiniger, MB, ChB
Presenting Author's Institution: Tel Aviv Sourasky Medical Center - Tel Aviv, Israel
Co-Author: Yael Stein MD - Hadassah Hebrew University Medical Center

Background: Comorbidities are a leading cause of maternal morbidity and mortality. In Israel, antenatal care is fragmented between community and hospital, and medical information is not conveyed automatically between these isolated platforms. We aimed to evaluate the frequency of reported comorbidities in laboring women: 1) in the community electronic medical records (EMR) 2) the hospital EMR, 3) history taken by anesthesiologist during labor and 4) postpartum interview.

Methods: Prospective descriptive cohort study (Apr-Sept2017) in a large tertiary hospital; women consented postpartum to a search for demographic, obstetric and medical comorbidities reported in: community and hospital EMR, anesthesiologist history, a postpartum interview with an experienced anesthesiologist. We used two variables with high predictive value (0.85) for severe maternal morbidity during delivery: ≥4 packed red blood cells (PRBC) and intensive care unit (ICU) admission during pregnancy or after delivery.

Results: We interviewed 263 women. Distribution of comorbidities (most severe only for each woman) is shown in Figure 1. Table 1 presents frequencies of all recorded comorbidities. The hospital EMR and anesthesiologist missed many diagnoses reported in the community EMR; the most frequently under-reported were musculoskeletal and neurologic diagnoses. One woman did not report familial cholinesterase deficiency; another reported diplopia while failing to report the recent severe multi-trauma motor vehicle accident that caused it. Women did not report all community diagnoses in the postpartum interview. Six women were hospitalized in the ICU (4 healthy women after for PPH; 2 with comorbidities for preeclampsia). Two healthy women and one with comorbidities received ≥4 PRBC units.

Conclusions: Maternal comorbidities were unreported by women thus unknown to the clinicians during delivery. Musculoskeletal and neurologic diagnoses were the most frequently unreported diagnoses. The most robust source for medical diagnoses was the community EMR. However requiring physicians to search every patient\'s community EMR is a burden. Privacy and costs limit automatic transfer of reported diagnoses from the community to hospital EMRs. The pre-anesthesia evaluation clinic could bridge this gap between community and hospital care but requires significant manpower and women may be unaware of its existence and the need for assessment.

Figure: Distribution of co-morbidities (most important comorbidity presented)

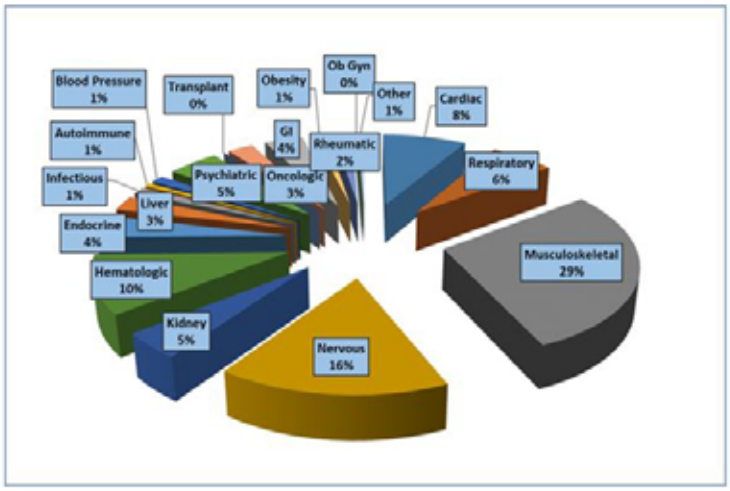


Table: Frequencies of recorded comorbidities

Comorbidity diagnoses	Diagnoses reported in community EMR	Diagnoses reported in hospital EMR	Diagnoses reported in Anesthesiologist history	Diagnoses reported in postpartum interview
TOTAL number reported	337	114	37	151
Cardiac	15	8	3	10
Respiratory	20	11	5	9
Musculoskeletal	53	5	7	27
Neurological	40	7	2	17
Renal	10	1	0	7
Hematologic	29	8	7	16
Endocrine	32	9	5	16
Liver	9	3	0	4
Infectious	14	0	0	2
Autoimmune	5	4	0	2
Blood pressure related	2	3	2	4
Psychiatric	13	8	2	13
Oncologic	7	5	0	7
Gastrointestinal	24	4	2	4
Obesity	17	2	0	1
Rheumatic	7	1	1	3
Other categories	33	8	1	3

Abstract #: T1A-58

Maternal Health Care Insurance Dictates Obstetrical Care and Maternal-Fetal Outcome

Presenting Author: Manuel C. Vallejo, MD, DMD
Presenting Author's Institution: West Virginia University - Morgantown, WV
Co-Author: Robert E. Shapiro MD - West Virginia University
Christa L. Lilly PhD - West Virginia University
David R. Saldivar MD - West Virginia University
Norman D. Ferrari MD - West Virginia University

Introduction: Financial barriers in the form of health insurance may affect access to maternal health care services. Maternal health care disparities exist for the types of obstetric care and outcomes. The purpose of this study is to determine if maternal health care insurance effects the type of obstetrical care and maternal-fetal outcome.

Methods: After local IRB approval, the maternal quality assurance database was queried over a 3-year period from July 1, 2015 through June 30, 2018 (n=4199). Private insurance quality assurance indicators were compared to parturients with Medicaid/Medicare insurance. Interval data was analyzed using Mann-Whitney or t-test, nominal data using Chi-square with Odds Ratios (OR) as appropriate. Alpha was set to 0.05.

Results: Parturients with Private insurance (n=3352) tended to be older (Mean years: 29.1 v. 26.1, $p < 0.0001$), weigh more (median BMI: 31.7 v. 30.8, $p = 0.004$), present with less gravida (median 2 v. 3, $p < 0.0001$) and parity (median 2 v. 2, $p < 0.0001$), have more advanced gestation median 38.9 v. 38.0, ($p < 0.0001$), and have a neonate with a higher 5-minute Apgar score (median 9 v. 9, $p = 0.009$) than Medicaid/Medicare parturients (n = 847). Additionally, Medicaid/Medicare parturients were less likely to be admitted for induction with oxytocin (OR: 0.84, $p = 0.047$), receive labor epidural analgesia (OR: 0.79, $p = 0.003$), have a delivery supplemented with local anesthesia (OR: 0.53, $p = 0.04$), and have a primary cesarean section (OR: 0.66, $p = 0.002$). Conversely, Medicaid/Medicare parturients were more likely to be of African-American descent (OR: 1.75, $p = 0.008$), be a current known smoker (OR: 5.37, $p < 0.0001$), have a positive urine drug screen (OR: 3.39, $p < 0.0001$), and receive a general anesthetic (OR: 1.97, $p < 0.0001$), Table.

Discussion: Maternal health care insurance can factor into the use and quality of obstetrical care and outcome. The health care team must be acutely aware of the existence of and contributors to health disparities and be willing to work toward their elimination in order to provide the best care possible for all women. Implementation of comprehensive health care reform strategies can ensure all women and newborns have access to and receive comprehensive high quality, high-value maternity care.

Reference:
J Health Popul Nutr. 2013;31(4): S81-S105.

Abstract #: T1A-58

TABLE: COMPARISONS BETWEEN AND PRIVATE AND MEDICAID/MEDICARE INSURANCE PARTURIENTS (N=4199)

		PRIVATE	MEDICAID/MEDICARE	P VALUE
DEMOGRAPHIC DATA[A]		(N=3352)	(N=847)	
	AGE (YR)	29.1 ± 5.5	26.1 ± 5.9	< 0.0001
	BMI (KG/M^2)	31.7 ± 8.3	30.8 ± 8.3	0.004
	GRAVIDA	2 [1-3]	3 [2-4]	< 0.0001
	PARITY	1 [0-1]	1 [0-2]	< 0.0001
	GESTATION (WK)	38.9 ± 3.5	38 ± 4.1	< 0.001
	CAUCASIAN/WHITE (%)	91.1%	91.3%	0.91
	AFRICAN AMERICAN (%)	2.3%	3.9%	0.008
	CURRENT SMOKER (%)	12.2%	42.9%	< 0.0001
	URINE DRUG SCREEN + (%)	8.8%	27.4%	< 0.0001
LABOR INDUCTION				
	OXYTOCIN (%)	27.5%	24.1%	0.047
ANESTHESIA				
	EPIDURAL (%)	56.0%	50.3%	0.003
	GENERAL (%)	3.0%	5.7%	0.0001
	LOCAL (%)	2.6%	1.4%	0.04
MATERNAL OUTCOME				
	VAGINAL (%)	62.7%	64.8%	0.25
	PRIMARY C/S (%)	61.3%	51.1%	0.002
	TUBAL (%)	7.0%	10.3%	0.002
NEONATAL OUTCOME	APGAR 1 < 7 (%)	19.0%	20.7%	0.26
	APGAR 5 < 9 (%)	26.5%	31.1%	0.009

[A]MEDIAN AND IQR REPORTED FOR GRAVIDA AND PARITY

Abstract #: T1A-77

The Obstetric Comorbidity Index (OB-CMI) as a predictor for admission to high dependency or intensive care unit

Presenting Author: Ilai Ronel, BMBS, BMedSci
Presenting Author's Institution: Tel Aviv Medical Center - Tel Aviv, Tel Aviv
Co-Author: Tahel Ronel Phd - University College London
Brian T Bateman MD - Brigham and Women's Hospital and Harvard Medical School
Eyal Egoz B.Sc - Tel Aviv Medical Center
Idit Matot MD - Tel Aviv Medical Center
Carolyn F Weiniger MB ChB - Tel Aviv Medical Center

Introduction: Almost 4% of laboring women will experience a near-miss event associated with morbidity and risk of death. We aimed to assess the obstetric comorbidity index (OB-CMI) [1] as a predictor for high dependency unit (HDU) or intensive care unit (ICU) admission in a 12,000 annual deliveries tertiary center.

Methods: Retrospective case-control study of women delivering Jan 2016-Jun 2018. The study group comprised all obstetric admissions to the HDU or ICU in the immediate post-partum period or within the peri-partum period - 6 weeks antepartum to 6 weeks postpartum, for at least 4 hours. The controls were 2000 women who underwent uneventful deliveries in the same time period. Demographic, medical and obstetric characteristics were retrieved. Specific co-morbidities were noted and the OB-CMI score calculated. The difference between OB-CMI scores for study vs. control group was evaluated using Mann-Whitney U test. The area under the receiver operating curve (AUC), reflecting OB-CMI as a predictor for HDU or ICU admission, was calculated using R© programming language.

Results: 1062 study group women identified, 963 (90.7%) HDU and 99 (9.3%) ICU admissions. Demographics and obstetric characteristics are summarized in Table 1. The most common co-morbidities in both groups were previous cesarean delivery or myomectomy, maternal age (35-44 years), multiparity and pre-eclampsia (Table 2). The median (range) OB-CMI scores for study and control groups were 1 (0-17) and 0 (0-6), respectively. The OB-CMI score distributions differed significantly (Mann-Whitney U=1440300, p-value<0.0001, effect size r=0.314). The AUC was 0.678 (95% confidence interval 0.658-0.698). The OB-CMI scores of multiple samples of 1062 controls were randomly selected and compared with scores from the study group. This resulted in highest mean accuracy of 0.652, achieved at OB-CMI scores of ≥2. The associated sensitivity was 0.482 and specificity was 0.822.

Discussion: In our population, we report a significantly higher OB-CMI score for women admitted to HDU or ICU vs. women with uneventful deliveries. Using OB-CMI score cut-off of 2 or above, nearly half of women with adverse outcomes were identified, while still maintaining high specificity. However, due to the low sensitivity, many women with low scores would not be identified using this score.

Reference:

1. Bateman BT et al. Obstetrics and Gynecology. 2013;122(5):957–65

Abstract #: T1A-77

Table 1: Cohort Demographics

	Total cohort (n=3062)	Admitted to HDU/ICU (n=1062)	Uneventful delivery (n=2000)
Total LOS *	4.0 (5.0)	6.1 (7.3)	2.9 (2.4)
Age *	33.3 (5.2)	34.3 (5.5)	32.7 (4.9)
Parity #	1 (0-11)	1 (0-8)	1 (0-11)
Gravidity #	2 (1-14)	2 (1-12)	2 (1-14)
BMI (kg/m²) *	28.0 (5.1)	28.2 (5.3)	28.0 (4.8)
Birth type n (%):			
Cesarean Delivery	1066 (34.8)	685 (64.5)	381 (19.1)
Vaginal Delivery	1730 (56.5)	300 (28.2)	1429. (71.5)
Vacuum Extraction	244 (8.0)	68 (6.4)	176 (8.8)
Late abortion	18 (0.6)	6 (0.6)	12 (0.6)
Vaginal Breech	2 (0.1)	1 (0.1)	1 (0.1)
Not reported	2 (0.1)	1 (0.1)	1 (0.1)
Blood products #:		n=448	n=23
Packed cells	2.0 (0-24)	2 (1-24)	1 (1-2)
Fresh frozen plasma	0.0 (0-18)	2 (1-18)	2 (2-3)
Cryoprecipitate	0.0 (0-8)	2 (1-8)	0 (0-0)
Platelet	0.0 (0-4)	1 (1-4)	0 (0-0)
Ventilated in the ICU Days #		n=21 2 (1-20)	

Key: HDU = High dependency unit; ICU = Intensive care unit; LOS = length of stay; BMI = body mass index; * = mean (Standard deviation); # = median (range)

Table 2 Bateman Obstetric Co-Morbidity Index Frequencies among Women admitted to HDU/ICU and Women with Uneventful Deliveries

	Total cohort (n=3062, %)	Admitted to HDU/ICU (n=1062, %)	Uneventful delivery (n=2000, %)
Severe Pre-eclampsia	148 (6.5)	143 (11.9)	5 (0.5)
Pre-eclampsia/hypertension	173 (7.6)	154 (12.8)	19 (1.8)
Congestive heart failure	4 (0.2)	3 (0.2)	1 (0.1)
Pulmonary hypertension	0 (0)	0 (0)	0 (0)
Ischemic heart disease	0 (0)	0 (0)	0 (0)
Congenital heart disease	7 (0.3)	4 (0.3)	4 (0.4)
Multiparity	132 (5.8)	103 (8.5)	29 (2.7)
Intrauterine fetal demise	3 (0.1)	1 (0.1)	2 (0.2)
Placenta Previa	21 (0.9)	21 (1.7)	0 (0)
Post cesarean/myomectomy	376 (16.5)	169 (14)	207 (19.2)
Autoimmune disorder	13 (0.6)	9 (0.7)	4 (0.4)
HIV	0 (0)	0 (0)	0 (0)
Coagulopathy	82 (3.6)	39 (3.2)	43 (4.0)
CVA/Seizure	22 (1.0)	15 (1.2)	7 (0.6)
Chronic renal failure	21 (0.9)	15 (1.2)	6 (0.6)
Asthma	24 (1.1)	24 (2.0)	0 (0)
Diabetes mellitus with insulin	6 (0.3)	6 (0.5)	0 (0)
Age > 44	63 (2.8)	46 (3.8)	17 (1.6)
Age 40-44	281 (12.3)	141 (11.7)	140 (13.0)
Age 35-39	824 (36.1)	280 (23.2)	544 (50.5)
Substance abuse	4 (0.2)	2 (0.2)	2 (0.2)
Alcohol abuse	0	0 (0)	0 (0)
BMI > 50	2	1 (0.1)	1 (0.1)
BMI > 40	76	29 (2.4)	47 (4.4)
Total OB-CMI #		1 (0-17)	0 (0-6)

Key: HDU = High dependency unit; ICU = Intensive care unit; HIV = Human immunodeficiency virus; CVA = Cerebrovascular accident; BMI = body mass index; OB-CMI = Obstetric co-morbidity index; # = median (range)

Abstract #: T1A-83

Majority next day discharges: evaluation of an enhanced recovery programme for elective caesarean delivery

Presenting Author: Sarah Ciechanowicz, MA, MRes, FRCA
Presenting Author's Institution: University College London Hospital - London, London
Co-Author: Emily Robson FRCA - University College London Hospital
Lisa Nicholls FRCA - Luton and Dunstable University Hospital
Rachel Coathup FRCA - University College London Hospital
Nisa Patel FRCA - University College London Hospital

Introduction: Enhanced recovery (ER) after obstetric surgery has become popular internationally, with many units now practicing or planning adoption. However, there is limited evidence on the optimum perioperative interventions, and wide protocol variation exists. We present an analysis of our ER programme for elective caesarean delivery (CD).
Methods: Baseline audit was performed preceding introduction of ER (2014,2016; n=50,57); repeated during introduction (2017; n=120), and at one year (2018; n=29). We compared clinical characteristics, ER components, pathway compliance, length of hospital stay (LOS), time women felt ready for discharge (TRD) and maternal satisfaction. For women included in early introduction, correlation of clinical characteristics and ER components to LOS/TRD were analysed. Graphpad Prism 8.0, USA was used for analysis.

Results: ER was associated with a reduced LOS from median [IQR] 53 [27 to 57] to 34 [28 to 56] hours (h) (P = 0.01). TRD was 25 [24 to 29] h after ER. Next-day discharges increased from 37% to >50%, maternal satisfaction from 79% to >92% of women, both maintained at one year. Pathway compliance was sustained from 49% (2016) to 75% (2017) and 68% (2018). ER components correlated to LOS (Table). Time to first mobilisation (FM) and urinary catheter removal (UCR) had a stronger correlation to TRD: r=0.57 (0.36 to 0.73); P=0.0001 and r=0.46 (0.22 to 0.65); P=0.0003 respectively. FM discriminated between early (≤36 h) vs. delayed (>36 h) LOS (median [IQR] time 8 [7 to 10.75] vs. 9 [8 to 12] h, respectively; P=0.01). There was no difference in LOS for previous CD (P=0.56).

Discussion: Time to FM and UCR, and intraoperative blood loss had the strongest association with LOS. The hallmarks of our programme are an early mobilisation assessment by midwives at 6 h post neuraxial anaesthesia, and UCR from 8 h. We believe these interventions are instrumental to drive early discharge, although we can not attest causation. Our data could indicate the importance of minimising surgical blood loss. Our ER programme has been sustained at one year with a majority of women going home the next day. We found multidisciplinary involvement essential to maintenance, with our postnatal ward midwife lead 'champions' sustaining interest in excellent post-CD ER care.

Reference:

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Characteristic/component	Spearman r (95% C.I) correlation to LOS	P value
Time to first mobilisation	0.35 (0.14 to 0.53)	0.001
Intraoperative blood loss	0.33 (0.10 to 0.52)	0.004
Time to urinary catheter removal	0.26 (0.04 to 0.45)	0.02
Fasting time solids	-0.22 (-0.42 to 0.00)	0.05
Pain on mobilisation	0.20 (-0.01 to 0.40)	0.05
Maternal age	-0.17 (-0.30 to -0.04)	0.01
Body mass index	0.17 (0.01 to 0.33)	0.04
Fasting time fluids	0.06 (-0.16 to 0.27)	0.58

Abstract #: T1A-95

Postpartum readmission rates and inpatient mortality in pregnancies complicated by sickle cell disease: A multistate analysis 2007-2014

Presenting Author: Evelyn E. Bae MD
Presenting Author's Institution: New York-Presbyterian Hospital - Weill Cornell Medicine
Co-Author: Virginia Tangel MA - Weill Cornell Medicine, Center for Perioperative Outcomes
Robert S. White MD - NewYork-Presbyterian Hospital - Weill Cornell Medicine
Anna S. Nachamie BS - Weill Cornell Medicine, Center for Perioperative Outcomes
Sharon E. Abramovitz MD - NewYork-Presbyterian Hospital - Weill Cornell Medicine
Nathan A. Liu MD - NewYork-Presbyterian Hospital - Weill Cornell Medicine

Background: Sickle cell disease (SCD) in pregnancy has been associated with increased maternal mortality and morbidity. Previous studies have reported increased hospital admissions and length of stay (LOS) in sickle cell patients throughout pregnancy due to sickle cell and pain crises, which are known to occur more frequently in pregnancy. In this study, we aimed to compare post-partum outcomes between SCD and non-sickle cell populations.

Methods: We conducted a retrospective analysis of discharge data for 6,911,916 inpatient deliveries in the states of California, Florida, New York, Maryland, and Kentucky from 2007 to 2014 using data from the State Inpatient Databases Healthcare Cost and Utilization Project. We compared unadjusted rates and adjusted odds of 30- and 90-day readmission rates, in-hospital mortality, LOS, and total hospital charges in SCD, sickle cell trait, and non-sickle cell patients.

Results: The incidence of SCD was 0.1% (4,758 patients). The inpatient mortality rate was 0.3% in the SCD group. Compared to non-sickle cell patients, SCD patients were nearly five times more likely to die in-hospital (aOR: 4.92, 95% CI: 2.65-9.15, $p < 0.001$), 26% more likely to be readmitted up to 30 days post-delivery (aOR: 1.26, 95% CI: 1.12-1.42, $p < 0.001$), and 90% more likely to be readmitted up to 90 days post-delivery (95% CI: 1.73-2.08, $p < 0.01$). The SCD group had a longer median LOS (3 days, IQR: 2-5) vs. 2 days (IQR: 2-3) in the non-SCD group, and greater median total hospital charges, SCD: $17,808 (IQR: $10,490-$30,125) vs. non-SCD $13,365 (IQR: $8,526-$20,798). SCD patients were 1.32 times more likely than non-sickle cell patients to experience a minor complication such as deep venous thrombosis, urinary tract infections, sepsis/shock (95% CI: 1.89-2.85, $p < 0.001$), and 2.44 times more likely to experience a major complication such as pneumonia, cardiac arrest, stroke, and mechanical ventilation (95% CI: 2.88-4.11, $p < 0.001$).

Patients with sickle cell trait were more likely to be readmitted at both 30 and 90 days (aOR: 1.12, 95% CI: 1.04-1.21, and aOR: 1.09, 95% CI: 1.03-1.17, $p < 0.001$, respectively) and experience a major complication (aOR 1.34, 95% CI: 1.15-1.57, $p < 0.001$).

Conclusion: SCD in pregnancy is associated with increased inpatient mortality, LOS, hospital charges, and postpartum complications and readmissions. The presence of sickle cell trait was associated with a significant but smaller likelihood of morbidity. Our findings confirm disparate outcomes in sickle cell pregnancies and provide further insight into the impact of SCD on patterns of healthcare utilization.

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Abstract #: T1B-134

Anesthesia workforce density and failure-to-rescue from maternal morbidity.

Presenting Author: Jean Guglielminotti M.D., Ph.D.
Presenting Author's Institution: Columbia University College of Physicians and Surgeons
Co-Author: Cynthia A Wong M.D. - University of Iowa Carver College of Medicine
Ruth Landau M.D. - Columbia University College of Physicians and Surgeons
Guohua Li M.D., Dr. P.H. - Columbia University College of Physicians and Surgeons

Background: Each year in the United States, 50 000 parturients experience a life-threatening complication and 700 die (1). Progression from a complication to death is defined as a failure-to-rescue (FTR). FTR captures the premise that not all complications are avoidable but that systems should allow recognition and response to these complications to prevent death (2). Research indicates that higher density of obstetricians at state-level is associated with decreased maternal mortality (3). Despite their growing involvement in maternal care, the association between anesthesiologists' density and maternal outcomes has not been examined. This study tested the hypothesis that a higher density of anesthesia providers is associated with a lower FTR from maternal morbidity.

Methods: This retrospective study analyzed maternal morbidity and mortality data from delivery and postdelivery discharges of the National Inpatient Sample (NIS) 2012-2015, a 20% national representative sample. The CDC definition of maternal morbidity was used (4). Numbers of obstetricians, midwives, physician anesthesiologists and certified registered nurse anesthetists (CRNA) per 1000 births in the 9 census divisions were abstracted from the Area Health Resources file 2012-2015. The adjusted odds ratio (aOR) of FTR associated with provider density was estimated using robust logistic regression.

Results: During the study period, the NIS recorded a total of 57,446 parturients with maternal morbidity, including 202 deaths (FTR rate: 3.5 per 1000; 95% CI, 3.0-4.0). The lowest FTR rate was in the Mountain Division (1.8 per 1000) and the highest in the South Atlantic Division (5.3 per 1000). Both CRNA density and proportion of CRNAs among anesthesia providers were significantly higher in discharges recording FTR than in discharges not recording FTR (Table 1). Obstetricians', midwifes', and physician anesthesiologists' densities did not differ between discharges with and without FTR. After adjustment, only CRNA density was associated with FTR (aOR 1.05; 95% CI, 1.02-1.09).

Conclusions: CRNA density at the census division level is associated with increased FTR from maternal morbidity. The underlying mechanisms of this unexpected association remain to be determined.

Table 1: Comparison of obstetric care providers' density between discharges with and without failure-to-rescue in the 57,446 delivery and postdelivery discharges recording maternal morbidity in the National Inpatient Sample, 2012-2015.

	No failure-to-rescue (N = 57,244)	Failure-to-rescue (N = 202)	P-value	Crude OR (95% CI)	Adjusted OR (95% CI)
Density of provider (per 1000 births)					
Obstetricians (per 1000 births)	9.9 (7.9-10.2)	10.0 (8.8-10.3)	0.17	1.02 (0.95-1.09)	n.s
Midwifes					
Advanced practice nurse midwifes (per 1000 births)	1.6 (1.3-1.7)	1.6 (1.3-1.7)	0.45	1.02 (0.83-1.25)	n.s
Certified nurse midwifes (per 1000 births)	3.0 (2.3-3.4)	3.4 (2.3-3.4)	0.79	1.01 (0.90-1.14)	n.s
Physician anesthesiologists (per 1000 births)	10.7 (9.5-11.6)	10.6 (9.5-11.6)	0.19	0.97 (0.92-1.04)	n.s
CRNA (per 1000 births)	10.5 (9.0-14.0)	12.5 (9.6-14.3)	< 0.001	1.06 (1.03-1.09)	1.05 (1.02-1.09)
Anesthesia workforce composition					
Proportion of CRNA among anesthesia providers[a]	49.9% (39.5-56.7)	52.3% (40.5-57.4)	< 0.001	1.02 (1.01-1.03)	n.s

Abbreviations: CI: confidence interval; n.s.: not significant; OR: odds ratio.

Footnote: Results expressed as median (interquartile range). Similar results were observed in a sensitivity analysis limiting delivery and postdelivery discharges to discharges recording postpartum hemorrhage, severe hypertensive disorders of pregnancy, or pulmonary embolism.

[a] Calculated as number of CRNA / (number of CRNA + number of physician anesthesiologists).

References:

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2. Friedman, Am J Obstet Gynecol 2016;215:795.e1-14
3. Sullivan, Am J Obstet Gynecol 2005;193:1083-8
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Abstract #: T1B-158

Defining Factors That Impact Obstetric Anesthesia Workload

Presenting Author: Alea Gillian Morrison M.D.
Presenting Author's Institution: Cedars Sinai Medical Center - Los Angeles, California
Co-Author: Sydney Selzer MD - Cedars Sinai Medical Center
Brian Bensadigh MD - Cedars Sinai Medical Center
Andrew Geller MD - Cedars Sinai Medical Center
Mark Zakowsk MD FASA - Cedars-Sinai Medical Center

Introduction: Optimal staffing of obstetric anesthesiology services for labor and delivery units has not been well defined, with widely varying staffing practices nationally. Staffing and economic concerns affect every hospital and type of practice. Staffing needs are complex and beyond single criteria such as deliveries/year. This is the first study to examine through expert consensus using the Delphi Method what constitutes adequate staffing for obstetric anesthesia and what factors should be considered including direct clinical, indirect clinical and non-clinical workloads of providing obstetric anesthesia services.

Methods: After IRB approval, we performed a modified three round Delphi survey to identify factors that impact the workload of the obstetric anesthesiologist. A list of factors that might influence obstetric anesthesia workload was generated by the authors, including direct clinical, indirect clinical and non-clinical workload. Ten experts were identified by membership on the SOAP Board of Directors or the ASA Committee on Obstetric Anesthesia with geographic and practice diversity. The experts were asked to rank each task according to importance on a seven-point Likert scale (1 = Strongly Disagree and 7 = Strongly Agree. Consensus was set a priori at ≥ 70% Likert score of ≥ 5. The result of the Delphi study is a list of agreed upon tasks that are deemed important in determining the workload for an obstetric anesthesiologist.

Results: Nine experts completed the entire Delphi Study. See Table 1 for summary of factors that achieved consensus.

Conclusion: Expert consensus determined Obstetric Anesthesia workload comprises direct clinical, indirect clinical and non-clinical components, with varying levels of additional time needed. Staffing allocation for obstetric anesthesia services need to take theses components, which may vary by practice, into account. Single metrics like deliveries per year is not robust enough to solely determine staffing needs.

Table 1: Factors That Contribute to Workload of Obstetric Anesthesia Anesthesia Providers

Dedicated OB Anesthesia staffing	
1 minimum	>1500 deliveries/yr
2 minimum	>5000 deliveries/yr
Trainee, equivalence	40-60% of fully trained workload
Direct Patient Care	
Epidural management AFTER initial placement	>20 min/epidural
Non-Analgesic care, post-delivery	30-60 min/24h
Factors affecting Procedural Time	
BMI>40, Scoliosis, Lumbar hardware	>25% longer
Indirect patient care activities	
Safety rounds, OR set-up, etc.	>1 h/day
Not anesthesia, assistance to RN/OB	>30 min/day
Pre-admission anesthesia consultations, if offered	5-10 h/week
Administrative & QI activities	5-10 h/week
Response times: should have adequate staffing for	
Labor epidural request	15 min
Urgent cesarean (decision to incision)	30 min
Emergent (Decision to incision)	15 min

Abstract #: T1B-159

Utilization, outcomes, and costs of extracorporeal membrane oxygenation among pregnant women in the United States, 1999-2014.

Presenting Author: Bushra W. Taha M.D.
Presenting Author's Institution: Columbia University College of Physicians and Surgeons
Co-Author: Jean Guglielminotti M.D., Ph.D. - Columbia University College of Physicians and Surgeons
Guohua Li M.D., Dr. P.H. - Columbia University College of Physicians and Surgeons
Ruth Landau M.D. - Columbia University College of Physicians and Surgeons

Introduction: Despite its life-saving potential in leading causes of maternal mortality (1) utilization of extracorporeal membrane oxygenation (ECMO) in obstetric patients remains uncommon (2). Evidence for its efficacy and safety in pregnancy is scarce. The aim of this study was to analyze ECMO utilization, costs and outcomes in obstetric patients in the United States.

Methods: Data were obtained from the National Inpatient Sample 1999-2014, a 20% representative sample of discharge records. ECMO was identified using the ICD-9-CM code 39.65. Pregnancy and ECMO complications were identified using ICD-9-CM algorithm. Indication for ECMO was identified by analysis of ICD-9-CM codes in individual discharge records. Hospital costs were calculated and expressed in constant $2014. Trends were tested using adjusted weighted logistic regression.

Results: During the study period 20,454 adult (>15 years old) ECMO cases were identified of which 331 were pregnant women (1.6%). ECMO utilization during pregnancy increased from 1.2 per million deliveries in 1999-2002 to 12.4 in 2011-2014 ($P < 0.001$), with isolated cardiogenic shock as the most common indication (49.5%). Most common conditions associated with ECMO use were sepsis, cardiomyopathy, and aspiration pneumonia with marked differences in mortality and hospital costs depending on the condition (Table). Mortality rates decreased over time in both cohorts but to a greater extent in the pregnant cohort (-57% vs -21% in the general adult cohort; Figure 1A), but with similar median hospital costs ($146,706 vs $170,451, respectively; $P = 0.69$; Figure 1B). There was no difference in rates of thrombotic or hemorrhagic complications between the cohorts.

Conclusion: We identified for the first time that ECMO utilization in pregnancy is associated with reduced mortality than in the general adult population, without increased risk for hemorrhagic or thromboembolic complications. The association between aspiration pneumonia after cesarean delivery and ECMO warrants further evaluation, as this was not an expected finding. Our analysis suggests that ECMO is an effective intervention in the setting of acute maternal conditions, particularly for women with influenza, myocardial infarction, and aspiration pneumonia in which mortality rates were very low.

References:

1. Obstet Gynecol 2017;130,366-37
2. Semin Perinatol 2018;42:21-2

Abstract #: T1B-159

Table: Conditions, Outcomes & Costs Associated with ECMO Utilization in Pregnancy; National Inpatient Sample 1999 – 2014

Conditions	Cases (N_w = 259)	Death (N_w = 88)	Total hospital costs ($2014)[b]
Sepsis (Undifferentiated)	57 (22.1%)	14 / 57 (25.3%)	193,012 (18,356-322,920)
Cardiomyopathy	43 (16.6%)	24 (55.6%)	221,455 (190,791-300,320)
Aspiration pneumonia	25 (9.7%) including 15 after cesarean delivery	-[a] (≈ 20%)	61,164 (51,135-207,139)
Pulmonary embolism	24 (9.3%)	-[a] (≈ 40%)	78,940 (71,761-108,349)
Infectious pneumonia	20 (7.5%)	15 / 20 (75.0%)	114,625 (67,793-225,649)
Influenza	19 (7.3%)	0 / 19 (0.0%)	195,819 (124,251-312,310)
Myocardial infarction	18 (7.1%)	0 / 18 (0.0%)	300,846 (119,808-496,709)
Other [c]	53 (20.5%)	19 / 53 (22.1%)	--

Results are expressed as weighted number (N_w and %) and median (interquartile range).

[a] Because of HCUP data use agreement restrictions on small cell size, the number of observed cases and exact proportions are not presented.

[b] Costs are calculated as the product of total hospital charges and a cost-to-charge ratio, both provided by the NIS. Costs are expressed in $2014 using the consumer price index for inpatient hospital services.

[c] Other includes the following possible causes: eclampsia, pulmonary hypertension, hemorrhage, myocarditis, amniotic fluid embolism, heart valve disease, and septic cardiomyopathy.

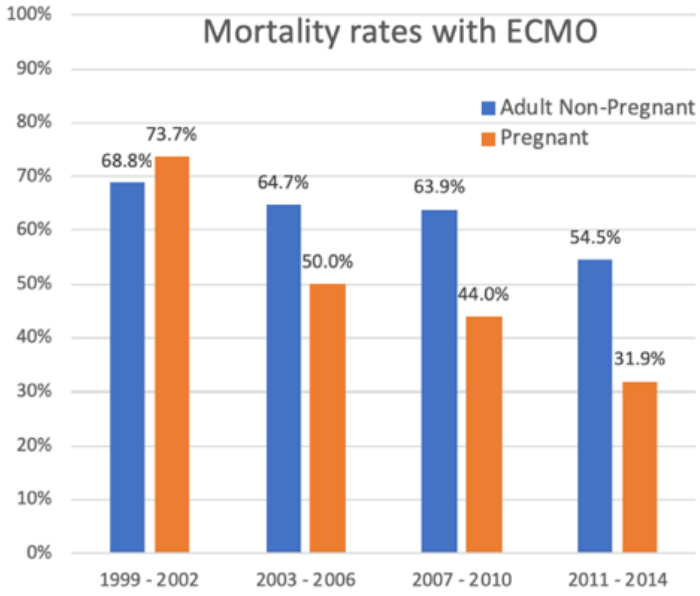

Figure 1A. Mortality rate in pregnant cohort was 39.2% vs 58.0% in adult non pregnant cohort (P < 0.001; adjusted OR 0.63; 93% CI, 0.40-0.99)

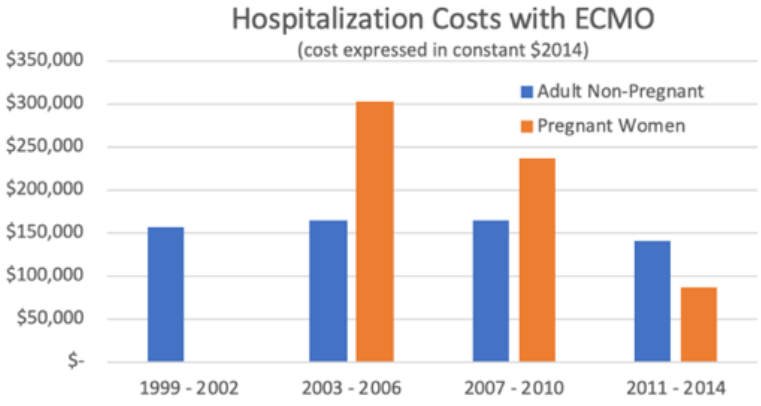

Figure 1B. Median unadjusted hospital costs were $170,451 in the adult non-pregnant cohort and $146,706 in the pregnant cohort (P = 0.69).

Abstract #: T1B-164

Healthcare Provider Perceptions of a Novel Automated Maternal Electronic Surveillance System

Presenting Author: Thomas T Klumpner MD
Presenting Author's Institution: University of Michigan - Ann Arbor, MI
Presenting Author Status:
Co-Author: Joanna A Kountanis MD - University of Michigan - ,
Melissa E Bauer DO - University of Michigan - ,
Kevin K Tremper PhD, MD - University of Michigan - ,

Introduction: A leading cause of preventable maternal death is related to delayed or inadequate response to clinical warning signs (1). As previously described (2), we developed an FDA-cleared automated electronic surveillance tool, AlertWatch OB (AWOB). This tool was fully implemented in April 2017 and selectively pages labor and delivery nurses to initially evaluate abnormal vital signs before paging clinicians with sustained vital sign abnormalities. To our knowledge, this is the first time computer software has been used on a labor and delivery unit to deliver targeted automated early warning pages to all labor and delivery providers. This survey study evaluates healthcare provider perceptions of this system.

Methods: An anonymous online survey was sent to providers on the labor and delivery unit, including labor and delivery nurses (RN), certified nurse midwives (CNM), obstetrics (OB) residents and fellows, anesthesiology trainees as well as OB, family medicine (FM) and anesthesiology faculty on 12/13/18. Survey domains included: perceptions of the system's effect on patient care, alarm fatigue, and continued use of the system. Survey responses were collected on 1/28/19.

Results: The overall survey response rate was 45% (235/523). RNs (35% of 235 respondents) and OB/FM faculty (19% of respondents) were the most frequent respondents. Respondents agreed or strongly agreed the system improved: response time to severe morbidity (65%), patient safety (65%), communication (59%), management of severe morbidity (50%) and teamwork (42%). Of those who had received a page, 54% felt that they received pages "too frequently" and 45% felt that they received pages "the right amount of the time." Four respondents agreed or strongly agreed with the statement "I feel that AWOB pages have caused patient harm." The majority, 83% of respondents, felt that the system should remain in use, but acceptance rates varied. For example, 12/20 (60%) of CNM, 68/83 (82%) of RN, 39/45 (87%) of OB/FM faculty, and 48/55 (87%) of anesthesia provider respondents felt the system should remain in use.

Discussion: Most respondents felt that the system improved patient safety, communication and response time to severe morbidity. With any automated system, false positive notifications are unavoidable, and alarm fatigue is a concern. Many respondents felt that they received pages too frequently. Despite this, 83% of respondents felt that the system should remain in use on our unit. Response bias, recall bias and limited survey response are important limitations of this study. A large majority of providers on our unit support the continued use of this automated maternal electronic surveillance system. Additional studies are required to determine an objective impact of this system on maternal care and how the system can be improved.

References

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2. BMC Anesthesiol. 2018; 18: 78. PMID: 29945569

Abstract #: T1B-184

Extracorporeal Life Support in Pregnancy: A Systematic Review and Meta-analysis

Presenting Author: Emily E. Naoum M.D.
Presenting Author's Institution: University of Michigan - Ann Arbor, MI
Co-Author: Andrew Chalupka M.D., M.B.A. - Massachusetts General Hospital
Jonathan Haft M.D. - University of Michigan
Mark MacEachern M.L.I.S. - University of Michigan
Brian Bateman M.D., M.Sc - Brigham and Women's Hospital
Melissa Bauer D.O. - University of Michigan

Background: Cardiovascular disease is the leading cause of pregnancy-related mortality contributing to more than a quarter (26%) of maternal deaths(1). Extracorporeal life support (ECLS) can support patients through either cardiac or respiratory failure and its use has increased and expanded substantially in the last decade. While uncommon, it has been successfully utilized in the peripartum period. The reported survival rate for pregnant patients undergoing ECLS is significantly higher than the overall survival with adult ECLS for pulmonary (59%) or cardiac (42%) causes with maternal survival rates ranging from 70-80% and fetal survival rates 65-72%(2-6).

The aim of this systematic review is to perform a comprehensive search of ECLS in the pregnant, peripartum, and postpartum periods and to define the reported indications, timing, management strategies, population specific considerations, and outcomes.

Methods: OVID MEDLINE, Embase, Web of Science, and CINAHL databases were searched to capture studies regarding ECLS in the pregnant, peripartum, and postpartum periods. Data was collected for indication, maternal demographics, gestation, timing, duration, and type of ECLS, and maternal and fetal morbidity and mortality.

Results: Overall 2116 studies were identified and reviewed and 234 studies met inclusion criteria. There were a total of 334 cases of ECLS during the peripartum period reported including 35 deliveries on ECLS and 11 cases including cardiopulmonary bypass pre- or post-ECLS. There were 83 (24.9%) cases in the antepartum period, 80 (24.0%) cases intrapartum (<1 day), and 117 (35%) cases in the postpartum period (1-42 days). The most common indications for ECLS overall in pregnancy included ARDS (45.1%), cardiac failure (34.9%), and cardiac arrest (15.8%). The maternal survival was 253 (75.8%) and fetal survival was 159 (74.3%). The most common maternal complications included moderate bleeding (32.3%), severe bleeding requiring surgical intervention (14.1%) and vascular complications (4.2%). The most commonly reported fetal complications include preterm delivery in 71 (33.2%) and NICU admission in 55 (25.7%).

Discussion: ECLS in the peripartum period demonstrates value and reasonable safety in this population and should be considered in cases of refractory respiratory failure, cardiogenic shock, cardiac arrest, septic and/or obstructive shock. These results may be limited by publication bias. Nevertheless, the current literature favors the implementation of ECLS in pregnant patients with severe morbidity as an effective therapy.

References:

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Abstract #: T1C-202

Anesthesia management in pregnant patients with Ebstein anomaly

Presenting Author: Carmelina Gurrieri M.D.
Presenting Author's Institution: Mayo Clinic - Rochester, MN
Co-Author: Emily E. Sharpe M.D. - Mayo Clinic
Katherine W. Arendt M.D. - Mayo Clinic

Introduction: Ebstein's anomaly (EA) is a rare congenital cardiac disease characterized by malformation of the tricuspid valve leaflets and right ventricle. Obstetric, cardiac, and anesthetic concerns in pregnant patients with EA include development of congestive heart failure, intrapartum arrhythmia, embolic events, preterm delivery and fetal or neonatal death. Few reports are available in the literature in regards to anesthetic management for these patients. (1,2)

Methods: The Mayo Clinic Medical Records Database was utilized to identify pregnant patients with known EA who delivered at Mayo Clinic from January 2000 to December 2018. Medical records were reviewed to evaluate peri-partum care with a focus on anesthetic management.

Results: During the study period, a total of 10 deliveries among 7 patients were identified. Five patients had surgically corrected EA; 4 (57%) had persistent moderate to severe right ventricular enlargement with reduced systolic function on first trimester echocardiogram; 3 (42%) had preexisting cardiac arrhythmias. All deliveries except one received neuraxial analgesia: 2 (28%) epidural, 1 (14%) combined spinal– epidural, 1 (14%) dural puncture epidural, 1 (14%) continuous spinal anesthetic after an unintended dural puncture (UDP), 4 (57%) spinal for elective cesarean delivery (CD). Two patients undergoing vaginal delivery had continuous ECG monitoring. Invasive arterial blood pressure monitoring was used in two CDs and in one forceps assisted vaginal delivery. Four patients had anesthetic and obstetric complications including placental abruption, postpartum hemorrhage, post-dural puncture headache, worsening congestive heart failure (CHF) and arrhythmias. Five patients were admitted to the intensive care unit for post-delivery monitoring. No fetal or maternal deaths occurred.

Conclusions: In our cohort, a significant number of patients had moderate to severe right ventricular failure. Cardiac events included CHF and arrhythmias, obstetric events included placental abruption and postpartum hemorrhage, and anesthetic events included an UDP requiring an epidural blood patch. Although patients with EA can have significant right ventricular failure, their obstetric and anesthesia outcomes appear superior to patients with right ventricular failure as a result of pulmonary hypertension.

References:

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2. Ross FJ et al. Semin Cardiothorac Vasc Anesth 2016, 20(1) 82–92

Abstract #: T1C-202

Table 1: Patient demographics, medical history, anesthetic and obstetric management, outcome.

Pt #	Age *	Gravity/ Parity	Gestational age¥	Grade of TR/ RV function‡	Initial surgery repair	Other cardiac surgeries	Other cardiac diseases	Arrhythmias	Type of Delivery	Anesthesia	Maternal complications
1α	33	G1P0	38	Mild TR; Moderate RV enlargement with mild↓ systolic function	None	None	PFO	None	NSVD	Epidural	None
1β	38	G2P1	38	Mild TR; Moderate RV enlargement with mild↓ systolic function	None	None	PFO	None	NSVD	None	Precipitous delivery
2	28	G1P0	39	Mild TR; Mild-Moderate RV enlargement with mild↓ systolic function	24 y/o: Cone Repair; TV annuloplasty; right reduction atrioplasty	None	ASD	None	NSVD	Epidural	None
3	24	G1P0	40	Severe TR; Mild RV enlargement with mild↓ systolic function	<1 y/o: Percutaneous balloon valvuloplasty	15 y/o: TV repair; WPW ablation 19 y/o: TVR+PVR; right PA patch enlargement; right reduction atrioplasty; closure ASD; SVT ablation	ASD PR, severe	WPW SVT	NSVD	Intrathecal catheterϒ	PPH; PDPH requiring epidural blood patch
4α	28	G1P0	39	Severe TR; Severe RV enlargement with preserved systolic function	27 y/o: TVR; right reduction atrioplasty	None	ASD	None	CD for placenta abruption and NRFHT	CSE	Placenta abruption
4β	31	G2P1	38	Severe TR; Moderate RV enlargement with mild↓ systolic function	27 y/o: TVR; right reduction atrioplasty	None	ASD	None	CD, elective repeat	Spinal	None
4γ	33	G3P2	37	Severe TR; Severe RV enlargement with moderate-severe systolic function	27 y/o: TVR; right reduction atrioplasty	None	ASD	None	CD, elective repeat	Spinal	None
5	25	G3P0	33	Severe TR; Severe RV enlargement with moderate-severe↓ systolic function	12 y/o: TVR	None	2º AV block Mobitz I	None	CD, urgent	Spinal	SVT at 33 weeks gestation
6	28	G2P1	36	Mild TR; Normal RV with preserved systolic function	None	None	None	SVT	CD, elective repeat₱	Spinal	GDMA; SVT at 26 weeks gestation
7	38	G1P0	39	Severe TR; Moderate RV enlargement with moderate-severe↓ systolic function	7y/o:TV repair; right reduction atrioplasty	22 y/o: TVR; Vtach ablation 29 y/o: Atrial flutter ablation; PM placement	Infra-Hisian block	Vtach Atrial flutter	Forceps-assisted vaginal delivery	DPE	None

Pt= patient; TR= tricuspid regurgitation; echo= echocardiogram; RV= right ventricle; NA= not available; PFO= patent foramen ovale; NSVD= normal spontaneous vaginal delivery; TV= tricuspid valve; ASD= atrial septal defect; y/o= years old; WPW= Wolf Parkinson White cardiac arrhythmia; TVR= tricuspid valve replacement; PVR= pulmonary valve replacement; PA= pulmonary artery; SVT= supraventricular tachycardia; PR= pulmonary regurgitation; PPH= post-partum hemorrhage; PDPH= post-dural puncture headache; CD= cesarean delivery; NRFHT= non reassuring fetal heart tome; AV= atrio-ventricular cardiac block; GDMA= gestational diabetes mellitus; Vtach= ventricular tachycardia; PM= pacemaker; DPE= dural puncture epidural

*= Patient age is reported in years; ¥= gestational age reported in weeks; ‡ grade of tricuspid valve regurgitation and right ventricle function at initial echocardiogram; §= Patient age at repair expressed in year; ϒ= Epidural placement complicated by accidental dural puncture. Epidural catheter was consequently threaded into the intrathecal space; ₱= patient had prior CS at outside facility.

Pt1α: first pregnancy; pt1β: second pregnancy; Pt4α: first pregnancy; pt4β: second pregnancy; pt 4γ third pregnancy.

Abstract #: T1C-212

Patient Expectations and Preferences Regarding Anesthesia Care Surrounding Cesarean Delivery

Presenting Author: Jaime Daly MD
Presenting Author's Institution: Massachusetts General Hospital - Boston, MA
Co-Author: Aaron Smith BA - University of Chicago
David Arnolds MD, PhD - University of Chicago
Brendan Carvalho MBBCh, FRCA - Stanford University
Barbara Scavone MD - University of Chicago

Introduction: Women's expectations and preferences surrounding cesarean delivery (CD) is poorly elucidated (1). Carvalho et al. at Stanford University Hospital studied patient preferences for anesthesia-related outcomes after CD and determined that avoiding pain was most important relative to side-effects, and that paralysis was the most common anesthesia-related fear (2); however, most subjects in that study were Caucasian, had graduate degree education and had median annual household incomes of $50,000-100,000. The intention of this study was to determine these preferences in an urban, largely African-American population of more limited education and financial means. We hypothesized that this population might have dissimilar preferences and expectations regarding their anesthesia care during cesarean delivery.

Methods: Our population consisted of patients presenting for scheduled CD or induction of labor to our academic inner-city practice. We followed the same methodology of the Stanford University Hospital study (2). Patients were administered a preoperative survey regarding demographics and expectations and preferences and a briefer postoperative survey. Descriptive statistics were used to present data using n (%) for categorical data and median (interquartile range (IQR)) for continuous data.

Results: Of 93 patients offered the study, 75 consented to participate. Overall 73 completed a preoperative survey and 64 a postoperative survey. The study population consisted of mostly African-Americans with some college education, 58% of whom were married and 64% of whom had annual income less than $50,000 (Table 1). Pain during and after CD were ranked as least desirable outcomes and approximately 50% of patients expressed fear of paralysis as their principal concern with spinal/epidural anesthesia. Please see Table 1 for complete results.

Conclusions: Similar findings occurred despite the demographic differences between our patients and those in the previous study, perhaps indicating that fundamental concerns transcend demographic differences. Our results emphasize the importance of addressing paralysis during preoperative assessment to help ease patient concerns. Findings from this study should be used to improve anesthetic care and patient satisfaction by allowing the anesthesiologist to more closely meet patients' expectations.

References:

1. Pilnick et al. Social Science & Medicine 2011;72:1374-82
2. Carvalho et al. Anesth Analg 2005;101:1182-87

Abstract #: T1C-212

DEMOGRAPHICS (n=73)	
Age (yr)	29 (25 - 34)
Marital Status	
Married/cohabitate	44 (60)
Single	29 (40)
Ethnicity	
African-American	49 (67)
Caucasian	6 (8)
Hispanic	12 (16)
Other	6 (8)
Schooling	
Graduate Degrees	11 (15)
Bachelor's Degree	11 (15)
Some college	30 (41)
High school	18 (25)
Less than 12 years	3 (4)
Annual household income in dollars	
<20k	22 (30)
20-50k	25 (34)
50-100k	15 (21)
100-200k	8 (11)
>200k	3 (4)
PREFERENCES, EXPECTATIONS, AND FEARS (Preoperative n=73)	
During your cesarean would you prefer to be:	
Awake	49 (67)
Asleep	9 (12)
Awake but sleepy	15 (21)
After surgery do you expect to be in:	
No pain	15 (21)
Some pain	38 (52)
Moderate	18 (25)
Severe pain	2 (3)
On a scale of 1-10, how much pain would you tolerate rather than expose your baby to any medication you receive?	7 (5-8)
What is your biggest fear with spinal/epidural anesthesia?	
Pain on insertion	8 (11)
Failure to provide pain relief	6 (8)
Paralysis	36 (49)
Backache	9 (12)
Headache	1 (1)
PREFERENCES, EXPECTATIONS, AND FEARS (Postoperative n=64)	
Did you have any unpleasant side effects during or after surgery?	
Yes	53 (83)
Nervous before surgery	17 (27)
Nausea	30 (47)
Vomiting	30 (47)
Pain during surgery	2 (3)
Pain after surgery	11 (17)
Shivering during surgery	9 (14)
Itching	38 (60)
Kept nodding off	1 (2)
Neck pain and headache	1 (2)

PREFERENCE RANKING (Scale 1-10 where 1=least want to avoid, 10=most want to avoid)

	Preoperative n=73	**Postoperative n=64**
Pain during surgery	9.5 (8-10)	9 (8-10)
Itching	5 (4-7)	5 (4-7)
Nausea	6 (5-8)	7 (6-8)
Nervousness	4 (3-5)	3 (3-6)
Shivering	5 (4-6)	5 (4-6)
Cramping	6 (5-8)	6 (5-7)
Good Recovery	1 (1-2)	1 (1-1)
Sleepy	3 (2-4)	2 (2-4)
Vomiting	7 (5-8)	7 (5-8)
Pain after surgery	9 (5-10)	9 (4-10)
Preferred dose of pain medication		
Lowest (high risk pain, low risk SE)	7 (10)	2 (3)
Moderate (similar risks pain and SE)	40 (55)	39 (61)
Highest (low risk pain, moderate risk SE)	25 (34)	21 (33)

Data expressed as median (interquartile range) or n (%)

Abstract #: T1C-223

Improving Decision-to-Incision Time in Unscheduled Cesarean Deliveries: Use of a Proactive Preoperative Huddle

Presenting Author: Andrew N. Chalupka M.D., M.B.A.
Presenting Author's Institution: Massachusetts General Hospital - Boston, Massachusetts
Co-Author: Lisa Leffert M.D. - Massachusetts General Hospital
Erik Clinton M.D. - Massachusetts General Hospital
Elizabeth West M.S.N., R.N. - Massachusetts General Hospital
Wilton Levine M.D. - Massachusetts General Hospital
Rebecca Minehart M.D. - Massachusetts General Hospital

Background: Historical standards have called for 30 minutes or less to pass between the decision to perform an unscheduled cesarean delivery (CD) and the start of the case. More recent guidelines still specify a 30 minute target but allow more leeway, suggesting that the interval should "[incorporate] maternal and fetal risks and benefits."(1) At our institution, while this interval is not routinely recorded, sample measurements showed that the 30-minute target was not consistently met. A process improvement project was undertaken to improve decision-to-incision time for unscheduled CD by addressing perceived deficiencies in organization, teamwork, and communication.

Methods: The intervention consisted of two elements. First, the unit's preoperative huddle was redesigned to include an explicitly-stated target time for OR entry and opportunities for each team (obstetrics, anesthesiology, and nursing) to state remaining barriers to OR entry, resource needs, and anticipated timing. Secondly, the workflow sequence was inverted; rather than teams independently carrying out tasks first and later joining in a huddle as a final step, the huddle was accelerated to become the initial step following decision for CD. The primary outcome was time between case booking (a proxy for decision time) and time of OR entry. Data collection was continuous for four weeks prior to and four weeks following the intervention.

Results: Timing data was collected for 26 pre- and 31 post-intervention cases. Prior to intervention, the mean time between decision and OR entry was 33.5 minutes, median time was 33.5 minutes, and standard deviation was 16.0 minutes. Following intervention, the mean time was 18.0 minutes, median time was 17.0 minutes, and standard deviation was 11.2 minutes. Hypothesis testing for the mean time interval was carried out via Mann-Whitney U testing, with a U statistic of 639 and a two-tailed p-value of 0.0002.

Discussion: Through modification of a labor unit's huddle tool to include explicit target times and a discussion of teams' remaining tasks and needs, as well as redesign of the workflow for unscheduled CD to perform the preoperative huddle immediately, the mean latency between decision and OR entry was significantly reduced. Variability in timing also decreased. These improvements were likely due to facilitation of communication between teams, improved awareness of others' remaining tasks, and increased goal orientation. In addition to patient care benefits, reducing this time interval benefits physicians by minimizing waiting, thus freeing time for other clinical tasks. Hospitals benefit through more efficient use of fixed facility resources. Future process improvement projects can focus maximizing efficiency and minimizing variability in the time period between OR entry and incision.

References:

1. Riley LE, Stark AR, eds. Guidelines for Perinatal Care, 7th Ed. Washington: American College of Obstetricians and Gynecologists; c2012.

Abstract #: T1C-245

Factors contributing to time from patient entry to operating room (OR) to spinal anesthesia administration for scheduled cesarean delivery in a large academic center

Presenting Author: Hanna Hussey MD
Presenting Author's Institution: Columbia University Medical Center - New York , NY
Co-Author: Beatriz Corradini Msc - Columbia University Medical Center
Jean Guglielminotti MD - Columbia University Medical Center
Ruth Landau MD - Columbia University Medical Center

Background: Ongoing interdisciplinary meetings in our academic center have prompted the evaluation of numerous factors contributing to operating room (OR) inefficiencies. We evaluated the contribution of 'anesthesia' to possible delays and examined factors thought to affect the time from patient entry to the OR to spinal anesthesia administration in elective cesarean deliveries (CD).

Methods: In this ongoing observational study, data were collected from electronic anesthetic records between June-Dec 2018. Presence of Ob Anesthesia attending for spinal/CSE placement by residents/fellows is guaranteed for all CD. It is standard practice to hit touch-screen buttons when patient enters OR (in OR) and when spinal dose is injected (spinal). Patient demographics, anesthetic technique, resident level of training, attending, were collected. Outcomes were time to spinal (TTS) calculated as time from 'in OR' to 'spinal' (min) and excess TTS defined as time >75th percentile (18 min).

Results: Analysis included 304 elective CD under spinal (N=259) or CSE (N=45). Median TTS was 14min (IQR 11-18) and excess TTS rate was 22%. Univariate analysis of TTS and excess TTS is presented in Table. In univariate analysis, higher BMI and CSE were associated with both increased TTS and excess TTS. The level of training (by CA-year or months in Ob anesthesia) did not influence TTS, but there were marked variations in TTS and excess TTS among the 10 Ob Anesthesia attendings (from 10 to 16 min for TTS and 9 to 40% for excess TTS) Using mixed-effects models, younger age and CSE predicted excess TTS (Table).

Discussion: As anticipated, higher BMI and CSE were associated with increased time to spinal dose administration. Contrary to our expectation, residents' level of training did not impact time to spinal; this is likely due to the fact that attendings are always present and will intervene when junior residents are unsuccessful on 1st attempt. We did not expect the significant variability between attendings, although this had been anecdotally reported by the nurses. This data will allow to evaluate trends and more importantly to reassure all stakeholders that despite the high acuity of our patients and presence of novice trainees, our performance with a median time of 14min from OR entry to spinal dose is actually quite remarkable. Further analysis of the interaction between resident's level of training and attendings (pairings) will be of interest.

Abstract #: T1C-245

TABLE: Time to spinal (TTS) and excess TTS for day-time elective cesarean deliveries (N=304)

Univariate analysis	Count (Number of cases)	TTS in min Median (25th-75th percentiles)	P-value[a]	Excess TTS Count (%)	P-value[b]	Crude OR (95% CI)
PATIENT						
Age (year)			0.13		0.07	
- ≤ 29	43	16 (11-19)		12 (27.9%)		Reference
- 30-39	211	14 (11-18)		50 (23.7%)		0.80 (0.38-1.68)
- ≥ 40	50	13 (11-16)		5 (10.0%)		0.29 (0.09-0.90)
BMI (kg/m2)			0.005		0.003	
≤ 24.9	25	14 (11-17)		3 (12.0%)		Reference
25-29.9	89	13 (11-16)		11 (12.4%)		1.03 (0.27-4.04)
30-34.9	92	14 (10-17)		20 (21.7%)		2.04 (0.55-7.50)
≥ 35	98	16 (12-21)		33 (33.7%)		3.72 (1.04-13.35)
Calendar						
Day			0.011		0.28	
Monday	64	13 (10-17)		13 (20.3%)		Reference
Tuesday	61	16 (13-21)		20 (32.8%)		1.91 (0.85-4.30)
Wednesday	61	15 (11-17)		12 (19.7%)		0.96 (0.40-2.31)
Thursday	38	14 (10-18)		8 (21.1%)		1.05 (0.39-2.81)
Friday	60	13 (11-16)		10 (16.7%)		0.78 (0.32-1.95)
Saturday	6	11 (8-13)		0 (0.0%)		--
Sunday	14	17 (14-19)		4 (28.6%)		1.57 (0.42-5.81)
Month			0.21		0.67	
June	53	12 (10-16)		8 (15.1%)		Reference
July	40	15 (12-19)		10 (25.0%)		1.88 (0.66-5.30)
August	56	13 (11-17)		10 (17.9%)		1.22 (0.44-3.38)
September	43	16 (13-20)		13 (30.2%)		2.44 (0.90-6.59)
October	56	15 (10-18)		13 (23.2%)		1.70 (0.64-4.51)
November	42	14 (12-18)		10 (23.8%)		1.76 (0.62-4.94)
December	14	14 (12-17)		3 (21.4%)		1.53 (0.35-6.75)
ANESTHESIA						
Technique			< 0.001		< 0.001	
CSE	45	17 (14-24)		21 (46.7%)		Reference
Spinal	259	14 (11-17)		46 (17.8%)		0.25 (0.13-0.48)
Resident			0.47		0.56	
CA1	78	15 (10-19)		20 (25.6%)		Reference
CA2	118	15 (12-18)		28 (23.7%)		0.90 (0.47-1.75)
CA3	83	14 (11-17)		15 (18.1%)		0.64 (0.30-1.36)
Fellow	25	14 (10-16)		4 (16.0%)		0.55 (0.17-1.80)
Attendings			0.002		0.033	
#1	35	10 (7-15)		3 (8.6%)		
#2	21	12 (8-16)		4 (19.0%)		
#3	44	13 (11-16)		3 (6.8%)		
#4	21	14 (13-17)		4 (19.0%)		
#5	20	14 (12-18)		5 (25.0%)		
#6	30	15 (12-17)		6 (20.0%)		
#7	40	15 (10-20)		14 (35.0%)		
#8	32	16 (14-18)		8 (25.0%)		
#9	36	16 (11-19)		10 (27.8%)		
#10	23	16 (11-23)		9 (39.1%)		
Multivariable analysis [c]	**TTS (linear model)**			**Excess TTS (logistic model)[d]**		
	Coefficient (se)		**P-value**	**Coefficient (se)**	**P-value**	**Odds ratio (95% CI)**
Age (per 1year increase)	-0.180 (0.068)		0.08	-0.084 (0.030)	0.05	0.919 (0.867-0.975)
Spinal (vs CSE)	-6.045 (1.009)		< 0.001	-1.472 (0.362)	< 0.001	0.230 (0.113-0.466)

TTS defined as time from patient entry to OR to spinal dose administration.

Excess TTS defined as > 75th percentile (≥18 minutes)

[a] from Wilcoxon or Kruskal-Wallis test

[b] from Chi-2 or Fisher exact test

[c] Age, BMI, day, month, neuraxial technique, resident level of training were included in modelisation using mixed-effects models, with attending being the random effect: patients' age (younger) and CSE (vs spinal) predicted excess TTS.

[d] Logistic model performance: C-index = 0.737 (95% CI, 0.672-0.802) and Hosmer-Lemeshow test P-value = 0.10

Abstract #: T1C-249

Can one improve OR efficiency in the labor and delivery unit?

Presenting Author: Hanna Hussey MD
Presenting Author's Institution: Columbia University Medical Center - New York , NY
Co-Author: Beatriz Corradini Msc - Columbia University Medical Center
Jean Guglielminotti MD - Columbia University Medical Center
Ruth Landau MD - Columbia University Medical Center

Background: Operating room (OR) efficiency is critical in the health care environment as providers and administrators attempt to meet an increasing demand for high quality and effective healthcare systems. On-time surgical start is a metric of quality, however most Labor & Delivery units struggle to meet general OR efficiency targets, due to the nature of obstetric care with urgent cases delaying scheduled cesarean deliveries (CDs). As part of an ongoing QI initiative, all actionable factors interfering with on-time start of scheduled CDs are currently evaluated. We decided to examine on-time start (OTS) rates over 6 months, hypothesizing that it improved over time in response to several initiatives & team efforts.

Methods: Using anesthesia electronic records, all scheduled CDs between June and mid-December 2018 were identified. Patient demographics (age & BMI), procedure characteristics (day, month, 1st case of the day, primary CD, high-risk OB/MFM case), and anesthesia factors (level of training of residents, years of practice of attending) were recorded, as well as patient entry in the OR. 'Late-start' was defined when patient entry in the OR occurred > 20 min after scheduled time. Multivariable analysis was applied to identify factors associated with 'late-start'.

Results: There were 323 scheduled CDs during the study period; OTS rate was 40.6% (Table). First case of the day increased the odds for OTS (p=0.015; aOR 0.47, 95%CI 0.29-076). There was variability month by month (p<0.001) with highest odds for OTS in November (aOR 0.34, 95%CI 0.15-0.78; Table). Anesthesia providers had no impact on 'late-start'. Causes for late-start were patient tardiness (10%), delays in blood products availability (valid type & screen ± blood ready; 15%), availability of obstetricians (other than urgent OR case; 15%), anesthesiologists (0), nursing staff or scrub technician (5%), NICU team (5%), and other emergency 'bumping' the scheduled case (44%).

Discussion: OR efficiency in the obstetric setting is contingent to unique factors which are not all actionable. Our finding that over 40% of delayed cases are due to other urgent CDs underscores the premise that Labor & Delivery units operate differently from general ORs. We identified specific issues with blood type screening and products readiness that are currently addressed. While it appears that OR efficiency in our unit is far from optimal, OTS seems to improve and our aim is to achieve 70-80% within the next 6 months.

Abstract #: T1C-249

TABLE: Analysis of OR start time according to patient, procedure, anesthesia providers characteristics (N=323 scheduled cases)

	On-time start (N =131)	Late-start * (N = 192)	Univariate analysis		Multivariable analysis
			P-value[a]	Crude OR (95% CI)	Adjusted OR (95% CI)
PATIENT					
Maternal age (years)			0.73		
≤ 29 (N=48)	17 (35.4%)	31 (64.6%)		Reference	
30-39 (N=221)	92 (41.6%)	129 (58.4%)		0.77 (0.40-1.47)	
≥ 40 (N=54)	22 (40.7%)	32 (59.3%)		0.80 (0.36-1.78)	
BMI (kg/m2)			0.16		
≤ 24.9 (N=30)	14 (46.7%)	16 (53.3%)		Reference	
25-29.9 (N=94)	46 (48.9%)	48 (51.1%)		0.91 (0.40-2.08)	
30-34.9 (N=95)	34 (35.8%)	61 (64.2%)		1.57 (0.68-3.60)	
≥ 35 (N=102)	37 (36.3%)	67 (65.7%)		1.58 (0.70-3.60)	
PROCEDURE					
First case of the day			**0.015**		
- Yes (N=133; 41.2%)	65 (48.9%)	68 (51.1%)		0.56 (0.35-0.88)	**0.47 (0.29-0.76)**
Day			0.18		
Monday (N=69)	26 (37.7%)	43 (62.3%)		Reference	
Tuesday (N=64)	20 (31.2%)	44 (68.8%)		1.33 (0.65-2.73)	
Wednesday (N=62)	25 (40.3%)	37 (59.7%)		0.89 (0.44-1.81)	
Thursday (N=42)	23 (54.8%)	19 (45.2%)		0.50 (0.23-1.09)	
Friday (N=64)	26 (40.6%)	38 (59.4%)		0.88 (0.44-1.77)	
Saturday (N=7)	2 (28.6%)	5 (71.4%)		1.51 (0.27-8.36)	
Sunday (N=15)	9 (60.0%)	6 (40.0%)		0.40 (0.13-1.26)	
Month			**< 0.001**		
June (N=59)	27 (45.8%)	32 (54.2%)		Reference	Reference
July (N=47)	14 (29.8%)	33 (70.2%)		1.99 (0.89-4.46)	2.02 (0.89-4.60)
August (N=59)	19 (32.2%)	40 (67.7%)		1.78 (0.84-3.76)	1.86 (0.87-3.99)
September (N=44)	20 (45.5%)	24 (54.5%)		1.01 (0.46-2.22)	1.01 (0.46-2.24)
October (N=57)	17 (29.8%)	40 (70.2%)		1.99 (0.92-4.26)	**2.23 (1.02-4.87)**
November (N=43)	30 (69.8%)	13 (30.2%)		0.37 (0.16-0.84)	**0.34 (0.15-0.78)**
December (N=14)	4 (28.6%)	10 (71.4%)		2.11 (0.59-7.49)	2.36 (0.65-8.56)
Primary CD			0.97		
- Yes (N=120; 37.2%)	48 (36%)	72 (37.5%)		1.04 (0.65-1.64)	
High risk OB (MFM) (missing =3)			0.20		
- Yes (N=122; 38.1%)	44 (36.1%)	78 (63.9%)		1.39 (0.87-2.21)	
ANESTHESIA Providers					
PROVIDER					
Resident (year of training)			0.39		
- CA1 (N=82 cases)	38 (46.3%)	44 (53.7%)		Reference	
- CA2 (N=126 cases)	49 (38.8%)	77 (61.1%)		1.36 (0.77-2.38)	
- CA3 (N=87 cases)	36 (41.3%)	51 (58.6%)		1.22 (0.67-2.25)	
- Fellow (N=28 cases)	8 (28.6%)	20 (71.4%)		2.16 (0.85-5.46)	
Attending (years of practice as OB Anesthesia Faculty)			0.25		
- ≤ 9 years (N=26 cases)	7 (26.9%)	19 (73.1%)		Reference	
- 10-20 years (N=154 cases)	61 (39.6%)	93 (60.4%)		0.56 (0.22-1.42)	
- ≥ 21years (N=143 cases)	63 (44.1%)	80 (55.9%)		0.47 (0.19-1.18)	

[a] from Chi-2 or Fisher exact test

Multivariable analysis of late start included in the model: BMI, day, month, 1st case, obstetric risk (MFM team), attending years of practice, selection of variables used a backward procedure.

Model performance: C-index = 0.678 (95% CI, 0.618-0.737) and Hosmer-Lemeshow test P-value = 0.99

*Late start was defined when patient entry to the OR occurred > 20 minutes after scheduled time.

First cases are scheduled at 8:15am and 8:45am; following cases are scheduled at 10:30am, 12:15pm and 2pm.

Delays due to patient tardiness, admission delays, blood type & screen not available, blood products not ready, more urgent case going to the OR, anesthesiologists, obstetricians, nursing staff, scrub technician, environmental services not available, were noted.

Abstract #: T1C-305

Validation of a risk model for women with suspected placenta accreta spectrum

Presenting Author: Carolyn Weiniger MB ChB
Presenting Author's Institution: Tel Aviv Sourasky Medical Center, Tel Aviv, Israel - Tel Aviv, Israel
Co-Author: Elana Reitman MD - Columbia University medical center
Laurence Ring MD - Columbia University medical center
Lisa Deutsch PhD - BioStats, Modiin
Ruth Landau MD - Columbia University medical center

Background: Correct antenatal diagnosis of placenta accreta spectrum (PAS) is crucial because outcomes are optimized when delivery occurs with highest capabilities and interventions at a level III or IV maternal care facility. A mathematical model to predict actual PAS among women using antenatal information from 3 variables (ultrasound imaging, number of prior cesarean deliveries (CD) and placenta previa) was previously developed on a cohort of 92 women (1). Our aim was to evaluate the robustness of the risk score using a validation cohort of suspected PAS cases from another tertiary medical center.

Methods: The validation cohort was prospectively gathered in a single-site tertiary delivery center. Ultrasound imaging, number of prior CD and diagnosis of placenta previa were recorded, as well as confirmation of PAS by OB surgeons at the time of delivery and/or pathology. The previously derived risk score (range 0 to 1 from the model equation combining the 3 variables) (1) was applied to the validation data and a receiver operator characteristic (ROC) curve generated according to actual status of PAS diagnosis; the area under the curve (AUC) was calculated as well.

Results: In the validation cohort (N=99), 85 had PAS confirmed by OB/pathology and 11 did not. The risk score performance to identify women with and without PAS according to OB and/or pathology diagnosis is presented in the Figures. The training set optimum cut-point 0.208 was applied on the validation dataset calculated risk score. It provides a sensitivity 97.7% and a specificity 36.4%. The combination model (pooled training and validation sets) had an of AUC 0.8241, 95%CI 0.7471 to 0.9012. Using the same 0.208 cut-point from the training model, sensitivity for the actual PAS diagnosis in the pooled model was 96.4% and specificity was 49.0%.

Conclusion: In this validation study, the mathematical model risk score appears to continue to differentiate aptly between those who did versus did not have PAS. If applied antenatally according to the 3 clinical variables (ultrasound imaging, number of prior CD and placenta previa) the sensitivity and specificity of the PAS diagnosis can be evaluated. The sensitivity of this model is higher than reported for ultrasound imaging alone, 91% (95%CI 87 to 94%) (2). This can aid optimum multidisciplinary planning for women with suspected PAS.

References:

1. Int J Obstet Anesth 2013;22(4):273-9
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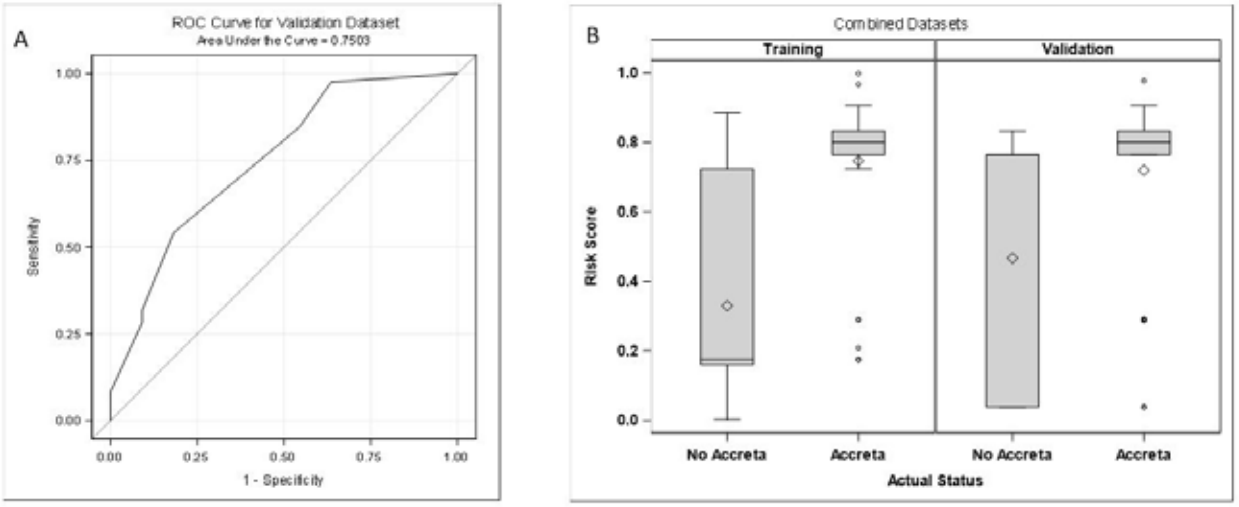

Risk score performance to identify women with and without PAS according to surgeon and/or pathology diagnosis.

A. The validation set ROC curve AUC was 0.7503, 95% CI 0.5886-0.91192. (AUC was 0.846 in the training set). In the validation set, for each 10% unit increase in risk score, the likelihood of PAS increased by Odds Ratio 37.5% 95%CI 1.112 to 1.702.
B. The box plot shows the training set and validation set risk score distribution between women with and without PAS according to surgeon and/or pathology diagnosis. The plots appear similar.

Abstract #: T1D-321

Where should we place the hands during chest compressions in parturients? A pilot study on trans-thoracic echocardiographic localization of the left ventricle.

Presenting Author: Carlos Delgado MD
Presenting Author's Institution: University of Washington - Seattle, WA
Co-Author: Katie Dawson MD - University of Washington
Becky Schwaegler BS, RDCS - University of Washington
Roshini Zachariah MD - University of Washington
Sharon Einav MSc, MD - Shaare Zedek Medical Center and Hebrew University of Jerusalem
Laurent Bollag MD - University of Washington

Background: Effective chest compression is one of the few interventions that affects the outcome of cardiopulmonary resuscitation (CPR)(1). AHA guidelines recommend the hands be placed on the lower third of the sternum for compressions during pregnancy(2). Additionally, manual uterine displacement is endorsed to alleviate vena cava compression(3). In pregnant women, the heart is rotated to the left(4), although there is no imaging evidence of vertical displacement(5). We sought to evaluate the effect of the gravid uterus and left uterine displacement on the position of the maternal left ventricle (LV) using trans-thoracic echocardiography (TTE).

Methods: Twenty women in the 3rd trimester of a singleton pregnancy (>28 weeks gestational age) were prospectively enrolled (12/2017-12/2018). Demographic and obstetric data were obtained. A registered diagnostic cardiac sonographer performed imaging. The following TTE images were acquired in the supine and left lateral decubitus position using a 30° wedge: parasternal long (PLAX) and short axis (PSAX) at the lower third of the sternum; and PLAX and PSAX of the LV position using each patient's ideal imaging window (showing the best image of mid-LV at 90°degree transducer orientation so as not to under- or overestimate LV location). The primary outcome was the distance (cm) between images from the lower third of sternum, suggested location for CPR hand placement, and the ideal imaging window.

Results: Demographic variables are included in Table 1. Mean cranial displacement of the LV in relationship the lower third of the sternum was 5.8 (±2) cm in the supine position and 6.1 (±2) cm in the lateral (wedge) position (p=0.6). No evidence of lateral cardiac displacement was observed in either the supine or the wedge position (Table 2).

Conclusions: This is the first study using TTE to document the position of the LV during the third trimester of pregnancy. The maternal LV was consistently located 6cm cranial to the lower third of the sternum. There may be justification for reinstating the recommendation for more cranial hand placement during chest compressions in maternal cardiac arrest, but further validation is required.

References:

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3. Ryo E, et al. Int J Gynaecol Obstet. 1996;55(3):213-8.
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Table 1. Demographic Characteristics (n=20)

Variable	
Height (cm)	161 (± 8.2)
Weight (kg)	78 (± 14.2)
BSA (m2)	1.8 (± 0.2)
Age (years)	31 (± 4.3)
Gestational Age (weeks)	32 (± 2.6)
Amniotic Fluid Index	14 (6.4)
NYHA functional class	I
HTN (%)	25
Pre-eclampsia (%)	20
Pre-existing structural cardiac disease (%)	0
Beta-blocker theraphy (%)	30

Values expressed as mean (± SD) or proportions

Table 2. LV position in relationship to lower third of sternum (n=20)

Variable	Mean (± SD)
Cranial displacement, supine (cm)	5.8 (± 1.9)
Lateral displacement, supine (cm)	0.1 (± 0.7)
Cranial displacement, wedge (left lateral) (cm)	6.1 (± 2.0)
Lateral displacement, wedge (left lateral) (cm)	0

Values expressed as mean (± SD)

Abstract #: T1D-340

The Language, Nature and Variability of Women's Experiences of Physical Pain During Childbirth: A Visually-driven Qualitative Study

Presenting Author: Pamela J Angle MD MSc DPhil (c)
Presenting Author's Institution: Sunnybrook Health Sciences Ctr - Toronto, Ontario
Co-Author: Christine Kurtz-Landy RN, PhD - York University
Jasmine Djordjevic BSc - Sunnybrook Health Sciences Ctr
Arthur Zaltz MD FRCPS - Sunnybrook Health Sciences Ctr

Introduction: Women\'s experiences of physical pain during childbirth have yet to be meaningfully described in the literature. A more robust understanding of the nature and variability of these experiences and the common language women use to describe them is required to advance understanding of childbirth pain, its measurement, and its treatment.

Methods: This two-phase exploratory descriptive, visually-driven, qualitative study explored/described the nature and variability and common language of women\'s childbirth pain experiences over the course of labor and delivery. Forty healthy native-English speaking women of mixed parity participated in in-depth, face-to-face interviews during labor and/or early postpartum periods. Phase 1(n=25) explored/described physical pain across a broad spectrum of childbirth experiences; phase 2(n=15) explored the meaning of "back pain" and other pain types identified in women requesting labor epidural top ups. In both phases, women endorsed/generated pain descriptors from a list on a Pictorial Pain Mapping Tool and "mapped" them to pain drawings at 4 time points during labor and delivery. Common pain names were generated for each pain type identified using drawing/descriptor sets and used to develop a Lexicon of Childbirth Pain. Common pain names combined with their patterns and relative pain ratings were used to compare women\'s experiences and the relative importance of pain patterns over time within context based on clinically important groups (e.g. parity, epidural use, delivery mode).

Findings: An understanding of common physical types of childbirth pain, their multidimensional nature and their patterns over time in individual women, and themes which emerged from multiple contrasts based on parity, epidural use, fetal malposition and delivery mode, produced a broader framework out of which women's multidimensional experiences of childbirth pain can be understood and used to advance treatment. Findings showed that women experienced multiple different types of physical pain during childbirth; these varied in their presence, severity and associated distress within the same woman and between women over time. Some pain types and patterns were associated with important clinical findings such as fetal position and operative delivery.

Conclusions: Women experience multiple types of physical pain during childbirth. These may be identified using common pain names and their corresponding pain drawing/descriptor sets. Findings suggest that some physical pain types and patterns may be useful in predicting labor outcomes and for targeting pain management/treatment.

Abstract #: T1D-351

Single Site Experience with Pulmonary Hypertension in Pregnancy

Presenting Author: Megan E Gauthier DO, MBA
Presenting Author's Institution: University of Cincinnati Medical Center - Cincinnati, OH
Co-Author: Lesley Gilbertson MD - University of Cincinnati
Andrea Girnius MD - University of Cincinnati

Background: Pulmonary hypertension (PHTN) in pregnancy is associated with a high maternal mortality and morbidity. The World Health Organization classifies PHTN as Class IV indicating that pregnancy is contraindicated. These patients present multiple challenges for anesthetic management during delivery. We describe a case series of 7 patients with PHTN delivering at our institution over a 5 year period.

Methods: Following Institutional Review Board approval we performed retrospective chart reviews of patients with PHTN from any cause who received pregnancy care at our institution. Demographic data, pulmonary pathology, pre-pregnancy and peripartum pulmonary status, pregnancy course, mode of delivery, method of anesthesia/analgesia and postoperative complications were described.

Results: Data from 7 parturients was collected from 2011 to 2016 with varying etiologies of PHTN. There were 6 cesarean deliveries (CD) and one vaginal delivery (VD). Four of the CD were done emergently for maternal decompensation. The VD and 2 CD were done as scheduled procedures following medical optimization. General anesthesia was performed in 3 CD and Neuraxial anesthesia (NA) was performed for the VD and 3 CD. Specifically, 1 had a single shot spinal, 1 had a combined spinal-epidural, and 1 had an intrathecal catheter. Complications occurred in 5 patients and included cardiogenic shock requiring pulmonary vasodilator or inotropic support (n=2), postpartum hemorrhage (n=3), and maternal death (n=1). Five patients were admitted to the surgical ICU following delivery, 1 to the medical ICU and 1 remained on labor and delivery. For birth control 5 patients had bilateral tubal ligations prior to hospital discharge, 1 had a Depo-Provera shot and 1 had an Essure tubal ligation 2 months postpartum. For neonatal outcomes, there was 1 neonatal death in the setting of emergency CD and maternal cardiac arrest. The gestational age for the emergency deliveries ranged from 26w3d to 33w6d and for the scheduled deliveries was between 34w4d to 38w5d.

Discussion: Caring for these complex patients requires multidisciplinary management early in their pregnancy. At the beginning of this review our institution did not have a method in place to care for these patients. In 2015, a multidisciplinary clinic for cardiac patients was started which helped capture these patients and plan for their delivery. With improved care coordination, patients were able to be optimized, their deliveries were more likely to be scheduled and we were able to minimize the number of emergent deliveries required. As pregnancy is contraindicated in patients with PHTN contraception planning is crucial; 6 of our patients had long term contraception within 2 months of delivery. By optimizing predelivery medical condition and minimizing emergent deliveries patients were more likely to be candidates for NA anesthesia, had greater potential for delivering closer to term and had fewer cardiopulmonary complications.

Abstract #: T1D-420

Elective vs Emergent Cesarean Deliveries for Placenta Previa: A Retrospective Cohort Study

Presenting Author: Jie Zhou MD, MS, MBA, FASA
Presenting Author's Institution: Brigham and Women›s Hospital, Harvard Medical School - Boston, MA
Co-Author: Wenjie Qing MD - Brigham and Women›s Hospital

Background: Patients with placenta previa (PP) can cause repeated bleeding during pregnancy. Obstetricians always attempted to arrange scheduled cesarean delivery to prevent unexpected bleeding in prenatal period and to improve maternal and neonatal outcomes. The study was to evaluate the different outcomes between the scheduled and emergent cesarean deliveries (CD) of parturients with PP.

Methods: We retrospectively reviewed the records of parturients who had PP that underwent cesarean delivery at Partner Healthcare System from October 2015 to October 2018. 259 cases were identified. A total of 153 cases with vaginal delivery, resolved previa in 3rd trimester, parturient with multi-parity or other concomitant severe comorbidities were excluded. Women who delivered via electively scheduled CD (Group SCD) were compared with those who had an emergent CD (Group ECD). Demographic data, anesthesia and procedure situation and laboratory data were collected. Continuous data were analyzed using the independent two sample t-test or non-parametric Wilcoxon test, and frequency data were analyzed using the Chi-square test or Fisher exact test, depending on data distribution.

Results: There was no significant different demographic characteristics between either groups. Group ECD had lower preoperative hemoglobin (P=0.005) and hematocrit (P=0.002) than group SCD. There were significantly lower gestational age (p=0.03) and baby's birth weight (p=0.002) with group SCD. There was no difference between the 2 groups with regards to anesthesia and/or procedure time, intraoperative estimated blood loss, blood transfusion, rate of cesarean hysterectomy, newborn resuscitation and neonatal intensive admission.

Discussion: As the risk of major hemorrhage increases rapidly after 36 weeks of gestation, expert opinions have highlighted that timing of delivery must be individualized and women with uncomplicated PP should undergo SCD on an optimize day. While the neonatal risk of preterm is well established, the timing of delivery must balance the maternal and neonatal risk. ECD might be triggered by prenatal hemorrhage, but no difference was identified in outcomes between the 2 groups. Our study implied that in asymptomatic patients, attempt to prolong gestational age might be warranted to achieve better neonatal prognosis and reduce complications from unnecessary preterm birth.

table2	maternal and neonatal outcomes		
	scheduled	emergent	P value
Variables:	(n=66)	(n=40)	
Anesthesia time(min)	104(85-145)	109.5(88-137)	P=0.88
Anesthesia methods(n)			P=1.00
General anesthesia (GA)	2(3.03)	3(7.50)	
Neuraxial anesthesia (NA)	60(90.91)	37(92.50)	
NA to GA	4(6.06)	0(0)	
Volume infusion (ml)	2000(1500-2500)	1500(1000-2350)	P=0.14
Blood transfusion(n)	9(13.63)	11(27.5)	P=0.08
Procedure time(min)	59(48-78)	52.5(41-70)	P=0.07
Estimated blood loss(ml)	800(800-1200)	900(700-1500)	P=0.70
RBC transfusion(ml)	900(350-1200)	600(300-800)	P=0.46
Cesarean hysterectomy(n)	5(7.58)	3(7.50)	P=1.00
Preoperative			
HGB, g/dl	11.85±1.20	11.09±1.51	P=0.005
HCT, %	34.87±3.14	32.56±4.40	P=0.002
Postoperative			
HGB, g/dl	11.23±11.30	9.72±1.36	P=0.40
HCT, %	29.22±4.09	28.95±4.58	P=0.75
Baby's weight (kg)	3.02±0.55	2.63±0.66	P=0.002
Newborn rescue resuscitation(n)	24(60.00)	16(40.00)	P=0.11
NICU admission（n）	41(62.12)	18(45.00)	P=0.09
Apgar score>7			
in 1 min(n)	59(89.39)	31(77.5)	P=0.10
in 5 min(n)	63(95.45)	39(97.5)	P=1.00
Gestational days	274.39±16.06	265.48±24.01	P=0.03
	39.2±2.29	37.93±3.43	

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2. Jauniaux ERM, BJOG 2018

Abstract #: T1D-429

Evaluating pre-delivery obstetric anesthesia consultations among obese parturients

Presenting Author: Adithya D Bhat MD
Presenting Author's Institution: Northwestern University Feinberg School of Medicine/Prentice Women›s Hospital - Chicago, IL
Co-Author: Felisha Gonzalez BS - Northwestern University Feinberg School of Medicine
Michelle A Kominiarek MD, MS - Northwestern University Feinberg School of Medicine
Paloma Toledo MD, MPH - Northwestern University Feinberg School of Medicine

Background: Obesity is a contributing factor in over 50% of maternal deaths. Obesity in pregnancy is associated with increased risks of hypertensive disorders, venous thromboembolism, respiratory depression, and postpartum hemorrhage. In 2015, the American College of Obstetrics and Gynecology recommended that all obese parturients receive an anesthetic consultation prior to delivery to improve outcomes; however, the frequency and content of these consultations is largely unknown. The objectives of this study were to evaluate the proportion of women with BMI > 50 kg/m2 who received an anesthetic consultation prenatally, and evaluate the content of the consultations.

Methods: This retrospective, single-institution, cross-sectional study evaluated electronic medical record data for a preexisting dataset of all deliveries between 01/01/2015 and 12/31/2016 . Parturients with BMI > 50 kg/m2 were identified, and the chart was reviewed for a prenatal obstetric anesthesia consultation . If a consult was completed, the content of the consultation was extracted. A rubric containing 20 evidence-based recommendations was developed. Each consultation was assigned a score out of 20 possible points based on the number of recommendations communicated with the patient. Our primary outcome was the proportion of parturients with a BMI > 50 kg/m2 who received a prenatal obstetric anesthesia consultation.

Results: 167 parturients with a BMI > 50 kg/m2 were identified. Only 6 parturients (3 %) received prenatal obstetric anesthesia consults. The recommendations made in each consultation are shown in Table 1. The most frequent recommendations were implications for possible difficult intubation and the need for possible continuous pulse oximetry postoperatively.

Discussion: Our data suggest that obstetric anesthesia consultation for parturients with a BMI > 50 kg/m2 occurred rarely, and those that were performed were not comprehensive. This study highlights the need for both addressing barriers to prenatal consultation and standardizing recommendation content, as prenatal consultation may help reduce maternal morbidity and mortality in these high-risk parturients.

Figure 1: Content of Prenatal Obstetric Anesthesia Consultations

	Parturient #					
Evidence-Based Recommendations	1	2	3	4	5	6
Discussion about IV access						
Difficult IV Access						
Need for >1 IV						
Need for central venous cannulation						
Need for arterial line						
Cardiology consultation				X		
Recommendation echocardiogram						
Preparation for hemorrhage (e.g., type and screen)						
Need for early neuraxial	X			X		
Increased difficulty for neuraxial placement	X					
Longer time to place neuraxial	X					
Increased neuraxial failure rate						
Change in technique (e.g., epidural vs. combined spinal epidural, paramedian vs midline, ultrasound guided)						
Difficult airway	X		X		X	
Frequent assessments of airway and functional epidural catheter						
Aspiration precautions						
Recommendation for sleep study						
Recommendation for Positive Airway Pressure if known Obstructive Sleep Apnea		X	X			
Continuous postoperative pulse oximetry		X	X	X		
Need for supplemental oxygen after delivery			X			
Total Score (out of 20 points)	4	2	4	3	1	0

Abstract #: T1H-445

DETECTION OF POSTOPERATIVE RESPIRATORY DEPRESSION IN HIGH RISK PATIENTS UTILIZING RESPIRATORY VOLUME MONITORING

Presenting Author: Anna-Maria Eid MD
Presenting Author's Institution: Yale New Haven Hospital - New Haven, CT
Co-Author: Mohamed Elgamal MD - Yale New Haven Hospital
Mohamed Eid MD - Yale New Haven Hospital
Antonio Gonzalez-Fiol MD - Yale New Haven Hospital
Man Ching Cheung PhD - Respiratory Motion, Inc.
Aymen Alian MD - Yale New Haven Hospital

Introduction: Previous modalities identifying respiratory depression (RD) include pulse oximetry (SpO2), capnography (Capno) & clinical assessment, all indirect measurements – i.e. late indicators of RD. Respiratory Volume Monitoring (RVM) provides a direct quantitative measure of ventilation in non-intubated patients. This study evaluates the clinical utility of RVM vs SpO2 and Capno in identifying RD in obstetric patients.

Methods: High risk parturients scheduled for cesarean delivery receiving neuroaxial anesthesia with opioids were enrolled (ongoing). Inclusion criteria were BMI>35 kg/m2, with any following risk factors (pre-eclampsia, gestational hypertension, diabetes & OSA). MV/TV/RR were measured by RVM (ExSpiron1Xi, Respiratory Motion Inc, Watertown, MA). MV was presented as a % of predicted MV (MVPRED) based on body surface area. Low MV was defined as MV <40%MVPRED for ≥2min. Low MV resulted in an audible alarm as an indication of respiratory depression. SpO2 & Capno were measured continuously (LifeSense, Nonin Medical Inc) with defined alarm thresholds (Fig. 1). Alarm rates were compared across the three monitoring modalities.

Results: Under IRB, 16 patients (age:31±7yrs, BMI:42±7kg/m2) were monitored with RVM for 21±3 hours. 7 of these patients were also monitored with SpO2 and Capno. RVM reported metrics 90% of the time, with the remaining 10% due primarily to patient disconnection for ambulation. SpO2 and Capno reported data 70% and 6% of the time, respectively, with missing data due primarily to patient non-compliance or sensor dislodgement (Fig. 1A). RVM alarms were generally preceded by opioid administration (Fig. 1B). RVM had 1 false alarm across all patients with a false alarm rate of 0.0029 alarms/hr, significantly lower than SpO2 (2.14 false alarms/hr) or Capno (6.75 false alarms/hr) ($p = 0.002$, ANOVA). All 208 SpO2 alarms & 54 Capno alarms were considered false by standard criteria.

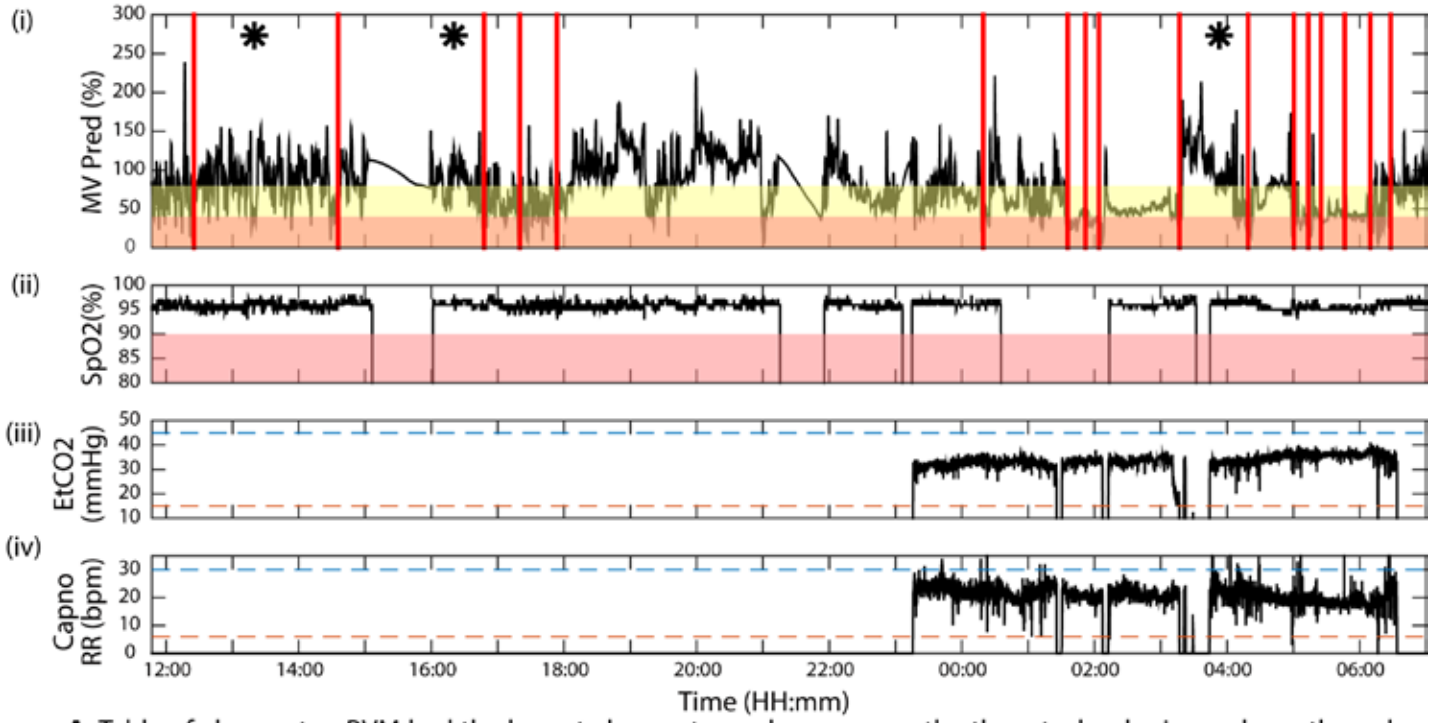
Conclusions: RVM was able to provide useful respiratory data in post-partum patients and consistent with other studies* identified opioid induced RD when other monitoring devices did not. RVM displayed an extremely low false alarm rate (0.003 false alarms/hr vs 2.17 and 6.75 for SpO2 & Capno, respectively). RVM provided earlier and more consistent data due to greater patient and staff compliance. RVM has the potential to improve patient safety without alarm fatigue or a negative impact on workflow.
*Galvagno et al. JTACS 80(5):S162-170, 2016

Abstract #: T1H-445

A

	RVM	Pulse Oximetry	Capnography
Patients	16	7	7
Monitored hours / Study hours (%)	329/364 (90%)	97/139 (70%)	8/139 (6%)
Alarm-free hours (% of monitored hours)	301 (91%)	56 (58%)	0 (0%)
Total Alarms	59	208	54
Total alarms per hour	0.179	2.14	6.75
False alarms per hour	0.003	2.14	6.75
True alarms per hour	0.176	0	0

B



A. Table of alarm rates. RVM had the lowest alarm rate per hour among the three technologies and was the only device reporting true alarms. Monitored hours is the fraction of time the device was acquiring physiological values. Alarms were defined as: 1) RVM: true alarms as MV < 40% of MVPRED for ≥ 2 min with false alarms caused by poor sensor placement, 2) SpO2: true alarms as Pulse Sat. <90% for ≥ 5 minutes, with false alarms due to intermittent probe dislodgement, 3) Capnography: true alarms as RR < 8 or > 30 and as EtCO2 <15 or > 45 mmHg, with false alarms due to nasal cannula dislodgement.

B. An example plot of patient data for RVM, SpO2 and capnography monitoring. (i) MV as a % of MVPRED is shown for the entire monitoring stay. Patient had repeated low MV (vertical lines) following opioid doses (asterisk). Patient alternated between low MV (darker shaded area) and adequate MV (lighter shaded area) when self-stimulated by low MV alarms. RVM reported metrics 100% of the time, excluding the times the patient was ambulating. (ii) SpO2 reported data only 82% of the time (excluding ambulating times) and did not produce any true alarms (SpO2 < 90%). Shaded area represents alarm threshold. (iii) End-tidal CO2 (EtCO2) reported data only 30% of the time due to patient discomfort with nasal cannula. Dashed lines represent alarm thresholds. (iv) Respiratory rate (RR) reported by capnography resulted in alarms due to nasal cannula dislodgement. Dashed lines represent alarm thresholds. RVM data demonstrate a decrease in MV following opioid administration consistent with early diagnosis of respiratory depression, while SpO2 and EtCO2 did not report true physiological alarms.

Abstract #: T1H-447

Optimizing antepartum maternal resuscitation during cardiac arrest after 20 weeks estimated gestational age: a pragmatic approach

Presenting Author: Rebecca D Minehart MD, MSHPEd
Presenting Author's Institution: Massachusetts General Hospital/Harvard Medical School - Boston, MA
Co-Author: Jaime L. Daly MD - Massachusetts General Hospital/Harvard Medical School
Andrew N. Chalupka MD, MBA - Massachusetts General Hospital/Harvard Medical School
May C.M. Pian-Smith MD, MS - Massachusetts General Hospital/Harvard Medical School
Elizabeth P. West RNC, MSN, WHCNP - Massachusetts General Hospital/Harvard Medical School
Erik M. Clinton MD - Massachusetts General Hospital/Harvard Medical School

Introduction: Resuscitation of antepartum maternal cardiac arrest (AMCA) for EGA >20 weeks is distinct from management of postpartum arrest, due to need for perimortem delivery (PD) within 4 minutes if return of spontaneous circulation (ROSC) is not achieved [1,2]. This gives a narrow window of 4 minutes during which a team must identify reversible causes and initiate empiric treatments to improve chances of survival and maintenance of pregnancy if maternal ROSC is attained. Because of this limited time frame during which maternal ROSC would alter the course of mother and fetus by obviating the need for PD, we sought a pragmatic approach to empirically treating etiologies which could be reversed within the first 4 minutes after AMCA.

Methods: AHA/ACC guidelines for maternal cardiac arrest were reviewed, for a total of 37 etiologies for all arrest conditions [1]. Etiologies were analyzed by the following criteria: 1) direct causality vs indirect causality for cardiac arrest; and 2) potentially reversible in the first 4 minutes, given ideal conditions with ready access to all needed resources. In addition to accepted ACLS guidelines, including initiation of high-quality chest compressions with manual left uterine displacement, early defibrillation, and administration of 1mg epinephrine IV at the 4 minute mark if no maternal ROSC was achieved [1], specific treatment options were identified that would be helpful for reversible causes, and would not be contraindicated in or worsen other conditions, for potential empiric treatments during the first 4 minutes in an AMCA (>20 wks EGA).

Results: 24 etiologies were identified as direct causes of cardiac arrest; 9 of those were deemed to be treatable within 4 minutes in "best" circumstances: local anesthetic toxicity, hypoxemia/respiratory depression, hypotension (all-cause), hypovolemia, anaphylaxis, arrhythmia, magnesium toxicity, cardiac tamponade, and tension pneumothorax. For all but 2 conditions, the following treatments were deemed to have favorable risk/benefit ratios as empiric treatments for AMCA within the first 4 minutes after ACLS initiation (in addition to ACLS as described above): intubation with hyperventilation, small dose epinephrine (<1mcg/kg), 20% lipid emulsion bolus +/- infusion, rapid 1L IV fluid administration, and calcium gluconate 1gm IV. The remaining two etiologies (cardiac tamponade and tension pneumothorax), which necessitated needle decompression, were deemed to be too risky for empiric use.

Conclusion: While focus should continue on practicing and preparing teams to treat AMCA with PD to improve maternal survival if ROSC is not achieved within 4 minutes [1-3], we believe teams should include a standard empiric approach aimed at optimizing maternal resuscitation prior to PD.

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Abstract #: T1H-452

Obstetric Comorbidity Index (OB-CMI) as a predictor for general anesthesia in women undergoing cesarean delivery.

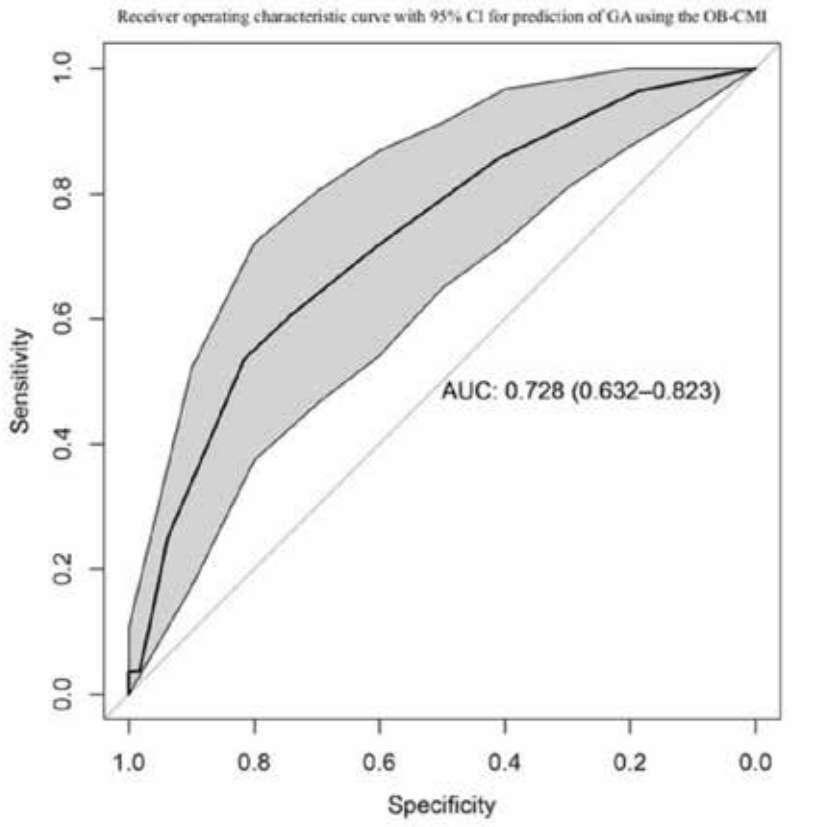
Presenting Author: Shubhangi Singh MBBS
Presenting Author's Institution: Brigham and Women›s Hospital - Boston , MA
Co-Author: Sarah Rae Easter MD, MS - Brigham and Womens Hospital
Kara G Fields MS - Brigham and Women's Hospital
Michaela K Farber MD, MS - Brigham and Women's Hospital
Brian T Bateman MD, MSC - Brigham and Women's Hospital
Lawrence C Tsen MD - Brigham and Women's Hospital

Background: Neuraxial anesthesia (NA) is preferred over general anesthesia (GA) for cesarean delivery (CD), but certain maternal and fetal conditions such as fetal bradycardia, hemodynamically unstable hemorrhage, or maternal coagulopathy necessitate GA. Increasing maternal morbidity may increase the risk for GA during CD. The OB comorbidity Index (OB-CMI) is a tool to identify pregnant patients at risk for morbidity, intensive care unit (ICU) admission, and mortality that has been validated in multiple populations (1, 2). Maternal comorbidities identifiable on admission to Labor and Delivery (weighed by the strength of association with maternal morbidity) are assigned points that sum into a single score. The objective of this study was to evaluate OB-CMI as a predictor of GA requirement during CD.

Methods: In this single center prospective cohort study, mode of anesthesia and OB-CMI for all women at or beyond 23 weeks of gestation undergoing CD between 2/14/2018 and 7/31/2018 were recorded. OB-CMI was calculated by the primary nurse at the time of admission to L & D and updated every 12 hours until delivery. In emergent cases where OB-CMI before CD was not available (n=161), OB-CMI documented closest to the time of delivery was abstracted. Univariable logistic regression was used to investigate the association between OB-CMI and GA.

Results: Of 935 women who underwent CD, 28 (3%) received GA. The NA and GA groups were comparable in terms of demographics, gravidity and parity. The median OB-CMI for patients who required GA was 5 (IQR 2-6.5) as compared to 2 (IQR1-4, P<0.001) for those who received NA. A 1-point increase in OB-CMI was associated with 1.33 (95% CI: 1.18, 1.51) times increased odds of receiving GA for CD. The C-statistic for the association between the OB-CMI and GA was 0.728 (95% CI 0.632-0.823) (Figure) indicating good discrimination.

Conclusions: A higher OB-CMI score was associated with increased risk of receiving GA. Although it needs to be further evaluated, OB-CMI may help predict GA requirement in women undergoing CD. A high OB-CMI score can prompt the anesthesiologist to establish a plan for potential airway or fasting management in advance of delivery or indicate mechanisms for earlier epidural placement.



References:
1. Obstet Gynecol. 2013 Nov;122(5):957-65.
2. BJOG. 2015 Dec; 122(13): 1756.

Abstract # T1H-456

'To lock up or not to lock up?'- A survey of the storage of obstetric anaesthetic drugs in London tertiary hospitals, UK.

Presenting Author: Simon J. FitzGerald, MBBD, BSc, FRCA
Presenting Author's Institution: Guy's and St Thomas' Hospitals, London, UK
Co-Author: Nhathien Nguyen-Lu, BMedSci(Hons), BMBS, FRCA - Guy's and St Thomas' Hospitals, London, UK

Introduction: In the UK there is currently no specific advice on the storage of non controlled drugs in anaesthetic rooms, as opposed to clear guidance on the storage of controlled drugs. In the field of obstetric anaesthesia 83% of surveyed UK anaesthetists never use this room for anaesthesia, going directly to theatre for induction(1). The anaesthetic room often remains the place of storage and preparation for our anaesthetic drugs. The UK Care Quality Commission (CQC), requires that non-controlled drugs not in use remain locked up, which seems at odds with national guidance suggesting non-controlled drugs cupboards may remain unlocked in defined circumstances(2). It is a serious patient safety concern if drugs cannot be easily obtained in very time critical obstetric emergencies.

The ASA have recognised that procedures designed to prevent unauthorized access to non-controlled drugs must not impede the imperative for patient safety. The Royal Pharmaceutical Society recommends there should be a standard of practice (SOP) covering drug storage that will put patient safety first but will ensure the safety and security of medicines we store and use.

Methods: Clinical leads for obstetric anaesthesia in 16 London hospitals were invited to complete an email questionnaire. Questions examined the preparation, storage and access of common emergency obstetric anaesthetic drugs, the existence of SOPs in each local department and any adverse patient critical incidents due to inaccessible drugs.

Results: Responses from 11 London hospitals (69% response rate). Only 2 (18%) of the hospitals surveyed had SOPs for safe storage and there was one account where lack of immediate access contributed to a critical incident of laryngospasm. Four of the hospitals had improved security of drugs as a direct consequence of CQC inspection.

Discussion: A uniform practice has not been adopted in our region. There is a need for a consistent SOP that uses a risk management approach, which will minimise accidental or unauthorised intentional access whilst balancing the need for urgent immediate access in obstetric emergencies. Hospitals with the most consistent security policy across non-controlled anaesthetic drug modalities have done so with either fridge key-codes or zoned security for each theatre.

n = 11	ARE THEY PRE-DRAWN UP? (Y/N) n (%)	STORAGE LOCATION n (%)	LOCKED UP? (Y/N) n (%)	HOW TO ACCESS? n (%)
Epidural top-up drugs	Yes =0 (0%) No = 11 (100%)	Neuraxial trolley = 4(36%) Cupboard / Draw anaesthetic room = 3 (27%) Cupboard / Draw theatre = 3 (27%) Other =1 (9%)	Y = 2 (18%) N = 9 (82%)	Keypad entry= 2 (18%) Freely available = 9 (82%)
GA Drugs	Yes = 5 (45%) No = 3 (27%) Variable = 3 (27%)	*Theatre* fridge = 3 (27%) *Anaesthetic room* fridge = 6 (56%) Cupboard + fridge = 2 (18%)	Yes = 5 (45%) No =6 (55%)	Freely available = 5 (45%) Code entry to fridge = 3 (27%) Code/swipe access to theatre = 2 (18%) Tamper proof seal = 1 (9%)
Vasopressors	Yes = 10 (91%) No = 1 (9%)	Theatre = 5 (45%) Anaesthetic room = 6 (55%)	Yes = 5 (45%) No = 6 (55%)	Freely available = 5 (45%) Code entry to fridge = 3 (27%) Code/swipe access to theatre = 2 (18%) Tamper proof seal = 1(9%)
Uterotonics	Yes = 2 (18%) No = 9 (82%)	Theatre = 2 (18%) Anaesthetic room = 9 (82%)	Yes = 5 (45%) No = 6 (55%)	Freely available = 5 (45%) Code entry to fridge = 3 (27%) Code/swipe access to theatre = 2 (18%) Tamper proof seal =1 (9%)

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Abstract #: T1H-468

Delays in Administration of Antihypertensive Medication on Labor and Delivery for Severe Range Blood Pressures at a Tertiary Care Center

Presenting Author: Sara M. Seifert MD
Presenting Author's Institution: Brigham and Women›s Hospital - Boston, MA
Co-Author: Rochelle J Molitor MD - Brigham and Women›s Hospital
Erica Holland MD - Brigham and Women's Hospital
Brian T Bateman MD - Brigham and Women's Hospital
Julian N Robinson MD - Brigham and Women's Hospital
Michaela K Farber MD - Brigham and Women's Hospital

Introduction: Severe-range blood pressure (SRBP) in pregnancy (> 160/110 mmHg) can lead to significant maternal/fetal morbidity and mortality such as intracranial hemorrhage, cerebral and pulmonary edema, placental abruption, acute renal failure, liver rupture, seizures, and death (1-3). The National Partnership for Maternal Safety Severe Hypertension in Pregnancy bundle of 2016 recommends treatment of sustained SRBP within 15 minutes (4). We sought to quantify the frequency of delays in administration of antihypertensives for SRBP.

Methods: In this retrospective cohort study, we examined all patients with SRBP admitted to Labor and Delivery at a single large tertiary care center between 11/1/2018 and 1/31/2019. Patients were included if they received a rapid acting antihypertensive medication and had SRBP, defined as ≥ 160 mmHg systolic or 110 mmHg diastolic, for ≥ 15 minutes. Patients were excluded if they received nifedipine for preterm labor or were treated at other sites (e.g., intensive care unit or operating room). We report clinical characteristics and outcome variables using descriptive statistics and linear regression.

Results: A total of 71 patients had sustained SRBP and received 102 rapid acting antihypertensive medication doses. Patients were aged 21-48 and self-reported as 35.2% White, 30.0% Black, 5.6% Asian, and 21.1% Hispanic. Initial blood pressures ranged from 160-200 mmHg systolic and 77-116 mmHg diastolic (median 167/98 mmHg). The median time that patients' blood pressure remained ≥ 160/110 was 77 minutes (range 18-450 minutes). The median time to receive an antihypertensive from first SRBP was 45.5 minutes (range of 0-232 minutes); only 9.9% of patients were given treatment within the recommended 15 minutes. There was no correlation in the severity of the initial blood pressure and the time to receive treatment (R2 = 0.0016). The most commonly used first line agent was labetalol (46.1%), followed by hydralazine (35.5%), and nifedipine IR (18.4%). Of the 102 antihypertensive medications administered, labetalol was up-titrated 14 times (max dose 60mg), hydralazine was up-titrated 11 times (max dose 20mg), nifedipine IR was up-titrated 0 times (max dose 10mg), and median time to up-titration was 40 minutes (range 15-100 minutes). Of the 25 times medication was up-titrated, a second rapid acting medication was added in 4 cases.

Conclusion: Most patients did not receive antihypertensive therapy within the recommended 15 minutes following recognition of SRBP or recommended up-titration, despite written protocols promoting this practice. Patients commonly had SRBPs for extended periods. Systems need to be developed to facilitate timely treatment of patients with SRBPs and for more rapid up-titration if initial treatments do not bring BP within a safe range.

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Abstract #: T1I-473

Rapid Response Team (RRT) Calls - An Additional Marker for Maternal Morbidity

Presenting Author: Abida Hasan MD
Presenting Author's Institution: University of Illinois at Chicago - Chicago, IL
Co-Author: Joanna Izewski MD - University of Illinois at Chicago
Micaela Della Torre MD - University of Illinois at Chicago
Abby R Koch MA - University of Illinois at Chicago,
Stacie E Geller PhD - University of Illinois at Chicago
Joan E Briller MD - University of Illinois at Chicago

Background: Severe maternal morbidity (SMM) has increased in the United States from 1993 to 2014.[1,2] Common measures of SMM include transfusion of ≥4 units of blood or intensive care unit (ICU) admission per Society of Maternal Fetal Medicine (SMFM) and the American College of Obstetricians and Gynecologists (ACOG) statements.[3]

Rapid response systems (RRT) are a patient safety strategy associated with reduced cardiac arrest outside of the ICU but contribution of RRTs to SMM assessment is less well known.[4]

Study Design: Retrospective analysis of women pregnant or up to 6 weeks postpartum age 18-50 for whom an RRT was called between January 2014 and August 2018 at a university center. Standard indications for RRT include: new blood pressure <90 or >200; heart rate <40 or >150 beats per minute; pulse oximetry <88%; uncontrolled bleeding; acute neurologic change (AMS); seizure; chest pain with ECG changes; or staff concerns of patient's status. Hemorrhages are managed separately at our institution during pregnancy and were not included.

Results: 56 events in 48 women met inclusion criteria. Mean age, gravidity, and parity respectively were 29.2 (SD±6.9, range 18-49), 2.85 (SD±1.7, range1-8),1.69 (SD1.4, range 0-6). The most common indication for RRT was AMS in 29 women (52%), followed by circulatory indication in 17 women (30%), and staff concerns in 8 women (14%). Only 2 women had respiratory compromise (3.6%). Analysis of short-term outcomes revealed that all patients survived until hospital discharge. The majority, 40 women (71%) remained in their room, but 10 (18%) were transferred to the ICU, 4 (7%) were transferred to a stepdown unit, 1 (2%) was transferred to the Emergency Department, and 1 (2%) was transferred to Labor and Delivery.

Conclusion: While 18% of cases would have been reviewed on the basis of ICU admission alone, a majority would not meet criteria for review for SMM under current ACOG/SMFM consensus statement. A significant proportion of women had escalation in care. Review of RRTs may capture additional maternal morbidities otherwise missed. Further analysis of risk factors and outcomes provides opportunities for care improvement.

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Abstract #: T1I-479

Complications associated with anesthetic care in obstetrical patients: A population-based study in Canada

Presenting Author: Leyla Baghirzada MD, MPH
Presenting Author's Institution: University of Calgary, Cumming School of Medicine - Calgary, Alberta
Co-Author: David Archer MD - University of Calgary
Andrew Walker PhD - University of Calgary
Mrinalini Balki MD - University of Toronto

Background: Complications associated with anesthetic care in obstetrics in high-income countries are rare (~1/1000 anesthetic interventions).1This rate is too low to be informative for practitioners. We provide a population-based summary of the frequency of anesthesia-related complications in obstetrical patients in Canada.

Method: We analyzed the database of the Canadian Institutes of Health Information for women hospitalized during pregnancy, delivery or puerperium (gestation ≥ 20 weeks) in all provinces of Canada except Quebec from Apr 2004 to Mar 2017. Complications were identified by ICD-10-CA codes. We used univariate and multivariate regression to model medical and obstetrical conditions and procedures independently associated with anesthesia-related complications.

Result: 12,318 anesthesia related adverse events occurred among 2,601,034 hospitalizations over 12 year period (Table 1). The most common adverse events were spinal and epidural anesthesia induced headache. The event rate for difficult/failed intubations and pulmonary complications was low. Of the 11,841 women who suffered an event, two died (fatality rate: 16.9/100,000 interventions; 95% CI 4.2-68/100,000). The deaths were unrelated to anesthesia interventions. The frequency of anesthesia related events per year varied from 304 to 513/100,000 interventions (P < 0.001). There was significant variation in the incidence among Canadian provinces (206 to 803/100,000 interventions (P < 0.001). Women ≤ 25 yrs old were significantly less likely to suffer an anesthetic event (adjusted OR 0.90; 95% CI 0.85-0.95). Anesthesia related events were more likely in those who had a cesarean delivery (adjusted OR 1.17; 95% CI 1.12-1.23). Use of general anesthesia for an intervention was significantly associated with an anesthetic event (adjusted OR 3.17; 95% CI 2.99-3.36). Noteworthy associations between cardiomyopathy (adjusted OR 6.24; 95% CI 2.70-14.43), obstructive sleep apnea (adjusted OR 2.31; 95% CI 1.25-4.25) and an anesthetic event were found. Postpartum hemorrhage and preeclampsia were the most common conditions associated with an anesthetic event.

Conclusion: The incidence of anesthesia related events in obstetric patients in Canada is rare and declining. However, anesthesiologists should be prepared to manage them, especially in women undergoing cesarean delivery under general anesthesia, or having preexisting medical conditions.

Table 1. Frequency of anesthesia related adverse events from nationwide sample of patients during April 2004 and March 2017.

Anesthesia related complications	Pregnancy	Labor and Delivery	Puerperium	Total N (%)
Aspiration pneumonitis due to anesthesia	-	24	-	24 (0.2)
Pulmonary complications of anesthesia	4	98	26	128 (1.03)
Cardiac complications of anesthesia	9	143	19	171(1.4)
Central nervous system complications of anesthesia	5	130	26	161 (1.3)
Toxic reaction to local anesthesia	1	23	4	28 (0.2)
Spinal and epidural anesthesia induced headache	185	3567	3155	6907 (56.1)
Other complications of spinal and epidural anesthesia	182	3441	456	4079 (33.1)
Failed or difficult intubation	8	119	12	139 (1.1)
Other complications of anesthesia	41	496	81	618 (5.01)
Unspecified complications of anesthesia	11	42	10	63 (0.5)
Total	**446**	**8083**	**3789**	**12,318**
Patients with complications				**11,841**

Reference:
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Abstract #: T1I-481

Name/Claim/Aim for Obstetric Crises: A New Paradigm in Crisis Resource Management

Presenting Author: Rebecca D Minehart MD, MSHPEd
Presenting Author's Institution: Massachusetts General Hospital/Harvard Medical School - Boston, MA
Co-Author: Jenny W Rudolph PhD - Massachusetts General Hospital/Harvard Medical School
Robert L. Nadelberg MD - Massachusetts General Hospital/Harvard Medical School
Erik M. Clinton MD - Massachusetts General Hospital/Harvard Medical School
Roxane Gardner MD, MSHPEd, DSc - Brigham & Women's Hospital/Harvard Medical School

Scope of Problem: Obstetric emergencies occur infrequently [1], but require organized application of crisis resource management (CRM) principles to facilitate teamwork and provide optimal care [2]. Despite detailed knowledge of CRM principles introduced decades ago [3], it is challenging to recall and apply these high-level concepts during a stressful maternal and fetal crisis. At the Center for Medical Simulation (CMS) (Boston, MA), we sought to create an easy-to-remember mnemonic that incorporated all 11 CRM principles for use in interprofessional obstetric simulation training, along with a robust teamwork theoretical base.

CRM Mnemonic Creation: The 11 CRM principles incorporated were: 1) Call for help early, 2) Anticipate and plan, 3) Know the environment, 4) Use all available information, 5) Allocate attention wisely, 6) Mobilize resources, 7) Use cognitive aids, 8) Communicate effectively, 9) Distribute the workload, 10) Establish role clarity, and 11) Designate leadership. We sought to underscore the importance of psychological safety and fostering speaking up in our diverse groups, which would maximize input and distributed leadership throughout the management of a crisis. Therefore, we promoted the role of an "Event Manager," someone designated to encourage team organization as well as updated communication and input from the team. In addition, we encouraged group members to hold a "Basic Assumption" about each other, that everyone was attempting to do his or her best work.

To minimize cognitive load under stress, we focused our creation on an easy-to-remember mnemonic, into which we incorporated all 11 CRM principles into a Pre-Name phase, and then to "Name/Claim/Aim" to facilitate: 1) "Naming" the clinical problem out loud; 2) "Claiming" the role of "event manager" and asking others to state their roles; and 3) "Aiming" the team with a brief list of interventions. The Pre-Name phase incorporates knowing the environment, anticipating and planning, and calling for help early. The "Name" phase includes effective communication, anticipating and planning, and mobilizing resources. The "Claim" phase is the most extensive, and includes all CRM principles except those included in Pre-Name. We included a cognitive aid of suggested roles for teams to fulfill. The "Aim" phase includes effective communication, mobilizing resources, using all available information, and using cognitive aids.

Application: "Name/Claim/Aim" has been adopted into formalized simulation training at Massachusetts General Hospital, and into our Emergency Manuals located throughout. Further research will target clinical outcomes. By streamlining CRM principles to promote recall and application, we hope to further best team practices during obstetric crises.

References:

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Abstract #: T1I-482

Arnold Chiari Malformation (ACM) Type I and Syringomyelia (S) in Pregnancy: Challenging Conventional Obstetric and Anesthetic Management

Presenting Author: Jennifer Fichter MD
Presenting Author's Institution: Wake Forest School of Medicine - Winston Salem, NC
Co-Author: Peter Pan MD - Wake Forest School of Medicine

Intro: Arnold Chiari malformation Type 1(ACM), is rare (2–5/10K) and is characterized by downward herniation of the cerebellar tonsils through the foramen magnum. Syringomyelia (S) present in up to 80% of ACM cases. Because Valsalva or neuraxial anesthesia (NA) can alter ICP, OB and anesthetic management of parturient with ACM & syringomyelia (ACMS) has traditionally meant cesarean delivery (CD) with GA despite lack of evidence. While case series on S have challenged conventional management, no series has focused specifically on ACMS. A G2P1 patient with ACMS presented for our preop consultation prior to repeat CD. She underwent ACM repairs as a teen and continues to experience daily HA and paresthesias. Even though she is active in competitive crossfit, her neurosurgeon recommended CD and no NA, so her 1st delivery was via CD/GA. Her upcoming CD prompted our literature review and analysis for evidence based management.

Methods: We conducted a database search using PubMed (1.19.19). Keywords used: "pregnancy" and "ACM, syringomyelia." Inclusion criteria: pregnancies with ACMS, delivery mode and anesthetic. Exclusion criteria: full text unavailable. Descriptive statistics were performed.

Results: Our review identified 14 abstracts that met inclusion criteria. We collected data on 19 patients(21 pregnancies). Mean patient demographics: age 30.9, gravida 1.8, parity 0.45, 38 wk GA at delivery. ACMS repair data was available for 17/21. 10/17(59%) had repair, 7/17(41%) had not. For those without repair: 3/7(43%)CS, 4/7 (57%)VD. Of those CS: 1/3(33%)GA, 2/3 (67%)NA. Of those VD: 3/4(75%) had NA, 1/4(25%) PO/IV meds. For those with repair: 6/10(60%)CS, 4/10(40%)VD. Of those CS: 4/6(67%)GA, 2/6(33%)NA. Of those VD: 2/4(50%)NA, 1/4(25%)IV/PO med, 1/4(25%) nothing. No serious complications occurred in any case.

Conclusion: Our results suggest that, contrary to traditional thought, VD and NA can be considered for ACMS patients. NA may even be a safer for some. GA in ACMS patients has been associated with increased risk, such as difficult intubation given more common c-spine immobility, prolonged neuromuscular block and abnormal autonomic response on intubation/emergence with associated elevation of ICP. While we would consider NA for our patient, her case highlights the importance of patient-team decision-making to safety incorporate her wish. Final unfolding story of her CD in Feb will be presented at SOAP.

References:

Ghaly. SNI. 2017; Garvey. AA. 2017; Kaplan CNN 2008

Table 1: Parturients with ACM-1 and Syringomyelia, Case Reports

Author (Publication Yr)	Age	G/P	GA at delivery	ACM repaired	Presenting sxs	Delivery Mode	Anesthesia	Complications
Doblas et al (2003)	32	G3P0	34	NA	No	Forceps VD	Epidural	None
Lopez et al (2007)	19	NA	38	NA	Sensory changes	SVD	Epidural	Syncope post-epidural, transient weakness
Nawaz and McAtamney (2010)	32	G1P0	37	NA	HA, sensory changes	C/S	GA	None
Lopez Torres et al (2011)	27	G1P0	41	NA	No	Vacuum VD	Epidural	Transient NV
Parker et al (2002)	30	G1P0	39	No	No	Forceps VD	Epidural	None
Mueller and Oro (2005)	30	G2P1	32	No	HA, sensory changes	SVD	Epidural	None
Nel et al (2008)	31	G2P1	38	No	HA	C/S	Epidural	None
Muthukumar and Christopher (2013)	27	G1P0	NA	No	Areflexia	Vacuum VD	Epidural	None
Ghaly et al (2017)	24	G1P0	39	No	Hyperreflexia	C/S	GA	None
Roper et al (2018)	37	G4P1	40	No	None	SVD	PO/inhaled	None
Roper et al (2018)	40	G5P2	39	No	None	C/S	Spinal	None
Parker et al (2002)	26	G1P0	38	Yes	HA, paresthesias	C/S	Epidural	Pre-existing sxs resolved w/i 24hr
Agusti et al (2004)	37	G1P0	NA	Yes	Sensory changes, areflexia	C/S	GA	Prolonged action atracurium
Mueller and Oro (2005)	30	G1P0	NA	Yes	HA, motor and sens changes	SVD	None	None
Bensghir et al (2011)	41	G2P0	39	Yes	Motor changes, areflexia	C/S	GA	None. Difficult intubation
Ghaly et al (2012)	34	G2P1	38	Yes	HA, paresthesias	C/S	GA	None
Teo (2018)	40	G1P0	38	Yes	Sensory changes	C/S	Spinal	None
Roper et al (2018)	33	G2P1	36	Yes	HA	SVD	Epidural	None
Roper et al (2018)	28	G3P2	39	Yes	None	SVD	Epidural	None
Roper et al (2018)	29	G1P0	39	Yes	HA	C/S	GA	None
Roper et al (2018)	22	G1P0	40	Yes	NA	SVD	PO/inhaled	None

NA: Not available

Abstract #: T1I-483

Risk for Neuraxial Morphine-Associated Adverse Events and Neonatal Falls: A Retrospective Observational Study

Presenting Author: Chad Dean MD
Presenting Author's Institution: UPMC Magee-Womens Hospital - Pittsburgh, Pennsylvania
Co-Author: Bedda Rosario PhD - University of Pittsburgh
Ashraf Habib MBBCh, MSc, MHSc - Duke University
Grace Lim MD, MSc - UPMC Magee-Womens Hospital

Intro: Risk estimations of clinically significant respiratory depression (CSRD) associated with neuraxial morphine are limited by lack of comparison to morphine non-exposed groups. Such comparisons are necessary to inform comprehensive approaches to preventing postpartum maternal sedation, as sedation from any cause can lead to harm. For example, postpartum neonatal falls (NF) have been reported, but NF risk associated with neuraxial morphine is unknown. We aimed to calculate the risk of CSRD associated with neuraxial morphine use. Secondarily, we assessed the risk for NF associated with neuraxial morphine.

Methods :A single-institution retrospective cohort included vaginal or cesarean deliveries from 2014-2018. CSRD was defined as rapid response activation for sedation/respiratory depression and/or naloxone to reverse suspected opioid-related sedation/respiratory depression. NF cases were identified by event reporting system (report rate ~100%) and reviewed by hand for temporal proximity to reports of maternal sleep/sedation. The primary outcome was incidence of CSRD associated with neuraxial morphine exposure. Secondary outcome was NF risk from maternal sleep/sedation associated with neuraxial morphine. Multivariable logistic regression was used; where event rates were low, proportion rate estimates with 95% confidence intervals were reported.

Results: Of 33,419 unique encounters, 23,162 (69.3%) were vaginal and 10,257 (30.7%) cesarean. There were no cases of rapid response for sedation/respiratory depression. 1 case of postpartum naloxone for "sedation" was a cesarean under general anesthesia without neuraxial morphine. Due to low numbers, risk estimation could not be calculated. However, estimated CSRD prevalence (rate) was 0.3:10,000 (95%CI, 0.000004-0.0002). Of 14 NF cases, 9 (64.3%) were temporally related to maternal sleep/sedation, 5 (35.7%) were mechanical/car seat issues. Postpartum NF rate from maternal sleep/sedation was 1:3,717 (95%CI, 0.00014-0.00051). NF from maternal sleep/sedation was not associated with neuraxial morphine after adjusting for covariates (medications with sedative effects, body mass index, age, delivery time, delivery mode) (adjusted OR 0.50, 95%CI 0.03-8.08, P=0.63).

Conclusion: Postpartum CSRD and NF are rare. These events occur independent of neuraxial morphine exposure. Anesthesiologists should be concerned with preventing postpartum sedation/respiratory depression beyond mitigating risks from neuraxial morphine exposure.

Case	MOD	Breastfeeding	Neuraxial morphine used	If cesarean, time-to-drop after morphine exposure (hours)	IT morphine dose (mcg)	Epidural morphine dose (mg)	Induction of labor	Duration of L&D Stay* (hours)	Time of the last oral or parenteral opioid prior to drop (hours)	Cummulative oral/parenteral opioid exposure prior to drop (MME)	Exposure to sedative (non-opioid) medications	Note
1	Cesarean	Yes	Yes	5	200	--	No	7	--	--	No	--
2	Vaginal w/ assist	Yes	No	--	--	--	No	13	8	855	No	methadone 60mg daily maintenance
3	Cesarean	Yes	Yes	14	250	--	No	4	13	18.75	Yes	ketamine 180mg, midazolam 2mg intraoperatively; diphenhydramine 25mg x2
4	Cesarean	Yes	Yes	41	150	--	No	3**	4	45	Yes	diphenhydramine 25mg x3
5	Cesarean	Yes	Yes	30	--	3	No	20	4	67.5	Yes	diphenhydramine 25mg x2
6	Cesarean	Yes	Yes	105	200	--	No	2**	3	930.8	Yes	diphenhydramine 25mg intraoperatively
7	Cesarean	Yes	Yes	51	150	--	No	13	24	15	Yes	diphenhydramine 25mg x4
8	Cesarean	Yes	Yes	73	150	--	No	3**	2	225	Yes	diphenhydramine 25mg x1
9	Vaginal	Yes	No	--	--	--	No	24	9	--	Yes	gabapentin 800mg x6, escitalopram 10mg x2, buprenorphine maintenance (8mg daily)

Table. Cases of neonatal falls that were temporally associated with reports of mother falling asleep/sedation. Risk factors for sedation, maternal fatigue, obstetrical factors, medication factors, and other special considerations about these cases are noted.
**Definition of duration of L&D stay: Start time: time of admission to L&D, End time: time of delivery*
***Scheduled, elective cesarean delivery*
L&D, labor and delivery; MME, milligram morphine equivalent; MOD, mode of delivery; IT, intrathecal

Abstract #: T110-484

Circulatory concerns:a common cause of rapid response calls in the puerperium frequently resulting in care escalation

Presenting Author: Joanna Izewski MD
Presenting Author's Institution: University of Illinois at Chicago - Chicago, Illinois
Co-Author: Abida Hasan MD - University of Illinois at Chicago
Micaela Della Torre MD - University of Illinois at Chicago
Abby R Koch MA - University of Illinois at Chicago
Stacie E Geller PhD - University of Illinois at Chicago
Joan E Briller MD - University of Illinois at Chicago

Background: Severe maternal morbidity (SMM), generally identified by intensive care unit (ICU) admission or ≥4 units blood transfusion, is increasing in the US and is associated with a high rate of preventability similar to maternal mortality1. Cardiovascular disease is a major contributor to mortality2. Rapid response teams (RRT) are a patient safety strategy associated with reduced cardiac arrest outside of the ICU3. The contribution of RRTs in identification of women with SMM is less known.

Study Design: Retrospective cohort study of all women pregnant or up to 6 weeks postpartum aged 18-50 for whom RRTs were called at a university hospital between January 2014 and August 2018. Indications for calling an RRT included: 1. New systolic blood pressure <90mmHg or >200 mm Hg; 2. New heart rate <40 bpm or >150 bpm; 3: Respiratory rate <10 per minute or >28 per minute; 4. Pulse oxygenation <88%; 5. Acute neurologic change; 6. Seizure >5 minutes; 7. New onset chest pain with ECG change; 8. Staff concerns. RRTs were considered circulatory if called for indications 1-4, or 7. Management of hemorrhages is a separate protocol. Descriptive statistics were calculated comparing circulatory RRTs with other etiologies.

Results: 56 RRTs were called for 48 women. Circulatory etiology was found in 17 women (30.9%). Mean age, gravidity, and parity in the cohort with circulatory etiology were 29.5 (S.D. ±8.2, range 18-49); 2.4 (S.D. ±1.3, range 1-6); and 1.6 (S.D. ±0.97, range 1-6) respectively; not significantly different from other RRTs. All patients survived until hospital discharge, but 47% required escalation of care either to an ICU [5 patients (29%)] or stepdown unit [3 patients (18%)]. This is a significant difference in care escalation compared to RRTs for non-circulatory indications (47% vs 18%, P=0.046). Trend for ICU admission was also higher (29% vs 13% N.S). The remaining 9 patients (53%) did not require escalation of care. The most common circulatory concerns were tachycardia [n =11 (65%)] or hypotension [n= 3 (18%)]. The majority, 13 (76%), occurred in the postpartum period, 4 (24%) occurred antepartum.

Conclusion: Circulatory concerns are common causes of RRTs. While there were no maternal mortalities, a large proportion required care escalation with a higher proportion requiring ICU admission than in women with RRTs of other etiology. Further analysis of risk factors for circulatory etiologies may help decrease SMM.

References:

1. Geller SE, Rosenberg D, Cox SM, et al. The continuum of maternal morbidity and mortality: factors associated with severity. Am J Obstet Gynecol 2004; 191(3): 939-44.
2. Briller J, Koch AR, Geller SE. Maternal Cardiovascular Mortality in Illinois, 2002-2011. Obstetrics and gynecology 2017; 129(5): 819-26.
3. Winters BD, Weaver SJ, Pfoh ER, Yang T, Pham JC, Dy SM. Rapid-response systems as a patient safety strategy: a systematic review. Ann Intern Med 2013; 158(5 Pt 2): 417-25.

Abstract #: T110-490

Is the transfusion of whole blood better for resuscitation in cesarean delivery? A Retrospective analysis of the transfusion of whole blood versus component therapy during cesarean delivery.

Presenting Author: Miakka N Smith MD
Presenting Author's Institution: University of Texas Southwestern Medical Center - Dallas, TX
Co-Author: Nwamaka Nnamani MD - University of Texas Southwestern Medical Center
Kelechi Anyaehie MD - University of Texas Southwestern Medical Center

The rate of postpartum hemorrhage has risen dramatically, along with a rise in blood transfusion rates. The rate of cesarean delivery has increased drastically in the past decade and is well over 30% in the USA. Subsequently, there is the added risk of abnormal placentation, which can contribute to maternal and fetal morbidity and mortality via placenta accreta, increta, and percreta. Whole blood (WB) contains all of the individual blood components,yet there are concerns for the use of WB including the efficacy of platelet after cold storage, the risk of transfusion reaction from un-cross matched WB, and the logistical issues. The primary aim of the study is to compare the average number of overall units transfused in patients receiving WB versus component therapy (CT) during hospital stay. Secondary aim is to compare the incidence of 3 common adverse outcomes: Renal failure, Heart failure, and Transfusion-related lung disease in patients receiving WB vs. CT.

Results: Our study consists of retrospective analysis of all subjects who underwent C-sections and received a blood transfusion at Parkland Hospital L&D Unit during 01/01/2010 through 12/01/2016. Exclusion criteria included pre-existing coagulation abnormalities, renal failure, peripartum cardiomyopathy, or acute lung injury, and patients who underwent Massive Transfusion Protocol intraoperatively. Approximately 1500 subjects were included in the study with preliminary analysis of 296 subjects. Subjects were divided into 3 groups according to blood product given: only (WB) (n=121), only (CT) (PRBCs, Platelet, FFP, or Cryo) (n=82), or Both WB + CT (n=93). On average, patients in the WB group were transfused 2.365 (SD= 0.872) units of WB. Patients in the CT group were transfused 4.306 (SD= 1.705) units of PRBCs and 0.047 (SD= 0.263) units of platelets. Patients in the combination group (both WB and CT) were transfused 3.198 (SD = 1.769) units of WB, 3.979 (SD= 3.725) units of PRBCs, 0.521 (SD= 1.187) units of FFP, 0.135 (SD = 0.690) units of platelets, and 0.729 (SD= 5.281) units of Cryo. Acute renal failure was seen in 0.34% of subjects in WB group and 1.01% of subjects in CT group. Respiratory failure was seen in 1.0% of patients in WB group and 0.33% of patients in CT group. Heart failure was not experienced in either group.

Conclusion: The preliminary results reveal a decreased number of units transfused in patients receiving WB vs. CT. The data regarding complication rates is currently inconclusive (P>.05) due to the limited study size. Analysis of the entire study population (n=1500) will allow testing for a 15% difference between the mean numbers of units transfused with 80% power and a level of significance of 0.05. We hypothesize fewer complications in the WB group providing potential advantages in managing serious obstetric hemorrhage.

References:

1. Transfusion 2016; 56; 2165–2171., 26(6): 406-414
2. BMC Pregnancy Childbirth. 2009; 9:55.
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Abstract #: T110-512

Management of the Parturient with Pheochromocytoma and Paraganglioma: a review of 21 patients

Presenting Author: Kaitlyn Brennan DO MPH
Presenting Author's Institution: Mayo Clinic - Rochester, MN
Co-Author: Sarah Dodd MD - Mayo Clinic
Michelle Ochs Kinney MD - Mayo Clinic
Emily E Sharpe MD - Mayo Clinic

Introduction: Management of parturients with pheochromocytoma or metabolically active paraganglioma presents a challenge to the anesthesiologist. Presentation during pregnancy is rare and diagnosis can be difficult as it can mimic other causes of hypertension in pregnancy. However, antenatal diagnosis is crucial for improved maternal and fetal outcomes as undiagnosed pheochromocytoma has high mortality for both mother and fetus.1 Surgical management is dependent on gestational age at time of diagnosis, tumor location, and characteristics.2 While most patients will have pheochromocytoma resection concomitant with delivery or post-partum, patients who fail medical management may require resection during pregnancy.3

Methods: Patients with pheochromocytoma or paraganglioma in pregnancy were identified from our medical records database. Patient demographics, timing of diagnosis, treatment during pregnancy, anesthetic management during labor, postpartum recovery location, and maternal and fetal outcomes were collected.

Results: Twenty-one distinct patients who had 40 pregnancies were included. Six patients were diagnosed during pregnancy, 7 were diagnosed postpartum, and 8 were diagnosed prior to pregnancy. Of the 8 diagnosed prior to pregnancy, 3 had pre pregnancy attempts at resection. Of the patients diagnosed prior to pregnancy or antepartum, 1 had resection of the tumor during pregnancy, 1 had resection at the time of delivery, and 13 had resection postpartum. One patient diagnosed pre pregnancy had an emergent cesarean delivery (CD) for refractory hypertension. One woman had a previable delivery for severe hypertension uncontrolled with medication. Of the patients diagnosed in the postpartum period, all 7 had symptoms during pregnancy and 3 were diagnosed with preeclampsia with severe features, representing potential premature diagnostic closure. Two of the patients diagnosed in the postpartum period had emergent CD for refractory severe hypertension. Postpartum, 8 women were observed in the intensive care unit (ICU) and 1 developed cardiogenic shock. Two women have since died from their disease.

Discussion: Management of pheochromocytoma and paraganglioma in pregnancy and peri-delivery requires a patient-specific plan designed by a multi-disciplinary team, involving obstetric anesthesiology, maternal fetal medicine, general surgery, and endocrinology. Patients often present on vasoactive medications, may need invasive monitoring, and are at high risk for morbidity and mortality. Tumor location and timing of diagnosis is key to determining risk of anesthetic complication at time of delivery. Late diagnosis and resulting delay in appropriate treatment resulted in worse outcomes, such as emergency delivery, ICU admission, and, in 1 case, cardiogenic shock.

References:

1. Harrington JL. World J Surg (1999) 23:182–186
2. Biggar MA. Br J Surg. (2012) 100:182-190
3. Donatini G. Surg Endosc (2018) 32:3890-3900

Abstract #: T110-519

Pulmonary Hypertension and Pregnancy: Analysis of A Case Series of Thirteen Cases

Presenting Author: Jie Zhou MD, MS, MBA, FASA
Presenting Author's Institution: Brigham and Women›s Hospital, Harvard Medical School - Boston, MA
Co-Author: Wendong Chen MD - BWH

Pulmonary Hypertension and Pregnancy: Analysis of A Case Series of Thirteen Cases

Background: Pulmonary hypertension (PHTN) in pregnancy has long been regarded as high risk for maternal and neonatal complications. Anesthesia management of parturients with PHTN is often challenging, yet literature has been scarce. Our study aimed to identify whether pregnancy outcomes vary by etiology and severity of pulmonary hypertension.

Methods: A retrospective review of medical records from Partners HealthCare Systems was conducted from 1998 to 2018 to identify pregnant women with PHTN. Demographics, etiology, management, and outcomes of maternal and fetal medical records were collected. According to the 2013 World Health Organization the etiology of pulmonary hypertension all patients were divided into 5 groups. PHTN was defined as a mean pulmonary artery pressure greater than 25 mmHg and mean pulmonary artery pressure value of 25 to 49 mmHg, or greater than 50 mmHg or systolic pulmonary artery pressure 70 mmHg or greater corresponded to the mild, or severe PHTN, respectively. Descriptive statistics were used to analysis outcomes.

Results: Thirteen pregnant women with PHTN were identified, including 6 cases due to left heart disease (Etiology 1), 2 cases due to lung diseases and/or hypoxia (Etiology 2), 3 cases due to autoimmune disease (Etiology 3), 1 case due to chronic thromboembolic (Etiology 4) and 1 case with unclear multifactorial mechanisms (Etiology 5). Multidisciplinary approach was practiced except for 1 case with left heart disease. 7 cesarean deliveries were performed; 9 had vaginal delivery under labor epidural. 2 patients were admitted to surgical intensive care unit for postpartum care. We will present the complete cases series at the SOAP meeting.

Discussion: In this retrospective study, we described maternal and fetal outcomes of 13 pregnant women with PHTN. Peripartum maternal and fetal mortality of these patients is often associated with PHTN etiology classification, the severity of PHTN, other comorbidities. Anesthetic method is determined by a multidisciplinary team approach. The functionality of the team works will eventually determined the course and outcomes.

References:

1. Dhaval Kolte, et al. J Am Heart Assoc. 2018;7:e009729
2. Sun et al. Medicine (2018) 97:44
3. Marie-Louise Meng, et al. Obstet Gynecol 2017;129:511–20

Abstract #: T110-519

Table 1. The demographics of 13 Women with Pulmonary hypertension and Pregnancy

Group	Age (yr)	Marital status	BMI (kg/m^2)	PAH value (TEE)(mmHg)	Terminal pregnancy	Delivery time(W)	Multiple pregnancy	postpartum Visit PAH value(TEE) (mmHg)	ECOM Therapy	Maternal Prognosis
1	34	Single	21.1	42.00	NO	36	1	24.00	NO	Alive
1	26	Single	23.8	36.00	NO	38	1	NO	NO	Alive
1	30	Single	30.3	38.00	NO	38	3	NO	NO	Alive
1	49	Married	36.1	36.00	NO	37	1	35.00	NO	Alive
1	37	Married	27.0	49.00	NO	38	1	NO	NO	Alive
1	35	Single	24.5	39.00	NO	35	1	39.00	NO	Alive
2	29	Married	33.0	35.00	NO	40	2	28.00	NO	Alive（ lung transplant）
2	40	Partner	40.5	59.00	NO	34	1	30.00	NO	Alive
3	30	Married	34.1	39.00	NO	38	1	32.00	NO	Alive
3	37	Unknown	41.2	35.00	NO	32	1	33.00	NO	Alive
3	36	Married	32.6	37.00	NO	36	1	25.00	NO	Alive
4	45	Single	18.2	70.00	NO	35	1	14.00	NO	Alive
5	52	Married	33.6	64.64	NO	37	1	30.00	NO	Alive

Table 2.The outcome of maternal and fetal

	Group1	Group 2	Group 3	Group 4	Group 5
Etiology ,n(%)	6 (46.00)	2 (15.00)	3 (23.00)	1 (8.00)	1 (8.00)
BMI ,n(%)					
Low weight	0 (0.00)	0 (0.00)	0 (0.00)	1 (100.00)	0 (0.00)
Normal weight	1 (16.00)	1 (50.00)	0 (0.00)	0 (0.00)	0 (0.00)
Over weight	2 (34.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)
Weight obesity	3 (50.00)	1 (50.00)	3 (100.00)	0 (0.00)	1 (100.00)
Diagnosis of Pre-Pregnancy, n(%)	5 (84.00)	2 (100.00)	3 (100.00)	1 (100.00)	1 (100.00)
Cardiac Catheterization, n(%)	0 (0.00)	1（50.00）	2（67.00）	0 (0.00)	0 (0.00)
Pulmonary hypertension , n(%)					
Mild PHTN	6 (100.00)	2 (100.00)	2 (67.00)	0 (0.00)	0 (0.00)
Severe PHTN	0 (0.00)	0 (0.00)	1（33.00）	1（100.00）	1（100.00）
Multidisciplinary team therapy, n(%)	5（84.00）	2（100.00）	3(100.00)	1（100.00）	1（100.00）
Delivery mode, n(%)					
Vaginal delivery	3（50.00）	1（50.00）	2（67.00）	1（100.00）	1（100.00）
Cesarean delivery	3（50.00）	1（50.00）	1（33.00）	0 (0.00)	0 (0.00)
Delivery time, n(%)					
Preterm	2 (34.00)	1（50.00）	2（67.00）	1（100.00）	0 (0.00)
Term	4（66.00）	1（50.00）	1（33.00）	0 (0.00)	1（100.00）
Anesthetic methods , n(%)					
Labor Epidural	2 (34.00)	1（50.00）	0 (0.00)	0 (0.00)	1（100.00）
General anesthesia	1 (16.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)
Epidural	2 (34.00)	0 (0.00)	2（67.00）	0 (0.00)	0 (0.00)
Spinal	0 (0.00)	1（50.00）	0 (0.00)	0 (0.00)	0 (0.00)
Perioperative conditions , n(%)					
Normal	5（84.00）	2（100.00）	3（100.00）	1（100.00）	1（100.00）
Abnormal	1 (16.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)
Hemodynamic perioperative, n(%)					
Stability	6 (100.00)	1（50.00）	2（67.00）	1（100.00）	1（100.00）
Instability	0 (0.00)	1（50.00）	1（33.00）	0 (0.00)	0 (0.00)
Use vasoactive drugs, n(%)	0 (0.00)	1（50.00）	1（33.00）	0 (0.00)	0 (0.00)
SICU Therapy, n(%)	0 (0.00)	1（50.00）	0 (0.00)	1（100.00）	0 (0.00)
Discharge time(〉4Days), n(%)	2 (34.00)	2 (100.00)	2 (67.00)	1（100.00）	1（100.00）
Fetal weight(〈2500g) , n(%)	1 (16.00)	1（50.00）	2 (67.00)	1（100.00）	0 (0.00)
Apgars score 5min(〈7) , n(%)	1 (16.00)	0 (0.00)	1（33.00）	0 (0.00)	0 (0.00)
NICU Therapy, n(%)	3 (50.00)	1 (50.00)	1（33.00）	1（100.00）	1 (100.00)

Abstract #: T110-554

Caring for Jehovah's Witnesses Parturient: A Retrospective Chart Review

Presenting Author: Jie Zhou MD, MS, MBA, FASA
Presenting Author's Institution: Brigham and Women›s Hospital, Harvard Medical School - Boston, MA
Co-Author: Yao Zhang MD - BWH

Background: Jehovah's Witnesses (JW) parturients who are known for their refusal of primary blood components pose unique challenges to anesthesiologists and obstetricians along the process of labor. We conducted a retrospective analysis to identify the treatment patterns and issues that arise during the delivery in this population.

Methods: In the present study, we retrospectively identified cases who were Jehovah's Witnesses and delivered at Partners HealthCare System from May 2015 to December 2018. Demographic information, acceptance of blood transfusion, types of accepted blood products, hematological supports, as well as clinical data during anesthesia and delivery were reviewed and analyzed. The information of accepted blood products was available from a document in the inpatient's chart.

Results: A total of 78 JW women experienced 84 deliveries in this cohort. The information about accepted blood products was finally obtained in 51 women. Twenty-three women (46%) expressed refusal of any blood products, whereas approximately 54% of JW patients accepted at least one type of blood products. The acceptable blood product types included albumin, platelets, fresh frozen plasma, cryoprecipitate and fibrinogen concentrate (Table 1). JW women with cesarean delivery accepted more types of blood product than those who delivered vaginally. There were no fatal postpartum hemorrhage and maternal deaths. The mean estimated blood loss at cesarean delivery, and vaginal delivery was 763.8 ± 128.8 mL [range 500–1000 mL] and 317.7 ± 160.5 mL [range 50–800 mL] respectively. The mean cesarean duration from incision to procedure closing was 58.6 ±14.0 min.

Discussion: Our data suggest that there was variability among JW parturients' willingness to accept the range of blood products. Preprocedural consultation between the Jehovah's Witness patient and anesthesiologist, obstetrician and/or midwife staff must be conducted early and continued throughout the perinatal period. The mean of estimated blood loss in this study during cesarean and vaginal delivery was lower than the hospital average of approximately 8% and 13% during the study period. The mean duration from incision to procedure closing was also longer than the hospital average. These differences suggested that care providers may hold more awareness of increased mortality of postpartum hemorrhage in this population.

Table 1 Summary of Acceptance Rate of Alternatives to Blood Transfusion of the JW Parturients

	Cesarean delivery (N=22)	Vaginal delivery (N=28)	Total(N=50)
Acceptance of blood transfusion			
Accepted all	3(14%)	2(7%)	5(10%)
Accepted some	10(45%)	12(43%)	22(44%)
Declined all	9(41%)	14(50%)	23(46%)
Accepted blood product type			
Albumin	8(36%)	10(36%)	18(36%)
Platelets	4(18%)	0	4(8%)
Fresh frozen plasma	4(18%)	1(4%)	5(10%)
Cryoprecipitate	7(32%)	1(4%)	8(16%)
Fibrinogen concentrate	4(18%)	0	4(8%)
Accepted autotransfusion type			
Nonmonomeric hemodilution	1(5%)	2(7%)	3(6%)
Cell saver	14(64%)	15(54%)	29(58%)

References:

1. Mason, et al, 2015
2. Husarova, et al, 2016

Sepsis & Pregnancy

Alexandria J Hill, MD
Maternal-Fetal Medicine
High Risk Pregnancy Center
Las Vegas, NV
ahill@hrpregnancy.com

I have no conflicts to disclose.

LEARNING OBJECTIVES

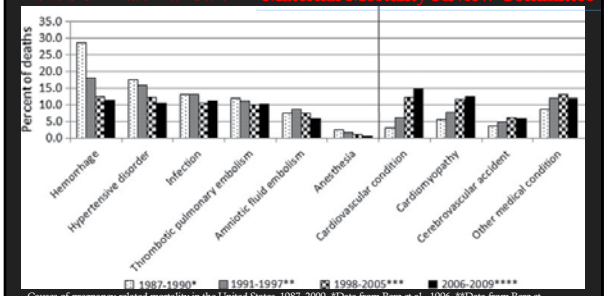
1. Identify the concern for sepsis
2. Understand the physiologic needs and interventions specific to the pregnant patient
3. Initiate the appropriate evaluation and treatment for sepsis

"Maternal sepsis is a significant cause of maternal morbidity and mortality and is a **preventable** cause of maternal death."

Society for Maternal-Fetal Medicine. Sepsis during pregnancy and the peurperium. Am J Obstet Gynecol 2019.

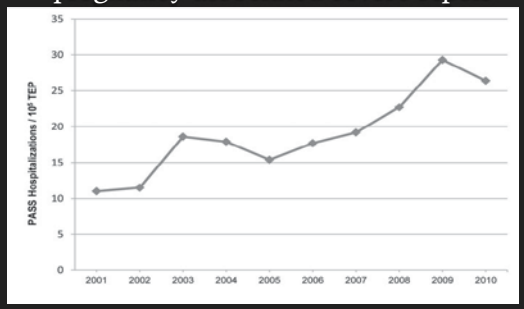
Cause specific pregnancy-related mortality in the US from 1987 - 2009

Levels of Maternal Care Maternal Mortality Review Committee



Causes of pregnancy-related mortality in the United States, 1987–2009. *Data from Berg et al., 1996. **Data from Berg et al., 2003; ***Data from Berg et al., 2010; **** Data from Centers for Disease Control and Prevention.

The age-adjusted annual incidence of pregnancy-associated severe sepsis



PASS: pregnancy-associated severe sepsis; TEP: total estimated pregnancy. Oud L, Watkins P. Evolving trends in the epidemiology, resource utilization, and outcomes of pregnancy-associated severe sepsis: a population-based cohort study. J Clin Med Res 2015;7:400-16.

CASE

- 34 yo G1 admitted at 15w2d with trichorionic triplets and PPROM after her 4th IVF cycle
- 98.3˚, 98 bpm, BP 114/63
- Started on Ampicillin and Azithromycin
- Cerclage in situ, removed next day
- Triplet A delivered HD 1, placenta in situ
- Admit lab: WBC 11.4 with 79% segs, no bands, Hb 10.7, plt 331
- HD 10, 1916: 100.3˚, 107 bpm, BP 109/58
- HD 11, 0300: 100.3˚, resident called, no orders

LEARNING OBJECTIVES

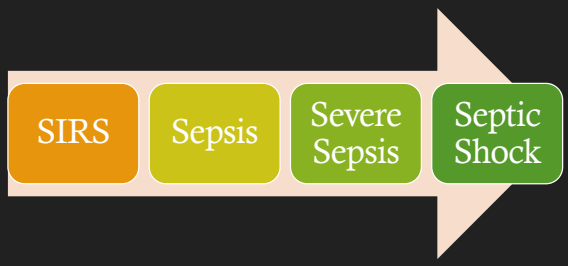
1. **Identify the concern for sepsis**
2. Understand the physiologic needs and interventions specific to the pregnant patient
3. Initiate the appropriate evaluation and treatment for sepsis

Sepsis 1 (1991)

- SIRS (systemic inflammatory response syndrome)
- Sepsis
- Severe sepsis
- Septic shock

Sepsis 2 (2001)

Defined SIRS with more precision and more organ markers for failure associated with severe sepsis



The American College of Chest Physicians (ACCP)
Society of Critical Care Medicine (SCCM)

Sepsis 2

Infection | **SIRS** | Sepsis | Severe sepsis | Death

A non-specific clinical response including > 2 of the following:

- **Temperature >38°C or <36°C**
- **Heart rate >90 beats/min**
- **Respiratory rate >20/min**
- **White blood cell count >12,000/mm³ or <4,000/mm³ or >10% immature neutrophils**

As well as infection, SIRS can also be caused by trauma, burns, pancreatitis and other insults

Bone, R., (1992). Definitions for sepsis and organ failure and guidelines for the use of innovative therapies in sepsis. *Chest, 101* (6), 1481-1483.

Sepsis 2

Infection | SIRS | **Sepsis** | Severe sepsis | Death

SIRS with a presumed or confirmed infectious process

Bone, R., (1992). Definitions for sepsis and organ failure and guidelines for the use of innovative therapies in sepsis. *Chest, 101* (6), 1481-1483.

Sepsis 2

Infection → SIRS → Sepsis → **Severe sepsis** → Death

Sepsis with organ failure or tissue hypoperfusion*

- *SBP <90mmHg or
- MAP <70mmHg or
- SBP decrease >40mmHg below normal for age

Bone, R., (1992). Definitions for sepsis and organ failure and guidelines for the use of innovative therapies in sepsis. *Chest, 101* (6), 1481-1483.

Sepsis 2

Infection → SIRS → Sepsis → Severe sepsis → **Septic Shock**

Sepsis-induced hypotension despite adequate fluid resuscitation

Bone, R., (1992). Definitions for sepsis and organ failure and guidelines for the use of innovative therapies in sepsis. *Chest, 101* (6), 1481-1483.

Sepsis 3 (2016)

Issues with **prior** sepsis identification:

1) Major focus on inflammation
2) Seeming like there is a linear progression
3) Poor sensitivity and specificity of SIRS criteria
4) Severe sepsis is 'redundant'

The Third International Consensus Definitions for Sepsis and Septic Shock (Sepsis-3) JAMA. 2016 February 23; 315(8): 801–810. doi:10.1001/jama.2016.0287

Sepsis 3

- No longer considered a straight line
- No longer agree that '2 or more SIRS criteria' makes sepsis
- Scoring systems are not all well known across fields

The Third International Consensus Definitions for Sepsis and Septic Shock (Sepsis-3) JAMA. 2016 February 23; 315(8): 801–810. doi:10.1001/jama.2016.0287

SIRS (two or more)	qSOFA (two or more)
Temperature >38C or <36C	Glasgow Coma Score </= 13
Heart Rate >90 bpm	SBP </= 100mmHg
Respiratory Rate >20/min	Respiratory Rate >/= 22/min
WBC >12k or <4k Immature pmns >10%	

Sequential (sepsis-related) Organ Failure Score
Logistic Organ Dysfunction System

Why the SOFA score change of 2 or greater?

- Shows a 2 to 25 fold increased risk of DEATH versus those with a SOFA of less then 2
- Mortality risk of about 10%
- Higher mortality than those admitted with STEMI (8%)

The Third International Consensus Definitions for Sepsis and Septic Shock (Sepsis-3) JAMA. 2016 February 23; 315(8): 801–810. doi:10.1001/jama.2016.0287

SOFA
Sequential [Sepsis Related] Organ Failure Assessment

Variable	0	1	2	3	4
paO_2/FiO_2	>400	301-400	201-300	101-200	≤100
Platelet count $10^3/\mu L$	>150	101-150	51-100	21-50	≤20
Serum bilirubin mg/dL	<1.2	1.2-1.9	2-5.9	6-11.9	≥12
Hypotension	None	MAP <70mmHg	Dopamine <5μg/kg/min or dobutamine any dose	Dopamine >5μg/kg/min; epinephrine <0.1gμ/kg/min; norepinephrine ≤0.1μg/kg/min	Dopamine >15μg/kg/min; epinephrine >0.1gμ/kg/min; norepinephrine >0.1μg/kg/min
GCS	15	13-14	10-12	6-9	<6
Serum creatinine	<1.2	1.2-1.9	2-3.4	3.5-4.9	>5
Urine output	NA	NA	NA	<500 mL/24h	<200 mL/24h

The Third International Consensus Definitions for Sepsis and Septic Shock (Sepsis-3) JAMA. 2016 February 23; 315(8): 801–810. doi:10.1001/jama.2016.0287

Sepsis 3 proposed definitions

- Identify sepsis: **ORGAN DYSFUNCTION**, assessed through SOFA
  - * SOFA is for IDENTIFYING sepsis, not for guiding treatment/management
- Knowing that SIRS criteria are often a host response and not necessarily concern for organ dysfunction thus not leading to diagnosis of sepsis…for this reason, sepsis and severe sepsis are redundant

The Third International Consensus Definitions for Sepsis and Septic Shock (Sepsis-3) JAMA. 2016 February 23; 315(8): 801–810. doi:10.1001/jama.2016.0287

When do we have septic shock?

- A severe form, and **subset**, of sepsis that carries a higher risk of death than if the patient just had sepsis
- 3 variables AFTER fluid resuscitation:
  - Hypotension (MAP <65mmHg)
  - Need for vasopressors
  - Elevated lactate (>2mmol/L, or >18mg/dL)
- Septic shock carries 40% mortality

The Third International Consensus Definitions for Sepsis and Septic Shock (Sepsis-3) JAMA. 2016 February 23; 315(8): 801–810. doi:10.1001/jama.2016.0287

So how does an OB IDENTIFY sepsis…

LEARNING OBJECTIVES

1. Identify the concern for sepsis
2. **Understand the physiologic needs and interventions specific to the pregnant patient**
3. Initiate the appropriate evaluation and treatment for sepsis

Sepsis versus Pregnancy

Organ system	Clinical feature of sepsis	Pregnancy
CNS	AMS	
Cardiovascular	Hypotension	Hypotension
Pulmonary	ARDS	SOB
GI	Paralytic ileus	Constipation
Hepatic	Abnormal LFTs	Elevated ALP
Urinary	Oliguria, AKI	Increased GFR, urinary stasis
Hematologic	Thrombocytopenia, DIC	Thrombocytopenia, leukocytosis
Endocrine	Increased insulin resistance	Increased insulin resistance

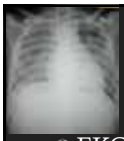
Society for Maternal-Fetal Medicine. Sepsis during pregnancy and the peuperium. Am J Obstet Gynecol 2019.

Hematologic

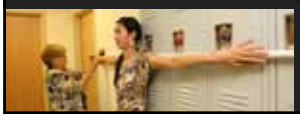
- INCREASE
  - Fibrinogen
  - PV & RBC volume
  - Risk of clots
  - Venous stasis
- DECREASE
  - H/H (PV↑ more than RBC vol)
    - Dilutional Anemia
  - Factor 11, 13

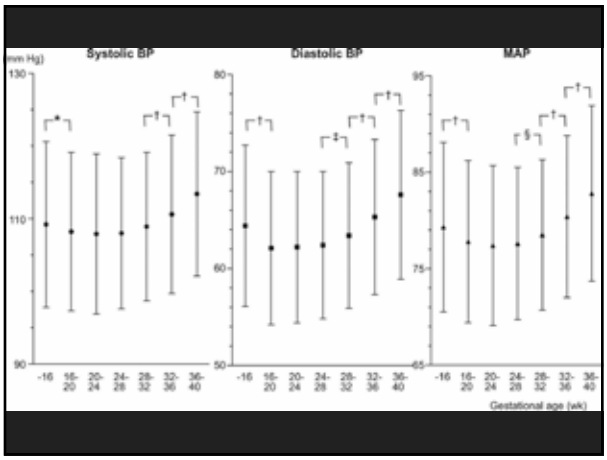
Hypervolemia + Anemia
Less viscous blood
Reduce resistance to flow
→Helps with placental perfusion
→Lowers cardiac work

Cardiac



- EKG: ST, T, see Q waves, inverted T waves
- CXR: cardiomegaly, heart rotated to L
- Arrhythmias: SVTs
- ***Increase: CO, HR, Preload***
- Decreased: Afterload (from lower SVR)





Pulmonary

- "Relative hyperventilation" & 50% ⇧MV →
- Expel excess CO2 (so baseline hypocapnea – help fetus eliminate CO2 across placenta) →
- Increase pH (Respiratory Alkalosis); normal RR
- Asthma: Retain CO2 → Resp Acidosis

MV: volume/1min
RR x TV

ABG changes

Non-Pregnant	Pregnancy
PaO_2: 80 -100	Increase
pH: 7.35-7.43	Increase
pCO_2: 37-40	Decrease
Bicarb: 22-26	Decrease

Tools

- MEOWS (UK)
  - Modified Early Obstetric Warning System
- MERC (US)
  - Maternal Early Warning Criteria

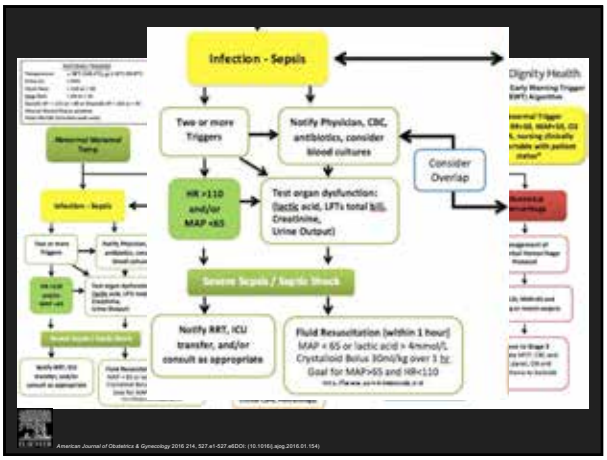
Tools decrease maternal morbidity?

Mhyre et al. Obstet Gynecol 2014;124:782-6
Singh et al. Anaesthesia 2012;67:12-8.

MEWT
Maternal Early Warning Tools

Maternal Triggers	
Temp	≥ 38°C (100.4°F) or ≤ 36°C (96.9°F)
Pulse Oximetry	≤ 93%
Pulse	> 110 or < 50
RR	> 24 or < 12
SBP	> 155 or < 80
DBP	>105 or < 45
Altered mental status	
Fetal HR > 160 (infection pathway)	

Shields et al. Use of maternal early warning trigger tool reduces maternal morbidity. Am J Obstet Gynecol 2016;214:527.e1-6.



Percentage of Maternal Early Warning Trigger screen positive and admitted to the ICU

Clinical pathway	Screened positive (n = 260)	ICU admissions (n = 47)
Sepsis	71.4%	38%
Cardiopulmonary	3.1%	6%
Hypertension	14.6%	15%
Hemorrhage	7.7%	31%
Multiple pathways	2.3%	
Pathways follow correctly	82.3%	
Physician intervention time points, <30 and <60 min	71.9% and 83.1%	

Predicting ICU admission: Sn 96.9%, Sp 99.9%, PPV 12%, NPV 99.9%

Shields et al. Use of maternal early warning trigger tool reduces maternal morbidity. Am J Obstet Gynecol 2016;214:527.e1-6.

LEARNING OBJECTIVES

1. Identify the concern for sepsis
2. Understand the physiologic needs and interventions specific to the pregnant patient
3. **Initiate the appropriate evaluation and treatment for sepsis**

SOFA
Sequential [Sepsis Related] Organ Failure Assessment

Variable	0	1	2	3	4
paO_2/FiO_2	>400	301-400	201-300	101-200	≤100
Platelet count $10^3/\mu L$	>150	101-150	51-100	21-50	≤20
Serum bilirubin mg/dL	<1.2	1.2-1.9	2-5.9	6-11.9	≥12
Hypotension	None	MAP <70mmHg	Dopamine <5μg/kg/min or dobutamine any dose	Dopamine >5μg/kg/min; epinephrine <0.1gμ/kg/min; norepinephrine ≤0.1μg/kg/min	Dopamine >15μg/kg/min; epinephrine >0.1gμ/kg/min; norepinephrine >0.1μg/kg/min
GCS	15	13-14	10-12	6-9	<6
Serum creatinine	<1.2	1.2-1.9	2-3.4	3.5-4.9	>5
Urine output	NA	NA	NA	<500 mL/24h	<200 mL/24h

The Third International Consensus Definitions for Sepsis and Septic Shock (Sepsis-3) JAMA. 2016 February 23; 315(8): 801–810. doi:10.1001/jama.2016.0287

TABLE 2 Obstetrically modified SOFA score

	Score		
System parameter	0	1	2
Respiration			
PaO_2/FIO_2	≥400	300 to <400	<300
Coagulation			
Platelets, $\times 10^9$/L	≥150	100–150	<100
Liver			
Bilirubin (μmol/L)	≤20	20–32	>32
Cardiovascular			
Mean arterial pressure (mmHg)	MAP ≥ 70	MAP < 70	Vasopressors required
Central nervous system	Alert	Rousable by voice	Rousable by pain
Renal			
Creatinine (μmol/L)	≤90	90–120	>120

Aust NZ J Obstet Gynaecol 2017;57:540-551

TABLE 1 Obstetrically modified qSOFA score

Parameter	Score: 0	Score: 1
Systolic blood pressure	≥90 mmHg	<90 mmHg
*Respiratory rate	Less than 25 breaths/min	25 breath/min or greater
Altered mentation	Alert	Not alert

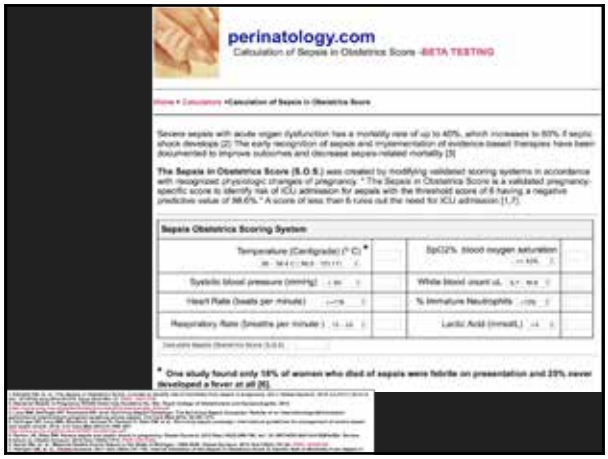
*SIRS: RR >20; qSOFA RR >/=22

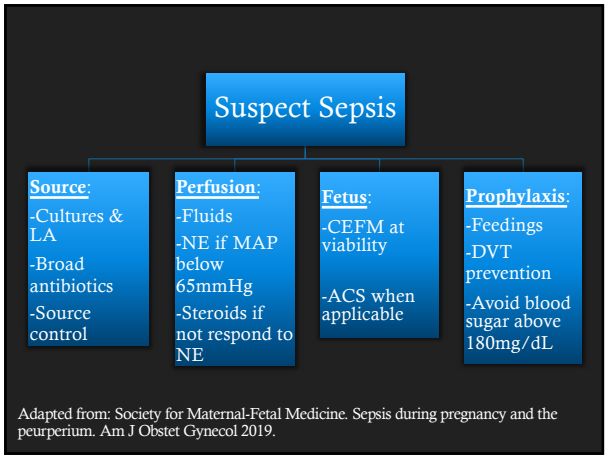
Aust NZ J Obstet Gynaecol 2017;57:540-551

Sepsis in Obstetrics Score (S.O.S.)

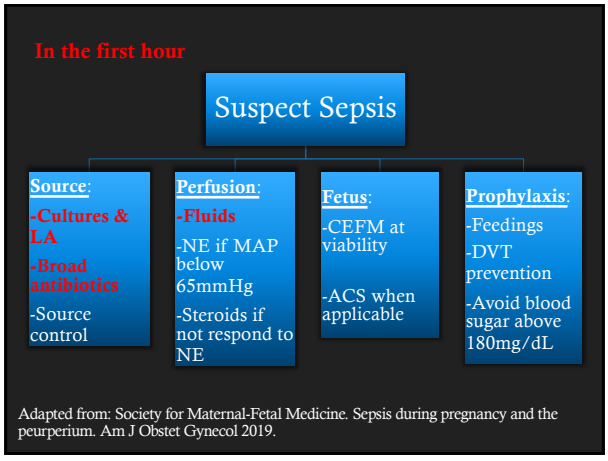
- Retrospective cohort with primary outcome of ICU admissions (n=850 over 2 years)
- S.O.S. score 6 and over had 89% Sn, 95% Sp, 17% PPV, 99.9% NPV for ICU admission
- Max S.O.S score is 28
- Prospective validation in 2017 (n=1,250 over 3 years) showed 64% Sn, 88% Sp, 15% PPV, 98.6% NPV; poor antibiotic administration

Am J Obstet Gynecol. 2014 Jul;211(1):39.e1-8. doi: 10.1016/j.ajog.2014.03.010. Epub 2014 Mar 12. The Sepsis in Obstetrics Score: a model to identify risk of morbidity from sepsis in pregnancy. Albright CM, Ali TN2, Lopes V3, Rouse DJ4, Anderson BL5.





Adapted from: Society for Maternal-Fetal Medicine. Sepsis during pregnancy and the peurperium. Am J Obstet Gynecol 2019.



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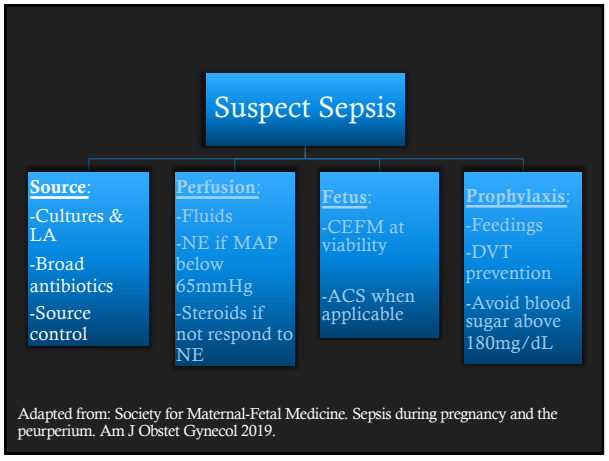


Adapted from: Society for Maternal-Fetal Medicine. Sepsis during pregnancy and the peurperium. Am J Obstet Gynecol 2019.

Labs PRIOR to antibiotics

- 2 Blood Cultures (minimum)
  - Aerobic and anaerobic (fungal?)
  - 1 percutaneous
  - 1 from each vascular access ≥ 48 hrs
- Urine Culture/Urinalysis
- Sputum Culture
- Wound Cultures
- Lactic Acid
- Image as needed

Dellinger, R. P., Levy, M. M., Carlet, J. M., Bion, J., Parker, M. M., & Jaeschke, R. et al. (2008). Surviving sepsis campaign: International guidelines for management of severe sepsis and septic shock: 2008. *Intensive Care Medicine, 34*, 17-60.

What about Lactate? [Mortality]

- Normal Lactate Level: 1.0 – 2.0 mmol/dL [5%]
- If Lactate 2.0 – 4.0: Diminished perfusion of oxygen to cells [7%]
- If Lactate >4.0: Shows complete tissue hypoxia, and will lead to [27%]…

ORGAN FAILURE

Causes of severe sepsis in pregnancy and puerperium

- Acute pyelonephritis
- Retained products of conception
- Chorioamnionitis or endometritis
- Pneumonia
  - Bacterial
  - Viral
- Inadequately treated necrotizing fasciitis
- Non-obstetric intraperitoneal
  - Appendicitis
  - Bowel infarction
  - Acute cholecystitis
  - Necrotizing pancreatitis

Barton OBG 2012;120(3)

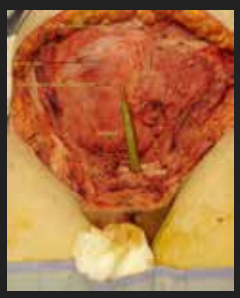
The two most common organisms identified in women dying of peripartum sepsis have been reported to be E coli. and group A streptococcus (GAS) [2,5,6]

In cases of suspected bacterial sepsis, when the source of infection is unclear , the Royal College of Obstetricians and Gynaecologists recommends ,empirically, broad spectrum antimicrobials active against Gram-negative bacteria, and capable of preventing exotoxin production (e.g. clindamycin) * from Gram-positive bacteria such as GAS , should be used , and therapy narrowed once the causative organism(s) has been identified [2]

CELLULITIS?

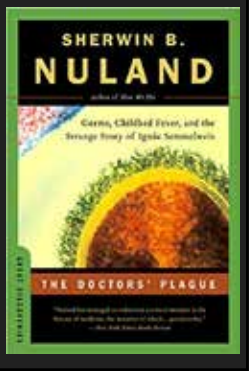
=

Readmitted 1 wk postpartum with lower abdominal pain, swelling of the labia and erythema across the lower suprapubic area. She had a vaginal delivery 1 week prior complicated by pubic symphysis separation. Treated with antibiotics for cellulitis 12 hours later… Athanassopoulos NZ Med J 2006



- **Shock - mentally obtunded and intense abdominal pain**
- **Necrotizing fasciitis**
- **Multi-organ dysfunction (acute renal failure, coagulopathy)**
- **Surgery**
  - **Necrotic tissue debrided**
  - **Day 12 – reconstructive surgery**
  - **Day 19 – reconstructive surgery**
- **Full recovery**

Athanassopoulos NZ Med J 2006

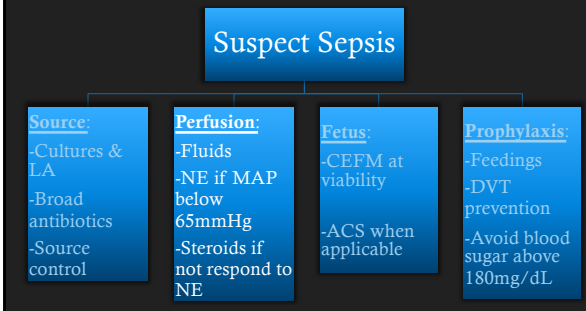


Source	Antibiotic
Community acquired pneumonia	-Cefotaxime -Ceftriaxone -Ertapenem -Ampicillin + azithromycin (or clarithromycin or erythromycin)
Hospital acquired pneumonia	-Piperacillin-tazobactam -Meropenem -Imipinem -Cefepime
Chorioamnionitis	-Ampicillin + gentamicin (add clindamycin or metronidazole if cesarean)
Endomyometritis	-Ampicillin + gentamicin + clindamycin (or metronidazole)
UTI	-Ampicillin + gentamicin -Piperacillin-tazobactam
Abdominal infection	-Ceftriaxone -Cefotaxime -Ceftazidime -Piperacillin-tazobactam
Skin and soft tissue	-Vancomycin + piperacillin-tazobactam -Penicillin G + clindamycin if suspect Group A strep

Society for Maternal-Fetal Medicine. Sepsis during pregnancy and the peuperium. Am J Obstet Gynecol 2019.

Ampicillin and Gentamicin cover ~90% of organisms that cause obstetric sepsis

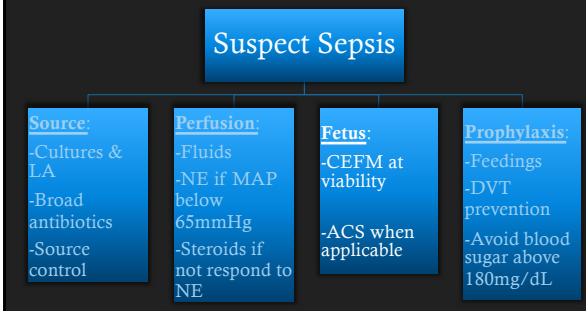
Bauer, ME et al. Anesthesia & Analgesia 2013;117(4):944-50



Adapted from: Society for Maternal-Fetal Medicine. Sepsis during pregnancy and the peurperium. Am J Obstet Gynecol 2019.

Blood Products

- PRBC: if Hb <7g/dL
- Platelets
  - <10k if no bleeding
  - <20k if high risk of bleeding
  - <50k if active bleeding/surgery
- FFP: if active bleeding



Adapted from: Society for Maternal-Fetal Medicine. Sepsis during pregnancy and the peurperium. Am J Obstet Gynecol 2019.

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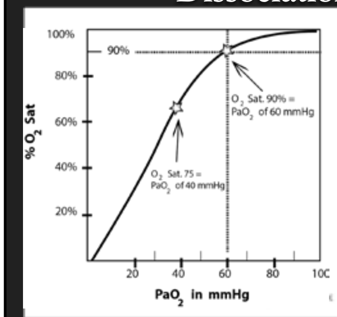
Fetus

https://www.alamy.com/stock-photo/vital-signs.html

Oxygen-Hemoglobin Dissociation Curve



" The OHD curve shows the percent of oxygen binding to Hgb per mmHg. An O2 sat of 90% corresponds to a PaO2 of 60 mmHg. Note how quickly Hgb loses oxygen below 90% saturation."

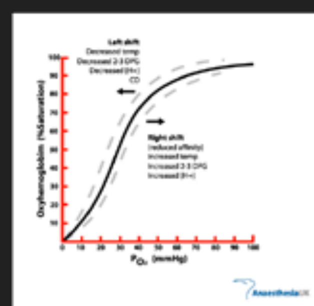
https://airwayjedi.com/2015/12/09/difference-oxygen-saturation-pao2/

Rule for the OHD Curve

PaO_2 mmHg	SaO_2 %
40	70
50	80
60	90

Between a PaO_2 of 60 and 100 mm Hg, the curve is **flat** (so small changes in PaO_2 can occur without a big drop in saturation and oxygen content)

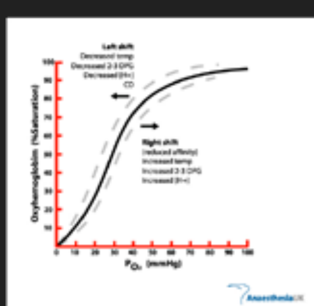
Oxygen-Hemoglobin Dissociation Curve



Right Shift

- Decreased oxygen affinity for hemoglobin
  - This is the expected shift at the tissues
- For any given PaO_2, SaO_2 will be lower
- ELEVATED THINGS CAUSE A RIGHT SHIFT (Up-Right)

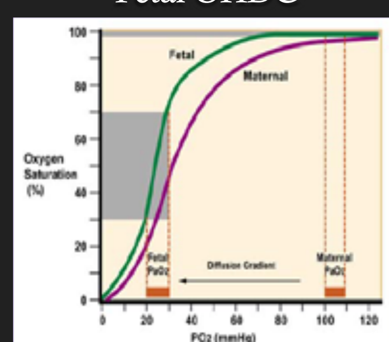
Oxygen-Hemoglobin Dissociation Curve



Left Shift

- Increased oxygen affinity for hemoglobin
  - This is the expected shift at the lungs (Left-Lungs)
- For any given PaO_2, SaO_2 will be higher
- LOW THINGS CAUSE A LEFT SHIFT

Fetal OHDC



The fetus has a LEFTWARD shift of the curve.

Suspect Sepsis

Source:
- -Cultures & LA
- -Broad antibiotics
- -Source control

Perfusion:
- -Fluids
- -NE if MAP below 65mmHg
- -Steroids if not respond to NE

Fetus:
- -CEFM at viability
- -ACS when applicable

Prophylaxis:
- -Feedings
- -DVT prevention
- -Avoid blood sugar above 180mg/dL

Adapted from: Society for Maternal-Fetal Medicine. Sepsis during pregnancy and the peurperium. Am J Obstet Gynecol 2019.

Prophylaxis

- Typical feedings as needed, additional 300 kCal per day
- Sequential compression devices
- Anticoagulation
- Insulin

CASE: 12 hour course of HD12

- 0448: 102.1˚, tylenol ordered
- 0530: Evaluated by resident
  - Blood and urine cultures ordered, started on Amp/Gent
- 0645: Attending arrives, US performed
- 0910: shivering, 98.2˚, tylenol ordered
- 1020: 102.3˚, attending notified, tylenol ordered
- 1050: 132 bpm, attending notified, no new orders
- 1426: shivering, resident notified, no new orders
- 1750: lab calls – both blood cultures positive for Gram Negative Rods

Patient moved to ICU

CASE: in the ICU

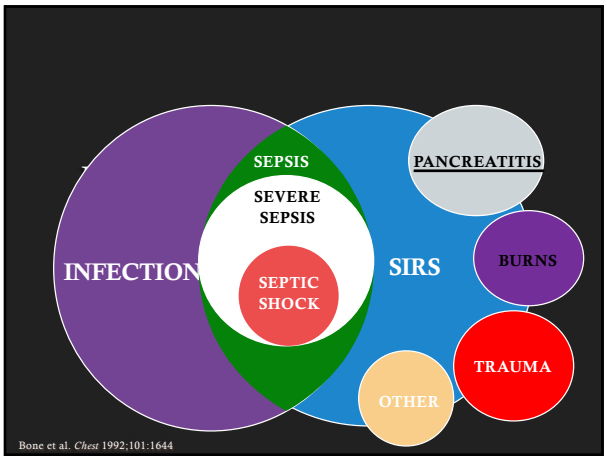
- BP 80/50 (MAP mid 50's), 120 bpm, sat 98% RA, RR 29
- Foley placed, minimal UOP
- Central line and arterial line placed
- Aggressive fluid bolusing, broad spectrum antibiotics
- Patient counseled regarding need to end pregnancy. By this time she is laboring spontaneously with BBOW in vagina. Received misoprostol (Cytotec) 400mcg po.

- 0330: Triplets B and C deliver, curettage for retained placentas
- Received over 7L crystalloid, 2U PRBC's in first night in ICU to maintain CVP > 8
- Norepinephrine bitartrate (Levophed) infusion started prn by 0800

Days in ICU

Delivery, curettage, transfusion

	Day 1 1600	2200	Day 2 0300	0800	1250
WBC	10.2	6.9	9.3	16.4	22.7
Bands	-	40%	54%	40%	32%
Hb	9.3	8.4	6.8	8.1	9.2
Platelets	261	209	137	154	152
Lactate	-	1.7	3.4	1.9	2.4
INR	-	1.3	1.5	-	1.5
Cr	-	0.46	0.44	-	0.4
CO2		19	20	-	21
SVO2	-	83%	-	-	72%



LEARNING OBJECTIVES

1. Identify the concern for sepsis
   - -Sepsis 3
2. Understand the physiologic needs and interventions specific to the pregnant patient
   - -Anemia, increased CO, alkalosis
3. Initiate the appropriate evaluation and treatment for sepsis
   - -Source, perfusion, fetus, prophylaxis

Thank you

- Email: ahill@hrpregnancy.com
- Twitter: @DrAJHill
- #SOAPAM2019

ASRA SOAP Panel
The Role of Truncal Blocks to Optimize Cesarean Delivery Analgesia

Brendan Carvalho MBBCh, FRCA, MDCH
Professor, Chief Obstetric Anesthesia Division
Stanford University School of Medicine
Immediate Past President, Society for Obstetric Anesthesia and Perinatology

Stanford Children's Health | Lucile Packard Children's Hospital Stanford

SOAP Society for Obstetric Anesthesia and Perinatology

1

Disclosures

Pacira Pharmaceuticals: Research funding

Gauss Surgical: Consulting

Rivanna Medical: Speaking honorarium, research GIFT funding

Flat Medical: Consulting

2

REGIONAL ANESTHESIA AND ACUTE PAIN

SPECIAL ARTICLE

Essentials of Our Current Understanding: Abdominal Wall Blocks

KJ Jim Chin, FRCPC,* John G. McDonnell, MD, FCARCSI,† Brendan Carvalho, MD,‡ Aidan Sharkey, FCAI,§ Amit Perna, FRCA,‖ and Jeffrey Gadsden, MD, FRCPC, FANZCA‖

Chin KJ. Reg Anesth Pain Med 2017;42: 133-183

3

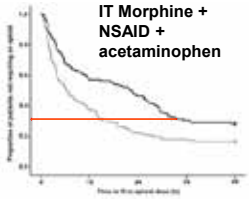
Learning Objectives

- Review truncal blocks that could be utilized for obstetric patients
- Discuss terminology, anatomy, indications and limitations of truncal blocks
- **List the evidence for improved cesarean delivery analgesia with transversus abdominis plane and quadratus lumborum blocks**

4

Post-Cesarean Delivery Pain Control

- **Provide "gold-standard" post-cesarean analgesia**
- **Neuraxial morphine + NSAIDs + acetaminophen**
- **Analgesic goal pain scores < 3:**
  Only 38% women achieve

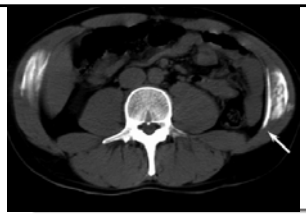


Carvalho B. Best Pract Res Clin Anaesthesiol. 2017;31(1):69-79
Valentine. Int J Obstet Anesth. 2015;24(3):210-6
Wrench. Int J Obstet Anesth 2007; 16: 17-21

5

Transversus Abdominis Plane Block

6



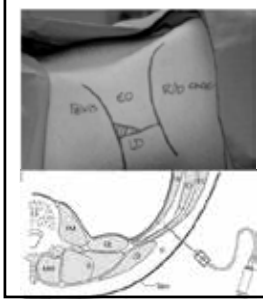
	Number of nerves identified by dissection	Number of nerves involved by dye (n)	Frequency of nerves involved by dye (%)
T9	9	0	0
T10	16	8	50
T11	16	16	100
T12	15	15	100
L1	14	13	93

McDonnell. Reg Anesth Pain Med. 2007;32(5):399-404
Tran. Br J Anaesth. 2009;102(1):123-7
Chin. Reg Anesth Pain Med. 2017;42(2):133-183

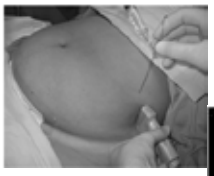
7

Transversus Abdominis Plane Block

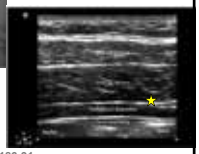
Blind Technique



Ultrasound-Guided



Mid-axillary or Posterior Approach

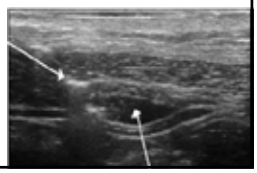


McDonnell. Anesth Analg 2008;106:186-91
Costello. Reg Anesth Pain Med 2009; 34:586-9
Tran. Br J Anaesth. 2009; 102:123-7

8

TAP Blocks: Ultrasound-Guided vs. Blind

- Meta-analysis subgroup analysis:[1]
  Pain scores, analgesic use post-cesarean <u>favored ultrasound</u>
- Blind placement: Needle tip and local anesthetic spread in correct plane <u>only 24%</u> of injections[2]
- Grade B recommendation, Level IIb evidence for ultrasound[3]



1. Mishriky. Can J Anaesth 2012; 59(8):766-78
2. McDermott. Br J Anaesth 2012; 108: 499-502
3. Abrahams. RAPM 2010;35:S36

9

Transversus Abdominis Plane Block
General Anesthesia

TAP blocks in cesarean delivery under general anesthesia

Tan et al.[11] 2012	N = 40, elective LSCS. Intraop: GA + IV morphine 0.15 mg/kg. Postop: IV PCA morphine	Bilateral USG lateral TAP blocks using 20 mL 0.25% levobupivacaine per side at the end of surgery
Eslamian et al.[10] 2012	N = 40, elective LSCS. Intraop: GA + IV morphine 0.1 mg/kg + sufentanil 15 µg. Postop: PR diclofenac 100 mg every 24 h + IV tramadol 50 mg every 4 h prn	Bilateral LMG TAP blocks using 15 mL 0.25% levobupivacaine per side at the end of surgery

- Less morphine use (12.3 vs 31.4 mg at 24 h)
- Less tramadol use (75 vs 250 mg)
- Longer time to 1st opioid (210 vs 30 min)
- Lower rest pain (at 12 h not at 24 h)
- Lower dynamic pain to 24 h

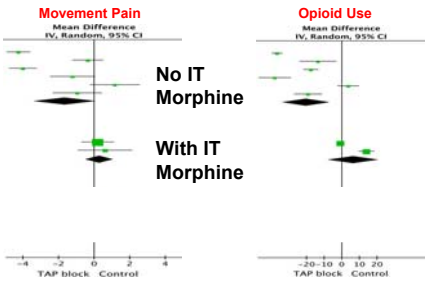
Consent: UK survey only 65% respondents obtained

Chin KJ. Reg Anesth Pain Med 2017;42: 133-183
Tan TT. Eur J Anaesthesiol. 2012;29:88–94
Eslamian L. J Anesth. 2012;26:334–338
Kearns RJ. Int J Obstet Anesth. 2011;20:103–104

10

TAP Block: Analgesic Efficacy Post-Cesarean

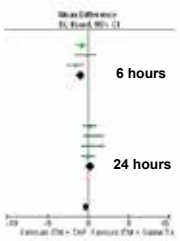
Mishriky. Can J Anaesth 2012; 59(8):766-78
Abdallah. BJA 2012; 109 (5): 679–87



11

TAP Block: Efficacy Post-Cesarean

Pain Movement



Champaneria. Int J Obstet Anesth. 2016;28:45-60

Less opioid use <6 hours

Costello. Reg Anesth Pain Med 2009; 34:586-9

Lee AJ. J Clin Anesth. 2013;25:475–482

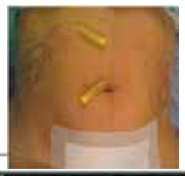
12

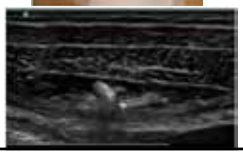
Catheter-based Technique

CASE REPORTS

Transversus abdominis plane catheters for post-cesarean delivery analgesia: a series of five cases

L. Bollag, P. Richebe, C. Ortner, R. Landau



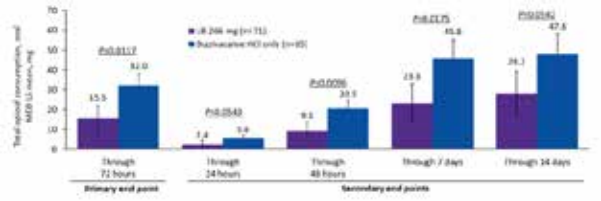


TAP catheter use: 41-70 h
Time to 1st opioid request: 21-32 h
Pain score (VAS 0-10): 0.4-2.4

Bollag. Int J Obstet Anesth 2012;21:176-80

13

TAP Block: Liposomal Bupivacaine vs. Bupivacaine Post-Cesarean Delivery

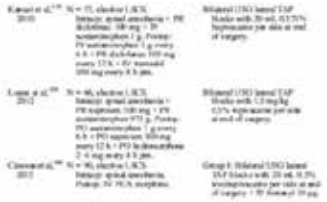


More opioid sparing: 53.5% vs. 24.7%
Lower pain scores AUC over 72 h

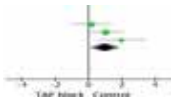
Nedeljkovic SS et al. Multicenter, Randomized, Double-Blind, Controlled Trial. SOAP 2019

14

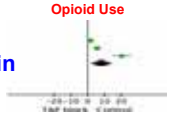
TAP Block vs. Intrathecal Morphine Post-Cesarean



Movement Pain



Opioid Use



Reduces incisional not deep visceral pain

Chin KJ. Reg Anesth Pain Med 2017;42: 133-183
Mishriky. Can J Anaesth 2012; 59(8):766-78
Abdallah. BJA 2012; 109 (5): 679–87

15

Rescue TAP Block Post-Cesarean

Case Series:

	NVPS-Pre (0-10)	NVPS-Post (0-10)	Time NVPS reduction (min)	Analgesic time (hr)
Case 1	9	2	20	12.3
Case 2	10	3	18	10.3
Case 3	9	2	27	19.9

Mirza. Can J Anaesth 2013;60:299-303

Case Reports:
TAP for debilitating pain from abdominal wall hematoma following cesarean delivery
TAP for neuropathic pain after cesarean delivery

Randall IM. Anesth Analg 2008; 106: 1928
Cowlishaw P. Reg Anesth Pain Med. 2009;34:183

16

TAP Block Indications in Cesarean Delivery Setting

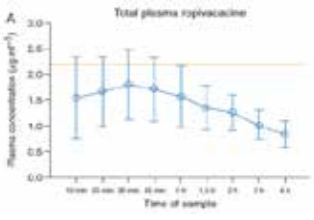
TABLE 6. Clinical Settings Where TAP Blocks Are Indicated for the Provision of Cesarean Delivery Analgesia

Setting	Indication
At time of surgery after wound closure	Cesarean delivery under general anesthesia; cesarean delivery with spinal anesthesia without the use of intrathecal morphine
In recovery or on postpartum floor	Rescue analgesic for severe incisional pain; postoperative analgesic technique for high or escalating IV opioid requirements
Patient-specific factors	NSAIDs contraindicated or withheld because of obstetric concerns; Opioid-dependent

Chin KJ. Reg Anesth Pain Med 2017;42: 133-183

17

TAP Block: Safety



Ropivacaine 3 mg/kg diluted to 40 ml
(20+20 ml)
- **12 of 30 exceeded 'toxic' threshold**
- **3 symptomatic**

Griffiths. BJA 2013; 110 (6):996-1000

Bupivacaine 50 mg each side
- **3 of 17 exceeded 'toxic' threshold**
- **Peak: 30 min**
- **Half-life: 8.8 hours**

Trabelsi. IJOA 2017 April 22

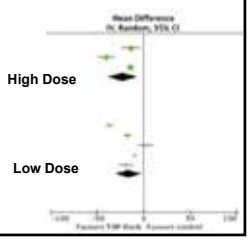
Local Anesthetic Toxicity:
Study terminated prematurely due to a seizure
Case report of convulsions in two patients

Chandon. PLoS ONE 2014 9(8) e103971
Weiss. Reg Anesth Pain Med 2014; 39: 248-51

18

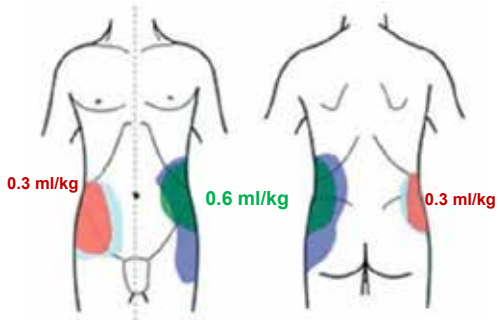
High-dose vs. Low-dose for TAP blocks
Post-Cesarean Delivery

- High (>50 mg) or low dose (≤ 50 mg bupivacaine equivalents per side)
- Meta-analysis: 14 studies (770 women)
- No differences
  - Opioid consumption
  - Time to first analgesia
  - Pain scores
  - Satisfaction
  - Nausea, vomiting, pruritus



Ng. Br J Anaesth. 2018;120(2):252-263

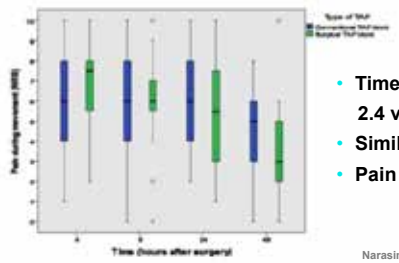
19



Carney. Anaesthesia 2011;66:1023-30

20

Surgical vs. Ultrasound Guided TAP
Post-Cesarean Delivery



- Time taken to perform block
  2.4 vs 12.1 min
- Similar 24 h morphine use
- Pain scores not different

Narasimhulu. Int J Obstet Anesth 2018; 35, 26–32

21

Transversus Abdominis Plane Block
Adjuvants

Sufentanil (50 mcg), Fentanyl (50 mcg), Clonidine (75 mcg)

- Do not provide significantly better quality analgesia than local anesthetic alone

Dexamethasone (8 mg)

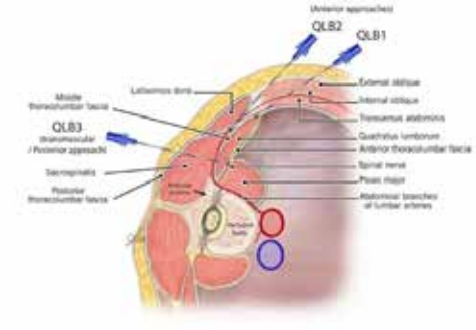
- Modest prolongation of analgesia

Eslamian L. Acta Med Iran 2016;54:185e90.
Bollag L. Reg Anesth Pain Med 2012;37:508e14
Wang LZ. Exp Ther Med. 2016;11(4):1441-1446
Chin KJ. Reg Anesth Pain Med 2017;42: 133-183
Akkaya A. Eur Rev Med Pharmacol Sci. 2014;18(5):717-22.

22

Quadratus Lumborum Block

23

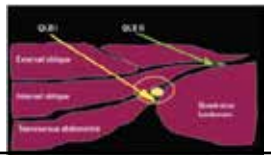


Elsharkaway H. ASRA News 2015; 15 (4): 34-40

24

Quadratus Lumborum
Post-Cesarean Delivery

- No IT Morphine but NSAIDs and acetaminophen
- Bilateral QLB Type 2: 0.2 mL/kg 0.125% bupivacaine
- Lower rest and dynamic pain scores up to 48 h
- Lower morphine use 6 h (2 vs 7 mg), 12 h (8 vs 14 mg), not at 24 h and 48 h



Blanco R. Eur J Anaesthesiol 2015; 32:812–818

25

Quadratus Lumborum
Post-Cesarean Delivery

US-guided QLB Type 1

Ropivacaine 0.2% (30 ml); 0.375% (24 ml)

No IT Morphine

- Less opioid consumption
- Time until first opioid dose longer
- Lower pain scores

Krohg A. Anesth Analg 2018;126:559–65
Mieszkowski MM. Ginekologia Polska 2018; 89, 2: 89–96

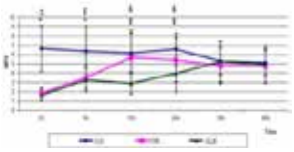
26

Quadratus Lumborum Block vs. IT Morphine
Post-Cesarean Delivery

US-guided QLB Type 1

Ropivacaine 0.375% (24 ml) vs. 100 mcg IT morphine

- Lower morphine requirements
- Time until first opioid dose longer
- Less rest and movement pain
- Less opioid-related side effects



Salama ER. Korean J Anesthesiol. https://doi.org/10.4097/kja.d.18.00269 [Epub ahead of print]

27

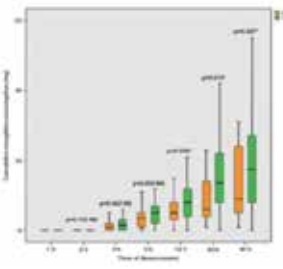
Quadratus Lumborum
Post-Cesarean Delivery

ClinicalTrials.gov

10 listed studies

28

Quadratus Lumborum vs. TAP Block
Post-Cesarean Delivery



QLB Type 2 vs. TAP:

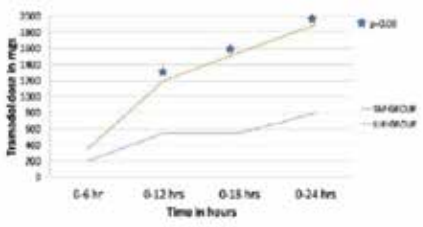
No IT Morphine but NSAIDs and acetaminophen

- Less morphine 12h (↓38%), 24h (↓ 55%) and 48h (↓ 48%)
- Fewer morphine demands
- No differences in pain at rest or with movement (AUCs)

Blanco R. Reg Anesth Pain Med 2016;41: 757–762

29

Ilioinguinal-Iliohypogastric Nerve vs. TAP Block
Post-Cesarean Delivery

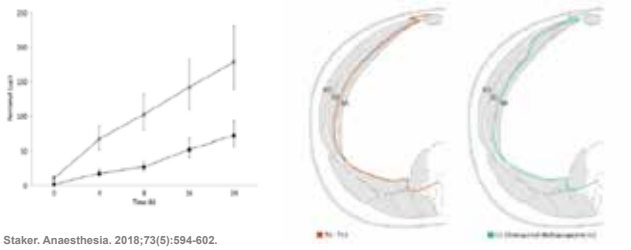


- TAP: 57% did not require analgesics in 24 h period
- ILIH: 13% did not require analgesics

Vamsee Kiran. Anesth Essays Res. 2017; 11(3): 713–717

30

Ilioinguinal-Transversus Abdominis Plane (I-TAP) Block
Post-Cesarean Delivery

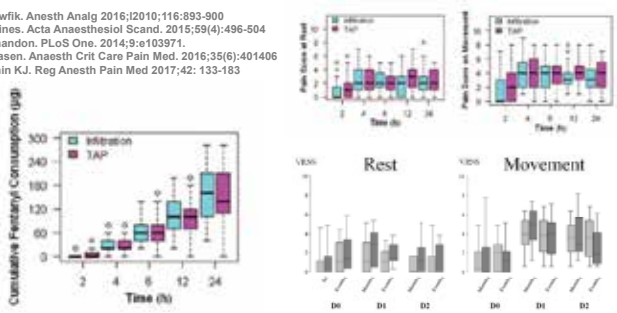


Staker. Anaesthesia. 2018;73(5):594-602.

31

TAP block vs. Wound Instillation

Tawfik. Anesth Analg 2016;I2010;116:893-900
Teines. Acta Anaesthesiol Scand. 2015;59(4):496-504
Chandon. PLoS One. 2014;9:e103971.
Klasen. Anaesth Crit Care Pain Med. 2016;35(6):401406
Chin KJ. Reg Anesth Pain Med 2017;42: 133-183



32

Quadratus Lumborum
Block Spread

QL blocks 40 mL 0.375% levobupivacaine (20 mL each side)
2382 patients
Reported quadriceps muscle weakness
Lateral 7/771(1%), posterior 285/1485(19%), anterior 65/81(90%) and intramuscular 0/45(0%)

Ueshima H. J Clinical Anesthesia 2018; 44:104

A A Pract. 2018 Dec 11. doi: 10.1213/XAA.0000000000000920. [Epub ahead of print]

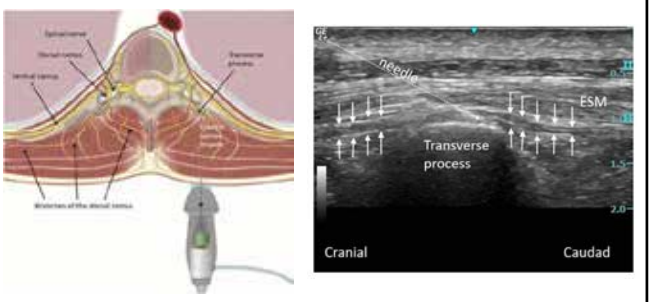
Horner's Syndrome and Upper Extremity Weakness After Quadratus Lumborum Block for Postcesarean Section Analgesia: A Case Report.

Anderson M[1], Chernishof V[1], Norris MC[2].

33

Erector Spinae Plane Block

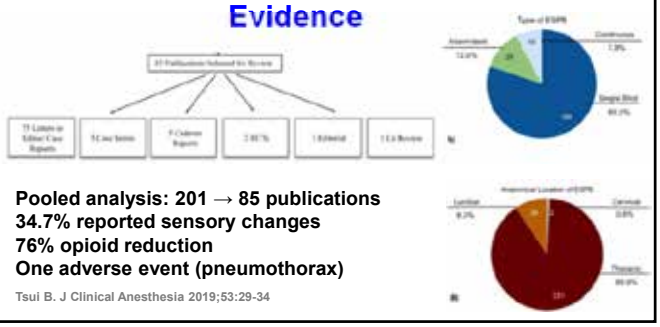
34



Eng HC. ASRA News, Feb 2018
Melvin et al. Can J Anaesth 2018;65(9):1057-1065.

35

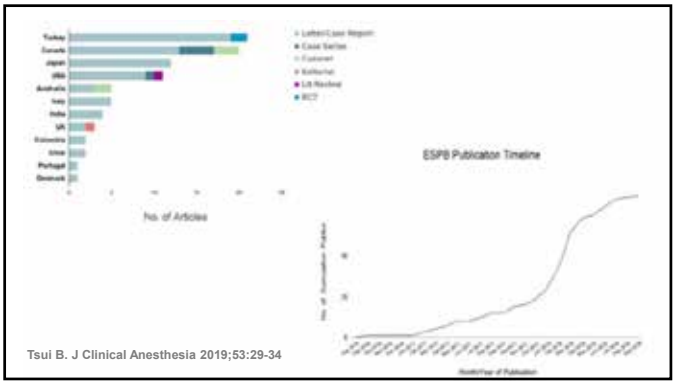
Erector Spinae Plane Block
Evidence



Pooled analysis: 201 → 85 publications
34.7% reported sensory changes
76% opioid reduction
One adverse event (pneumothorax)

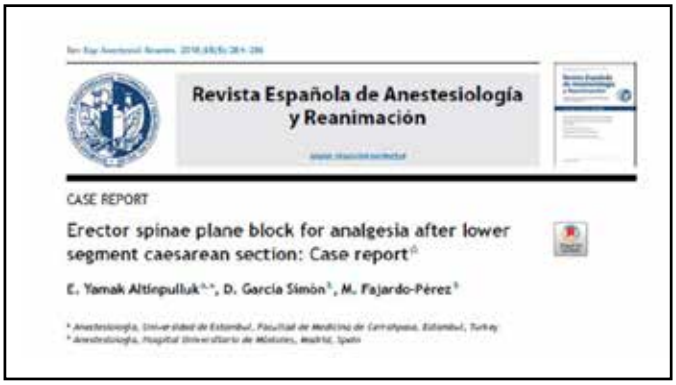
Tsui B. J Clinical Anesthesia 2019;53:29-34

36



Tsui B. J Clinical Anesthesia 2019;53:29-34

37



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Erector Spinae Plane Block
Case report

- Cesarean delivery with general anesthesia
- Transverse process T9
- 20 ml bolus 0.25% bupivacaine
- Sensory loss pin prick test T6-L1 dermatomes
- Pain score ranged from 1-3/10
- Opioid requirements 22.9 mg IV morphine over 48 h

Yamak Altinpulluk E. Rev Esp Anestesiol Reanim. 2018;65(5):284-286

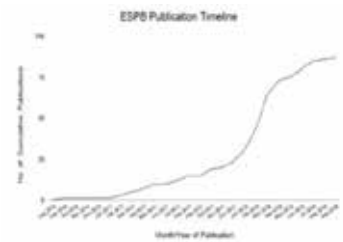
39

40

Erector Spinae Block
Post-Cesarean Delivery

ClinicalTrials.gov

1 listed Cesarean Studies
Comparing TAP, QBL, ESP



Tsui B. J Clinical Anesthesia 2019;53:29-34

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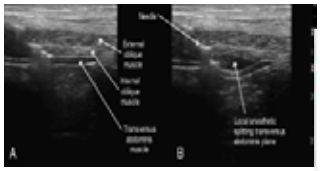
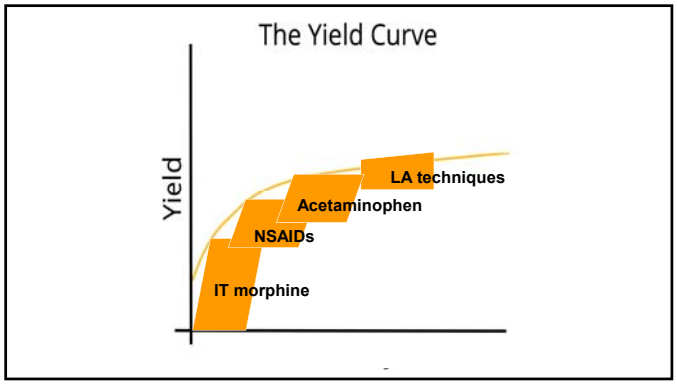
Technique and Training



Costello. Reg Anesth Pain Med 2009; 34:586-9

Median TAP distance
2.9 cm before vs. 3.9 cm after
cesarean delivery

42



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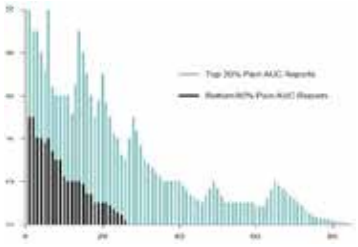
Postpartum Pain Burden (20% vs. 80%)



Komatsu R. Br J Anaesth. 2018;121(2):417-426

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Brendan Carvalho
Professor, Chief Obstetric Anesthesia Division
Department of Anesthesiology, Perioperative and Pain Medicine
Stanford University School of Medicine

bcarvalho@stanford.edu

@carvalb

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ASRA-SOAP Panel

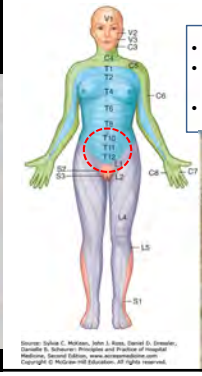
The Role of Truncal Blocks to Optimize Cesarean Delivery Analgesia

Ki Jinn Chin, MBBS (Hons), MMed, FRCPC
Associate Professor
Toronto Western Hospital
University of Toronto
gasgenie@gmail.com
@KiJinnChin

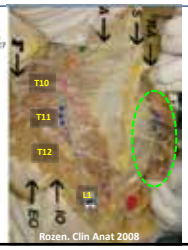
Sources of pain in cesarean section

Myocutaneous
Infraumbilical
Midline
Low transverse

Visceral
Uterine



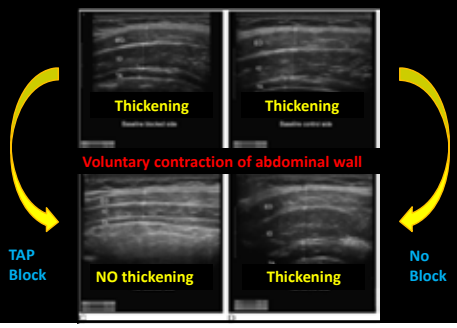
- Nerves communicate
- Non-segmental innervation
- Midline crossover



Cutaneous Sensory Block Area, Muscle-Relaxing Effect, and Block Duration of the Transversus Abdominis Plane Block
A Randomized, Blinded, and Placebo-Controlled Study in Healthy Volunteers

Discernable cutaneous sensory loss in fascial plane blocks is
- **Variable**
- **Patchy**

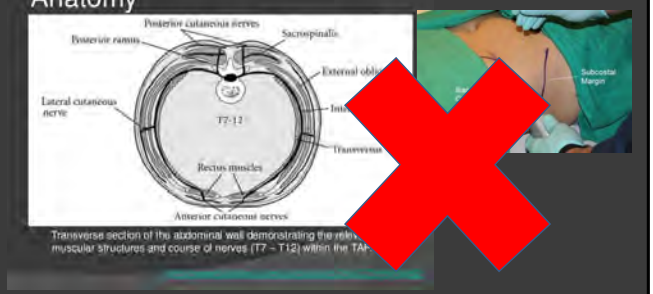
Motor blockade is an important component of analgesia



TAP Block

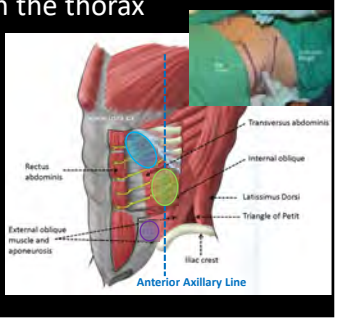
No Block

Anatomy



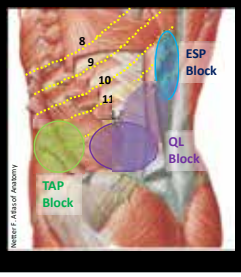
Abdominal wall innervation originates in the thorax

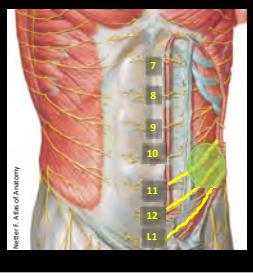
- T6-T9 enter the TAP between the AAL and the midline
- Lateral to the AAL, only T10-L1 are located in the TAP
- L1 enters the TAP at the level of the ASIS



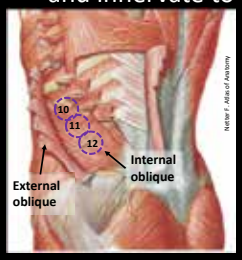
Rozen WM. Clin Anat 2008, 21: 325-333.

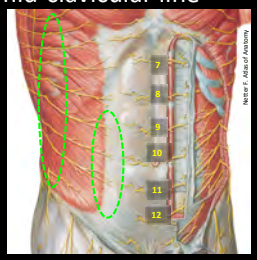
Abdominal wall innervation originates in the thorax





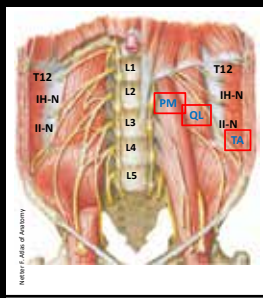
Lateral cutaneous branches emerge in mid- or posterior axillary line and innervate to mid-clavicular line





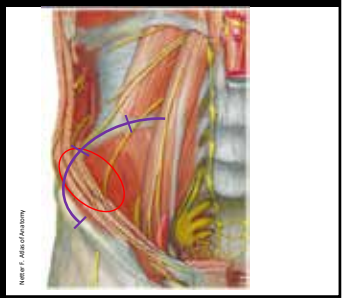
Ilioinguinal & iliohypogastric nerves are branches of lumbar plexus

- They emerge from under psoas major
- They run anterior to quadratus lumborum muscle
- They initially run deep to transversus abdominis muscle

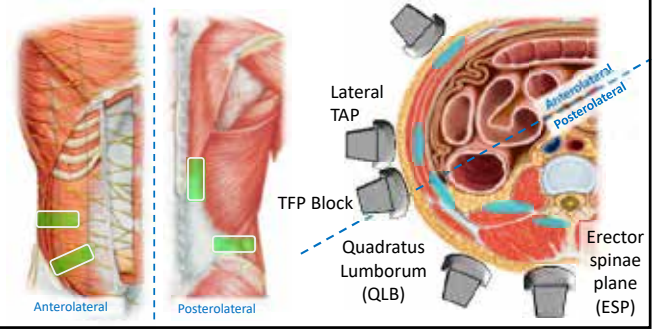


Ilioinguinal & iliohypogastric nerves are branches of lumbar plexus

- They enter the TAP towards the anterior 1/3 of iliac crest
- They lie cranial to the iliac crest and the ASIS



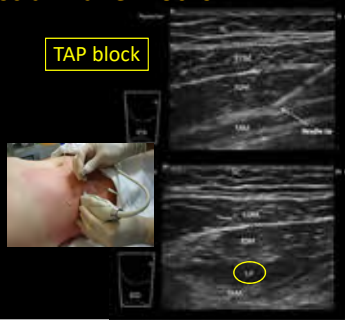
Truncal Fascial Plane Blocks



Paraspinal & Fascial Plane Blocks

- Injection into a plane between 2 fascial layers
  - Muscle

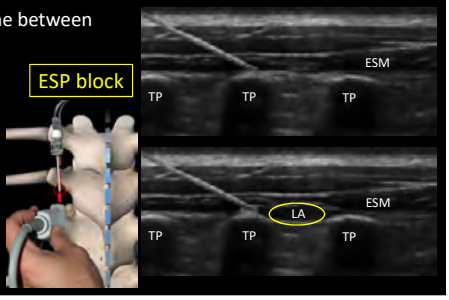
TAP block



Paraspinal & Fascial Plane Blocks

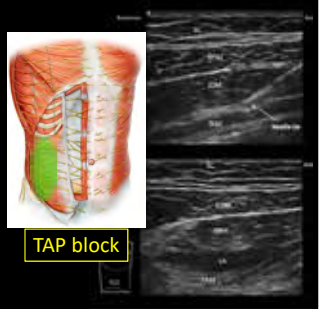
- Injection into a plane between 2 fascial layers
  - Muscle
  - Bone

ESP block



Paraspinal & Fascial Plane Blocks

- Injection into a plane between 2 fascial layers
  - Muscle
  - Bone
- Targets nerves
  - In the fascial plane

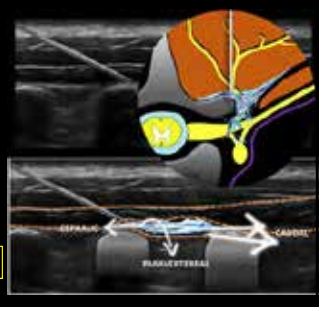


TAP block

Paraspinal & Fascial Plane Blocks

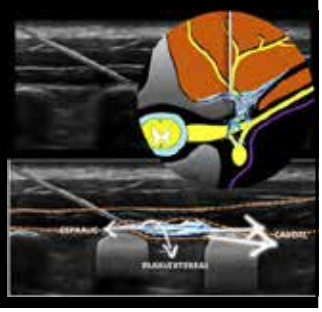
- Injection into a plane between 2 fascial layers
  - Muscle
  - Bone
- Targets nerves
  - In the fascial plane
  - In compartments connected to the fascial plane

ESP block



Paraspinal & Fascial Plane Blocks

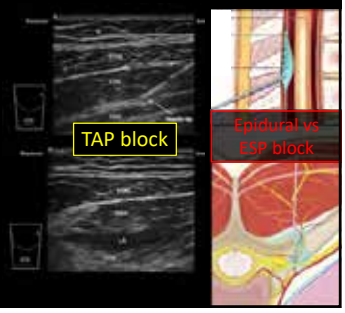
- Injection into a plane between 2 fascial layers
  - Muscle
  - Bone
- Targets nerves
  - In the fascial plane
  - In compartments connected to the fascial plane
- "Volume-based" block
  - Physical spread is key



Paraspinal & Fascial Plane Blocks – Safe?

- Distant from discrete nerves
  - Asleep vs awake patient
- Distant from major blood vessels
  - Coagulation abnormalities
- Distant from vital structures
  - Vertebral canal
  - Viscera
  - Pleura

TAP block

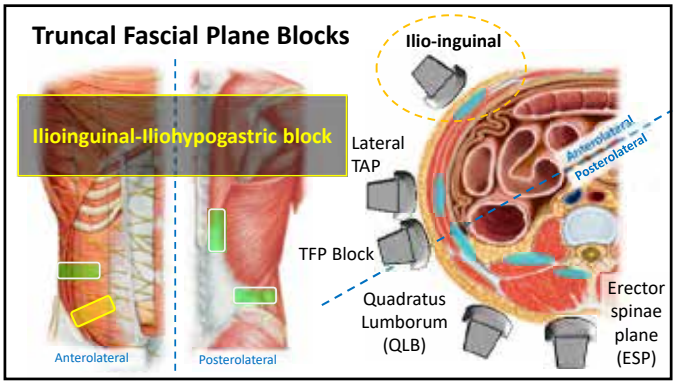


Local Anesthetic Systemic Toxicity (LAST)

- **Systemic absorption vs. intravascular absorption**
  - USG-PNB = 0.06% *(Barrington et al. RAPM 2013)*
  - ESP block = 1.6% *(Tulgar et al. Cureus 2019)*
- **Be mindful of total dose delivered**
- **Add epinephrine, even to ropivacaine**
- **Be vigilant (>30 minutes to peak plasma conc)**
- **Be prepared to manage LAST**

REBEL EM

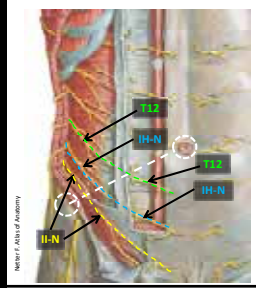
Truncal Fascial Plane Blocks



Ilioinguinal-Iliohypogastric block

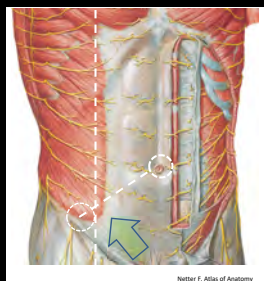
Ilioinguinal-Iliohypogastric Block

- The II and IH nerves run very close to the ASIS
- T12 lies more cranial and medial to the II and IH nerves

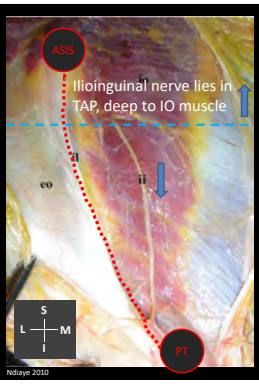


Ilioinguinal-Iliohypogastric Block

- Medial to the mid-clavicular line and ASIS, EO is an aponeurosis, not a muscle



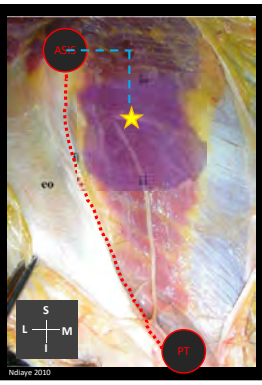
Netter F. Atlas of Anatomy



Ndiaye 2010

Tremendous variability in where II and IH nerves run
- in relation to ASIS
- where they pierce muscle layers

More inferiorly and medially, ilioinguinal nerve will pierce IO muscle and lie superficial to it



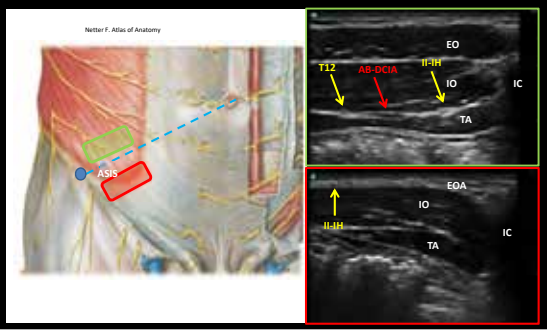
Multiple landmark-guided techniques described
(single pop, double pop, etc)

Good technique in absence of US

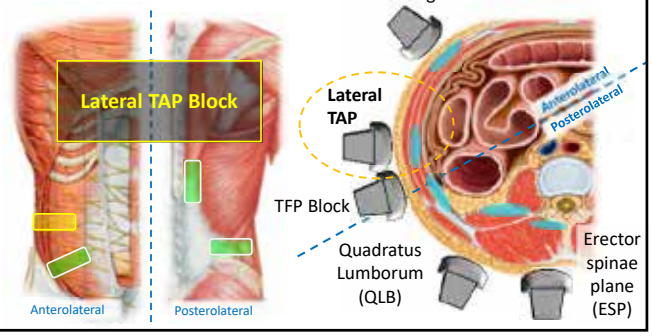
If using an injection point medial and inferior to the ASIS, reasonable to utilize a single pop (piercing of EO aponeurosis)

- Should spread to both nerves.
- Reduces risk of excessive depth.

USG Ilioinguinal-Iliohypogastric Block

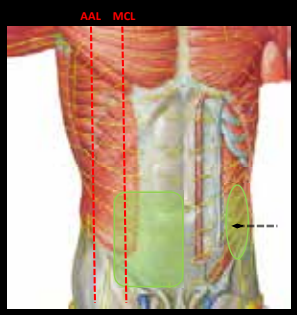


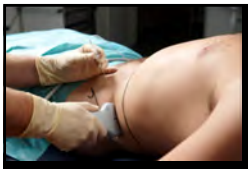
Truncal Fascial Plane Blocks



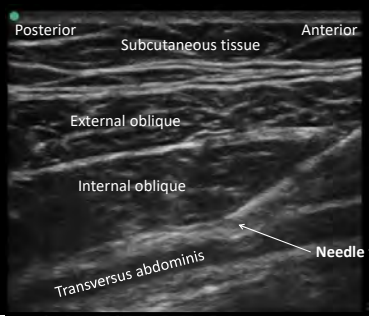
Clinical Application of Lateral TAP BLock

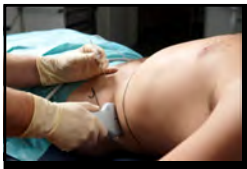
- Anatomical coverage
  - Medial to MCL / AAL
  - Infraumbilical
  - Somatic innervation T10-T12
  - L1 ≥ 50% of the time



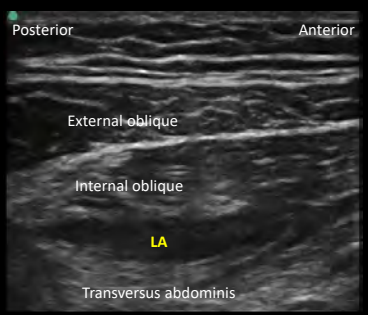


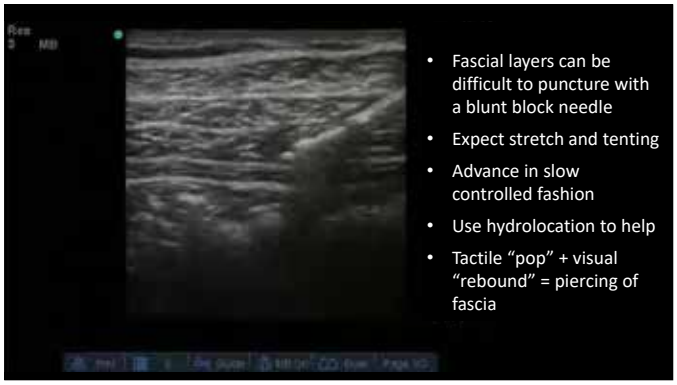
USG lateral TAP block

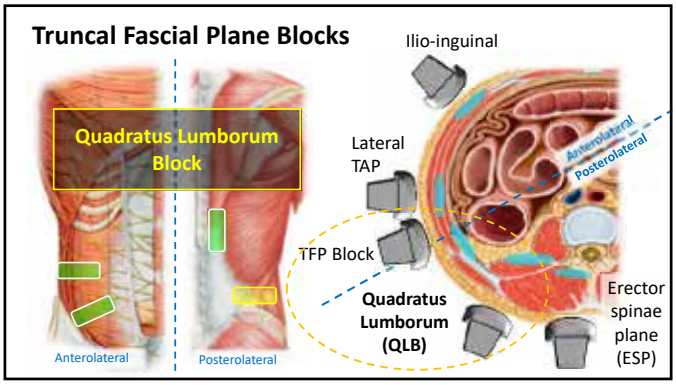


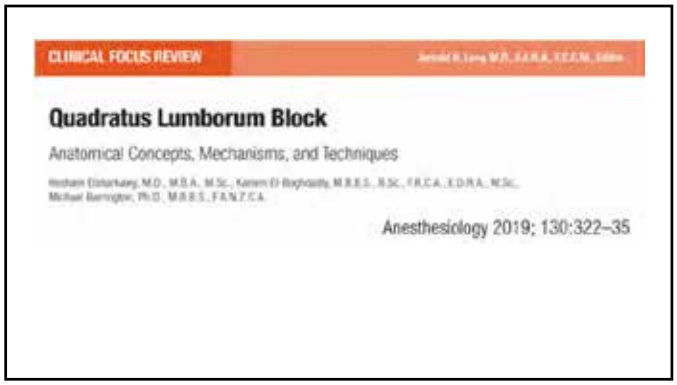


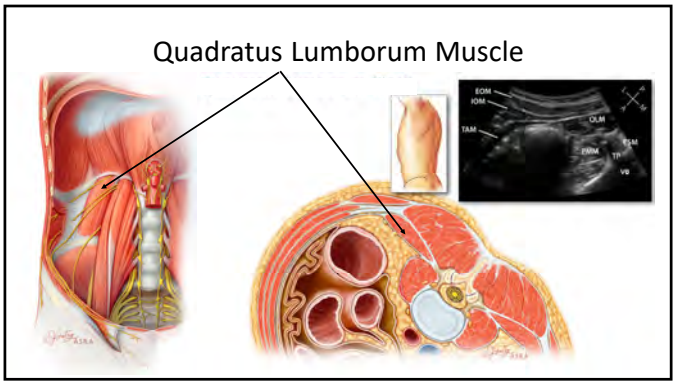
USG lateral TAP block

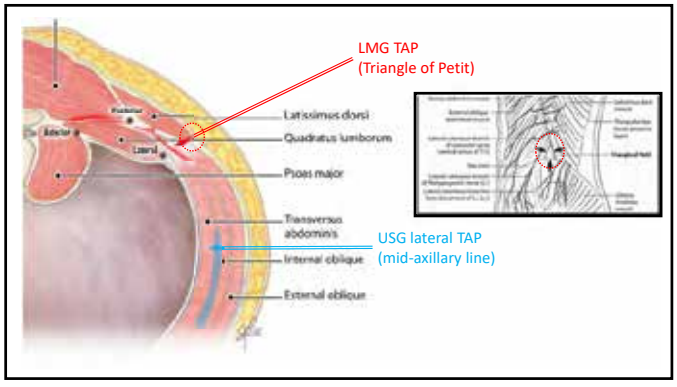


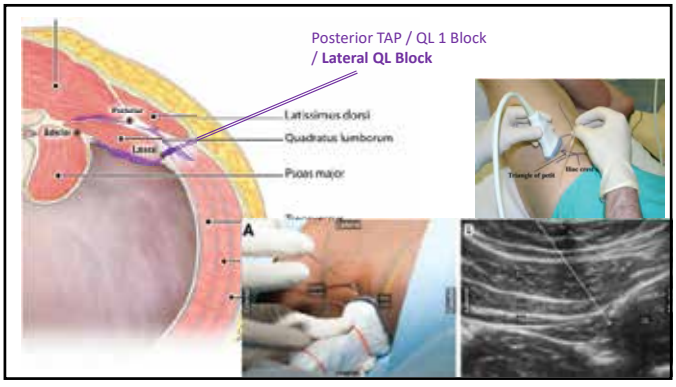

• Fascial layers can be difficult to puncture with a blunt block needle
• Expect stretch and tenting
• Advance in slow controlled fashion
• Use hydrolocation to help
• Tactile “pop” + visual “rebound” = piercing of fascia

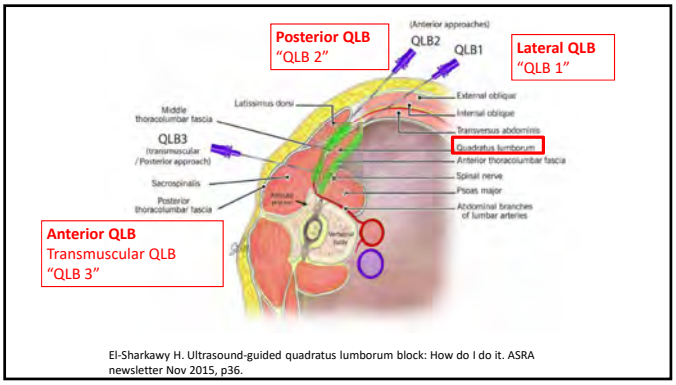

Truncal Fascial Plane Blocks
Ilio-inguinal
Quadratus Lumborum Block
Lateral TAP
Anterolateral
Posterolateral
TFP Block
Quadratus Lumborum (QLB)
Erector spinae plane (ESP)
Anterolateral
Posterolateral


CLINICAL FOCUS REVIEW
Quadratus Lumborum Block
Anatomical Concepts, Mechanisms, and Techniques
Anesthesiology 2019; 130:322–35

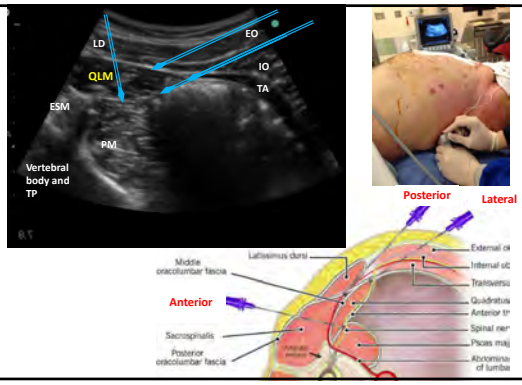

Quadratus Lumborum Muscle

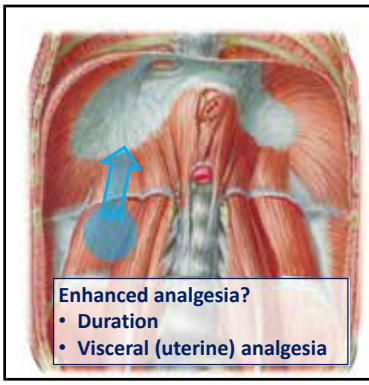

LMG TAP
(Triangle of Petit)
Latissimus dorsi
Quadratus lumborum
Psoas major
Transversus abdominis
Internal oblique
External oblique
USG lateral TAP
(mid-axillary line)


Posterior TAP / QL 1 Block
/ Lateral QL Block
Latissimus dorsi
Quadratus lumborum
Psoas major
A
B

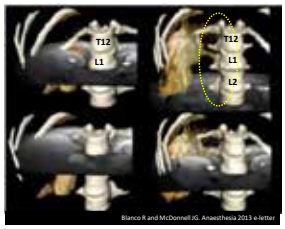


El-Sharkawy H. Ultrasound-guided quadratus lumborum block: How do I do it. ASRA newsletter Nov 2015, p36.



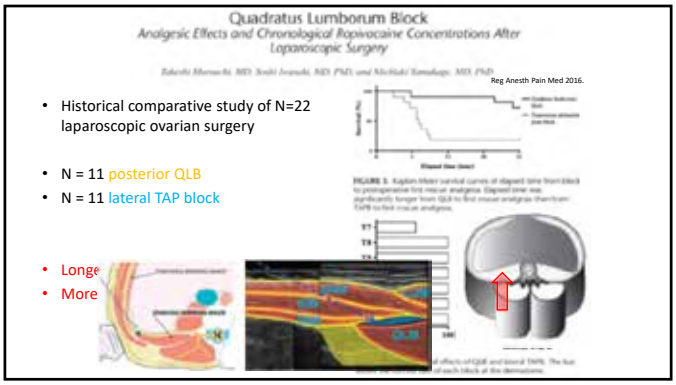


Spread between thoracolumbar fascia & transversalis / endothoracic fascia, under arcuate ligaments of diaphragm to thoracic paravertebral space

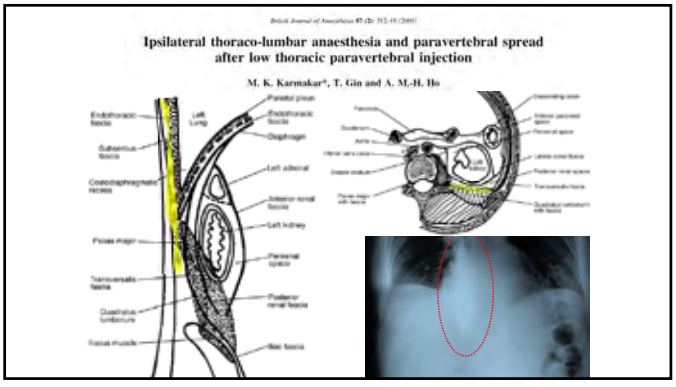


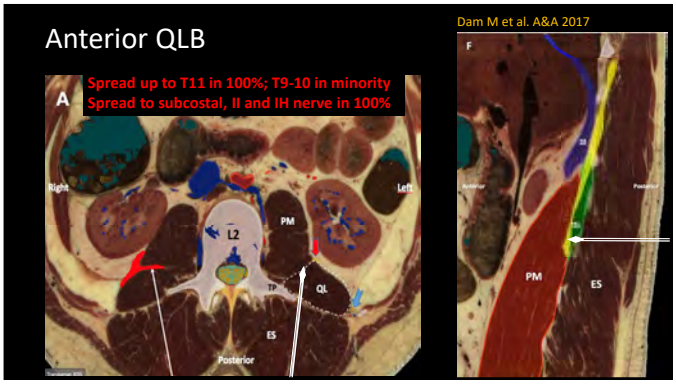
Blanco R and McDonnell JG. Anaesthesia 2013 e-letter

Enhanced analgesia?
- **Duration**
- **Visceral (uterine) analgesia**



- Historical comparative study of N=22 laparoscopic ovarian surgery
- N = 11 posterior QLB
- N = 11 lateral TAP block
- Longe
- More



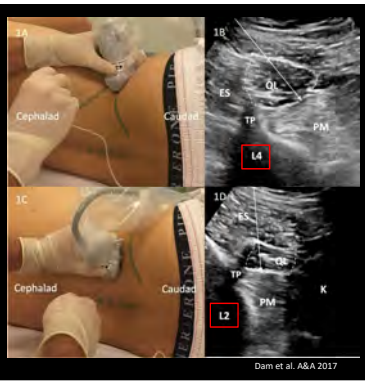


Anterior QLB

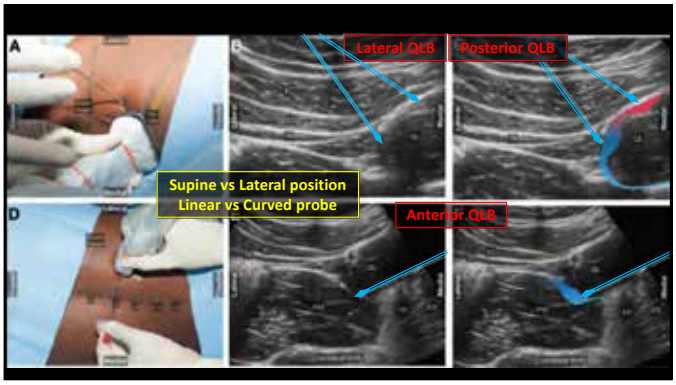
Transmuscular QLB

Transverse Oblique Paramedian (TOP) QLB

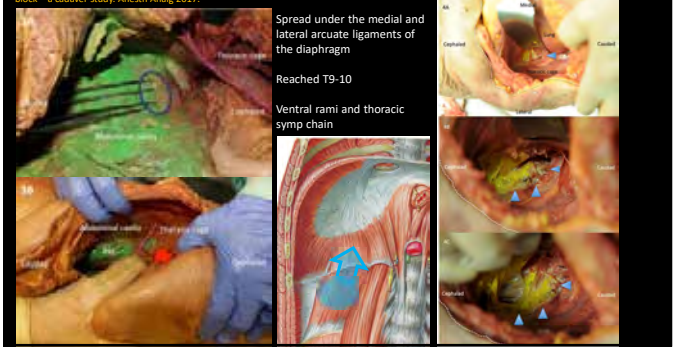
More cephalad
More posterior
More PVB spread?



Dam et al. A&A 2017



Dam M, Moriggl B, Hansen CK, Hoermann R, Bendtsen TF, Borglum J. The pathway of injectate spread with the transmuscular quaratus lumborum (TQL) block – a cadaver study. Anesth Analg 2017.



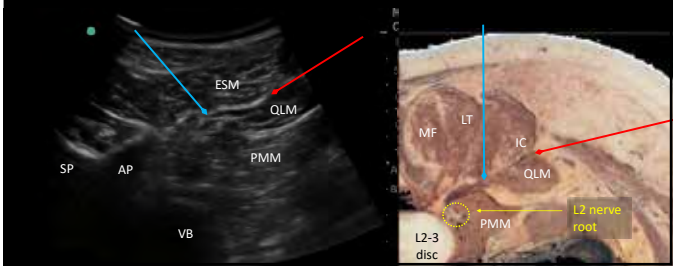
Spread under the medial and lateral arcuate ligaments of the diaphragm

Reached T9-10

Ventral rami and thoracic symp chain

Mechanism for Posterior QLB?

- An erector spinae plane block at the lumbar level??



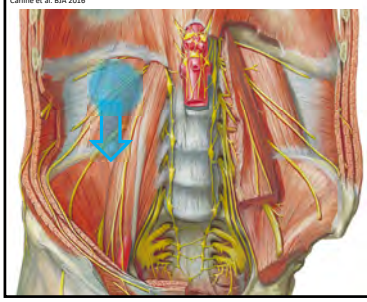
Clinical Application of QLB

- May provide more extensive analgesia vs TAP
- Paravertebral spread = visceral analgesia??

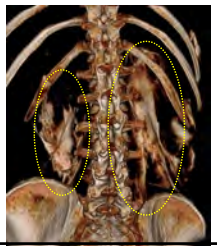
- May be technically more difficult
  - Deeper block – especially the transmuscular QLB
  - Lateral positioning
- Interindividual variability still likely
- Optimal volume and concentration?

There may also be spread to upper branches of lumbar plexus with anterior (transmuscular) QLB

El-Boghdadly et al. Anaesthesia 2016
Carline et al. BJA 2016



Abdominal wall block?
and/or
Hip block?
Beware LL weakness



CAUTION

Quadratus lumborum block: are we aware of its side effects? A report of 2 cases

Correspondence Journal of Clinical Anesthesia 44 (2018) 104

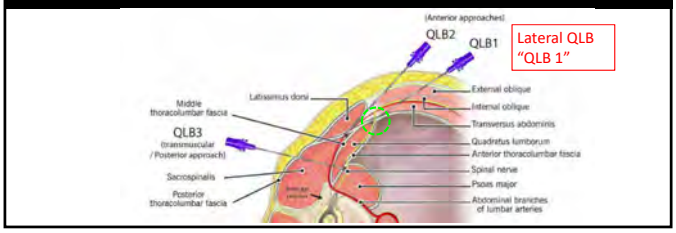
Incidence of lower-extremity muscle weakness after quadratus lumborum block

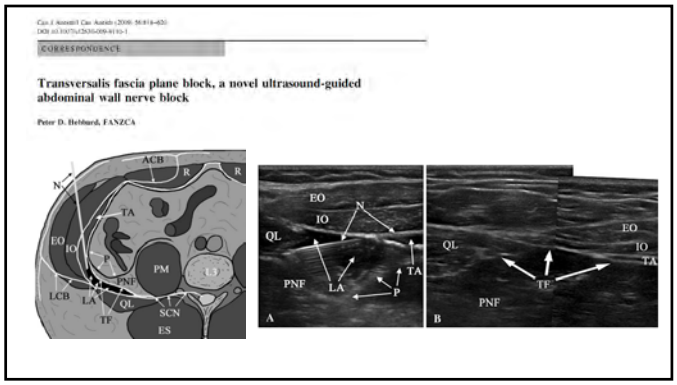
Case Report

Lateral (n=771)= 1%
Posterior (n=1485)= 19%
Anterior (n=81)= 90%

..unilateral hip flexion and knee extension weakness leading to unplanned overnight admission following LATERAL QL block with 20ml... fluid.

Lateral QLB or Transversalis Fascia Plane (TFP) block?



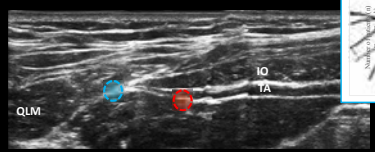


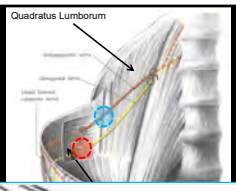
Transversalis fascia plane block, a novel ultrasound-guided abdominal wall nerve block

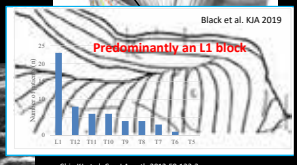
Peter D. Hebbard, FANZCA

QLB1 vs TFP block

- TFP vs QLB1
  - Imaging plane is just above iliac crest vs between iliac crest and costal margin
  - Injection occurs lateral vs medial to tapered end of TA







Chin KJ et al. Can J Anesth 2012;59:122-3.

https://youtu.be/B11mTGietIs

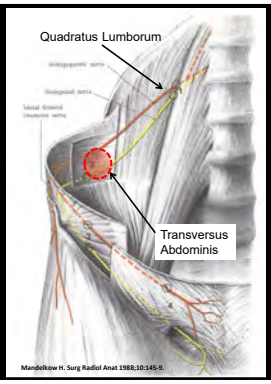
TFP Block

- Anterior iliac crest bone graft harvest
- 50% reduction in peri-operative opioid requirements
- Reduction in PACU pain NRS from 4-6 to 0-2.

- Surgery in the L1 dermatome

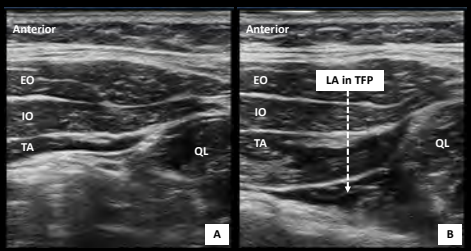
Chin KJ et al. Can J Anesth 2012;59:122-3.

https://youtu.be/B11mTGietIs

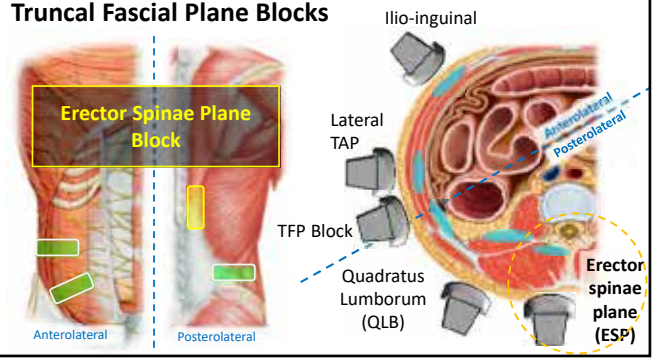


Mandelkow H. Surg Radiol Anat 1988;10:145-9.

TFP Block - Spread



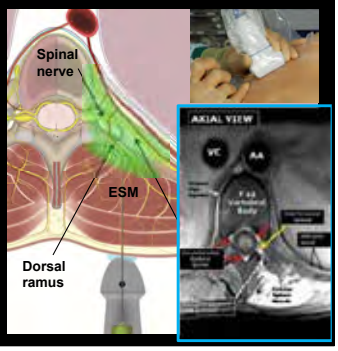
Truncal Fascial Plane Blocks



The ESP block

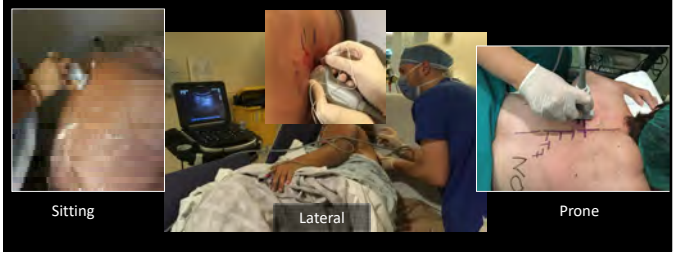
- Ultrasound-guided
- Paraspinal
- Musculofascial plane
- Deep to erector spinae muscle (ESM)
- Superficial to transverse process
- Blockade of the ipsilateral thoraco-lumbar spinal nerves
- Sympathetic chain

"Paravertebral by proxy"

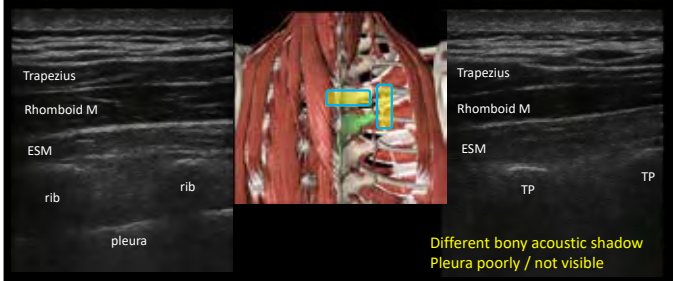


Performing the ESP block

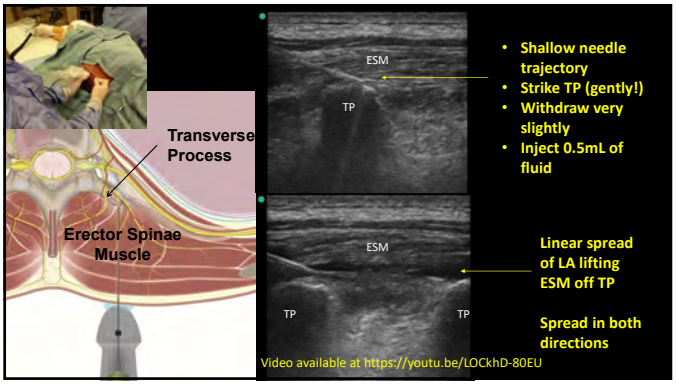
- Patient position
- Transducer – linear vs curved



Scanning – Identify tip of TP



Different bony acoustic shadow
Pleura poorly / not visible

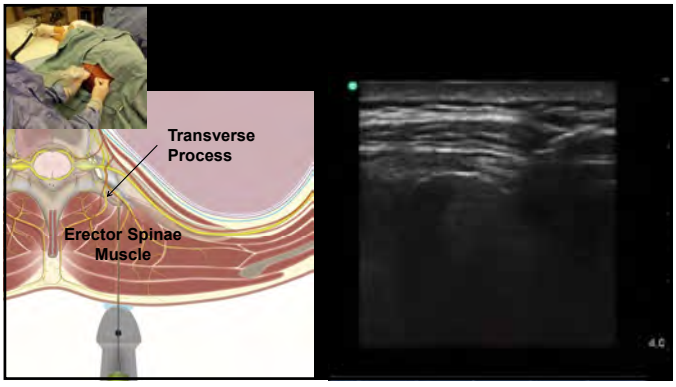


- **Shallow needle trajectory**
- **Strike TP (gently!)**
- **Withdraw very slightly**
- **Inject 0.5mL of fluid**

Linear spread of LA lifting ESM off TP

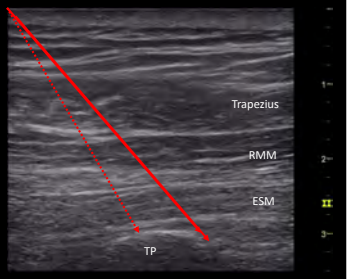
Spread in both directions

Video available at https://youtu.be/LOCkhD-80EU

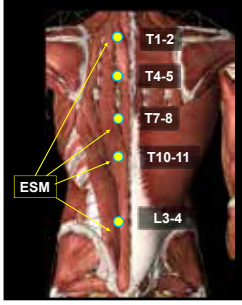


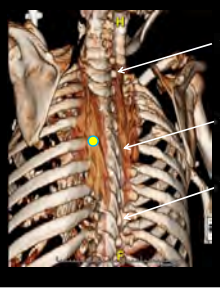
Needling - Pitfalls and Pearls

- Needle insertion can be painful
  - Anesthetize muscle with a longer needle
- IP alignment and needle visualization can be difficult
  - Ergonomics and positioning
  - Meticulous selection of skin insertion site
- Opening up the tissue plane can occasionally be difficult
  - Aim for "far" side of TP
  - "Skim" off the TP to go deeper



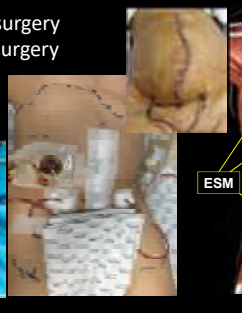
The ESP Block – highly versatile

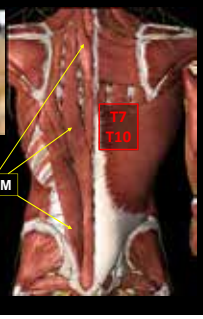




ESP Block for Abdominal Analgesia

- Upper abdominal surgery
- Lower abdominal surgery
- Flank surgery
- LSCS





ESP Block – Visceral Analgesia

The Erector Spinae Plane Block Provides Visceral Abdominal Analgesia in Bariatric Surgery
A Report of 3 Cases

Mechanism of the erector spinae plane block: insights from a magnetic resonance imaging study

mechanism of the ESPB. A 38-yr-old female (who consented to this report) with post-surgical chronic visceral abdominal pain received an ultrasound-guided ESPB, which rendered her pain free. Four months later, the

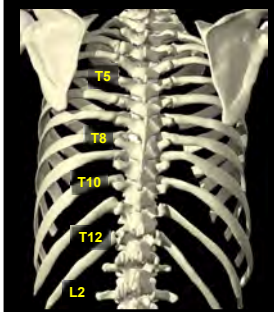

Erector spinae plane block for analgesia after lower segment caesarean section: Case report.

- Lateral position
- Bilateral ESP at T9 TPs
- **20ml** 0.25% bupivacaine per side
- T6-L1 sensory loss
- VAS 2/10 in PACU
- VAS 1-3/10 during hospital stay
- 24-hour IV morphine use = 22.9mg


Ultrasound guided erector spinae plane block as a cause of unintended motor block.

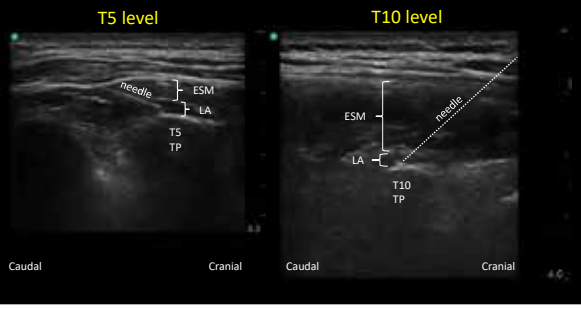
- Lateral position
- Bilateral ESP at T11 TPs
- **25ml** of LA (15ml of 0.5% bupivacaine, 5ml lidocaine 2% and 5ml NS)
- T9-L3 sensory loss
- VAS 3/10 in PACU
- 2/5 weakness of hip and knee flexion
- Resolution by 16 hours
- VAS ≤ 4/10 with NSAIDs only

Different Levels = Different Transverse Processes



- Lower thoracic TPs = deeper
- Lower thoracic TPs = shorter
  - Non-existent at T12
- Lumbar TPs = deep
  - Lumbar plexus is very close by
- Curved-array transducer may be preferable for depths >5cm

Different Levels = Different Transverse Processes



ESP in LSCS – more investigation needed

Potential Advantages

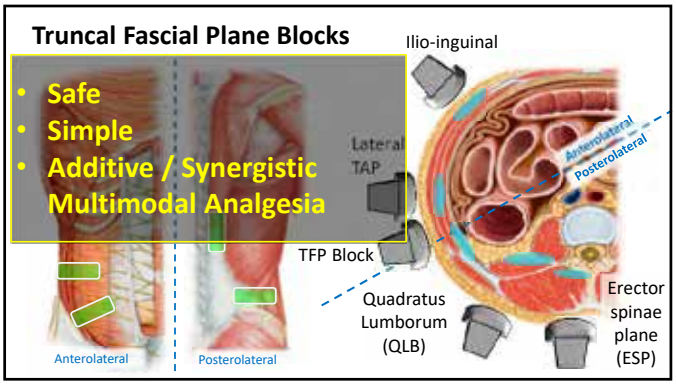
- Superior analgesia?
  - More reliable coverage?
  - Visceral analgesia?
  - Longer duration?
- Continuous catheter insertion
  - Safe
  - Unobtrusive

Potential Disadvantages

- Requires turning lateral
- Unclear what level it is best performed at
  - Technical considerations
  - Side-effects

Truncal Fascial Plane Blocks

- **Safe**
- **Simple**
- **Additive / Synergistic Multimodal Analgesia**



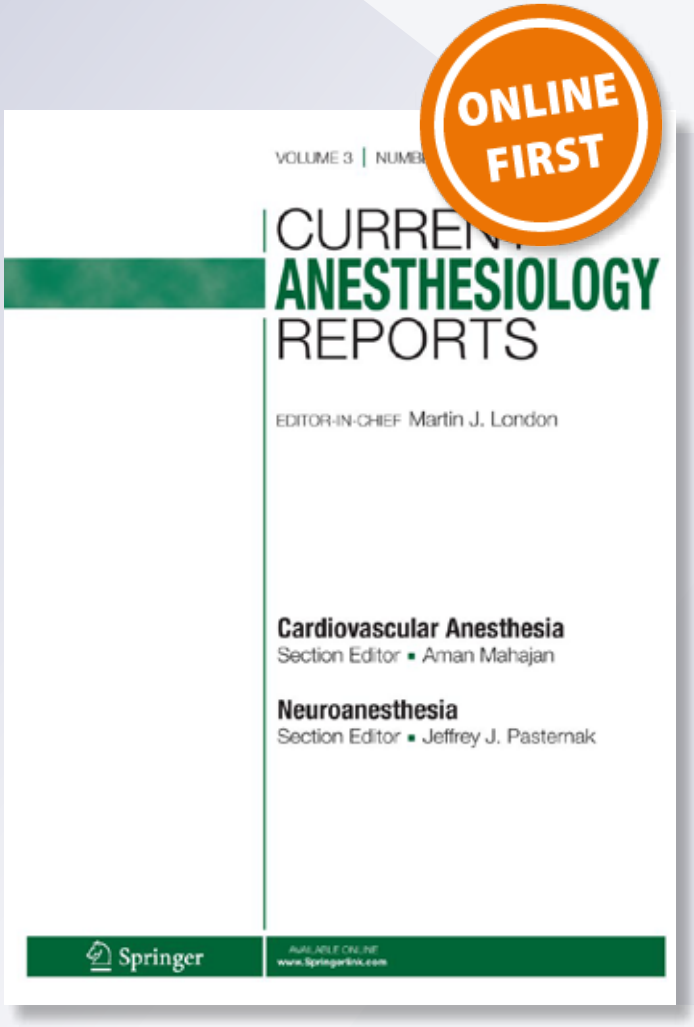
Anesthetic Considerations in the Care of the Parturient with Obesity

Jaime L. Daly & Vilma E. Ortiz

Current Anesthesiology Reports

e-ISSN 2167-6275

Curr Anesthesiol Rep
DOI 10.1007/s40140-019-00312-5



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https://doi.org/10.1007/s40140-019-00312-5

OBSTETRIC ANESTHESIA (LR LEFFERT, SECTION EDITOR)

Anesthetic Considerations in the Care of the Parturient with Obesity

Jaime L. Daly[1] · Vilma E. Ortiz[1]

Abstract

Purpose of Review The goal of this review is to summarize recent findings on the physiologic alterations posed by maternal obesity and implications for the anesthetic care of mother and infant.

Recent Findings Obesity is rising nationally and globally. Many studies show associations between excess weight during pregnancy with increased morbidity and mortality. Parturients with obesity are at a higher risk of endocrine, cardiac, pulmonary, and post-operative complications. A neuraxial catheter is recommended given the higher risk of an operative delivery. Consultation by an obstetric anesthesiologist is helpful for patient education and planning.

Summary Maternal mortality is the highest in the USA compared to other high-income countries. Understanding the association between obesity and maternal morbidity and mortality is critically important. The obstetric anesthesiologist can improve care by understanding not only the patient's medical needs, but also anticipating complications and having appropriate equipment available. Multi-disciplinary care optimizes outcomes.

Keywords Maternal obesity · Maternal mortality · Obesity · Cesarean delivery · Obstetric anesthesia

Introduction

Between 1980 and 2013, the worldwide rates of overweight and obesity have increased by 28% in adults and 47% in children [1]. This excess weight is often categorized on the basis of body mass index (BMI)—a calculation of weight in kilograms divided by height in square meter (see Table 1) [2, 3]. According to 2014 data from the World Health Organization (WHO), there are 1.9 billion adults, 18 years and older, who are overweight. Globally, 11% of the adult males and 15% of adult females are affected by obesity [4]. In the USA, 2013–2014 data from 5455 adults who participated in the National Health and Nutrition Examination Survey (NHANES) revealed that 35.0% of men had a BMI $\geq$ 30 and 5.5% had a BMI $\geq$ 40. Among adult women, 40.4% were found to have a BMI $\geq$ 30 and 9.9% had a BMI $\geq$ 40. This prevalence is unchanged since 2005 among men and represents a slight increase in obesity among women [5].

Focusing on women of reproductive age, current estimates show that more than 20% of women in the world have obesity (BMI $\geq$ 30) [6•]. As there is no pregnancy-specific definition of obesity, pregnant women are determined to be affected by overweight or obesity based on their pre-conception BMI. While obesity in Asian countries remains around 10% [6•], the European Peristat Database revealed that 30–37% of women had a pre-pregnancy BMI in the overweight and obese categories [7]. Among women giving birth in the USA in 2014, more than 50% were overweight or had obesity prior to pregnancy. This continuing upward trend of obesity is concerning as it affects the wellbeing of the woman and baby during gestation, but also impacts their long-term health.

Obesity and Maternal Mortality

Worldwide, maternal mortality rates have been declining. In contrast, recent decades have seen an increase in maternal mortality in the USA. This rise means that, compared with other high-income countries, the USA currently has the highest rate of maternal mortality [8, 9]. Parturients with obesity may have twice the risk of mortality, which is alarming given the high percentage of US women affected by obesity.

Section Editor: LR Leffert

This article is part of the Topical Collection on *Obstetric Anesthesia*

✉ Vilma E. Ortiz
vortiz@mgh.harvard.edu

[1] Department of Anesthesia, Critical Care & Pain Medicine, Massachusetts General Hospital, 55 Fruit St., Boston, MA 02114, USA

Published online: 18 January 2019

Table 1 BMI classifications [2, 3]

Normal BMI	BMI 18.5–24.9 kg/m^2
Overweight	BMI 25–29.9 kg/m^2
Class I obesity	BMI 30–34.9 kg/m^2
Class II obesity	BMI 35–39.9 kg/m^2
Class III obesity	BMI > 40 kg/m^2

Although a clear link between obesity and maternal mortality is ill defined, the assumption is that the presence of significant obesity-related conditions during gestation may portend greater mortality. Such associated comorbidities include hypertensive disorders (which include preeclampsia and eclampsia), cardiomyopathy, cardiovascular conditions [10•], and diabetes [11]. Women with obesity are also at a higher risk of postpartum hemorrhage and sepsis [11].

A large Swedish population-based study found an association between maternal BMI > 35 and maternal hypertension, preeclampsia, gestational diabetes, cesarean delivery, and stillbirths [12]. More recently, a retrospective cohort study spanning a 10-year period (2004–2013) in the state of WA examined the association between pre-pregnancy BMI and severe maternal morbidity. Class III obesity increased the likelihood of sepsis, acute renal failure, shock, and cardiovascular and cerebrovascular events [13••]. BMI > 45 has been associated with an increase in post-cesarean complications, including wound infection and post-partum emergency department visits [14]. Understanding this relationship between excess adiposity and morbidity is crucial as it may signify a risk of mortality not only during pregnancy but also long-term [15].

Obesity is more prevalent in non-Hispanic American Indian/Alaska Native women, non-Hispanic black women, and those whose payment source are Medicaid [16], which may partly explain the disparity in maternal deaths by race and ethnicity. Nationally, black women are 2.6 times more likely to die during childbirth compared to white women; non-Hispanic American Indian/Alaska Native women have almost twice the maternal mortality rate of white parturients [17]. This association between maternal obesity and mortality is critically important, as it is potentially preventable through improvements in pre-conception health, prenatal care, and optimization of medical care [18].

Obesity's Impact on Maternal Health

Key to understanding the myriad health implications of excess adiposity is recognizing that beyond its role in energy flux, adipose tissue, particularly visceral fat, is a complex endocrine organ [19]. Its cell-signaling proteins (adipokines) can affect metabolic and inflammatory pathways and are known to impact several obesity-related conditions such as insulin resistance and hypertension [20].

Gestational Diabetes

In a meta-analysis of 20 studies, Chu et al. reported that the unadjusted odds ratio (OR) of developing gestational diabetes (GDM) was 2.1 (95% confidence interval (CI) 1.8–2.5), 3.6 (3.1–4.2), and 8.6 (5.1–16.0) among women with overweight, obesity, and severe obesity compared with normal-weight pregnant women, respectively [21]. GDM may be a harbinger of increased susceptibility to glucose intolerance and cardiovascular risk later in life. When a group of women previously affected by GDM were compared with a group of healthy controls 5-year post-partum, the GDM group had higher glucose concentrations during an oral glucose tolerance test, lower adiponectin, and increased levels of C-reactive protein—all markers of a heightened state of inflammation [22].

Pregnancy-Related Hypertension

Excess adiposity is a risk factor for pregnancy-related hypertension (PRH), including preeclampsia [23••]. In a systematic review of 13 cohort studies conducted between 1980 and 2002, O'Brien et al. noted that each 5–7 increment in pre-pregnancy BMI led to a doubling of the risk of preeclampsia [24]. This relationship remains even after controlling for confounders such as chronic hypertension, diabetes, and multiple gestations. Compared to women who were normotensive during gestation, a history of PRH increases the likelihood of hypertension and cerebrovascular disease later in life [25, 26]. Other cardiac manifestations of PRH include left ventricular hypertrophy, concentric remodeling, diastolic dysfunction [27], as well as atrial fibrillation/flutter (AF) [28, 29]. The associations between PRH and long-term chronic disease later in life further illustrates that PRH is not just a disorder of pregnancy.

Sleep-Disordered Breathing

Sleep-disordered breathing (SDB) is a general term for breathing difficulties during sleep. It covers several conditions ranging from loud snoring to obstructive sleep apnea (OSA), which is the most common form of SDB. The prevalence of obstructive sleep apnea (OSA) in pregnant women is difficult to estimate given the paucity of epidemiologic studies utilizing objective measures such as polysomnography. However, several recent studies estimate that 10–30% of pregnant women are affected by OSA [30, 31]. OSA is associated with an increased risk of PRH, diabetes, and adverse myocardial and cerebrovascular events as well as in-hospital death [32, 33••, 34, 35]. Although commonly used OSA screening tools are not predictive of OSA in the parturient, BMI > 35, falling

asleep while speaking, and hypertension had a good correlation with OSA [36]. In a recent prospective study involving women in early and mid-pregnancy, BMI and frequent snoring were found to be predictive of SDB [37]. Parturients deemed at high risk for OSA should be referred for polysomnography, the gold standard for diagnosis. If the findings confirm the diagnosis of OSA, treatment with continuous positive airway pressure (CPAP) should be initiated.

Pregnancy-associated, non-allergic rhinitis affects approximately 18–42% of pregnant women [38, 39]. The resulting mucosal hyperemia manifests as nasal congestion resulting in an increase in nasopharyngeal resistance [40, 41], which can contribute to obstructed breathing. Excess neck and oropharyngeal fat deposition; pregnancy-associated, non-allergic rhinitis; and OSA can all contribute to SDB in the parturient.

Venous Thromboembolism

Venous thromboembolism (VTE) during gestation is a leading cause of maternal morbidity and mortality in the developed world. It can present at any point during gestation or the post-partum period as deep-venous thrombosis (DVT) and or a pulmonary embolism (PE). Obesity in early pregnancy was associated with an increased risk of VTE (adjusted OR, 5.3; 95% CI, 2.1–13.5) in a Danish nested case-control study involving more than 71,000 women. The odds ratio was adjusted for age, parity, clomiphene citrate stimulation, and diabetes [42]. The state of chronic inflammation, heightened oxidative stress, and predisposition for venous stasis that characterize obesity [43] combine with the hypercoagulable state of pregnancy to place the parturient with obesity at higher risk for VTE compared to non-obese pregnant women.

Increased Risk of Cesarean Delivery

According to the CDC, 31.9% of all births are via cesarean delivery (CD), including primary, repeat and unplanned CDs [44]. Kominiarek et al. sought to assess the impact of BMI on the risk for CD in laboring parturients. They performed a retrospective review of 124,389 deliveries in which the BMI and delivery route were recorded. CD rate was understandably highest in patients with prior CDs. Interestingly, the CD rate in nulliparous women with BMI of 40 was 42%. Also, the CD rate in all groups (nulliparas, multiparas without prior CD, and multiparas with prior CD) was higher in the group with a BMI > 40 [45]. Sturm et al. showed that class I–III obesity is increasing at a higher rate than normal weight and overweight in the USA; therefore, future analysis of CD risk in patients affected by BMIs > 40 merits further analysis [46].

Maternal Obesity's Impact on Neonatal Health

The offspring of women with high BMI is also at risk for adverse outcomes. In addition to a higher incidence of spontaneous and medically indicated pre-term delivery [47–49], maternal obesity has been linked to macrosomia (fetal weight > 4000 g), shoulder dystocia, late fetal death, and congenital malformations [12, 50–52]. A recent Swedish population-based cohort study examined 2001–2014 data from 1.2 million live born singletons in order to estimate the risks of major congenital malformations according to maternal BMI in early pregnancy. A total of 43,550 (3.5%) offspring had any major congenital malformation. Compared with offspring of normal-weight mothers (risk of malformations 3.4%), the proportions and adjusted risk ratios (95% CI) of any major congenital malformation among the offspring of mothers with excess adiposity were overweight, 3.5% and 1.05 (95% CI 1.02 to 1.07); obesity class I, 3.8% and 1.12 (95% CI 1.08 to 1.15), obesity class II, 4.2% and 1.23 (95% CI 1.17 to 1.30); and obesity class III, 4.7% and 1.37 (95% CI 1.26 to 1.49) [53].

In a retrospective study of 3029 children with cerebral palsy, Villamor et al. observed that, compared with children of normal-weight mothers, the adjusted hazard ratio (HR) of cerebral palsy was 1.22 for overweight, 1.28 for obesity class I, 1.54 for obesity class II, and 2.02 for obesity class III [54]. Although an association was noted in this retrospective epidemiologic study, the possible mechanisms underlying a potential link between excess maternal adiposity and cerebral palsy in their offspring are unclear. Additionally, some studies speculate that maternal obesity is also linked to behavioral disorders such as autism spectrum disorders, hyperactivity, and ADD [55, 56]. The uterus is the environment of the fetus for 9 months. We are beginning to learn how obesity and its related conditions (insulin resistance, heightened state of inflammation, and oxidative stress) alter the uterine environment to effect changes in the DNA structure and function resulting in altered gene expression, repair, and pathologic changes in childhood and adult life [57].

Pre-conception Counseling

Mothers-to-be with obesity are predisposed to obesity and metabolic disorders after delivery, and thus are at a higher risk of complications in future pregnancies. Part of the increased risk stems from the difficulty in losing excess weight gained during pregnancy. Her offspring is likely to be affected by childhood obesity and metabolic dysfunction, thus perpetuating the cycle of obesity and metabolic disease [58, 59]. This underscores the importance of appropriate pre-conception and early pregnancy counseling on appropriate nutrition and recommendations for gestational weight gain. In 2009, the

Institute of Medicine published its updated gestational weight gain guidelines (Table 2), which call for less weight gain for pregnant women with obesity [60].

For certain patients, weight-loss surgery represents the best option for losing excess weight. In a meta-analysis of 20 cohort studies evaluating the impact of bariatric surgery on pregnancy-related outcomes, Kwong et al. found that, despite several benefits, weight-loss surgery was not devoid of risk. The 8364 subjects who had bariatric surgery revealed a reduction in GDM (OR 0.21; 95% CI 0.12–0.36), large babies—a composite of large for gestational age and macrosomia (OR 0.35; 95% CI 0.19–0.62)—all hypertensive disorders (OR 0.38; 95% CI 0.27–0.53), post-partum hemorrhage (OR 0.32; 95% CI 0.08–1.37), and cesarean section rates (OR 0.63; 95% CI 0.39–1.02). On the other hand, the authors noted an increase in small babies—a composite of small for gestational age and intrauterine growth restriction (OR 2.18; 95% CI 1.41–3.38) and pre-term deliveries (OR 1.33; 95% CI 1.01–1.75). Not surprisingly, when compared to restrictive surgeries (e.g., vertical banded gastroplasty), malabsorptive procedures resulted in a greater increment in small for gestational age infants and a higher reduction in large for gestational age infants [61]. Contributing factors to these adverse perinatal outcomes includes surgical complications (e.g., small-bowel herniation) as well as micronutrient deficiencies associated with bariatric surgery, particularly malabsorptive procedures [62].

Monitoring and Access

Monitoring considerations on labor and delivery involve two patients: the mother and fetus. Maternal non-invasive blood pressure can be difficult to obtain in patients with very large and/or conically shaped arms due to improper blood pressure cuff fit. If using alternative sites (such as the forearm) is not feasible, then invasive blood pressure monitoring may be necessary. Obtaining intravenous access can be facilitated by the use of ultrasound guidance.

Intrapartum electronic fetal heart rate (FHR) and uterine contraction (UC) monitoring are commonly done externally. In patients with excess abdominal adiposity, both signals are subject to distortion, making it necessary to use internal monitoring: fetal scalp electrode and intrauterine pressure transducer. In addition to a risk of maternal and fetal infection, the use of these modalities is limited to patients whose cervix is dilated, after rupture of membranes.

Anesthetic Considerations

Pre-anesthetic Considerations

Providing care to patients with obesity on the labor and delivery floor presents many technical challenges: difficulty with monitoring, intravenous (IV) access, neuraxial placement, and airway management. As these are seldom discussed in advance with patients, a consultation with an anesthesiologist prior to admission to labor and delivery can be invaluable. It allows the anesthesiologist and the patient to engage in conversation regarding possible challenges she may face during her labor and delivery. The anesthesiologist can provide education to the patient about various anesthetic concerns such as the importance of timely neuraxial catheter placement. Consultation can allow for specific testing (such as a transthoracic echocardiogram—TTE) to be completed before admission.

Neuraxial Considerations

The OB anesthesiologist cares for patients on the labor and delivery floor in many ways, but our most common interaction involves managing the neuraxial labor analgesia and cesarean delivery anesthesia. Neuraxial techniques for relief of labor pain include epidural catheter, including dural puncture epidural; intrathecal catheter; and combined spinal-epidural (CSE) analgesia. Irrespective of which option is chosen, increased adipose tissue can obscure helpful anatomic landmarks. Edward et al. studied patients undergoing lumbar puncture in a neurology clinic and found that, of the multiple factors that could contribute to difficult lumbar punctures, BMI was the only factor that had an inverse correlation with success [63]. Ultrasound guidance can help overcome this challenge. Sahin et al. demonstrated in 100 parturients, 50 non-obese (BMI < 30), and 50 with obesity (BMI ≥ 30), that a lower number of puncture attempts was required when

Table 2 Recommendations for weight gain during pregnancy, based on pre-pregnancy body mass index (BMI) [60]

Pre-pregnancy BMI	BMI (kg/m^2)	Total weight gain range (lbs)	Weight gain* in the second and third trimesters (lb) (mean range [lb/week])
Underweight	< 18.5	28–40	1 (1–1.3)
Normal	18.5–24.9	25–35	1 (0.8–1)
Overweight	25.0–29.9	15–25	0.6 (0.5–0.7)
Obesity (includes all classes)	≥ 30.0	11–20	0.5 (0.4–0.6)

*Calculations assume a 0.5–2 kg (1.1–4.4 lbs) weight gain in the first trimester

ultrasound was used in both groups of patients [64]. Ultrasound can also be used to estimate the depth to the epidural space in patients with obesity using either the transverse or paramedian approach [65]. There is some anecdotal evidence that as an anesthesiologist becomes more familiar with caring for patients with obesity, these failure rates can be reduced.

Barring any contraindications or patient refusal, neuraxial anesthesia (either spinal, epidural, or CSE) is the preferred anesthetic for cesarean delivery; general anesthesia is reserved for emergencies. When choosing the neuraxial block in a patient with obesity, the most important consideration is the length of the procedure [66]. Utilizing primary cesarean delivery data (singleton gestation) from the Maternal-Fetal Medicine Units Network Cesarean Registry, Girsen et al. found that increasing BMI was related to increased incision to delivery interval and total operative times, specifically in women whose BMI exceeded 40 [14, 67]. Patients with obesity are more likely to have a vertical skin incision or classical uterine incision, which can affect not only length of time in the operating room but also post-operative pain management [14].

Spinal Anesthesia

A spinal anesthetic may involve a single injection of both local anesthetic and opioid into the subarachnoid space or leaving a catheter in the subarachnoid space (continuous spinal anesthesia). The advantages of a single-shot spinal are that it provides a dense and reliable block with a minimal risk of post-dural puncture headache (PDPH) if a small gauge (25–27), pencil point needle is used. Disadvantages include limited duration of action and increased likelihood of cephalad spread in patients with obesity, particularly when the BMI $\geq$ 50 [68, 69]. A spinal catheter has the advantage of extending the duration of the anesthetic but has the risk of causing a PDPH. PDPH may be less likely in parturients who do not push before delivery and those with a BMI $\geq$ 50 [70].

Epidural Anesthesia

Typically placed to provide labor analgesia, an epidural catheter provides the option of prolonging the anesthetic to meet the duration of the surgery. Another advantage is its potential use to deliver post-operative analgesia. Common downsides include incomplete sacral coverage and catheter failure. Kula et al. completed a 12-month retrospective analysis correlating BMI with labor epidural procedure difficulty and analgesia failure. They found an increased rate of difficulty and catheter failure of 2.5- and 2.1-folds, respectively [71]. These difficulties were attributed to technical challenges during placement, specifically attempts at multiple lumbar levels and challenges in maintaining labor analgesia resulting in more clinician boluses. Dysfunctional labor could not be ruled out as a cause of increased clinician bolus requirements.

Combined Spinal-Epidural Anesthesia

A combined spinal-epidural (CSE) integrates the advantage of the rapid onset, reliable subarachnoid block with the flexibility of dosing the epidural catheter in case of a prolonged surgical procedure. Thus, it is our recommended anesthetic for cesarean delivery in this patient population. The spinal injection acts as the primary anesthetic and its sensory level should be followed closely during cesarean delivery. The epidural can be dosed with lidocaine or chloroprocaine if intraoperative supplementation is needed. The most likely time for breakthrough pain during cesarean delivery is upon entering the fascia or with uterine manipulation. These triggers of pain cannot be tested pre-emptively with either a spinal or primary epidural prior to incision. Additionally, a CSE provides confirmation that the catheter is in the correct anatomic location, reducing the chance of neuraxial failure [72].

Though it may seem that performing a CSE may take longer than placing a spinal anesthetic, a 2014 study by Ross et al. found no difference in mean time for placement of a spinal and placement of a CSE [73]. A potential disadvantage of the CSE is delayed recognition of a non-functioning epidural catheter. However, a retrospective review of 2395 anesthetic, obstetric, and quality assurance records reported a 6.6% epidural catheter failure rate for CSE compared to a failure rate of 11.6% for epidural catheters [72].

Airway Management

The risk of aspiration has always been a concern for the obstetric anesthesiologist. Although pregnancy itself does not result in delayed gastric emptying [74], pain (e.g., labor) and the use of opioids slow down gastric emptying; therefore, a laboring patient, regardless of BMI, is at risk for aspiration during induction of a general anesthetic. Wong et al. demonstrated that gastric emptying did not differ in non-laboring pregnant patients with obesity compared to pregnant patients with normal weight [75]. Thus, the same fasting guidelines used in the general adult population should be applied to pregnant women regardless of BMI.

Respiratory changes accompanying obesity as well as pregnancy adversely impact pulmonary mechanics [41]. The higher rate of oxygen utilization characteristic of these states, coupled with a decrease in lung volume resulting from reduced chest wall compliance and cephalad displacement of the diaphragm, reduces functional residual capacity (FRC). This decrease in FRC, as well as an increase in oxygen consumption of 30–60%, can exacerbate nocturnal hypoxemia

and account for the rapid arterial oxygen desaturation during apnea.

Patients with obesity are at risk of being more difficult to ventilate and intubate; pregnancy further complicates this situation. Difficulty is attributed to multiple factors: failure to align the pharynx and larynx, progesterone mediated edema of the airway, and enlarged breast tissue (making a short handled laryngoscope necessary). It is twice as common to be unable to visualize the larynx in parturients with obesity compared to non-obese parturients [76]. Proper patient positioning is a pivotal component of successful laryngoscopy. The head-elevated position (e.g., ramp or reverse Trendelenburg) for patients with obesity has been shown to be advantageous for improving the Cormack and Lehane scores [77]. Video laryngoscopy may decrease the risk of failed airway management in pregnant women with obesity [78].

Conclusion

The global trend towards excess adiposity touches all aspects of the medical care of the affected parturient. Understanding obesity's impact on each physiologic system—notably cardiovascular and respiratory function—as well as the fetus is pivotal in tailoring the anesthetic management to meet the needs of this growing segment of the population. Ideally, the anesthetic care of those with severe obesity (e.g., BMI > 50) and/or significant comorbidities should begin with an antenatal anesthetic consultation. A multi-disciplinary team approach is likely to result in medical optimization and allow each team to make necessary preparations prior to the patient's admission to the maternity unit.

Extending beyond the patient–caregiver interaction, as our society's waistline continues to expand, it is important to provide an environment that supports the medical needs of patients with obesity and the safety of the caregiver. This entails knowledge and implementation of facilities and equipment design considerations that allow the provision of safe care. A detailed discussion of this topic is beyond the scope of this article and has been recently reviewed elsewhere [79]. Specific to the anesthetic management of the high BMI parturient, it is imperative that all equipment found in the general operating rooms for the management of difficult IV and neuraxial placement (ultrasound device with a variety of probes—curvilinear, vascular, and TTE, an assortment of neuraxial needle lengths) as well as the management of a difficult airway (e.g., difficult airway cart with fiberoptic scope and video laryngoscopy) be available to the labor and delivery unit. Team-based care and preparedness when possible are critical in ensuring that parturients with obesity have the safest outcomes during their labor and delivery.

Compliance with Ethical Standards

Conflict of Interest Jaime L. Daly and Vilma E. Ortiz declare they have no conflict of interest.

Human and Animal Rights and Informed Consent This article does not contain any studies with human or animal subjects performed by any of the authors.

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- •• Of major importance

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Abstract #: T2A-170

Primary Choice of Laryngoscopy Blade & Risk of Difficult Intubation in Parturients undergoing Cesarean Delivery

Presenting Author: Justin Morello MD
Presenting Author's Institution: Ochsner Clinic Foundation - Jefferson, LA
Co-Author: Kirbie Broughton MD - Ochsner Clinic Foundation
Allison Clark MD - Ochsner Clinic Foundation
Andrew King n/a - Ochsner Clinical School
Bobby Nossaman MD - Ochsner Clinic Foundation

Introduction: Securing the parturient airway in a safe and timely manner is essential during general anesthesia for cesarean delivery. The goal of any therapeutic intervention is to increase the probability of success or decrease the probability of harm. These probabilities are expressed as ratios or as risks in which the outcome event is compared in one or more groups (1). The purpose of this study was to calculate the odds ratios and relative risk of difficult intubation during primary laryngoscopy with the use of three commonly available laryngoscopy blades: Miller, Macintosh, or videolaryngoscope. Difficult intubation is defined as more than two attempts at securing the maternal airway or an exchange to a different airway tool during this process (2).

Methods: Following institutional review board approval, data from 468 electronic medical records in parturients undergoing general anesthesia for cesarean delivery were extracted over a 6-year period. Key associations, odds ratios, and relative risks included 95% confidence intervals (CI). The role of these blades used during primary laryngoscopy on the incidence of modified Cormack-Lehane views and on the incidence of difficult intubation were analysed with statistical tests set at the more stringent P<.005 value to minimize the risk of false discovery rates (3,4).

Results: The incidence of difficult intubation was 4.2% (CI 2.7-6.5%) with three failed intubations recorded (airways managed with LMA or mask ventilation). When the modified Cormack-Lehane views observed during primary laryngoscopy were grouped into III & IV versus I & II cohorts; there were no significant differences in the incidence of difficult laryngoscopic views (II I& IV) provided by the type of blade (Macintosh: 4 CI 2-9%; Miller: 6 CI 3-10%; Videolaryngoscopy: 4 CI 2-10%; P=.7738). However, odds ratios and relative risks for difficult intubation were dependent on the type of blade used during primary laryngoscopy (Table 1).

Discussion: This analysis suggests that although similar incidences of modified Cormack-Lehane III & IV laryngoscopic views were provided by these three blades; Miller blade laryngoscopy provided the lowest odds ratio and relative risk for difficult intubation during general anesthesia for cesarean delivery.

Table 1: Incidence of Difficult Orotracheal Intubation by Laryngoscopy Blade

Macintosh Laryngoscopy

	Difficult Intubation				
Count (%)	**Yes**	**No**	**P value**	**OR CI**	**Relative Risk CI**
Modified Cormack-Lehane III&IV	2 (50)	2 (50)	.0026	53 [5-590]	27 [5-147]
Modified Cormack-Lehane I&II	2 (2)	107 (98)			

Miller Laryngoscopy

	Difficult Intubation				
Count (%)	**Yes**	**No**	**P value**	**OR CI**	**Relative Risk CI**
Modified Cormack-Lehane III&IV	2 (17)	10 (83)	.0214	13 [2-85]	15 [3-67]
Modified Cormack-Lehane I&II	3 (2)	192 (98)			

Videolaryngoscopy

	Difficult Intubation				
Count (%)	**Yes**	**No**	**P value**	**OR CI**	**Relative Risk CI**
Modified Cormack-Lehane III&IV	2 (50)	2 (50)	.0162	18 [2-152]	18 [2-150]
Modified Cormack-Lehane I&II	5 (5)	88 (95)			

OR: odds ratios; CI: 95% confidence intervals; P<.005 is statistically significant.

References

Lang 2006

Rose 1994

Colquhoun 2014

Benjamin 2018

Abstract #: T2A-197

Anesthetic and obstetric predictors of general anesthesia in urgent or emergent cesarean delivery: a retrospective case-control study

Presenting Author: Kristi Downey MSc
Presenting Author's Institution: Department of Anesthesia and Pain Management, Mount Sinai Hospital, University of Toronto - Toronto, Ontario
Co-Author: Gita Raghavan MD - Department of Anesthesia and Pain Management, Mount Sinai Hospital, University of Toronto
Naveed Siddiqui MD, MSc - Department of Anesthesia and Pain Management, Mount Sinai Hospital, University of Toronto
Wendy Whittle MD, PhD - Department of Obstetrics and Gynecology, Mount Sinai Hospital, University of Toronto
Xiang Y. Ye MSc - Maternal-Infant Care Research Centre, Mount Sinai Hospital
Jose Carvalho MD, PhD - Department of Anesthesia and Pain Management, Mount Sinai Hospital, University of Toronto

Introduction: Regional anesthesia (RA) is preferable to general anesthesia (GA) for cesarean delivery (CD). Use of GA in the pregnant woman is associated with increased maternal and neonatal morbidity.1 While RA is the preferred anesthetic technique for CD, GA may be necessary in certain situations. We sought to systematically evaluate current practices on our labour and delivery unit to identify anesthetic and obstetric predictors that may be modified to reduce our rates of GA for CD.

Methods: This was a retrospective, case-control study. Women undergoing urgent/emergent CD from January 1, 2015 to December 31, 2017 were identified. Of all women who received GA for urgent/emergent CD, 97 were selected at random, stratified by year; a corresponding control group was randomly selected of women who received RA for urgent/emergent CD, also stratified by year. Data included patient characteristics, pre-existing comorbidities, primary obstetric indication for CD, timing of events around delivery, post-partum complications, and neonatal outcomes. Specific anesthetic data included type of anesthetic administered, indication for specific anesthetic, and pertinent characteristics of airway management (GA group) and epidural analgesia in situ (RA group). Anesthetic and obstetric predictors of GA were examined using both univariate and multivariable analyses.
Results: 7282 CD were performed during the study period, of which 3681 were urgent/emergent (50.5%). Of all urgent/emergent CD, 254 were done under GA (6.9%). Non-reassuring fetal heart rate (NRFHR) was the most common obstetric indication for urgent/emergent CD amongst the cases (40%) and controls (40%). Amongst the cases, GA administration was most commonly due to "limited time due to maternal/fetal compromise" (56%), followed by "maternal contraindication to RA" (25%) and "inadequate RA" (17%) (Table 1). Possible anesthetic and obstetric predictors for GA for CD included primigravida ($p=0.004$), lower gestational age ($p<0.001$), ASA >2 ($p<0.001$), NRFHR ($p=0.03$), cord/fetal prolapse ($p=0.0009$), and Code 77 ("maternal/fetal emergency") activation ($p=0.0016$).

Conclusion: Identification and timely interdisciplinary communication of risk factors leading to NRFHR and cord/fetal prolapse may allow for advance anesthetic planning and avoidance of GA for urgent/emergent CD. Opportunities to improve technical aspects and surveillance of regional anesthesia should also be sought.

References:
1IJOA 2011;20;10-16

Table 1. Anesthetic indications for general anesthesia in urgent or emergent cesarean delivery

Limited time due to maternal/fetal compromise	**54**
Non-reassuring fetal heart rate:	39
Sudden onset bradycardia/recurrent decelerations (n=31)	
Immediately following labour epidural placement (n=3)	
During fetal intrauterine transfusion (n=3)	
During attempted external cephalic version (n=2)	
Cord/fetal prolapse	13
Placental abruption	2
Maternal contraindication to neuraxial anesthesia	**24**
Pregnancy-related contraindication:	19
Thrombocytopenia (n=9)	
Anticoagulation given as in-patient (n=5)	
Obstetrical hemorrhage (n=4)	
Sepsis (n=1)	
Pre-pregnancy related contraindication:	5
Immune thrombocytopenic purpura (n=1)	
Von Willebrand disease (n=1)	
Hereditary dysfibrinogenemia (n=1)	
Dilated cardiomyopathy/pulmonary hypertension/CHF (n=1)	
Previous spine surgery and SCS in situ (n=1)	
Inadequate neuraxial anesthesia	**17**
Failure of in-situ epidural top-up:	14
Effective labour epidural with no top-ups in labour (n=6)	
CD within 1 hour of epidural placement (n=3)	
Epidural requiring ≥3 top-ups during labour (n=2)	
Parturient with 3 resited epidurals (n=1)	
Morbidly obese parturient (BMI 51) (n=1)	
5/10 pain score documented 30 mins prior to CD (n=1)	
Failure of neuraxial anesthesia initiated in the OR:	3
Attempted spinal insertion unsuccessful (n=1)	
Inadequate block noted after skin/fascia opened (n=1)	
Excess muscle tension interfering with surgical closure (n=1)	
Need for intraoperative conversion to GA:	**2**
Invasive Placenta	2

CD = cesarean delivery; CHF = congestive heart failure; SCS = spinal cord stimulator; BMI = body mass index

Abstract #: T2A-237

A case-series describing analgesic approaches in women receiving general anesthesia for cesarean delivery

Presenting Author: Ben Shatil MD
Presenting Author's Institution: Columbia University Medical Center - New York , NY
Co-Author: Xiwen Zheng MD - Columbia University Medical Center
Bahaa Daoud MD - Columbia University Medical Center
Beatriz Corradini Msc - Columbia University Medical Center
Ruth Landau MD - Columbia University Medical Center

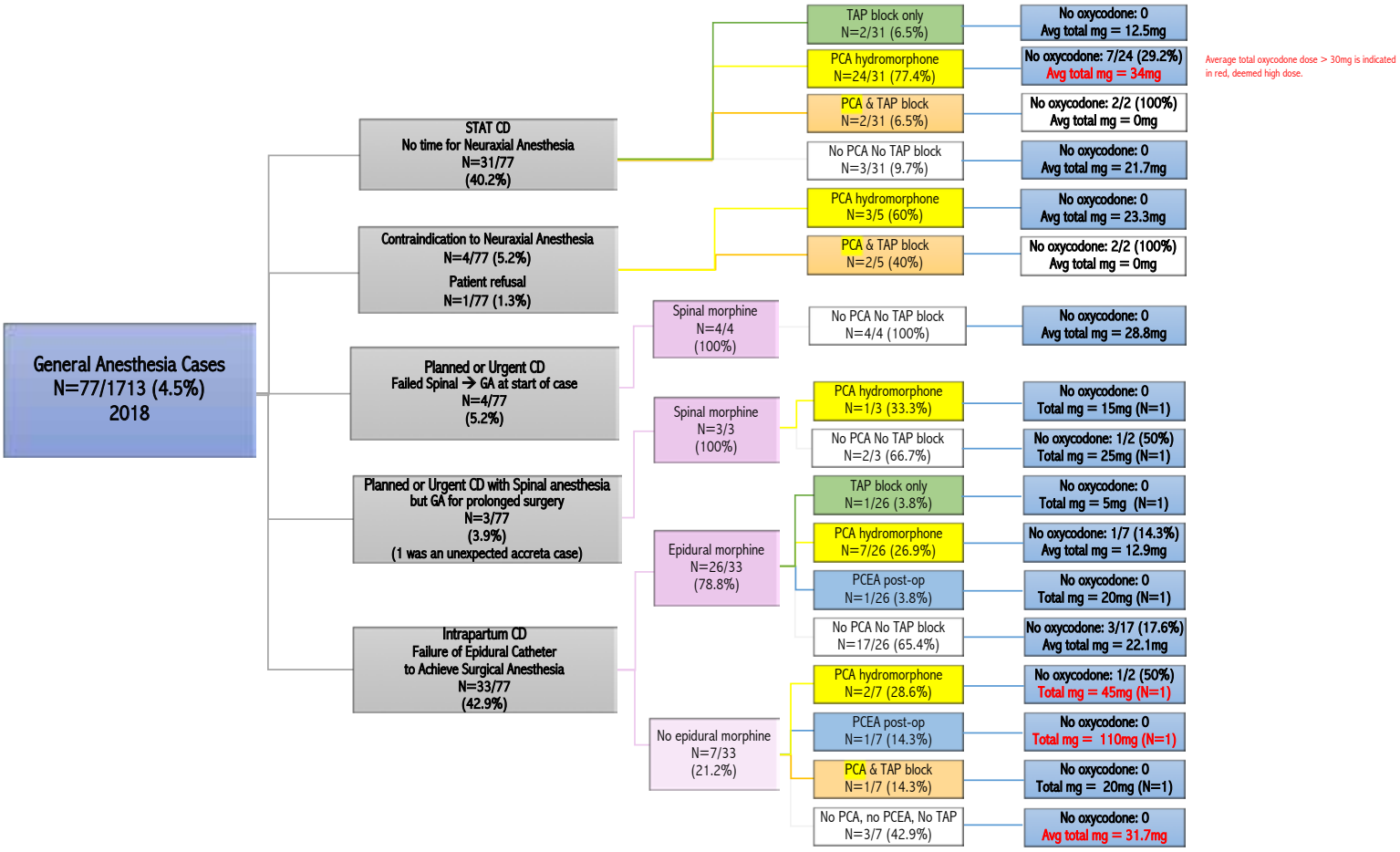
Introduction: Neuraxial anesthesia for cesarean delivery (CD) is performed in more than 95% of cases in academic centers in the US, which allows neuraxial opioids for post-CD analgesia to be provided. Circumstances leading to women receiving general anesthesia (GA) for CD are numerous and varied and for that reason, such cases are most often excluded from clinical studies evaluating pain outcomes and analgesic consumption. We believe that these women actually represent the outliers that may require enhanced analgesic modalities, and therefore decided to evaluate the circumstances for GA and subsequent analgesia management, in an attempt to find patterns that may guide protocols.

Methods: Using electronic anesthesia records, 1713 CD cases were identified during a 9-month study period in 2018, of which 77 (4.5%) received a GA. Circumstances leading to the GA were assessed (STAT, contraindication to neuraxial, patient refusal, failure of intrapartum epidural, failed spinal, spinal wearing off). Analgesia modalities (neuraxial morphine, TAP block, IV PCA hydromorphone, PO oxycodone use) were recorded for each case.

Results: The 2 most common circumstances for GA were failure of intrapartum epidural catheter to achieve surgical anesthesia (33/77; 42.9%) followed by emergent CD with no time for spinal (31//77; 40.2%) (Figure). Overall, 33 women (42.9%) received neuraxial morphine (26 epidural and 7 spinal). Most women with failed epidural anesthesia received epidural morphine (26/33; 79%), among those not receiving epidural morphine (N=6/33; 18.2%), 3 received no TAP, PCA or PCEA, and average in-hospital oxycodone use was 31mg. Overall, 42 women (29.5%) received IV PCA hydromorphone, and 9 women (11.7%) received a TAP block (of which 5 received both TAP and PCA). Among the 60 women (77.9%) taking oxycodone, the average dose was 25.4mg (± 34.6 SD). Only 4 women received no systemic opioids (no PCA or oxycodone), however all had received neuraxial morphine (3 epidural & 1 spinal).

Discussion: This descriptive analysis of all cases receiving GA in our institution in 2018 allowed us to identify that while opioid-sparing approaches for cases receiving neuraxial anesthesia are now robustly promoted, this is not yet the case when GA is provided. Only a handful of women received a TAP block, and 30% received IV PCA hydromorphone. Next steps will be to increase the use of TAP blocks or quadratus lumborum blocks.

Abstract #: T2A-237



Abstract #: T2A-283

Optimal time interval for preoxygenation in pregnant patients: Determination of the EI90 between high-flow nasal oxygen and standard facemask tidal volume preoxygenation using a biased-coin sequential allocation method

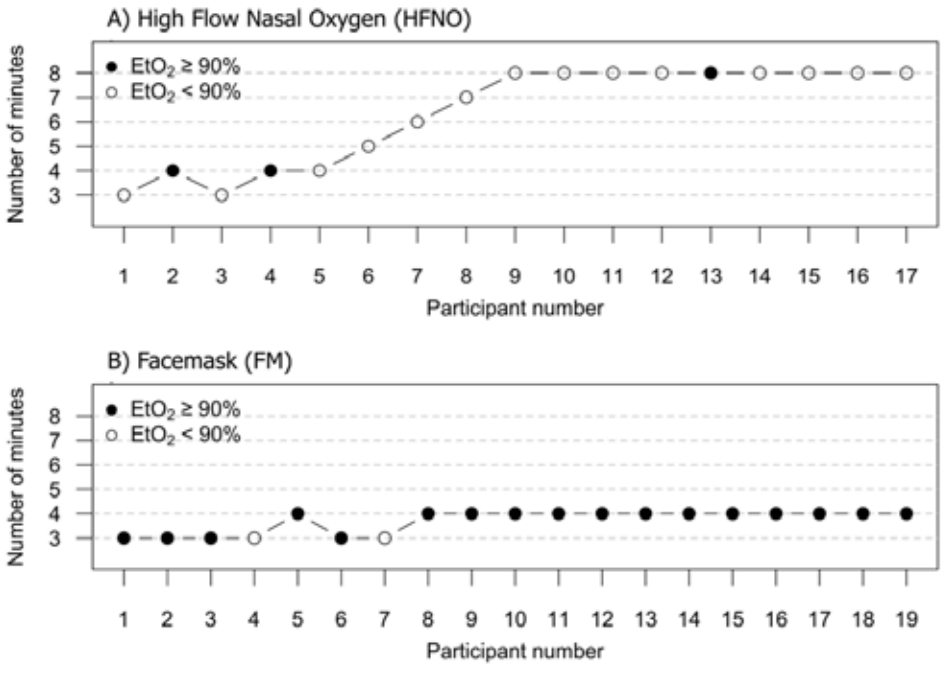
Presenting Author: Kelly L Au MD FRCPC
Presenting Author's Institution: BC Women›s Hospital, University of British Columbia - Vancouver, BC
Co-Author: William Shippam MBChB FRCA - BC Women's Hospital, University of British Columbia
James Taylor BSc - BC Women's Hospital, University of British Columbia
Arianne Albert PhD - BC Women's Hospital, University of British Columbia
Anthony Chau MD FRCPC MMSc - BC Women's Hospital, University of British Columbia

Introduction: After a fixed interval of 3 min of tidal volume (TV) breathing, high-flow nasal oxygen (HFNO) at 50-70L/min was found to be unreliable at achieving a mean end-tidal oxygen concentration (ETO2) ≥90% compared to standard facemask (FM) preoxygenation in pregnant patients. [1,2] Whether adequate preoxygenation could be achieved with HFNO using a longer interval is not currently known. We aimed to determine the optimal time interval for 90% of parturients (EI90) with TV breathing preoxygenation using either FM or HFNO for women undergoing elective cesarean delivery.

Methods: Following ethics committee approval and informed consent, healthy, term, non-laboring parturients received 100% oxygen (O2) via FM or HFNO (OptiflowTM). Patients were placed in ramped position with left uterine displacement. Baseline values were recorded after 30s of TV breathing of 21% O2 at 12 L/min. Patients then continued TV breathing of 100% O2 at 15 L/min via FM or 50L/min HFNO at a time interval determined using a 9:1 biased-coin sequential allocation design to determine EI90. The primary outcome was effective preoxygenation, defined as an ETO2≥90%. Secondary outcomes included proportion of patients achieving ETO2≥90, patient satisfaction and tolerance of the interventions.

Results: To date we studied 19 women on FM and 17 on HFNO. The estimated EI90 was 3.7 min (95% CI 3.4-6.3) for FM using isotonic regression analysis with pooled-adjacent-violators algorithm. The EI90 for HFNO could not be estimated as it reached a response plateau, but it is clear that 8 min is insufficient to achieve 90% EtO2 for most women. The mean(SD) ETO2 achieved was 90.5% (4.8%) for FM and 79.6% (9.2%) for HFNO. 15% of the patients in the HFNO could not tolerate the intervention. The proportion of patients reliably achieving ETO2 90% was 89.5% in FM and 17.6% in HFNO.

Discussion: The optimal time interval for TV preoxygenation in healthy parturients via FM is approximately 3.7 min. HFNO consistently failed to achieve ETO2≥90% and extending the time interval to 8 min does not lead to significant gain in ETO2 levels with the HFNO technique.



References:

1. Shippam et al Anaesthesia 2019
2. Tan et al BJA 2019

Abstract #: T2A-297

Airway Management for 377 Cesarean Deliveries Under General Anesthesia

Presenting Author: Adam Olson B.S.
Presenting Author's Institution: Texas A&M Health Science Center College of Medicine - Temple, TX
Co-Author: Grace Kohn N/A - Baylor University
Georgina Kolcun M.S. - Texas A&M Health Science Center College of Medicine
Vivianna Wu B.S. - Alabama College of Osteopathic Medicine
Courtney Shaver M.S. - Baylor Scott & White Health
Michael P Hofkamp M.D. - Baylor Scott & White Health

INTRODUCTION: In the SCORE study, D'Angelo and colleagues reported that failed intubation occurs as frequently as 1 out of every 533 cesarean deliveries (CD) under general anesthesia (GA)1. In 2013, our department liberalized our approach to GA for CD in response to a series of morbidity and mortality conferences where presented patients underwent CD with apparent inadequate analgesia. From 2014 to 2018, our department made capital investments in equipment that resulted in a greater availability of video laryngoscopes. Our primary aim was to determine how airways were ultimately secured when CD was performed under GA and our secondary aim was to report serious complications arising from airway management.

METHODS: Using a combination of our electronic medical record system and the official labor and delivery handwritten log of deliveries, we verified capture of every CD from July 1, 2014 to June 30, 2018. Demographic information for each CD as well as information on the mode of laryngoscopy, number of intubation attempts, how the airway was secured, and any complications were recorded.

RESULTS: 377 subjects had GA for CD; 364 of these subjects had complete data regarding airway management. 275, 89, and 3 subjects had airways that were ultimately secured with direct laryngoscopy (DL), video laryngoscopy (VL), and fast track laryngeal mask airway (LMA), respectively. Table 1 illustrates the use of direct and video laryngoscopy stratified by academic year. Complications included one aspiration that occurred during an emergent CD and one airway that wasn't secured until after delivery (a LMA was used as a temporizing measure). All airways were eventually secured with an endotracheal tube with no surgical airways.

DISCUSSION: Most of the airways in CD under GA were secured by DL with one attempt. The use of VL increased as equipment became more available. Fast track LMA was used to secure three airways; there is not enough data to determine if VL was available at the time. We had no failed airways and one aspiration; our study was not powered to measure serious complications. Further studies are needed with detailed data on airway management to determine best practices for CD under GA.

References:

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	2014-2015	2015-2016	2016-2017	2017-2018
Direct laryngoscopy attempted (rate)	73 (90.12%) (N=81)	82 (85.42%) (N=96)	74 (66.67%) (N=111)	45 (59.21%) (N=76)
Number of direct laryngoscopies (1,2,3)	69,3,0 (N=72)	72,9,0 (N=81)	67,5,2 (N=74)	44,1,0 (N=45)
Video laryngoscopy attempted (rate)	8 (9.88%) (N=81)	16 (16.67%) (N=96)	42 (37.84%) (N=111)	31 (40.9%) (N=76)
Number of video laryngoscopies (1,2,3)	8,0,0 (N=8)	13,2,1 (N=16)	38,4,0 (N=42)	30,1,0 (N=31)

Abstract #: T2A-317

Preoperative fasting times and patient experience for elective cesarean delivery – a quality improvement project using the Plan-Do-Study-Act method

Presenting Author: Natasha Clunies-Ross MBBS BSc FRCA
Presenting Author's Institution: BC Women›s Hospital, University of British Columbia - Vancouver, British Columbia
Co-Author: Joanne Douglas MD FRCPC - BC Women›s Hospital, University of British Columbia
James Brown MBChB (Hons) MRCP FRCA FRCPC - BC Women's Hospital, University of British Columbia
Roanne Preston MD FRCPC - BC Women's Hospital, University of British Columbia
Anthony Chau MD FRCPC MMSc - BC Women's Hospital, University of British Columbia

Introduction: The 2016 ASA Practice Guidelines for Obstetric Anesthesia, [1] and the ERAS Society guidelines for Antenatal and Preoperative care in Cesarean Delivery [2] suggest that women should be encouraged to drink clear fluids until 2h before and be able to eat a light meal up to 6h before elective surgery. In practice, we have observed that many women are often fasted longer than required, especially when emergency cases impact upon an elective operating list. The aim of this study was to use the Institute for Healthcare Improvement Plan-Do-Study-Act (PDSA) process [3] to evaluate preoperative fasting times for patients scheduled for cesarean delivery (CD) and to determine patient experience at our institution.

Methods: We conducted a prospective cross-sectional survey on patients scheduled for CD at our institution from September to November 2018. Each parturient was given an 8-item paper survey to complete on arrival to the preoperative unit on the day of surgery. Questions included time of last food and drink, fasting instructions received, experience of thirst, hunger or low energy levels and whether they thought time period for fasting was appropriate. Our primary outcome was the difference between instructed vs actual fasting time for liquids and solids analyzed by paired sample t-tests. Instructed fasting time was defined as the time interval in hours parturients were told to fast up until scheduled time of CD. Actual fasting time was defined as time fasted up until time of entry to the operating room. Secondary outcomes included patient satisfaction and perception on preoperative fasting instructions.

Results: 123 patients of a possible 200 were surveyed during the period; 77 patients refused to participate or were not approached due to language barrier. Full data for 102 patients were analyzed. There was a significant difference in mean instructed and actual fasting duration for liquids (6.6h vs. 8.5h, $p<0.00001$); and for solids (8.5h vs. 12.5h, $p<0.00001$). Immediately before surgery 51% of patients reported being thirsty, 52% were hungry, 16% reported low energy levels and 6% reported they were given unclear or conflicting fasting instructions. Approximately 25% of parturients also reported that fasting times for liquids and solids were too long.

Discussion: We found that parturients scheduled for CD at our institution were instructed and fasted for significantly longer than the recommended guidelines and that maternal experience was poor. Based on these findings, we aim to target preoperative staff to improve fasting information given to parturients, so they better align with current guidelines. We also intend to examine factors that delay patient entry to the operating room. A follow-up survey will be conducted to see if these interventions will lead to improved maternal experience.

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2. Wilson RD et al. AJOG 2018
3. Taylor, M et al. BMJ Qual Saf. 2014

Abstract #: T2A-346

General Anesthesia Rate and Use of Anesthetic Adjuncts for 3,143 Cesarean Deliveries

Presenting Author: Grace Kohn N/A
Presenting Author's Institution: Baylor University - Waco, TX
Co-Author: Adam Olson B.S. - Texas A&M Health Sciences Center College of Medicine
Georgina Kolcun M.S. - Texas A&M Health Science Center College of Medicine
Vivianna Wu B.S. - Alabama College of Osteopathic Medicine
Courtney Shaver M.S. - Baylor Scott & White Health
Michael P Hofkamp M.D. - Baylor Scott & White Health

Introduction: One institution reported a cesarean delivery (CD) under general anesthesia (GA) rate of less than one percent but did not report the use of anesthetic adjuncts that ostensibly facilitated this low rate1. In 2013, our department liberalized our approach to GA for CD in response to a series of morbidity and mortality conferences where presented patients underwent CD with apparent inadequate analgesia. Our primary aim was to report our GA for CD rate and our secondary aim was to report our use of anesthetic adjuncts for CD for a period of four academic years.

Methods: Using our institution's official handwritten labor and delivery unit log of deliveries, we verified capture of every CD from July 1, 2014 to June 30, 2018. For CD that did not undergo GA, data including anesthetic technique and use of anesthetic adjuncts including intravenous (IV) fentanyl, IV ketamine, and inhaled nitrous oxide was collected. A more detailed data collection was performed for subjects who underwent GA, which included demographic information, indication for GA, how the airway was secured, and serious complications.

Results: 3,143 CD were performed during the study period. 2640, 235, and 11 subjects appeared once, twice, and three times in the study, respectively. Our GA for CD rate for the entire study period was 11.99%. 147(4.68%), 315(10.02%), and 68(2.16%) of total CD received inhaled nitrous oxide, IV fentanyl, and IV ketamine, respectively, without GA. 65(2.07%) of CD received both inhaled nitrous oxide and IV fentanyl without GA. 16(0.51%) of CD received inhaled nitrous oxide, IV fentanyl, and IV ketamine without GA. 2293(72.96%) of CD received no anesthetic adjuncts. 377 subjects received GA for CD; 124(3.95%), 171(5.44%), and 82(2.61%) were for perceived inadequate time to initiate neuraxial anesthesia, failure of neuraxial anesthetic, and maternal comorbidities/preference, respectively. Serious complications included one aspiration during an emergent CD and one high spinal block. There were no failed airways or maternal deaths.

Discussion: Our GA for CD rate of 11.99% was higher than the 5.6% reported in the SCORE study2; our neuraxial failure rate of 5.44% was higher than the 1.7% reported in the same study. Our deviation in outcomes from the SCORE study could reflect a more aggressive approach to inadequate analgesia. Our study was not powered to detect serious complications. Further large studies examining the relationship between patient satisfaction and anesthetic technique for CD are needed.

References:

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Abstract #: T2A-350

Clinical Trial of Transnasal Humidified Rapid Insufflation Ventilatory Exchange (THRIVE) pre-oxygenation in Women having Planned Caesarean Delivery.

Presenting Author: Saba Al-Sulttan MBChB MSc FRCA
Presenting Author's Institution: University College London Hospitals NHS Trust - London, London
Co-Author: Ryan Howle MBChB BSc FRCA - University College London Hospitals NHS Trust
Columb Malachy FRCA FFICM - University Hospital South Manchester
Sohail Bampoe BSc MSc MBBS FRCA - University College London Hospitals NHS Trust
Pervez Sultan MBChB MD(Res) FRCA - University College London Hospitals NHS Trust

Introduction: THRIVE, Transnasal Humidified Rapid-Insufflation Ventilatory Exchange, is a form of high-flow humidified nasal oxygen delivery system delivers high concentrations of oxygen and may improve pre-oxygenation before the start of general anaesthesia and allows continued apnoeic oxygenation after induction of anaesthesia between apnoea and successful tracheal intubation and ventilation. The aim is to determine the number of vital capacity (VC) breaths required using THRIVE to pre-oxygenate 90% of parturients to an end-tidal oxygen concentration fraction (FETO2) of >0.90 (EN90).

Methods: After ethical approval We used an up-down sequential allocation methodology to investigate the effective number of VC breaths with THRIVE that produces a therapeutic response (i.e. FETO2 of >0.90) in 90% of the parturients (EN90). Each patient was assessed with 3 interventions, THRIVE mouth closed, THRIVE mouth open and with standard facemask pre-oxygenation.

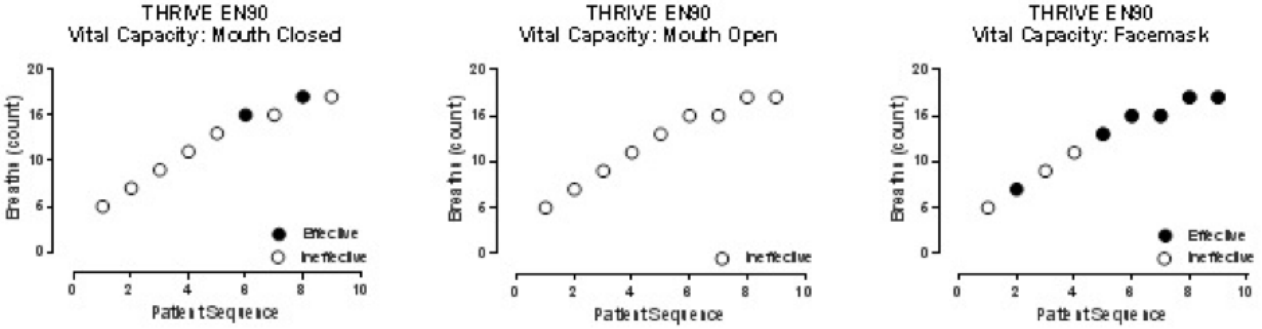
The primary aim of the trial is to determine the number of vital capacity breaths required using THRIVE mouth closed to pre-oxygenate 90% of parturients to a FETO2 of >0.90 (EN90). Secondary outcomes include assessment of THRIVE mouth open, facemask pre-oxygenation, maternal satisfaction and fetal outcomes. The study plans to enroll N=50 parturients. This preliminary analysis was to simply compare the initial relative performances of the methods of oxygenation in the study. McNemar chi-square tests with exact P values were used to assess the paired responses with $P<0.05$ as significant.

Results: The results for date for n=9 patients are shown in the Figure. The rates for successful oxygenation were 2, 0 and 6 for THRIVE mouth closed, THRIVE mouth open and facemask respectively. At the numbers of vital capacities tested so far, facemask appears to be significantly (P=0.031) more effective than THRIVE mouth open.

Discussion: Although it is too early to conclude, up to 17 VC breaths were not reliably successful in achieving FETO2 of >0.90 with THRIVE, 4 of 7 of these unsuccessful participants had their ETO2 of 90 achieved via traditional facemask oxygenation. This suggests that the failure to pre-oxygenate can be due to THRIVE rather than the participants at the range of VC breaths tested so far.

References:

PCF Tan, AT Dennis. High-flow humidified nasal pre-oxygenation in pregnant women. Anaesthesia. 2016; 71: 847-61.



Abstract #: T2A-404

Availability of Advanced Airway Equipment on Labor and Delivery Units

Presenting Author: Nakia Hunter MD
Presenting Author's Institution: Northwestern University Feinberg School of Medicine - Chicago, Illinois
Co-Author: Paloma Toledo MD, MPH - Northwestern University Feinberg School of Medicine
Elizabeth M.S. Lange MD - Northwestern University Feinberg School of Medicine

Introduction: Obstetric patients have a higher incidence of failed intubation compared to non-pregnant patients. Failure to obtain an advanced airway in emergency situations can result in devastating consequences for both the mother and fetus. The Obstetric Anaesthetists' Association and Difficult Airway Society (OAA/ DAS) guidelines for management of difficult and failed tracheal intubation in obstetrics recommend immediate availability of a video laryngoscope for all obstetric general anesthetics. We sought to identify the availability of advanced airway equipment in academic obstetric anesthesia units in the US. We hypothesized that 75% or more would have a video laryngoscope available.

Methods: A survey was developed by an expert panel. The survey domains included hospital characteristics and the availability of advanced airway equipment on the labor and delivery (L&D) unit. The electronic survey was emailed to 98 directors of obstetric anesthesia units in the US. The primary outcome was the proportion of units which have dedicated advanced airway equipment, specifically video laryngoscopes, for management of difficult or emergency airways. Univariate statistics were used to characterize survey responses.

Results: The survey response rate was 59%. 100% of respondents had at least one video laryngoscope, but only 84% had a flexible fiberoptic scope available. All respondents had laryngeal mask airways readily available, whereas only 47% and 78% had percutaneous tracheostomy and cricothyrotomy kits available, respectively. The equipment available in responding units is shown in Table 1.

Discussion: The majority of academic L&D units have immediate access to at least one piece of advanced airway equipment, specifically a video laryngoscope. Every L&D unit has the appropriate equipment for initial management of a difficult airway; however, several units do not stock equipment for possible surgical airways, i.e. tracheostomy and cricothyrotomy kits. Given the potential morbidity and mortality associated with difficult or failed intubation, it is imperative that all units evaluate their ability to access emergency airway equipment.

Advanced airway equipment	Percent availability
Video laryngoscope	100%
Flexible fiberoptic intubation equipment	84%
Rigid laryngoscope blades	90%
Tracheal tubes of assorted sizes	97%
Tracheal tube guides (e.g. bougie/ introducer)	97%
Exhaled CO_2 detector	88%
Laryngeal mask airway (or other supraglottic airway devices)	100%
Intubating laryngeal mask airway	76%
Percutaneous tracheostomy kit	47%
Cricothyrotomy kit	78%

Abstract #: T2B-92

Vasopressor use for spinal hypotension during Cesarean delivery: A Bayesian network meta-analysis of fetal and maternal outcomes

Presenting Author: Matthew M Reschke D.O.
Presenting Author's Institution: Washington University in St. Louis - St. Louis, MO
Co-Author: David Monks MBChB, FRCA, MSc - Washington University in St. Louis
Narender P Makkar M.D. - University of Manitoba
Arvind Palanisamy MD, PhD - Washington University in St. Louis
Yehuda Ginosar M.D. - Washington University in St. Louis
Preet M Singh MBBS, MD - Washington University in St. Louis

Introduction: Spinal anesthesia is the preferred anesthetic for cesarean delivery however the resultant hypotension from the sympathectomy can be dangerous to the fetus and mother. There have been multiple paradigm shifts as to what the ideal vasopressor is in treating this syndrome. These have included ephedrine, phenylephrine, mephentermine, metaraminol, and most recently studies have begun examining the role of norepinephrine. This network meta-analysis (NMA) is the first that compares and ranks vasopressors for spinal hypotension. This comes at an opportune time as norepinephrine has developing interest and research efforts.

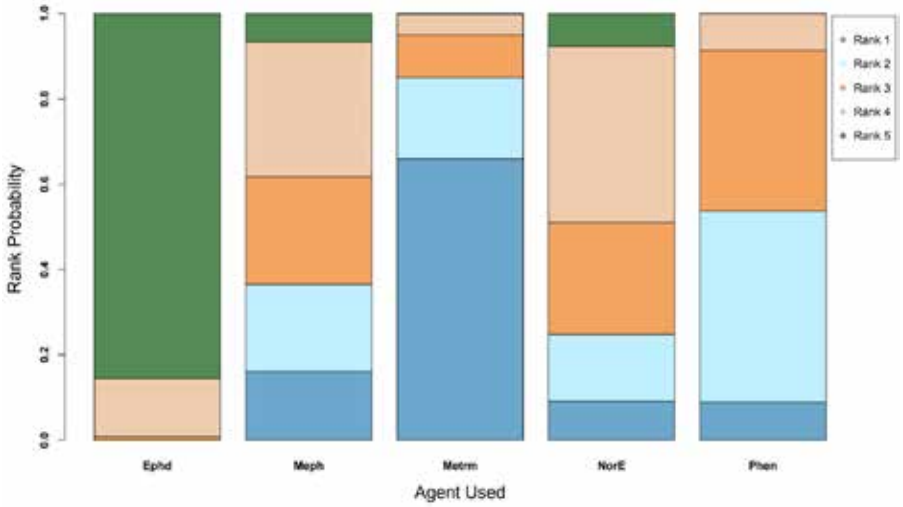
Methods: Multiple databases were searched for randomized controlled trials comparing vasopressors in treatment of spinal hypotension for cesarean delivery. Pooled estimates for fetal acid-base status and maternal outcomes were calculated using a Bayesian modeling. The risk of bias in the included trials was assessed based upon the Cochrane Collaboration recommendations.

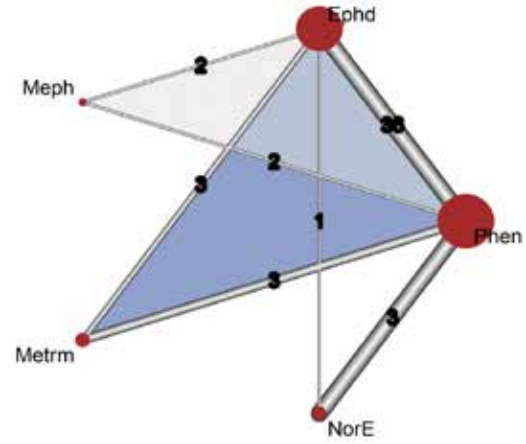
Results: 51 randomized controlled trials with a total of 3955 patients matched our inclusion criterion. NMA was evaluated using a random-effect model. Our initial evaluation examined umbilical ABG pH and base excess. Metaraminol had the lowest probability of having acidosis on umbilical ABG, followed by mephentermine, phenylephrine, norepinephrine and ephedrine. Norepinephrine has lowest probability of having a large base excess followed closely by mephentermine and metaraminol, and then phenylephrine and ephedrine.

Conclusions: While the data involving norepinephrine is limited, this NMA demonstrates it may not be superior to medications such as metaraminol. At the time of the conference we will have run regression models to separate the outcomes based on continuous versus intermittent, prophylactic versus therapeutic, elective versus emergent cesarean delivery, and to evaluate maternal outcomes. This serves as the first ever network meta-analysis to compare vasopressor outcomes after spinal hypotension during cesarean delivery.

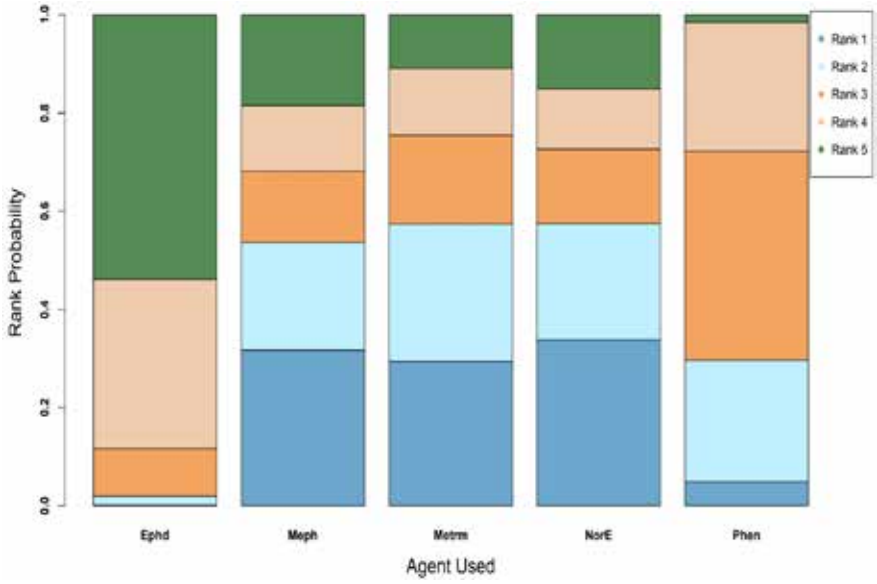
Abstract #: T2B-92

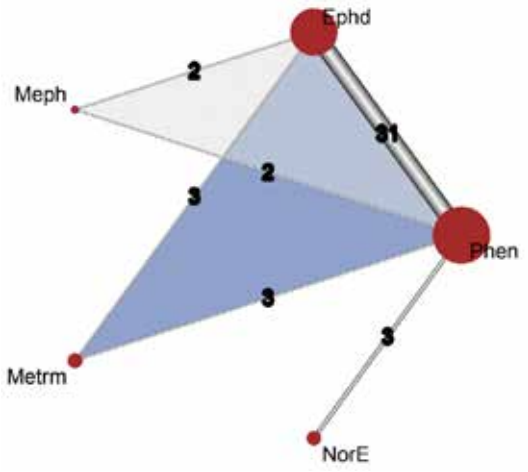
ABG pH: Rankogram and Network Graph





ABG Base Excess: Rankogram and Network Graph





Abstract #: T2B-143

Prevention hypotension after spinal anesthesia for cesarean section: systematic review and a network meta-analysis

Presenting Author: Kelly Fedoruk MD FRCPC
Presenting Author's Institution: Sunnybrook Health Sciences Centre
Co-Author: Stephen H Halpern MD, MSc, FRCPC - Sunnybrook Health Sciences Centre and University of Toronto
John Fitzgerald MB FRCA - Sunnybrook Health Sciences Centre
Sandra M Jadin MD - unnybrook Health Sciences Centre
Clarita Margarido MD - unnybrook Health Sciences Centre
Brendan Carvalho MBBCh, FRCA, MDCH - Stanford University School of Medicine

Introduction: Hypotension is common after spinal anesthesia and may lead to maternal and fetal compromise. Strategies to reduce the incidence of hypotension include the use of prophylactic vasopressors and volume loading. This network meta-analysis compares, using direct and indirect evidence, multiple interventions and rank them according to probable efficacy. This is not possible with standard meta-analysis with pairwise comparisons.

Methods: We sought (RCTs) in women undergoing spinal anesthesia for elective CS. We included interventions that increased intravascular volume and vasopressors. Comparators also included placebo, and we excluded trials that treated rather than prevented hypotension. The primary outcome was the incidence hypotension. Secondary outcomes were nausea, tachycardia, bradycardia and reactive hypertension; Apgar scores and umbilical cord pH. Using Stata 15.1, we set up a network of all possible direct and indirect comparisons and generated a network map (Fig 1), and reviewed for consistency and inconsistency. We determined the probable ranking of each intervention, from best to worst of all treatments as calculated by the surface under the cumulative ranking (SUCRA) curves. Using random effects models, relative risk and standardized mean difference were used to compare dichotomous and continuous variables respectively.

Results: We retrieved 168 RCTs and used 101 studies comprised of 7390 patients for this analysis. 12 treatment options were compared. The network was not inconsistent (p=0.29). Vasopressors scored consistently better in hypotension prevention than fluid-loading techniques (Table 1). Pairwise analysis showed no statistically significant differences between vasopressors except phenylephrine was better than ephedrine(p=0.038). Colloid was more effective than crystalloid (p=0.000). Crystalloid was similar to placebo (p=0.83) Vasopressors were more efficacious in preventing nausea than fluids. There were no differences in among treatments for any other outcomes.

Conclusion: Vasopressors are more effective than fluid loading to reduce the incidence of hypotension, findings consistent with the recommendations of the recent consensus practice guidelines. Crystalloid preload or coload is not effective. These findings should be used to guide practice change.

Reference:
Anaesthesia 2018;73:71

Abstract #: T2B-143

Figure 1: Network meta-analysis direct and indirect comparisons of prophylactic strategies to prevention of spinal hypotension during cesarean section. Node size is proportional to the number of studies, edge width is proportional to the number of comparisons.

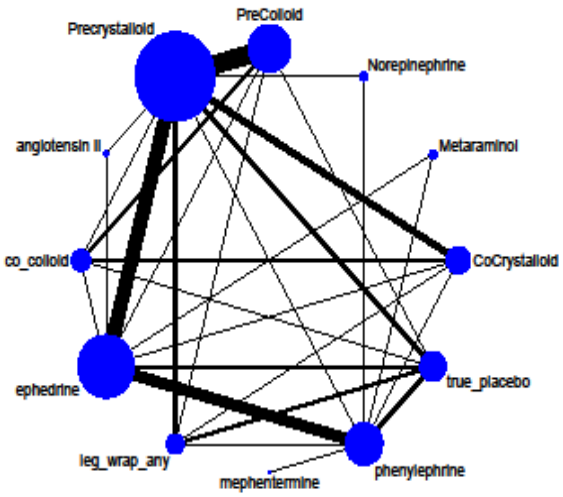


Table 1: Network meta-analysis probable efficacy of vasopressor and volume loading prophylactic strategies to prevention of spinal hypotension during cesarean section

Treatment	Mean Rank	SUCRA
Norepinephrine	2.8	84.1
Angiotensin II	3	81.8
Metaraminol	3.3	78.8
Mephentermine	3.7	75.1
Phenylephrine	4.5	68.4
Leg wrapping	5.7	57.1
Ephedrine	6.4	50.6
Pre-colloid	7.8	38.3
Co-Colloid	8.3	33.7
Co-Crystalloid	10.2	16.5
Placebo	11	9.4
Pre-crystalloid	11.3	6.3

Treatment ranking, best to worst. SUCRA=Surface Under Cumulative Ranking is the percentage probability best treatment. Pre=preloading (administration of fluids prior to spinal); Co=coloading (administration of fluids immediately after spinal).

Abstract #: T2B-216

A randomized double-blind study comparing prophylactic norepinephrine and ephedrine infusion for maternal spinal hypotension during cesarean section

Presenting Author: Mao Mao Master
Presenting Author's Institution: Nanjing Medicial University Affiliated Ob/Gyn Hosptial - Nanjing, China
Co-Author: Xian Wang Doctor - Nanjing Medicial University Affiliated Ob/Gyn Hosptial
XiaoFeng Shen Master - Nanjing Medicial University Affiliated Ob/Gyn Hosptial
ShiQin Xu Master - Nanjing Medicial University Affiliated Ob/Gyn Hosptial

Background: Many studies have shown the efficacy of norepinephrine for treatment of spinal hypotension during cesarean section via comparing to phenylephrine. However, there has been little research into the comparison between norepinephrine and ephedrine, another commonly used vasopressor, when used for management of maternal hemodynamics.

Methods: Ninety-seven parturients scheduled for elective cesarean section were randomly assigned to receive prophylactic infusion of norepinephrine 4 μg/min (group N; n=48) or ephedrine 4 mg/min (group E; n = 49) immediately post spinal anesthesia with systolic blood pressure (SBP) targeted at 80-120% of baseline. Rescue bolus norepinephrine 8 μg was given whenever SBP reached the predefined lower limit. Our primary outcomes were maternal SBP and heart rate (HR). Secondary outcomes included incidence of tachycardia (HR >100bpm), bradycardia (HR < 60 bpm), hypertension (SBP > 120% baseline), hypotension (HR < 80% of baseline), as well as hypotensive episodes, number of rescue top-ups, and hemodynamic control precision including median performance error (MDPE) and median absolute performance error (MDAPE). Maternal side effects including headache, nausea, vomiting, dizziness, chest pain, short of breath, shivering, as well as neonatal Apgar scores, umbilical arterial (UA) blood gas and pH were collected as well.

Results: SBP and HR throughout the observational time points was comparable between groups. However, standardized SBP and HR over time was lower in group N compared to group E (87.2 ± 9.6 vs. 91.4 ± 9.5, P = 0.04, difference: 4.1 ± 1.9 [95% confidence interval {CI}: 0.27 to 8.0], and 70.3 ± 11 vs. 75 ± 11, P = 0.04, difference: 4.7 ± 2.2 [95% CI: 0.24 to 9.1], respectively). Further, women in group N experienced fewer cases of tachycardia (4.2% vs. 30.6%, P = 0.002, odds ratio: 0.11 [95% CI: 0.02 to 0.47]) and a lower MDPE for HR (1.3 ± 9.6 vs. 8.4 ± 13.5 bpm, P = 0.003, difference: 3.1 ± 1.8 [95% CI: -0.6 to 6.7]). Furthermore, UA blood gas showed a higher base excess (BE) and a lower lactate in group N compared to group E (both P < 0.001). Other hemodynamics variables, as well as maternal side effects and neonatal outcomes were similar between groups.

Conclusion: Our data report norepinephrine infusion at 4 μg/min was slightly inferior to equipotent ephedrine infusion at 4 mg/min for SBP maintenance; however, it presents fewer cases of tachycardia, a less fluctuation of HR, and a less stressed fetal status compared to ephedrine.

Abstract #: T2B-238

Choice of epidural local anesthesia for cesarean delivery: A Bayesian network meta-analysis of comparative speed and quality of block.

Presenting Author: Matthew Reschke D.O.
Presenting Author's Institution: Washington University in St. Louis - St. Louis, Missouri
Co-Author: David Monks MBChB, FRCA, MSc - Washington University in St. Louis
Swarup Varaday MBBS - Washington University in St. Louis
Yehuda Ginosar BSc, MBBS - Washington University in St. Louis
Arvind Palanisamy MD, FRCA - Washington University in St. Louis
Preet Singh MBBS, MD - Washington University in St. Louis

Introduction: The use of rapid-onset drugs for epidural local anesthesia (LA) can facilitate urgent cesarean delivery avoiding general anesthesia and its associated risks for mother and baby. In an era of medication shortages, it is important to have precise comparative information on all available medications. The objective of this network meta-analysis (NMA) was to compare and rank the local anesthetics most commonly utilized for the urgent conversion of epidural analgesia for labor to an epidural anesthetic for cesarean delivery. This study expanded upon the most recent meta-analysis performed in 2011 which omitted both buffered lidocaine and 3% chloroprocaine1.

Methods: Medical databases were searched for randomized trials comparing different epidural LAs for onset-time to surgical anesthesia. Pooled estimates for onset time were calculated by Bayesian modeling. The risk of bias in the included trials was assessed based upon the Cochrane Collaboration recommendations.

Results: Sixteen randomized-controlled-trials with a total of 862 patients matched our inclusion criterion for the six most common LAs. NMA was performed using a random-effect model. The deviance information criterion for the model was 32.9 (34 data points). Pooled onset time was fastest for 3% chloroprocaine, followed sequentially by 2% lidocaine with epinephrine (buffered with bicarbonate), 2% lidocaine with epinephrine, 0.75% ropivacaine, 0.5% bupivacaine, and 0.5% levobupivacaine which were 0.36, 3.32, 4.93, 5.51 and 6.63 minutes slower respectively. No difference was found in incidence of intraoperative hypotension or need for supplementation.

Conclusions: This network meta-analysis used data from both direct and indirect comparisons of LAs, for the first time, to provide a rank-order of time to onset of epidural anesthesia. When rapid conversion for cesarean is warranted, 3% chloroprocaine has the fastest onset followed by buffered lidocaine with epinephrine then unbuffered lidocaine with epinephrine, ropivacaine, bupivacaine and levobupivacaine. This analysis can be used by clinicians to improve maternal and neonatal outcomes by selecting the fastest-acting LA available in their healthcare setting.

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Abstract #: T2B-238

Figure 1: Rankogram comparing the probability that the given epidural local anesthetic had the fastest time to onset

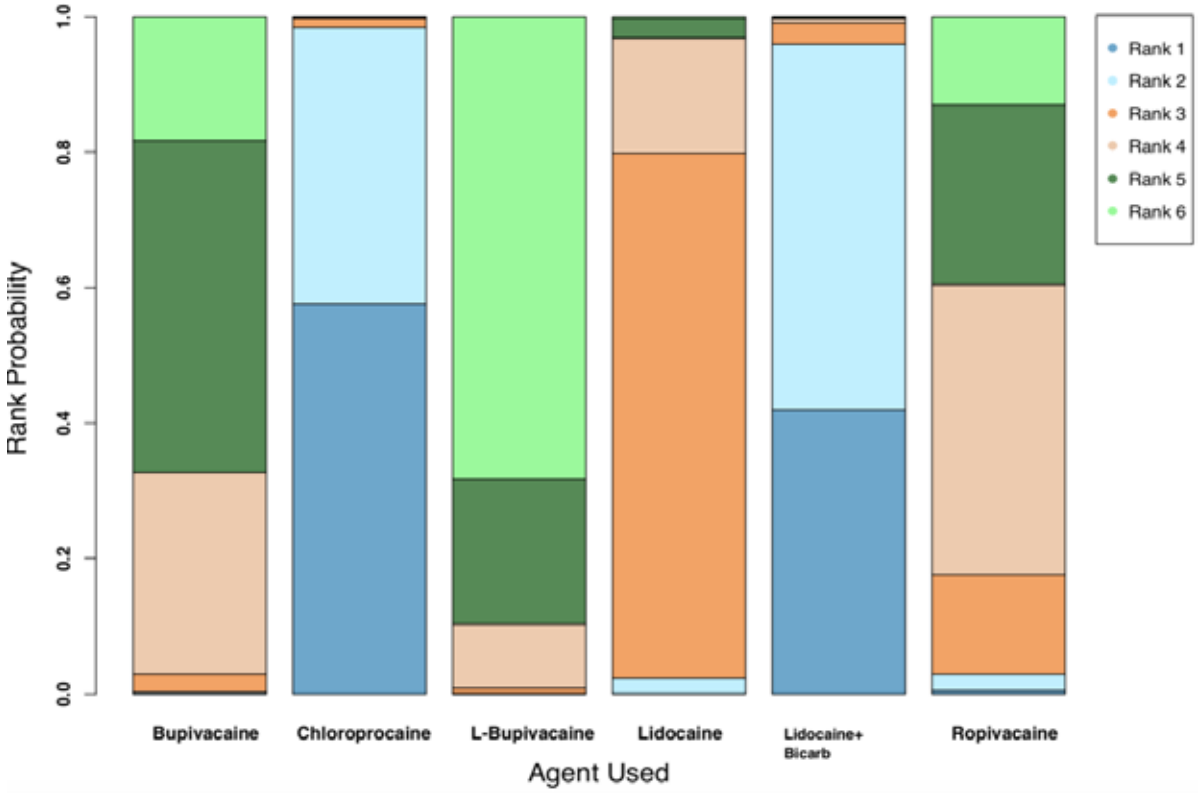
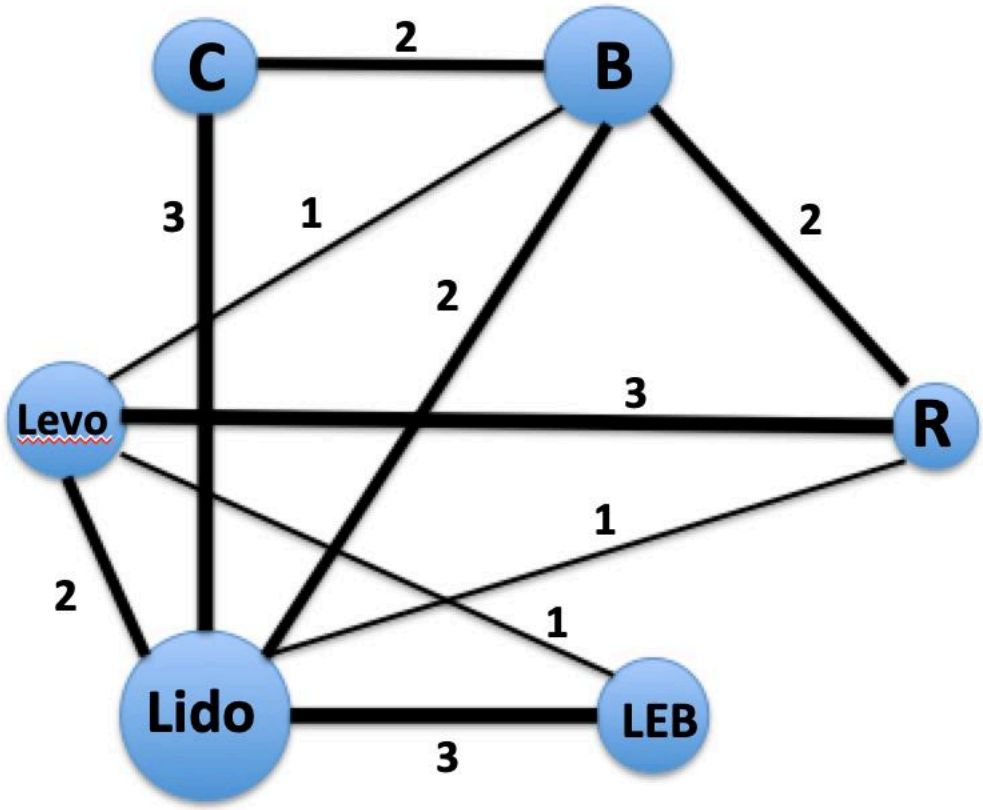


Figure 2: Network Plot



Abstract #: T2B-279

Transient Maternal Hypotension: Risk Factor for NICU Admission after C-section?

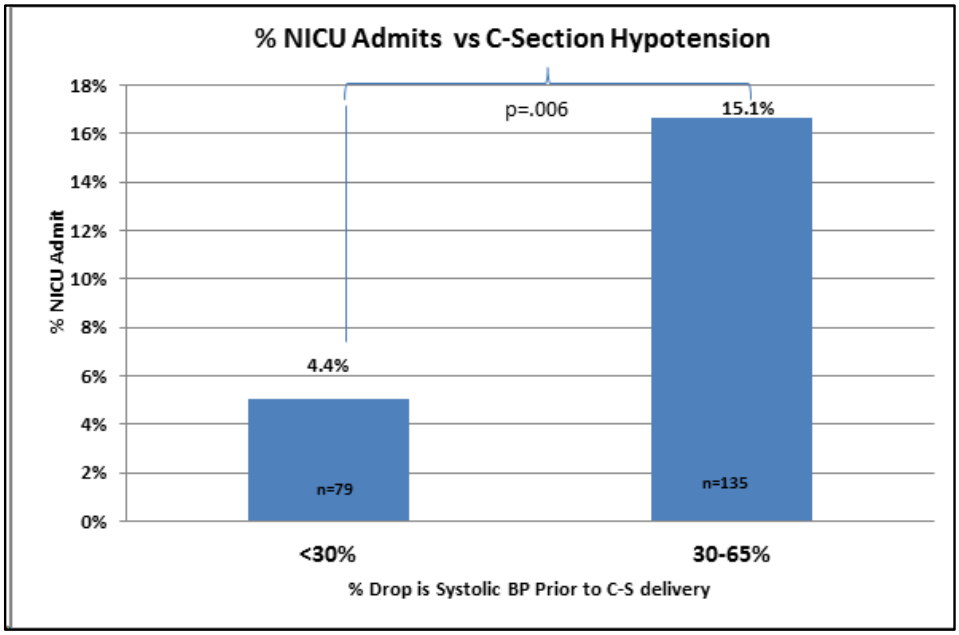
Presenting Author: Alejandra Valladolid MD, FAAP
Presenting Author's Institution: Indiana University - Indianapolis, IN
Co-Author: Catherine Proctor MS - Franciscan Health
Stephanie Vickrey RT - Franciscan Health
Amy Spots MBA, BSN, RN, NE-BC - Franciscan Health
Lori Yates Hodges RN, MSN - Franciscan Health
Paul Winchester MD - Indiana University

Background: Higher incidence of respiratory distress/NICU admission has been reported in infants delivered by elective repeat c-section versus VBAC[1]. Maternal hypotension during c-section as a potential contributor to the increased risk for NICU admission has not been investigated. Many factors affect uterine perfusion in the operating room including maternal supine positioning and regional anesthesia. Severity of maternal hypotension and preventive strategies by anesthesiologists are variable we sought to investigate these in elective c-sections at term and its association with risk of NICU admission.

Methods: Retrospective mother/baby chart review of elective c-sections at term gestational age over 12 months. Maternal risk factors were characterized. Percent declines in predelivery maternal blood pressure were calculated for each case. The blood pressure declines were compared to adverse neonatal outcomes: (APGARS, need for resuscitation, need for respiratory support and need for NICU admission).

Results: A total of 214 charts were reviewed (2016-2017). Mean gestation at delivery was 38 weeks. All deliveries were performed with regional anesthesia (spinal). NICU admission rate (NAR) was 8.4% overall and significantly associated with: maternal diabetes, current tobacco use, fetal growth abnormalities and ASA score. But not significantly associated with maternal age, race/ethnicity, and fetal heart rate categories. Average maternal blood pressure declines were: 38 torr (26%) systolic, 27 torr (33%) diastolic and 30 torr (29%) mean. Systolic maternal blood pressure decline (sMBPD ≥30% occurred in 79/214 (37%) cases. sMBPD ≥30% was associated with significantly lower APGAR1 (7.86 vs 8.22) p=.007 and lower APGAR 5 (8.69 vs 8.93) p=0.01. Neonatal resuscitative interventions were more likely if sMBPD ≥30% vs <30% (34% vs 14%) p=.0005. NAR was 4.4% in sMBPD<30% vs 15.1% for ≧ 30%(p=.006). sMBPD varied significantly by providers including the use of prophylactic vasoconstrictor administration suggesting an important difference among providers.

Conclusion(s): NAR after elective c-section at term is > 3 times higher when sMBPD is >30% prior to delivery and predicted by prenatal factors. Modifications in anesthesia practice may reduce NICU admission risk in term planned c-sections.



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Abstract #: T2B-325

Randomized Double-blinded Comparison of Prophylactic Norepinephrine and Phenylephrine Infusion During Spinal Anesthesia for Cesarean Delivery in Twin Pregnancies

Presenting Author: Weijia Du MD
Presenting Author's Institution: Shanghai First Maternity and Infant Hospital - Shanghai, Shanghai
Co-Author: Weijia Du MD - Shanghai First Maternity and Infant Hospital
Xin Fang MD - Shanghai First Maternity and Infant Hospital
Zhendong Xu MD.PHD - Shanghai First Maternity and Infant Hospital
Zhiqiang Liu MD.PHD - Shanghai First Maternity and Infant Hospital

Introduction: Norepinephrine has recently been regarded as an alternative to phenylephrine for treatment of post-spinal hypotension during cesarean delivery(CD)1, but all of these studies were conducted in singleton pregnant women. Twin pregnancies have become considerably more frequent these years as a result of developing assisted reproductive techniques, however, few data have been published on perioperative maternal hemodynamic changes in twin pregnancies2. The objective of this study was to compare prophylactic infusion of phenylephrine and norepinephrine for maintaining maternal blood pressure after spinal anaesthesia in twin pregnancies during elective CD.

Methods: This was a double-blinded, randomized, controlled study including 58 healthy twin pregnant women, gestation>36 weeks and scheduled for CD under spinal anesthesia. After spinal induction, either norepinephrine 6μg/ml or phenylephrine 75μg/ml was started infusion at a fixed rate of 1ml/min . Systolic arterial pressure(SAP) was targeted near baseline until delivery.The infusion was stopped if the SAP was more than baseline. Side effects were treated properly.The primary outcome was maternal cardiac output(CO). Other parameters of maternal hemodynamics, cord gases, Apgar score and adverse events were also compared.

Results: Data were analyzed from 56 patients (28 patients in each group, from Dec 2017 to Dec 2018). From infusion until delivery, for norepinephrine versus phenylephrine, there was no difference between groups in CO(7.35L/min vs. 7.31 L/min, P =0.91)(Fig). Maternal hemodynamic parameters including SAP , heart rate, systemic vascular resistance and stroke volume were similar (all P >0.05). The umbilical arterial pO2 of Twin A in norepinephrine group was higher than that in phenylephrine group (P = 0.04). Other neonatal outcomes and incidence of maternal nausea and vomiting, hypotension, bradycardia and reactive hypertension were similar between groups.

Conclusion: When administered as a prophylactic fixed-rate infusion, phenylephrine and norepinephrine are both appropriate selections for maintaining maternal blood pressure after spinal anaesthesia in twin pregnancies. There is no clear evidence that norepinephrine is superior to phenylephrine in this study.

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Abstract #: T2B-325

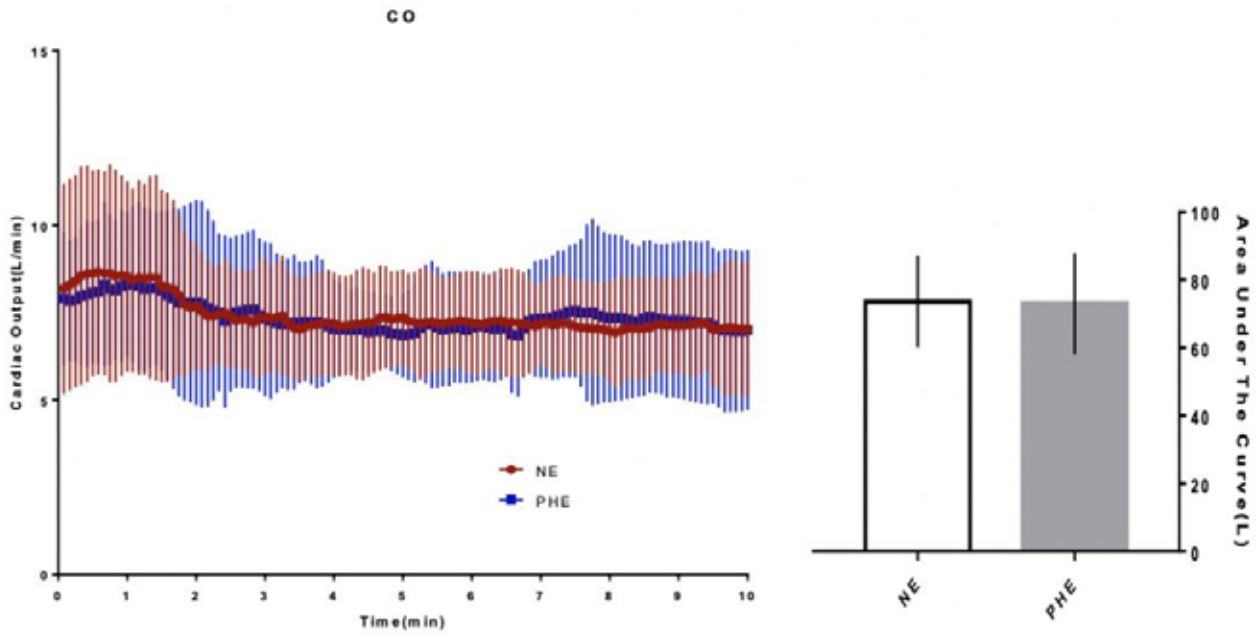


Fig.Continuous changes in cardiac output(CO): On the left side of the panels, data are continuous values for the first 10 minutes from drug infusion shown as mean and SD. On the right side of the panels, bars show the area under the curve for the two groups (N = norepinephrine and P = phenylephrine) and shown as mean and SD. Comparison of the calculated values for standardized area under the curve in Group N and Group P showed that cardiac output was similar between groups(7.35L/min vs. 7.31 L/min, P = 0.91).

Abstract #: T2B-335

Association between dose of hyperbaric bupivacaine, maternal hypotension, and neonatal outcome: Retrospective database study of 7111 women undergoing cesarean delivery under spinal anesthesia

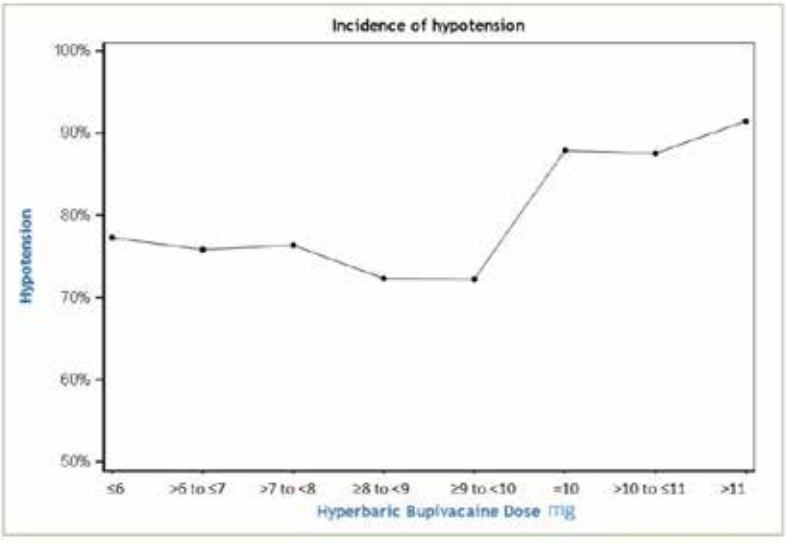
Presenting Author: Carolyn Weiniger MB ChB
Presenting Author's Institution: Tel Aviv Sourasky Medical Center, Tel Aviv, Israel - Modiin, Israel
Co-Author: Michael Heesen MD - Kantonsspital Baden, Baden, Switzerland
David Knigin MD - Hadassah Hebrew University Medical Center, Israel
Frederic Deutsch MA - BioStats, Modiin, Israel
Alexander Avidan MD - Hadassah Hebrew University Medical Center, Israel

Background: A previous meta-analysis reported inadequate clinical analgesia using ≤8mg hyperbaric bupivacaine (HB) for spinal anesthesia for cesarean delivery (CD) (1). However, these low doses were associated with less maternal hypotension. Our primary aim was to investigate the relationship between HB dose and the occurrence of spinal hypotension. We also investigated the relationship between HB dose and vasopressor use and umbilical vein pH.

Methods: Retrospective study of CD in 1 institution (2 centers: district and tertiary), 2012-18. Data on all CD with spinal anesthesia and recorded HB dose were retrieved from the anesthesia information management system and hospital information system: patient age, vasopressor boluses (phenylephrine/ephedrine), emergency CD and umbilical cord pH (where available). Hypotension was defined as any systolic blood pressure either <80% baseline or <100mmHg from anesthesia start until delivery.

Results: 7,111 CD were included. HB dose administered was ≤8mg for 29%, 9-9.5mg for 12%, 10mg for 51% and >10mg for 8%. Incidence of ≥1 one spinal hypotension episode was higher in women who received ≥10mg HB, Figure; however even women with lower HB doses had hypotension. Phenylephrine was administered to 38% and ephedrine to 28% of the women. The Spearman Rank Correlation for dose of HB and phenylephrine was 0.4453, p<0.0001; and for dose of HB and ephedrine was 0.0129, p=0.28. A logistic regression model found higher likelihood of spinal hypotension with HB dose ≥10mg, OR 2.20, 95%CI 1.93 to 2.52; and with increased maternal age (continuous variable) OR 1.03 95%CI 1.02 to 10.4; but lower likelihood in emergency surgery OR 0.81, 95%CI 0.71 to 0.93. Umbilical cord pH was retrieved for 2392 CD (96.7% were electives); 0.5% had pH<7.0 and 9.5% had pH<7.2. 10.8% of the women receiving HB≥10mg had pH<7.2 versus 7.6% receiving HB<10mg, 0.0079.

Conclusion: Our major finding was a higher threshold value for increased risk of hypotension with ≥10mg HB. HB dose showed a moderate correlation with phenylephrine bolus doses. Since hypotension was observed regardless of HB dose, even the lower HB doses may require prophylactic vasopressors. We confirmed prior studies reporting that spinal hypotension is less frequent in emergency CD. Moreover, we observed a significantly higher frequency of neonatal acidosis with the higher doses of bupivacaine, likely associated with hypotension.



The distribution of hypotensive episodes between start of anesthesia until delivery was: 28% women had 1; 22% had 2; 16% had 3; 11% had 4, 23% had >4.

References:
1. Arzola BJA 2011; 107: 308–18

Abstract #: T2B-472

Predictors of vasopressor requirements to achievenormotensionin pregnant women undergoing cesarean delivery under spinal anesthesia.

Presenting Author: Shubhangi Singh MBBS, MD
Presenting Author's Institution: Brigham and Women›s Hospital - Boston , MA
Co-Author: Yun-Yun Chen MD - Brigham and Women›s Hospital
Daniele Parise MD - Brigham and Women's Hospital
Vesela Kovacheva MD, MS - Brigham and Women's Hospital

Introduction: The administration of spinal anesthetic for cesarean delivery (CD) can lead to significant maternal hypotension which is associated with nausea, vomiting, lightheadedness, and in rare cases, stroke in the mother, as well as acidosis, hypoxia and low Apgar scores in the neonate. Prophylactic phenylephrine infusion is routinely used to prevent profound hypotension and improve the outcome for both mother and baby. Several studies have shown that factors like emergency CD, labor and lower preoperative anxiety can be associated with lower phenylephrine requirements, however there are no clear predictors to guide clinical decision making. In this study we sought to determine the risk factors associated with increased vasopressor needs in order to maintain normal maternal blood pressure.

Methods: We included all patients who had CD under spinal anesthesia in the past year in our tertiary institution and where the maternal systolic blood pressure was maintained 90-149 mmHg using phenylephrine infusion. Patients with any history of hypertension, preeclampsia or postural hypotension were excluded, as well as those with inadequate intraoperative blood pressure control or incomplete medical records. Single- and multivariable linear regression models were used to predict the factors associated with the amount of phenylephrine used in the 20 minutes after the spinal injection.

Results: In our retrospective cohort of 259 patients, using one-factor linear regression, we found that the total amount of vasopressor used to maintain normotension is proportionate to the amount of bupivacaine in the spinal (P=0.02); there was no significant effect of age, BMI, presence of labor, parity, weeks of gestation, diabetes, depression and the weight of the baby. After adjusting for the amount of bupivacaine, there was still no significant effect of the above variables using multi-factor linear regression model (Table).

Conclusion: We found strong association of the vasopressor utilization and the amount of bupivacaine administered in the spinal anesthetic. Our results suggest that patients, who receive higher bupivacaine amounts, are likely to need higher doses of prophylactic vasopressors to maintain normal blood pressure. Further studies are needed to determine what other factors should be considered to guide vasopressor administration.

Table 1. Multi-variate linear regression of the total amount of vasopressor needed to maintain normal maternal blood pressure (P=0.08, R2=0.03, entire model).

		95% Confidence interval		
	Beta Coefficient	Lower	Upper	P value
Bupivacaine	384.51	68.96	700.07	0.02
Labor	-7.73	-98.05	82.60	0.87
Diabetes	22.95	-100.74	146.64	0.72
Depression	71.94	-15.83	159.70	0.11

Abstract #: T2B-496

Personalized Hemodynamics: A Statistical Model Predicting The Changes In Maternal Systolic Blood Pressure After Spinal Anesthesia for Cesarean Delivery

Presenting Author: Daniele Parise M.D.
Presenting Author's Institution: Brigham and Women›s Hospital - Boston, MA
Co-Author: Yun-Yun Chen M.D. - Brigham and Women›s Hospital
Shubangi Singh M.B.B.S. - Brigham and Women's Hospital
Kara Fields B.S. - Brigham and Women's Hospital
Vesela Kovacheva M.D. - Brigham and Women's Hospital

Introduction: Maternal hypotension after spinal anesthesia can pose significant risk for both the mother: lightheadedness, nausea, ultimately, end-organ hypoperfusion; and the fetus: acidosis, hypoxia, and low APGAR scores. Prophylactic vasopressor administration may result in under- or over-treatment of maternal systolic blood pressure (SBP) and present risk for both mother and baby safety. There is little evidence-based guidance about the administration of vasopressors due to the challenges of predicting the maternal SBP course after the onset of spinal anesthesia. The aim of this study is to create a statistical model to prognosticate the next SBP in pregnant women undergoing cesarean delivery under spinal anesthesia.

Methods: We included healthy patients who had cesarean delivery under spinal anesthesia and excluded any patients with history of hypertension, preeclampsia, baseline SBP<90mmHg or incomplete records. We used the vital signs and vasopressor doses from intraoperative records in the 5 minutes before and after spinal anesthesia. A linear mixed-effects model with a gaussian random intercept was used to estimate the association of the following fixed effects with change in SBP from baseline at the next minute: age, BMI, mean baseline SBP, mean baseline HR, amount of bupivacaine, current SBP change from baseline, and current cumulative vasopressor dose. Model fit was assessed by calculating the marginal pseudo-R2 (the variance explained by fixed effects) and conditional pseudo-R2 (the variance explained by entire model) for generalized mixed-effect models.

Results: We used 386 high quality patient records. The average age was 34.3±4.6 years and the average BMI was 30.4±5.6 kg/m2. The mean baseline SBP was 128.7± 13.3 mmHg and the mean baseline HR was 92.7±14.7 bpm. Using linear mixed effects model (Table 1), we found that a change in SBP from baseline at the current timepoint explains 65.9% of the variability in change in SBP from baseline at the next timepoint.

Conclusion: We created a predictive model of the changes in maternal SBP after spinal anesthesia. Our next steps will be to determine the corresponding amounts of vasopressor needed to maintain normal SBP. These results will help refine vasopressor administration and tailor the dose to the particular patient, which will ultimately increase the safety of both mother and baby.

Table 1. Linear mixed-effects model for prediction of change in SBP from baseline at the next minute.

Parameter	Beta (95% CI)	P value
Intercept	35 (27.1, 42.9)	<0.001
Age (per 5 year increase)	-0.3 (-0.7, 0.2)	0.198
BMI (per 5 kg/m2 increase)	-0.2 (-0.6, 0.1)	0.224
Mean baseline SBP (per 1 mmHg increase)	-0.3 (-0.3, -0.2)	<0.001
Mean baseline HR (per 10 bpm increase)	-0.5 (-0.8, -0.2)	<0.001
Bupivacaine in spinal (per 1 mL increase)	-0.1 (-3.6, 3.4)	0.963
Change in SBP from baseline (per 1 mmHg increase)	0.6 (0.6, 0.6)	<0.001
Vasopressor dose (per 10 mcg increase)	0.4 (0.3, 0.4)	<0.001

Marginal pseudo-R^2 (variance explained by fixed effects) = 0.677
Conditional pseudo-R^2 (variance explained by entire model) = 0.709

Abstract #: T2C-149

Ultrasound Measurement of the Optic Nerve Sheath Diameter in the Parturient

Presenting Author: Merry Colella MD
Presenting Author's Institution: Beth Israel Deaconess Medical Center - Boston, MA
Co-Author: John J Kowalczyk MD - Beth Israel Deaconess Medical Center
Margaret O'Donoghue MD - Albany Medical Center
Yunping Li MD - Beth Israel Deaconess Medical Center
Philip Hess MD - Beth Israel Deaconess Medical Center

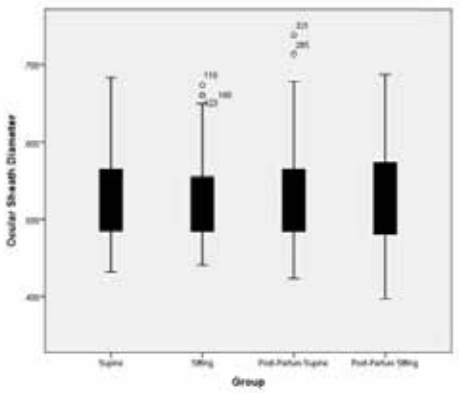
Introduction: The optic nerve sheath (ONS) is a flexible tube contiguous with the sclera and dura mater. ONS diameter (ONSD) correlates with intracranial pressure (ICP) due to continuity with the subarachnoid space (1). ONSD can be measured on ultrasound (US) and correlates with direct measurements of ICP by invasive monitoring (2) and with head computer tomography findings of increased ICP (3). Thus, ONS US is a noninvasive tool for identifying patients with elevated ICP. Multiple studies have identified an ONSD of >5 mm as a sensitive threshold value for an ICP>20 mmHg. Changes in ICP may occur in pregnancy, and ONS US may be useful for detecting and monitoring these changes. However, normal values in pregnancy are unknown. In this study, we aimed to establish normal values for both antepartum and postpartum ONSD on US in healthy term parturients.

Methods: 20 women undergoing scheduled cesarean delivery with neuraxial anesthesia enrolled. A small 12 MHz linear transducer was placed over the closed eyelid of each eye, the ONS was identified, and the best possible images were stored for measurement (Fig 1a). For each participant, a total of 12 antepartum ONSD measurements were taken (3 of each eye in both the seated and supine positions). These measurements were repeated at least 24 hours postpartum. The Shapiro-Wilk test was used to assess the normality. Independent-samples t-test and Mann-Whitney U test were used to compare outcomes, as appropriate.

Results: Chronbach's alpha (0.93) showed a high level of intrapatient consistency within each set of 3 measurements. No significant difference in means between left and right ONSD was seen in any data set. The median ONSD in the antepartum supine position was 5.29 mm [0.485-0.565]. All median values were above 5.23 mm, and no significant difference was found when comparing Supine to Sitting (p=0.821), Supine to Post-Partum Supine (p=0.794) and Supine to Post-Partum Sitting (p=0.965) (Fig 1b).

Conclusions: Measurement of ONSD by US can be used with high levels of intrapatient reliability. There is no statistically significant difference in ONSD from pre- to post-partum in our interim analysis, which suggests there may be a single range of normal for the entire peripartum period. Median values for healthy parturients appear to exceed the previously established threshold for elevated ICP.

1a.



2a.

References:

1. Surg Radiol Anat 1996; 18(4):323-8.
2. Acad Emerg Med 2008; 15:201-204.
3. Ann Emerg Med 2007; 49:508-14.

Abstract #: T2C-190

Assessment of sensory block level to cold during epidural analgesia for labor: poor degree of agreement between testing in opposite directions

Presenting Author: Eliane C. S. Soares MD, MSc, Fellowship in Obstetric Anesthesia
Presenting Author's Institution: Anesthesia and Pain Management - Mount Sinai Hospital/University of Toronto - Belo Horizonte, Minas Gerais
Co-Author: Balki Mrinalini MD, MSc - Anesthesia and Pain Management - Mount Sinai Hospital
Downey Kristi MSc - Anesthesia and Pain Management - Mount Sinai Hospital
Xiang Y Ye MSc - Maternal-Infant Care Research Centre - Mount Sinai Hospital
Jose Carvalho MD, PhD - Anesthesia and Pain Management - Mount Sinai Hospital

Introduction: Assessment of sensory block level (SBL) during epidural analgesia for labor is an essential component of clinical practice. Such assessment is not standardized. While some assess the block from anesthetized to non-anesthetized dermatomes, others assess it in the opposite direction. The objective of this study was to determine the degree of agreement between these two practices. We hypothesized that the degree of agreement would be high and that both techniques would identify the same SBL.

Methods: We conducted a prospective cohort study in women receiving epidural analgesia for labor. The epidural catheter was placed at L3-L4 and women received a loading dose of 15 mL of bupi 0.125% with fentanyl 50mcg, followed by a PIEB regimen of bupi 0.0625% with fentanyl 2mcg/mL. Two investigators were randomized to perform bilateral assessments of the SBL to cold using a standard ice bag at 1 and 2 hours after the loading dose. They were blinded to each other's results. We compared 2 methods of assessment: a) from anesthetized to non-anesthetized dermatomes (caudad-cephalad direction-UP) and b) from non-anesthetized to anesthetized dermatomes (cephalad-caudad direction-DOWN). In both methods, the C3 dermatome was used as control (baseline cold). We defined Upper SBL (USBL) as the highest dermatome with any detectable block to cold and Lower SBL (LSBL) as the highest dermatome with complete block to cold. The primary outcomes were the USBL and LSBL to cold at 1 and 2 hours after the loading dose. The degree of agreement in the primary outcomes was assessed using Kappa statistics.

Results: We enrolled 30 women. The degree of agreement in the primary outcomes assessed by the two methods was poor-fair (estimated kappa 0.02 to 0.24). However, Spearman's correlation coefficient and regression analysis revealed a strong linear relationship between the methods. The UP method typically showed lower or similar SBL when compared to the DOWN method. The USBL and LSBL were typically 2 dermatomes apart (Table 1).

Table 1. Comparison between upper and lower sensory block levels, degree of agreement and correlation between UP and DOWN testing

		Upper Sensory Block Level		Lower Sensory Block Level	
		UP method	Down method	UP method	Down method
1 hr - Right side	Sensory level, median (IQ range)	T9 (T6 - T11)	T8 (T5 - T10)	L1 (T11 - L3)	T11 (T10 - L2)
	Kappa	0.13 †		0.17 †	
	Spearman's correlation coefficient	0.79†		0.86 †	
1 hr - Left side	Sensory level, median (IQ range)	T9 (T6 - T10)	T7 (T6 - T8)	T11 (T10 - L2)	T10 (T9 - T11)
	Kappa	0.13 †		0.02	
	Spearman's correlation coefficient	0.86 †		0.68 †	
2 hr - Right side	Sensory level, median (IQ range)	T8 (T5 - T9)	T7 (T5 - T9)	T11 (T10 - L2)	T10 (T9 - T12)
	Kappa	0.24 †		0.09	
	Spearman's correlation coefficient	0.85 †		0.71†	
2 hr - Left side	Sensory level, median (IQ range)	T8 (T5 - T9)	T8 (T5 - T9)	T10 (T9 - T12)	T10 (T8 - T11)
	Kappa	0.16 †		0.07	
	Spearman's correlation coefficient	0.80 †		0.74 †	

Notes: UP Method = Anesthetized to non-anesthetized direction (caudad-cephalad direction);
DOWN Method = Non-anesthetized to anesthetized direction (cephalad-caudad direction); † $p<0.05$

Conclusion: The SBL to cold assessed by the two methods are strongly correlated but their agreement is poor/fair. Given the small difference in SBL detected with both methods, it may be acceptable to use either in clinical practice. However, the lack of standardization may impact studies involving assessment of SBL to cold. The clinical implication of the difference between USBL and LSBL remains to be determined. Reference: Anaesthesia 2015;70:421-28

Abstract #: T2C-220

LUNG ULTRASOUND PATTERNS IN PARTURIENTS UNDERGOING VAGINAL AND CESAREAN DELIVERY

Presenting Author: Paul Macias M.D., M.S., R.D.
Presenting Author's Institution: Stanford School of Medicine - Stanford, CA
Co-Author: Jennifer G. Wilson M.D. - Stanford University School of Medicine
Naola S. Austin M.D. - Stanford University School of Medicine
Nan Guo Ph.D. - Stanford University School of Medicine
Brendan Carvalho M.D. - Stanford University School of Medicine
Clemens M. Ortner M.D. - Stanford University School of Medicine

BACKROUND: Lung ultrasound (LUS) is a highly sensitive tool for detecting increased extravascular lung water (EVLW) and diagnosing pulmonary interstitial syndrome (PIS), which precede the development of pulmonary edema (Lichtenstein et al. 2004; Gargani et al. 2007). In healthy term parturients, a recent observational study found LUS patterns comparable to that of non-pregnant patients, however, it is unknown if PIS develops after the processes of labor and vaginal or cesarean delivery (Arbeid et al. 2017). The aim of this study was to determine the prevalence of PIS in healthy term parturients undergoing vaginal, elective and unplanned intrapartum cesarean deliveries.

METHODS: A prospective cohort study (IRB #39605) at an academic hospital with an epidural rate of 83% and a cesarean delivery rate of 32%. We enrolled healthy (ASA status ≤2) term (≥37 weeks gestation) women undergoing vaginal (VD), planned elective CD (eCD) or unplanned (failure to progress, arrest of descent, and/or fetal intolerance of labor) intrapartum CD (uCD). Applying an eight-region technique, LUS was performed within four hours of delivery. PIS was defined as ≥2 positive lung regions per hemithorax, with a positive lung region defined as the presence of ≥3 B-lines per image. All scans were performed by a single examiner and reviewed by two independent, blinded observers.

RESULTS: After screening 108 parturients, LUS was performed in 75 women (n=25 per group). No PIS (0/25; 0%, 95%CI 0-12%) was found in the VD and eCD groups, but in 2/25 (8%, 95%CI 1-26%) women following uCD (P=0.324, Fisher's exact test). PIS correlated clinically with the development of pulmonary edema in one woman in the uCD cohort. ≥1 positive lung regions were present in 5/25 (20%), 6/25 (24%), and 12/25 (48%) women following VD, eCD, and uCD, respectively, (P=0.067, Chi-Square test; Figure 1). Mean number of positive lung regions was 1.1±1.8 in uCD cohort and 0.4±0.8 in the other two groups (P=0.049, Poisson regression; Figure 1).

CONCLUSIONS: Although many focal areas of increased EVLW (20-48% prevalence) can be identified on LUS, the prevalence of PIS is low among healthy term parturients immediately after delivery. Findings suggest CD compared to VD does not increase the likelihood of developing signs of increased EVLW on LUS, however CD following labor may, and factors for this observation are being further explored.

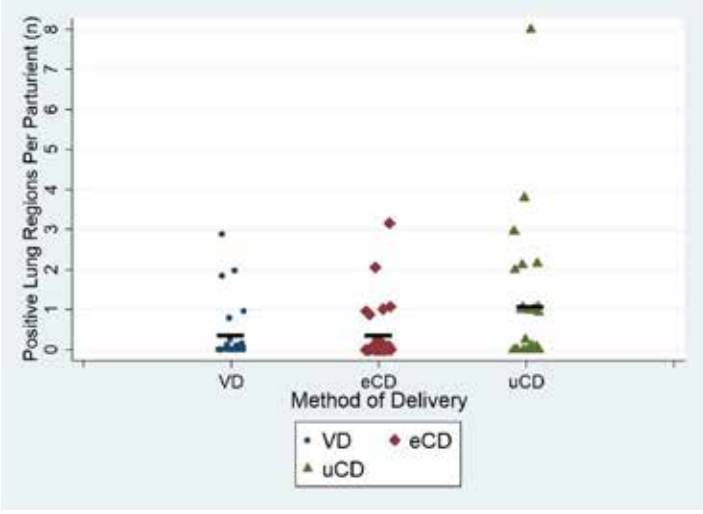


Figure 1. Number of positive lung regions per parturient, identified on lung ultrasound in women following a vaginal delivery (VD), elective Cesarean delivery (eCD), or an unplanned intrapartum CD (uCD). A total of eight regions (four per hemithorax) were scanned.

REFERENCES:

Lichtenstein, Anesthesiology 2004

Gargani, CCM 2007

Arbeid, GynObsInv 2017

Abstract #: T2C-250

The Influence of an International Teaching Program on the Use of Spinal Analgesia for Labor and Regional Anesthesia for Cesarean Delivery in Tuzla, Bosnia and Herzegovina

Presenting Author: Ivan Velickovic M.D., FASA
Presenting Author's Institution: SUNY Downstate Medical Center - Tenafly, NJ
Co-Author: Joanna Serafin Ph.D. - SUNY Downstate Medical Center
Denis Odobasic M.D., Prim - University Clinical Center Tuzla
Senida Keser M.D., Prim - University Clinical Center Tuzla
Dzenita Ljuca M.D., Prof - University Clinical Center Tuzla
Enida Nevacinovic M.D., Doc - University Clinical Center Tuzla

Introduction: University Clinical Center Tuzla (UCCT) is the second largest Clinical Center in Bosnia, with approximately 3000 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.

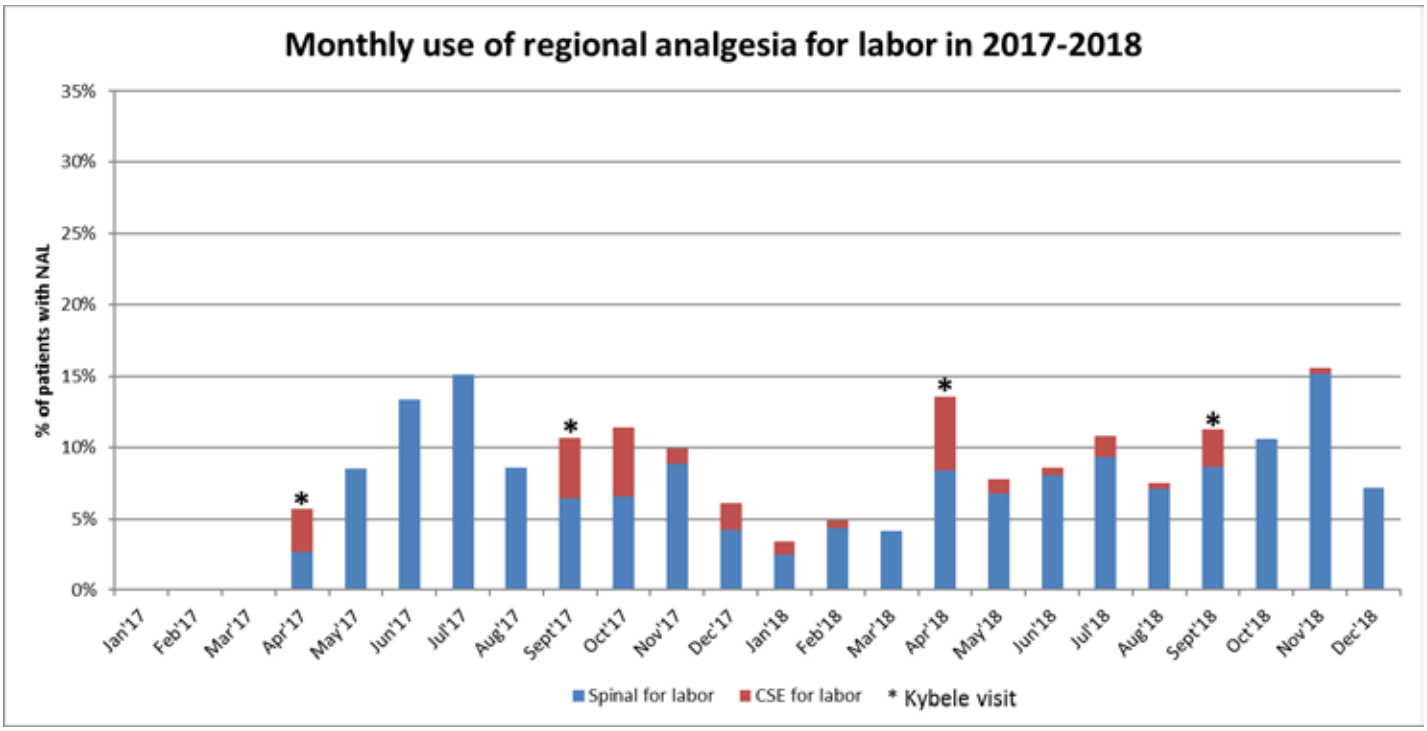
Method: In April and September 2018, a Kybele team, visited UCCT for 5 and 5 days respectively to conduct training in RA for CD and neuraxial analgesia for labor (NAL). The data were retrospectively collected on the use of RA for CD and on the use of NAL for the period of January 1st, 2018 to December 31st, 2018.

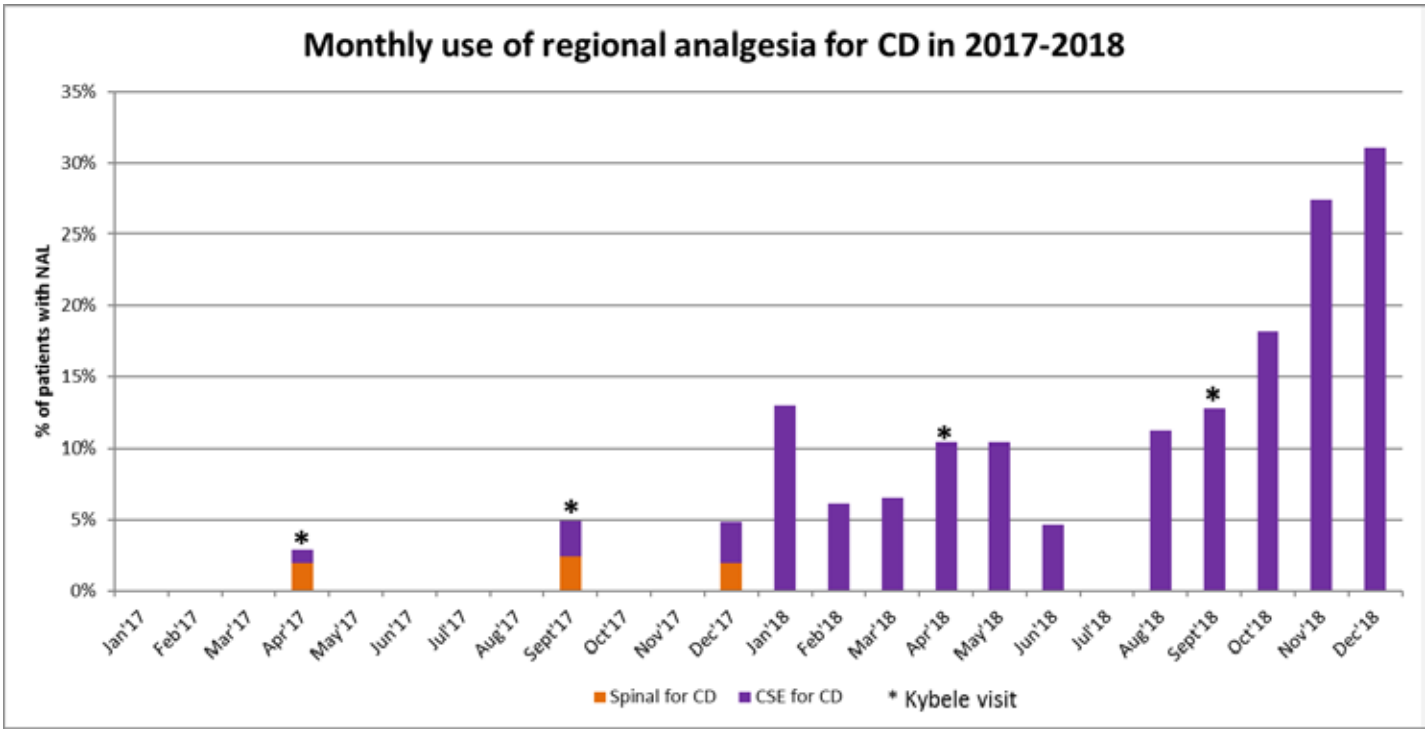
Results: The monthly and annual use of RA for labor and CD is shown in the Figure 1. A total of 221 patients had NAL for labor during 2018, comparable to 218 in 2017. Also, a total of 119 RA were done for CD an increase of 915% comparing with 2017. The trend across visits indicates increasing RA use over time, for CD and no change in use of RA for labor. Majority of the faculty is now comfortable with single shot spinal (SSS) for labor and increasing number of faculty members are comfortable with spinal anesthesia for CD.

Discussion: Our efforts during first visit resulted in creation of labor analgesia service. During the second visit we concentrated on epidural/CSE and faculty members expressed willingness to learn these techniques. During the third and fourth visit we concentrated on spinal anesthesia for CD.

Conclusion: SSS analgesia is an excellent option for labor analgesia where there is limited or no experience with epidural/CSE analgesia. SSS analgesia was very well accepted by patients and obstetricians. Spinal anesthesia for CD was also very well accepted among patients and obstetricians. There remains limited availability of trained anesthesiologists and obstetricians and lack of patient education on the benefits of RA and NAL. The local team has started education sessions for their patients about the benefits of RA for labor and NAL for CD. Future Kybele team visits will concentrate on training additional faculty on the use of epidural/CSE for labor and RA for CD. Plans are made to invite practitioners beyond UCCT (Zenica) to increase RA and NAL utilization across the country.

Abstract #: T2C-250





Abstract #: T2C-262

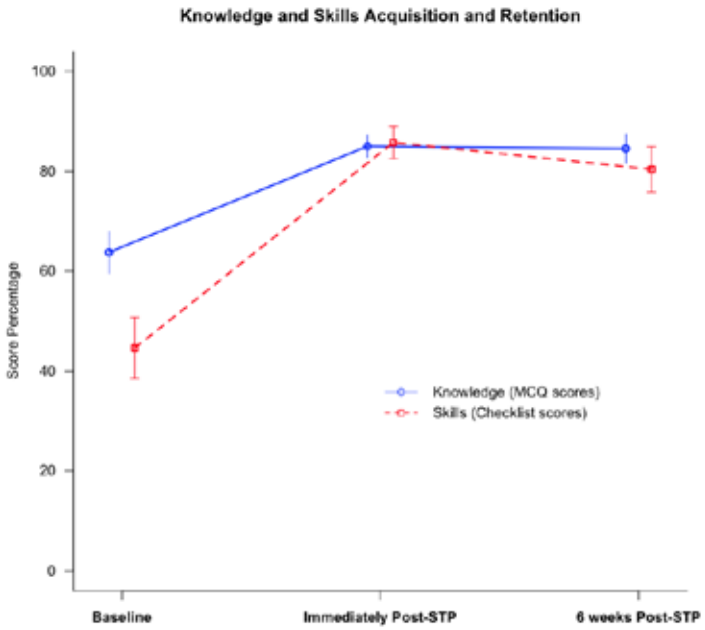
Acquisition and Retention of Knowledge and Skills by Operating Room Nurses in Providing Anesthetic Assistance during Emergency Cesarean Delivery under General Anesthesia

Presenting Author: Zahid Sunderani MD FRCPC
Presenting Author's Institution: B.C. Women›s Hospital and Health Centre - VANCOUVER, British Columbia
Co-Author: Roanne Preston MD FRCPC - B.C. Women's Hospital
Trevor Kavanagh MB BCh BAO FCAI FRCPC - B.C. Women's Hospital
James Taylor BSc - B.C. Women's Hospital
Arianne Albert PhD - Women's Health Research Institute
Anthony Chau MD FRCPC MMSc - B.C. Women's Hospital

Introduction: During emergency cesarean delivery, an anesthesiologist often needs additional assistance from operating room nurses (ORN) to safely induce general anesthesia (GA).[1] This role requires specific knowledge and skills; however, due to low institutional rates of GA cesarean deliveries, ORN may not be comfortable providing assistance. Consequently, we developed and administered a 30-min structured training program (STP) to all ORN. We hypothesized there would be significant improvement in knowledge and skills following STP, and that these would be retained at 6 weeks and 6 months.

Methods: Following ethical approval for waiver of consent, 42 ORN at our institution were invited to participate. First, in groups of 2 to 3 participants, baseline knowledge was assessed using a 14-item paper multiple choice questionnaire (MCQ); skills were assessed using a 12-item checklist scored by direct observation during simulated induction of GA. Next, a 20-min didactic lecture followed by a 10-min hands-on skills station were delivered. Finally, knowledge and skills were immediately re-assessed after STP, and again at 6 weeks and 6 months. Topics covered in STP included intraoperative monitors, airway equipment, patient positioning, pre-oxygenation and rapid sequence intubation. Primary outcome was knowledge and skills retention measured by change in mean MCQ and checklist scores at 6 weeks and 6 months analyzed by independent samples t-test. Secondary outcome was knowledge and skill acquisition after STP. P-values were adjusted for multiple comparisons.

Results: To date, data were collected for 35 ORN up to 6 weeks. Compared to baseline, there was a significant increase in both mean MCQ (84.7% vs. 63.7%, p<0.0001) and checklist scores (86.3% vs. 46.3%, p<0.0001) immediately post-STP.(Fig) At 6 weeks, mean MCQ score remained stable but a significant decay in mean checklist score was found (86.3% vs. 81.4%, p=0.018).



Discussion: The knowledge and skills in providing anesthetic assistance by ORN were low at baseline; however, significant improvement occurred following a STP. Consistent with findings in the literature, we found there was greater retention of knowledge by our ORN compared to skills at 6 weeks.[2] While awaiting follow-up data at 6 months, these early results suggest that skill retention may require more frequent reinforcement than knowledge retention.

References:

1. Williams C et al. Brit J Nurs 2018
2. Yang CW et al. Resuscitation 2012

Abstract #: T2C-337

GPS for Neuraxial Block - A RCT Evaluation of Neuraxial Block Placement Between Using Palpation of Landmarks Versus Pocket-Size Handheld 3-D Guided Ultrasound (US) Navigation Device in Obese Parturients

Presenting Author: Jennifer Fichter MD
Presenting Author's Institution: Wake Forest School of Medicine - Winston Salem, NC
Co-Author: Vernon Ross MD - Wake Forest School of Medicine
Lynne Harris BSN - Wake Forest School of Medicine
Peter Pan MD - Wake Forest School of Medicine

Background: Palpation(P) of the spinous process and surface landmarks is the traditional method for neuraxial block(NB) placement. However, P becomes challenging in obese parturients. Ekinci et al and Wang et al showed conventional ultrasound(CUS) decreased NB attempts especially when P was difficult.1,2 CUS is limited by its bulkiness, less optimal image around the spine, long learning curve and subjective user interpretation. A new pocket size US (Accuro,Rivanna Inc) addresses some of these limitations by providing real time navigating guidance using pattern recognition algorithm for spinal bony structures with simulated 3D image overlay to identify the midline intervertebral space. We hypothesized that such US (Accuro) may reduce time and attempts to obtain LOR during CSE in obese patients.

Methods: After Novant Health & Wake Forest IRB approval, 60 parturients, with BMI>30 and requesting NB analgesia, were planned for informed consent and randomization to groups(Gp) P and US(U). Gp P utilized usual landmark P to identify Tuohy needle insertion site (NIS). In Gp U, NIS was identified and marked by Accuro US, and a second provider, without P of landmarks, performed the CSE. Experienced providers performed the CSE in both groups. The primary outcome was the time from Tuohy needle insertion to epidural loss of resistance (LOR). Secondary outcomes included: # of Tuohy needle passes and redirections, 1st attempt success, US scanning or P time and patient's reported VAS pain and satisfaction scores (0-10) on the CSE. 30/group was required to show a 20% group difference in time to LOR with power=0.80, α=0.05 and $P<0.05$ as significant.

Results: 49(23-Gp P, 26-Gp U) of 60 planned evaluable subjects were enrolled so far. Demographics were similar between groups. Median US scanning time was 31s in Gp U vs 25s for P in Gp P. Median time to LOR was shorter (94s) in Gp U than the 108s in Gp P. 50% of Gp U and 30% of Gp P accomplished LOR with 1st pass without redirection. Mean and median number of needle passes and redirections and patients' reported pain VAS with CSE were lower in Gp U (Table 1). Statistics will be performed after all 60 subjects enrolled and presented at SOAP.

Conclusions: Preliminary data suggest use of Accuro US may shorten time for successful LOR, increase success rate of 1st pass without redirection and lessen pain vs traditional P method in CSE for obese parturients.

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2. Wang Q, et al. CMJ 2012;125:3840-3

Abstract #: T2C-337

Table 1: Summary of Results – Demographics and Outcomes

Outcomes		All Subjects (N=49)		Palpation (P) Group P (n=23)		Ultrasound (U/S) Group U (n=26)
Age (years)	Median	28		28		27
	IQR	24 - 30		24 - 30		25 - 32
	Mean±SD	28±5		27±5		29±6
BMI(kg/m²)	Median	34		35		34
	IQR	32 - 38		32 - 38		32 - 39
	Mean±SD	35±4		35±4		35±3
Weight (kg)	Median	94		94		94
	IQR	86 - 105		88 - 103		87 - 108
	Mean±SD	96±13		94±12		97±14
Estimated Gestation Age (wk)	Median	39		38		39
	IQR	37 - 40		37 - 39		37 - 40
	Mean±SD	39±2		38±2		39±2
US Scan/Palpation time(Seconds)	Median	29		25		32
	IQR	14 - 44		13 - 45		19 - 43
	Mean±SD	34±32		28±18		38±41
Tuohy Needle - Skin Insertion to LOR (Seconds)	Median	95		108		94
	IQR	61 - 194		73 - 204		52 - 176
	Mean±SD	149±148		157±132		142±163
Number of Tuohy Needle Passes (n)	Median	1		1		1
	IQR	1 - 2		1 - 2		1 – 1.8
	Mean±SD	1.5±0.9		1.7±1.1		1.4±0.8
Success with a Single Pass of Tuohy Needle with No Re-Directing	n/N	19/49		7/23		12/26
	(%)	39%		30%		46%
Number of Tuohy Needle Re-Directing (n)	Median	1		2		1
	IQR	0 - 3		0 – 3.5		0 – 2.9
	Mean±SD	1.9±2.6		2.7±3.2		1.9±2.6
Patient's VAS pain score of the CSE Procedure (0-10)	Median	4.0		5.0		3.5
	IQR	3.0 – 5.0		3.0 – 5.5		2.0 – 5.0
	Mean±SD	4.0±2.2		4.7±2.3		3.5±2.0

IQR= Interquartile range ; Mean IQR = Mean of IQR ; SD =Standard Deviation;

U/S= Ultrasound; LOR=Loss of Resistance

Abstract #: T2C-348

Impact of spinal ultrasound training on landmark identification of L3/L4 interspace

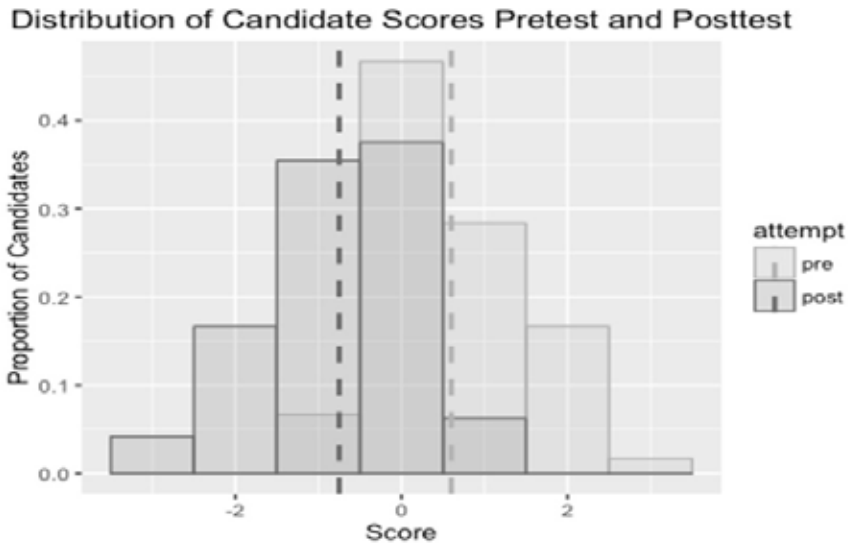
Presenting Author: Ruchira Patel MBBS, BSc, FRCA
Presenting Author's Institution: Homerton University Hospital NHS Foundation Trust - London
Co-Author: Priya Shinde MD, DNB, FRCA - Homerton University Hospital NHS Trust
Joana Neves MBChB, FRCA - Homerton University Hospital NHS Trust
Barbara E Erêche MBChB, BSc (Hons), Math Stat - Homerton University Hospital NHS Trust
Desikan Rangarajan PhD, MBBS, FRCA - Homerton University Hospital

Background: Tuffier\'s line, commonly used to identify the L3/4 interspace, can be unreliable with several studies identifying that operators tend to be more cephalad 1,2. This can potentially damage the conus following spinal anaesthesia. We explored whether training in lumbar spine ultrasound (LSU) improved accuracy of the landmark identification of the L3/4 interspace.

Method: We assessed the accuracy of landmark identification of the L3/4 interspace by anaesthetists pre and post intervention, the intervention being two LSU teaching sessions, 2 weeks apart with practice interim. Participants were asked to identify the L3/4 interspace on models. The accuracy of their marking was assessed against hidden markings of the intervertebral spaces, identified earlier using ultrasound by a clinician trained in LSU. Participants were unblinded to the purpose of the study, but remained blinded to their results. Post-intervention, participants were again asked to identify the L3/4 interspace on models and the accuracy was assessed as before, by a trained clinician.

Results: We studied 6 participants with 10 models at preintervention, and 8 models at post-intervention giving us 60 and 48 data points respectively. Pre-intervention there was significantly higher identification of the L3/4 interspace by candidates using the landmark technique (avg 0.6 interspinous space above L3/4) compared to post-intervention (avg 0.75 interspinous space below L3/4). Assuming non-parametric distribution, the Wilcoxon rank test gives a p=0.031, rejecting the hypothesis that these results are due to chance, with 95% CI.

Discussion: Forty five per cent of candidates identified the L3/4 at a higher interspace using the landmark technique. After a short period of training in LSU, candidates did not identify the L3/4 interspace at extreme cephalad levels. Once unblinded candidates may have been overcautious in their landmark identification of L3/4, but arguably that is the value of training in LSU. Our data suggests that training in LSU could reduce the incidence of identification of high interspinous spaces for neuraxial block. We recommend LSU be used alongside the current landmark technique when teaching neuraxial procedures. Our study was limited by a small sample size, self selection of candidates and lack of control group and random sampling.



References

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2. Anaesthesia 2001; 56:235 -47

Abstract #: T2C-422

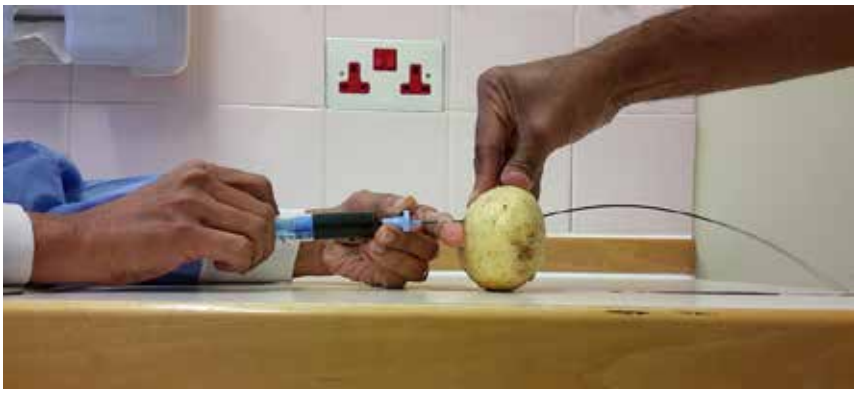
Epidural Simulators: The Potato, The Banana and The Mannikin

Presenting Author: Preetam Tamhane MBBS, MD, FRCA
Presenting Author's Institution: Basildon & Thurrock Univ. Hospitals NHS Trust - Basildon, Essex
Co-Author: Yin Yong Choo MBBS, FRCA - Basildon & Thurrock University Hospitals NHS Trust

Introduction: Epidurals are commonly performed for labour analgesia, for the treatment of chronic back pain or to provide peri-operative analgesia for major operations. [1]

Data from the 3rd National Audit Project of the Royal College of Anaesthetists showed that 40% of the 700,000 central neuroaxial blocks performed annually in the NHS are epidurals, with the majority being performed by anaesthetists. [2]

For many trainees, inserting an epidural for the first time in a patient can be very daunting and nerve-wrecking. The opportunity to be able to practice the feel of the loss of resistance technique on a model/manikin has been regarded to be extremely helpful. The development of different types of epidural simulators for this purpose have been of particular interest [1], including the use of basic greengrocer's items such as root vegetables and fruits as a cheap, effective, realistic and simple alternative to the commercial epidural simulator.



Method: Anaesthetists in our hospital were asked to compare the potato, the banana and the commercially available manikin, and to rate and compare the feel of the loss of resistance as well as the feel of the 'ligamentum flavum'.

Results

- 78% of anaesthetists surveyed were aware of commercial epidural simulators, and only 26% were aware of greengrocer's items used as epidural simulators.
- Most anaesthetists use loss of resistance to saline (65%) and continuous pressure (61%).
- The feel of the loss of resistance was best in the potato (81%), followed by the manikin (78%), and then the banana (70%).
- The feel of the ligamentum flavum was best in the potato (67%), followed by the manikin (58%), and then the banana (48%).

Conclusion: We started this project to find the perfect epidural simulator as an educational tool to aid the teaching of performing epidurals. In conclusion, there is no perfect simulator model. But, the potato has emerged as the simulator model with the closest feel of loss of resistance and feel of ligamentum flavum to the real patient, and the 'feel' is better when using the loss of resistance to saline method with continuous pressure.

References:

1. Vaughan N, Dubey VN, Wee MY, Isaacs R. A Review of Epidural Simulators: Where are we Today? Med Eng Phys. 2013 Sep;35(9):1235-50.
2. Cook TM, Counsell D, Wildsmith JAW. Major complications of central neuraxial block: report on the 3rd National Audit of The Royal College of Anaesthetists. Br J Anaesth 2009;102:179-90.

Abstract #: T2D-272

A Randomized Controlled Trial of Intrathecal Chloroprocaine vs. Bupivacaine for Cervical Cerclage

Presenting Author: Alaa Basura MD
Presenting Author's Institution: Tufts Medical Center - Boston, MA
Co-Author: Natalia Stamas MD, Medical Center
Dan Drzymalski MD - Tufts Medical Center

Background: Cervical cerclage is an ambulatory surgical procedure commonly performed under neuraxial anesthesia. Bupivacaine, commonly used for spinal anesthesia, is considered a "longer acting" local anesthetic, whose block may last significantly longer than necessary for cervical cerclage. Alternatively, chloropropaine is a shorter acting agent with faster recovery time (1, 2). The aim of this study was to determine if there is a difference in duration of motor block. Our hypothesis was that chloroprocaine would result in shorter duration of motor block.

Methods: After IRB approval and written informed consent, parturients undergoing a prophylactic McDonald cervical cerclage from 10/2/2017 to 8/24/2018 at an academic institution were randomized to receive an equal volume of either chloroprociane 40 mg or bupivacaine 7.5 mg for spinal anesthesia. A blinded observer recorded the evolution of sensory and motor block until complete regression, as well as time to ambulation and micturition. The primary outcome was duration of motor block. Student's t-test and Kaplan-Meier's method were used to statistical analysis.

Results: Of 18 parturients approached, 10 parturients were recruited and randomized. The duration of motor block was for chloroprocaine vs. bupivacaine was 75±6 vs. 99±48 min, p=0.36. Comparing chloroprocaine vs. bupivacaine, there were differences in the duration of sensory block (127±20 vs. 210±56 min, p=0.02, see figure) and the duration until micturition (111±31 vs. 233±40 min, p=0.002).

Conclusion: While duration of motor block was similar between the two groups, parturients receiving chloroprocaine had shorter duration of sensory block and time to micturition. The lack of difference in motor block may be due to the doses used or small sample size.

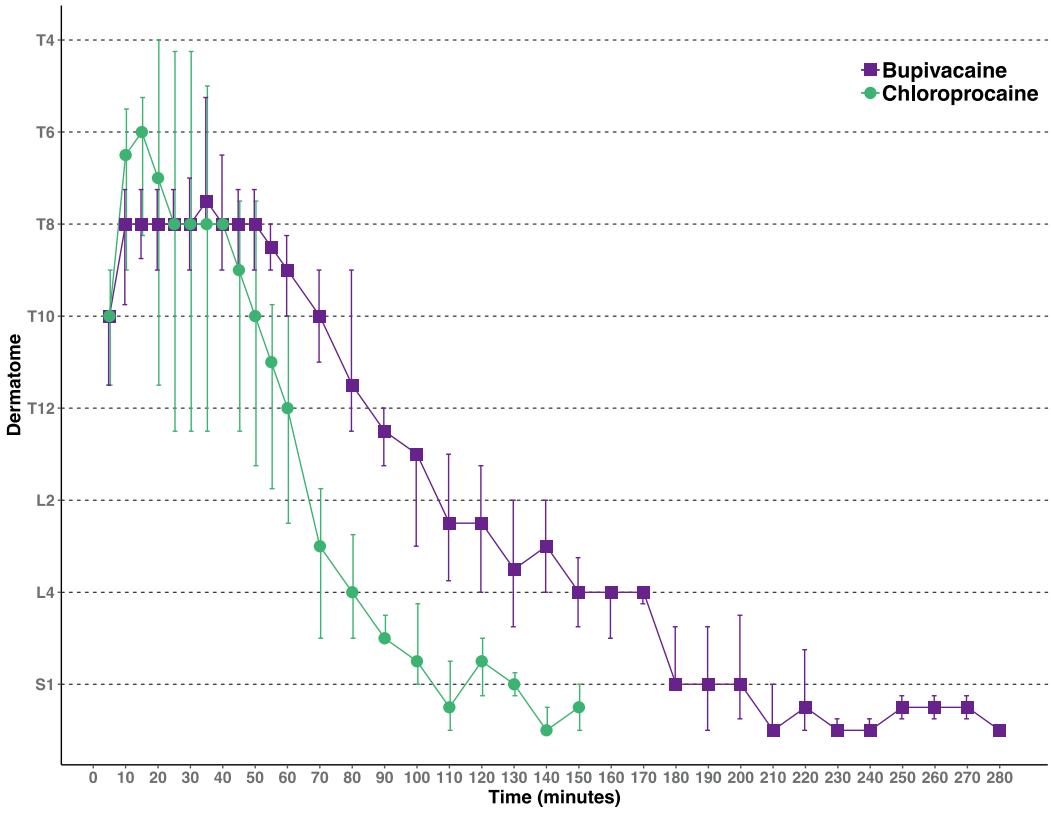


Figure 1: Regression of the dermatomal level of the sensory block over time: comparison of patients receiving an intrathecal injection of either bupivacaine 7.5 mg (n = 5) or chloroprocaine PF 40 mg (n = 5) *p 0.02*

Abstract #: T2D-309

'How much is too much?': Spinal bupivacaine for intrapartum cesarean delivery following failed labor epidural – A retrospective cohort analysis

Presenting Author: Alla Yarmosh M.D., M.C.R.
Presenting Author's Institution: University of Texas - Southwestern - Dallas, Texas
Co-Author: Nwamaka Nnamani M.D. - University of Texas - Southwestern
Mary C. Sunna CRNA - University of Texas - Southwestern
Emily Melikman MD - University of Texas - Southwestern

Introduction: Conversion of epidural labor analgesia (ELA) to surgical anesthesia can be inadequate. CSE and Spinal anesthesia (SA) are viable options to avoid the complications of GA. Certain circumstances arise when the parturient cannot receive CSE such as severe platelet abnormality, inability to thread the catheter during CSE placement and urgent C/S; in these instances, SA can be employed. However, controversy exists about the dose of LA and the side effects including high/complete spinal and failed blocks. There is a paucity of large cohort study in this area. We conduct a retrospective cohort analysis in our university teaching hospital with over 12,000 annual deliveries to evaluate the incidence of high and failed spinal and describe our experience using a narrow range of LA dose.

Methods: After IRB approval, we retrospectively collected data from medical records of parturients who received SA or CSE for intrapartum C/S following failed ELA between 2012-2016. We have 500 eligible subjects who meet our inclusion criteria of failed ELA with 0.125% bupivacaine and fentanyl 2 mcg/ml at continuous infusion rate of 8-12mls/hr and received hyperbaric 0.75% bupivacaine for C/S.

Results: Preliminary analysis of 100 subjects out of 500 eligible cases indicate mean (+/-SD): Age (years) 26.7 (+/-6.93), Height (cm) 158.1 (+/- 5.64), BMI (kg/m2) 33.63 (+/- 6.8), Epidural infusion time: 9.1 (+/- 5.36) hours, Labor epidural sensory level pre SA(Median, range): T8 (T2-T12), Spinal/CSE sensory level (median, range): T4, (C8-T6), 0.75% Hyperbaric Bupivacaine Dose HBD (median, range) 10.5, 7.5-15 mg, Fentanyl (mcg) (median, range): 20, (15-20), Percent requiring phenylephrine 40%, Percent requiring ephedrine: 24%, Umbilical Artery pH (median, range): 7.23 (6.93-7.34). One patient (1%) had a high spinal and required assisted ventilation (SA HBD 10.5mg). 3% subjects had failed blocks, 2 received CSE with HBD 7.5mg and 1 had SA with HBD 10.5mg. HBD of 10.5mg was given to 30% of subjects and 74% of subjects received 10.5mg or greater.

Discussion: Preliminary analysis indicate that spinal anesthesia should be considered and dosed adequately in intrapartum C/S particularly in circumstances when a CSE cannot be placed.

Abstract #: T2D-315

Comparison of Chloroprocaine to Lidocaine/ Epinephrine/ Bicarbonate/ Fentanyl for Epidural Anesthesia in Elective Cesarean Delivery: A Randomized study

Presenting Author: Prannal Bansal MD
Presenting Author's Institution: University of Arkansas for Medical Sciences - Little Rock, Arkansas
Co-Author: Nadir Sharawi MD - University of Arkansas for Medical Sciences
Cameron Taylor MD - Duke University
Jill Mhyre MD - University of Arkansas for Medical Sciences

Background: Epidural extension anesthesia allows rapid conversion of labor epidural analgesia into surgical anesthesia. The ideal local anesthetic solution for epidural extension anesthesia remains unclear, with most evidence drawn from observational data.

Methods: This single center randomized, double-blind, noninferiority study conducted from February to November 2018 tested the hypothesis that chloroprocaine (CP) would be noninferior to a mixture of lidocaine, epinephrine, bicarbonate, and fentanyl (LEBF) in terms of onset time to surgical readiness for epidural extension anesthesia. ASA II patients with a singleton pregnancy scheduled for elective cesarean delivery (CD) had lumbar epidurals placed pre-operatively. Analgesia was induced with 0.0625% bupivacaine with 2 mcg/ml fentanyl to achieve a T10 sensory level. The same solution was infused at 10 ml/hr until OR entry. Participants with bilateral blockade were randomized into 2 groups: group CP received 20 ml of 3% CP with 4 ml saline and group LEBF received 20 ml of 2% lidocaine, 0.15 ml of 0.1% epinephrine, 2 ml of 8.4% bicarbonate, 100 mcg fentanyl. Dosing was standardized to measure time to loss of touch sensation bilaterally at the T7 dermatomal level, the primary outcome. The secondary outcome was the need for intraoperative analgesia supplementation. The non-inferiority margin was set at 180 sec, and the study was powered assuming a standard deviation of 4 minutes, to a significance level of 5% and a power of 90%.

Results: 70 patients (35 in each group) were enrolled; 2 patients from CP and 1 from LEBF were withdrawn due to inadequate block preoperatively. Demographics, side effects and duration of surgery were comparable between groups. Analysis of the primary outcome to surgical onset time between the CP group (655 + 258 sec) and LEBF group (558 + 269 sec) of - 97 sec (95% CI, - 11 to 204; P=0.003). The upper CI of the difference 204 sec, was more than the predefined noninferiority margin of 180 sec (Figure 1). Therefore, the data is insufficient to confirm noninferiority of CP compared to LEBF. 7 CP patients (21%) and 4 LEBF patients (12%) required intraoperative analgesia supplementation (P=0.3).

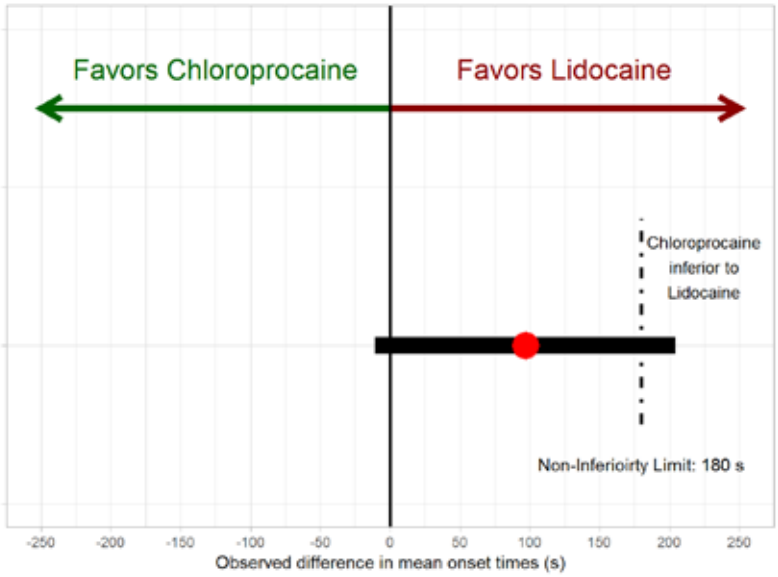


Figure 1. Noninferiority diagram with observed difference to onset time of bilateral T7 sensory block between the chloroprocaine and lidocaine (with epinephrine, bicarbonate, and fentanyl) group. The dashed line designates the noninferiority margin. The error bars designate the 95% CI of the difference between the chloroprocaine and lidocaine groups.

Discussion: CP was found to be not non-inferior to LEBF in regards to onset times of surgical anesthesia for CD. Future investigations should evaluate whether LEBF provides faster onset of anesthesia compared with CP.

Abstract #: T2D-354

Comparison of Isobaric and Hyperbaric Bupivacaine for Spinal Anesthesia in Patients Undergoing Postpartum Bilateral Tubal Ligation

Presenting Author: Jeffrey S Chen MD
Presenting Author's Institution: UT Southwestern Medical Center - Dallas, TX
Co-Author: Maria Lima BA - UT Southwestern Medical Center
Tristyn St. Thomas-Achoja MD - UT Southwestern Medical Center
Emily Melikman MD - UT Southwestern Medical Center
Enas Kandil MD, Msc - UT Southwestern Medical Center
Nwamaka Nnamani MD, MSc - UT Southwestern Medical Center

Background: Hyperbaric (HB) and isobaric (IB) bupivacaine have been used for spinal anesthesia in obstetric surgery. Past studies do not demonstrate superiority of one formulation over the other [1][2]. The purpose of this retrospective study is to evaluate the efficacy and failure rates of spinal anesthesia with hyperbaric (0.75%) versus isobaric (0.5%) bupivacaine in patients undergoing postpartum bilateral tubal ligation (BTL).

Methods: The records of 100 HB and 100 IB patients who received postpartum BTL between June 2017 to August 2018 were collected. Demographics, spinal anesthetic variables, supplemental anesthetic medications, and conversion to general anesthesia were compared. Spinals were performed with the patient in the sitting position and followed by the supine position after injection. As per standard practice at our institution, 20mcg of fentanyl was added to the bupivacaine.

Results: There was no difference in patient demographics between the HB and IB groups (Table 1). Median dose of HB was 10mg and IB was 10.5mg with a range of 5 - 21mg. Patients receiving IB were more likely to receive supplemental medications such as fentanyl (40% HB vs 66% IB, $p < 0.05$), midazolam (84% HB vs 98% IB, $p < 0.05$), and propofol (4% HB vs 11% IB, $p < 0.05$). Rate of conversion to general anesthesia, constituting a failed spinal block, tended to be higher in patients receiving IB (4% HB vs 9% IB, $p = 0.076$).

Conclusion: The results showed that IB bupivacaine had an increased need for supplemental anesthetics despite similar doses of bupivacaine used in each group. This finding suggests IB bupivacaine is less effective than HB bupivacaine for tubal ligation procedure. There may also be an increased risk of failure with need for conversation to general anesthesia with IB bupivacaine. Possible explanations for these findings include differences in the density of block, rise of the block due to baricity, and operator unfamiliarity with IB dosing. [3]

Table 1: Demographics for patients undergoing bilateral tubal ligation.

	Hyperbaric			Isobaric		
	Mean	Median	IQR	Mean	Median	IQR
Age (yrs) :	32.04	32	8	32.45	32.5	8
Height (in):	62.38	62	3.88	61.37	63	3.03
Weight (kg):	82.74	81.5	21.8	82.51	80.3	18.23
BMI:	32.82	32.9	7.94	32.20	32.6	6.6
Gravidity:	4.17	4	2	4.37	4	2
Parity:	3.59	3	1	3.77	3.5	1.25
Abortion:	0.56	0	1	0.65	1	1

Abbreviations: IQR - interquartile range

References:

1. Sng BL, Siddiqui FJ, Leong WL, et al. Hyperbaric versus isobaric bupivacaine for spinal anaesthesia for caesarean section. Cochrane Database Syst Rev. 2016;9:CD005143.
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3. Beecroft, Christina. Spinal anaesthesia. Anaesth Intensive Care. 2015;16(11):563-565

Abstract #: T2D-393

High and Total - Spinal Anesthesia: A Systematic Review

Presenting Author: Unyime Ituk MBBS, FCARCSI
Presenting Author's Institution: University of Iowa - Iowa City, IA
Co-Author: Erik W Anderson MA - Carver College of Medicine University of Iowa
Michael Heffernan BS - Carver College of Medicine University of Iowa
Unyime Ituk MBBS - University of Iowa
Cynthia Wong MD - University of Iowa

Introduction: High- or total spinal anesthesia is a rare yet serious complication of neuraxial anesthesia that can be caused by unintentional or unrecognized injection of local anesthetic into the subarachnoid space or unintentional cephalad extension of a neuraxial blockade. A prospective multicenter audit reported an incidence in the obstetric population of 1:4,336 neuraxial procedures.1 Multiple case reports and small series have highlighted this complication, but these individual reports give little information about risk factors, natural history of the event, and best treatment practices. Our aim was to perform a qualitative systematic review to identify all reports, identify commonalities and develop a better understanding of risk factors, the natural history, and best treatment practices.

Methods: This study was conducted according to PRISMA guidelines and the protocol was registered on the PROSPERO website. PubMed, EMBASE, CINAHL, Web of Science, Cochrane and Google Scholar were systematically searched without date restrictions. We manually searched the UK Confidential Enquiries into Maternal Deaths (1970-2017), the abstracts from annual meetings of the Society for Obstetric Anesthesia and Perinatology (2009-2018) and the American Society of Anesthesiology (2000-2018). Data extracted from each report included patient demographics, primary procedure, type and level of neuraxial anesthesia, drugs and doses, first sign or symptom, time of first sign or symptom, intervention, time until resolution, and observed complications.

Results: The search identified 8,052 sources. After de-duplication and eligibility screening, 91 sources and 127 cases were eligible for inclusion. Patient demographics, primary procedure, neuraxial anesthesia used, and patient outcomes are reported in the Table. Nine patients died (5 immediately and 4 within one week) and 2 had permanent injury).

Variable	Data
Patient Demographics	
Age (mean [range])	33 y [2 m – 89 y]
Sex (n)	
Female	93
Male	22
Unknown	11
Surgical Procedures (n)	
Obstetric	77
Orthopedic	10
General surgery	10
Vascular surgery	5
Postoperative epidural analgesia	5
Urology surgery	4
Gynecologic surgery	4
Unknown	11
Neuraxial procedure (n)	
Epidural	58
Spinal	23
CSE	21
Epidural converted to spinal	6
Double epidural catheter	2
CSE converted to epidural	2
Epidural with general	2
CSE with additional spinal top-up	1
Unknown	11

Discussion: Most patients who experienced high or total spinal anesthesia had perioperative complications but were discharged without permanent sequelae. Most patients had rapid onset of initial signs, but 27 patients presented with symptoms more than 30 minutes after the injection of anesthetic. A high index of suspicion and high-quality resuscitation are necessary to good outcomes.

References:

1. D\'Angelo R, et al.. Anesthesiology 2014 Jun;120:1505-12

Abstract #: T2D-427

Epidural test dose practices in current day obstetric anesthesia practice: A literature review

Presenting Author: Yahui Tammy Symons MD, FRCPC
Presenting Author's Institution: Schulich Medicine & Dentistry, Western University - London, Ontario
Co-Author: Magdalena Terlecki MD - Western University
Indu Singh MD, FRCPC - Western University
Ian McConachie FRCA, FRCP - Western University

Background: The ideal epidural test dose should allow the detection of a malpositioned catheter, be readily available, safe, and effective, with high sensitivity and low specificity.1 The classical intrathecal and intravenous test dose has been proposed as 45 mg of lidocaine with 15 mcg of epinephrine.2,3 There is no consensus regarding the content and nature of the ideal test dose in obstetric anesthesia. This literature review aimed to clarify current epidural test dose practices in recent years as published in a leading Obstetric Anesthesia journal.

Methods: A literature review of all articles published in the International Journal of Obstetric Anesthesia from 2009 to 2018 was conducted. Articles that mentioned use of an epidural test dose were identified and data pertaining to type and dose of local anesthetic, volume, presence of additives, and method of administration were reviewed.

Results: In all issues published in the last 10 years, an epidural test dose was mentioned in a total of 42 papers. Of these, 36 articles went into detail regarding type and nature of the test dose. We have included 42 test doses as described in these studies. The three most commonly used local anesthetics were lidocaine in 27 of cases (64.3%) followed by ropivacaine in 8 (19.0%), and bupivacaine in 7 (16.7%). Dose of lidocaine used ranged from 40-60mg. Doses of ropivacaine ranged from 5.1-50mg and bupivacaine from 5-20mg. Levobupivacaine was used in
2 articles (4.8%) at doses of 6.5mg and 15mg. Chloroprocaine was used in 1 case (2.4%) at a dose of 60mg. Epinephrine was included in the test dose in 17 articles (40.4%) and 6 included a narcotic (14.3%). Separate intrathecal and intravascular test doses were performed in 2 studies (4.8%).

Discussion: Our findings suggest that there is no consensus amongst obstetric anesthetists regarding the ideal test dose. Lidocaine is the most commonly used local anesthetic, but there is significant variation in use of other local anesthetics and in the doses chosen. A widely used obstetric anesthesia reference text cites lidocaine 40-60mg and bupivicaine 7.5mg as acceptable intrathecal test doses, with the addition of epinephrine to allow for combined intrathecal and intravenous test dosing.1 Intravenous test dose without epinephrine would require lidocaine 100mg, bupivacaine 25mg, or chloroprocaine 100mg. Based on our findings it would appear that most authors administer an intrathecal test dose only, and test doses of local anesthetics not listed in the reference text are in use. Finally, some authors reported performing a test dose but did not elaborate on further details. Improved documentation going forward is important, as well as further research to determine the ideal test dose.

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2. Survey of Anesthesiology 1982;26(5):306-7.
3. Journal of clinical anesthesia 2003;15(6):474-7.

Abstract #: T2D-450

Conservation measures during national drug shortages in 2018: a case series of 200 women receiving isobaric bupivacaine for cesarean delivery

Presenting Author: Laurence E Ring MD
Presenting Author's Institution: Columbia University - New York, NY
Co-Author: Xiwen Zheng MD - Columbia University
Beatriz Raposo MS - Columbia University
Ruth Landau MD - Columbia University

Background: In early 2018, critical shortages of bupivacaine affected obstetric anesthesia practice in an unprecedented way. Centers reported dwindling supplies and no availability of hyperbaric 0.75% bupivacaine (HBB), whether in spinal kits or in batches. After a reviewing options, isobaric bupivacaine 0.5% (IBB) was identified as best alternative for HBB. Studies of IBB versus HBB for cesarean delivery (CD) did not identify differences in level of block, need for vasopressors, side effects, or failure of block.(1,2) Based on the SOAP advisory3 and discussions with our Pharmacy leadership to assess the available inventory, it was decided that daily aliquoting by Pharmacy of IBB 0.5% syringes (15mg/3ml) for spinal anesthesia for CD would be the best solution for our L&D unit.

Methods: Our division members were informed (1) conservation measures were indispensable for the next 4-6 months, (2) IBB (12-15mg with neuraxial opioids per usual standard) was to be used for non-emergent or straightforward cases, (3) HBB would be reserved for emergent or complex cases. A case report form (CRF) evaluating onset time (min), delay in skin incision time, high dermatomal block, significant hypotension despite immediate start of phenylephrine infusion, maternal tachycardia, and conversion to GA was completed for all cases with IBB or HBB. CRFs was reviewed weekly to identify major complications and provide feedback related to IBB use. Subjective concerns with IBB vs HBB were also gathered.

Results: IBB was used between Feb 14- June 15 2018; 246 CRFs were collected representing 95% of cases done under spinal anesthesia during the shortage period. IBB was used in 200 cases, which far exceeded the available supply of over that period, and 46 cases received HBB.

With IBB, delayed onset (>12 min resulting in skin incision being delayed) occurred in 25 cases (12.5%), failure of surgical block requiring a 2nd neuraxial procedure occurred in 4 cases (2%), significant hypotension (SBP < 65mmHg) occurred in 7 cases (3.5%) with one patient requiring transient mask ventilation for high spinal , prolonged maternal tachycardia (>150bpm) in 2 cases, and urgent CD were done in a timely fashion with IBB in 2 cases. With HBB (urgent cases by definition), a longer than acceptable onset (>10 minutes) occurred in 6 cases (13%) with 1 requiring conversion to GA (STAT CD for abruption). There was significant hypotension (SBP <65mmHg) in 1 case (2.1%).

Conclusion: While this conservation measure allowed us to maintain our usual practice of providing neuraxial anesthesia for over 95% of all CD with only 1 case converted to GA, perception was that using IBB provided less reliable surgical block (longer onset, higher block, hemodynamic instability) and all were happy to resume to usual care mid-June.

References:

1. Anaesthesia 2018;73:790-1.
2. Anaesthesia 2018;73:499-511.
3. https://soap.org/2018-bupivacaine-shortage-statement.pdf

Abstract #: T2D-480

Contingency plan for 0.75% hyperbaric bupivacaine shortage: Ensuring maternal safety

Presenting Author: Kokila N Thenuwara MD, MME, MHCDS
Presenting Author's Institution: University of Iowa - Iowa City, IA
Co-Author: Unyime Ituk MBBS, FCARCSI - University of Iowa

Introduction: Drug shortages rose by 27% from 2017-18 in the United States, with resultant economic and patient safety implications. The Shortage of 0.75% hyperbaric bupivacaine (HB), the local anesthetic of choice for spinal anesthesia for cesarean delivery (CD) has significant implications in obstetric anesthesia. We would like to highlight steps in developing a contingency plan (CP) to mitigate this shortage.

Methods:
Key steps (Appendix-1)
Created multidisciplinary chain of communication: pharmacy to providers
Consolidated remaining 0.75%HB stocks
Obstetric anesthesia team shared insights, experiences using alternative local anesthesia and reviewed literature of comparison to 0.75 %HB

CP Communicated to providers caring for CD patients: Alternative drug choice of 1.4cc 0.75% plain bupivacaine+15micrograms fentanyl+150micrograms preservative free morphine; plain bupivacaine when used for CD can be unpredictable, thus we chose to administer it via a combined spinal epidural (CSE) technique, which takes longer than a spinal, thus less desirable for emergent CD resulting in parturients undergoing general anesthesia (GA). Thus, remaining stock of 0.75% HB was allocated for such cases to avoid GA. CP reversed at resolution

Results: Duration of shortage: 6 months
Remaining 0.75%HB 100vials
346 CD performed
87vials of 0.75%HB used
Quality data by providers showed no adverse patient events and unwarranted GAs for emergency CD.

Discussion:
Patient safety: Providers were familiarized with the alternative drug, dosing and method of administration to avoid medication errors.
Anesthesia training: Trainees Re-trained to perform CSE for CD with attention to spread but had reduced training in spinals for CD.

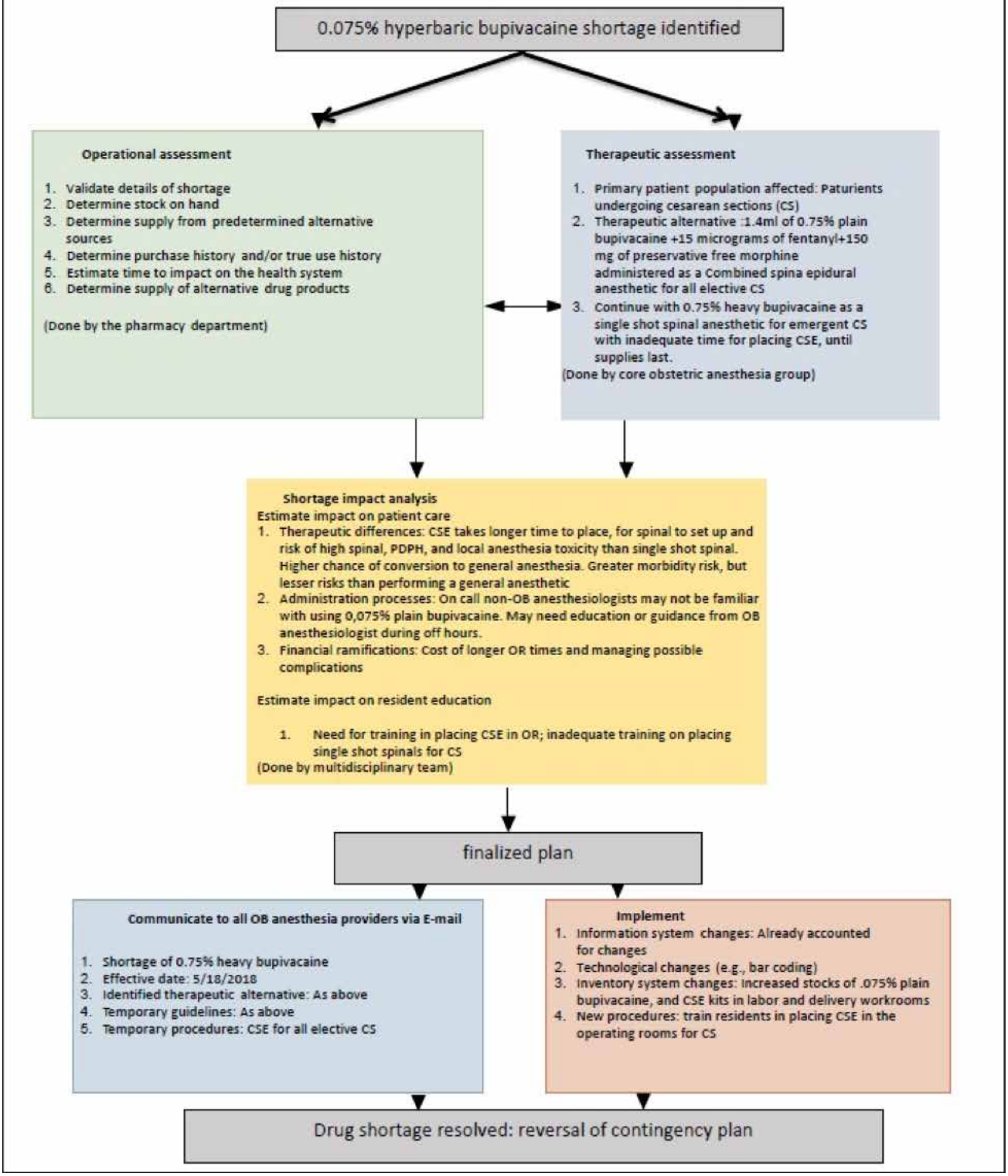
Ethical concerns:
Dilemma of patients' right to be informed on aspects of their care if morbidity and mortality is significantly increased with the alternative plan.

Conclusion: The key to navigating shortage was early communication between pharmacy and anesthesia, timely proposal of a CP, with goal of avoiding GA for CD due to selective allocation of remaining drug.
At national level, an early warning system to allow institutions to develop CP early, with restricted allocation of drugs by manufactures to minimize drug hoarding should be created.

(SOAP) Advisory in Response to Shortages 2018, ASHP Guidelines on Managing Drug Product Shortages in Hospitals and Health Systems. 2009

Abstract #: T2D-480

Appendix 1. Process map for decision making and managing drug shortages based on ASHP Guidelines on Managing Drug Product Shortages in Hospitals and Health Systems



Abstract #: T2D-499

Dosing of Intrathecal Bupivacaine in Super Obese Patients Undergoing Cesarean Delivery: A Retrospective Review

Presenting Author: Ryan M Militana DO
Presenting Author's Institution: University of Illinois at Chicago - Chicago, IL
Co-Author: Corinne C Weinstein MD - University of Illinois at Chicago
Jacqueline M Galvan MD - University of Illinois at Chicago
Heather C Nixon MD - University of Illinois at Chicago

Introduction: It has been theorized that obese parturients require a reduction in intrathecal local anesthetic dose compared to non-obese counterparts during cesarean delivery (CD). Publications examining intrathecal bupivacaine dosing in obese patients are limited to subject populations with BMIs less than 40kg/m2 and fail to demonstrate a clear need to lower dosages. However, no data exists regarding intrathecal dose requirements in super obese parturients with BMIs > 50kg/m2. This retrospective study examines the sensory levels in super morbidly obese patients receiving either high or low dose hyperbaric bupivacaine.

Methods: Following IRB approval, the University of Illinois Obstetrics QI Cesarean Delivery Database was queried to identify patients with a BMI of 50kg/m2 or higher who underwent CD from 10/1/12-1/25/19. Each patient's chart was hand searched to verify BMI, the use of intrathecal hyperbaric bupivacaine for CD and identify exclusion criteria (< 34 wks GA, < 148cm height, fetal wt > 4500gm, multiple gestations). Intrathecal bupivacaine doses were categorized as low dose LD (≤ 9 mg) or high dose HD (> 10mg) and sensory levels were categorized as inadequate (T7 or below), adequate (T4-T6), or high (T3 or above).

Results: A total of 230 subjects were identified and 130 were excluded due to alternative anesthetic technique (129) or missing data (1). Of the 100 pts who received intrathecal anesthesia with hyperbaric bupivacaine, 78 met inclusion criteria (16 low dose, 62 high dose). In the study group (Table 1), 23.29% had high levels (0 LD, 17 HD), 76.71% had adequate levels (15 LD, 41 HD), and 6.41% had inadequate levels (1 LD, 4 HD). High dose bupivacaine doses were associated with high sensory levels via Chi-square analysis (p-value 0.017). In the high dose group, one patient had a high spinal that required respiratory support.

Discussion: Our study demonstrates that HD intrathecal bupivacaine is associated with a high sensory levels (above T3) in super obese pts. There were no differences in the rates of inadequate levels between the high and low dose groups. Limitations of this study include the retrospective nature of the data and the small LD group size. Future prospective studies are needed to define ideal dosing in this population, but low dose intrathecal administration (7.5-9.0mg) may be a reasonable approach in combination with a CSE technique in this population.

References:

Carvalho, et al.(2011).Anesthesiology,114(3),529-535

Table 1

Group	**High Level** T3 or above	**Adequate Level** T4-T6	**Low Level** T7 or below
High Dose	17 (27.42%)	41 (66.13%)	4 (6.45%)
Low Dose	0 (0%)	15 (93.75%)	1 (6.25%)

Abstract #: T2H-244

Dexmedetomidine after cesarean for the treatment of shivering: Blinded Interim Analysis

Presenting Author: Sichao Xu MD
Presenting Author's Institution: Beth Israel Deaconess Medical Center - Boston, MA
Co-Author: Sichao Xu MD - Beth Israel Deaconess Medical Center
Erin J Ciampa MD - Beth Israel Deaconess Medical Center
Margaret O'Donoghue MD - Albany Medical Center
Yunping Li MD - Beth Israel Deaconess Medical Cente
Philip E Hess MD - Beth Israel Deaconess Medical Center

BACKGROUND: Multiple factors including temperature changes, hormonal and psychological stress, and neuraxial anesthesia and contribute to peripartum shivering that is experienced by many women. Past studies have demonstrated a decreased incidence in postoperative shivering with IV dexmedetomidine (DEX) in non-obstetric surgeries.(1) Intrathecal DEX has been shown to reduce post-cesarean shivering,(2) but IV DEX has not been studied in the obstetric population. We hypothesized that patients undergoing scheduled cesarean who receive IV DEX might have reduced incidence and severity of post-operative shivering. The blinded interim safety analysis of our randomized study is presented here.

METHODS: We randomized patients to receive either normal saline or 10 mcg of IV DEX after birth during cesarean delivery. Spinal anesthesia included 11.25mg bupivacaine, 25mcg fentanyl, and 0.25mg morphine. Temperature was measured once before and within 1 hour of surgery. Demographic, obstetric and anesthetic data were collected. At baseline (pre-operatively) and 30- and 60-minutes after arrival in the recovery room, patients were asked to report their pain, nausea, pruritus, shivering, dry mouth, and sedation on a 0-10 continuous rating scale. At the same timepoints, investigators recorded objective signs of vomiting, and assessed shivering, pruritus and sedation using a 5-point Likert scale. We performed univariate assessment of the relationship between symptom severity and group assignment using the Mann-Whitney test, with $p<0.025$ considered significant.

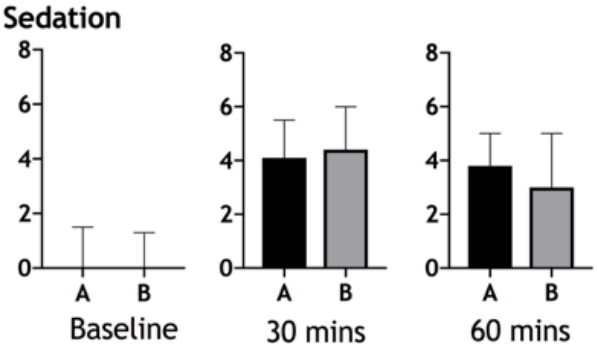
RESULTS: 50 patients were enrolled and 38 completed the study; 19 in each group. Patient characteristics were similar between groups. Both the subjective and objective side effect scores measured at baseline, and also at 30 min and 60 min postoperatively were similar between groups (FIGURE). The percentages of patients who required postoperative medication for pain, nausea, pruritus and GI symptoms within 24 hours were also similar between groups.

CONCLUSIONS: DEX 10mcg administered IV after cesarean delivery does not cause significant side effects in patients undergoing scheduled cesarean delivery, including the need for additional medications in the post-operative period. It is safe to continue the study and complete our assessment of the effect of DEX on severity of postoperative shivering with a target sample size of 100.

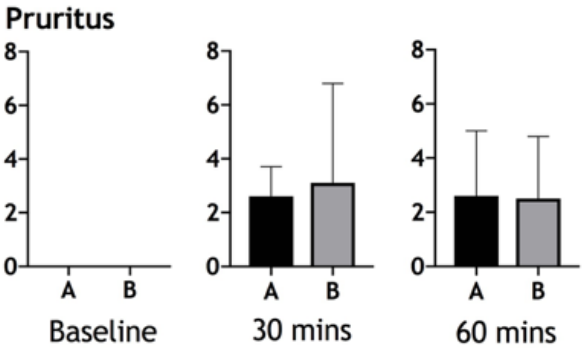
References:

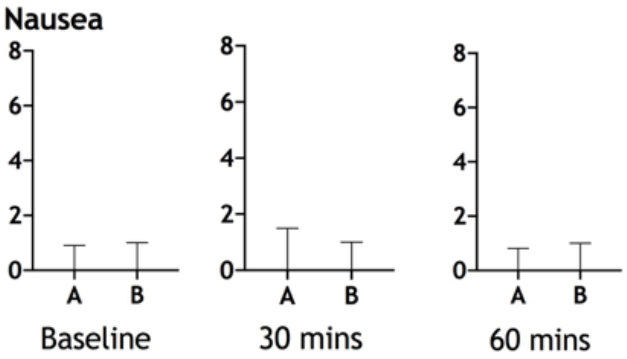
1. Can J Anaesth 2015;62:816-29
2. Drug Des Devel Ther 2017;11:1107–1113

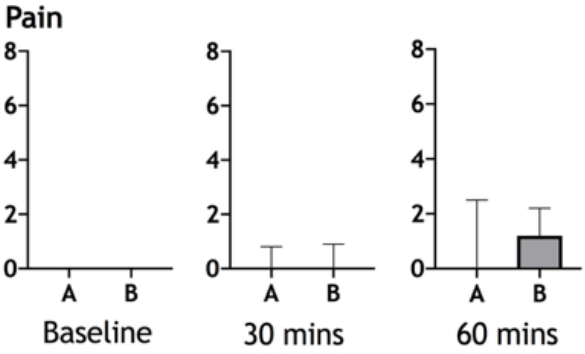
Abstract #: T2H-244

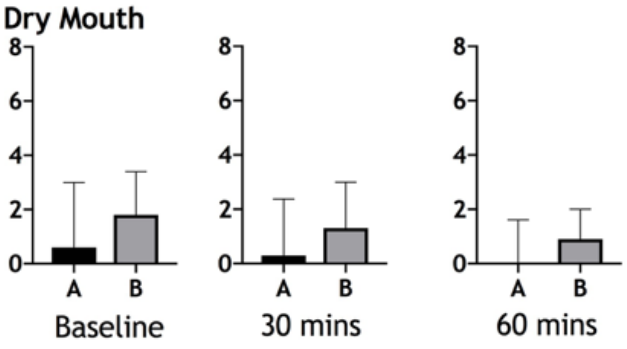


Median and IQR of patient provided scores at baseline (pre-op), 30mins- and 60mins-post-op. P values are non-significant.









Abstract #: T2H-254

Combined Spinal Epidural Versus Single Shot Spinal for Postpartum Tubal Ligation With Intrathecal Isobaric Bupivacaine 0.5%: A Retrospective Review

Presenting Author: Steven C Eubank M.D.
Presenting Author's Institution: Baylor Scott & White Health - Temple, TX
Co-Author: Courtney Shaver M.S. - Baylor Scott & White Health
Michael P Hofkamp M.D. - Baylor Scott & White Health

Introduction: A predicted shortage of hyperbaric bupivacaine 0.75% prompted the Society for Obstetric Anesthesia and Perinatology (SOAP) to issue an advisory suggesting that isobaric bupivacaine (IB) 0.5% be used in doses of 2.5-2.6 ml when combined with opioids or up to 3.0 ml when not combined with opioids for cesarean delivery (CD) spinal anesthesia1. While there was no specific mention of postpartum tubal ligations (PPTL), we used the CD recommendations as a proxy and recommended that a combined spinal epidural (CSE) be used in place of a single shot spinal (SSS), a departure from our practice. Our hypothesis was that subjects who received CSE for PPTL would have a lower conversion rate to GA compared to subjects who received SSS.

Methods: We used billing data from our electronic medical record to search for subjects undergoing PPTL from April 1, 2018 to November 30, 2018. Subjects were included if IB 0.5% was used as a spinal anesthetic for PPTL. Demographic data was recorded along with the dose in ml of IB, dose of subarachnoid opioids, whether a CSE or SSS was used, use of anesthetic adjuncts, and whether the subject needed conversion to GA.

Results: 63 subjects met inclusion criteria and 12 (19.0%) required conversion to GA. 28 and 35 subjects had CSE and SSS for PPTL, respectively. One CSE subject and 11 SSS subjects required conversion to GA, corresponding to conversion rates of 3.7% and 31.4%, for the respective groups (p=0.0051). No subjects with SSS had a subsequent epidural placed after a failed spinal anesthetic and nine CSE subjects received supplemental epidural analgesia. Table 1 describes the demographics and clinical variables of the two groups.

Discussion: The advantage of the CSE over the SSS is the ability to provide supplemental epidural anesthesia if the spinal component fails. Anesthesiologists who chose CSE had a statistically and clinically significant lower rate of conversion to GA despite no difference in IB 0.5% spinal dose. CSE should strongly considered over SSS as an anesthetic technique when IB 0.5% is used as a spinal anesthetic for PPTL.

Society for Obstetric Anesthesia and Perinatology. Society for Obstetric Anesthesia and Perinatology (SOAP) Advisory in Response to Shortages of Local Anesthetics in North America. https://soap.org/2018-bupivacaine-shortage-statement.pdf Published April 2018. Accessed January 30, 2019.

Abstract #: T2H-254

	Combined Spinal Epidural (N=28)		Single Shot Spinal (N=35)		P value
Age	29.50 (range 21.00-41.000	N=28	28.00 (range 27.00-44.00)	N=35	0.7975
Gravity	4.00 (range 2.00-6.00)	N=28	4.00 (range 2.00-7.00)	N=35	0.5610
Parity	3.00 (range 1.00-6.00)	N=28	3.00 (range 1.00-5.00)	N=35	0.8515
Height (cm)	161.30 (range 152.40-175.30)	N=28	162.60 (range 147.30-177.80)	N=35	0.8070
Weight (kg)	80.50 (range 45.50-133.80)	N=28	73.10 (range 53.80-145.60)	N=35	0.4345
Dose of IB 0.5% (ml)	3.0 (range 2.00-3.00)	N=28	3.0 (range 1.00-3.00)	N=35	0.4839
Conversion to GA	No=27	Yes=1	No=24	Yes=11	0.0051*
Intrathecal fentanyl	No=13	Yes=15	No=23	Yes=12	0.1243
Intravenous fentanyl	No=23	Yes=4	No=21	Yes=4	1.0000
Inhaled nitrous oxide	No=25	Yes=2	No=25	Yes=0	0.4910

Abstract #: T2H-273

Cosyntropin in the Prevention and Treatment of Post Dural Puncture Headache. Time for Revisit

Presenting Author: Omar A Alyamani MBBS
Presenting Author's Institution: University of Maryland - Baltimore, Maryland
Co-Author: Shobana Bharadwaj MBBS - University of Maryland
Bhavani Kodali MBBS - University of Maryland
Jessica Galey MD - University of Maryland
Andrew Malinow MD - University of Maryland

Cosyntropin in the Prevention and Treatment of Post Dural Puncture Headache. Time for Revisit

Introduction: Post Dural Puncture Headache (PDPH) is one of the most common complications of dural puncture whether accidental or intentional following neuraxial labor analgesia. Incapacitating symptoms lasting one week occurred in 39% patients with PDPH. The incidence of Dural Puncture (ADP) with 16-18 gauge epidural needles in obstetric anesthesiology practice is around 1%. About 60% of the cases with ADP developed PDPH and more than half required an Epidural Blood Patch (EBP). Cosyntropin is considered as reasonable choice for treatment of PDPH when EBP is contraindicated or in areas where expertise to perform EBP is lacking. Cochrane review showed a statistically significant decrease in PDPH by 50% and the need for EBP by 63% after ADP. Despite this review, the clinicians are skeptic to use Cosyntropin as prophlaxis or treatment for PDPH. For few years at this Institution, CoSyntropin is being used as prophylactic measure to decrease PDPH. The purpose of this study is to retrospectively evaluate the effectiveness of Cosyntropin in the prevention of PDPH, or the need for EBP.

Methods: This is a retrospective study looking at the incidence of PDPH requiring conservative therapy or EBP after intentional or accidental dural puncture with epidural needle for labor analgesia. After IRB approval the data of 178 obstetric patients who had accidental dural puncture between the years of 2002 and 2015 was evaluated. Any patients with previous history of headaches were excluded. The cases of DP before the implementation of CoSyntropin protocol constituted historical control group. Whereas all patients subsequent to introduction of the protocol constituted the study group. The protocol consisted of administering intravenous CoSyntropin 750 µg in one liter of Ringer Lactate over 8 hr soon after delivery in all patients who had known DP. A second dose was administered if the patient reported headache.

Results: Historical control group consisted of 130 patients. Thirty patients (23%) developed headache in the postpartum period and some received EBP. In the 48 patients who constituted the study group who received prophylactic or prophylactic and second dose of IV Cosyntropin, 2 patients (4.3%) developed postpartum PDPH and one received an EBP for severity. There is statistically significant decrease in the incidence of headache following ADP in CoSyntropin group. Although there was trend towards low incidence of EBP in the CoSyntropin group, it did not reach statistical significance.

Conclusion: IV Cosyntropin could potentially be a preventive and/or therapeutic option for PDPH after dural puncture and may decrease headache at discharge following labor and delivery. Trend towards a decreasing need for EBP requires further elucidation.

Abstract #: T2H-330

Does 1 hour pre-treatment with P6 stimulation further reduce intra-cesarean nausea and vomiting when compared with application of P6 immediately prior to CSE?

Presenting Author: Danielle Levin B.A.
Presenting Author's Institution: Rutgers - Robert Wood Johnson Medical School - New Brunswick, New Jersey
Co-Author: Shaul Cohen MD - Rutgers - Robert Wood Johnson Medical School
Ushma Thomas MD - Rutgers - Robert Wood Johnson Medical School
Scott Mellender MD - Rutgers - Robert Wood Johnson Medical School
Geza Kiss MD - Rutgers - Robert Wood Johnson Medical School

Introduction: Approximately 80% of parturients experience nausea and vomiting (N&V) during cesarean section (CS) when no prophylactic antiemetic treatment is given. While IV antiemetic medications have been advocated to prevent intraoperative N&V during CS, they are not entirely effective and may carry multiple adverse effects. In our recent randomized clinical trial, we found that a non-pharmacological method, P6 stimulation, reduces intraoperative N&V, without any side effects. We conducted a 3.5 year retrospective review to evaluate whether a 1-hour pre-treatment with P6 stimulation prior to the initiation of combined spinal epidural anesthesia (CSE) could further reduce the rate of intraoperative N&V.

Methods: Following IRB approval, we identified 171 parturients scheduled for elective CS with CSE who had: group I (n=67) received P6 stimulation on the right wrist 1 hour prior to induction of CSE and throughout the CS, group II (n=44) received P6 stimulation immediately prior to CSE administration and throughout the CS, and group III (n=60) did not receive P6 stimulation. The P6 stimulator was turned on gradually to the highest level of intensity tolerated by the Pt. Evidence of N&V was collected intraoperatively. Excel was utilized for Chi-squared test, T-test, and ANOVA analyses.

Results: Baseline characteristics were similar between the 3 groups. Markedly fewer Pts experienced intraoperative vomiting in the P6 group (18.2%) than in the 1hr P6 pretreatment group (31.4%, P=0.04). Pts in the P6 group tolerated a significantly lower level of P6 stimulation (36.9±11.5mA) than in the 1-hr P6 pretreatment group (42.7±9.6mA, P<0.005). Furthermore, fewer Pts experienced intraoperative N&V in each of the treatment groups than in the control group (P<0.05).

Discussion: When Pts received the P6 stimulation 1hr prior to the initiation of CSE, they had more time to get used to the stimulator and tolerated a higher voltage of P6 stimulation. However, the extended exposure to the higher P6 stimulation voltage did not further reduce the incidence of N&V in our Pts. P6 stimulation continues to be a simple, non-invasive, effective prophylactic alternative antiemetic treatment that could be of great interest to Pts and obstetric anesthesiologists who prefer less invasive care with fewer side effects for CS performed under CSE.

References:

1. Lussos SA, et al. Reg Anesth. 1992;17(3):126.
2. Griffiths JD, et al. Cochrane Database Syst Rev. 2012(9):CD007579.

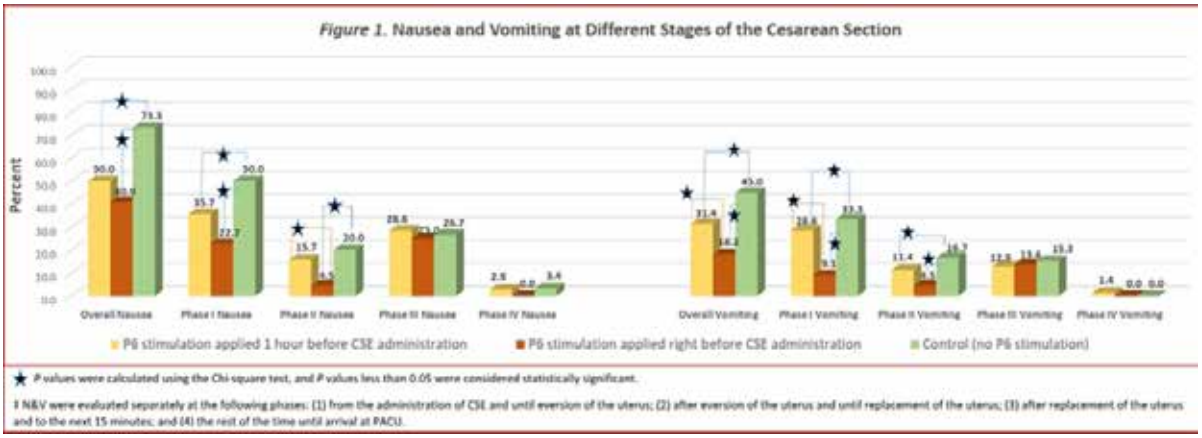


Figure 1. Nausea and Vomiting at Different Stages of the Cesarean Section

★ *P* values were calculated using the Chi-square test, and *P* values less than 0.05 were considered statistically significant.

† N&V were evaluated separately at the following phases: (1) from the administration of CSE and until eversion of the uterus; (2) after eversion of the uterus and until replacement of the uterus; (3) after replacement of the uterus and to the next 15 minutes; and (4) the rest of the time until arrival at PACU.

Abstract #: T2H-364

Determining the Incidence of Chlorhexidine Gluconate Transfer from Skin to Surgical Gloves

Presenting Author: James D Taylor BSc
Presenting Author's Institution: BC Women›s Hospital, University of British Columbia - Vancouver, British Columbia
Co-Author: Vit Gunka MD FRCPC - BC Women's Hospital, University of British Columbia
Anthony Chau MD FRCPC MMSc - BC Women's Hospital, University of British Columbia
Elena Polishchuk PhD - University of British Columbia
Arianne Albert PhD - BC Women's Hospital
Simon Massey MB BCh MRCP FRCA FRCPC - BC Women's Hospital, University of British Columbia

Introduction: Alcohol-based chlorhexidine gluconate (CHG) is recommended as the antiseptic solution for skin preparation prior to central neuraxial blockade.[1] As CHG is highly neurotoxic and implicated in cases of severe neurological injury,[2] current recommendations to prevent CHG from reaching neuraxial spaces include allowing the solution to fully dry and changing surgical gloves if they are visually contaminated with CHG.[1] The purpose of this study was to determine the incidence of CHG transfer from skin to surgical gloves following skin preparation.

Methods: With ethical approval and informed consent, 20 volunteers were placed in a sitting position and the skin of the lumbar region was prepared in a standardized manner using ChloraPrep® (2% CHG in 70% isopropyl alcohol with sunset yellow dye). The skin preparation area was divided into 4 quadrants and 3 samples were swabbed across each quadrant at 3, 4, 5 and 10 mins following skin preparation using cotton tipped applicators wrapped in Neolon® 2G Surgical Gloves. 5 min samples were used to assess potential CHG re-transfer, or double transfer, from surgical gloves following initial transfer from skin by applying 0.5mL of normal saline to replicate a wet skin surface. Samples were then immediately swabbed and re-swabbed. A swab of skin of the thoracic region was taken as a control. Samples were submerged in 500uL of indicator solution, which yields an intense red colour when CHG is present.[3] Positive samples were confirmed by 3 blinded outcome assessors. Primary outcome was incidence of CHG transfer at 3, 4 and 10 min. Secondary outcomes were incidence of dye transfer and incidence of CHG transfer at 5 min.

Results: Controls were negative for CHG and dye. At 3, 4 and 10 min, 100% of samples were positive for CHG, a significantly greater proportion compared to samples positive for dye (Table 1). At 5 min, 85% (95%CI 61-96) of samples were positive for CHG and 0% (0-20) positive for dye.

Discussion: Incidence of CHG transfer from skin to surgical gloves was 100% at 3, 4 and 10 min. CHG transfer was not always associated with dye transfer, suggesting CHG cannot be easily detected visually. Additionally, positive samples at 5 min suggest when the surgical glove encounters a wet surface, CHG can further transfer onto another medium following initial transfer from skin.

Table 1. Percentage of samples positive for CHG and dye at 3, 4 and 10 min following skin preparation.

	% of Samples Positive for CHG (95%CI)	% of Samples Positive for Dye (95%CI)	p-value[a]
3 min	100 (80-100)	55 (32-76)	0.02
4 min	100 (80-100)	60 (36-80)	0.02
10 min	100 (80-100)	70 (46-87)	0.04

[a]McNemar tests with Holm-corrected p-values for multiple comparisons.

References:

1. Campbell JP et al. Anaesthesia 2014
2. Killeen T et al. Anaesthesia 2012
3. Edmiston CE et al. Infect Control Hosp Epidemiol 2016

Abstract #: T2H-370

PRESTO vs. EXIT for the Management of Prenatally Anticipated Difficult Airway: Techniques and Outcomes

Presenting Author: Olivia Nelson MD
Presenting Author's Institution: Children›s Hospital of Philadelphia - Philadelphia, PA
Co-Author: Luv R Javia MD - Children's Hospital of Philadelphia, Perelman School of Medicine at the University of Pennsylvania
Nahla Khalek MD, MPH - Children's Hospital of Philadelphia, Perelman School of Medicine at the University of Pennsylvania
Natalie E Rintoul MD - Children's Hospital of Philadelphia, Perelman School of Medicine at the University of Pennsylvania
Edward R Oliver MD, PhD - Children's Hospital of Philadelphia, Perelman School of Medicine at the University of Pennsylvania
Holly L Hedrick MD - Children's Hospital of Philadelphia, Perelman School of Medicine at the University of Pennsylvania

Background: Anticipated neonatal difficult airway can be an indication for birth via Ex-Utero Intrapartum Treatment (EXIT) procedure. However, the EXIT procedure confers additional maternal operative risk. An alternative strategy is a Procedure Requiring Second Team in the OR (PRESTO) where the fetus is delivered by scheduled cesarean delivery and the potentially difficult airway is managed by a multidisciplinary resuscitation team including surgeons, neonatologists, anesthesiologists, nurses, and respiratory therapists. We present airway management techniques and outcomes of 38 patients at a single quaternary care center from 2009-2017 who presented with prenatally anticipated neonatal difficult airways based on prenatal imaging.

Methods: Retrospective chart review of fetuses with prenatally anticipated neonatal difficult airway evaluated at a single institution from 2009-2017 was performed. Operative notes, resuscitation records, anesthesia records, progress notes, prenatal diagnosis and imaging, and maternal blood transfusion rates were reviewed.

Results: 38 patients met inclusion criteria. 16 were managed by PRESTO and 22 by EXIT. Subjects managed by PRESTO had micrognathia due to craniofacial syndromes (n=9), or smaller or less invasive neck masses (n=7). Subjects managed by EXIT had large cervical lymphangiomas (n=7), teratomas (n=10), cystic masses (n=2), epulis (n=2) or goiter (n=1). Gestational age at delivery was 37.4 weeks for PRESTO vs. 36.4 weeks for EXIT (p=0.08). Four of the PRESTO cases did not require neonatal airway intervention. Of the 12 PRESTO cases where the neonate was intubated, 6 were intubated with a fiberoptic scope through a laryngeal mask airway, 3 with a rigid bronchoscope, and 3 by direct laryngoscopy. Of the 22 EXIT patients, management was widely varied according to the underlying pathology and included interventions such as cyst drainage or mass resection. Airway techniques ranged from direct laryngoscopy to retrograde intubation or tracheostomy. One mother experienced placental abruption during EXIT procedure, requiring transfusion of 2 units of packed red blood cells, whereas there were no intraoperative maternal complications in the PRESTO cohort.

Conclusions: The potential benefit to the fetus of placental bypass during EXIT procedure must be weighed against the increased maternal risks of transfusion as well as recommendations to wait for 2 years for a subsequent pregnancy and to deliver by cesarean during future pregnancies. PRESTO is associated with decreased maternal operative morbidity and vaginal birth after cesarean is typically a delivery option during future pregnancies. However, PRESTO should only be offered in centers that have the capacity to assemble an expert multidisciplinary airway management team on short notice, including on nights and weekends.

Abstract #: T2H-376

Labor Epidural Catheter Reactivation for Postpartum Tubal Ligation

Presenting Author: Andrea Girnius MD
Presenting Author's Institution: University of Cincinnati - Cincinnati, Ohio
Co-Author: Megan Gauthier DO - University of Cincinnati
Lesley Gilbertson MD - University of Cincinnati

Background: There are multiple anesthetic options for postpartum tubal ligation (PPBTL) after vaginal delivery. A labor epidural can be left place until the BTL and dosed with local anesthetic to achieve a surgical level. However, re-activating epidural catheters that have not been running is not always successful, and the timing of PPBTL on the labor and delivery floor is variable. Shorter delivery to PPBLT intervals are generally needed to achieve high epidural success rates, with success rates of as high as 80% reported even after 24 hours. (1) On our labor and delivery unit, epidural catheters may remain in place and unused for over 24 hours before the procedure is performed. However, our actual rate of epidural success is uncertain when the catheter has remained in place but unused for this period of time.

Methods: Following Institutional Review Board approval, retrospective and prospective data was collected on patients who had labor epidurals and subsequent PPBTL. Information collected included baseline demographics, time of epidural placement, time of infusion cessation, time of dosing for PPBTL, success of the epidural as surgical anesthetic for PPBTL, and further details about the anesthetic used for the procedure.

Results: Data from 144 patients was collected. Overall, 83 epidurals (58%) were successfully used as the primary anesthetic for PPBTL and 61 (42%) were unsuccessful. For each category (time epidural was turned off and time epidural in place), data was grouped into 4-8 hour windows. For epidurals turned off for <12 hours (n=80, 56%), the successful reactivation rate was 70%. For epidurals turned off > 12 hours (n=64, 44%), the successful reactivation rate was 42.2%. Epidurals that had been in place for <16 hours or less (regardless of infusion time) had a successful reactivation rate of 71%, while epidurals that had been in place for > 16 hours had a successful reactivation rate of 45%. Insufficient dermatomal level was the most common reason the epidural was not able to be used as the primary anesthetic. General anesthesia was the most commonly used backup anesthetic.

Discussion: Our epidural reactivation rate is overall lower than previously published reports. As expected, the greater the time the epidural remains unused, the less likely it is to be a successful primary anesthetic for a PPBTL. There is a drop off in success rate after 12 hours of non-use and after 16 hours of total epidural time. The reasons for this are unclear as many of the unsuccessful epidurals seem to remain in the epidural space but do not provide an adequate surgical level.

Conclusion: Data on this topic has aided our ability to counsel patients on their anesthetic options and surgical planning for PPBTL following vaginal delivery.

References:

1. Goodman, EJ at al "The rate of successful reactivation of labor epidural catheters for postpartum tubal ligation surgery" Reg Anesth Pain Med 1998;23(3):258-261

Abstract #: T2H-463

Spinal anesthesia for postpartum tubal ligation: a retrospective analysis of the association of intrathecal bupivacaine dosing with inadequate surgical blocks

Presenting Author: Sydney E Reed AB
Presenting Author's Institution: Duke University School of Medicine - Durham, North Carolina
Co-Author: Matthew Fuller MS - Duke University Medical Center
Ashraf S Habib MBBCh, MSc, MHSc, FRCA - Duke University Medical Center

Background: Previous studies investigating intrathecal bupivacaine dosing for postpartum tubal ligation (PPTL) present conflicting conclusions. An early study reported that PPTL patients required 30% more intrathecal bupivacaine than those who underwent cesarean delivery (CD) [1]. Similarly, another study showed that the same intrathecal bupivacaine dose yielded higher sensory blocks for CD as compared to PPTL [2]. Yet a different study reported adequate surgical blocks for PPTL with 7.5 mg of hyperbaric bupivacaine, a dose lower than that used for CD [3]. As such, we performed a retrospective database analysis to assess the rates of inadequate spinal anesthesia for PPTL with different doses of hyperbaric bupivacaine.

Methods: Anesthetic records of women who underwent PPTL under spinal anesthesia with hyperbaric bupivacaine between 2003 and 2018 were examined. An inadequate block (primary outcome) was defined as requiring supplementation with IV analgesics such as ketamine, propofol, or fentanyl > 50mcg, requiring a repeat block, or conversion to general anesthesia (GA). A failed block was defined as requiring a repeat block or conversion to GA. Cases in which there was no evidence of any block after the spinal or in which IV analgesics were given before but not after block placement were excluded. Patients were categorized into three groups based on hyperbaric bupivacaine dose [7.5-9.75mg (group 1), 10.5-12mg (group 2), and ≥13.5mg (group 3)] for analysis.

Results: 448 women met inclusion criteria and were included in the analysis (n=14, 333, and 101 in groups 1, 2, and 3 respectively). The results are summarized in the table. An inadequate block occurred in 20.8% of cases [28.6%, 21.6%, and 16.8% in groups 1, 2, and 3, respectively ($p = 0.41$)] and a failed block occurred in 5.1% of cases [14.3%, 5.4%, and 3.0% in groups 1, 2, and 3, respectively ($p = 0.15$)].

Conclusion: Lower doses of bupivacaine were associated with relatively high rates of inadequate and failed blocks. However, the relatively small sample size limits the statistical power of this study to detect differences between bupivacaine dose ranges. Larger studies are needed to further evaluate the optimal dosing of bupivacaine for PPTL.

References:

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2. Teoh WH. Int J Obstet Anesth. 2008;17:228-232.
3. Huffnagle SL. Reg Anesth Pain Med. 2002;27:284-288.

Abstract #: T2H-463

Baseline Characteristics	Bupivacaine Dose 7.5-9.75mg (n=14)	Bupivacaine Dose 10.5-12mg (n=333)	Bupivacaine Dose ≥13.5 mg (n=101)	Total (n=448)	p-value
Age (yrs)	29 (26, 33)	29 (26, 34)	31 (28, 34)	30 (26, 34)	.0313[1]
BMI (kg/m^2)	31 (29, 34)	32 (29, 36)	32 (28, 35)	32 (29, 36)	.8842[1]
Height (cm)	162 (159, 165)	163 (160, 168)	163 (160, 165)	163 (160, 168)	.3232[1]
Weight (kg)	82 (78, 97)	84 (75, 98)	85 (75, 94)	84 (75, 97)	.5771[1]
ASA Score					.0412[2]
1	2 (14.3%)	30 (9.0%)	3 (3.0%)	35 (7.8%)	
2	12 (85.7%)	263 (79.0%)	78 (77.2%)	353 (78.8%)	
3	0 (0.0%)	40 (12.0%)	20 (19.8%)	60 (13.4%)	
IT Fentanyl Dose (mcg)	15 (15, 20)	15 (10, 15)	15 (15, 15)	15 (10, 15)	<.0001[1]
Outcomes					
Inadequate Spinal	4 (28.6%)	72 (21.6%)	17 (16.8%)	93 (20.8%)	.4111[2]
Failed Spinal	2 (14.3%)	18 (5.4%)	3 (3.0%)	23 (5.1%)	.1453[2]
Pressors Used	0 (0.0%)	53 (15.9%)	18 (17.8%)	71 (15.9%)	.2380[2]
IV Fentanyl Used	2 (14.3%)	50 (15.0%)	12 (11.9%)	64 (14.3%)	.7270[2]
Ketamine Used	0 (0.0%)	21 (6.3%)	4 (4.0%)	25 (5.6%)	.6224[2]

Continuous variables are given as median (IQR) and categorical are given as number (%)
[1]Kruskal-Wallis test, [2]Fisher's Exact test
ASA: American Society of Anesthesiologists, IT: Intrathecal, IV: Intravenous.

Abstract #: T2H-542

Restrospective Review of Monitored Anesthesia Care versus General Endotracheal Anesthesia for Non-Cardiac Intrauterine Fetal Interventions

Presenting Author: Deep Patel B.S.
Presenting Author's Institution: Baylor College of Medicine - Houston, TX
Co-Author: Adam Adler M.D. - Baylor College of Medicine
Ali Hassanpour M.D. - Baylor College of Medicine
Olutoyin Olutoye M.D. - Baylor College of Medicine
Arvind Chandrakantan M.D. - Baylor College of Medicine

AIMS: Fetal intervention is a relatively new field and anesthetic technique per procedure varies by fetal center. Monitored anesthesia care (MAC) has emerged as an alternative to traditional general endotracheal anesthesia (GA), but feasibility and safety have not fully been investigated. This study compares the outcomes of MAC and GA in non-cardiac intrauterine fetal interventions.

METHODS: All non-cardiac intrauterine fetal intervention cases performed at the Texas Children's Hospital Pavilion for Women from July 2012 to July 2016 were retrospectively analyzed and categorized by mode of anesthesia. Preoperative patient physical status, number of intraoperative medications required, duration of procedure, and complications were compared between the MAC and GA groups. The number of cases in which mode of anesthesia converted to GA from MAC was also identified.

RESULTS: During the 4-year study period, a total of 512 non-cardiac fetal interventions were performed with 396 under MAC and 116 under GA (Table 1). Average preoperative ASA physical status classification was not found to be statistically significant. The average duration of procedures and number of medications administered between the MAC and GA groups was found to be significant (Table 1). Eight cases (2.02%) in the MAC group required conversion to GA (intubation due to surgical reasons). Out of the 8 conversions, 3 were because of patient inability to lay still for an extended period (due to patient distress (2) and back pain from pregnancy complicated by polyhydramnios (1)). The other 5 conversions were due to changes in surgical plan that required GA. There were 2 complications (intubation during procedure due to anesthetics) in the MAC group (0.51%) compared to 0 complications in the GA group. One of the complications was intubation for airway protection in a patient with persistent nausea and vomiting. The other intubation occurred in a patient with a high spinal block who became unresponsive after vomiting and difficulty breathing.

CONCLUSION: MAC is a reasonable alternative to GA for fetal intervention. Fetal interventions performed under MAC require less intra-op medication and have a shorter procedure duration as compared to interventions under GA. Our study shows a low complication rate with MAC and GA at .51% and 0%. Given its safety and low complication rate, MAC should be considered as a viable anesthesia option for non-cardiac intrauterine fetal interventions when available.

Table 1: Comparison of procedures performed under MAC and GA

	MAC (n=396)	GA (n=116)	P-value
Conversions	8 (2.02%)	n/a	
Complications	2 (0.51%)	0	
Number of meds administered (mean ± SD)	7.96 ± 2.85	17.99 ± 4.54	<0.0001
Duration of procedure (mean ± SD) minutes	125.1 ± 38.4	279.3 ± 104.1	<0.0001
ASA Physical Status Class (mean ± SD)	1.97 ± 0.53	1.87 ± 0.52	0.0835

Abstract #: T2I-42

Comparison of spinal anesthesia induction time among three neuraxial techniques for emergency cesarean delivery.

Presenting Author: Risa Fukushima M.D.
Presenting Author's Institution: Tokyo Women›s Medical University - Shinjyuku-ku, Tokyo
Co-Author: Yusuke Kasuya M.D., Ph.D. - Tokyo Women's Medical University
Keiko Okuyama M.D. - Tokyo Women's Medical University
Minoru Nomura M.D., Ph.D. - Tokyo Women's Medical University
Makoto Ozaki M.D., Ph.D. - Tokyo Women's Medical University

Background: Although extension of epidural analgesia is a standard method for cesarean delivery (CD) following labor epidural analgesia, administration of subarachnoid block has been preferred in our institute due to its dense blockade. However, a spinal tap for women in whom an epidural catheter has already been placed for labor is sometimes difficult, which may result in conversion to general anesthesia. The aim of this study was to investigate the time needed for spinal tap in parturients with versus without labor epidural analgesia.

Method: The medical records of all emergent CDs over a 4-year period from 2014 to 2017 at a university hospital in Japan were retrospectively studied. Exclusion criteria included (1) patients who did not receive spinal anesthesia, (2) preterm parturients. The cases were divided into 3 groups according to the intraoperative analgesia technique: subarachnoid block group (SAB), supplementation of subarachnoid block following labour epidural analgesia group (LEA), and combined spinal and epidural block group (CSE). Patient characteristics and anesthesia induction time (IT) were recorded; the IT was defined as the time from arrival in the operating room to subarachnoid injection. For patients who received the second spinal tap due to insufficient analgesia by the first spinal block, the time to the second drug injection was recorded as the IT. For statistical analysis, ANOVA and Tukey-Kramer's HSD post hoc test were used, and a p value <0.05 was considered statistically significant.

Results: A total of 469 emergent CDs were performed during this period. Among them, 231 preterm and 17 without intraoperative subarachnoid block patients were excluded from this study. Eighty-one, 58, and 82 cases were found in SAB, LEA, and CSE, respectively. Body mass index and ASA physical status did not differ among 3 groups, but maternal age in LEA was significantly older than in SAB (36.4 vs. 34.3 year; $p=0.0289$). The mean IT in CSE group was 21.8 minutes and significantly longest among the 3 groups. Between LEA and SAB, IT in LEA was significantly longer than that in SAB (16.9 vs. 13.3 minutes, $p=0.0075$).

Conclusion and discussion: The longest induction time in CSE can be explained as the additional time for the replacement of an epidural catheter. The different result between LEA and SAB may be due to the expanded spinal space after labor epidural analgesia, which may support our hypothesis that spinal tap following labor epidural can be sometimes difficult. Although maternal age in LEA was significantly older than in SAB, which might have associated with failed subarachnoid blockades, it has been reported that maternal age is not a risk factor for failure of spinal anesthesia in CDs. Therefore we also speculated that this difference of age does not have strong influence on IT. Further studies will be required to investigate the mechanism by image examinations such as lumber spinal ultrasonography.

Abstract #: T2I-76

Labor epidural analgesia to cesarean section anesthetic conversion failure: a national survey in the United Kingdom

Presenting Author: Neel Desai MB ChB (Hons) BSc (Hons) FHEA FRCA MRCP MRCS
Presenting Author's Institution: Guy›s and St Thomas› NHS Foundation Trust - Southwark, London
Co-Author: Andrew Gardner BM BCh MSc - Guy's and St Thomas' NHS Foundation Trust
Brendan Carvalho MB BCh FRCA - Stanford University School of Medicine

Background: Conversion of labor epidural analgesia to surgical anesthesia for cesarean delivery can fail [1] and management of this situation continues to be debated [2]. Our aim was to determine the most common obstetric anesthesia practice in this context.

Methods: All members of the Obstetric Anaesthetists' Association in the United Kingdom were emailed an online survey in May 2017. It obtained information on factors influencing the decision to utilize an existing labor epidural for cesarean section and, in scenarios where epidural top up resulted in no objective sensory blockade, bilateral T10 sensory block or unilateral T6 sensory block, factors influencing management and selection of anesthetic technique. Differences in management options between respondents were compared using chi-square test.

Results: We received 710 survey questionnaires with an overall response rate of 41%. Most respondents (89%) would consider topping up a labor epidural for category one cesarean section. In evaluating whether or not to top up an existing labor epidural, the factors influencing decision making were how effective the epidural had been for labor pain (99%), category of cesarean section (73%) and dermatomal level of blockade (61%). In the setting of failed epidural top up, the most influential factors were the category of cesarean section (92%), dermatomal level of blockade (78%) and assessment of airway. Spinal anesthesia was commonly preferred if epidural top up resulted in no objective sensory blockade (74%), bilateral T10 sensory block (57%) or unilateral T6 sensory block (45%) (Table 1). If the sensory block level was higher or unilateral, then a lower dose of intrathecal local anesthetic was selected and alternative options such as combined-spinal epidural and general anesthesia were increasingly favored. Complications related to a repeat neuraxial technique after failed epidural top up were reported by a significant number of respondents. Twenty eight (4%) and 250 (35%) respondents, for instance, reported having encountered either a high or total spinal after a combined spinal-epidural and spinal, respectively.

Conclusions: Our survey revealed variations in the clinical management of a failed epidural top up for cesarean delivery, suggesting guidelines to aid decision making are needed.

Table 1. Usual next management step of respondents if a top up of an existing labour epidural for a category 2 caesarean section resulted in an inadequate or failed sensory block

Management	No objective sensory block (*n*=709)	Bilateral T10 sensory block (*n*=699)	Unilateral T6 sensory block (*n*=691)
CSE	87 (12.3)	129 (18.5)	105 (15.2)
General anaesthesia	67 (9.4)	120 (17.2)	150 (21.7)
Repeat epidural	2 (0.3)	11 (1.6)	13 (1.9)
Spinal	524 (73.9)	398 (56.9)	310 (44.9)
Withdraw in situ epidural catheter	6 (0.8)	10 (1.4)	65 (9.4)
Other	23 (3.2)	31 (4.4)	48 (6.9)

Data presented as number (%).
CSE, combined spinal-epidural.
In these scenarios, respondents were told to assume that neither further epidural top ups nor time would result in any change in the dermatomal level of the sensory block, and assessment of the patient would demonstrate no undue concerns about the airway and no obvious difficulties in achieving a neuraxial technique if needed.

References:

1. Mankowitz SKW, et al. Anesth Analg 2016;123:1174-80.
2. Carvalho B. Anaesthesia 2012;21:357-9.

Abstract #: T2I-168

Factors Related to Abnormal Coagulation Testing in Preeclampsia

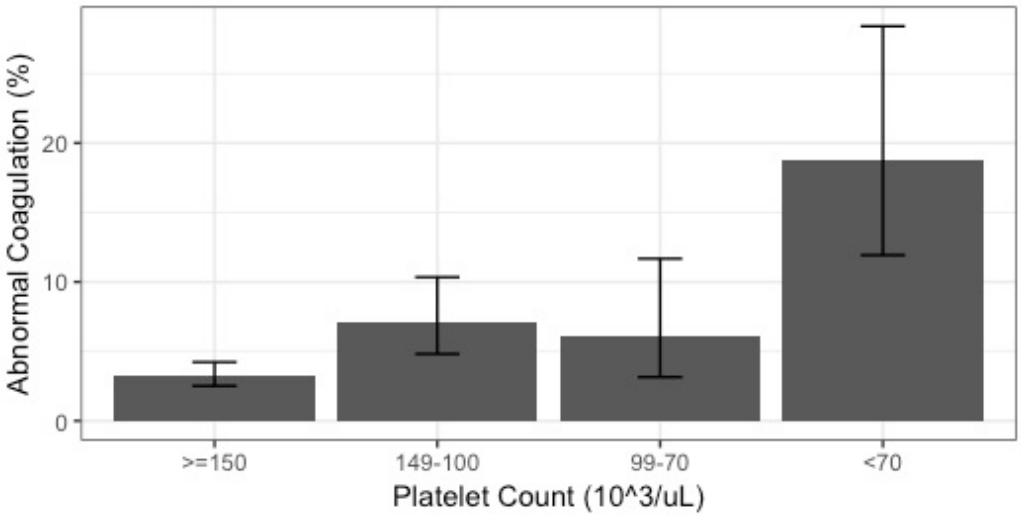
Presenting Author: David J Combs MD, PhD
Presenting Author's Institution: Massachusetts General Hospital and Harvard Medical School - Boston, MA
Co-Author: Brian T Bateman MD, MSc - Brigham and Women's Hospital and Harvard Medical School

Introduction: Along with thrombocytopenia, women with preeclampsia are at heightened risk for coagulopathy, potential contraindications to neuraxial procedures. There is limited evidence to inform laboratory evaluation of coagulopathy in preeclampsia and whether completing such testing should delay neuraxial techniques. Current recommendations are based on an analysis of 100 women with preeclampsia wherein abnormal coagulation testing was rare for platelet counts above 100,000/μL (Leduc L. et al, 1992).

Methods: Using a clinical registry of two academic tertiary care hospitals, we performed a cross-sectional study of abnormal coagulation testing in preeclamptic deliveries between 1995 and 2018. Patients who received anticoagulant medication in the 30 days prior to delivery were excluded. For all patients, the platelet count determined at the time of admission and coagulation parameters (measured no later than 2 hours after the platelet count) were obtained. The frequency of abnormal coagulation test results, defined as either an activated partial thromboplastin time (aPTT) or the international normalized ratio (INR) above the reference range, was compared across patients grouped by their initial platelet count.

Results: Of 2,235 deliveries with preeclampsia, 103 (4.6%) had abnormal coagulation testing. The risk of abnormal coagulation testing increased with decreasing platelet counts. For patients with an initial platelet count ≥ 150,000/μL the risk was 3.3% (95% CI: 2.5% to 4.2%), for 149,000 to 100,00 /μL was 7.1% (95% CI: 4.8% to 10.3%), for 99,000 to 70,000/μL was 6.15% (95% CI: 3.2 to 11.7%), and for less than 70,00 was 18.8% (95% CI: 11.9% to 28.4%; p = 3.0 x 10-9). When abnormal coagulation was defined as an aPTT ≥ 40 s or an INR ≥ 1.4 (potentially more clinically meaningful thresholds) the frequencies of abnormal testing across the four platelet groups were 1.3%, 4.1%, 3.1%, and 7.1%, respectively. Patterns of abnormal coagulation testing were not meaningfully different after excluding patients with antepartum hemorrhage or known congenital coagulopathy.

Conclusion: In patients with preeclampsia at delivery, the frequency of abnormal coagulation testing is higher in those with a lower initial platelet count. In such patients, anesthesiologists will need to weigh the risks and benefits of proceeding with neuraxial techniques without coagulation testing.



Abstract #: T2I-284

Neuraxial Techniques in Thrombocytopenic Patients Across Populations: A Systematic Review and Meta-analysis

Presenting Author: Melissa E Bauer D.O.
Presenting Author's Institution: University of Michigan - Ann Arbor, MI
Co-Author: Roulhac D Toledano MD, PhD - NYU-Langone
Tim Houle PhD - Massachusetts General Hospital
Mark MacEachern MLIS - University of Michigan
Lisa Leffert MD - Massachusetts General Hospital

Background: There is currently no consensus regarding the threshold platelet count to ensure safe neuraxial techniques. There are numerous reports of the safe performance of lumbar punctures (LPs) in severely thrombocytopenic patients, but reports of neuraxial blockade in thrombocytopenic parturients are limited. (1) Given the rarity of spinal epidural hematoma (SEH), more data are needed to inform clinical practice. This systematic review consolidates all reported lumbar neuraxial procedures from multiple diverse thrombocytopenic populations to further elucidate the risk.

Methods: MEDLINE, Embase, Cochrane, CINAHL databases were searched for articles about thrombocytopenic patients (less than 100 x 10^9/L) who received a lumbar neuraxial technique and subsequently did or did not develop SEH. Articles were excluded if the patient also received anticoagulation or if the platelet count/range was not reported. Platelet count, thrombocytopenia etiology, neuraxial procedure type, and patient population (e.g. obstetric, cancer, pediatric) were collected. To evaluate the expected distribution, generalized additive models with interval censoring were used. This approach allowed flexible curves to fit the distribution and can properly weight the available evidence that is reported using coarsened data (i.e., reported using frequency bins).

Results: Of 4167 articles reviewed, 132 met inclusion criteria. 7790 lumbar neuraxial procedures were performed without SEH formation, mostly LPs in pediatric cancer patients [4781(61%)]. 32 cases of SEH were reported, most in cancer patients [13(41%)] after LPs [24(75%)] with platelet counts less than 50,000 [19(59%)]. The 4 reported obstetric SEHs occurred at platelet counts of 58,000, 66,000, 71,000, and 91,000. (2-5) A density plot of neuraxial techniques performed with events of SEH is shown in Figure 1.

Discussion: Reported cases of SEH in thrombocytopenic patients after lumbar neuraxial procedures are exceedingly rare. Although the incidence of thrombocytopenia in pregnancy is 7-12%, (6) there are very few reported cases of SEH with neuraxial procedures. This systematic review and a subsequent modified delphi process will form the basis of the forthcoming SOAP interdisciplinary consensus statement on neuraxial techniques for thrombocytopenic parturients.

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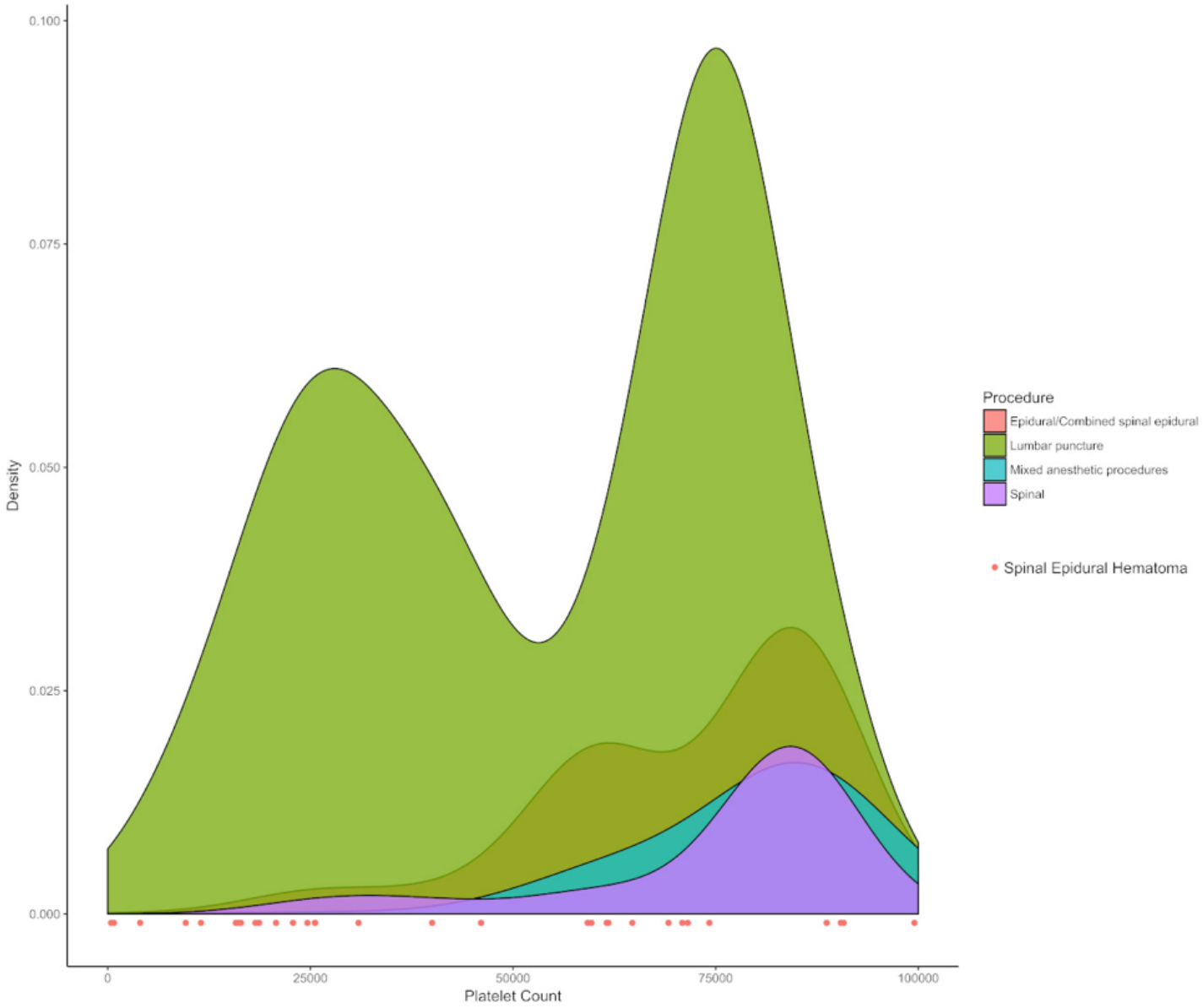
Abstract #: T2I-284



Abstract #: T2I-328

Anesthetic Management of Von Willebrand Disease in Pregnancy

Presenting Author: Sharon C Reale MD
Presenting Author's Institution: Brigham and Women›s Hospital - Boston, MA
Co-Author: Michaela K Farber MD, MS - Brigham and Women›s Hospital
Jean M Carabuena MD - Brigham and Women's Hospital

Introduction: Von Willebrand disease (vWD) is the most common heritable bleeding diathesis and involves quantitative (type 1,3) or qualitative (type 2) defects in von Willebrand factor with associated abnormalities in factor VIII and platelets. There are limited reports and no definitive guidelines on the anesthetic management of vWD in pregnancy. Here we describe the management of patients with vWD in pregnancy at a single center over a 20-year time period.

Methods: After obtaining IRB approval, we searched our institution's Research Patient Data Registry for patients with the concurrent diagnoses of pregnancy and vWD between January 1, 2000 and January 1, 2019. Descriptive statistics were performed.

Results: A total of 48 individual patients and 68 deliveries were identified. Mean age at the time of delivery was 30.5 years. Type of vWD and obstetric anesthesia management is as shown in the table. Neuraxial techniques were used in 58/68 deliveries. 28 deliveries (29%) were by cesarean (14 spinal, 12 epidural, 2 general anesthesia). 40 deliveries were vaginal (32 epidural). Of the patients who did not receive neuraxial anesthesia, the reasons were as follows: patient preference (4), precipitous delivery (4), and general anesthesia for cesarean delivery due to concern for vWD (2).There were no noted adverse anesthetic outcomes, including neuraxial hematoma. There were 8 cases of postpartum hemorrhage (PPH), 50% requiring transfusion. Two patients received DDAVP after PPH onset. PPH etiologies were atony (4 cases), placenta accreta (2), and not defined (2).

Discussion: To our knowledge, this is the largest case series describing the anesthetic management and outcomes of parturients with vWD. Type 1 vWD is the most common subtype, and neuraxial anesthesia was safely performed in such cases due to procoagulant upregulation in pregnancy. Most patients with vWD in pregnancy were evaluated by a hematologist at our center. Knowledge of the specific subtype of vWD by testing prior to pregnancy was critical to direct management, as was bleeding history and family history. Management must be individualized based on patient characteristics, hematology recommendations, and obstetric delivery plans.

References:

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2. Butwick J Clin Anesth 2007
3. Marrache IJOA 2007
4. Choi AA 2009

Abstract #: T2I-328

Total patients	**n=48**	**1st Pregnancy**	**2nd Pregnancy**	**3rd Pregnancy**
vWD type 1	**n=34**	**n=34**	**n=16**	**n=2**
vWD panel checked in pregnancy		20 (59%)	5 (31%)	1 (50%)
Abnormal VWD panel in pregnancy		0	0	0
Prior history of treatment for procedure*		13 (38%)	6 (38%)	0
Mode of delivery vaginal		23 (68%)	8 (50%)	0
Neuraxial anesthesia performed		29 (85%)	15 (94%)	2 (100%)
Pre-treatment prior to neuraxial		10 (29%)	0	0
vWD type 2(a,n,m)	**n = 5**	**n = 5**	**n = 1**	**N/A**
vWD panel checked in pregnancy		4 (80%)	0	
Abnormal VWD panel in pregnancy		4 (80%)	0	
Prior history of treatment for procedure*		3 (60%)	0	
Mode of delivery vaginal		4 (80%)	0	
Neuraxial anesthesia performed		2 (40%)	0	
Pre-treatment prior to neuraxial		2 (40%)	0	
vWD type 2b	**n = 1**	**n = 1**	**N/A**	**N/A**
vWD panel checked in pregnancy		1 (100%)		
Abnormal VWD panel in pregnancy		0		
Prior history of treatment for procedure*		1 (100%)		
Mode of delivery vaginal		0		
Neuraxial anesthesia performed		1 (100%)		
Pre-treatment prior to neuraxial		0		
vWD type unknown	**n=8**	**n=8**	**n=1**	**N/A**
vWD panel checked in pregnancy		5 (63%)	0	
Abnormal VWD panel in pregnancy		0	0	
Prior history of treatment for procedure*		3 (38%)	1 (100%)	
Mode of delivery vaginal		5 (63%)	0	
Neuraxial anesthesia performed		8 (100%)	1 (100%)	
Pre-treatment prior to neuraxial		2 (25%)	0	

*With desmopressin or humate P

Abstract #: T2I-486

Patients Prefer Spinal Anesthesia Without Long Lasting Neuraxial Narcotics Over General Anesthesia for Repeat Cesarean Delivery Despite Increased Post Delivery Pain and Pruritis

Presenting Author: Curtis Baysinger M.D.
Presenting Author's Institution: Vanderbilt University School of Medicine - Nashville, TN
Co-Author: Suzana Sobot M.D. - University Clinical Center of Republic of Srpska (UKCRS)
Sanja Cuk M.D. - University Clinical Center of Republic of Srpska (UKCRS)
Ivan Velickovic M.D. - SUNY Downstate
Ferne Braveman M.D. - University of Southern California at Los Angeles

Background: Spinal anesthesia (SA) conveys significant benefit to the parturient undergoing cesarean delivery (CD), but is not used with the same frequency in Eastern European hospitals as those in Western Europe. We recently began a project to increase the use of SA for CD at the University Clinical Center of Republic of Srpska (UKCRS). We instituted a post delivery quality improvement process, developed in partnership with Kybele Worldwide, to analyze patient satisfaction and common side effects after general (GA) or SA for CD during our project period.

Methods: Patient de-identified data collection were approved by the Ethical Commitee of UKC RS. GA was conducted using a propofol, succinylcholine induction, inhaled isoflurane in air/oxygen maintenance with 100 ug to 200 ug of IV fentanyl, and atracurium muscle relaxation. SA utilized 12 mg of 0.5% intrathecal isobaric bupivacaine and 15 ug of fentanyl. Systemic ketoprofen and tramadol were administered prn for post CD pain relief. Patient data were collected by a blinded UKC RS Quality Improvement team on the first postoperative day, July-September, 2017. Age, height, weight, parity, number of previous CDs, type of anesthesia with previous CD, instances of nausea ,vomiting (N/V) and pruritis, and a 0 – 10 verbal analog scale score (VAS) of overall post CD pain since delivery and patient satisfaction were recorded. Students t, chi square, and Mann-Whitney U tests were used where appropriate. A $p \leq 0.05$ was considered significant.

Results: (Table) The survey included data from 157 patients; 123 received GA (79%); 34, SA (21%). Age, height, weight, parity, and number of previous CDs did not vary between groups. Overall satisfaction scores and the incidence of N/V were similar. Patients reported higher overall post CD VAS pain scores and more post CD pruritis with SA. Of 61 patients with previous GA for CD, 13 received SA.; no one received GA after prior SA. All 13 patients with current SA and prior GA expressed preference for SA over GA for future CD.

Conclusion: Overall satisfaction scores for both groups were high. The patients in SA group had higher overall post CD pain scores and pruritus, thus emphasizing the need for adoption of long acting neuraxial opioids for post CD pain relief at UKCRS. Despite increased post CD pain and pruritis, parturients prefer SA over GA for a subsequent CD.

Table: Results

	General Anesthesia (N=123)	Spinal Anesthesia (N=34)
Overall satisfaction with anesthesia score	9.6	9.5[#]
Overall post CD pain score	4.2	5.5[†]
Pruritis (%)	3.3	50[•]
Nausea (%)	46	68[°]
Vomiting (%)	5.7	8.9[+]

CD; Cesarean Delivery
[#]p = 0.87; [†]p = 0.05; [•]p = 0.001; [°]p = 0.29; [+]p = 0.43

Abstract #: T2I-505

Epidural Catheter Movement in Parturients with Class 3 Obesity

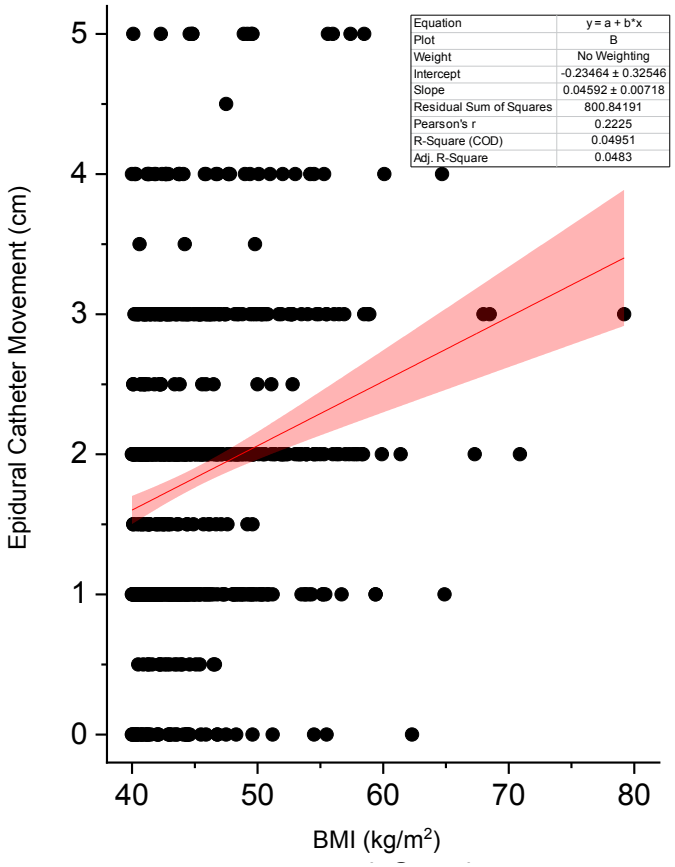
Presenting Author: Jennifer Fichter MD
Presenting Author's Institution: Wake Forest School of Medicine - Winston Salem, NC
Co-Author: Kenneth Nelson MD - Wake Forest School of Medicine
Lynne Harris BSN - Wake Forest School of Medicine

Background: Epidural catheter movement (ECM) with changes in parturient positioning was first described in 1997 by Hamilton et al., who conducted a prospective study evaluating ECM with patient movement. 1 They found that with increasing BMI, epidural catheters (EC) moved a statistically significant amount with patient repositioning. While their study included obese women, it did not look specifically at parturients with Class 3 obesity (C3O), defined by the CDC as BMI≥40.2 OB anesthesiologists today care for double the number of women with C3O than they did in 1997.3 The amount of ECM is important to know so that precise adjustments can be made for optimal anesthetic effects and to prevent EC failure. We hypothesized that we would replicate the Hamilton study's findings of ECM in obese women, finding greater ECM in our C3O parturients.

Methods: Following IRB approval, we performed a retrospective chart review of all labor epidurals/CSEs placed in 2017 and 2018 at our institution. We reviewed neuraxial procedure notes of all women with a BMI≥40 and gathered the following data: distance to epidural space, distance of initial EC placement, and distance of final EC position after patient repositioning. ECM was defined as the difference between initial and final EC positions. A scatter plot was created to evaluate the correlation of BMI and ECM. Data were analyzed using OriginPro 2019; OriginLab; Northampton, MA.

Results: Data were collected on 788 women identified as having a BMI≥40. Median BMI was 43.6, and the highest reported BMI was 79.2. ECM ranged from 0-5cm (median 2cm). Pearson's correlation coefficient for BMI and ECM was 0.2225 with an R2 value of 0.0496 (Figure 1).
Conclusion: Our data reveal a weakly positive correlation between BMI≥40 and ECM in parturients receiving epidural labor analgesia. We believe it is likely that this retrospective methodology underestimates the true degree of ECM. First, patient repositioning was not specifically documented in the procedure note. Our standard repositioning places the patient laterally, but it is not known how often this occurred. Secondly, precise EC measurements were not made. We have initiated a prospective study to address these weaknesses but currently do not have enough data to report.

Epidural Catheter Movement (Sitting to Lateral Position) vs BMI



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Abstract #: T2I-555

Factor XI Deficiency in the Parturient: A Retrospective Review

Presenting Author: Migdalia H Saloum MD
Presenting Author's Institution: Mount Sinai West Hospital - New York , NY
Co-Author: Julio E Marenco MD - Mount Sinai West
Barbara Orlando MD - Mount Sinai West
Deborah Stein MD - Mount Sinai West

Factor XI (FXI) deficiency is a rare inherited coagulation disorder. The number of patients presenting to labor and delivery with FXI deficiency has significantly increased, mainly due to an antenatal screening test in our health system. This screening test has identified a large number of patients, mostly heterozygotes, that had been otherwise asymptomatic for the disorder. As opposed to other hemophilias, FXI deficiency is not a well characterized coagulation disorder and has a variable bleeding phenotype. There is poor correlation between factor levels and bleeding, which presents a clinical challenge, especially in the consideration of neuraxial anesthesia. There is no clear consensus on the safe level of factor XI for neuraxial anesthesia placement. In addition, there is variability in the decision to transfuse FFP. We present a retrospective review of the anesthetic management of 25 patients with FXI deficiency. Of the 25 patients, 22 received neuraxial anesthesia. 10 patients delivered via cesarean section, and 15 patients delivered vaginally. The 3 patients that did not receive neuraxial had factor levels of 7%, 28% and 35% and delivered vaginally with remifentanil PCA or nitrous oxide for analgesia. Of the 22 patients that received neuraxial, 11 patients where in the mild range (near 50%), and 13 patients were in the mild/moderate range (20-50%). None of the 11 patients in the mild range received FFP transfusion, while 6 of the 13 patients in the mild/moderate (20-50%) group received transfusions. It\'s evident that this mild/moderate deficiency population presents the most challenges, as it is unclear what their obstetric hemorrhage and/or epidural hematoma risk is. therefore, there is more variability in management. 6 patients received FFP during their labor, ranging from 1 to 3 units. The patients that received FFP had factor levels of 28% (no neuraxial), 38%, 41%, 33%, 38%, and 31%. The lowest factor level that received neuraxial anesthesia (spinal) was 31% and was delivered via cesarean section after transfusion of 3 units FFP. The patients that did not receive FFP and received neuraxial anesthesia had factor levels of ranging from 35% - 71%. Interestingly, the lowest factor level to receive neuraxial without a transfusion was 35%, while another patient with the same factor level was given nitrous oxide for delivery. It is evident that there is significant variability in the management of patients with mild/moderate FXI deficiency. Influencing variables include patient antepartum consultation with a hematologist, differences in recommendations by consulting hematologists, antepartum anesthesia consult, previous bleeding history and obstetrical delivery plan.

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Abstract #: T210-187

Is PIEB superior to PCEA for labor analgesia? A novel In-vitro variable resistance and flow dynamic epidural simulation model analyzes this controversy.

Presenting Author: Lert Rusha MD
Presenting Author's Institution: University of Maryland Medical Center - Baltimore, Maryland
Co-Author: Shobana Bharadwaj MBBS - University of Maryland Medical Center
Bhavani Shankar Kodali MD - University of Maryland Medical Center

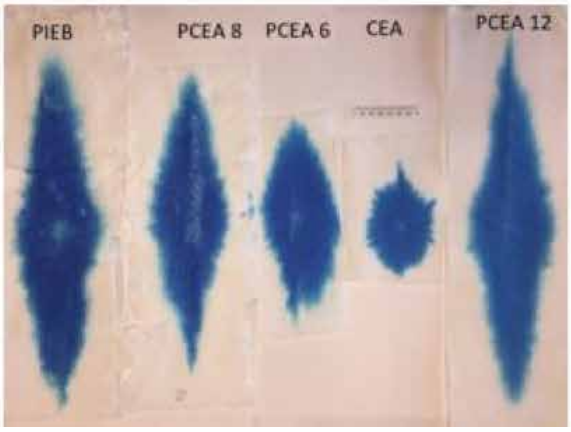
Clinical studies have conflicting conclusions of superiority of Programmable Intermittent Epidural Bolus (PIEB) over Patient Controlled Epidural (PCEA), or continuous epidural (CEA) for labor analgesia. Epidural spread of drugs is dependent on several factors and these have not been elucidated. We designed an epidural model to analyze epidural flow dynamics of currently used epidural labor analgesia modes and study a high volume PCEA as a 'test' mode.

Methods: An epidural space of 3 to 4 mm was fabricated by interposing 1¾ inch diameter PVC tube into a 2-inch diameter clear polycarbonate (PC) tube. The PVC tube was wrapped with two layers of Bounty absorbable paper with wavy pattern to simulate noncontiguous epidural space and absorption of the fluid by fat and vasculature. Intervertebral foramina of 78 mm2, interspaced 30 mm apart, were fashioned on each side of the PC tube. Two sets of models were fabricated for simultaneous study. The epidural catheter was placed inside the epidural space and connected to Cadd Solo pump programed with PIEB (9 ml q45min pump delivered, and 10 ml q10 min, patient option, limit 48 ml/hr), PCEA8 (8 ml/hr,8 ml q15 min, limit 32 ml), PCEA6 (6/6q15,32), and 12 ml/hr CEA. The driving fluid was normal saline with methylene blue. The patient-controlled boluses were used as permissible in each mode to the maximum limit allowed . The distribution of the dye was analyzed using SketchAndCalc Area Calculator. The effect of gravity was studied in by repeating simulations for each of PIEB and PCEA6 modes in lateral position by turning the model 90 degrees. In addition, the effect of decreased resistance in the epidural space for these two modes was studied by decreasing one layer of Bounty paper. A 'test' high volume PCEA12 (12/10 q15,42) was also studied in both supine and lateral positions.

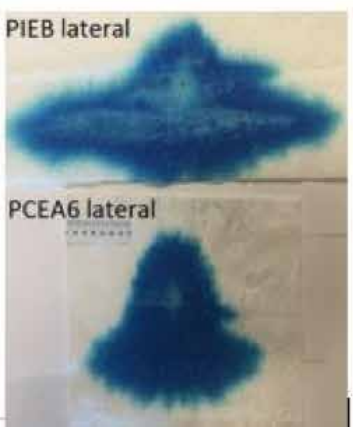
Results: Areas of spread are shown in figure and varied from 189.1 (PIEB) to 52.8 cm2 (CEA) demonstrating PIEB's superiority over PCEA6, 8, and CEA (Figure). In simulated lateral position, gravity favored better spread in the dependent area. Decreasing resistance increased epidural area of distribution, (PIEB 229 to 410, and PCEA6 113 to 289 cm2). 'Test' high volume mode PCEA12 was as effective as PIEB (185 vs 189 cm2). This novel model demonstrates that volume and frequency of doses together with position and compliance of epidural space determines final distribution of epidural fluid.

References:

IJOA 2016;26:32-38. GM-4, SOAP 2018; S1B6, SOAP 2018



Mode	Area cm^2	Circumference cm
PIEB supine	189.18	79.6
PCEA 8	137.8	65.41
PCEA 6	113.74	50.32
CEA	52.87	32.64
PCEA 12	185.22	81.06
Low Resistance		
PIEB	410.61	112.27
PCEA 6	289.48	84.21
Lateral turning	**Area UP**	**Area Down from cather**
PIEB	41.4	180.5 cm^2
PCEA 6	29.2	81.0 cm^2



Abstract #: T210-219

Comparison of the expulsive efforts between labor epidural group and no-analgesia group and the effects of the expulsive efforts on women receiving epidural analgesia for labor and their neonates. A prospective observational study

Presenting Author: Hitomi Asaba M.D
Presenting Author's Institution: Hamamatsu University Hospital - Hamamatsu, Shizuoka
Co-Author: Hitomi Asaba M.D - Hamamatsu University Hospital
Chieko Akinaga M.D/PhD - Hamamatsu University Hospital
Shingo Kawashima M.D/PhD - Hamamatsu University Hospital
Satoshi Naruse M.D - Hamamatsu University Hospital
Yoshiki Nakajima M.D/PhD - Hamamatsu University Hospital

Background: At our institution, labor epidural analgesia has been provided since 2005. For safe and smooth delivery under epidural analgesia, induction of effective voluntary maternal expulsive efforts is important. Anesthesiologists have been striving to recognize this benefit with midwives and obstetricians. However, midwives and obstetricians consider that dedication of women with epidural analgesia toward expulsive efforts is poor and induction of expulsive efforts is difficult. To date, no study has evaluated expulsive efforts and compared expulsive efforts between women with labor epidural and those without analgesia. Even the effects of expulsive efforts on parturients and neonates have not been studied. Therefore, we compared expulsive efforts between the labor epidural group and no-analgesia group and evaluated the effect of expulsive efforts on the parturient and the neonate.

Methods: Midwives in charge of delivery evaluated expulsive efforts in the labor epidural group and the non-analgesia group using a visual analogue scale (0 points: insufficient, 100 points: sufficient). The evaluation items were as follows: (1) parturients' response to coaching on expulsive efforts (timing of expulsive efforts and how to apply force during expulsive efforts), and (2) eagerness of the parturients toward expulsive efforts. Evaluation scores of the expulsive efforts were compared between the two groups. We also analyzed correlations of the evaluation score of expulsive efforts with duration of labor, volume of blood loss during labor, umbilical artery pH (UApH), Apgar score, Edinburgh scores on days 2–4 postpartum, and type of breastfeeding.

Results: Sixty patients in the labor epidural group and 100 patients in the no-analgesia group were evaluated. Evaluation scores of the expulsive efforts were not significantly different between the two groups. Evaluation scores of expulsive efforts showed no correlation with the duration of labor, volume of blood loss during labor, UApH, the Apgar score, and the type of breastfeeding. However, the timing of expulsive efforts and Edinburgh scores showed a negative correlation (Spearman rank correlation coefficient: −0.188, $p = 0.02$). In multivariate analysis, the timing of expulsive efforts and eagerness scores were independent variables of the Edinburgh score.

Discussion: Evaluation scores of expulsive efforts in women who have labor epidural analgesia are not lower than those without analgesia. A negative correlation between the timing of expulsive efforts and Edinburgh scores indicates that anesthesiologists should pay more attention to parturients whose expulsive efforts are evaluated as insufficient, regardless of whether the delivery involves labor analgesia.

Abstract #: T210-287

A retrospective cohort assessment of the impact of programmed intermittent epidural bolus compared to continuous epidural infusion for labour analgesia

Presenting Author: Hilary MacCormick MD FRCPC
Presenting Author's Institution: IWK Health Centre - Halifax, Nova Scotia
Co-Author: Ronald B George MD FRCPC - IWK Health Centre
Gillian K Boudreau BA - Dalhousie University
Allana M Munroe BScPharm MD FRCPC - IWK Health Centre
Chris M Nash MD FRCC - IWK Health Centre

Background: Programmed intermittent epidural bolus (PIEB) is the next evolution of labor analgesia that may replace continuous epidural infusion (CEI). PIEB may result in a decreased amount of local anesthetic consumption, decreased duration of second stage of labor, and potential reduction in instrumental vaginal delivery (IVD) rates.(1) At the authors' institution the primary method of labor analgesia was CEI in conjunction with PCEA. Since 2015, PIEB with PCEA has been exclusively offered for labor analgesia. The goal of this study is to evaluate the impact on obstetrical outcomes after the institutional change in labor analgesia from CEI to PIEB.

Methodology: With institutional ethics and data access approval, a population-based cohort analysis was conducted using data from a provincially validated database. This database collects information on all pregnancy outcomes from our institution. Information on patient demographics, such as maternal age, gestational age, length of second stage of labor, fetal outcomes and mode of delivery are available. The study population included parturients with term, singleton pregnancies of vertex presentation, receiving epidural labor analgesia, that delivered at the authors' institution in 2014 (CEI) or 2017 (PIEB).

Results: The sample includes 7,967 patients; 4,299 who delivered in 2014 with CEI and 3,668 who delivered in 2017 with PIEB (Table 1). The patients were demographically similar except for parity and race/ethnicity. Patients in the CEI cohort less frequently had labor induced or augmented. The cesarean delivery rate was similar in each cohort. CEI was associated with lower IVD rates for forceps and vacuum deliveries. The second stage of labor was shorter compared with PIEB. The PIEB cohort experienced more perineal injuries.

Conclusions: Despite initial evidence suggesting possible improved analgesia with less motor blockade and possibly reduced IVD, institutional data from real life implementation suggests PIEB is associated with higher rates of IVD.

References:

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Abstract #: T210-287

Table 1

	CEI N = 4,299	PIEB N = 3,668	*P*-value
Age (years)	31 [7.6]	31 [7.5]	0.15
Race/Ethnicity (% Caucasian)	1,965 (46%)	1,457 (40%)	< 0.001
Gravidity	2 [2]	2 [2]	0.83
Parity	1 [1]	0 [1]	0.04
Gestational Age (weeks)	39.4 [1.9]	39.4 [2.0]	0.13
Induced Labor	1,381 (32%)	1,352 (37%)	<0.001
Augmented Labor	776 (18%)	724 (20%)	<0.001
Length of 2nd Stage (minutes)	83+/-97	89+/-96	0.01
Perineal Injury	2,232 (52%)	2,030 (55%)	0.002
Spontaneous Vaginal Delivery	3,032 (70%)	2,496 (68%)	0.02
Forceps Vaginal Delivery	155 (3.6%)	183 (5%)	0.002
Vacuum Vaginal Delivery	159 (3.7%)	206 (5.6%)	< 0.001
Cesarean Delivery	953 (22%)	783 (21%)	0.38

Data presented as Median[IQR], n(%), or Mean+/-SD
Continuous variables were assessed for normality, and all were found to be skewed and kurtotic; therefore non-parametric comparisons were made. Categorical variables were assessed using Pearson's chi squared or Fisher's exact tests.

Abstract #: T210-318

Women's Preferences for Analgesia Outcomes Associated with Labour Epidurals

Presenting Author: Alison Harding BSc
Presenting Author's Institution: Dalhousie University - Halifax, Nova Scotia
Co-Author: Ronald B George MD FRCPC - Dalhousie University
Allana Munro MD FRCPC - Dalhousie University
Brendan Carvalho MBBCh FRCA MDCH - Stanford University
Jillian Coolen MD FRCSC - Dalhousie University
Erna Snelgrove-Clarke RN PhD - Dalhousie University

Background: Labour epidural analgesia (LEA) is an important part of childbirth for women undergoing vaginal deliveries. However, women's preferences for LEA outcomes has been incompletely evaluated.

Objective: To determine women's preferences for LEA outcomes and whether they differ between antenatal and postpartum women.

Methods: This prospective cohort study was approved by the institutional ethics board. Questionnaires were distributed to two cohorts screened for eligibility: pregnant women (≥ 24 weeks gestation) at an antenatal visit and postpartum women during their childbirth admission. Common LEA outcomes were compiled using research published in leading anesthesia journals from June 2016 – May 2018. The list was appraised by two obstetric anesthesiologists to evaluate content validity. Volunteer patients, anesthesiologists and obstetricians reviewed the questionnaire for face validity. Participants ranked the outcomes according to perceived importance. They assigned each a number from 1 to 10 (priority ranking; 1 indicated the highest priority outcome and 10 the least). They also 'spent' $100 towards the outcomes (relative value scale), allocating more money to outcomes more important to them. Lastly, they were questioned (1 to 10 numeric ranking scale) regarding LEA expectations (antenatal) or satisfaction (postpartum).

Results: There were 220 questionnaires completed, 105 in the antenatal group and 115 in the postpartum group. The groups were not significantly different in terms of demographics. Achieving desired pain relief was the most important outcome for both groups. It was valued significantly more by the postpartum group who gave it an average of $46, while the antenatal group gave it an average of $35 (P=0.004). Postpartum women ranked \'experiencing a short time to achieve pain relief' as more important compared to antenatal women (Avg 5.2 vs. 3.8 (P<0.001)). Results for all outcomes are outlined in Table 1. The postpartum group reported more LEA satisfaction than the antenatal group indicated they were expecting (Avg 8.9 vs. 8.3 (P=0.004)). While both groups expected/experienced the same level of pre-epidural pain, the postpartum group experienced less post-epidural pain than the antenatal group expected (Avg 3.0 vs. 4.1 (P<0.001)).

Conclusions: Achieving desired level of pain relief and overall satisfaction with pain management was the greatest concern for women. Side effects such as leg weakness and pruritus were only mildly concerning.

Table 1 - Ranking and Relative Dollar Value of Potential Labour Epidural Outcomes

	Rank			Relative Dollar Value		
	Antenatal	Postpartum	*P*-value	Antenatal	Postpartum	*P*-value
Achieving desired pain relief	2.1 ± 1.9	1.6 ± 1.5	0.013	35 ± 26	46 ± 27	<0.004
Overall satisfaction with the pain management	3.9 ± 2.2	3.4 ± 1.9	0.108	14 ± 18	13 ± 16	0.061
Experiencing a short duration of labour	5.0 ± 2.3	5.5 ± 2.2	0.069	11 ± 15	6 ± 10	0.010
Experiencing a short time to achieve pain relief	5.2 ± 2.4	3.8 ± 2.1	<0.001	6 ± 9	10 ± 11	0.009
Avoiding complications such as low blood pressure	5.3 ± 2.5	6.3 ± 2.3	<0.002	8 ± 11	4 ± 6	0.006
Avoiding nausea and/or vomiting as a side effect	5.8 ± 2.4	6.3 ± 2.1	0.127	6 ± 9	6 ± 11	0.578
Receiving the smallest effective dose of pain medication	6.0 ± 3.0	6.5 ± 2.5	0.201	7 ± 11	4 ± 7	0.022
Avoiding anxiety related to labour pain	6.3 ± 2.7	5.9 ± 2.4	0.266	7 ± 11	5 ± 7	0.100
Avoiding leg weakness as a side effect	6.9 ± 2.3	7.3 ± 2.2	0.268	4 ± 7	4 ± 6	0.555
Avoiding itching as a side effect	8.5 ± 1.9	8.4 ± 2.1	0.757	2 ± 3	3 ± 6	0.073

Data are mean ± standard deviation. Rank = 1 to 10 from the highest priority (1) to the least (10). Relative dollar value = dollar value patients would pay out of $100 to achieve an outcome, e.g., postpartum women would pay $46 of their $100 to achieve their desired pain relief.

Abstract #: T210-444

Evaluating the role of acute pain versus cervical dilation in patient preferences for requesting epidural analgesia

Presenting Author: Davin Singh MD
Presenting Author's Institution: Northwestern University Feinberg School of Medicine - Chicago, IL
Co-Author: Catherine Gao BA - Mayo
Daniel Pinto PhD - Marquette
Paul Fitzgerald RN - Northwestern
Paloma Toledo MD - Northwestern

Introduction: Neuraxial labor analgesia is the most effective way to manage labor pain. Several factors may influence the decision and timing of using epidural analgesia including pain, proximity to delivery, or other factors. Patients are often dissatisfied with long delays between analgesia request and delivery. Yet, on busy labor and delivery units, anesthesiologists must prioritize when multiple patients request epidural analgesia simultaneously. Therefore, the objective of this study was to evaluate patients' preferences for the timing of epidural labor analgesia. We hypothesize that pain is more important than cervical dilation in patient's willingness to wait for neuraxial labor analgesia.

Methods: English-speaking women who received neuraxial labor analgesia were approached postpartum. Participants completed a survey which asked about demographic information, cervical dilation and pain score at the time they requested their labor epidural, their attitudes and beliefs about timing intervals, and an adaptive conjoint analysis to determine preferences for epidural analgesia timing. The conjoint analysis presented 'choice sets' where respondents chose between two alternative combinations of pain scores and cervical dilations (i.e. attributes) and answered "In which of these scenarios are you more likely to find a longer wait time for epidural anesthesia acceptable." Preference values, or part-worth utilities, represent the relative importance of each attribute, were calculated using linear models. The primary outcome was the preference value for pain versus cervical dilation in the timing of epidural anesthesia.

Results: Three hundred women were enrolled in the study and three women were excluded. Pain was weighted 1.6 times more important than cervical dilation in preference values from the conjoint analysis. The median pain score at epidural analgesia request was 8 (interquartile range [IQR]: 6 - 9), and the median cervical dilation was 4 cm (IQR: 4 – 5 cm). The median time women expected to wait between analgesia request and epidural catheter placement was 20 minutes (IQR: 15 – 30 min), while the median time they were willing to wait was 30 minutes (IQR: 20 – 45 min). The median perceived actual wait time was 15 minutes (IQR: 10 – 20 min).

Discussion: The important finding of this study is that pain is more important to patients than cervical dilation when requesting epidural analgesia, and patients with higher pain scores are less willing to tolerate a delay in epidural catheter placement. While there is not a standard interval between request and neuraxial placement, organizations have suggested intervals of 20 – 30 minutes, which are shown in this study to be acceptable for patients. Aligning patient preferences, and prioritizing epidural catheter placement in patients by higher pain scores rather than cervical dilation may result in improved patient satisfaction.

Abstract #: T210-509

Comparison of Continuous Epidural Infusion vs. Programmed Intermittent Epidural Bolus Labor Analgesia on the Incidence of Instrumented Vaginal Delivery: A Before-After Study

Presenting Author: Daniele Parise M.D.
Presenting Author's Institution: Brigham and Women›s Hospital - Boston, MA
Co-Author: Elizabeth Devlin M.D. - Brigham and Women›s Hospital
Stacey Burns M.D. - Brigham and Women's Hospital
Kara Fields B.S. - Brigham and Women's Hospital
Brian T Bateman M.D., MSc - Brigham and Women's Hospital
Michaela K Farber M.D. - Brigham and Women's Hospital

Background: Programmed intermittent epidural bolus (PIEB) is a relatively recent technique for labor analgesia that evolved from continuous epidural infusion(CEI). Compared to CEI, PIEB provides superior analgesia due to reduced hourly local anesthetic consumption, less physician intervention, and improved maternal pain and satisfaction scores (1,2). The reduced local anesthetic with PIEB may lower the incidence of motor block and need for instrumental vaginal delivery (IVD) but existing data do not consistently show this. Our institution transitioned from CEI with PCEA to PIEB with PCEA for labor analgesia on May 21, 2018 (along with a reduction in the concentration of the local anesthetic). Here we report the comparative frequency of IVD in a before-after study, along with a range of secondary outcomes that may be attributable to the approach to epidural management. We hypothesize that the PIEB group will have a lower rate of IVD.

Methods: Women who had epidural analgesia for singleton vaginal delivery at a tertiary center from March 31-May 20, 2018 (CEI group) and from May 22-July 26, 2018 (PIEB group) were evaluated. The CEI group received bupivacaine 0.125% + fentanyl 2mcg/ml; 6ml/hr infusion, PCEA bolus of 6ml every 15 minutes. The PIEB group received bupivacaine 0.0625 + fentanyl 2mcg/ml; 9 mL PIEB every 45 minutes, PCEA bolus of 10 ml every 15 minutes. Patients requiring catheter replacement, epidural bolus within 60 minutes of placement, spinal catheter and/or inadvertent dural puncture, or with a deviation in epidural dosing were excluded. The primary outcome was incidence of IVD. Secondary outcomes included the presence of motor block (defined as Modified Bromage Scale score 1-3: moderate/severe block), duration of the 2nd stage of labor, and frequency of cesarean delivery. Binary outcomes were compared between groups using multivariable logistic regression and continuous outcomes were compared between groups using multivariable linear regression.

Result: A total of 1,276 women were identified and 1,239 analyzed: 544 CEI patients (10 of 554 excluded) and 695 PIEB patients (27 of 722 excluded). Demographic and other measured characteristics were similar between groups. The rate of IVD was 43/544 (7.9%) vs. 46/695 (6.6%; adjusted OR 0.76, 95% CI 0.48-1.18, P=0.221) for CEI vs. PIEB groups, respectively. Motor block was greater in the CEI vs. PIEB group (17.1 vs 3.0%; adjusted OR 0.14, 95% CI 0.09-0.23, P<0.001). There was no difference in duration of 2nd stage of labor or rate of cesarean delivery.

Conclusions: Our unit's transition from CEI to PIEB (along with a reduction in the concentration of the epidural mix) for labor analgesia was accompanied by a reduction in the frequency of IVD that did not reach statistical significance. There was no effect on rate of cesarean delivery in labor. We observed a markedly lower frequency of documented motor block.

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1. Anesth Analg 2011:113(4); 826–31.
2. IJOA 2016:26; 32-8

Abstract #: T210-521

General Anesthesia in Cesarean Delivery Instances in the Era of Video Laryngoscopy: A Retrospective Review

Presenting Author: Jie Zhou MD, MS, MBA, FASA
Presenting Author's Institution: Brigham and Women›s Hospital, Harvard Medical School - Boston, MA
Co-Author: Shuang Fan BS - BWH
Xing Xue MD - BWH

Background: The application of video laryngoscope greatly improved the visibility of patients' airway, and the no cases of difficult intubation can be observed as the consequence.

Method: We identified and collected information of 385 parturients who underwent cesarean section under GA from the Partners HealthCare electronic medical system from January 2016 to December 2018 by the submission date of abstract. The demographic information, indications for cesarean delivery, anesthesia techniques, mode of airway management, and surgery time were collected and analyzed. The one-sample ANOVA test was used to compare the demographic information of the population. The two-tailed T-test and chi-square test were used to compare the occurrences of cesarean deliveries under GA between this study and the previous study from the same institution for the period of 2000 to 2005.

Results: From January 2016 to December 2018, 32.52% to 33.09% of total deliveries ranging from 11,697 to 15,044 cases every year were delivered through cesarean section. 2.55% to 3.22% of cesarean delivery cases were operated under GA. A statistically significant ($p<0.001$) increase can be observed when comparing the rate of cesarean deliveries that required GA from the period of 2000-2005 to the period of 2016-2018. There were sixteen cases of atraumatic repeated intubation attempts with one intubation instance that resulted in tracheal laceration. No difficult airway was identified, and no anesthesia-related mortality occurred. 14.3% overall increase ($p=0.002$) can be observed when comparing the application rate between the use of video laryngoscope and the use of direct laryngoscope from 2016 to 2018.

Discussion: From the previous studies at Brigham and Women's hospital, the conclusion was made that incidences of cesarean deliveries under GA were declining despite the fact that there was an increasing number of cesarean deliveries. Our study found that the rate of cesarean deliveries under GA is increasing over past decade, likely due to the more satisfying mode of airway management and usage of video laryngoscope. We will continue data collection and present the complete data set and analysis at SOAP.

Table 1. The Demographic Information Analysis of Year 2016-2018

	2016 (n = 97)	2017 (n = 129)	2018 (n = 159)	*p*-value
Age (year)	32.6 ± 6.1	32.8 ± 5.4	32.3 ± 6.4	0.772
BMI (kg/m^2)	32.3 ± 7.1	31.7 ± 7.1	32.0 ± 7.6	0.805
Gestational Age (week)	36.9 ± 3.7	36.0 ± 4.5	36.8 ± 4.0	0.234

Table 2. Total Number of All Deliveries, Cesarean Deliveries (%), Cases that Required General Anesthesia and Percentage

	2016	2017	2018
Total Deliveries	11697	14757	15044
Cesarean Deliveries	3804	4883	4945
Cesarean Delivery Rate (%)	32.52%	33.09%	32.87%
Cesarean Deliveries Requiring GA	97	129	159
Cesarean GA rate (%)	2.55%	2.64%	3.22%

Table 3. Time of Day

	2016	2017	2018
7am-3pm, n (%)	38 (39.2)	41 (31.8)	65 (40.9)
3pm-7am, n (%)	89 (60.8)	88 (68.2)	94 (59.1)

References:

1. Palanisamy A, et al. Int J Obstet Anesth 2011; 20: 10-16
2. Tsen L, et al. Int J Obstet Anesth 1998 ; 7: 147-152

Abstract #: T210-543

Effect of Neuraxial Labor Analgesia on Circadian Rhythm of Labor: A Retrospective Cohort Study

Presenting Author: Jie Zhou MD, MS, MBA, FASA
Presenting Author's Institution: Brigham and Women›s Hospital, Harvard Medical School - Boston, MA
Co-Author: Li Wang MD - BWH
Gangli Guo MD - BWH
Wenjie Qing MD - BWH

Background: The study of Varea et al revealed a clear circadian pattern of human births which was diurnal with a higher incidence of deliveries in the early morning in winter or morning in summer based on old delivery data of Casa de Maternidad in Madrid between 1887-1892. Bakker et al also suggested that induction of labor in the morning might improve outcomes. We performed this retrospective review to examine the circadian rhythm of labor and the impact of neuraxial labor analgesia (NLA).

Methods: 27,826 delivery data from 1/1/2016 to 12/31/2017 at the Partners Healthcare Systems were collected, of which 17,165 vaginal deliveries were included. 13,722 parturients received NLA; 3,443 delivered naturally without NLA. Parturients were divided into 12 groups every 2 hours based on the baby delivery time of the day based on the Chinese celestial and sexagenary cycle system, as 23:00-1:00, 1:00-3:00, 3:00-5:00, 5:00-7:00...21:00-23:00. We analyzed delivery pattern as percentage during each time slot allocations, to determine the effect of circadian rhythm of labor in parturients with and without NLA.

Results: Distribution of delivery time in spontaneous vaginal deliveries without NLA showed a diurnal pattern with a peak in the early morning between 3:00-5:00 at 9.8%, and the nadir between 15:00-17:00 at 6.9%. The birth time distribution showed a sinusoidal pattern of parturients who delivery without NLA. The distribution of birthing times of parturients with NLA were significantly different. (P<0.001) (Figure 1)

Discussion: Interestingly, our study demonstrated similar sinusoidal birthing time as Varea et al in parturients with delivered naturally without NLA. Administration of NLA obscured the natural diurnal birthing pattern. This was a preliminary analysis of our data with an intention to mimic the presentation of Varea et al. We are planning on secondary analysis by addition of parity data and other relevant factors in order to better understand the onset and progress of labor process.

Figure 1: Circadian rhythm of vaginal delivery with or without neuraxial analgesia

References:

1. Varea C, et al. Am J Hum Biol 2014;26:707
2. Bakker JJ, et al. Cochrane Database Syst Rev 2013;28:CD007707
3. Arendt K, et al. Anesth Analg 2008;107:2096

Abstract #: T210-546

Effect of Anesthesia Methods on Recovery of Patients Undergoing Cervical Cerclage

Presenting Author: Jie Zhou MD, MS, MBA, FASA
Presenting Author's Institution: Brigham and Women›s Hospital, Harvard Medical School - Boston, MA
Co-Author: Xing Xue MD - BWH
Shuang Fan BS - BWH
Min Wei MD - BWH
Danran Zhou BS - BWH

Background: Cervical cerclage operation is an important procedure to prevent or treat cervical incompetence or insufficiency. The procedure usually lasts no more than 30 minutes and is traditionally performed under spinal anesthesia. With the increased demand for enhanced recovery, the application of deep sedation or intravenous general anesthesia (IVGA) has emerged. The purpose of this study is to review the cervical cerclage cases performed under different anesthesia methods.

Methods: A retrospective review of all the patients who underwent cervical cerclage procedure at the Partners HealthCare Systems from July 2015 to January 2019 was conducted. Data including demographic information, anesthesia method, surgical duration, complications, and recovery time were collected. Three groups of parturients were identified based on the anesthesia methods of spinal (Group SP), IVGA (Group IVGA) and spinal plus IVGA (Group SP+IVGA). Statistical analysis was performed using SPSS version 20.0 software.

Results: A total of 365 parturients were included in this study, among which 336 patients received spinal anesthesia, 18 received IVGA, and 11 received spinal + IVGA. Demographic characterizations of the 3 groups were similar ($p > 0.05$). The recovery time of the IVGA group was significantly ($p = 0.000$) shorter than the Group SP. In all three groups, prophylactic drugs (Ondansetron or metoclopramide) were used to minimize the risk of postoperative nausea and vomiting (PONV). In this study, no patients suffered from the PONV, and no complications were observed. Though no significant difference was found between the duration of surgery of IVGA and SP ($p > 0.05$), the induction time was significantly decreased in Group IVGA compare to Group SP.

Discussion: Previous studies indicated that cervical vaginal cerclage is often performed under spinal anesthesia. Our results indicated that IVGA in cervical cerclage could be advantageous due to improved recovery time with no increased risk. However, we have not explored the effect of different IV drugs, dose concentrations, and their potential effects on the fetus.

Table 1. Characteristics of Anesthesia Approaches to Cervical Cerclage

	Group IVGA (n = 19)	Group SP (n = 332)	Group SP+IVGA (n = 4)	p-value (IVGA vs. SP)
Age (year)	33.5 ± 4.3	33.2 ± 4.9	36.1 ± 4.9	0.790
BMI (kg/m^2)	28.0 ± 6.7	28.0 ± 6.3	28.0 ± 5.9	0.972
Induction Time (min)	4.2 ± 2.3	20.3 ± 12.9	13.1 ± 9.1	0.000
Duration of Surgery (min)	62.2 ± 15.2	57.8 ± 9.3	56.6 ± 12.9	0.065
Recovery Time (min)	117.8 ± 45.8	259.9 ± 134.6	291.9 ± 137.5	0.000

References:

1. Bolla D, et al. Arch Gynecol Obstet 2017; 295(4):885-890.
2. Berghella V, et al. Am J Clin Exp Obstet Gynecol 2013; 209(3):181-192.
3. Moore D, et al. Anesth Analg 1980: 59: 743-750.

Defining, Evaluating and Influencing Recovery After Cesarean Delivery Research Hour

Brendan Carvalho MBBCh, FRCA, MDCH

Professor, Chief Obstetric Anesthesia Division
Stanford University School of Medicine
Immediate Past President, Society for Obstetric Anesthesia and Perinatology

1

Disclosures

No relevant financial relationships or funding to disclose

Gauss Surgical: Consulting
Rivanna Medical: Speaking honorarium, research GIFT funding
Pacira Pharmaceuticals: Research funding
Flat Medical: Consulting

2

Learning Objectives

- Define recovery after cesarean delivery
- List tools (with focus on the ObsQoR-10) and key metrics that can be used to evaluate and track recovery
- Discuss maternal and neonatal factors that can improve recovery after cesarean delivery

3

Speakers

Pervez Sultan
Associate Professor, Stanford University

Ashraf Habib
Professor, Duke University

4

Cesarean Delivery: Anesthetic Outcomes

5

6

What is Recovery?

"A return to a normal state of health, mind or strength"

- Difficult to define, complex and multidimensional
- Physical, physiological, psychological, emotional, economic, and social health components
- Dependent on patient, anesthetic and surgical factors, as well as postoperative complications

7

Comprehensive Definition of Surgical Recovery? Five Defining Attributes

- An energy-requiring process
- A return to a state of normality and wholeness defined by comparative standards
- Regaining control over physical, psychologic, social and habitual functions
- Returning to preoperative levels of independency or dependency in activities of daily living
- Regaining one's optimum level of well-being

Allvin R. J Adv Nurs 2007;57:552-8

8

Term "recovery" means different things to different stakeholders

Patient's Perspective:

The absence of symptoms and the return of their ability to perform activities as they could before their operative treatment (and pregnancy)

Lee L. Surgery 2014;155:211-6
Kleinbeck SV. AORN J 1994;60:7-8

9

Table. Stages of recovery

Phase of recovery	*Definition*	*Time frame*	*Threshold*	*Outcomes*
Early	From OR to discharge from PACU	Hours	Safety (sufficiently recovered from anesthesia and safe to go to floor)	Physiologic and biologic
Intermediate	From PACU to discharge from hospital	Days	Self-care (able to care for self at home)	Symptoms and impairment in ADL
Late	From hospital discharge to return to usual function and activities	Weeks to months	Return to normal (baseline or population norms)	Function and health-related quality of life

Lee L. Surgery 2014;155:211-6

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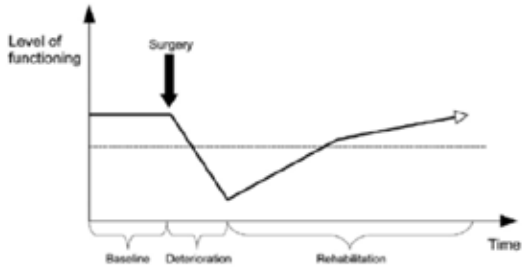

Lee L. Surgery 2014;155:211-6

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Patient-Reported Outcome Measures of Functional Recovery

Sharawi N. Systematic Review Anaesthesia 2019 In press

- PSC - Postpartum Symptom Checklist
- EQ-5D-3L (or EQ-5D) - EuroQol Questionnaire
- SF-36 - 36 Item Short Form Survey
- PISQ-12 - Pelvic Organ Prolapse/Urinary Incontinence/Sexual Function Short Form
- BPI - Brief Pain Inventory (assessed using a NRS; numerical rating scale)
- OWHS - Oxfordshire Women's Health Study questionnaire
- KATZ ADL - KATZ Activities of Daily Living Scale
- QoL-40 - Quality of Recovery Score 40
- SIL-Ger - Salmon's Item List (German version)
- RPQoL - Rural Postpartum Quality of Life
- WHOQOL-BREF - World Health Organization Quality of Life (short version)
- RCSS - Recovery from Caesarean Section Scale
- **ObsQoR-11 - Obstetric Quality of Recovery-11**

12

Self-Assessed Functional Recovery

Vaginal delivery:
Median (range): 20 (3-77) days
95%: 47 days

Cesarean delivery:
Median (range): 27 (10-85) days
95%: 50 days

Komatsu R. Anesthesiology. 2017;127(4):684-694

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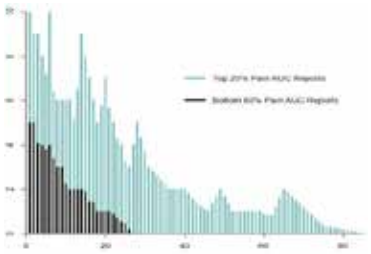
Self Assessed Functional Recovery



Komatsu R. Br J Anaesth. 2018;121(2):417-426

14

Brendan Carvalho
Professor, Chief Obstetric Anesthesia Division
Department of Anesthesiology, Perioperative and Pain Medicine
Stanford University School of Medicine

bcarvalho@stanford.edu

@carvalb

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Defining, Evaluating and Influencing Recovery After Cesarean Delivery

Pervez Sultan MD
Department of Anesthesiology
Associate Professor, Division of Obstetric Anesthesia
Stanford University School of Medicine
Honorary Senior Lecturer
University College London
Twitter: @pervezsultan5

UCL Stanford University

1

Learning Objectives

- Why we should evaluate recovery following cesarean delivery
- Uses of patient reported outcome measures (PROMs)
- Assessment of PROM quality (COSMIN criteria)
- Available PROMs to assess recovery following cesarean delivery
- Development and evaluation of new PROM (ObsQoR-11)

2

Recovery following cesarean delivery

- Commonly performed surgery
- Recovery takes "6 weeks"
- Multiple domains of recovery
- QoR-40 and QoR-15
  - PROMs used after non-obstetric surgery
  - Few robust measures of recovery after cesarean

3

Use of PROM Data

7.7.1 **Best Practice Tariff (BPT)**

A BPT is a national price that is designed to incentivise high quality and cost effective care. The aim is to reduce unexplained variation in clinical quality and to spread best practice. [32]

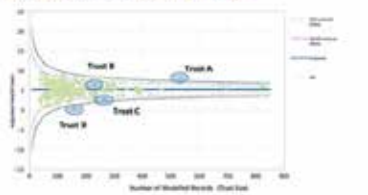
In 2010/11, BPTs were introduced for four service areas[33]. In 2011/12, this extended to six additional service areas, which included primary knee replacement and primary hip replacement outcomes. From 2014/15, PROMs data has been used to inform the payment criteria for primary knee replacement and primary hip replacement BPTs. Providers have to meet PROMs and National Joint Registry (NJR) based targets to achieve full payment. The 2014/15 PROMs-based targets are:

- PROMs participation rate being at least 50%
- Average health gain for OHS and OKS not being below the lower 99.8% control limit[34]

The 2014/15 BPT payments for primary knee replacement and primary hip replacement outcomes is likely to be based on 2013/14 provisional PROMs data.

4

Figure 1: Screenshot of Funnel Plot



The above organisations used in this example would be interpreted accordingly

Table 2: Interpretation of trust outcomes

Organisation name	Significance	Interpretation
Trust A	Upper 99.8%	Among the best outcomes
Trust B		Average outcomes
Trust C	Lower 99%	Below average outcomes
Trust D	Lower 99.8%	Among the worst outcomes

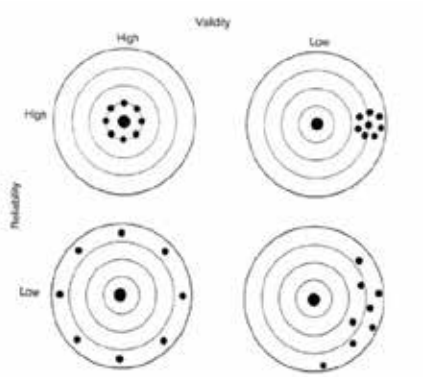
5

Patient Reported Outcome Measures (PROMs)

- Research performed using PROMs of unknown quality is a waste of resources
- This is **WIDESPREAD** practice
- Selecting best PROM for recovery following cesarean needs high quality studies measuring:
  - Validity
  - Reliability
  - Responsiveness

6

Validity vs. Reliability



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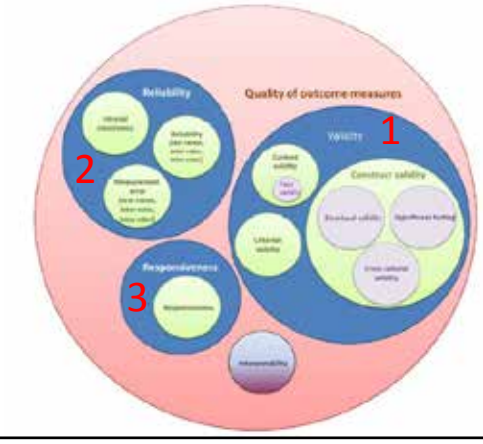
COnsensus based Standards for the selection of health Measurement INstruments (COSMIN) criteria

8



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COSMIN Checklist

Measurement property	Description
Content validity	Extent to which the PROM represents all facets of a construct e.g. different aspects of recovery domains
Structural validity	Extent to which PROM measures what it is supposed to measure e.g. compare PROM with another measurement agreed to measure
Internal consistency	Unidimensionality of a test (ability to measure a single attribute) and use of Cronbach's alpha (reliability measure – how closely related a set of items are as a group)
Cross cultural validity	Consistent results seen in translated / culturally adapted versions
Reliability	Variance attributable to true difference between individuals
Measurement error	Variations among individuals which are not due to true differences
Hypothesis testing	Correlation in accordance with hypothesis e.g score and LOS
Responsiveness	Ability to detect change over time
(Criterion validity)	(How well scores perform when compared to a gold standard)

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COSMIN criteria

1. Assess quality of studies reporting use of PROMs
2. Determine psychometric quality of PROMs utilized
1. Identify the most promising outcome measure

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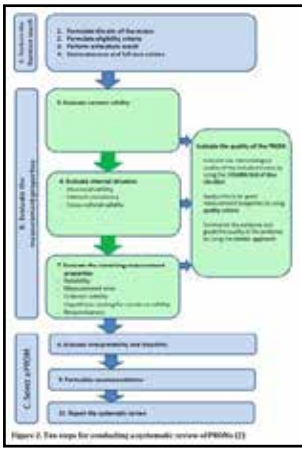

Which PROM best assesses functional recovery following cesarean delivery?

5 database literature search looking for psychometrically evaluated PROMs:
- functional recovery OR
- functional + psychological recovery

Evaluation of studies using psychometrically evaluated PROMs

Determine psychometric quality of PROMs utilized using COSMIN criteria

Recommendation

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PROMS used to evaluate postpartum functional recovery

- 12 PROMs used to assess the quality of recovery after CD
- 18 different studies
- n = 8,962 patients

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No studies	Abbreviation	PROM Full Title
1	PSC	Postpartum Symptom Checklist
4	EQ-5D-3L	EuroQol Questionnaire
6	SF-36	36 Item Short Form Survey
1	PISQ-12	Pelvic Organ Prolapse/Urinary Incontinence/Sexual Function Short Form Questionnaire
1	BPI	Brief Pain Inventory
1	OWHSQ	Oxfordshire Women's Health Study questionnaire
1	KATZ ADL	KATZ Activities of Daily Living Scale
1	QoL-40	Quality of Recovery Score 40
	SIL-Ger	Salmon's Item List (German version)
1	RPQoL	Rural Postpartum Quality of Life
1	WHOQOL-BREF	World Health Organization Quality of Life (short version)
1	RCSS	Recovery from Caesarean Section Scale

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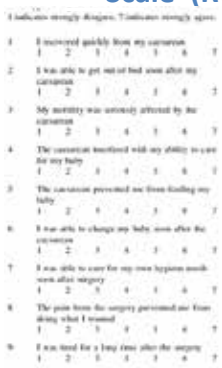
Recovery from Caesarean Section Scale (RCSS)



Int J Obstet Anesth 2006;15:18–23.

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Domains

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COSMIN -Overall Level of Evidence

Rating	Level of evidence	Criteria
+++	Strong Positive	Consistent findings in multiple studies of good methodological quality or in one study of excellent methodological quality
++	Moderate Positive	Consistent findings in multiple studies of fair methodological quality or in one study of good methodological quality
+	Limited Positive	One study of fair methodological quality
?	Unknown	Only studies of poor methodological quality
+/-	Conflicting	Conflicting findings
-	Limited Negative	One study of fair methodological quality
--	Moderate Negative	Consistent findings in multiple studies of fair methodological quality or in one study of good methodological quality
---	Strong Negative	Consistent findings in multiple studies of good methodological quality or in one study of excellent methodological quality

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Performance of PROMs

- Few adequate measures of functional recovery following CD.
- Future development of PROMs for use in the CD setting should include multiple domains and undergo validation as outlined by the COSMIN criteria.

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DEVELOPMENT OF A NEW PROM: OBSQOR-11

Br J Anaesth. 2019 Jan;122(1):69-78.

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Development of the ObsQoR-11 score

- **ObsQoR-40**
  - Removal of non-OB items
  - Removal of non-NA items
- **ObsQoR-19**
  - Expert evaluation
  - Addition of NA and OB items
- **ObsQoR-31**
  - Stakeholder evaluation and ranking
  - >2/3stakeholder support
- **ObsQoR-22**
  - Tested against global health score (0-100) at 24 and 25 h
  - Post hoc factor analysis performed on ObsQoR-22 items
- **ObsQoR-11**
  - Evaluation in different populations (DGH, USA, SVD, urgent)

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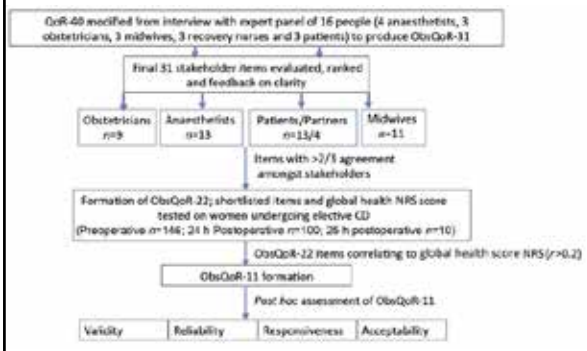

Br J Anaesth. 2019 Jan;122(1):69-78

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DOMAIN (1) PHYSICAL COMFORT

23

QoR-40	Items removed after expert review	Items added after exert review	ObsQoR-31 Draft items	Items removed (<2/3 stakeholder support)	ObsQoR- 22	ObsQoR-11 (Correlation with NRS and post hoc factor analysis)
Able to breathe						X
Good sleep				X		
Enjoy food	X					
		Itchiness				X
Feel rested				X		
Nausea				MERGED ITEMS		Nausea & vomiting
Vomiting						
Dry retching	X					
		Dry lips / mouth		X		
Restless	X					
Shaky / twitching	X					
Shivering						Shivering
Too cold	X					
Dizzy						Dizzy

24

DOMAIN (2)
EMOTIONAL STATE

25

QoR-40	Removed After expert review	Added after exert review	ObsQoR-31 Draft items	Items removed	ObsQoR- 22	ObsQoR-11
General well being	X					
In control						In control
Comfortable						Comfortable
Bad dreams	X					
Anxious						X
Angry	X					
Depressed						X
Alone	X					
Difficulty falling asleep	X					

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DOMAIN (3)
PHYSICAL INDEPENDENCE AND CARE OF NEONATE

27

QoR-40	Removed After expert review	Added after exert review	ObsQoR-31 Draft items	Items removed	ObsQoR- 22	ObsQoR-11
Normal speech	X					
		Sensation normal				X
		Able to hold baby				Able to hold baby
Wash, brush teeth	X					
		Mobilise independently				Mobilise independently
Look after appearance				X		
Write	X					
		Personal hygiene				Personal hygiene
Return to work	X					
		Pre-pregnancy state		X		
		Able to change nappy		X		
		Able to feed / nurse				Able to nurse / feed
		Able to pass urine				X

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DOMAIN (4)
PSYCHOLOGICAL SUPPORT

29

QoR-40	Removed After expert review	Added after exert review	ObsQoR-31 Draft items	Items removed	ObsQoR- 22	ObsQoR-11
Communicate with staff						X
Communicate with family	X					
		Communicate with partner				X
Support from doctors	X					
Support from nurses	X					
Support from family	X					
Understand instructions						X
Confused	X					

30

DOMAIN (5)
PAIN

31

QoR-40	Removed After expert review	Added after exert review	ObsQoR-31 Draft items	Items removed	ObsQoR- 22	ObsQoR-11
Moderate pain						Moderate pain
Severe pain						Severe pain
		Perineal pain				X
Headache						X
Muscle pain				X		
Back ache				X		
Sore throat	X					
Sore mouth	X					

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VALIDITY

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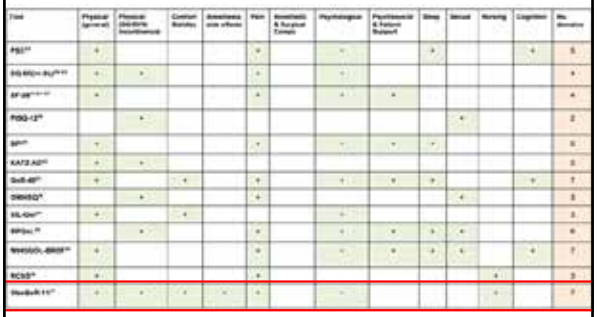

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Validity - Accuracy

	Structural validity		Hypothesis testing
	Global health score <70	Global health score >70	24 h score Correlation with LOS (r)
Elective CD (n=100)	87 [72 -95]	100 [91.3 -105]	-0.39 (p=0.003)
Emergency CD (n=100)	64 [50.5 -78.5]	97 [86.5-101]	-0.24 (p=0.02)

Br J Anaesth. 2019 Jan;122(1):69-78
Int J Obstet Anesth [Epub ahead of print]

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RELIABILITY

36

Reliability

- Internal consistency
  - Cronbach's alpha 0.75 (emergency) >0.7 (elective)
  - Inter-item correlation
- Split-half reliability
  - Elective 0.76
  - Emergency 0.96 (parts contribute equally)
- Test-retest reliability (24 and 25 h)
  - Elective: 82% of items having a correlation of >0.6
  - Emergency: Intraclass correlation coefficient r ≥0.62
- Floor and ceiling effects
  - ObsQoR-11 score was 6% before operation and 0% at 24 h
  - Emergency 1% and 0% (24 and 25 h)

Br J Anaesth. 2019 Jan;122(1):69-78
Int J Obstet Anesth [Epub ahead of print]

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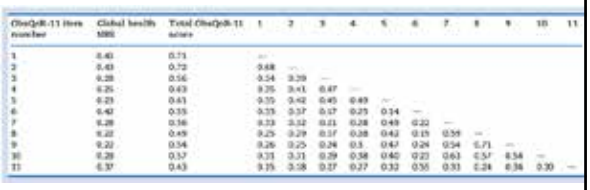
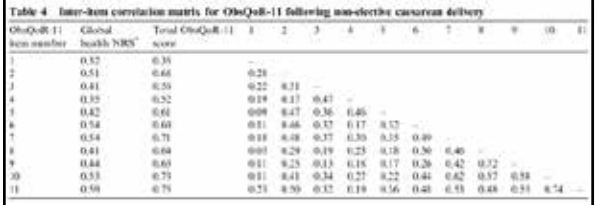
Inter-item correlation (elective)



Br J Anaesth. 2019 Jan;122(1):69-78

38

Inter-item correlation (emergency)



Int J Obstet Anesth [Epub ahead of print]

39

RESPONSIVENESS

40

Responsiveness - Elective

- Cohen effect size

  $$\frac{\text{mean preop score - 24 h postop score}}{\text{SD baseline}}$$

- Standardised response

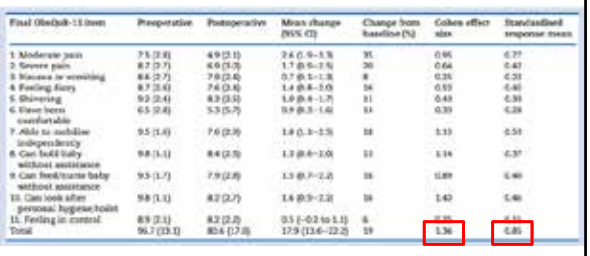
  $$\frac{\text{mean preop score - 24 h postop score}}{\text{SD change in scores}}$$

- Mean preop score - 24 h postop score

Br J Anaesth. 2019 Jan;122(1):69-78

41

Responsiveness - Elective



Br J Anaesth. 2019 Jan;122(1):69-78

42

Responsiveness – Emergency Intra-class correlation (24 vs. 25 h)

Table 5 Intra-class correlations for ObsQoR-11 items

ObsQoR-11 item	Intra-class correlation
Moderate pain	0.78
Severe pain	0.87
Nausea or vomiting	0.89
Dizziness	0.84
Shivering	0.86
Comfortable	0.62
Mobilisation	0.85
Hold baby	0.72
Nurse baby	0.88
Personal hygiene	0.98
Control	0.85
ObsQoR-11 score	0.96

Int J Obstet Anesth [Epub ahead of print]

43

ACCEPTABILITY AND FEASIBILITY

44

Acceptability and feasibility

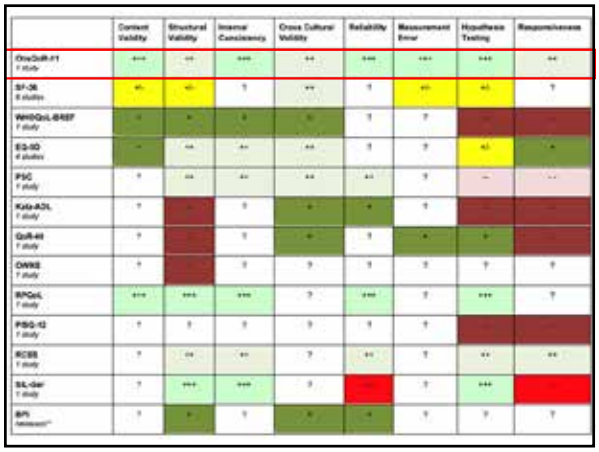
- Recruitment rate (not always at bedside!)
- Successful completion rate
- Time taken to complete questionnaire:
  - 117 [89 – 156] sec
  - Range 66 – 300 sec

Br J Anaesth. 2019 Jan;122(1):69-78
Int J Obstet Anesth [Epub ahead of print]

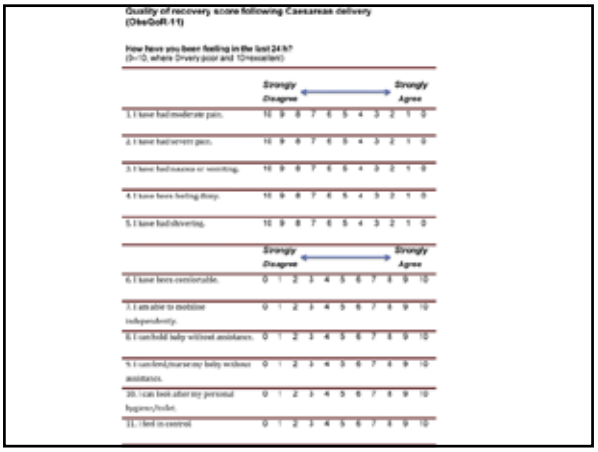
45

Rating	Level of evidence	Criteria
+++	Strong Positive	Consistent findings in multiple studies of good methodological quality or in one study of excellent methodological quality
++	Moderate Positive	Consistent findings in multiple studies of fair methodological quality or in one study of good methodological quality
+	Limited Positive	One study of fair methodological quality
?	Unknown	Only studies of poor methodological quality
+/-	Conflicting	Conflicting findings
-	Limited Negative	One study of fair methodological quality
--	Moderate Negative	Consistent findings in multiple studies of fair methodological quality or in one study of good methodological quality
---	Strong Negative	Consistent findings in multiple studies of good methodological quality or in one study of excellent methodological quality

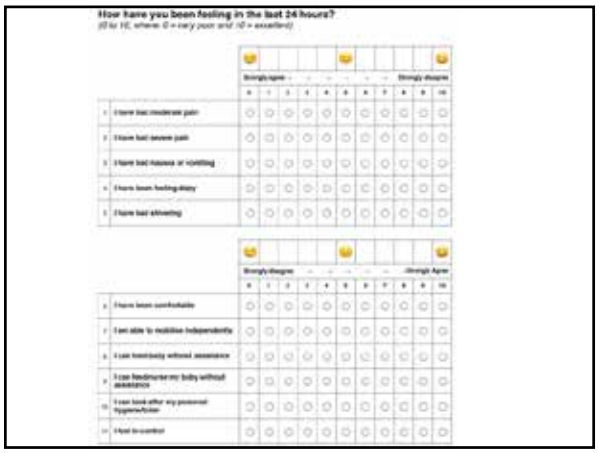
46



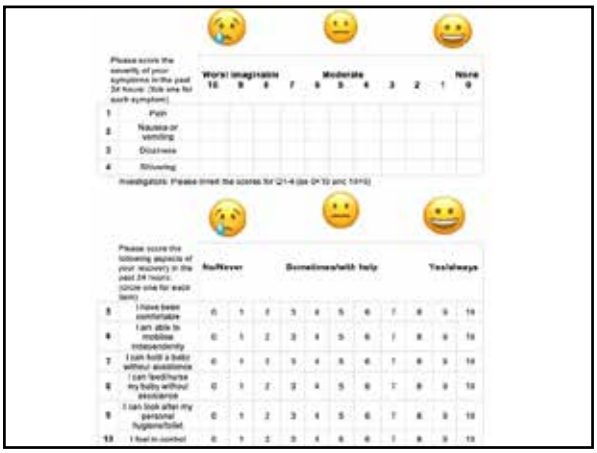
47



48



49



50

Research Hour - Defining, Evaluating and Influencing Recovery After Cesarean Delivery

Ashraf S Habib, MBBCh, MSc, MHSc, FRCA
Professor
Chief, Division of Women's Anesthesia

Duke Anesthesiology

1

Objectives

- How can we influence recovery after cesarean delivery?
- What are the gaps in our knowledge and areas for research?

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Quality of Recovery following CD

Pain	Multimodal analgesia
Nausea Vomiting	IONV/PONV prophylaxis Opioid sparing strategies
Dizziness	Prevention of hypotension Non-sedating agents
Shivering	Prevention of hypothermia
Breastfeeding Holding Baby	Skin to skin Adequate analgesia Breastfeeding support
Mobilizing Personal hygiene In control	Adequate Analgesia Patient Education

Ciechanowicz S. Br J Anaesth 2019;122: 69-78

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3

Influencing Recovery after Cesarean Delivery

- Prevention of hypotension
- Prevention of hypothermia
- Nausea and vomiting prophylaxis
- Postoperative analgesia

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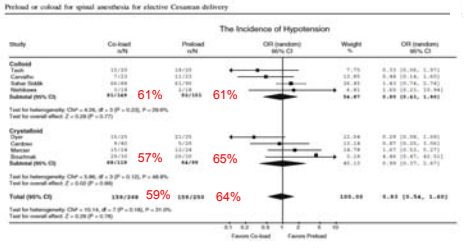
4

Spinal Induced Hypotension
Fluids



Banerjee A. Can J Anesth 2010;57:24-31

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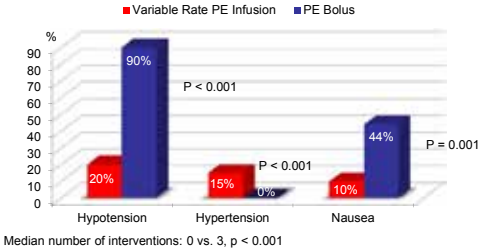
Spinal Induced Hypotension
Prophylactic Phenylephrine Infusion



Median number of interventions: 0 vs. 3, p < 0.001

Siddik-Sayyid S. Anesth Analg 2014;118:611-8

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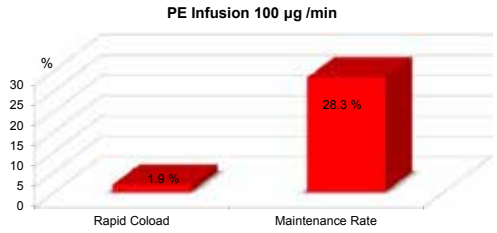
Spinal Induced Hypotension

Fluid co-load with phenylephrine infusion



Less PE with coload (56 vs. 42 mcg/min, p=0.008)

Ngan Kee. Anesthesiology 2005;103:744-50

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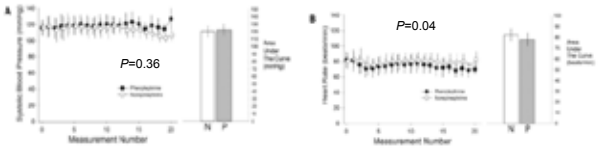
7

Phenylephrine vs. Norepinephrine

Maternal Hemodynamic Data

Systolic Blood Pressure **Heart Rate**



Computer-controlled infusion:
Norepinephrine 5 µg/ml vs. Phenylephrine 100 µg/ml

Ngan Kee WD. Anesthesiology 2015;122:736-45

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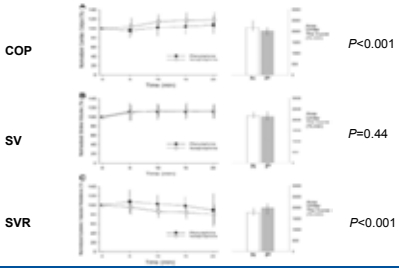
Phenylephrine vs. Norepinephrine

Maternal Hemodynamic Data



Ngan Kee WD. Anesthesiology 2015; 122: 736-45

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Phenylephrine vs. Norepinephrine

Neonatal Outcomes

Table 3. Neonatal Outcome

	Norepinephrine Group	Phenylephrine Group	*P* Value
Birth weight (kg)	3.11 [2.86–3.37]	3.19 [3.04–3.36]	0.37
Apgar score at 1 min <8	0	0	
Apgar score at 5 min <8	0	0	
Umbilical arterial blood gases			
pH	7.30 [7.28–7.33]	7.29 [7.28–7.32]	0.45
Pco_2 (mmHg)	50 [48–56]	52 [48–56]	0.77
Po_2 (mmHg)	15 [13–18]	14 [11–16]	0.20
Base excess (mmol/l)	−2.0 [−3.7 to −1.0]	−2.4 [−4.2 to −0.8]	0.87
Oxygen content (ml/dl)	6.0 [4.4–7.7]	5.2 [3.8–7.0]	0.29
Umbilical venous blood gases			
pH	7.35 [7.34–7.37]	7.34 [7.32–7.36]	0.031
Pco_2 (mmHg)	41 [38–45]	41 [38–45]	0.99
Po_2 (mmHg)	27 [23–30]	26 [23–28]	0.23
Base excess (mmol/l)	−3.0 [−4.1 to −2.0]	−3.5 [−5.0 to −2.4]	0.06
Oxygen content (ml/dl)	12.7 [11.2–14.4]	11.8 [9.6–13.7]	0.047

Values are median [interquartile range] or number.

Ngan Kee WD. Anesthesiology 2015; 122: 736-45

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Knowledge Gaps

- What is the optimal fluid administration regimen?
- Is there a place for goal-directed fluid therapy in conjunction with prophylactic vasopressors?
- Is there a place for norepinephrine overall or in specific patient populations?

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Influencing Recovery after Cesarean Delivery

- Prevention of hypotension
- Prevention of hypothermia
- Nausea and vomiting prophylaxis
- Postoperative analgesia

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Impact of Hypothermia

- Increased blood loss
- Increased wound infection
- Myocardial ischemia
- Prolonged drug action
- Prolonged recovery and hospital stay/ increased costs

Frank SM. JAMA 1997;277;1127-34. Kurz A. NEJM 1996; 334;1209-15
Schmied H. Lancet 1996;347;289-92. Lenhardt R. Anesthesiology 1997;87:1318-23

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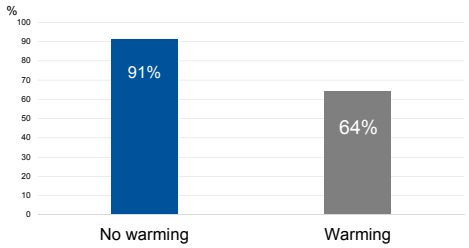
Incidence of Hypothermia



Cobb B. Anesth Analg 2016;122:1490-7

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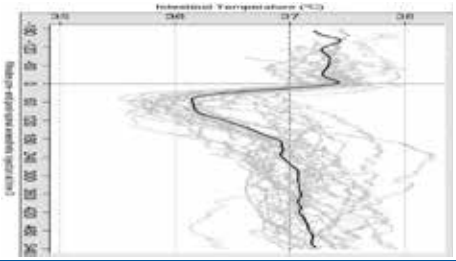
Magnitude and Duration of Temperature Drop



du Toit. Anesth Analg 2018;126:190-195

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Active Warming

Outcome (n studies)	MD, RR or SMD (95% CI)
End of surgery temperature (10)	0.43 (0.27, 0.59)
Shivering (12)	0.58 (0.43, 0.79)
Thermal Comfort (4)	0.90 (0.36, 1.45)
Hypothermia (5)	0.66 (0.50, 0.87)
Umbilical artery pH (3)	0.02 (0.00, 0.05)

Sultan P. Br J Anaesth 2015;115:500-10

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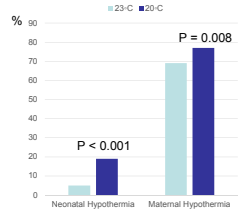
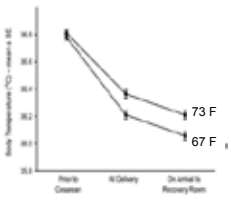
OR Ambient Temperature

Neonatal and Maternal Hypothermia



Maternal Temperature



Duryea EL. Am J Obstet Gynecol 2016; 214: 505.e1-505.e7

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Knowledge Gaps

- What is the magnitude of and duration of hypothermia in women receiving neuraxial morphine?
- What are the consequences of hypothermia in women undergoing cesarean delivery?
- What is the optimal warming strategy (ies)?

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Influencing Recovery after Cesarean Delivery

- Prevention of hypotension
- Prevention of hypothermia
- Nausea and vomiting prophylaxis
- Postoperative analgesia

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Prevention of IONV

- **Anesthetic factors:**
  - Prevention of hypotension (PE Infusion)
  - Good quality block (ITF)
    - RR (95% CI) = 0.41 (0.24. 0.70), NNT = 6.5
  - Combination Antiemetics
    - Metoclopramide + ondansetron
      - 23% vs. 49% with placebo
- **Surgical factors:** Exteriorization and irrigation

Ngan Kee W. Br J Anaesth 2004;92:469-74 Mannulang TR. Anesth Analg 2000; 90:1162-6
Uppal V. Anesth Analg 2019 (Epub ahead of print) Habib AS. Obstet Gynecol 2013;101:615-23

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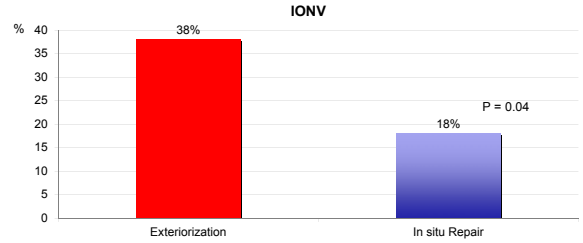
20

Exteriorization of the Uterus and IONV



Siddiqui M. Obstet Gynecol 2007;110:570-5

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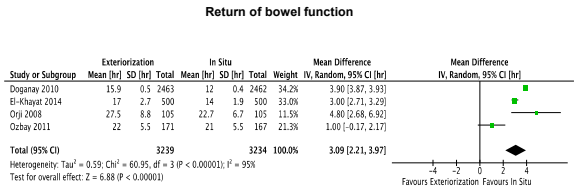
21

Exteriorization of the Uterus and Bowel Function



Zaphiratos V. Can J Anesth 2015;62:1209-20

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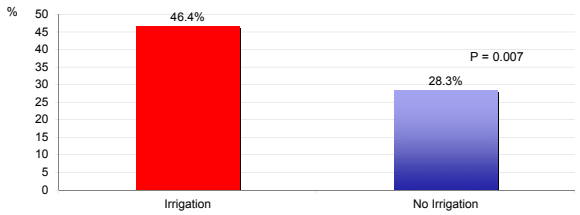
22

Intra-abdominal Irrigation and IONV



ION:RR: 1.68, 95% CI:1.36–2.06
IOV: RR: 1.70, 95% CI: 1.28–2.25

Viney R. Obstet Gynecol 2012;119:1106-11
Eke AC. J Matern Fetal Neonatal Med 2016;29:1588-94

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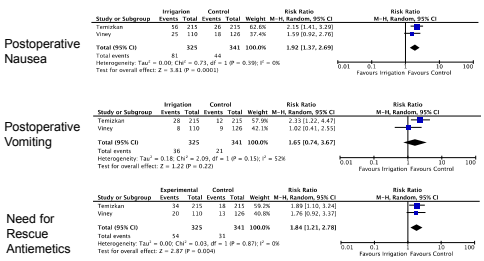
23

Intra-abdominal Irrigation and PONV



Eke AC. J Matern Fetal Neonatal Med 2016;29:1588-94

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Prevention of PONV

- **Combination Antiemetic Therapy**
- **Analgesia**
  - Dose of ITM
  - Opioid sparing techniques

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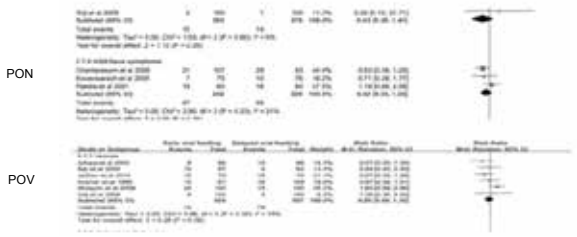
Early vs. Delayed Feeding

PONV



Huang H. J Matern Fetal Neonatal Med 2016;29:423-9

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Knowledge Gaps

- Does preoperative CHO drink impact IONV/PONV? What is its impact in the cesarean delivery patient population?
- Universal multimodal antiemetic prophylaxis or risk adapted approach for PONV prophylaxis?
- What is the optimal PONV prophylactic regimen?

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Influencing Recovery after Cesarean Delivery

- Prevention of hypotension
- Prevention of hypothermia
- Nausea and vomiting prophylaxis
- Postoperative analgesia

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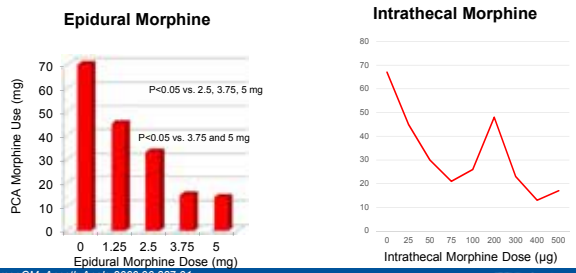
Dose Response of Neuraxial Morphine



Palmer CM. Anesth Analg 2000;90:887-91
Palmer CM. Anesthesiology 1999;90:437-44

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ITM Dose and Pruritus/PONV

Table 4. Summary of Maternal Secondary Outcomes

Outcomes	No. studies	No. patients (low dose, high dose)	MD/OR	MD/OR (95% CI)	P	I^2	NNT/NNH
Pain scores at 12 h	2	74, 72	MD	2.54 (−2.55 to 7.63)	0.33	0	NA
Pain scores at 24 h	1	18, 19	MD	1.00 (−2.50 to 4.50)	0.58	NA	NA
Pruritus	8	228, 192	OR	0.34 (0.20 to 0.59)	0.0001	0	5.9
Severe pruritus	5	156, 131	OR	0.32 (0.16 to 0.61)	0.0006	0	7.0
Vomiting	7	180, 138	OR	0.38 (0.19 to 0.75)	0.005	0.03	7.7
Nausea or vomiting	7	196, 174	OR	0.44 (0.27 to 0.73)	0.002	0	8.3
Antiemetics	2	79, 75	OR	0.69 (0.32 to 1.45)	0.33	0	NA

CI = confidence interval; MD = weighted mean difference; NA = not applicable; NNH = numbers needed to harm; NNT = numbers needed to treat; OR = odds ratio.

Sultan P. Anesth Analg 2016; 123:154-64

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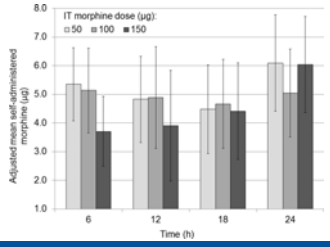
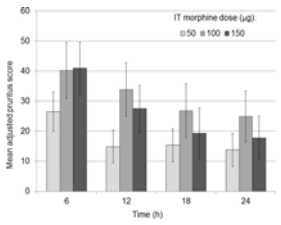
Dose Response of Neuraxial Morphine

Morphine use



Pruritus scores



Berger JS. Int J Obstet Anesth 2016;28: 3-11

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Combination of NSAIDs and Acetaminophen

- Combination > acetaminophen alone in 85% of studies
- Combination > NSAIDs alone in 64% of studies
- Pain scores reduced by 35%/37% over acetaminophen/ NSAIDs
- Analgesic needs reduced by 39%/31% over acetaminophen/NSAIDs

Ong CKS. Anesth Analg 2010;10:1170-9

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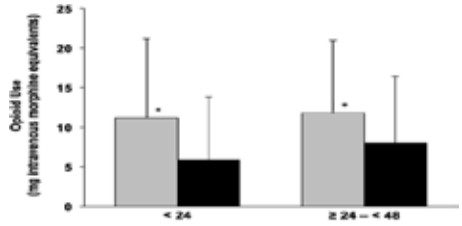
32

Scheduled Acetaminophen vs. PRN Acetaminophen/Opioid Combination



Need for opioids: 83% vs. 72%, P = 0.03
Lower pain scores first 24 h

Valentine AR. Int J Obstet Anesth 2015;24:210-16

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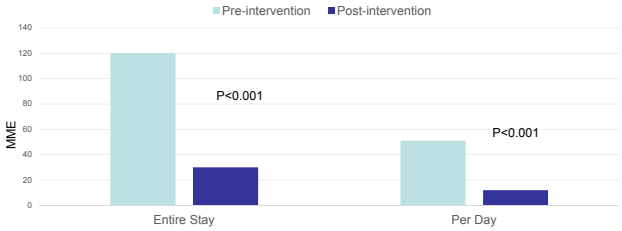
Scheduled Acetaminophen vs. Acetaminophen/Opioid Combination



Smith AM. Obstet Gynecol 2019;133:700-6

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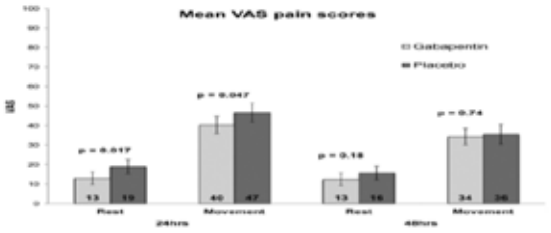
Gabapentin



Sedation: 55% vs. 38%, P = 0.03
Severe Sedation: 8% vs. 2%, P = 0.02

Monks DT. Anesthesiology 2015;123:320-6

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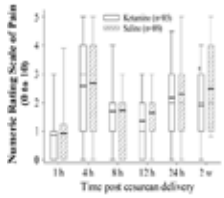
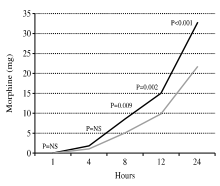
Ketamine

10 mg IV following Delivery



0.5mg/kg IM followed by 2 µg/kg/min for 12 h



Bauchat JR. Int J Obstet Anesth 2011;20:3-9
Suppa E. Minerva Anesthesiol 2012;78:774-81

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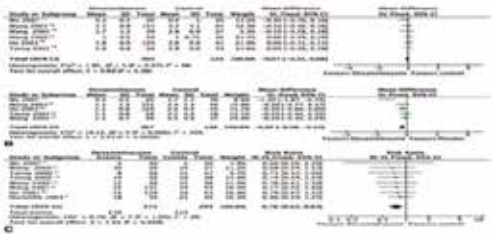
Dexamethasone

Early Pain (0-4 h)

Late Pain (24 h)

Need for rescue analgesics



Allen TK. Anesth Analg 2012;114:813-22

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TAP Block

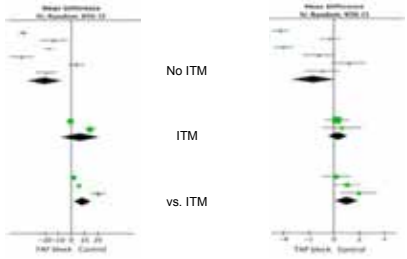
Opioid Consumption

Pain on Movement

No ITM

ITM

vs. ITM



Mishriky BM. Can J Anesth 2012;59:766-78

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Neuraxial Clonidine

Allen TK. Br J Anaesth 2018;120:228-240

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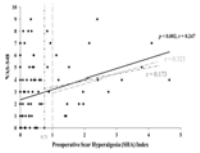
Prediction of Post CS Pain

- **QSTs**
- **Scar hyperalgesia**
- **Pain during LA infiltration**
- **Questionnaires**
  - STAI, HADS, PCS
  - Three simple questions



Gamez B. Anesth Analg 2018; 126:1606-1614 Pan PH. Anesthesiology 2013;118:1170-9 Orbach-Zinger S. Eur J Pain 2015;19:1382-8 Pan PH. Anesthesiology 2006;104:417-25

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Use of the Three Simple Questions to Individualize Postoperative Analgesia

Patients expected to be > 80th percentile for evoked pain intensity

Control Group
Morphine 150 mcg + Regular NSAIDs

Intervention Group
Morphine 300 mcg + Regular acetaminophen + Regular NSAIDs

Booth JL. Anesth Analg 2016;122:1114-9

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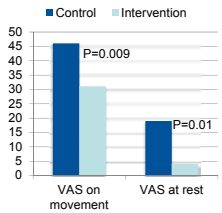
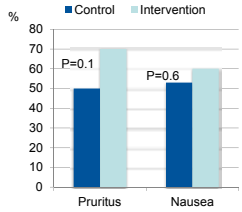
Use of the Three Simple Questions to individualize Postop Analgesia

Pain scores



Side Effects



Booth JL. Anesth Analg 2016;122:1114-9

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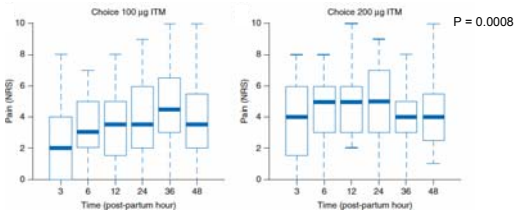
Patient Choice for Intrathecal Morphine Dose

Does it Reflect Opioid Consumption?



Median opioid consumption: 16 mg
Need for rescue antiemetics: 20%

Median opioid consumption: 25 mg
Need for rescue antiemetics: 9%

Carvalho B. Br J Anaesth 2017;118:762-771

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Knowledge Gaps

- Can predictive tests or patient led selection help personalize analgesia, optimize pain relief and the balance between analgesia and side effects?
- Which tools are clinically relevant?
- Are other truncal blocks beneficial? Could they be combined with lower doses of ITM? Is there a role for extended release preparations of local anesthetics?

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Abstract # O1-01

Preoperative warming for maintenance of normothermia in women receiving general anesthesia for cesarean delivery

Type: Original Research
Primary Author: Sung Uk Choi MD., PhD. - College of Medicine, Korea University
Additional Authors: Jae Woo Yi MD., PhD. - Kyung Hee University Hospital at Gangdong, College of Medicine, Kyung Hee University
Keum Young So MD., PhD. - Chosun University Medical College

Background: Women undergoing cesarean delivery are vulnerable to adverse effects associated with inadvertent perioperative hypothermia. In mid-2017, we introduced preoperative warming as a strategy to reduce intraoperative hypothermia. We simply provided warm air under the sheet covered by the parturient using forced-air warming system in the operating room. We report the prevalence and extent of hypothermia during cesarean deliveries under general anesthesia at our institution and evaluate the effect of the introduction of preoperative warming.

Methods: We performed a retrospective analysis of temperature data in parturients who underwent elective cesarean deliveries under general anesthesia during two-twelve-month periods: September 2017 to August 2018 and 1 years prior to this period (before preoperative warming implementation). Specifically, the following data were obtained: (i) first measured temperature; (ii) last measured temperature; (iii) percentage of hypothermic case; (iv) percentage of shivering case in postanesthesia care unit (PACU). Data were compared visually and using the Mann–Whitney U-test. Confidence intervals (CI) were obtained using the Hodges–Lehmann estimator.

Results: The average time of active warming before draping was 19.6 ± 4.1 min. Preoperative warming reduced the percentage of hypothermic case (43.0% to 19.7%) and increased the first measured temperature by a median of 0.6°C ($P < 0.001$, 95% CI 0.4–0.8°C. Additionally, it kept body temperature higher throughout the surgery and reduced the percentage of shivering case in PACU (31.6% to 9.9%).

Conclusion: Short period of preoperative warming prevented a fall in body temperature in parturients undergoing elective cesarean delivery under general anesthesia.

Abstract # O1-02

Association between general anesthesia for cesarean delivery and postpartum depression requiring hospitalization.

Type: Original Research
Primary Author: Jean Guglielminotti M.D., Ph.D. - Columbia University College of Physicians and Surgeons
Additional Authors: Ruth Landau M.D. - Columbia University College of Physicians and Surgeons Guohua Li M.D., Dr. P.H. - Columbia University College of Physicians and Surgeons

Background: Pain after childbirth is associated with an increased risk of postpartum depression (PPD) and labor neuraxial analgesia is suggested to decrease the incidence of PPD (1, 2). Furthermore, cesarean delivery and hysterectomy under general anesthesia (GA) are associated with severe acute and persistent pain compared with neuraxial anesthesia (3, 4). This study aimed to test the hypothesis that GA for cesarean delivery is associated with an increased risk of PPD, compared with neuraxial anesthesia.

Methods: A retrospective cohort of women who underwent cesarean delivery in New York State from 2006 to 2014 was constructed based on individually linked hospital discharge records. Exclusion criteria were: having more than 1 cesarean delivery during the study period, residing outside of New York State, having a GA for surgery or a delivery in the year before or in the year after the index delivery. The primary outcome was diagnosis of PPD during the index delivery hospitalization or a readmission within 1 year from hospital discharge. PPD was identified the ICD-9-CM algorithm developed by Savitz (5). The secondary outcomes were: 1) suicidal ideation or self-inflicted injury, 2) anxiety, and 3) post-traumatic stress disorder (PTSD). The odds ratio (OR) of PPD associated with GA was estimated using the inverse probability weighting method.

Results: Of the 428,204 cesarean delivery cases included, 34,356 had a GA (8.0%). Incident PPD was recorded in 1158 women (0.3%); 60% of PPDs were identified during a readmission with a median of 164 days after discharge. GA was associated with 55% increased risk of PPD (adjusted OR 1.55, 95% CI 1.24- 1.94) and 118% increased risk of suicidal ideation or self-inflicted injury (adjusted OR 2.18, 95% CI 1.37- 3.47) (Table 1). No difference was observed for the risk of anxiety or PTSD.

Conclusions: GA for cesarean delivery is associated with an increased risk of PPD and suicidal ideation or self-inflicted injury. While causality cannot be established, our analysis suggests that screening for PPD after cesarean delivery with GA should be heightened and followed well into the 4th trimester, particularly with our finding of increased suicidal ideation or self-inflicted injury among women having had a GA.

References:

1. Eisenach, Pain 2008;140:87-94
2. Lim, Anesth Analg 2018;126:1598-605
3. Catro-Alves, Anesth Analg 2011;113:1480-6
4. Nikolajsen, Acta Anaesthesiol Scand 2004;48:111-6 5. Savitz, Ann Epidemiol 2011;21:399-406

ıle 1: Risk of adverse psychiatric maternal outcomes associated with general anesthesia for cesarean delivery in the State Inpatient Database for New k, 2006-2013. Results were unchanged in sensitivity analyses 1) with further adjustment for a history of the examined psychiatric outcome during the ye ɔre the cesarean delivery and 2) limiting the identification of the psychiatric outcome during readmission to the first and second ICD-9-CM codes.

	Neuraxial anesthesia (N = 393,848)		General anesthesia (N = 34,356)				
	Number	Incidence (Per 1000; 95% CI)	Number	Incidence (Per 1000; 95% CI)	P-value [a]	Crude OR (95% CI)	Adjusted OR (95% CI)
ıstpartum depression	1034	2.62 (2.47-2.79)	124	3.61 (3.00-4.30)	0.001	1.38 (1.14-1.66)	1.55 (1.24-1.9
ıicidal ideation or self-inflicted injury	182	0.46 (0.40-0.53)	32	0.93 (0.64-1.31)	< 0.001	2.02 (1.38-2.94)	2.18 (1.37-3.4
ıxiety	636	1.61 (1.49-1.74)	50	1.45 (1.08-1.92)	0.53	0.90 (0.68-1.20)	1.19 (0.85-1.6
ıst-traumatic stress disorder	52	0.13 (0.10-0.17)	--[b]	--[b] (0.06-0.38)	0.47	1.32 (0.57-3.08)	1.40 (0.53-3.6

ɔreviations: CI: confidence interval; OR: odds ratio.

Fisher exact test for the comparison of the incidence between general and neuraxial anesthesia groups

Because of the data user agreement restrictions on small cell size, the number of observed cases and exact proportions are not presented.

Abstract # O1-03

Quantitative Sensory Testing to Predict Labor Pain and Postpartum Depression

Type: Original Research
Primary Author: Kelsea R LaSorda MPH - UPMC Magee-Womens Hospital
Additional Authors: Lia M Farrell BS - UPMC Magee-Womens Hospital
Lora McClain PhD - Magee-Womens Research Institute
Grace Lim MD, MS - UPMC Magee-Womens Hospital; Magee Womens Research Institute

Introduction. Emerging data suggests that perinatal pain and postpartum depression (PPD) symptoms are linked to one another. Little is known ab:ut predictors for the experience of labor pain, and by what mechanisms it relates to postpartum depression. We assessed quantitative sensory testing (QST) as a predictor of both perinatal pain and PPD symptoms.

Methods: Women were followed from the prenatal period through labor and delivery until six weeks and three months postpartum. Prenatal (third trimester) QST was performed for heat and mechanical temporal summation, heat and pressure threshold, and heat and pressure tolerance. Electronic labor pain data was collected hourly in real time, capturing pain unpleasantness and intensity on a 100mm line. Prenatal and postpartum data included anxiety and depressive symptoms, perceived social support, pain catastrophizing, and the Brief Pain Inventory (BPI). The primary outcome was Edinburgh Postnatal Depression Score (EPDS) at six weeks as a marker of PPD symptoms. Labor pain outcomes of interest were labor pain intensity area under the curve (AUC), pain unpleasantness AUC, pain intensity max, and pain unpleasantness max. Single and multivariable linear regressions examined QST measures as predictors of both EPDS and labor pain.

Results: 164 completed QST testing. Of these, 73 had 6-week EPDS, and 52 had complete labor pain diaries and received epidural analgesia. After adjusting for covariates (baseline: anxiety, body mass index (BMI), pain catastrophizing, EPDS, race), the six-week EPDS was significantly associated with heat temporal summation (tTS), and the three-month EPDS scores were significantly associated with mechanical temporal summation (mTS, probe weight). In adjusted analyses, mTS and heat threshold were significantly predictive for baseline EPDS. For labor pain outcomes, after adjusting for BMI, pain catastrophizing, race, last known cervical exam at the time of labor epidural analgesia request, and duration of labor, no labor pain outcomes were significantly related to any QST measures.

Conclusions: QST measures, specifically mTS and tTS, may be useful for predicting EPDS in the prenatal, 6- week postpartum, and 3-month postpartum periods. Prenatal QST appears inadequate for predicting perinatal pain. These findings point to potential unique and distinct pathways for perinatal pain and PPD, although potential common mechanisms by pain inhibition/CPM plasticity need to be evaluated.

	Adjusted R^2	Parameter Estimate	95% Confidence Interval	*P*-value
EPDS at baseline (prenatal)				
mTS delta pain score	0.530	0.362	0.00937 to 0.71497	0.044*
Post heat threshold pain score	0.590	1.252	0.57309 to 1.93163	<0.001*
mTS average pain score	0.535	0.012	0.00176 to 0.02054	0.020*
EPDS at 6 weeks postpartum				
tTS average pain score, run 1	0.227	0.515	0.16912 to 0.86068	0.004*
tTS average pain score, run 2	0.218	0.475	0.14108 to 0.80919	0.006*
tTS average pain score, total	0.225	0.511	0.16489 to 0.85686	0.004*
EPDS at 3 months postpartum				
mTS probe weight	0.115	-0.009	-0.01702 to -0.00181	0.016*
mTS average pain score	0.122	0.280	0.06180 to 0.49901	0.013*

Table. Quantitative sensory testing variables associated with depression scores at specific time points around labor and delivery. Models are adjusted for baseline anxiety, body mass index, pain catastrophizing score, African American race, and baseline EPDS score.
**P>0.05*
EPDS, Edinburgh postnatal depression score; mTS, mechanical temporal summation; tTS, temperature/heat temporal summation

Abstract # O2-04

Postpartum Pain Type, Especially Affective Dimensions of Pain, Predict Increased Opioid Requirements

Type: Original Research
Primary Author: Grace Lim MD, MS - UPMC Magee-Womens Hospital **Presenting Author:**
Additional Authors: Kelsea R LaSorda MPH - UPMC Magee-Womens Hospital Bedda Rosario PhD - UPMC Magee-Womens Hospital Elizabeth Krans MD - UPMC Magee-Womens Hospital Steve Caritis MD - UPMC Magee-Womens Hospital

Introduction: Pain is a multidimensional construct comprising sensory, cognitive, and affective dimensions. We assessed relationships between acute postpartum pain type, pain intensity and opioid dose. We hypothesized that affective dimensions of pain associated with postpartum opioid dose.

Methods: A retrospective, mixed-methods design was used to analyze quantitative and qualitative pain responses from postpartum women during hospitalization. Patient-reported pain descriptors were coded using established pain terms from SF-MPQ and PROMIS inventories. Based on these terms, codes were produced for the following pain types: affective/evaluative, visceral/nociceptive, somatic/nociceptive, dynamic/evoked, neuropathic, nociceptive, nociceptive and/or neuropathic. Pain intensity scores (0-10 numeric rating scale) were given with each pain descriptor. Multivariable linear mixed-effects model analyses assessed between- and within-person relationships for: 1) pain type (primary predictor) and pain intensity (0-10); and 2) pain type (primary predictor) and oxycodone dose (mg). The influence of opioid dependence history (OUD) on these relationships was assessed by interaction terms.

Results: 2,609 women provided 44,522 unique pain scores/descriptors during their postpartum hospital stay. Opioid dose requirement was 1.04 mg (P<0.001) higher for women with affective pain compared to women without affective pain, after controlling for age, gravidity, parity, and mode of delivery. Similarly, but to a lesser extent (lower coefficients), other pain types were associated with increased opioid dose (Table 1). Postpartum pain intensity was nonspecific and associated with multiple different pain types (Table 2). A history of OUD increased the relationship between pain type, pain intensity, and opioid dose. For a woman with OUD, times when she had affective pain resulted in pain scores 0.93 points higher; between OUD women, expected pain scores were 6.24 points higher for women with affective pain. Similarly, for a woman with OUD, times when she had nociceptive and/or neuropathic pain resulted in oxycodone doses 1.56 mg higher; between OUD women, expected oxycodone dose was 11.38 mg higher for women with this pain type.

Conclusions: Pain type is linked to postpartum opioid dose requirements; affective dimensions of pain show the highest contributions to this relationship. Pain intensity scores (0-10) are inadequate to comprehensively assess the postpartum acute pain experience, particularly for important outcomes such as opioid use.

Table 1. Relationship between postpartum pain type and opioid dose consumption in hospital.

Type of Pain	Oxycodone Dose (unadjusted)		Oxycodone Dose (adjusted)	
	Estimate	*P*-value	Estimate	*P*-value
Affective/Evaluative	1.6282	< 0.0001	**1.0221**	**0.0005**
Visceral/Nociceptive	0.01692	0.7809	0.2392	**0.0003**
Somatic/Nociceptive	0.5383	0.0261	0.6646	**0.0109**
Dynamic/Evoked	1.113	0.3785	1.5157	0.2565
Neuropathic	0.07083	0.7184	0.1125	0.5729
Nociceptive	-0.1568	0.0071	-0.394	**< 0.0001**
Nociceptive and/or Neuropathic	-0.1837	0.2094	-0.1852	0.2156

Table 2. Relationship between postpartum pain type and pain intensity/pain scores by 0-10 numeric rating scale.

Type of Pain	Pain Intensity (unadjusted)		Pain Intensity (adjusted)	
	Estimate	*P*-value	Estimate	*P*-value
Affective/Evaluative	1.8339	< 0.0001	**1.7874**	**< 0.0001**
Visceral/Nociceptive	0.07784	0.0013	0.1078	**< 0.0001**
Somatic/Nociceptive	0.9289	< 0.0001	0.8918	**< 0.0001**
Dynamic/Evoked	0.5249	0.296	0.4551	0.4009
Neuropathic	0.7932	< 0.0001	0.7593	**< 0.0001**
Nociceptive	-0.175	< 0.0001	-0.1972	**< 0.0001**
Nociceptive and/or Neuropathic	0.05728	0.3169	-0.0030	0.9621

Abstract # O1-05

Case-control study to investigate the relationship between postdural puncture headache and postpartum psychological and physical morbidities

Type: Original Research
Primary Author: Sharon Orbach-Zinger MD - Rabin Medical Centre and sackler faculty of medicine, Tel Aviv Univerisity
Additional Authors: Olya Matkovski MD - Assaf Harofeh Medical Center
Carolyn F Weiniger MB ChB - Tel-Aviv Sourasky Medical Center
Michal Y Livne MD - Rabin Medical Centre and Sackler Faculty of Medicine, Tel Aviv University Eitan Mangobi MD - Rabin Medical Centre and Sackler Faculty of Medicine, Tel Aviv University Leonid A Eidelman MD - Rabin Medical Centre and Sackler Faculty of Medicine, Tel Aviv University

Background: Accidental dural puncture (ADP) occurs in 0.4-6% of labor epidurals (LE), leading to postdural puncture headache (PDPH) that may cause chronic headache and backache (1). Information regarding psychological sequelae after PDPH is lacking. The primary study aim was to investigate the incidence of postpartum depression (PPD) after PDPH. Secondary aims were to investigate postpartum stress disorder (PTSD), chronic postpartum headache, backache, and breastfeeding after PDPH.

Methods: Case-control study of women who received LE. Cases were women who developed documented PDPH after ADP, identified from medical records (Jan 2012-18) and controls were women with a normal LE in that 24hr period. Women from 2 hospitals gave verbal consent by telephone (study period Jul-Dec 2018) to answer questions about PPD, PTSD, headache, backache (prior to LE and current), and breastfeeding using questionnaires (Table 1). Cases and controls were compared using appropriate comparison statistics, significance was $p<0.01$. A multivariable regression analysis was performed to evaluate factors (ADP, epidural blood patch (EBP), current headache, current backache and breastfeeding) associated with PPD. A sub-group analysis of PDPH women with vs without EBP investigated the same outcomes.

Results: PDPH women (n=132) and case-controls (n=276) had similar age, parity, BMI and questionnaire time-interval since ADP (median 48 months). Table 2 presents questionnaire findings. Among PDPH women the incidence of PPD was 67(52.3%) vs 31(11.2%) for controls, $p<0.0001$. Current headache and backache and possible PTSD were also significantly higher among PDPH women, and they were less likely to breastfeed. Multivariable regression analysis showed that ADP significantly increased the likelihood of PPD, Odds Ratio 7.81 (95% CI 3.55-14.9). EBP was performed for 60(45.5%) PDPH women. PDPH women with vs without EBP had similar rates of PPD (56.5 vs 48.3% $p=0.35$); possible PTSD (15.0 vs 11.3% $p=0.53$); headache (32.2 vs 33.4% $p=0.89$); and backache (40.7 vs 43.5% $p=0.75$).

Discussion: In our case-control study, we found increased incidence of PPD and possible PTSD after PDPH, and decreased breastfeeding. We confirmed that PDPH was associated with chronic headache and backache (1). Our results suggest that EBP does not protect against PDPH-related postpartum complications. Given the increased likelihood of PPD after PDPH, these women require postpartum follow-up. 1. Webb CA, Anesth Analg. 2012.

Abstract # O1-05

Table 1: Telephone survey items presented according to order of questions

Telephone Survey Item	Question format / Definitions
Opening introduction statement	We know you received an epidural on (DATE INSERTED). We know epidural can cause headache in some cases. We want to ask you questions about headache.
Pre-labor headache questions	Before the epidural did you have a headache? How frequent and how severe?
Current headache questions	Since the epidural until now did you have a headache? How frequent and how severe?
Pre-labor backache questions	Before the epidural did you have a backache? How frequent and how severe?
Current backache questions	Since the epidural until now did you have a backache? How frequent and how severe?
Breastfeeding questions	After the epidural did you breastfeed and how long did you breastfeed for?
Edinburgh postnatal depression scale (PPD)	Validated PPD questionnaire. Depression defined as ≥10 (scale 0-30)
Posttraumatic stress disorder (PTSD)	Validated PTSD questionnaire PCL-5. Possible PTSD was defined as >33 (0-80)

Table 2: Questionnaire responses for women after the labor epidural according to with versus without postdural puncture headache (PDPH)

	Women with PDPH N=132	Case-controls without PDPH N=276	P value
Pre-labor headache	28 (21.2%)	38 (13.8%)	0.06
Current headache ǂ	42 (32.6%)	42 (15.2%)	<0.0001*
Pre-labor backache ǂ	23 (17.4%)	38 (13.8%)	0.34
Current backache ǂ	58 (43.9%)	58 (21.0%)	<0.0001*
Breastfeeding initiation ǂ	74 (54.5%)	212 (76.8%)	<0.0001*
Breastfeeding duration ł (months)	1.5 (0-6)	3.5 (1-8)	0.005*
PPD ǂ	67 (52.3%)	31 (11.2%)	<0.0001*
PTSD scores ł	7(0-20.5)[0-77]	0(0-0)[0-39]	<0.0001*
Possible PTSD ǂ	17 (12.8%)	1 (0.4%)	<0.0001*

Key: ł=median(interquartile range)[range]; ǂ=number(%)
PDPH=postdural puncture headache; PPD=postpartum depression; Postpartum stress disorder=PTSD;
Possible PTSD=PCL-5 score>30 (PTSD cannot be confirmed without clinical interviews);
Postpartum depression =Edinburgh postpartum depression score≥10; *significant result was p<0.01

Program Material

Friday, May 3, 2019

- **Best Paper Session**
  Moderators: Jill M. Mhyre, M.D.; Arvind Palanisamy, M.B., B.S., M.D., FRCA
- **Scientific Poster Session #3**
  Moderator Leaders: Melissa E. Bauer, D.O.; Allison J. Lee, M.D., M.B., B.S.
- **Interdisciplinary Panel - Cardiac Disease**
  Moderator: Katherine W. Arendt, M.D.
  Speakers: Joan E. Briller, M.D.; Alexandria J. Hill, M.D.; Marie-Louise Meng, M.D.
- **American Society of Anesthesiologists (ASA) Update**
  Introduction: Mark I. Zakowski, M.D., FASA
  Speaker: Linda J. Mason, M.D., FASA, ASA President
- **Resident/Fellow Case Presentations**
  Moderator Leader: Jacqueline M. Galvan, M.D.

Abstract #:BP-01

Prescription Opioid Use After Vaginal Delivery and Subsequent Persistent Opioid Use and Misuse

Presenting Author: Brian T Bateman MD, MSc
Presenting Author's Institution: Brigham and Women's Hospital/Harvard Medical School
Co-Author: Yanmin Zhu PhD - Brigham and Women's Hospital/Harvard Medical School
Loreen Staub MD - Brigham and Women's Hospital/Harvard Medical School
Sonia Hernandez-Diaz MD, DrPH - Harvard School of Public Health
Krista F Huybrechts MS, PhD - Brigham and Women's Hospital/Harvard Medical School

Introduction: Prior studies show that approximately 30% of women in the United States fill an opioid prescription after vaginal delivery (1,2), making this a common source of exposure to opioids in young women. Limited evidence is available regarding the impact of prescription opioid use after vaginal delivery on the risk of subsequent persistent opioid use and misuse.

Methods: We assembled a nationwide cohort of Medicaid beneficiaries who delivered vaginally between 2009 and 2013 and who were not chronic opioid users or diagnosed with an opioid use disorder during pregnancy. We required continuous Medicaid enrollment from at least 90 days before to 365 days after vaginal delivery. We identified prescription opioid dispensings within 7 days of the date of delivery. Persistent opioid use (primary outcome) was defined as >=10 opioid fills or >120 days\' supply dispensed from 30 to 365 days after the date of delivery. Newly recorded diagnoses of opioid use disorder (secondary outcome) were ascertained during the same interval.

We conducted logistic regression after propensity-score (PS) 1:1 matching to control for potentially confounding conditions including maternal demographics, comorbidities, and vaginal delivery complications. To control for potentially unmeasured confounders, we performed an instrumental variable analysis (IVA) using a 2-stage least squares approach. To define the instrument, facilities were ranked within region according to their opioid dispensing rate after vaginal delivery and divided into deciles (rate of opioid dispensing in the bottom decile was 4.5% vs. 76.6% in the top decile).

Results: Among 226,995 vaginal deliveries, 29.9% had an opioid dispensing within 7 days of delivery. Overall, 3,113 of the 67,954 (4.6%) prescription opioid exposed vs. 1,445 of the 159,041 (0.9%) unexposed met criteria for persistent opioid use during the year of follow-up, for an unadjusted odds ratio (OR) of 5.2 (95% CI, 4.9 - 5.6) and a risk difference (RD) of 3.7% (95% CI, 3.5% - 3.8%). After PS matching, the risk remained higher among the prescription opioid exposed, with an OR of 2.7 (95% CI, 2.5 - 3.0) and a RD of 2.4% (95% CI, 2.3%- 2.6%). This was confirmed by the IVA (pseudo R2=0.3) with a RD of 2.8% (95% CI, 2.5% - 3.1%). For newly diagnosed opioid use disorder, the unadjusted OR associated with opioid exposure after delivery was 2.4 (95% CI, 2.2 - 2.5), which attenuated to 1.5 (95% CI, 1.4 - 1.6) after PS matching. The adjusted risk difference was 0.9% (95% CI, 0.7% - 1.0%) after PS matching and 2.1% (95% CI, 1.8% - 2.4%) using IVA.

Conclusions: Opioid exposure following vaginal delivery appears to be a trigger for future persistent opioid use and misuse, independent of confounding factors. Given this risk, prescription opioid use after vaginal deliveries should generally be avoided.

References:

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2. Drug Alcohol Depend. 2018 Jul 1;188:288-294.

Abstract #:BP-02

Thrombin induces enhanced calcium mobilization in TNF-sensitized uterine smooth muscle (USM) cells of African American patients compared to non-hispanic Caucasian patients

Presenting Author: George Gallos MD
Presenting Author's Institution: Columbia University
Co-Author: Shunsuke Hyuga MD - Kitasato University
Joy Vink MD - Columbia University
Parry C Robert MD - Columbia University

Objective: Racial disparity in preterm birth rates have been described for decades. Although associations with bacterial vaginosis, chronic inflammation, and TNFα levels have been reported to be higher in patients of African heritage, a biological mechanism for this observation has never been described. We questioned if myometrial cells chronically challenged with TNFα in vitro would display differential intracellular calcium [Ca2+]i mobilization between racial groups via a phospholipase-mediated pro-contractile pathway.

Methods: With IRB approval (#AAAL4005) and following consent, late gestation human USM was harvested from healthy patients undergoing elective c-section. Tissues were enzymatically dissociated and primary cultures established in vitro. To mimic a pro-inflammatory milieu, cells received chronic exposure to TNFα (0.01ng/mL x 5 days). USM cells were then loaded with the Ca2+ specific fluorophore Fura-2 AM (5 **μM**). To implicate the Gq/PLCβ pathway, cells were pretreated with vehicle (0.1% DMSO) or 6SH (50 **μM**) followed by stimulation with thrombin (1μM) or ionomycin (20μM). Evoked calcium fluorescence (340/380λ) was recorded by FlexStation 3 plate reader. Results were normalized to maximal calcium responses evoked by ionomycin, reported as mean ± SEM, and grouped by reported race. A one way ANOVA with Bonferroni\'s Multiple Comparison Test was used for statistical analysis.

Results: Stimulation of TNF-sensitized USM cells with thrombin elicits significantly higher intracellular calcium release in African American patients (59.8% + 3.4%, n=12) than in non-hispanic Caucasians (35.5% + 2.4%, n=15; p<0.01). Pre-treatment with the PLC-inhibitor 6SH significantly attenuated this evoked calcium release in African American (18.7% + 2.7%, n=12; p<0.001) and Caucasian (21.5% + 3.4%; p<0.05) USM cells. Total evoked calcium response by ionomycin was not significantly different based on race.

Conclusions: Pro-inflammatory sensitization of human USM cells with TNFα induces greater reactivity to thrombin challenge in African American patients than seen in Caucasian patients. Blockade with the PLCinhibitor 6SH illustrates this effect involves the Gq/PLCβ pathway. This is the first report of a biological mechanism related to pro-contractile pathways underlying the racial disparity observed in preterm labor.

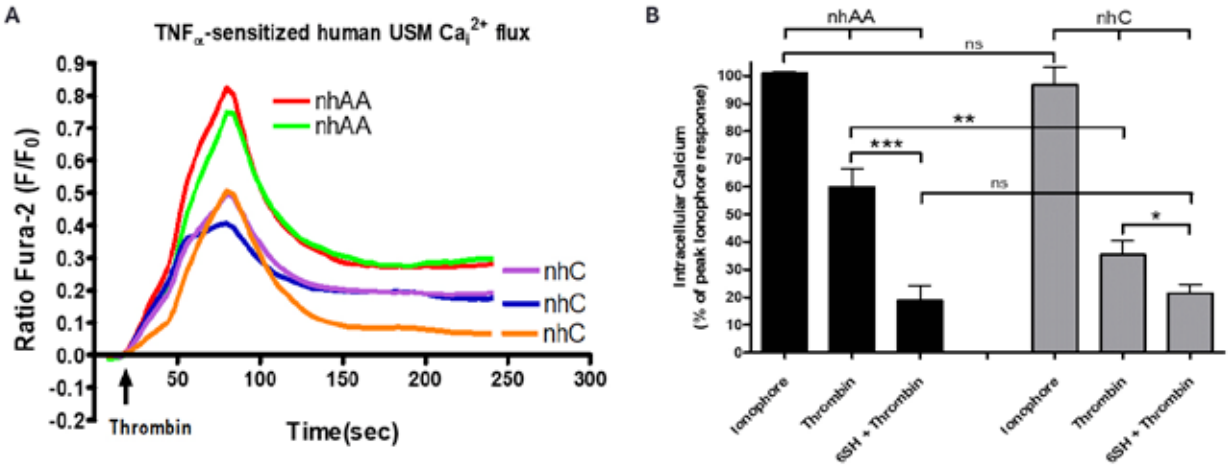

Figure 1. Racial disparity in uterine smooth muscle (USM) calcium (Ca_i^{2+}) mobilization. A) Representative tracing illustrating differences in Ca_i^{2+} fluorescence (FURA 2 340/380) evoked by stimulation with thrombin in TNFα-sensitized uterine smooth muscle (USM) cells from non-Hispanic African Americans (nhAA) compared to non-Hispanic Caucasian (nhC) USM cells. B) Compiled data normalized as percent of peak calcium induced by ionophore treatment illustrates nhAA USM cells exhibit enhanced thrombin-induced Ca_i^{2+} mobilization vs nhC USM cells. Pretreatment with PLC inhibitor (6-SH) significantly attenuates thrombin-induced Ca_i^{2+} flux. (ns = p>0.05, * = p<0.05, ** = p<0.01, *** = p<0.001; nhAA = 3 patients, nhC = 5 patients (n=12-15/group)

Abstract #:BP-03

Relationship Between Postpartum Mood Disorder and Delivery Experience: A Prospective Observational Study

Presenting Author: Joanna Kountanis MD
Presenting Author's Institution: University of Michigan
Co-Author: Maria Muzik MD - University of Michigan
Melissa Bauer DO - University of Michigan
Tammy Chang MD - University of Michigan
Elizabeth Langen MD - University of Michigan
George Mashour MD, PhD - University of Michigan

Background: Development of psychological sequelae is common in the postpartum period, with the incidence of depression as high as 19.2%.(1) Although posttraumatic stress disorder (PTSD) is not traditionally screened for, the incidence is as high as 15.7%.(2) Evidence suggests that traumatic events, such as severe pain in labor and obstetrical emergencies, may contribute to a postpartum mood disorder but the contribution of the birth experience to these outcomes is unclear.(3,4)

Methods: We conducted a prospective, longitudinal, observational study to test the hypothesis that events related to birth experience would be associated with the risk of developing postpartum PTSD or depression. (Table 1) Women were assessed at different time points for depression and anxiety utilizing a smartphone text or email message containing a link to the Edinburgh Postnatal Depression Scale and Perinatal Posttraumatic Stress Disorder screening tools. Women completed their postpartum screenings at 6 weeks and 3 months. The primary outcomes were the presence or absence of depression or PTSD. The risk of developing depression or PTSD was assessed by fitting logistic regression models for each variable using generalized estimating equations.

Results: We enrolled 600 antepartum women, 427 met inclusion criteria, 376 completed the entire study. The rate of depression at 6 weeks and 3 months postpartum was 15.9% and 12.7% respectively. The rate of PTSD at 6 weeks and 3 months postpartum was 6.2% and 5.1% respectively. Twenty-six women (8%) with a negative screening at 6 weeks later converted to a positive EPDS or PTSD screen at 3 months. Pre-existing history of anxiety or depression increased the risk of developing postpartum depression (OR 2.12 (1.30-3.47)) and PTSD (OR 3.15 (1.42-7.02)) at either 6 weeks or 3 months. Operative management of hemorrhage also increased the risk of developing PTSD (OR 4.44 (1.16-17.02)).

Discussion: A pre-existing history of anxiety or depression and operative management of hemorrhage predicted postpartum PTSD and depression. Furthermore, depression and anxiety either persisted or had a new onset at 3 months postpartum. Our findings support screening of PTSD, as well as screening beyond the traditional 6 week time period.

References:

1. Obstetrics and gynecology 2005;106(5 Pt 1):1071-83.
2. Clinical Psychology Review 2014;34(5):389-401.
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Table 1. Unanticipated Birth Events Analyzed

Events	**Subcategories Analyzed**
Neonatal Intensive Care Unit admission	n/a
Unanticipated Induction/Augmentation Indication	a. Maternal serious comorbidity; Pre-eclampsia without severe features, Pre-eclampsia with severe features, Gestational Hypertension b. Maternal comorbidity; Diabetes, Infection, Cholestasis, c. Fetal serious comorbidity; IUGR, Non-reassuring fetal status d. Failure to progress
Unanticipated Operative Delivery Indication	a. Vacuum, Forceps b. Non-reassuring fetal status c. Arrest of dilation, Arrest of descent Failed Trial of labor after cesarean (TOLAC)
Hemorrhage Management	a. 3 or more medications; 2nd dose oxytocin, methergine (methylergonovine maleate), cytotec (misoprostol), hemabate (carboprost) b. Manual removal of placenta c. Operative management; B-lynch, Bakri, D&C, Hysterectomy, Interventional radiology d. Blood transfusion e. ICU admission
Pain with labor epidural	a. # of times called into the room for pain b. # of times epidural replaced c. > or = 3 attempts OR > 45minutes to place epidural d. Pain score of 8, 9, or 10 with labor epidural in place
Pain during cesarean delivery	a. Epidural lidocaine bolus b. Intravenous medications; ketamine, narcotics, midazolam c. General anesthesia, Nitrous oxide d. Reassurance
Anticipated Inductions Indication	Social, Post-dates, Elective >40 weeks, Elective, "Other", Multiple gestation, Fetal anomalies
Anticipated Operative Delivery Indication	History of prior uterine surgery, Multiple gestation, Malpresentation, Elective

Abstract #:BP-04

Comparison of Quadratus Lumborum Block versus Transversus Abdominis Plane Block for Postoperative Pain after Cesarean Delivery - A Randomized Controlled Trial

Presenting Author: Caijuan Li MD
Presenting Author's Institution: Nanjing Maternity and Child Health Care Hospital, Nanjing Medical University
Co-Author: Yunping Li MD - Beth Israel Deaconess Medical Center
Mao Mao MD - Nanjing Maternity and Child Health Care Hospital
Shiqin Xu MD - Nanjing Maternity and Child Health Care Hospital
Xiaofeng Shen MD - Nanjing Maternity and Child Health Care Hospital
Philip Hess MD - Beth Israel Deaconess Medical Center

The transversus abdominus block (TAP) improves post-cesarean pain when neuraxial morphine is unavailable or ineffective (1). The quadratus lumborum block (QL) has been reported to be more effective (2) and potentially to provide visceral analgesia due to spread to the paravertebral space. A large sample study is needed to prove its efficacy compared to both TAP block and placebo.

Methods: ASA 2 women presenting for term singleton primary cesarean under spinal anesthesia (0.5% Ropivacaine 3ml) were randomized to receive a TAP, QL, or placebo block. Ultrasound guided TAP, QL and sham (no injection) were performed at the end of surgery with 0.25% Ropivacaine 30 ml each side which was blinded to the participants and blinded observers. Patients received a low-dose Butorphanol PCA with a 0.15mg/hr background infusion (PCA hourly maximal dose 0.87mg). Blinded observers (other than block operators) measured pain at rest and with movement, number of PCA requests (hits) and PCA doses received, sedation, nausea, vomiting and bowel sounds for 48 hr. The primary outcome was Butorphanol consumption. Comparisons made using repeated measures ANOVA among groups and Log rank analysis for time to first PCA request.

Results: 180 patients were enrolled, 177 completed the study. Groups were similar in patient and obstetric characteristics. Over the first 18 hours, patients in QL group made fewer PCA requests ($p=0.02$) and received fewer doses ($p=0.006$) (FIGURE 1) than the Control; but were not statistically different than the TAP group. Time to first PCA request was significantly longer in the QL and TAP groups than the Control group (QL 9h 52m vs. TAP 9h 16m vs. Control 5h 16m; $p<0.001$). Over the first 12 hours, pain scores at rest ($p=0.01$) and with movement ($p=0.02$) were lower in the QL and TAP groups than the Control (FIGURE 1). There were no differences among groups after 18 hours. No differences in side effects (sedation, nausea, vomiting, pruritus, respiratory rate, bowel sounds) or patient satisfaction among groups at any point (p=NS for all).

Conclusion: Both QL and TAP blocks were more effective at controlling pain at rest and with movement for the first 12 hours compared to a placebo control using PCA opioids with a low dose background. The QL block group had fewer PCA requests and doses than the control group for 18 hours and was lower but was not statistically different than the TAP block.

References:

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Abstract #:BP-04

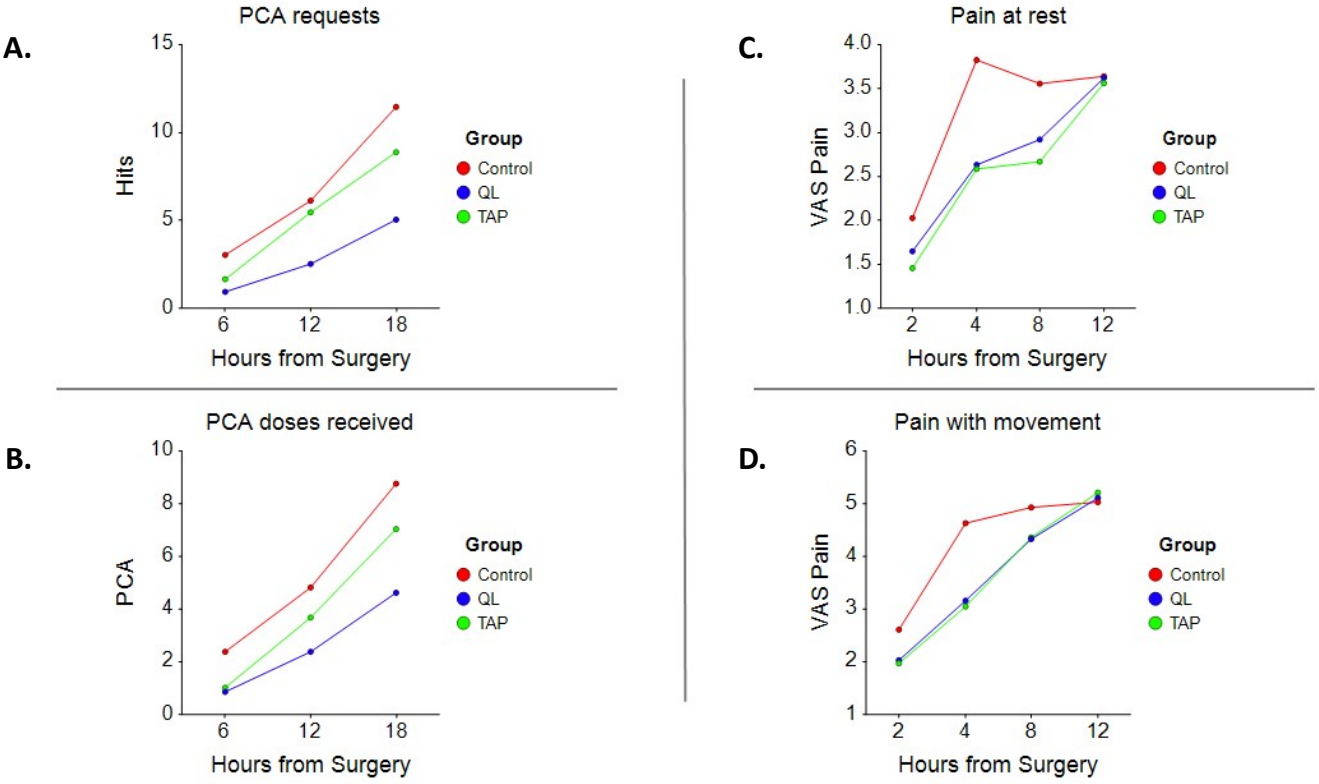

Figure 1. QL block and TAP block reduced PCA opioid requirement and provided pain relief after cesarean delivery compared to control group. A. Cumulative butorphanol demands; B. Cumulative butorphanol use; C. VAS pain scores at rest; D. VAS pain scores with movement. QL block Quadratus Lumborum block; TAP block Transversus Abdominis Plane block.

Abstract #:BP-05

Evaluation of Maternal-Fetal Placental Transfer of Sugammadex Using the Dual-Perfused, Single, Isolated, Human Placental Cotyledon

Presenting Author: Michael G. Richardson MD
Presenting Author's Institution: Vanderbilt University Medical Center
Co-Author: Raymond F. Johnson B.S. - Vanderbilt University Medical Center
Mallika S. Thampy M.D. - Vanderbilt University Medical Center
Curtis L. Baysingner M.D. - Vanderbilt University Medical Center

AIM: Safe use of sugammadex (SG) in pregnancy has not been established.[1] Extent of placental transfer, predicted to be minimal owing to its molar weight (2,178 g/mol) and high degree of polarity, is unknown. We used the single cotyledon dual-perfusion human placental model, a well-established method of determining placental drug transfer,[2] to measure maternal (M) to fetal (F) transfer of SG.

METHODS: IRB approval was obtained. Healthy women with an uncomplicated term pregnancy undergoing Cesarean delivery gave informed consent. Immediately after delivery, a single cotyledon was cannulated and perfused as previously described,[2] and SG transfer was studied using the closed model (M and F circuits were continuously recirculated).[2] After a 30-min equilibration period, SG (120 mcg/ml) and antipyrine (AP) (200 mcg/ml) were added to the M reservoir and allowed to equilibrate for 3 hours. AP, a freely diffusible flow-limited control marker, was used to control for interplacental variability in lobule size and intralobule experimental perfusion variability. 1 mL samples were taken from M and F circuits at 30-min intervals to measure SG and AP. Five closed experiments were performed. Perfusate sample SG and AP
concentrations were measured by LC-Mass Spectrometry (institution's Mass Spectrometry Core). Moles of drug in M and F circuits were calculated (molar concentration x volume) to derive SG and AP % transfer (amount of drug in F circuit divided by total drug in both reservoirs), as were transfer indices (SG % transfer/AP % transfer).

RESULTS: Five experiments were conducted. Analysis of AP controls confirmed normal control marker transfer. Analysis of SG molecules demonstrated negligible M to F transfer (Fig 1). Fetal SG concentrations were within the detection limit of mass spectroscopy. SG and AP transfer are shown (Fig 2). Mean SG/AT transfer index was 0.09 (SD 0.06) and ranged from 0.03 to 0.18.

CONCLUSIONS: M-F placental transfer of SG was minimal in this model, despite prolonged (3 hrs)
exposure of a maternal perfusate concentration exceeding that expected from high-dose (16 mg/kg) SG administration.[3,4] Our results suggest that fetal exposure from maternal administration of clinically relevant doses would be negligible in healthy term pregnant patients.

References:

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2. Johnson RF et al. Anesthesiology 1995;82:459
3. Kleijn et al. Br J Clin Pharmacol 2011;72:415
4. Staals LM et al. Br J Anaesth 2010;104:31

Abstract #:BP-05

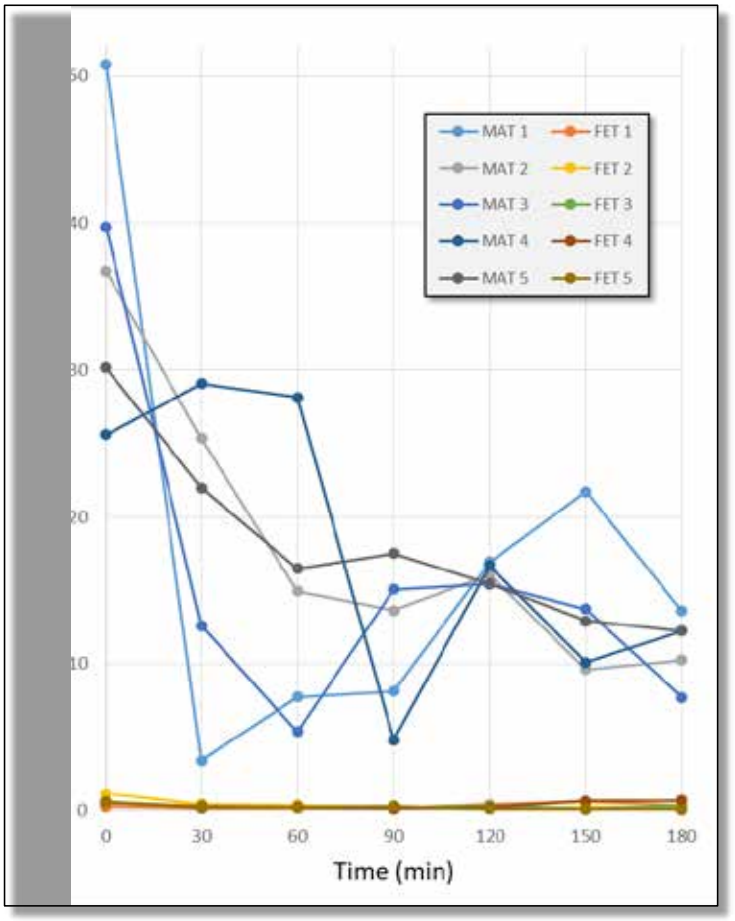


Figure 1: Concentration of suggamadex present in maternal (MAT) and fetal (FET) perfusate sampled, as determined by LC-mass spectroscopy assay, in 5 experiments. Time 0 is immediately after addition of sugammadex to maternal circuit.

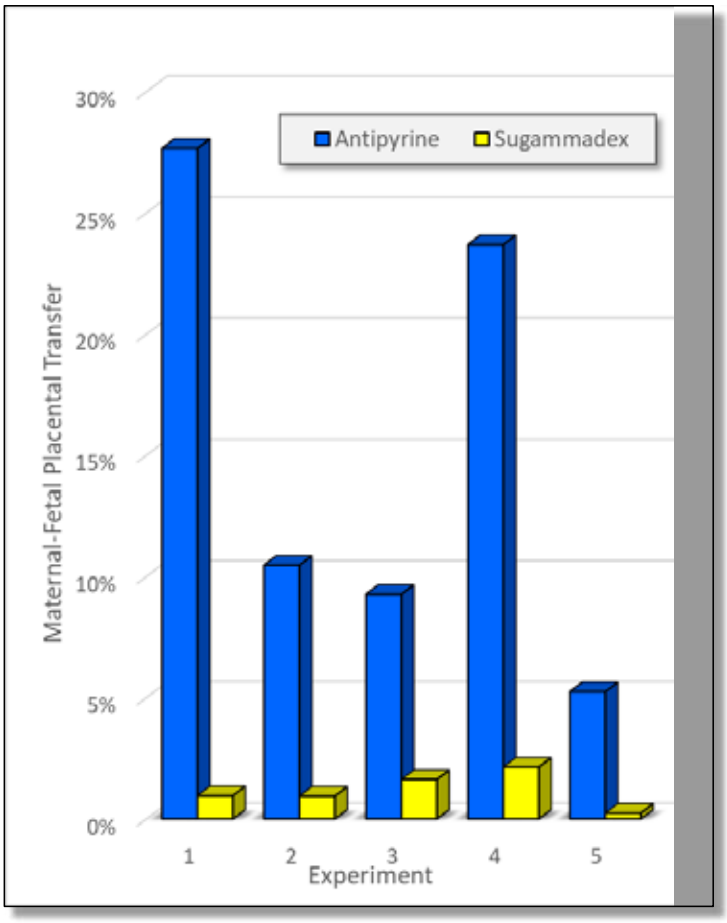


Figure 2: Figure: Maternal-fetal placental transfer of sugammadex and antipyrine (control) in five dual-perfusion placenta experiments. Sugammadex transfer is negligible in this model.

Abstract #:BP-06

Racial and ethnic disparities in obstetric complications: A retrospective analysis, 2007-2014

Presenting Author: Virginia Tangel MA
Presenting Author's Institution: Weill Cornell Medicine
Co-Author: Anne Budnick RN - NewYork-Presbyterian Hospital
Sharon Abramovitz MD - Weill Cornell Medicine
Robert S. White MD MS - Weill Cornell Medicine

Introduction: Disparities by race and ethnicity in obstetric care and intrapartum complications have been widely documented, though many studies have mostly only provided analyses of unadjusted rates (1,2). We aimed to expand on these analyses by adjusting for potential confounders at the patient and hospital level, in an effort to produce more precise odds of obstetric complications in individual racial and ethnic groups.

Methods: Using a sample of 6,911,916 deliveries from the State Inpatient Databases, Healthcare Cost and Utilization Project, Agency for Health Research and Quality for California, Florida, Kentucky, Maryland, and New York from 2007-2014, we analyzed the incidence of the presence of any obstetric complications by race/ethnicity, including: in-hospital mortality, cardiac arrest, intrauterine growth restriction, placental abruption, hospital length of stay greater than or equal to seven days, preterm birth, oligohydramnios, the need for a blood transfusion, stillbirths, premature ruptured membranes, Cesarean delivery, severe preeclampsia or eclampsia, anesthesia complications, cerebrovascular complications, sepsis or shock, and postpartum hemorrhage. We additionally analyzed complications individually if they had a prevalence greater than 1% in the entire dataset. Multivariate logistic regression models were fit for all outcomes, controlling for fixed patient comorbidities specific to an obstetric population and demographics (insurance payer, age, income status) and hospital characteristics (year of admission, state, delivery volume). Delivery type (vaginal, operative vaginal, or Cesarean) was included as an additional covariate in appropriate models.

Results: In adjusted analyses, black women were 16% more likely to experience any obstetric complication (aOR: 1.16, 95% CI: 1.15-1.17, $p < 0.001$), 26% more likely to have a placental abruption, 71% more likely to have a length of stay longer than 7 days, 34% more likely to develop oligohydramnios, 79% more likely to receive a blood transfusion (controlling for surgery type), 85% more likely to have a stillborn baby, 10% more likely to have membranes rupture prematurely, and 9% more likely to experience postpartum hemorrhage (regardless of surgery type), each as compared to white women.

Conclusion: While controlling for patient and hospital-level factors, black women are more likely to experience obstetric complications than white women. Provider education about the history of maternal health disparities, education to reduce implicit bias, and training to improve communication with patients are some actions that can be taken within hospitals to ameliorate racial and ethnic disparities in obstetrics and improve maternal outcomes.

References:

1. Creanga AA, et al. Obstet Gynecol. 2012;120(2):261-268
2. Berg CJ, et al. Obstet Gynecol. 2010;116(6):1302-1309

Abstract #: F3A-50

Split doses of oral opioids significantly reduced opioid consumption and related side- effects after cesarean delivery

Presenting Author: Jalal A Nanji MD, FRCPC
Presenting Author's Institution: University of Alberta Faculty of Medicine & Dentistry - Edmonton, Alberta
Co-Author: Nan Guo PhD - Stanford University School of Medicine
Edward T Riley MD - Stanford University School of Medicine
Brendan Carvalho MBBCh, FRCA, MDCH - Stanford University School of Medicine

Background: Despite multimodal analgesia, most women require opioids for breakthrough pain after cesarean delivery (CD). Opioids are associated with opioid-related side effects (including postoperative nausea and vomiting (PONV), pruritis, and respiratory depression), persistent opioid use after surgery, and drug transfer in breastmilk. The aim of this study was to evaluate the impact of a novel postoperative analgesic order-set that we introduced in an effort to reduce opioid consumption.

Methods: This retrospective impact study reviewed electronic medical record data before and after implementation of a new order-set for cesarean delivery performed under neuraxial anesthesia. Oxycodone orders changed from 5 mg (for verbal pain score ≤4/10) and 10 mg (for 5-10/10) to 2.5 mg (for verbal pain score 1-4/10) or 5 mg (for 5-10/10) with a registered nurse check within 1 hour following administration to administer another 2.5 mg or 5 mg respectively if needed. The primary outcome was opioid use in the first 48 hours. Secondary outcomes included incidence and treatment of PONV and pruritis, and verbal pain scores (average and peak) 0-48 h after cesarean delivery.

Results: 1050 women were evaluated (542 before and 508 after the change). Opioid use in the first 48 hours was significantly lower in the post-practice change group (median [interquartile range] 10.0 [1.3-25.0] mg before vs. 4.4 [0-12.5] mg after split dosing was introduced; P<0.001, Fig 1A). There was a small increase in average verbal pain score occurred (mean (standard deviation) 1.8 (1.0) before vs. 2.0 (1.3) after; P=0.01), but no difference in peak verbal pain score (5.9 (2.0) before vs. 6.0 (2.1) after; P=0.23). PONV was significantly reduced in the post-practice change group (30.9% before vs. 19.3% after; P<0.001, Fig 1B). Conclusions: This study of over 1000 patients found that splitting doses of oxycodone and allowing the patient to receive the remainder of the dose 1 hour later reduced 48-hour opioid use by over 50% and reduced opioid-related PONV after CD. This simple, patient-centered, opioid-reduction strategy did not compromise pain relief and should be further investigated and adopted in obstetric practices to reduce postpartum opioid consumption.

Figure 1a

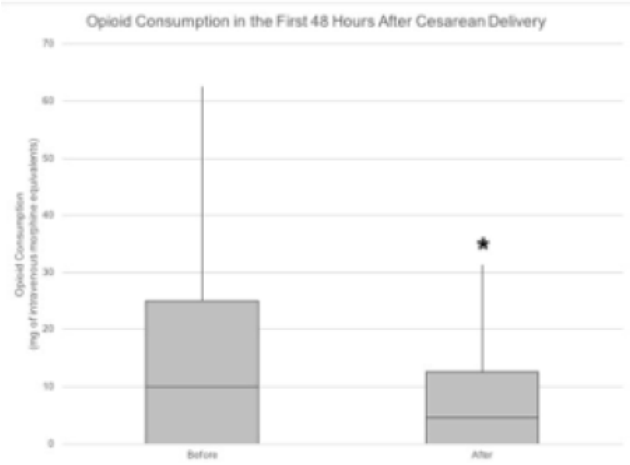
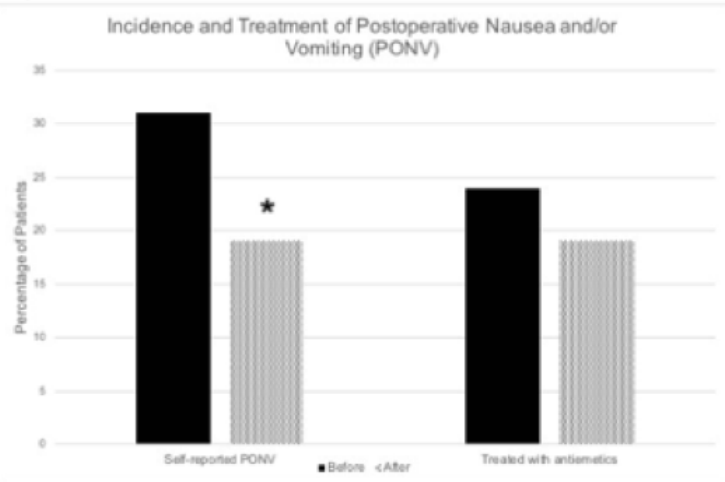


Figure 1b



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3. Best Pract Res Clin Anaesthesiol. 2017;31(1):69–79

Abstract #: F3A-195

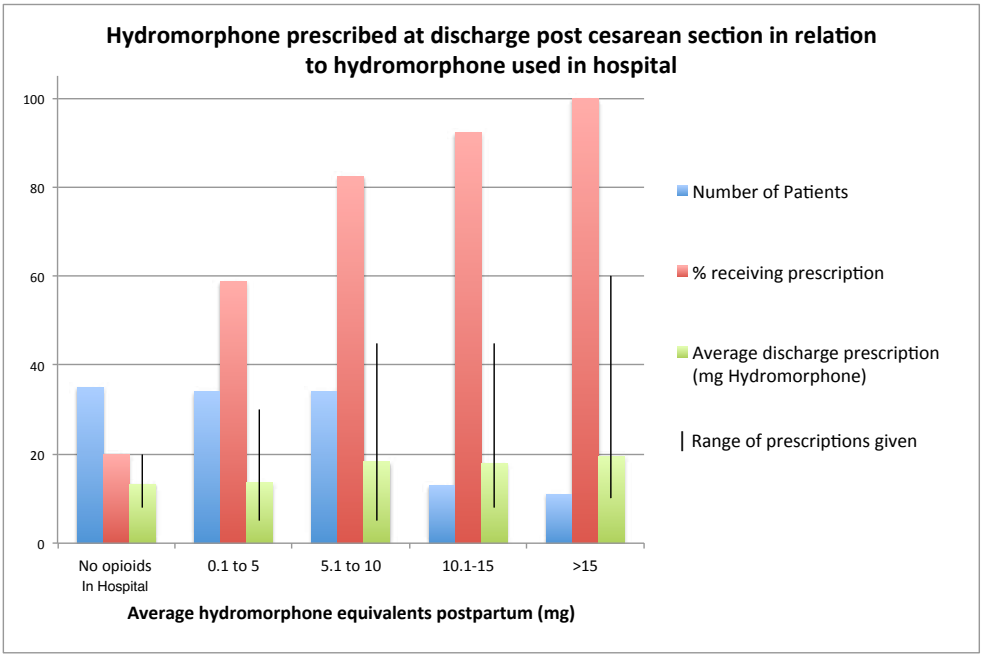
Correlation between in-hospital use of opioids post cesarean delivery and subsequent home prescriptions of hydromorphone

Presenting Author: George Dumitrascu Assistant Professor
Presenting Author's Institution: University of Ottawa - Chelsea, Quebec
Co-Author: Jessie Ursenbach MD - University of Ottawa
Marie-Chantal Dubois MD - University of Ottawa
Wesley Edwards MD - University of Ottawa

Background & Objective: Prolonged opioid use and development of addiction is an increasingly recognized concern after cesarean section, as the overall incidence of addiction to opioids in women is rising [1]. The amount of opioid prescribed at discharge from hospitals tends to exceed the amount needed/utilized by a significant margin, leading to leftover medication, susceptible to misuse [2]. In a recent survey, 53% of women reported taking no pills, or less than 5, of the amount prescribed at discharge [3]. The aim of this pilot project was to assess the correlation, if any, between in-hospital opioid use following cesarean delivery and the opioid prescription at discharge home at our university hospital.

Methods: After IRB approval, in a prospective observational cohort study, we collected data on patients undergoing cesarean delivery over a 10-week period at our tertiary-care hospital. Opioid consumption in hospital and opioid prescription at discharge home were recorded. The obstetrical team writing the prescriptions upon discharge was blinded as to which charts were reviewed.

Results: Of the 131 patients reviewed, 78 received opioid prescriptions at discharge, 49 did not and 4 were unknown. Demographic data was similar among all. 20% of the patients using no hydromorphone in hospital received discharge prescriptions averaging 13.3mg (range 8-20mg). As the opioid use in hospital increased, the percentage of patients receiving prescriptions tended to parallel this increase, such that 100% of parturients using more than 15mg hydromorphone in hospital received a prescription upon discharge. The amount prescribed increased also to an average of 19.3mg (range 5-60mg). See Figure



Conclusion: While a small increase in the amount prescribed for home paralleled an increased in-hospital opioid use, a lack of titration of the amount prescribed was apparent. Indeed, 1 in 5 patients who received no hydromorphone in hospital left with a prescription. Given the potential harm associated with opioids, we must improve the tailoring of prescriptions to our post-cesarean patients.

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Abstract #: F3A-246

Correlation between women's oxycodone intake after cesarean delivery and opioid prescriptions: are we overprescribing?

Presenting Author: Ruth Landau MD
Presenting Author's Institution: Columbia University Medical Center - New York , NY
Co-Author: Beatriz Corradini Msc - Columbia University Medical Center
Ben Shatil MD - Columbia University Medical Center
Xiwen Zheng MD - Columbia University Medical Center
Caroline Wu BA - Columbia University Medical Center

Background: Opioid use after surgery is the focus of recommendations aiming at reducing unnecessary in-hospital opioid use,[1] overprescribing at discharge,[2,3] risk for persistent use[4] and potential misuse. Opioid prescription (OP) patterns after cesarean delivery (CD) are far in excess of what women actually take at home,[2] and are not based on what women took in the last 24h before discharge.[3] Several initiatives promoting opioid-sparing analgesia after CD were implemented end of 2017 in our institution, we thus decided to examine trends in women's in-hospital oxycodone use as well as the OP they were sent home with.

Methods: Using an institutional QA/QI Opioid Dashboard, data was collected from all CD cases in 2018 (cases with prolonged stay>80h after delivery were excluded). Prescribers\' characteristics and prescription patterns were recorded. For each CD, in-hospital oxycodone use (overall and during last 24h), OP (yes/no) and number of prescribed pills (oxycodone/ Percocet 5mg) were noted. Overprescription was defined when a woman took no opioids in the last 24h but received an OP at hospital discharge; linear regression model was applied to assess correlation.[2]

Results: In 2018, 456/1503 (30.3%) women took no opioids after their CD; 89% received an OP at discharge (Fig A- B). There were 817 women (54.4%) who took no opioids in the last 24h, but 750 (91.8%) of them received an OP at discharge (Fig A). Overprescription occurred in 49.9% of the cohort (750/1503); there was no linear relationship between intake and OP (r2=0.09439, correlation 0.3; Fig D). Prescribers and OP patterns are presented (Table). The average in-hospital opioid intake per patient was 4.5 oxycodone pills (22.5mg), with an average 2.8 pills (14 mg) among those using opioids in the last 24h (N=686); the average number of prescribed pills at discharge was 19.5 (97.5mg) (Fig C)

Discussion: There was no correlation between the oxycodone intake in the last 24h and prescriptions women went home with, resulting in opioid overprescription in 50% of women undergoing a CD in 2018 in our institution. With an average prescription of 20 pills per patient, there may be up to 15,000 leftover pills in our patients' homes last year. We identified an urgent need for additional interventions to help prescribers achieve tailored prescriptions based on women's individual profile.

References:

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3. JAMA Surgery 2018;153(2)
4. JAMA Surgery 2017;152(6)

Abstract #: F3A-246

Last
4%)

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11	
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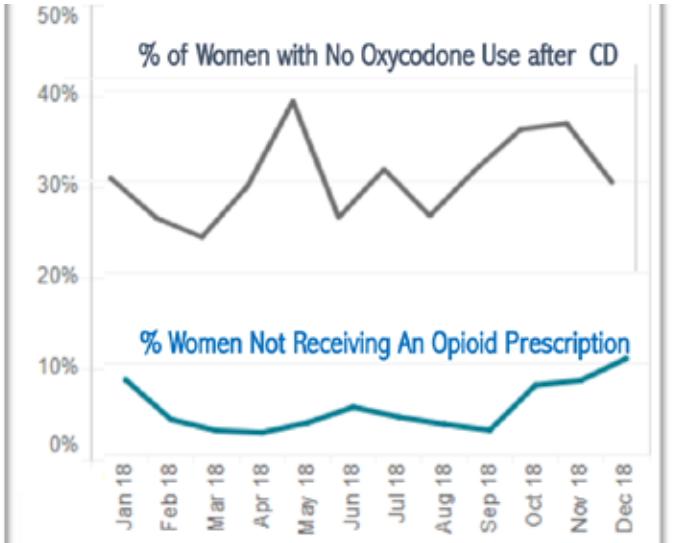
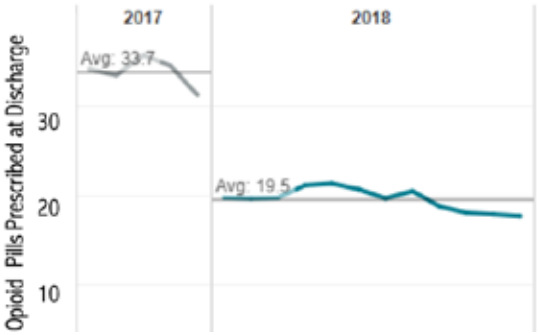
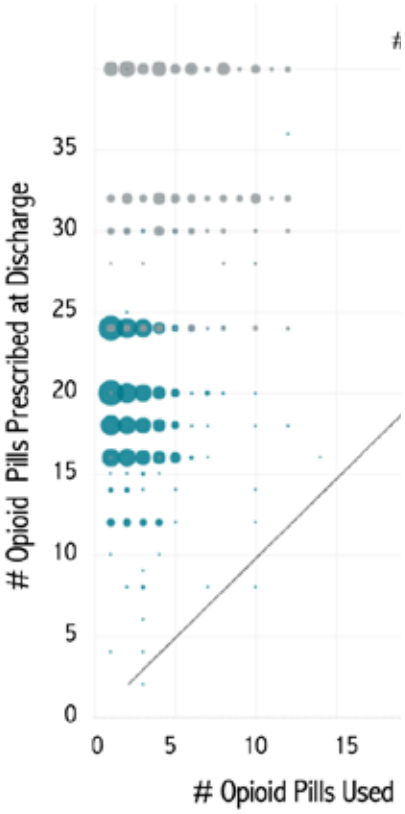


Fig C. Monthly trends for opioid prescriptions in 2017 & 2018





Each point represents a patient and clusters aggregate points. Clusters to the left along t amounts of opioids before hospital discharge b

Abstract #: F3A-398

Opioid use disorder and maternal outcomes following cesarean section; a multi-state analysis

Presenting Author: Maria M. Quincy M.D.
Presenting Author's Institution: Weill Cornell Medicine - New York, New York
Co-Author: Roniel Weinberg M.D. - Weill Cornell Medicine
Virginia Tangel M.A. - Weill Cornell Medicine
Sharon Abramovitz M.D. - Weill Cornell Medicine
Jaime Aaronson M.D. - Weill Cornell Medicine
Robert S White M.D., M.S. - Weill Cornell Medicine

Introduction: Opioid use disorder is a public health crisis in the United States, with an overdose mortality rate of more than 63,000 in 2016(1). Opioid abuse poses significant maternal and fetal risks, including intrauterine growth restriction, placental abruption, preterm delivery and neonatal abstinence syndrome(2). Recent research examining the association of maternal opioid use with maternal mortality and morbidity, as well as fetal outcomes, showed an increase in maternal death during hospitalization, cardiac arrest, and obstetric complications (3). There are no current studies that investigate maternal complications in a national cohort of patients with opioid use disorder who undergo cesarean delivery. Using data from the State Inpatient Database (SID), we examined the rates of maternal mortality and other post-delivery outcomes associated with opioid abuse among women undergoing cesarean delivery.

Methods: We performed a retrospective analysis of women who underwent cesarean delivery in California, Florida, New York, Maryland, and Kentucky (age 18+) using SID years 2007-2014. For our study outcomes of interest – inpatient mortality (primary), hospital length of stay, readmissions, and total monetary charges (secondary) – we compared both unadjusted rates and adjusted odds ratios (aOR) calculated through separate multivariate models. We conducted our data analysis using SAS 9.4 and Stata SE 15.

Results: In our five state cohort (2007-2014), 2,425,527 women underwent cesarean deliveries; of those, 10,703 (0.4%) were identified as having opioid use disorder. Women identified as having any prior opioid abuse had an increased aOR of inpatient mortality (aOR 2.48; 95%CI 1.20-1.50), increased 30-day (aOR 1.46; 95%CI 1.30-1.65), 90-day (aOR 1.70; 95%CI 1.55-1.88) readmissions, length of stay (IRR 1.02; 95%CI 1.00-1.04), and increased total charges (aIRR 1.05; 95%CI 1.03-1.07).

Discussion: We examined a five-state database to evaluate the number of women undergoing cesarean sections and found that women with opioid use disorder experienced increased inpatient mortality, length of stay, readmissions, and total charges. The opioid epidemic continues to be a public health crisis. With the increasing number of reproductive-age and pregnant women affected by opioid use disorder, it is essential to further understand its implications during pregnancy, as well as the postpartum period. We acknowledge that our findings are retrospective and observational and may be limited to cesarean deliveries. However, they highlight the need for further research to show the implications of opioid use disorder on maternal and fetal outcomes.

References:

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2. Stover MW et al. Opioids in pregnancy and neonatal abstinence syndrome. Seminars in Perinatology Nov 2015
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Abstract #: F3A-205

Factors associated with the non-use of oxycodone after cesarean delivery under neuraxial anesthesia

Presenting Author: Xiwen Zheng MD
Presenting Author's Institution: Columbia University Medical Center - New York, NY
Co-Author: Ben Shatil MD - Columbia University Medical Center
Bahaa Daoud MD - Columbia University Medical Center
Corradini Beatriz Msc - Columbia University Medical Center
Jean Guglielminotti MD - Columbia University Medical Center
Ruth Landau MD - Columbia University Medical Center

Background: Reducing the amount of opioids taken after cesarean delivery (CD) is now the recommended strategy to lower the risk of maternal complications, breastfed newborn sedation, persistent opioid use, misuse and diversion. No routine opioid prescription after CD is even proposed.(1) We decided to examine factors that may be associated with women not taking any oxycodone during their hospital stay after CD, which may guide more tailored approaches in our institution.

Methods: Women undergoing CD with neuraxial anesthesia from Jan-Sept 2018 were identified through electronic anesthesia records. Patient characteristics, obstetric, surgical and anesthesia data were collected. Primary outcome was 'non-use of oxycodone' (NUO) during the entire hospital stay (up to 80h). Anesthesia protocol includes neuraxial morphine (150mcg IT or 3mg epidural), IV ketorolac 30mg at end of case (unless CI), followed by standard q6h acetaminophen 975mg, ibuprofen 600mg. Oxycodone 5mg prn is only given for moderate (q4h) to severe (q3h) pain with a maximum daily dose of 30mg. Univariable and multivariable analysis was applied.

Results: After excluding 80 cases (4.7%; GA, complicated surgery or prolonged hospital stay), 1635 cases were analyzed. The number of women not taking any oral oxycodone (or other systemic opioid) was 537 (32.8%). Factors associated with NUO were (Table): adherence to order sets, delivery in satellite hospital, lower BMI, being Asian, delivery ≥39 weeks, and no tubal ligation. Intrapartum CD with epidural labor analgesia >20h was associated with decreased odds for NUO (adjusted OR 0.502; p=0.004).

Discussion: Recent strategies to reduce in-hospital opioid use have resulted in our finding of 1:3 women not taking oxycodone after CD. We were previously not able to identify factors associated with NUO since the ratio was only 1:10. Our finding that 20% of women were not taking the non-opioid analgesics as prescribed (non- adherence to order sets), which resulted in higher odds for oxycodone intake, warrants further nursing education and patient information on the risks/benefits associated with postoperative opioid use. Our data otherwise confirms some of the factors thought to increase opioid use (tubal ligation), but higher BMI was not expected to significantly increase opioid use. Another important and yet unreported association was prolonged intrapartum CD (> 20h) which reduced the odds for NUO.

References:

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Abstract #: F3A-205

Table: Analysis of factors associated with non-use of oxycodone during in-hospital stay for cesarean delivery under neuraxial anesthesia (N=1635)

	Use of Oxycodone (N = 1098; 67·2%)	Non-Use of Oxycodone (N = 537; 32·8%)	Univariable analysis		Multivariable analysis	
			P-value[a]	Crude OR (95%CI)	Adjusted OR[b] (95%CI)	P-value
Hospital			**< 0·001**			
Main academic hospital (N=1125; 68·8%)	790 (70·2%)	335 (29·8%)		0·65 (0·52-0·80)	**0·68 (0·54-0·87)**	**0·002**
Satellite hospital (N=510; 31·2%)	308 (60·4%)	202 (39·6%)				
Adherence to post CD order set	871 (79·3%)	462 (86·0%)	**0·001**	1·60 (1·21-2·13)	**1·48 (1·10-1·99)**	**0·010**
Patient demographics						
Maternal age (years)	32 (27-36)	32 (28-36)	0·28	1·01 (0·99-1·03)		
Race (data for N=1266)			**0·032**			
– White (N=560; 44·2%)	377 (67·3%)	183 (32·7%)		Ref·	Ref·	Ref·
– Hispanic (N=348; 27·5%)	226 (64·9%)	122 (35%)		1·11 (0·84-1·47)	**1·09 (0·84-1·41)**	**0·53**
– Black (N=280; 19·5%)	199 (71·1%	81 (28·9%)		0·84 (0·61-1·15)	**0·83 (0·63-1·11)**	**0·22**
– **Asian (N=80; 6·4%)**	42 (52·5%)	36 (45%)		1·77 (1·09-2·85)	**1·70 (1·08-2·66)**	**0·021**
BMI (per 1 unit increase; data for N=1633)	32·0 (28·6-36·5)	31·2 (27·8-34·7)	**< 0·001**	0·97 (0·96-0·99)	**0·98 (0·96-0·99)**	**0·025**
Parity ≥ 1	662 (60·3%)	307 (57·2%)	0·249	0·88 (0·71-1·08)		
Gestational age (weeks)			**< 0·001**			
– ≥ 39 (N=1036; 63·4%)	653 (63·0%)	383 (37·0%)		Ref·	Ref·	Ref·
– **35 to 38 (N=500; 30·1%)**	366 (73·2%)	134 (26·8%)		**0·62 (0·49-0·79)**	**0·71 (0·55-0·91)**	**0·006**
– **≤ 34 (N=99; 6·1%)**	79 (79·8%)	20 (20·2%)		**0·43 (0·26-0·72)**	**0·464 (0·27-0·79)**	**0·004**
Preeclampsia (N=157; 9·6%)	127 (80·1%)	30 (19·1%)	**< 0·001**	0·45 (0·30-0·68)		
Tubal ligation (N=203; 12·4%)	150 (73·9%%)	53 (26·1%%)	**0·035**	0·69 (0·50-0·96)	**0·66 (0·47-0·93)**	**0·019**
Night time (N=658; 40·2%)	448 (68·1%)	210 (31·9%)	0·55	0·93 (0·75-1·15)		
Primary CD (N=865; 52·9%)	583 (67·4%)	282 (32·6%)	0·86	0·98 (0·79-1·20)		
Elective (no labor) vs intrapartum CD			**0·008**			
Elective CD (N=737; 45·1%)	498 (67·6%)	239 (32·4%)		Ref·	Ref·	

Abstract #: F3A-235

Effect of spinal isobaric bupivacaine on opioid use after cesarean delivery

Presenting Author: Xiwen Zheng MD
Presenting Author's Institution: Columbia University Medical Center - New York , NY
Co-Author: Ben Shatil MD - Columbia University Medical Center
Laurence Ring MD - Columbia University Medical Center
Jean Guglielminotti MD - Columbia University Medical Center
Ruth Landau MD - Columbia University Medical Center

Background: During local anesthesia shortages in 2018, substitution of hyperbaric bupivacaine 0.75% (HBB) with isobaric bupivacaine (IBB) was proposed for non-urgent cesarean deliveries (CD).1 A recent systematic review (10 studies; N=614 subjects) reported a more rapid onset for HBB compared with IBB with no differences in conversion to GA or need for supplemental analgesia, but prolonged analgesic use was not mentioned.2 IBB with opioids results in a hypobaric solution spreading further cephalad than HBB with opioids,3 although the relevance of lower baricity on the duration of spinal morphine and fentanyl analgesia is unclear.4 We hypothesized that women receiving IBB rather than HBB have lower opioid use after CD and that time to 1st opioid dose will be delayed.

Methods: Between Feb-June 2018, IBB syringes were prepared daily by Pharmacy for non-urgent CD as a conservation measure due to HBB shortage. Anesthesia attending decided whether to use HBB (12mg) or IBB (12-15mg, with fentanyl 15mg & morphine 150mcg. Using electronic anesthesia records, all consecutive CDs under spinal anesthesia were identified and categorized into 2 groups (HBB vs IBB). Outcomes were non-use of oxycodone, cumulative dose of oxycodone and time to 1st oxycodone dose. Adjustment for the risk of receiving isobaric bupivacaine was applied.

Results: There were 299 cases with IBB (30.5%) and 682 with HBB, with differences in patient and cesarean characteristics between groups (urgent cases received HBB). There were no differences in any measured outcomes; adjusting for the risk of receiving IBB did not modify these findings (Table).

Discussion: Since we had no experience using IBB for CD but expected (1) prolonged duration of spinal block and (2) possible effect on the distribution/spread of spinal morphine due to lower baricity of spinal solution, we thought this may impact opioid use after CD. We found no differences between groups which is reassuring. Lack of observed difference may be due to many factors such as different clinical indication (although we performed risk adjustment), the fact that opioid use is relatively low now in our institution with 30% not using any oxycodone, or that the sample size is too small. We believe this is the 1st report examining in- hospital opioid use after spinal anesthesia with IBB.

References:

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2. Anaesthesia 2018;73;499-511
3. Can J Anaesth 1999;46;66-70
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Abstract #: F3A-235

bupivacaine groups

	Hyperbaric (N = 682)	Isobaric (N = 299)	P-value[a]
Patient			
Maternal Age (year)	32 (28-36)	33 (29-37)	0.004
Non-White race including Hispanics (missing = 220)	251 (50.1%)	154 (59.2%)	0.020
BMI (kg/m2)	31.6 (28.2-35.1)	31.5 (28.6-34.5)	0.82
Parity ≥ 1	514 (75.4%)	236 (78.9%)	0.26
Gestational age	39 (37-39)	39 (38-39)	0.012
Preeclampsia (yes)	46 (6.7%)	23 (7.7%)	0.69
Cesarean delivery			
Primary CD (yes)	246 (36.1%)	85 (28.4%)	0.024
Planned CD (yes)	435 (63.8%)	226 (75.6%)	< 0.001
Intrapartum CD (yes)	7 (1.0%)	3 (1.0%)	> 0.99
Main academic Hospital (yes, vs satellite hospital)	450 (66.0%)	218 (72.9%)	0.039
Nighttime (yes)	213 (31.2%)	66 (22.1%)	0.004
Tubal ligation (yes) (missing = 1)	95 (14.0%)	58 (19.4%)	0.039
Anesthesia			
uration of anesthesia care in OR (minutes; missing = 3)	96 (82-116)	100 (90-117)	0.005
Neuraxial clonidine (yes) (missing = 1)	74 (10.9%)	41 (13.7%)	0.24

Comparison of in-hospital opioid use				Not adjusted		Adjusted	
				Coefficient (95% CI)	P-value	Coefficient (95% CI)	P-value
Non-oxycodone user during entire hospital stay	216 (31.7%)	105 (35.1%)	0.32	0.155 (-0.132 to 0.442)	0.29	0.107 (-0.183 to 0.396)	0.47
Total cumulative oxycodone dose (mg)	20 (10-35)	20 (10-35)	0.96	-0.920 (4.365 to 2.525)	0.60	-1.414 (-4.824 to 1.996)	0.42
Time-to-first oxycodone dose (hour)	21 (8-32)	20 (9-31)	0.94	-1.508 (-4.432 to 1.416)	0.31	-1.218 (-4.149 to 1.713)	0.42

Abbreviations: BMI: body mass index; CD: cesarean delivery
Results are expressed as median (25^{th}-75^{th} percentiles) or count (%).
[a] P-values are from Chi-square or Wilcoxon tests.
Standardized post-CD orders included scheduled q6h NSAIDs & acetaminophen, with rescue oxycodone 5mg prn for moderate to severe pain (max daily dose 30mg).

Adjustment for the risk of receiving isobaric bupivacaine: Unadjusted risk for the 3 outcomes examined (oxycodone user (yes/no), cumulative dose of oxycodone (mg), and time to 1st oxycodone dose (hour)) associated with the use of isobaric bupivacaine was estimated using the regression coefficient from a logistic or linear regression model. In these models, outcomes were the dependent variables and bupivacaine (hyper- or isobaric) the independent variable.
Adjusted risk was estimated using an inverse probability of treatment weighting approach.

Abstract #: F3A-146

Impact of an enhanced recovery pathway for cesarean delivery on postoperative opioid use

Presenting Author: Sara Anne W Lester MD
Presenting Author's Institution: UAB - Birmingham, AL
Co-Author: Beomjy Kim BS - UAB School of Medicine - , Michelle D Tubinis MD - UAB
Charity Morgan PhD - UAB
Mark F Powell MD - UAB

Background: Enhanced recovery after surgery pathways have been implemented in a number of surgical specialties with positive outcomes. Cesarean delivery is one of the most common surgeries performed worldwide, and the adoption of enhanced recovery pathways for cesarean delivery is gaining popularity. We tested the hypothesis that implementation of an enhanced recovery pathway for cesarean delivery would be associated with a decrease in postoperative opioid consumption without negative impact on post-operative pain control, patient satisfaction, length of stay, or 30-day postoperative complications.

Methods: A single center observational cohort study that compared a retrospective cohort of women delivered by elective, scheduled cesarean section (January 1, 2017 to June 30, 2018) to a prospective cohort exposed to the enhanced recovery pathway (July 1, 2018 to December 31, 2018). The primary clinical outcome was maternal opioid use, measured as total oral morphine equivalents, during the inpatient postoperative stay. Secondary outcomes included post-operative pain scores, patient satisfaction, length of stay, and 30-day postoperative complications including unscheduled clinic visits and hospital readmission. We also evaluated process measures reflective of protocol adherence which included time to post-operative ambulation, oral intake, and urinary catheter removal.

Results: 547 patients were included, 112 in the enhanced recovery cohort (ERC) and 435 in the pre-enhanced recovery cohort (Pre-ERC). The ERC used significantly less oral morphine equivalents (OMEs) postoperatively compared with the pre-ERC (average total postoperative OME for the ERC was 60.34mg, vs 105.87mg in the pre-ERC, $p < 0.001$). 58.93% of patients in the ERC did not consume opioids within the 24hrs prior to discharge, compared with 25.75% in the Pre-ERC ($p < 0.001$). Post-operative pain scores were slightly lower in the ERC compared with the pre-ERC (average pain score 1.61/10 in EHC vs 1.90/10 in pre- EHC, $p = 0.033$, average daily maximum pain score 4.40/10 in EHC vs 4.93/10 in pre-EHC, $p = 0.047$). There was no significant difference in post-operative length of stay (81.37 hours in ERC vs 90.70 hours in pre-ERC, $p = 0.076$) or 30-day postoperative complication rate (12.50% in ERC vs 14.94% in pre-ERC, $p = 0.512$) between cohorts.

Conclusions: The implementation of an enhanced recovery pathway for cesarean deliveries was associated with a 43% reduction in post-operative opioid consumption. There was also a significant reduction in the percentage of patients who consumed opioids within 24hrs prior to discharge. Post-operative pain scores were slightly lower after implementation of the enhanced recovery pathway, without significant difference in length of stay or 30-day postoperative complications.

Abstract #: F3A-395

Alternatives to Opioids (ALTO)- An Initiative to Reduce Opioid Use in Cesarean Section Patients

Presenting Author: Seth E. Landa MD
Presenting Author's Institution: St. Joseph's University Medical Center - Paterson, NJ
Co-Author: Jonathan Markely DO - St. Joseph's University Medical Center - , Truocchio Matt MD - St. Joseph's University Medical Center
Winikoff Stephen MD - St. Joseph's University Medical Center
Bauman Greg MD - St. Joseph's University Medical Center

Background: The opioid crisis in the US has had a devastating toll with >400,000 overdose deaths from 1999- 2017. This epidemic has been driven by the misuse of prescription narcotics which then serves as a gateway to the use of heroin and illicit fentanyl. Cesarean section is the most common major surgical procedure in the US and opioids are routinely prescribed, both in the hospital and at discharge. Studies have reported an increased risk of new,persistent opioid use after prescription for acute pain in opioid naïve patients(1). Additionally, excessive prescribing leads to leftover medications which may then end up in the possession of an abuser. We recently introduced an initiative - the Alternatives to Opioids (ALTO) program- with the aim of decreasing opioid use following cesarean delivery, and we report our first year's results.

Methods: A multidisciplinary team was created including OB/Gyn and anesthesia faculty and residents,nursing, pharmacy and the director of the ALTO program(a pain fellowship-trained ER physician). Guidelines for post-section pain management were established. Initial management was with intrathecal or epidural morphine. Orders then included 4 doses of ketorolac,30 mg IV q 6 hrs;acetaminophen,975 mg po q 6 hrs x 72 hrs; and ibuprofen, 400mg po q 6hrs x 48 hrs following the ketorolac. Oxycodone/acetaminophen was removed from the order sets and replaced with oxycodone 5mg po q 6hr prn for rescue. Patients were discharged on ibuprofen and acetaminophen and pharmacy developed a hand out on the proper use of these drugs in combination. A small number of oxycodone tabs could be prescribed as needed.

Results: Prior to the start of the program 85% of patients used opioids post-section. This dropped to between 36-45% each quarter of 2018 as most pain needs were satisfactorily addressed by non-opioid analgesics. Initially 88.5% of patients were discharged with a prescription for narcotics but at the end of 2018 only 4% of patients received such a prescription.

Discussion: In the US,but not Europe, opioids for post-cesarean section pain are prescribed both in the hospital and upon discharge. This difference in practice may relate to the push in the US for treating pain as a "5th vital sign" with a tie in to reimbursement; and misguided teaching that narcotics were not addictive when given in the setting of pain. These factors have also contributed to the opioid epidemic(2). The use of multi-modal analgesia without opioids has been shown to be non-inferior to opioid regimens for moderate to severe pain(3).We developed institutional guidelines that maximized around-the-clock non-opioid analgesic use and were thereby able to minimize in-house and discharge opioid use. Conclusion:
By focusing on provider and patient education in multi-modal pain relief, in-hospital opioid use was halved and discharge prescriptions virtually eliminated.

References:

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2. Wong, BJA, 121(2) 2018
3. Chang,JAMA Intern Med 318(17) 2017

Abstract #: F3A-336

Transversus Abdominis Plane Block Versus Rectus Sheath Block for Postoperative Pain After Cesarean Delivery: A Randomized Controlled Trial

Presenting Author: Tulay Sahin Professor
Presenting Author's Institution: Kocaeli University Medical Faculty - Kocaeli, Kocaeli
Co-Author: Hadi Ufuk Yorukoglu Specialist - Kocaeli University
Tulay Sahin Professor - Kocaeli University
Ayse O. Kula, MD – Medial College of Wisconsin

Background: Undesired effects of pain can be prevented with efficient postoperative analgesia in patients who undergo cesarean operations. In addition, relationship with the mother and her new born baby will be provided earlier. With this study, we aimed to compare the postoperative analgesia effects of rectus sheath (RS) block and transversus abdominis plane (TAP) block in patients who undergo elective cesarean operations.

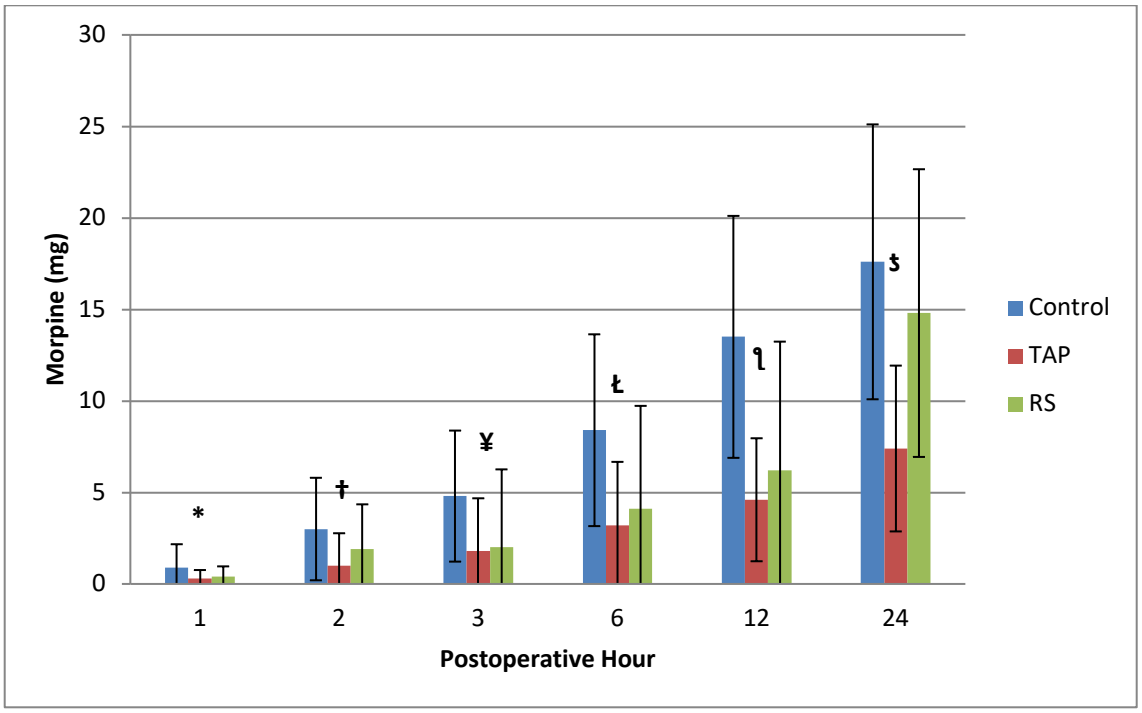
Methods: After receiving Ethical Committee approval and informed consent, 90 ASA I-II, aged 18-45 years, have >37 gestation weeks who were scheduled for elective cesarean operation were included to this study. Spinal anesthesia was performed with bupivacaine and fentanyl. At the end of the surgery, 1 gr iv paracetamol was given and the patients were provided with iv morphine patient controlled device. Patients were randomised into three groups with closed envelope technique. Bilateral ultrasound guided TAP block was performed to TAP group with 20 mL 0,25% bupivacaine, bilateral ultrasound guided rectus sheath block was performed to RS group with 20 mL 0,25% bupivacaine and no block was performed to control group. Primary object of this study was to compare the analgesia effects and morphine consumption between TAP block and rectus sheath block. Secondary outcomes were to compare the incidence of nausea and vomiting and the satisfaction rates of the patients.

Findings: NRS scores of both while resting and coughing were lower in TAP group at postoperative 2nd, 3rd, 6th, 12th and 24th hours ($p<0,05$). Morphine consumption was lower in TAP group at postoperative 1st, 2nd, 3rd, 6th, 12th and 24th hours ($p<0,05$). Patient satisfaction was higher in both TAP and RS groups compared to control group ($p<0,05$). Nausea and vomiting were lower in TAP group but it was statistically insignificant. Discussion: TAP block provides efficient postoperative analgesia in patients who undergo cesarean operation however postoperative analgesia provided with rectus sheath block is inadequate in patients who undergo cesarean operation.

Keywords: Cesarean operation, postoperative analgesia, transversus abdominis plane block, rectus sheath block

Abstract #: F3A-336

Morphine consumptions at postoperative 1st, 2nd, 3rd, 6th, 12th and 24th hours. Results are expressed as mean ± standard deviation.



*: Compared between TAP and Control groups (p=0,022)

†: Compared between TAP and Control groups (p<0,001)

¥: Compared between TAP and Control groups (p<0,001), compared between RS and Control groups (p=0,011)

Ł: Compared between TAP and RS groups (p=0,034), compared between TAP and Control groups (p<0,001)

ł: Compared between TAP and RS groups (p<0,001), compared between TAP and Control groups (p<0,001)

$: Compared between TAP and RS groups (p=0,036), compared between TAP and Control groups (p<0,001)

Abstract #: F3A-116

The Influence of an International Teaching Visit on the Use of the Quadratus Lumborum Block after Cesarean Delivery in Serbia

Presenting Author: Nada Pejčić M.D.
Presenting Author's Institution: Leskovac General Hospital - Leskovac, Serbia
Co-Author: Radomir Mitić M.D. - Leskovac General Hospital
Michael Akerman M.D. - Cornell Medical Center
Borislava Pujić M.D. - Clinical Center of Vojvodina
Mirjana Kendrišić M.D. - Sremska Mitrovica General Hospital
Ivan Velickovic M.D. - SUNY Downstate Medical Center

Background: The Quadratus Lumborum Block (QLB) is a posterior abdominal wall block that is performed exclusively under ultrasound guidance. Since 2015, QLB has been used for pain management after Cesarean Delivery (CD). A teaching visit by a fellowship trained anesthesiologists from the USA was arranged to Leskovac General Hospital (LGH) in April of 2017. Two anesthesiologists from LGH learned how to perform QLB and later on held a teaching sessions around the region in order to train other anesthesiologists.

Methods: All CD cases followed by QLB performance done during the period April 2017 – December 2018 were obtained from the anesthesia databases of LGH, Sremska Mitrovica General Hospital (SMGH), and Clinic of Gynecology and Obstetrics, Clinical Center of Vojvodina (CCV). Bilateral QLB type 1 was performed after CD done under either general anesthesia (GA) or spinal anesthesia (SA). QLB was performed either in the OR at the end of the surgery or in the recovery room. All patients that had QLB were checked for pain relief.

Results: In LGH, QLB was performed in 29 patients after CD done under GA, and in 12 patients after CD under SA. In CCV, QLB was performed in 56 patients after CD done under GA, and in 84 patients after CD under SA. In SMGH, QLB was performed in 4 patients after CD done under GA. All patients experienced significant pain relief after block performance, 0 to 2/10 on a numeric rating scale. In total, QLB was done in 34 patients in 2017 and in 151 patients in 2018, an increase of 332%.

Conclusions: QLB was introduced into LGH everyday clinical practice thanks to an international teaching visit (Kybele program1). Over the next year, two members of the department have trained physicians from other hospitals in the region. New regional workshops are planned in order to train additional physicians. New international visits are also planned in order to train local physicians new blocks. QLB can be easily performed thanks to the clear sonographic landmarks. QLB has almost eliminated postoperative opioid use in our patients. QLB can be used in CD patients done under either GA or SA. Successful implementation of QLB has started the interest in abdominal wall blocks in several Balkan countries.

References:

1. Baysinger C. et al. Increasing Regional Anesthesia Use in a Serbian Teaching Hospital through International Collaboration. Front. Public Health 09 June, 2017.

Abstract #: F3A-401

Development of a Virtual Reality Tool to Decrease Pain and Anxiety During Labor and Delivery

Presenting Author: Lindsey Ralls MD
Presenting Author's Institution: Stanford University - Stanford, CA
Co-Author: Brendan Carvalho MBBCh, FRCA - Stanford University
Thomas Caruso MD, MEd - Stanford University
Maria Menendez BA - Stanford University
Samuel Rodriguez MD - Stanford University

Background: Labor and peripartum medical procedures including epidural anesthesia can provoke significant anxiety and pain. Virtual reality (VR) technology has shown promising results for relieving anxiety and pain during various procedures, including wound care, IV placement, chemotherapy and dental procedures(1), but its role in the labor and delivery setting has not been well elucidated. The aim of this study was to develop VR technology for pregnant and laboring women.

Methods: IRB-approved prospective cohort study of three cohorts: nonpregnant women having previously undergone labor epidural (Group NP); non-laboring pregnant (2nd or 3rd trimester) women (Group P); and laboring women undergoing epidural placement (Group L). All participants completed a survey recalling pain and anxiety during their most recent labor epidural (if applicable), willingness to try VR and tendency toward motion sickness. Group L completed additional questions about their pre-epidural anxiety and pain. Participants were given a VR headset and guided through VR scenery; group L used the headset during epidural placement. After VR use all participants completed a feedback survey regarding their experience, including if they felt any nausea or discomfort, how helpful they felt VR would be for reducing pain and anxiety during future epidural placement or pain relief during labor, likelihood to use VR during future epidural placement, and preferred types of VR scenery. Group L also completed additional questions regarding their post-epidural anxiety and pain. Question responses were scaled using a 5-point Likert-type scale (for example, ranging from very unhelpful to very helpful); pain and anxiety were scored on a 0 to 10 scale.

Results: 20 women in each of the 3 groups participated in the study (n=60). Most women reported that VR would be helpful for decreasing anxiety (64%) and pain (51%) during future epidural placement, 76% said they would like to use the VR epidural relaxation experience during a future epidural placement, and 62% reported that VR would be helpful for labor pain management. In Group L, there was a significant reduction in pain (p=0.0009) and anxiety (p=0.0007) after VR use during epidural placement. Nausea was reported by 9% of participants; other side effects noted were discomfort from headset (headache, neck ache, heaviness of headset), fogging of mask, and difficulty focusing on images. Most desired VR scenes were underwater/ocean (75%), beach (66%), and waterfall (54%) versus mountains (32%), forest (31%), abstract patterns (2%) and "other" (3%).

Conclusions: VR appears to be helpful to alleviate pain and anxiety and was well-tolerated by patients. Most women felt that VR would be helpful during labor or epidural placement, and for labor pain management. Future investigations are required to determine if VR can reduce pain and anxiety during labor and delivery.

References:

1. Pain Manag. 2011 Mar; 1(2): 147–157

Abstract #: F3B-225

The use of tranexamic acid in postpartum haemorrhage (PPH) - a UK-Wide survey.

Presenting Author: Stephen Ramage MBBS BSc
Presenting Author's Institution: Frimley Park Hospital, Frimley Health NHS Foundation Trust - Camberley, Surrey
Co-Author: Sarah Armstrong MBBS MA - Frimley Park Hospital

Introduction: The WOMAN trial concluded that the early use of tranexamic acid (TXA) in PPH reduces mortality due to bleeding but also does not increase the risk of adverse effects (1). While some clinicians have viewed this study as a \"game changer\", others remain cautious as to the true impact of these results. We conducted this survey to gain an impression of the influence of the WOMAN trial on the use of TXA within obstetric units in the UK.

Methods: We conducted an OAA approved, national survey sent electronically to 164 obstetric anaesthesia departmental leads in the UK. We aimed to examine how clinicians' practices have changed as a result of the WOMAN trial and if local guidelines for the management of PPH have been updated. Respondents were asked if existing concerns remained regarding TXA use and if any adverse events were thought to be attributed to this drug.

Results: 70 responses were received (43% response rate). 74% of units stated they have increased TXA use following the publication of the WOMAN trial with some noting a decline in the use of blood products and that TXA may have played a role in this trend. 73% report existing departmental guidelines describing TXA use in PPH prior to the trial and, of these, 53% have subsequently been updated. 2% have developed new guidelines since the study. Of the remaining 27% without departmental guidelines, a majority (63%) intend to write new recommendations. 16% of respondents expressed concerns regarding the safety of TXA, in particular the perceived risk of thromboembolic complications. 7% reported adverse events associated with TXA including hypotension (6%) and seizures (1%).

Discussion: The survey results indicate an increase in TXA use in PPH management following the publication of the WOMAN trial. Many departments have either updated existing guidelines or developed new guidelines incorporating the use of TXA. Although the study design lends itself to criticism for having an unclear overall mortality benefit, the increase uptake in the use of TXA may be a result of both a reported decrease in deaths due to bleeding as well as a lack of adverse events. Comments from the survey reflect these considerations; while many departments reserve TXA for ongoing, active bleeding, some smaller, isolated units give it more liberally for PPH prophylaxis. Respondents do, however, advise caution in neglecting other measures to stop bleeding or administering TXA late once clotting factors have been consumed. Despite a NNT of 250, TXA is cheap, easy to administer and safe; the increase in its use reflects a national growing confidence that TXA may tip the balance towards a more favourable outcome in PPH.

References:

1. WOMAN Trial Collaborators. 2017. Effect of early tranexamic acid administration on mortality, hysterectomy, and other morbidities in women with post-partum haemorrhage (WOMAN): an international, randomised, double-blind, placebo-controlled trial. Lancet. 389(10084):2105–2116

Abstract #: F3B-289

The Safety and Feasibility of Intravenous Nitroglycerin Use In Women Undergoing Cesarean Delivery In The Second Stage of Labor

Presenting Author: Tina M Yu MD
Presenting Author's Institution: University of California San Francisco - San Francisco, CA
Co-Author: Stephanie Lim MD - University of California San Francisco
Jermaine Augustus MD - Kaiser Vacaville/Vallejo
Cinthia Blat MPH - University of California San Francisco
Mary Norton MD - University of California San Francisco
Jennifer Lucero MD - University of California San Francisco

Introduction: Cesarean deliveries (CD) in the second stage of labor are challenging given frequent difficulty extracting the fetal head. Prolonged second stage of labor has been associated with hysterotomy extension, and maternal and neonatal morbidity. Nitroglycerin (NTG) may assist with difficult deliveries. We studied the safety and feasibility of IV NTG in patients undergoing second stage CD.

Methods: In a randomized controlled trial, patients were allocated to NTG versus saline by randomized calendar blocks with random block sizes. Women age 18-45 at >37 weeks gestational age undergoing CD in the second stage of labor were eligible. Obstetricians were blinded to allocation to allow for unbiased determination of hysterotomy extension; administering anesthesiologists were not. At uterine incision, a 400mcg bolus of NTG (200mcg/mL) or 2mL of saline was given followed by an infusion of 800mcg/min of IV NTG or equal amount of saline. Concomitant bolus of phenylephrine (100mcg/mL) was given with NTG. The infusion of study drug was discontinued after delivery of the fetus or when 1600mcg total NTG given. Obstetricians could ask for NTG as standard care and patients in the saline arm could cross over.

Results: Among 18 patients consented in the study, 7 received IV NTG and 11 received saline. All CD were performed under epidural with 2% lidocaine. No adverse events were reported. Maternal mean arterial blood pressure (MAP) at uterine incision was 88.6 (+ 10.1, ns) and MAP at neonate delivery was 85.6 (+ 7.0, ns). Phenylephrine bolus dose between the NTG versus saline group was statistically significant (385.7 mcg vs 63.6 mcg, $p<0.05$). Fetal extraction time with NTG was 104.9 sec (+ 33.1) versus 131.0 sec (+ 84.1), not significant.

Discussion: This was a pilot safety and feasibility study of NTG at cesarean delivery on maternal and neonatal outcomes. Our study was stopped early for feasibility concerns, as enrollment was lower than anticipated. The study was not powered to detect a difference in fetal extraction time, although this would be an important outcome in future studies. We found no adverse outcomes when NTG was administered with phenylephrine. There was a trend toward shorter fetal extraction time and shorter operative time.

References:

Isquick S., et al. The association between nitroglycerin use and adverse outcomes in women undergoing cesarean delivery in the second stage of labor. J Matern Fetal Neonatal Med. 2017; 30 (11): 1297-1301

Abstract #: F3B-289

Measure	Total (n=18)	NTG (n=7)	Control (n=11)
Race/Ethnicity, n (%)			
White	11 (61.1%)	3 (42.9%)	8 (72.7%)
Black	1 (5.6%)	0 (0.0%)	1 (9.1%)
Asian/Pacific Islander	5 (27.8%)	3 (42.9%)	2 (18.2%)
Hispanic	0 (0.0%)	0 (0.0%)	0 (0.0%)
Multi-racial or other	1 (5.6%)	1 (14.3%)	0 (0.0%)
Maternal BMI (kg/m2), mean (±SD)	24.2 (±4.2)	22.4 (±3.9)	25.3 (±4.2)
Mother's age (years), mean (±SD)	34.7 (±3.6)	35.4 (±4.1)	34.3 (±3.3)
Nulliparous, n (%)	15 (83.3%)	6 (85.7%)	9 (81.8%)
Gestational age at delivery (wks), mean (±SD)	39.9 (±1.2)	40.0 (±1.4)	39.8 (±1.1)
Previous C-Section, n (%)	2 (13.3%)	0 (0.0%)	2 (22.2%)
Labor induced, n (%)	10 (55.6%)	3 (42.9%)	7 (63.6%)
Labor spontaneous, n (%)	8 (44.4%)	4 (57.1%)	4 (36.4%)
Assisted vaginal delivery attempted, n (%)	1 (5.6%)	0 (0.0%)	1 (9.1%)
Newborn birthweight (grams), mean (±SD)	3498.3 (±361.7)	3313.6 (±215.2)	3615.9 (±394.4)
Station at delivery (-5 to +5), median (IQR)	1 (0, 1)	1 (0, 1)	1 (0, 1)
Uterotonics givens			
Carboprost, n(%)	2 (11.1%)	0 (0.0%)	2 (18.2%)
Methylergonovine, n (%)	5 (27.8%)	1 (14.3%)	4 (36.4%)
Misoprostol, n (%)	2 (11.1%)	0 (0.0%)	2 (18.2%)
Did OB ask for NTG?, n (%)	3 (16.7%)	2 (28.6%)	1 (9.1%)
Total nitro given, mean (±SD)	590.7 (±688.2)	1376.1 (±304.8)	90.9 (±207.1)
Maternal Outcomes			
Hysterotomy Extension	7 (38.9%)	3 (42.9%)	4 (36.4%)
Length of Second Stage, mean (hr), (± SD)	5.3 (±4.2)	6.6 (±1.6)	4.5 (±5.0)
Neonatal Extraction Time, mean (s), (± SD)	120.8 (±68.7)	104.9 (±33.1)	131.0 (±84.1)
Total Operative Time (min), (± SD)	71.9 (±21.0)	68.3 (±22.0)	74.2 (±21.1)
Estimated Blood Loss (mL), (± SD)	997.2 (±207.6)	935.7 (±217.4)	1036.4 (±201.4)
Blood Transfusion	0	0	0
Neonatal Outcomes			
APGAR at 5 mins	9	9	9
Umbilical Artery pH, mean (± SD)	7.3 (±0.0)	7.3 (±0.0)	7.3 (±0.0)
Umbilical Artery BE, mean (± SD)	-3.0 (±1.2)	-2.7 (±1.0)	-3.2 (±1.4)
Umbilical Artery pCO2, mean (± SD)	47.6 (±7.8)	50.0 (±7.7)	46.0 (±7.9)
Umbilical Artery pO2, mean (± SD)	22.3 (±4.6)	22.9 (±5.6)	21.9 (±4.1)
NICU admission, n (%)	3 (16.7%)	1 (14.3%)	2 (18.2%)

All comparisons are not statistically significant

Abstract #: F3B-399

Implementing the Pregnancy Reasonably Excluded Guide (PREG) for Pre-Surgical Pregnancy Screening

Presenting Author: Margaret E. Long M.D.
Presenting Author's Institution: Mayo Clinic - Rochester, MN
Co-Author: Katherine W. Arendt M.D. - Mayo Clinic

Objective: To evaluate the success of the Pregnancy Reasonably Excluded Guide (PREG) for pregnancy assessment prior to general surgery procedures to improve the consistency of screening.

Design: The PREG was designed to accurately and efficiently screen for pregnancy prior to procedures by directing appropriate urine or serum pregnancy testing. The process allows for adult reproductive-aged women to participate in a shared-decision-making model to decide whether testing is needed. The PREG checklist includes both traditional (e.g. menopause, hysterectomy, sterilization, known pregnancy) and World Health Organization supported (contraceptive use, last menses, timing of coitus with a man) testing exclusions. Women may also simply request a pregnancy test without answering questions. We report the adoption of the PREG process in a large general surgery practice that previously had no institutionalized pregnancy screening procedure. Rates of pregnancy testing before and after implementation were evaluated.

Method: Women aged 18-51 years undergoing elective general surgery were administered the paper PREG questionnaire on the day of surgery. Nursing verbally confirmed responses privately with each woman and initiated testing as indicated by the PREG protocol. If the woman or nurse felt the patient was unable to independently read and freely respond to the PREG checklist, the patient was directed to pregnancy testing. The system provided the nurse with an order for urine qualitative pregnancy testing, or serum testing in the event a urine sample was not possible. Data was collected for 3 months prior to PREG implementation and 4.5 months after implementation with the exclusion of a 2-week interval transition period. Administrative data identified qualifying women and lab data identified pregnancy tests. Quality review provided surveillance for positive tests and missed diagnoses of pregnancy.

Results: Before implementation, 777 women were listed for surgery and 66 received pre-procedure pregnancy testing (8.49% ranging from 8.2-8.8%). After implementation, 1038 women were listed with 185 tested (17.82% ranging from 11.3-22.4%). After implementation, all patients consistently had a pregnancy assessment documented in their record. In this cohort, no pregnancies were diagnosed on the day of surgery and no failures to diagnose pregnancy were identified. Implementation of the process did not affect the average time patients spent in the preoperative area.

Conclusions: The PREG process provides an efficient, consistent method of screening for pregnancy prior to surgery in adult reproductive-aged women. In the setting where no standardized pregnancy evaluation was present, the rate of testing increased with implementation. Data collection is ongoing in larger populations and various settings which may provide support for the consistency and accuracy of the PREG system.

Abstract #: F3B-94

Validation of quality-of-recovery scoring tool (ObsQoR-10) in women following vaginal delivery - interim analysis

Presenting Author: Sei Nishimura MBBS, BSc(Hons), MSc
Presenting Author's Institution: Hillingdon Hospital NHS Trust - London, London
Co-Author: Flora Kormendy MD - Hillingdon Hospital NHS Trust
Sarah Ciechanowicz BMBCh, MA, MRes, FRCA - University College London Hospital
Constantinos Papageorgiou BMBCh, FRCA - Hillingdon Hospital NHS Trust
Pervez Sultan MBChB, MD(Res), FRCA - University College London Hospital

Introduction: Few robust scoring tools exist to evaluate postpartum recovery. The ObsQoR-11 tool has been developed and validated following elective and emergency caesarean delivery (1,2). We aimed to validate a modified ObsQoR-10 tool in women following instrumental and spontaneous vaginal deliveries.

Methods: The ObsQoR-10 tool was used in a service evaluation of women following vaginal delivery between October and December 2018. Participants completed a questionnaire at 24 hrs post-delivery and a subset of women at 25 hrs to assess reliability. Primary outcome was validity as assessed by: i) convergent validity [correlation with 100 mm visual analogue scale (VAS) of pain at rest and on mobilising]; ii) discriminant validity [correlation with early and prolonged post-delivery recovery as defined by length of hospital stay (LOS) of ≤36 hrs vs. >36 hrs respectively]; iii) content validity [correlation with LOS, BMI, maternal age, parity, gestational age, estimated blood loss and starting haemoglobin (Hb) concentration]. Secondary outcomes were reliability (assessed using Cronbach's alpha, inter-item correlation, split-half reliability and test-retest reliability by intra-class correlation) and feasibility of the questionnaire (completion rate and time taken).

Results: All participants completed the ObsQoR-10 at 24 hrs (50/50) and 24% at 25 hrs (12/50). ObsQoR-10 scores at 24 hrs post-delivery: i) had a strong negative correlation to VAS pain scores at rest (Spearman r= -0.61 (95% C.I. -0.76 to -0.39), p<0.01) and on mobilising (Spearman r= -0.67 (95% C.I. -0.80 to -0.47), p<0.0001); ii); were significantly higher in women discharged within 36 hrs (median 82 (77-93) vs. 65 (54- 81), p<0.01); iii) negatively correlated with LOS (r= -0.39; CI -0.61 to -0.11; p=0.01) and estimated blood loss (r= -0.31, CI -0.55 to 0.02; p=0.03) but not with any other evaluated clinical indicators (BMI: r= 0.09, p=0.55; maternal age: r= -0.19, p=0.19; parity: r= 0.22, p=0.12; gestational age: r= -0.11, p=0.44; starting Hb concentration: r= -0.23, p=0.11). We demonstrated good test reliability (Cronbach's alpha=0.79; inter-item correlation >0.15 in 82% items; split-half reliability (0.86) and test-retest reliability (r ≥0.60 for most items)). Acceptability and feasibility were excellent with 100% rate of successful completion and median [IQR] time to completion was 240 [180-300] secs.

Conclusion: Interim analysis demonstrates ObsQoR-10 to be a reliable and valid patient centred outcome measure when used to assess recovery after spontaneous and instrumental vaginal birth. In order to complete our validation of this scoring tool, we aim to evaluate a total of 100 women.

References:

1. Ciechanowicz et al. BJA 2018; 122: 69-78. 2. R. Howle. BJA 2018; 121(2):e19-e20.

Abstract #: F3B-549

The Trend of Surgical-Site Infections following Cesarean Delivery from 2015 to 2017: A Retrospective Study

Presenting Author: Jie Zhou MD, MS, MBA, FASA
Presenting Author's Institution: Brigham and Women's Hospital, Harvard Medical School - Boston, MA
Co-Author: Sue Yuan PhD - BWH

Background: Surgical-site infections (including endometritis and wound infection, SSIs) complicate 5 to 12% of cesarean deliveries (CDs), which results in extra burden on the new mother and may prolong hospitalization. The aim of our study was to assess the prevalence of infection and the distribution of infectious disease due to CDs.

Methods: With IRB approval, retrospective review of all parturients from 01/01/2015 to 12/31/2017 who delivered at the hospitals of Partner HealthCare System was conducted. Data including demographic information, diagnosis, health history, operative notes, culture reports and procedures were collected. Percentage, mean and standard deviation were used to descriptive these variables.

Results: In a total of 11,408 parturients, 333 (2.3%) cases with infection following CD were identified. The morbidity of infection from 2015 to 2018 were 3.49%, 2.66% and 2.81%, respectively. The mean body mass index (BMI) of these patients was 33. In the total of 333 infection cases, 233 patients (69.97%) experienced the outcome of SSIs, 76 (22.82%) had wound disruption, 26 (7.81%) had endometritis, and 8 (2.40%) parturients deteriorated into sepsis within the 30-day postoperative period. The most common anesthesia mode during these cesarean procedures was spinal anesthesia (34.83%) and no infection due to anesthesia procedure was found. Specimens from 167 patients' blood or abdominal/wound were collected to culture. 38 (22.75%) were positive of staphylococcus aureus, 20 were enterococcus faecalis and one case of Methicillin- resistant staphylococcus aureus (MRSA) among 88 abdominal/wound specimens. Staphylococcus aureus were found in 3 of 79 blood specimens.

Discussion: Postoperative infectious morbidity in women undergoing CD is devastating. Fortunately, our study demonstrated a downward trend of the morbidity compared to previous studies. We also found that BMI > 30 was an important characteristic among these parturients. We further confirmed that staphylococcus aureus and enterococcus faecalis are the common organism leading to hospital acquired infection among parturients. Further study is warranted to identify the risk factors related to SSIs following CDs and the prevention strategies.

References:

1. Tita A, et al. N Engl J Med 2016; 1231:1241.
2. Methodius G, et al. N Engl J Med 2018; 647:655.
3. Childress KM, et al. Am J Obstet Gynecol 2016;214;285.

Abstract #: F3B-526

Optimal timing of ultrasonographic assessment of uterine contractility in primary cesarean deliveries

Presenting Author: Nakia Hunter MD
Presenting Author's Institution: Northwestern University Feinberg School of Medicine - Chicago, Illinois
Co-Author: Jack M Peace MD - Northwestern University Feinberg School of Medicine
Mahesh Vaidyanathan MD, MBA - Northwestern University Feinberg School of Medicine

Introduction: Uterine atony remains the leading cause of maternal hemorrhage following cesarean delivery. Assessment of uterine contractility is critical for appropriate identification and treatment of atony. Current methods of measuring uterine tone are subjective and operator-dependent. Intraoperative ultrasound (US) has been proposed as an alternative means of objectively assessing uterine tone.

Our previously presented case series demonstrated a correlation between posterior uterine wall thickness as measured by US and the subjective assessment of uterine tone by the obstetrician (OB). We conducted an IRB-approved prospective evaluation of uterine tone, as measured by US, in patients expected to have normal uterine contraction following cesarean delivery. Our goal was to identify the appropriate time points during the procedure at which US will reliably evaluate uterine tone.

Methods: We recruited and evaluated 35 patients who presented for primary cesarean delivery. The primary outcome was US-measured thickness of the posterior uterine wall at 3 time points during surgery: immediately after externalization (T1), 5 minutes later (T2), then immediately prior to internalizing the uterus (T3). The secondary outcome was the subjective uterine tone score given by OB providers at each corresponding time point.

Results: 23 patients were included in our final analysis. The difference in measured posterior uterine wall thickness from T1-T2 and T2-T3, and in corresponding OB subjective uterine tone scores, were both found to be statistically significant (Table 1). A mean increase of 3.25 mm in the T1-T2 interval represented an early worsening of uterine tone, and a mean decrease of 2.95 mm in the T2-T3 interval represented improving tone after activation of oxytocin receptors. We further stratified the data for T2-T3 based on elapsed time to identify the ideal time interval between measurements.(Graph 1-2, Table 2)

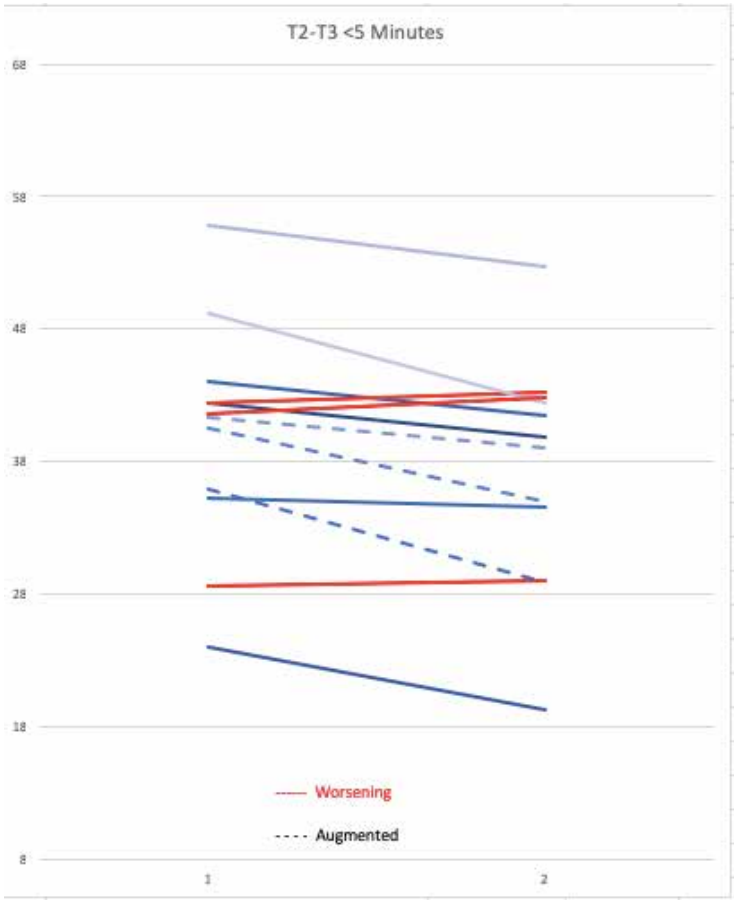
Discussion: We observed that uterine wall thickness increased from T1-T2, however shortened from T2-T3. This statistically significant change likely corresponds to delayed uterine contraction after delivery. Thus, the most accurate US assessment of uterine tone may come from evaluating the difference in posterior uterine wall thickness between hysterotomy closure (T2) and at least 5 mins later. We believe US-guided measurements of posterior uterine wall thickness can reliably evaluate uterine tone, thereby eliminating inter- individual variability.

Abstract #: F3B-526

Table 1:

Group	N	Mean	P-Value
T1-T2	23	3.25	0.0005
T2-T3	23	-2.95	0.0001
T1-T3	23	-0.3	0.72
OB Scores T1-T2	23	-1.7	0.0002
OB Scores T2-T3	23	-0.48	0.002
OB Scores T1-T3	23	-1.65	0.00001

Graph 1:



Graph 2:

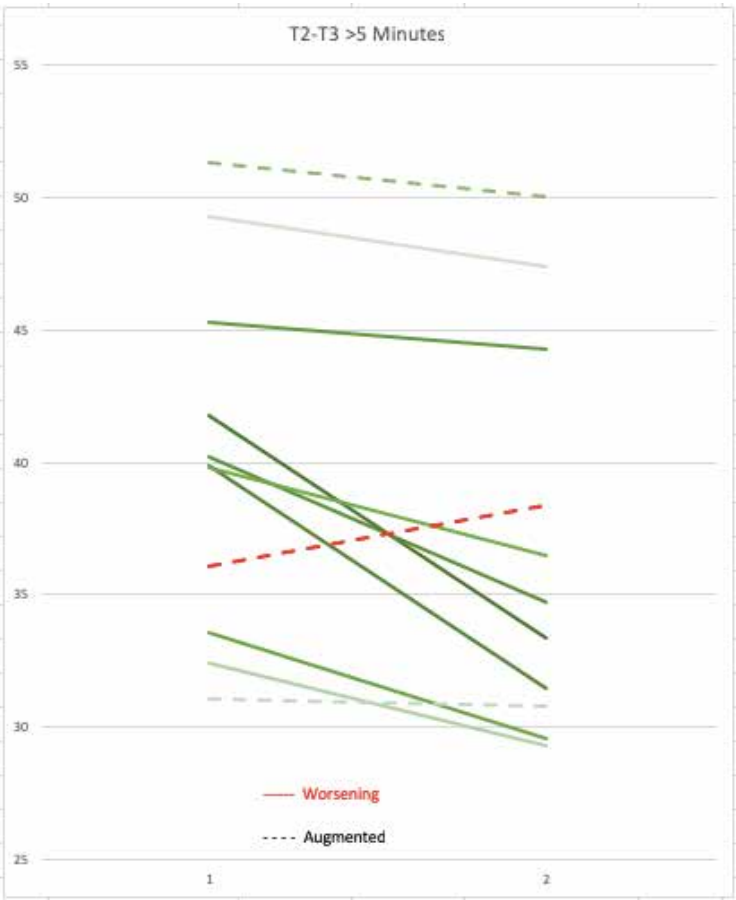


Table 2:

Group	N	Mean Dif	P-Value
T2-T3 >5 Mins	11	-3.17	0.005
T2-T3 <5 Mins	12	-2.74	0.006
OB Scores >5 Mins	11	-0.55	0.025
OB Scores <5 Mins	12	-0.42	0.054
T2-T3 >5 Mins w/o Augment	8	-4.45	0.001
T2-T3 <5 Mins w/o Augment	9	-2.01	0.054
OB Scores >5 Mins w/o Augment	8	-0.62	0.049
OB Scores <5 Mins w/o Augment	9	-0.33	0.081

Abstract #: F3B-423

Impact of Quantitative Blood Loss on Postpartum Hemorrhage Protocol Activation and Resource Utilization

Presenting Author: Matthew Hire MD
Presenting Author's Institution: Northwestern University - Chicago, IL
Co-Author: Elizabeth Lange MD - Northwestern University
Mahesh Vaidyanathan MD, MBA - Northwestern University
William Grobman MD, MBA - Northwestern
Kim Armour PhD, NP-BC, RDMS, NEA-BC - Northwestern University
Paloma Toledo MD, MPH - Northwestern University

Introduction: Postpartum hemorrhage (PPH) is a leading cause of maternal morbidity and mortality. Visual estimation of blood loss (EBL) is often inaccurate, and overestimation may result in inappropriate resource utilization. As accurate identification of blood loss may improve early recognition of PPH, several organizations have called for quantitative blood loss (QBL). The objective of this study was to determine if QBL measurement would result in fewer PPH protocol activations than visual EBL. A secondary objective was estimation of potential cost-savings of resources utilized in PPH management. We hypothesized that QBL estimates would result in a 30% reduction in the number of PPHs.

Methods: In this IRB-approved prospective observational trial, blood loss was estimated using the Gauss Triton System for 42 parturients who experienced PPH during cesarean delivery (1 liter by EBL assessment). The Gauss system uses a scale to measure clots and a tablet to capture images of surgical laps and suction canisters and uses a cloud-based algorithm to calculate blood loss. Clinicians were blinded to QBL measurements. Demographic, obstetric, medical and surgical data were collected, as well as resources mobilized in the PPH. Cost data were estimated using information available in the literature.

Results: Twenty-four patients (57%) would not have been classified as having PPH with QBL compared to EBL. The difference in median blood loss between QBL and EBL was 326 mL. Table 1 shows the interventions received by the patients who would not have been classified as PPH by QBL. Using the assumption that 100% of the resources would not have been utilized assuming QBL measurements, total cost-savings would be $2950. As a sensitivity analysis, given some resources may have been employed based on the clinical status of the patient, a 50% reduction in use would result in a cost-savings of $1475.

Intervention	*Number of times intervention utilized when QBL < 1000*
Labs Drawn	10
Conversion to Crossmatch	3
Additional Intravenous Access	7
Massive Transfusion Protocol	0
Packed Red Blood Cells	1
Plasma	0
Cryoprecipitate	0
Double Dose of Oxytocin	20
Methylergonovine	9
Carboprost	6
Misoprostol	5
Tranexamic Acid	1

Table 1. Individual resources are listed with the number of patients who did not meet PPH criteria by quantitative methods for the postpartum hemorrhage protocol who still had the given intervention.

Discussion: The important finding of this study is that QBL would have reduced patients classified as having PPH by EBL by over 50%. This represents a potential cost-savings of $2950, and reduced exposure to uterotonics and improved patient satisfaction from unnecessary interventions. One limitation is that the QBL measurements occurred after the CD and were not performed in real time. Future work should evaluate real-time assessment of QBL and impact on patient outcomes.

References:

1. Main E et al. Anesth Analg 2015;121:142–8
2. Kent et al. In: SOAP 50th Annual Meeting; 2018; Miami, FL.

Abstract #: F3B-51

Management of magnesium infusions at urgent intrapartum cesarean delivery: continue or stop?

Presenting Author: Hans P Sviggum M.D.
Presenting Author's Institution: Mayo Clinic - Rochester, MN
Co-Author: Kjerstin Anderson Hoff RN, MS - Mayo Clinic
Lindsay Hunter Guevara MD - Mayo Clinic

Magnesium sulfate is the drug of choice for prevention of eclampsia. Although its administration has been found to significantly reduce the risk of eclampsia, there is uncertainty about the extent of that risk reduction as well as the level of severity of preeclampsia that warrants its use. The American College of Obstetricians and Gynecologists recently published an update to the guidelines on managing hypertension in pregnancy with the recommendation "for women with preeclampsia undergoing cesarean delivery, the continued administration of parenteral magnesium to prevent eclampsia is recommended". No specific source is cited to support this recommendation. A document published by the Anesthesia Patient Safety Foundation in 2015 states that the magnesium infusion should be discontinued on transit to the operating room for an emergency cesarean delivery. It states further that the infusion can be restarted in the operating room for women for severe preeclampsia, and that it is useful to verify the infusion pump programming with the labor and delivery nurse prior to restarting. The primary aim of this study was to identify if there is a difference in the incidence of seizures in preeclamptic patients whose magnesium infusions are continued versus discontinued during cesarean delivery.

This retrospective cohort study included all women 18 years of age or greater over a ten-year period (2006- 2015) who were treated with magnesium for preeclampsia and underwent cesarean delivery. Group 1 consisted of patients who had magnesium continued throughout the entire delivery period. Group 2 consisted of patients who had magnesium discontinued at cesarean delivery and restarted after the procedure. Group 3 consisted of patients who had the magnesium discontinued and then restarted in the operating room before conclusion of the procedure.

A total of 280 patients (Group 1, n=169; Group 2, n=91; Group 3, n=20) were included for analysis. No patient in any group experienced a seizure within 24 hours of cesarean delivery. There were no differences between groups in estimated blood loss (p=0.803), blood transfusion (p=0.606), ICU admission (p=0.168), postoperative ventiliatory support (p=0.138), or need for calcium administration.

Although under powered given the rarity of eclampsia, this study found no evidence that discontinuing magnesium at the time of cesarean delivery increases the risk of seizures. The half-life of magnesium is approximately four-to-five hours for a person with normal renal function; and therefore the expected decrease in the plasma concentration in a patient during a cesarean delivery would be small. Continuing a magnesium infusion during urgent cesarean delivery carries risk of drug error/overdose/toxicity. Therefore, our findings support the practice of discontinuing magnesium at urgent cesarean delivery until it can be safely and cautiously restarted. Certainly, if it can be restarted in the operating room, this should be the goal.

Abstract #: F3B-375

Chorioamnionitis Increases Production of Pro-Resolving Mediators in the Human Placenta.

Presenting Author: Lukas Steger MD
Presenting Author's Institution: Brigham and Women's Hospital - Harvard Medical School - Boston, MA
Co-Author: Mieke A Soens - Brigham and Women's Hospital
Xavier De La Rose PhD - Brigham and Women's Hospital
Kathryn J Gray MD, PhD - Brigham and Women's Hospital
Thomas McElrath MD, PhD - Brigham and Women's Hospital
Charles N Serhan PhD, Dsc. - Brigham and Women's Hospital

Introduction: Chorioamnionitis is a common cause of preterm birth and can trigger fetal inflammatory responses leading to adverse neonatal outcomes including brain injury. Omega-3 polyunsaturated fatty acids (PUFA) in pregnancy reduce preterm births, the risk of low birth weight and perinatal death. However, the mechanisms underlying the protective effects of omega-3 PUFA are unknown. Omega-3 PUFAs are precursors to novel classes of pro-resolving mediators (SPMs): resolvins, protectins and maresins. SPMs reduce and resolve inflammation in many inflammatory disorders in animal models, but the role of SPMs in chorioamnionitis is unknown. We hypothesize that modulating SPM pathways improves maternal and neonatal outcomes in patients with chorioamnionitis. The aim of this study is to measure SPM levels and calculate the ratio of pro-inflammatory lipid mediators (LM) to SPMs in placentas of patients with and without chorioamnionitis.

Methods: Placental tissues from 3 women with histological confirmation of chorioamnionitis and maternal fever at time of delivery were obtained. In addition tissues from 3 control cases matched for maternal age and mode of delivery were used. (LifeCodes Cohort) Tissues were extracted using solid phase extraction followed by analysis of SPMs using liquid chromatography tandem mass spectrometry. SPMs, pro-inflammatory LMs and pathway markers were identified using multiple reaction monitoring and the presence of ≥ 6 diagnostic ions for each mediator. The LM were then quantified using Analyst software.

Results: Placentas affected by chorioamnionitis had significantly higher levels ($p \leq 0.05$) of both pro-inflammatory LM and SPMs. Interestingly, the ratio of pro-inflammatory prostanoids to SPMs was significantly higher ($p \leq 0.05$) in placentas from patients with chorioamnionitis compared to normal placentas.

Conclusion: Chorioamnionitis can lead to an up-regulation of both pro-inflammatory and pro-resolving pathways. In this first study to characterize LM profiles in placentas of patients with chorioamnionitis we found an increased ratio of pro-inflammatory prostaglandins to proresolving mediators. Future studies will assess whether SPM pathways can be targeted to improve neonatal outcomes and whether omega-3 PUFA's exert their protective actions through SPM biosynthesis.

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Abstract #: F3B-375

Figure 1

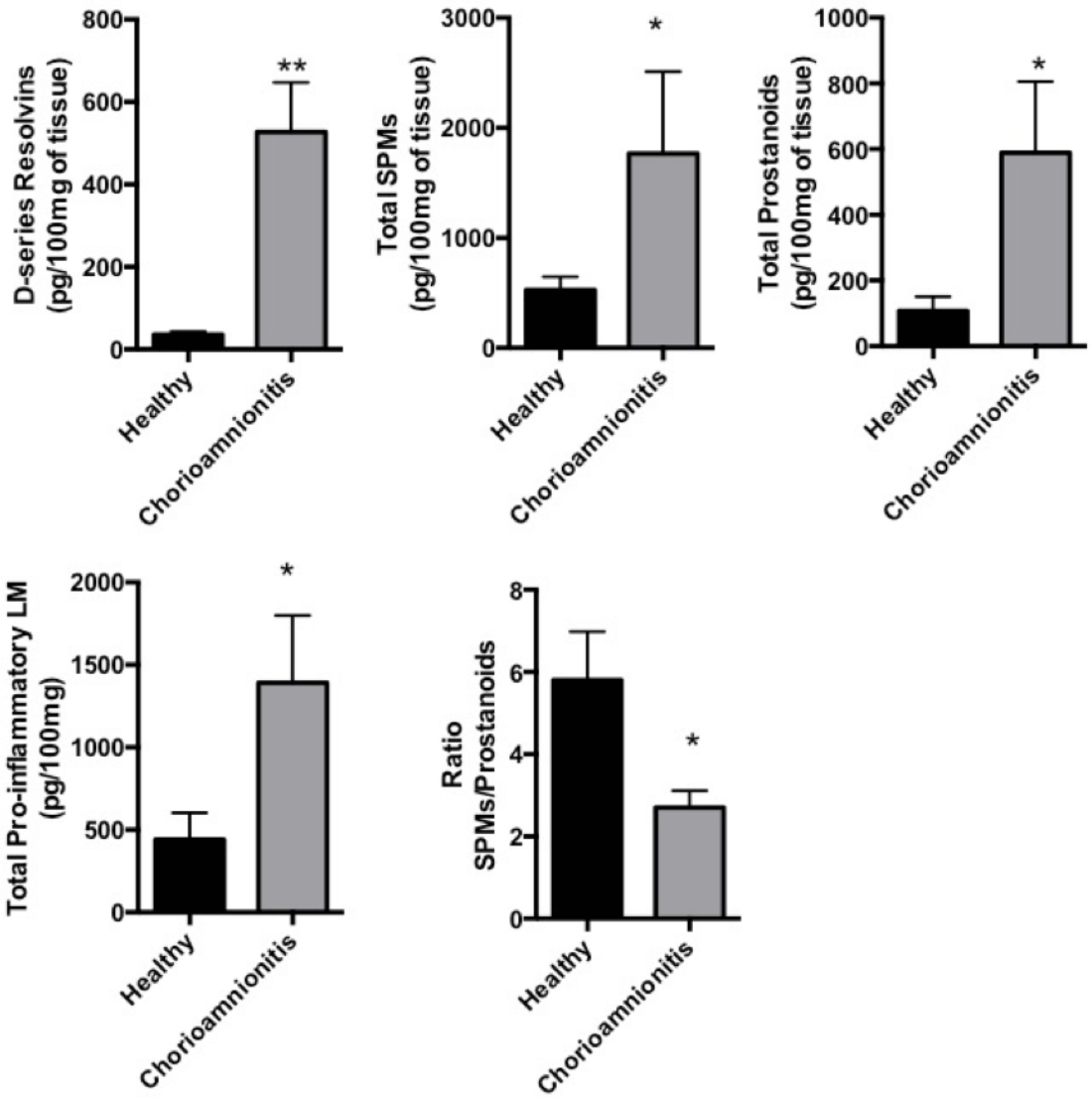


Figure 1: Metabololipidomic profiles of healthy placental tissue vs chorioamnionitis placental tissue
Total SPMs includes D and E series Resolvins, Protectins, Maresins, Lipoxins and pathways biomarkers. Pro-inflammatory LM include prostanoids (prostagandin E2 and D2), LTB_4 and TxB_2. Data are expressed as mean ± SEM. *p<0.05, **p<0.01

Abstract #: F3C-136

The effect of individual obstetricians on elective cesarean section surgical time

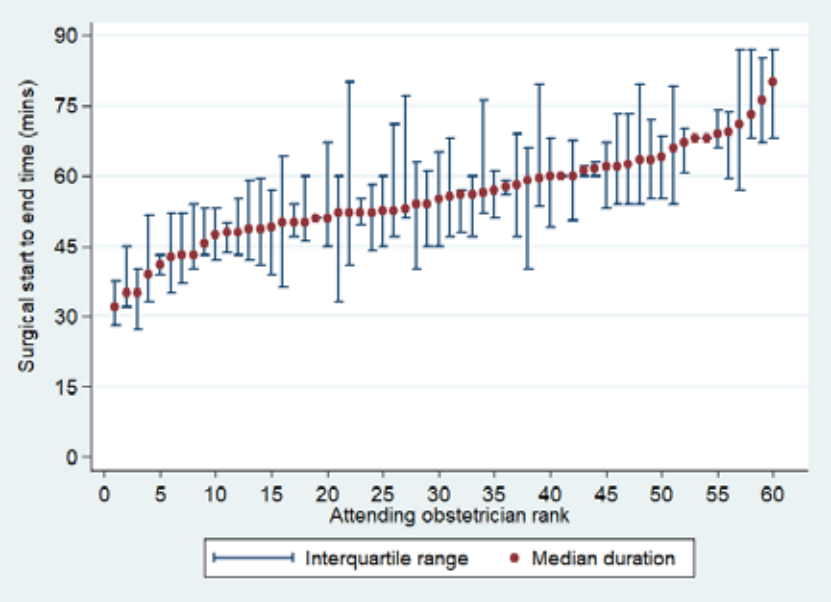
Presenting Author: Brian K Tse MD
Presenting Author's Institution: Stanford University - Stanford, CA
Co-Author: Brendan Carvalho MBBCh, FRCA, MDCH - Stanford University
Nan Guo PhD - Stanford University
Yair Blumenfeld MD - Stanford University
Alexander J. Butwick MBBS, FRCA, MS - Stanford University

Introduction: Prediction of surgical time for cesarean delivery (CD) is important to facilitate selection of the most appropriate anesthetic technique (single-shot spinal vs. combined spinal-epidural). Although several maternal factors (e.g., BMI, prior CD) may influence surgical time, less is known about the influence of obstetricians on surgical time. Our goal was to determine the extent of the variation in surgical time for elective CD amongst obstetricians, after controlling for certain patient characteristics and obstetricians' operative volume.

Methods: We conducted a retrospective observational study of 1090 women with singleton pregnancies undergoing elective CD under neuraxial anesthesia at a tertiary obstetric center between 2015-2017. We excluded women with abnormal placentation, ASA class ≥ 3, and if tubal ligation was also performed. Academic, private, and county obstetricians provide care at our institution. Variability of surgical times amongst individual obstetricians were assessed with linear mixed models, with the intraclass coefficient (ICC) to evaluate variation by obstetrician.

Results: 1090 elective CDs were performed between 2015 and 2017 by 62 obstetricians. The median surgical time was 54 minutes. The median times for the individual obstetricians ranged from 32 to 80 minutes (excluding two outliers of 126 and 180 minutes). The number of CDs performed by an individual obstetrician ranged from 1 to 79. Figure 1 is a caterpillar plot of unadjusted median surgical times by obstetrician. The surgical times were log-transformed in our mixed models. After adjusting for patient demographic (age, BMI) and obstetric factors (parity and gestational age) and each obstetrician's operative volume, the ICC was 32.3% (95% CI=22.2 to 44.5%).

Conclusion: Our findings suggest that differences between obstetricians account for 32% of the total variability in log surgical times. Future studies are needed to examine whether the decision to use single-shot spinal anesthesia vs. combined spinal epidural is influenced by obstetrician and patient factors, and to identify factors that account for the unexplained variance in surgical time.



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Abstract #: F3C-498

Delivery Mode is Associated with Rectus Abdominis Diastasis: A Retrospective Cohort Study

Presenting Author: Jie Zhou MD, MS, MBA, FASA
Presenting Author's Institution: Brigham and Women›s Hospital, Harvard Medical School - Boston, MA
Co-Author: Sue Yuan PhD - Brigham and Women›s Hospital

Background: The prevalence of rectus abdominis diastasis (RAD) is estimated at from 38% to 52%. RAD could be exacerbated by posture change and induce back strain due to reduced strength and function of the muscles. The aim of our study was to evaluate the association between delivery mode (DM) and RAD and other potential risk factors that may have impacts on RAD.

Methods: With IRB approval, medical records of patients with diagnosis of RAD from 01/01/2009 to 12/31/2018 who delivered at the hospitals of Partner HealthCare System were collected. Data including demographic information, diagnosis, operative notes, imaging reports and procedures were collected. Other potential concomitant risk factors including anesthesia mode, delivery frequency, noted adhesions in pelvic and abdominal cavity and coexisted conditions were also collected. Risk ratio was used to calculate the relative risk. Crosstabs analysis was used for analysis of differences among groups.

Results: A total of 317 patients with RAD diagnosis whose delivery operative notes were identified. Women who delivered via cesarean operation demonstrated 4.7 times greater risk of RAD than those women who never delivered via cesarean. Our subgroup analysis among the women who underwent one or more cesarean deliveries demonstrated that the frequency of adhesions in the abdominal or pelvic cavity increased with the number of cesarean deliveries(p=0.000). Neither low back pain nor hernia had significant associations with delivery mode and cesarean delivery frequency.

Discussion: Previous studies reported RAD is common during and after pregnancy. However, we failed in identifying published study concerning the association between delivery mode and RAD. Our study demonstrated a positive association between the delivery mode and RAD occurrence, indicating that cesarean delivery mode could be an important risk factor. Meanwhile, we also found that frequency of cesarean delivery might be a risk factor to the occurrence of adhesions in abdominal and/or pelvic cavity among women experienced such delivery. We did not detect significant associations concerning the occurrence of either low back pain or hernia in patients with RAD experienced delivery between different delivery mode. Further study is warranted to examine this potentially devastating condition.

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Abstract #: F3C-498

Table 1. Characteristics of the Patients with RAD.

Characteristics	Non-Cesarean Group (n=99)	Cesarean Group (n=218)			Total (n=317)
		1-Cesarean Subgroup (n=100, 45.87%)	2-Cesarean Subgroup (n=78, 35.78%)	≥3-Cesarean Subgroup (n=40, 18.35%)	
Age (yr)	37.4 (20-49)	37.8 (27-49)	39.2 (32-51)	38.5 (28-48)	38.0 (20.0-51.0)
Race or ethnic group, n (%)					
Non-Hispanic black	3 (3.03)	6 (6.00)	4 (5.13)	2 (5.00)	15 (4.73)
Hispanic	4 (4.04)	6 (6.00)	1 (1.28)	3 (7.50)	13 (4.10)
Other	92 (92.93)	88 (88.00)	73 (93.59)	35 (87.50)	288 (90.85)
Body mass index†					
Mean (kg/m^2)	26.03 ± 4.56	28.23 ± 5.99	28.18 ± 6.06	28.67 ± 5.41	27.57 ± 5.60
Category, n (%)					
18.0 to <25	45 (45.45)	33 (33.00)	23 (29.49)	10 (25.00)	111 (35.02)
25 to <30	35 (35.35)	35 (34.00)	32 (41.03)	14 (35.00)	116 (36.59)
30 to <40	18 (18.18)	29 (30.00)	17 (21.79)	10 (25.00)	74 (23.34)
≥40	1 (1.01)	3 (3.00)	5 (6.41)	2 (5.00)	11 (3.47)
Missing data, n (%)	0 (0.00)	0 (0.00)	0 (0.00)	4 (10.00)	
Pelvic and perineal pain, n (%)	19 (19.19)	20 (20.00)	9 (11.54)	6 (15.00)	54 (17.03)
Pain in thigh, n (%)	0 (0.00)	3 (3.00)	0 (0.00)	1 (2.50)	4 (1.26)
Pain in hip, n (%)	2 (2.02)	3 (3.00)	4 (5.13)	1 (2.50)	10 (3.15)
Low back pain, n (%)	13 (13.13)	22 (22.00)	16 (20.51)	5 (12.50)	56 (17.67)
Tumor, n (%)	6 (6.06)	13 (13.00)	4 (5.13)	5 (12.50)	28 (8.83)
Hernia, n (%)					
Incisional hernia	2 (2.02)	2 (2.00)	1 (1.28)	3 (7.50)	8 (2.52)
Bilateral inguinal hernia	1 (1.01)	0 (0.00)	0 (0.00)	0 (0.00)	1 (0.32)
Diaphragmatic hernia	1 (1.01)	3 (3.00)	2 (2.56)	0 (0.00)	6 (1.89)
Adhesions, n (%)‡					
Minimal	0 (0.00)	2 (3.00)	2 (2.56)	4 (10.00)	8 (2.52)
Moderate	0 (0.00)	2 (2.00)	7 (8.97)	7 (17.50)	16 (5.05)
Dense	0 (0.00)	0 (0.00)	6 (7.69)	10 (25.00)	16 (5.05)
NR	99 (100.00)	96 (95.00)	63 (80.77)	19 (47.50)	270 (87.38)
Anesthesia type					
Spinal	2 (2.02)	45 (45.00)	89 (57.05)	57 (43.51)	193 (39.71)
Epidural	72 (72.73)	43 (43.00)	36 (23.08)	15 (11.45)	166 (34.16)
Combined spinal epidural	0 (0.00)	4 (4.00)	7 (4.49)	14 (10.69)	25 (5.14)
General	0 (0.00)	7 (7.00)	4 (2.56)	2 (1.53)	13 (2.67)
Combined Epidural Local	1 (1.01)	0 (0.00)	0 (0.00)	0 (0.00)	1 (0.21)
Local	8 (8.08)	0 (0.00)	0 (0.00)	0 (0.00)	8 (1.65)
Reginal	1 (1.01)	0 (0.00)	0 (0.00)	0 (0.00)	1 (0.21)
None	7 (7.07)	0 (0.00)	0 (0.00)	0 (0.00)	7 (1.44)
Missing data	8 (8.08)	1 (1.00)	20 (12.82)	43 (32.82)	72 (14.81)

Notes: †- P = 0.02 between non-cesarean and cesarean group; ‡-p=0.000 among 1-cesarean, 2-cesarean and 3-cesarean subgroups; NR-not reported.

Abstract #: F3C-426

Association of operator experience and unintended uterine extension with hemorrhage at cesarean delivery.

Presenting Author: Eli Zarkhin MD
Presenting Author's Institution: NYU School of Medicine - New York, New York
Co-Author: Eli Zarkhin MD - NYU School of Medicine
Ghislaine C Echevarria MD MS - NYU School of Medicine
Christina Dgheim DO - NYU School of Medicine
Jerome Lax MD - NYU School of Medicine
Gilbert J Grant MD - NYU School of Medicine

Introduction: Cesarean delivery is the most commonly performed intra-abdominal surgery worldwide [1]. The rate of cesarean delivery the United States is approximately 32% [2]. Cesarean delivery is associated with a greater complication rate than vaginal delivery, including endometritis, wound infection, thromboembolic disorders and increased risk of readmission [3]. Hemorrhage is one of the most common complications of cesarean delivery [4]. Uterine extensions during low transverse cesarean delivery are associated with increased blood loss and higher rates of maternal blood transfusions [3,5]. This study was designed to retrospectively determine if the experience level of the operator was associated with risk of uterine extension and large blood loss during low transverse cesarean delivery.

Methods: We reviewed the electronic medical records of all cesarean deliveries performed at our institution from January 1 to December 31, 2018. Records with a quantified blood loss (QBL) of at least 1,000 mL were identified. Data was extracted from each record included demographics, obstetrical information, the presence of extension(s) of the hysterotomy incision, and name of the primary operator. The experience of the operator was determined as defined by years since completion of residency.

Results: A QBL of at least 1,000 mL was identified in 391 cesarean deliveries. Extension(s) of the hysterotomy incision was noted as the primary cause of hemorrhage in 18 deliveries (4.6%). In 14 of the 18 cesareans with extension(s) (77.8%), the primary operator had completed residency within the past 5 years ($p = 0.014$; Fisher's exact test).

Discussion: Uterine extensions are a common complication of low transverse cesarean delivery, and may increase maternal morbidity [3]. If the US cesarean delivery rate remains in excess of 30%, uterine extensions are destined to continue to contribute to postpartum hemorrhage. Our findings suggest that the incidence of uterine extensions may be modified by experience. Perhaps a focus on training to avoid uterine extensions can improve the performance of relatively inexperienced operators.

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Abstract #: F3C-478

Short-term effect of acupuncture for adenomyosis: a systematic review and meta-analysis

Presenting Author: Sue Yuan PhD.
Presenting Author's Institution: Xiangya Nursing School, Central South University - Changsha, Hunan
Co-Author: Qi Li Medical student - Xiangya Nursing School
Sue Yuan Ph D - BWH

Background: Adenomyosis is a common disease in women during reproductive age, which is associated with uterine enlargement, pelvic pain, excessive vaginal bleeding, and may decrease their quality of life. Hysterectomy is the standard treatment for adenomyosis, but not all patients of reproductive age can accept it. Acupuncture is increasingly popular as a complementary therapy in the treatment of adenomyosis. The aim of our systematic review was to evaluate the effect of acupuncture for adenomyosis.

Method: Ten electronic databases were searched for relevant articles published before January 2019. We searched Pubmed, Cochrane, Embass, Proquest, Web of science, Medline, Scopus, China National Knowledge Infrastructure (CNKI), VIP Information and the WanFang database. This study included randomized controlled trials (RCTs) of women with adenomyosis. The intervention was acupuncture combined or not combined with medicine. The comparison of acupuncture was medicine. The primary outcome was clinical efficacy, uterine size and dysmenorrhea severity and dysmenorrhea symptom, the secondary outcome was CA-125 level and adverse effect. The methodological quality was evaluated using the Cochrane risk-of-bias criteria. The results were analyzed by Review Manager 5.3 and expressed as Standardized mean differences (SMD) or mean differences (MD) with 95% confidence interval (CI).

Result: Eight RCTs (602 individual) were included. The results showed that acupuncture was more effective than medicine in clinical efficacy (Odds Ratio, OR=0.27, 95% CI= [0.17,0.45]), less severity in dysmenorrhea severity score (Mean Difference, MD=-2.06, 95% CI= [-2.70, -1.42]), and much smaller in uterine size (SMD=-0.38, 95% CI= [-0.69, -0.07]). The CA125 level (SMD=-0.72, 95% CI= [-1.07, -0.38]) was significant decreased compared to medicine treatment, VAS (SMD=-2.43, 95% CI= [-4.37, -0.49]) improved a lot. After 3 cycles treatment by acupuncture, the menstrual blood loss (SMD=-2.68, 95% CI= [-4.33, -1.04]) and the adverse effect Night sweats (OR=0.16, 95% CI= [0.03,0.94]) was reducing. The dysmenorrhea symptom (SMD=-0.69, 95% CI= [-1.50,0.12]) seems no significant change after 3cycles treatment by acupuncture.

Conclusion: After 3-cycles treatment by acupuncture, it seems that symptoms of adenomyosis improved compared to medicine with increased clinical efficacy, less pain severity, and smaller uterine size and fewer side effects. However, more high-quality randomized controlled trials and data is needed to support it.

Abstract #: F3C-455

Photoplethysmography for Prediction of Preeclampsia

Presenting Author: Tammy Y Euliano MD
Presenting Author's Institution: University of Florida - Gainesville, FL
Co-Author: Kostas Michalopoulos PhD - Convergent Engineering
Neil Euliano PhD - Convergent Engineering

Introduction: Preeclampsia (PE) is a major cause of maternal and neonatal death, particularly in low-resource settings. When treated properly, including management of blood pressure, seizure prophylaxis and often preterm delivery of the fetus, the maternal mortality rate is low. Advance prediction of PE would facilitate increased surveillance, early recognition and treatment of these patients, reducing complications. Biomarkers (e.g. S-Flt and PlGF) and uterine artery doppler have been proposed for this purpose and several groups have reported promising results.(1) The primary focus of this project is to develop an inexpensive, non-invasive, point-of-care test that can improve birth outcomes.

Methods: After written, informed consent, women receiving prenatal care at our medical center were enrolled and monitored with pulse oximetry and ECG at prenatal visits after 13 weeks. Upon delivery, subjects were labeled normotensive, HTN, or preE (including super-imposed). We analyzed the following data as indirect measures of arterial compliance during pregnancy: 1) Time lag between ECG and photoplethysmograph (PPG); 2) Heart rate variability; and 3) PPG waveform features. We used the Least Absolute Shrinkage and Selection Operator (LASSO) procedure to select the most informative features regarding the state of the subject. The classifier is a Linear Discriminant Analysis classifier trained with five-fold cross validation. To ensure the classifier appropriately models the data, it was trained and tested with 500 different trials.

Results: PE vs Normotensive: Using second trimester collections (24 PE, 37 controls), the system obtained an AUC of 0.83 (sensitivity 0.76, specificity 0.73). Using third trimester collections (23 PE, 84 controls), the system had an AUC of 0.90 (sensitivity 0.80, specificity 0.83).
PE vs HTN: Using second trimester collections (24 PE, 22 HTN), the system obtained an AUC of 0.91 (sensitivity 0.80, specificity 0.80). Using third trimester collections (23 PE, 41 HTN), the system had an AUC of 0.87 (sensitivity 0.84 specificity 0.79).

Discussion: Vascular reactivity changes pre-date the onset of preeclamptic. Doppler assessment of uterine artery flow and measurement of circulating angiogenic proteins has shown promise in the prediction of preeclampsia.(1) These tests, however, incur significant expense and are not practical for application in the developing world. Arterial stiffness and wave reflection also predict placental-mediated disease.(2) This study shows that inexpensive, non-invasive and reusable ECG and PPG technology may substitute for more expensive applanation tonometry.
This may allow prediction of preeclampsia and enhance prenatal management and preventative therapy research.

References:

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Abstract #:F3C-234

Multimodal analgesia after cesarean delivery: how well are we doing?

Presenting Author: Erik Romanelli MD
Presenting Author's Institution: Montefiore Medical Center - New York , NY
Co-Author: Beatriz Corradini Msc - Columbia Medical Center
Guglielminotti Jean MD - Columbia Medical Center
Ruth Landau MD - Columbia Medical Center

Background: Cesarean delivery is the most common inpatient procedure in the U.S. with a remarkably high opioid intake and prescription volume.1 The number of publications reporting on the opioid crisis in the U.S. in both the lay press and medical journals has escalated in the last years and data on prescribed opioid overdoses are alarming.2 We hypothesized that with this abundance of information, providers and patients are highly aware of issues surrounding opioid use, which will impact opioid intake after cesarean delivery. We therefore decided to examine non-opioid and opioid intake after CD during 2 epochs 12 months apart, expecting a decrease in opioid use in 2018 compared with that in 2017.

Methods: Data from all consecutive CDs under neuraxial anesthesia in Jan-Feb 2017 and Jan-Feb 2018 was collected retrospectively in our hospital (academic hospital with ~6,800 deliveries per year, CD rate of 30%). There was no change in obstetric or anesthesia practice, nor in pain order sets (see Table). All women receive neuraxial morphine (spinal dose = 150 mcg; epidural dose = 3mg). Comparisons between the 2 epochs included total in hospital paracetamol, ibuprofen/ketorolac doses, total in-hospital oxycodone dose (mg), time from CD to 1st oxycodone dose, the number of women not taking any oxycodone/percocet in hospital (Table).

Results: Our analysis included 239 CDs in 2017 and 218 CDs in 2018. Demographic data was similar in both epochs (Table). There was no difference in non-opioid or opioid doses between the 2 epochs. A vast majority of women took oxycodone (over 95% in both epochs) and the median cumulative dose of oxycodone was unchanged at 70mg.

Discussion: Our data suggests that despite ample media coverage about risks associated high opioid use, particularly in a breastfeeding population, opioid intake in our hospital did not decrease between 2017 and 2018. While this may appear as a 'natural experiment' with no intervention, our intention was to demonstrate that standardized order sets, providers education and patient information are necessary to reduce in-hospital opioid use. Since our providers believe that our protocols are promoting multimodal analgesia as recommended by ACOG and SOAP, this data should serve as the basis to implement more standardized opioid-sparing approaches.

References:

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Abstract #:F3C-234

	Jan-Feb 2017 (N = 239)	Jan-Feb 2018 (N = 218)	P-value
Patient			
Age	31 (26-35)	30 (26-35)	0.83
Non-White race including Hispanics (missing = 73)	193 (95.5%)	170 (93.4%)	0.49
BMI (kg/m2) (missing = 2)	33.3 (29.2-37.7)	32.8 (29.4-37.7)	0.99
Parity ≥ 1	138 (57.7%)	132 (60.6%)	0.61
Gestational age	39 (38-39)	39 (38-40)	0.32
Preeclampsia (missing = 1)	36 (15.1%)	20 (9.2%)	0.076
Cesarean delivery			
Primary CD	137 (57.3%)	105 (48.2%)	0.062
Planned CD	131 (54.8%)	132 (60.6%)	0.25
Nighttime (05:01 pm to 07:59 am)	85 (35.6%)	87 (39.9%)	0.39
Tubal ligation	25 (10.5%)	27 (12.4%)	0.62
Anesthesia			0.49
- CSE	36 (15.1%)	42 (19.3%)	
- Epidural	90 (37.7%)	78 (35.8%)	
- Spinal	113 (47.3%)	98 (45.0%)	
Anesthesia duration (min)	114 (88-602)	128 (91-570)	0.36
Non-opioids & oxycodone intake			
Total dose paracetamol (mg)	4737.8 (2472) 4550 (2925-6500)	4614.7 (2498.2) 4550 (2925-6500)	0.59
Total dose ibuprofen (mg)	3870.9 (1550.9) 3600 (3000-4800)	3909.8 (1571.5) 3600 (3000-4800)	0.98
Total dose ketorolac (mg)	44.5 (22.6) 30 (30-60)	47.2 (22.2) 30 (30-60)	0.17
No in-hospital opioid use (0mg)	**9 (3.8%)**	**9 (4.1%)**	**> 0.99**
Total cumulative oxycodone dose (mg)	**73.7 (37.7)** **70 (45-100)**	**74.2 (39.4)** **70 (45-100)**	**0.97**
Time-to-first oxycodone dose (hour)	**15.5 (10.2)** **14 (7-20)**	**14.2 (11.1)** **12 (5-20)**	**0.045**

Results are expressed as count (%), mean (± standard deviation), and median (25^{th}-75^{th} percentile).
[a] Comparison of categorical variable uses Chi-square test and of continuous variable Wilcoxon rank test.

Post-Cesarean Delivery Pain Orders : Percocet 5-325 mg, 1-2 tab q4-6h PRN, Ibuprofen 600mg q6h PRN

Abstract #: F3C-231

The impact of changing post-cesarean delivery pain order sets on opioid intake in a community-based hospital

Presenting Author: Bahaa Daoud MD
Presenting Author's Institution: Columbia university Medical Center - New York , NY
Co-Author: Ben Shatil MD - Columbia university Medical Center
Xiwen Zheng MD - Columbia university Medical Center
Erik Romanelli MD - Columbia university Medical Center
Jean Guglielminotti MD - Columbia university Medical Center
Ruth Landau MD - Columbia university Medical Center

Background: Multimodal analgesia after cesarean delivery (CD) is associated with enhanced recovery after surgery (ERAS) and reduced opioid use. Implementation of ERAS requires standardized protocols for pain management with scheduled non-opioid analgesics and opioids for breakthrough pain only. To achieve this goal, a change in post-CD pain order sets with scheduled non-opioid analgesics and opioids for rescue only was introduced end of 2017. We report here patterns of opioid use before and after the change in order set in a community-based hospital.

Methods: Data from consecutive CDs from Jan-April 2017 (BEFORE cohort) was collected without postpartum care providers (nurses, OB residents/Faculty) or patients being aware that a change was about to occur. New order set was launched in Nov 2017 (see below Table) written by the Anesthesia team for pain management from CD until discharge. To allow for nurses to adjust to the change, the AFTER cohort included all CDs from Jan-Sept 2018. Comparisons between the 2 cohorts included the number of non-users of oxycodone, cumulative in-hospital oxycodone dose, and time from CD to 1st oxycodone dose.

Results: After exclusion of CDs under GA ± failed neuraxial anaesthesia, we analyzed 206 CDs BEFORE and 510 CDs AFTER. Demographic data was similar in both cohorts, except for a decrease in the AFTER cohort in the proportion of non-White patients and planned CD (Table). Adherence to the new prescription of scheduled q6h NSAIDs & acetaminophen was 78%. The proportion of non-users of oxycodone increased from 31% to 40% (aOR for non-use of oxycodone=1.853 (95%CI 1.227-2.798). Cumulative oxycodone dose decreased by 25% but with no change in timing of 1st dose (Table).

Discussion: Our data show that a relatively simple change in order sets may succeed in reducing opioid use (number of users & cumulative in-hospital oxycodone dose); however we were expecting a larger effect of the new order sets. The modest impact of this intervention may be explained by (1) the fact that opioid use was already relatively low before the change in order sets in this community-based hospital, (2) adherence to the prescription of non-opioids was lower than anticipated (78%), (3) there was no structured/formal education for the postpartum nurses surrounding this initiative, and (4) patients did not receive any information about how to manage analgesics after CD. These findings will guide further initiatives in this specific hospital setting.

Abstract #: F3C-231

Table: Patient, cesarean delivery and anesthesia factors before and after order sets change, and effect of opioid use

	Before (N = 206) Jan-April 2017	After (N = 510) Jan-Sept 2018	P-value	
Patient				
Age	29 (26-32)	29 (25-33)	0.66	
Non-White race including Hispanics (missing = 171)	196 (99.0%)	257 (74.1%)	< 0.001	
BMI (kg/m2) (missing = 2)	30.8 (28.2-34.8)	32.0 (29.0-35.3)	0.019	
Parity ≥ 1	120 (58.3%)	327 (64.1%)	0.17	
Gestational age	39 (39-40)	39 (39-40)	0.085	
Preeclampsia (missing = 1)	6 (2.9%)	31 (6.1%)	0.12	
Cesarean delivery				
Primary CD	102 (49.5%)	241 (47.3%)	0.64	
Planned CD	121 (58.7%)	250 (49.0%)	0.023	
Night time (05:01 pm to 07:59 am)	82 (39.8%)	183 (35.9%)	0.37	
Tubal ligation	32 (15.5%)	69 (13.5%)	0.64	
Anesthesia			0.85	
- CSE	5 (2.4%)	13 (2.5%)		
- Epidural	79 (38.3%)	184 (36.1%)		
- Spinal	122 (59.2%)	313 (61.4%)		
Anesthesia duration (min) (missing = 2)	111 (77-572)	103 (81-642)	0.51	
Non-opioids & oxycodone intake				**Difference (95% CI) & Adjusted OR (95%CI)**
Adherence to new prescription of non-opioids: Acetaminophen & Ibuprofen taken as prescribed (yes/no)*	-	402/510 (78.8%)		-
No use of opioid (cumulative oxycodone dose = 0mg)	64/206 (31.1%)	202/510 (39.6%)	0.04	+8.5% (0.1 to 21.7)[b] 1.853 (1.277-2.798)[c]
Total oxycodone dose (mg)	18.9 (17.9) 10 (10-25)	13.8 (12.5) 10 (5-15)	0.003	-5.1 mg (-7.9 to -2.4)[b]
Time-to-first oxycodone dose (hour)	26.1 (18.0) 27 (11-37)	23.4 (19.5) 19 (6-34)	0.052	--

Results are expressed as count (%), mean (± standard deviation), and median (25^{th}-75^{th} percentile).
[a] Comparison of categorical variable uses Chi-square test and of continuous variable Wilcoxon rank test.
[b] The 95% CI is calculated for continuous variables using bootstrap with replacement (B=1000) and the percentile method
[c] Adjusted for all patient and cesarean delivery characteristics listed in Table.

All women received neuraxial morphine (spinal dose 150-200mcg, epidural dose 3mg) and IV ketorolac 30mg in the operating room (unless contraindicated)

Order sets between Jan-April 2017 (BEFORE cohort) were:

- Scheduled q6h ibuprofen 600mg ± PO acetaminophen 650mg (written by Obstetrical team)
- For breakthrough pain – prn q4h: if VAS 1-3 PO acetaminophen 650mg; if VAS 4-6 oxycodone 5mg; if VAS 7-10 oxycodone 10mg (written by Anesthesia team for the first 16h after neuraxial opioids, then written by Obstetrical team)

New order sets between Jan-Sep 2018 (AFTER cohort) were written by the Anesthesia team from CD until discharge:

- **Scheduled every 6h ibuprofen 600mg (or IV ketorolac 30mg if unable to tolerate PO) together with PO acetaminophen 975mg ****
- For breakthrough pain: if VAS 1-3 ibuprofen 200mg prn twice; if VAS 4-6 prn q4h oxycodone 5mg and if VAS 7-10 prn q3h oxycodone 5mg (30mg max daily dose of oxycodone)

* Adherence to new prescription of non-opioids was defined as: patient took acetaminophen & ibuprofen within 9h since delivery and then q6h (women with a contraindication to NSAIDs but taking acetaminophen as prescribed were considered as taking the non-opioids as prescribed) for at least 48h.
** For scheduled CD, PO acetaminophen 975mg was started preoperatively (for urgent CD, it was started in PACU

Abstract #: F3C-203

The Opioid Dependent Parturient - Is She Different?

Presenting Author: Melissa G Potisek MD
Presenting Author's Institution: Wake Forest University School of Medicine - Winston Salem, North Carolina
Co-Author: Lynnette Harris BSN - Wake Forest University School of Medicine
Laura Dean MD - Wake Forest University School of Medicine
Ashley Tonidandel MD - Wake Forest University School of Medicine
Julia Rushing MStat - Wake Forest University

Introduction: Maternal opioid use complicates 5.6 per 1,000 hospital births per year, with associated risks of later prenatal care, IUGR, and neonatal abstinence syndrome (NAS).[i] Opioid tolerance, nicotine use, and cormorbid psychiatric conditions further complicate postpartum pain management.[ii] An optimal care pathway for these women has not yet been identified. The purpose of this study was to examine care needs and patterns in mothers on opioids compared to the general population. We hypothesized that women with chronic opioid use would have increased psychiatric diagnoses, higher pain scores throughout the peripartum period, and greater inconsistency in discharge opioid prescriptions compared with controls. The results of this study will be used to guide the development of a care plan to optimize maternal outcomes and minimize risk of relapse postpartum.

Methods: A case-control, retrospective chart review was conducted at our high risk women's center (~ 6,000 deliveries/yr) looking at deliveries between Jan 1 2016 – Aug 9 2017. Patients were identified by reviewing charts of mothers whose infants who were admitted to the NICU for neonatal abstinence syndrome (NAS, n=194) and compared to women who delivered during the same time period whose infants were not admitted to the NICU for NAS (Non-NAS,N=194). Comparisons were made using independent t-tests (demographics), negative binomial test (ED visits) and Fisher's Exact test (opioid use and pain scores).

Results: Women in the NAS group had significantly lower BMIs ($p<.0001$), were more likely to smoke ($p<.0001$), and had more co-existing psychiatric diagnoses ($p<.0001$). There were no significant differences in mode of delivery, type of labor analgesia, or IV opioid use during labor. Women in the NAS group had significantly higher pain scores on admission to the labor floor (4.8 vs 3.7, $p<.006$), arrival to postpartum (4.0 vs. 2.2, $p<.0001$), and at discharge from the PACU (5.3 vs 2.9, $p<.001$). Interestingly, 39(20%) women in the NAS group were discharged with no new opioid prescription, while others in the group received a new Rx for one of seven different opioids of varying strength and quantity. None of the patients in the control group were sent out without a new opioid prescription (n=0). The NAS group had significantly more ED visits at our hospital within 6 mos of delivery than the non-NAS group ($p=0.0044$).

Conclusion: This chart review highlights the need for continued research on the optimal care pathway for patients using opioids during pregnancy. While reducing intrapartum and postpartum pain scores is an important goal, more pressing initiatives may include the incidence of overdose, relapse, and hospitalization after delivery. A multidisciplinary approach to pre and post-natal care, consistency in discharge opioids, and close follow up after delivery should likely be a part of future care pathways for this patient population.

References:

[i] Womenshealth.gov white paper

[ii] Pan and Zakowski

Abstract #: F3C-236

Postoperative Opioid Consumption after Intrapartum Cesarean Deliveries: The Effect of Repeat Cesarean Delivery

Presenting Author: Ben Shatil MD
Presenting Author's Institution: Columbia University Medical Center - New York , NY
Co-Author: Xiwen Zheng MD - Columbia University Medical Center
Bahaa Daoud MD - Columbia University Medical Center
Beatriz Corradini Msc - Columbia University Medical Center
Jean Guglielminotti MD - Columbia University Medical Center
Ruth Landau MD - Columbia University Medical Center

Introduction: Pain after cesarean delivery (CD) is referred to as one entity but circumstances of CD may influence postoperative pain and analgesic use. Unplanned intrapartum CD may be associated with increased postoperative opioid use,1 and repeat CD may result in increased pain secondary to central hypersensitization from previous surgery.2 The combined effects of labor and a previous uterine scar on analgesic use after a subsequent CD have not been examined. To test the hypothesis that repeat CD in the setting of uterine contractions triggers increased nociception, we compared postoperative oxycodone use in women undergoing repeat intrapartum CD (failed TOLAC) with women having a primary intrapartum CD.

Methods: All women receiving intrapartum epidural analgesia converted to anesthesia for CD between Jan-Sept 2018 were included in this retrospective analysis. Epidural anesthesia for CD and postoperative analgesia were standardized according to institutional anesthesia protocols and postoperative order set. Demographic and obstetrical factors were recorded. Primary outcome was non-use of oxycodone during hospital stay; secondary outcomes were total oxycodone dose and time to 1st oxycodone dose. Descriptive statistics were applied to compare the 2 groups (failed TOLAC vs intrapartum primary CD), with estimation of adjusted risk of opioid use using regression models.

Results: After exclusion of CDs under GA ± replaced neuraxial anaesthesia (N=59), there were 32 failed TOLAC (6%) of 529 intrapartum CD. Duration of labor was significantly shorter in failed TOLAC group (Table). Using univariate analysis, there was no statistically significant difference in proportion of women not taking oxycodone during hospital stay or total oxycodone dose (Table); after adjusting for maternal age, parity, gestational age, duration of labor before CD, night time and tubal ligation, total oxycodone dose was lower in failed TOLAC group (Table).

Conclusion: After adjusting for confounders (including duration of labor), oxycodone consumption was lower in women with failed TOLAC, which is contrary to our expectation. Since oxytocin-induced endogenous analgesia occurred in both cohorts, we are not sure how to explain this finding. We acknowledge that the proportion of women with failed TOLAC was low and that additional evaluation of the effect of labor with or without a previous CD in larger cohorts is needed.

References:

1. Obstet Gynecol 2019;133:354–63
2. Eur J Pain 2013;17:111-23

Abstract #: F3C-236

Table: Comparisons between primary intrapartum CD and failed TOLAC

	Intrapartum Primary CD (N = 497)	Failed TOLAC repeat CD (N = 32)	P-value[a]		
Patient					
Maternal Age (year)	30 (25-34)	31 (27-35)	0.081		
Race (missing = 126)			0.94		
- White	152 (40.3%)	10 (38.5%)			
- Hispanic	102 (27.1%)	8 (30.8%)			
- Black	95 (25.2%)	7 (26.9%)			
- Asian	28 (7.4%)	1 (3.8%)			
BMI (kg/m2) (missing = 1)	32.3 (28.6-36.5)	31.4 (29.2-33.5)	0.39		
Parity			**< 0.001**		
- 0	408 (82.1%)	0 (0.0%)			
- 1	61 (12.3%)	21 (65.6%)			
- ≥ 2	28 (5.6%)	11 (34.4%)			
Gestational age (weeks)	40 (39-40)	39 (39-40)	0.12		
Preeclampsia (yes)	66 (13.3%)	4 (12.5%)	> 0.99		
Labor and cesarean delivery					
Duration of labor before CD (hour) (missing = 2)*	14.3 (9.1-19.6)	8.5 (4.0-15.2)	**< 0.001**		
Night time (yes)	320 (64.4%)	25 (78.1%)	0.16		
Tubal ligation (yes)	6 (1.2%)	3 (9.4%)	**0.013**		
Oxycodone use				**Adjusted**	
				Coefficient (95% CI)	**P-value**
Non-user of oxycodone (cumulative dose = 0)	159 (32.0%)	16 (50.0%)	0.057	0.81 (-0.06 to 1.67)	0.068
Total cumulative oxycodone dose during hospital stay (mg)	20 (10-35)	10 (9-16)	0.062	-12.02 (-23.35 to -0.69)	**0.038**
Time-to-first oxycodone dose (hour)	17 (6-27)	11 (3-28)	0.64	-50.036 (-683.97 to 583.90)	0.88

Abbreviations: BMI: body mass index; CD: cesarean delivery

* Duration of labor defined as time from intrapartum neuraxial analgesia to CD (birth time)

Results are expressed as median (25^{th}-75^{th} percentiles) or count (%)

[a] P-values are from Chi-square, Fisher or Wilcoxon tests.

Adjusted coefficient was estimated using the regression coefficient from a logistic or linear regression model. Adjustment used the 6 variables listed in with a P-value ≤ 0.20: maternal age, parity, gestational age, duration of labor before CD, night time, and tubal ligation.

Abstract #: F3C-241

Impact of a 2-stage intervention to reduce oxycodone consumption after cesarean delivery

Presenting Author: Ben Shatil MD
Presenting Author's Institution: Columbia University Medical Center - New York , NY
Co-Author: Xiwen Zheng MD - Columbia University Medical Center
Bahaa Daoud MD - Columbia University Medical Center
Erik Romanelli MD - Montefiori Medical Center
Jean Guglielminotti MD - Columbia University Medical Center
Ruth Landau MD - Columbia University Medical Center

Background: Multimodal post-operative analgesia has been advocated for years to reduce opioid consumption, but opioid-sparing post-operative protocols have not been widely implemented. In addition, adherence to analgesia protocols is often hindered by insufficient nursing education about what the goals are, and scarce patient information on how to take pain medications. To address these limitations, we decided a 2-stage intervention with sustained provider education followed by a change in our institutions' post-cesarean order sets introducing the concept of stepwise multimodal opioid-sparing analgesia. We present here the effect of this 2-stage intervention on adherence to analgesia protocols and oxycodone consumption.

Methods: During the 1st stage (July-Oct 2017), all OB providers (nurses, NPs, OB residents/Faculty) were educated about the concept of stepwise multimodal opioid-sparing analgesia. The 2nd stage (Nov 2017) was a change in the computerized order sets for post-CD pain management such as 1) ibuprofen 600mg with acetaminophen 975mg to be given together every 6h regardless of pain scores, and 2) oxycodone to be given only for moderate/severe pain (footnote in Table). Data were collected for all CDs between Jan-April 2017 (BEFORE) and Jan-Sept 2018 (AFTER). Primary outcome was adherence to new order set. Secondary outcomes were proportion of women not using any oxycodone, total cumulative oxycodone dose and time to 1st oxycodone dose.

Results: After exclusion of CDs under GA, there were 491 CDs BEFORE and 1125 CDs AFTER. There were several demographic and obstetrical differences between the 2 epochs, notably a reduction in primary and planned CD (Table). Adherence to the new prescription of scheduled q6h NSAIDs & acetaminophen was 82.8%. The proportion of women not using oxycodone increased from 9.6% to 29.8%, cumulative median oxycodone dose decreased from 60mg to 25mg, and time to 1st oxycodone dose increased by 4h (Table).

Discussion: The impact of our 2-step intervention promoting a stepwise multimodal opioid-sparing approach exceeded expectations and resulted in a profound culture change. Adherence to the new orders was over 80% and allowed a 3-fold increase in the number of women not taking any oxycodone post-cesarean and an almost 3-fold decrease in cumulative oxycodone dose. Further efforts to achieve 100% adherence to this protocol will include additional nursing education and focused patient information to enable shared-decision making.

Abstract #: F3C-241

Table: Oxycodone use before and after provider education and implementation of stepwise opioid-sparing multimodal analgesia

	Before (N = 491) Jan-April 2017	After (N = 1125) Jan-Sept 2018	P-value	
Patient				
Age	33 (29-36)	33 (29-37)	0.50	
Non-White race including Hispanics (missing = 171)	214 (62.2%)	449 (48.9%)	< 0.001	
BMI (kg/m2) (missing = 2)	31.6 (27.5-35.7)	31.6 (28.1-36.9)	0.30	
Parity ≥ 1	246 (50.2%)	642 (57.1%)	0.013	
Gestational age	38 (37-39)	39 (37-39)	0.006	
Preeclampsia (missing = 1)	62 (12.7%)	126 (11.2%)	0.45	
Cesarean delivery				
Primary CD	309 (62.9%)	624 (55.5%)	0.006	
Planned CD	266 (54.2%)	487 (43.3%)	< 0.001	
Nighttime (05:01 pm to 07:59 am)	219 (44.6%)	475 (42.2%)	0.40	
Tubal ligation	61 (12.4%)	134 (11.9%)	0.83	
Anesthesia			0.84	
- CSE	44 (9.0%)	96 (8.5%)		
- Epidural	163 (33.2%)	361 (32.1%)		
- Spinal	284 (57.8%)	668 (59.4%)		
Anesthesia duration (min) (missing = 6)	113 (89-563)	124 (98-501)	0.001	
Non-opioids & oxycodone intake			**P-value[a]**	**Difference (95% CI)[b] Adjusted OR (95% CI)[c]**
Adherence to new prescription of non-opioids: Acetaminophen & Ibuprofen taken as prescribed (yes/no)*	-	931/1125 (82.8%)	-	
No use of opioid (cumulative oxycodone dose = 0mg)	47/491 (9.6%)	335/1125 (29.8%)	< 0.001	+20.2% (10.5 to 29.9) **3.995 (2.818-5.664)**
Total oxycodone dose (mg)	69.5 (52.2) 60 (30-95)	29.4 (22.3) 25 (15-40)	< 0.001	-40.1 mg (-44.6 to -36.0)
Time-to-first oxycodone dose (hour)	17.7 (13.7) 17 (4-26)	21.6 (18.1) 19 (8-29)	< 0.001	+3.9 hour (2.4 to 5.5)

Results are expressed as count (%), mean (1 sd), and median (25^{th}-75^{th} percentile).

[a] Comparison of categorical variable uses Chi-square test and of continuous variable Wilcoxon rank test.

[b] The 95% CI is calculated for continuous variables using bootstrap with replacement (B=1000) and the percentile method

[c] Adjusted for all patient and cesarean delivery characteristics listed in Table.

Stepwise multimodal opioid-sparing analgesia orders written by Anesthesia team (from CD until discharge) are:

- **Scheduled every 6h ibuprofen 600mg (or IV ketorolac 30mg if unable to tolerate PO) together with PO acetaminophen 975mg ****
- For breakthrough pain: if VAS 1-3 ibuprofen 200mg prn twice; if VAS 4-6 prn q4h oxycodone 5mg and if VAS 7-10 prn q3h oxycodone 5mg (30mg max daily dose of oxycodone)

* Adherence to new prescription of non-opioids was defined as: patient took acetaminophen & ibuprofen within 9h since delivery and then q6h (women with a contraindication to NSAIDs but taking acetaminophen as prescribed) for at least 48h were considered as taking the non-opioids as prescribed.

** For scheduled CD, PO acetaminophen 975mg was started preoperatively (for urgent CD, it was started in PACU).

Abstract #: F3D-534

Effects of Labor Stage Duration on Maternal and Perinatal Outcomes: A Retrospective Cohort Study

Presenting Author: Jie Zhou MD, MS, MBA, FASA
Presenting Author's Institution: Brigham and Women›s Hospital, Harvard Medical School - Boston, MA
Co-Author: Li Wang MD - BWH
Hongxia Wang MD - BWH
Qing Liu MD - BWH
Wenjie Qing MD - BWH
Min Wei MD - BWH

Background: The permitted durations of first and second stages of labor was increased in the American College of Obstetricians and Gynecologists (ACOG) published 2014 consensus. Recent studies showed increased incidence of adverse maternal and neonatal outcomes when second stage labor duration prolonged to greater than 3 hours with epidural analgesia. We performed a retrospective cohort study on the effects of labor stages on maternal and perinatal outcomes.

Methods: Retrospective analysis of medical record data from the Brigham and Women's Hospital during the year of 2017 was performed. Cephalic, term, singleton parturients with complete labor records were included, who planned for vaginal delivery. Adverse outcomes were defined if the parturient had operative vaginal delivery (OVD), intrapartum cesarean delivery (ICD), shoulder dystocia, postpartum hemorrhage (≥1000ml), 3rd or 4th degree perineal laceration, episiotomy, venous thromboembolism (VET), chorioamnionitis, maternal length of hospital stay ≥ 90th percentile (LOH90%), perinatal death, transfer to neonatal intensive care unit (NICU), Apgar score ≤ 7 at 1 min or 5 min. We defined the term total stage as the total of 1st and 2nd stages of labor durations.

Results: Of 1617 parturients included, spontaneous vaginal delivery (SVD) succeeded in 1434 (88.7%). OVD were 118 (7.3%); ICD were 65 (4.0%). The risk of OVD, hemorrhage, lacerations, LOH90%, NICU transfer, chorioamnionitis, episiotomy, Apgar ≤ 7 (5 min), shoulder dystocia increased with the prolonged first stage ($P < 0.05$). The risk of OVD, ICD, hemorrhage, lacerations, VET, LOH90%, NICU transfer, chorioamnionitis, episiotomy, Apgar ≤7 at both 1 min and 5 min increased with the prolonged 2nd stage duration and total stage duration of labor. ($P < 0.05$) (Figure 1)

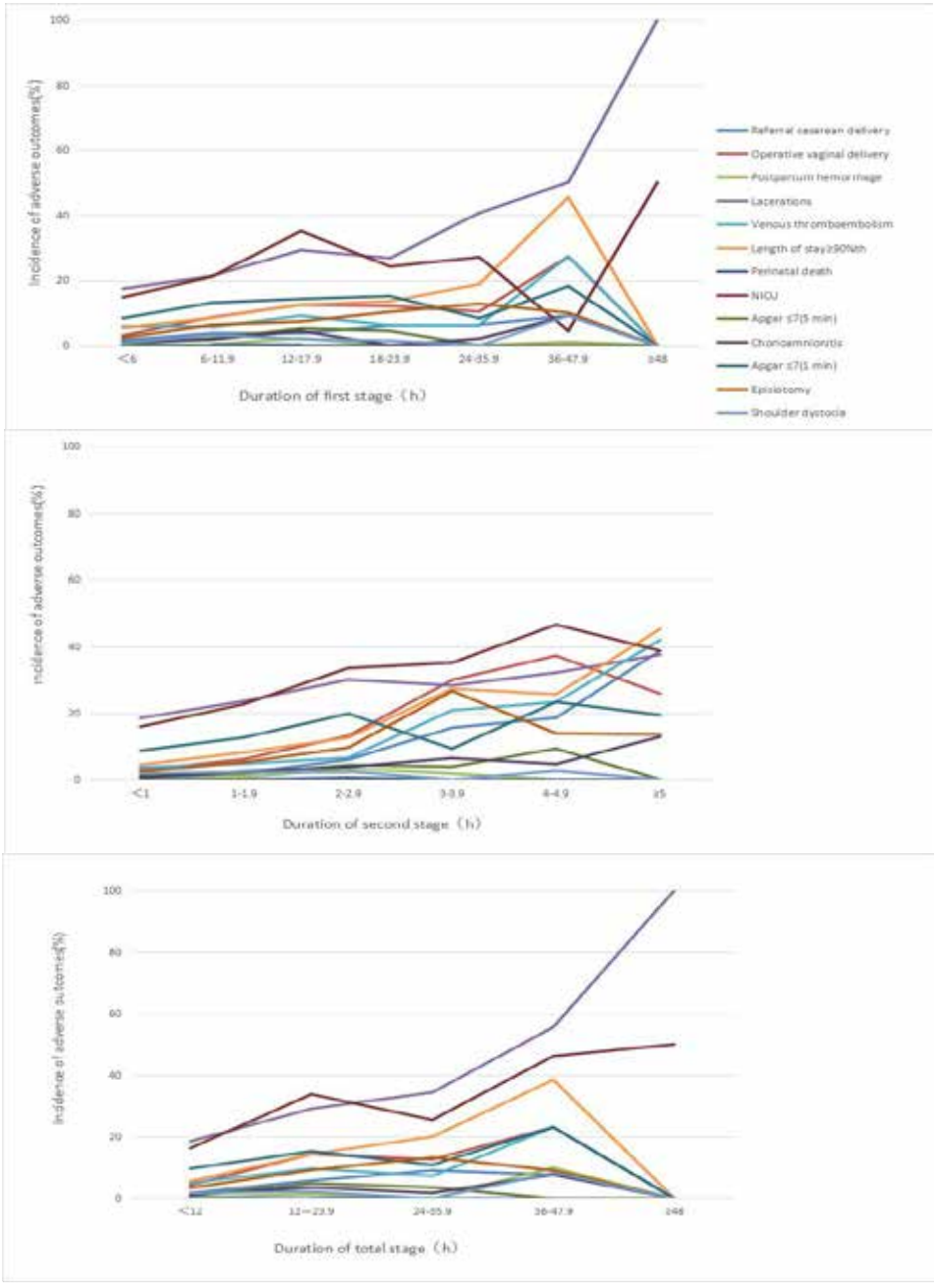
Discussion: Grantz et al found that the rates of spontaneous vaginal delivery without serious morbidity decreased with increasing 2nd stage duration. Our study further demonstrated that prolonged labor stages, either 1st stage, 2nd stage or total stages were related to maternal and perinatal adverse outcomes. We advocate for early intervention to reduce these unnecessary complications. Large prospective cohort studies should be performed to confirm these effects of labor stage durations.

References:

1. https://www.acog.org/Clinical-Guidance-and-Publications/Obstetric-Care-Consensus-Series
2. Cohen SM, et al. Ultrasound Obstet Gynecol 2017
3. Grantz, KL, et al. Obstet Gynecol 2018

Abstract #: F3D-534

Figure 1: Adverse outcomes of maternal and perinatal by labor stage duration in hours



Abstract #: F3D-538

Would Gestational Weight Gain Effect the Durations of Labor Stages?

Presenting Author: Jie Zhou MD, MS, MBA, FASA
Presenting Author's Institution: Brigham and Women›s Hospital, Harvard Medical School - Boston, MA
Co-Author: Li Wang MD - BWH
Xuyuan Ma MD - BWH
Qing Liu MD - BWH
Wenjie Qing MD - BWH
Min Wei MD - BWH

Background: Body mass index (BMI) and Gestational Weight Gain (GWG) of pregnant women are increasing globally. The Institute of Medicine (IOM) provided specific recommendations regarding the ideal GWG. GWG greater than or less than guideline recommendations were associated with higher risk of adverse maternal and perinatal outcomes. However, the association between GWG and duration of labor stage is unclear. We performed a retrospective study to elaborate the effect.

Methods: Of 1,994 parturients who delivered vaginally successfully from 1/1/2017 to 12/31/2017 at the Brigham and Women's Hospital (BWH), demographical data, labor stage durations, prepregnancy BMI (PPBMI), and GWG were collected. According to IOM recommendations, parturients were divided into below, within and above guideline groups. We analyzed the GWG and its correlation to age, height, weight, PPBMI, gestational age, birth weight and baby sex. The influence of GWG on the subgroup of 1,005 nulliparous women's labor stage durations were also analyzed.

Results: The average GWG was 13.8±13.2 kg. GWG was positively correlated with height, weight, gestational age, birth weight and baby sex (male vs female), but negatively correlated with the PPBMI ($P < 0.01$). Distribution of below, within and above groups of GWG in all of factors was different significantly. (Table 1) In nulliparous women with normal PPBMI (18.5 – 24.9 km/m2), above recommended GWG was significantly associated with longer duration of the first stage labor ($P=0.017$). There was no effect of GWG on the durations of second and third stages.

Discussion: GWG is an important indicator in the antenatal management of pregnancy. Our data indicated that 31.8% of the parturients with appropriate GWG per IOM recommendation. Our data implied that the following factors of parturients and neonates could be associated with higher possibility of above normal range GWG, which included mother's weight ≥ 90 kg, age < 25 years, height ≥ 170cm, PPBMI ≥ 25 km/m2, gestational age ≥ 40 weeks, baby birth weight ≥ 4000g, or male gender of baby. While GWG had little effect on labor duration, extra care should always be directed towards parturients with high risk factors according to the Development Origins of Health and Disease (DoHaD) hypothesis.

References:

1. Goldstein, RF, et al. JAMA 2017;317:2207
2. Bodnar LM, et al. Paediatr Perinat Epidemiol 2015;29:11
3. Barker DJ. J Intern Med 2007;261(5):412

Abstract #: F3D-538

Table 1: Maternal and neonatal characteristics associated with gestational weight gain, BWH, 2017

		n	GWG (kg)	F	P	Below n (%)	Within n (%)	Above n (%)	*X2*	P
n=1994			13.78±13.174			441 (22.1)	635 (31.8)	918 (46)		
Age(years)				1.186	0.314				12.792	0.015
	< 25	254	14.55±7.374			54 (21.3)	63 (24.8)	137 (53.9)		
	25-29	418	14.55±7.953			85 (20.3)	124 (29.7)	209 (50.0)		
	30-35	842	13.30±18.472			189 (22.4)	295 (35.0)	358 (42.5)		
	≥35	480	13.56±6.165			113 (23.5)	153 (31.9)	214 (44.6)		
Height(cm)				5.661	0.004				21.411	< 0.001
	< 160	449	11.96±24.523			126 (28.1)	149 (33.2)	174 (38.8)		
	160-169	1106	14.24±6.231			241 (21.8)	348 (31.5)	517 (46.7)		
	≥170	439	14.51±8.499			74 (16.9)	138 (31.4)	227 (51.7)		
Weight(kg)				39.57	< 0.001				523.02	< 0.001
	< 50	3	2.26±9.192			3 (100)	0 (0)	0 (0)		
	50-69	468	11.51±5.615			229 (48.9)	192 (41.0)	47 (10.0)		
	70-89	1060	14.58±5.595			171 (16.1)	380 (35.8)	509 (48.0)		
	≥90	463	15.60±8.458			38 (8.2)	63 (13.6)	362 (78.2)		
BMI(kg/m^2)				35.082	< 0.001				166.657	< 0.001
	<18.5	85	16.41±9.391			28 (32.9)	35 (41.2)	22 (25.9)		
	18.5-24.9	1150	14.78±5.081			298 (25.9)	440 (38.3)	412 (35.8)		
	25.0-29.9	447	14.09±6.439			52 (11.6)	100 (22.4)	295 (66.0)		
	≥30.0	312	10.83±9.153			63 (20.2)	60 (19.2)	189 (60.6)		
GA (weeks)				9.515	< 0.001				29.426	< 0.001
	< 32	13	8.58±9.575			7 (53.8)	3 (23.1)	3 (23.1)		
	32-36+6	108	13.29±10.223			33 (30.6)	25 (23.1)	50 (46.3)		
	37-39+6	1220	13.71±6.396			289 (23.7)	403 (33.0)	528 (43.3)		
	≥40	648	15.03±5.895			112 (17.3)	200 (30.9)	336 (51.9)		
Birth weight(g)				18.563	< 0.001				41.359	< 0.001
	< 2500	97	11.67±9.903			37 (38.1)	27 (27.8)	33 (34.0)		
	2500-3999	1758	14.04±6.267			390 (22.2)	572 (32.5)	796 (45.3)		
	≥4000	114	17.03±6.048			8 (7.0)	28 (24.6)	78 (68.4)		
Baby sex				13.281	< 0.001				15.548	< 0.001
	Male	1043	14.59±6.918			212 (20.3)	307 (29.4)	524 (50.2)		
	Female	951	13.52±6.114			229 (24.1)	328 (34.5)	394 (41.4)		

GA: Gestational Age; GWG: Gestational Weight Gain; BMI: Body Mass Index

Abstract #: F3D-459

Obstructive sleep apnea in pregnant women with chronic hypertension: A prospective observational cohort study

Presenting Author: Jennifer E Dominguez MD, MHS
Presenting Author's Institution: Duke University School of Medicine - Durham, NC
Co-Author: Mary Cooter MS - Duke University School of Medicine
Chad A Grotegut MD, MHS - Duke University School of Medicine
Ashraf S Habib M.B.B.Ch., MSc, MHSc, FRCA - Duke University School of Medicine

BACKGROUND: Chronic hypertension (cHTN) is an important co-morbidity for obstructive sleep apnea (OSA). OSA is also associated with peripartum complications. Identifying pregnant women with OSA is difficult given the poor reliability of OSA screening tools. The purpose of this on-going study is to determine if pregnant women with cHTN are at significantly higher risk of having undiagnosed OSA than BMI-matched normotensive pregnant controls. Our secondary aim is to examine the predictive value of the OSA prediction score proposed by Facco et al.(1), the Berlin questionnaire, and the Epworth Sleepiness Scale in this cohort of second trimester pregnant women.

METHODS: After IRB approval, recruitment began in May 2017 and is ongoing. Two groups of adult gravidas between 10-20 weeks gestation are being recruited: 1) those with cHTN (on medication or elevated blood pressures documented on two clinic visits); 2) those with normal blood pressure, no treatment for/history of cHTN, and matched for BMI with the cHTN group (± 3 kg.m-2) to control for the effect of obesity on OSA diagnosis and cHTN. Target enrollment is 50 subjects/group. Exclusion criteria include: OSA therapy; opioid or alpha-blockers use (can interfere with the home sleep test); secondary HTN; or non-English speaking. Following informed consent, subjects answered a set of self-reported sleep questions and were followed for pregnancy outcomes. Subjects undergo home sleep testing using an FDA-approved WatchPAT™ device (Itamar Medical Ltd., Caesarea, Israel) during one night of sleep.

RESULTS: As of this time, 79 subjects have undergone home sleep testing (41 cHTN, 38 controls). All 79 subjects had valid sleep studies of more than 2 hours. Patient demographics, screening questionnaires, and home sleep test data are summarized in the Table. The prevalence of OSA among gravidas with cHTN is high compared to BMI-matched controls (63% vs. 34%). Among women with OSA, 58% of the cHTN group had moderate to severe OSA vs. 8% of the normotensive group.

CONCLUSIONS: Preliminary data from this ongoing, observational, prospective study suggest that cHTN is an important independent risk factor for OSA in pregnant women, and that OSA may be more severe when co-morbid with cHTN. We expect to present the completed study with statistical analysis at the SOAP meeting.

References:

1. Facco FL, Ouyang DW, Zee PC, Grobman WA. Development of a pregnancy-specific screening tool for sleep apnea. J Clin Sleep Med. 2012;8(4):389-394.

Abstract #: F3D-459

	Chronic Hypertension (N=41)	Control (N=38)	Total (N=79)
Patient Demographics			
Age (yrs)	34.15 (4.60)	29.16 (6.26)	31.75 (5.98)
Pre-pregnancy BMI (kg/m^2)	38.37 (9.71)	37.87 (9.29)	38.13 (9.45)
BMI (kg/m^2)	38.93 (9.39)	38.18 (9.42)	38.57 (9.35)
Neck circumference (cm)*	37.23 (4.44)	36.27 (4.17)	36.78 (4.31)
Gestational Age (wks)	15.34 (2.70)	15.71 (2.64)	15.52 (2.66)
Race/Ethnicity			
White	15 (36.6%)	15 (39.5%)	30 (37.9%)
Black	24 (58.5%)	20 (52.6%)	44 (55.7%)
Asian	0	1 (2.6%)	1 (1.3%)
Other	2 (4.9%)	2 (5.3%)	4 (5.1%)
Hispanic	1 (2.4%)	1 (2.6%)	2 (2.5%)
Hypertension Severity measures			
Systolic blood pressure	130.07 (11.42)	113.26 (10.24)	121.99 (13.71)
Diastolic blood pressure	83.59 (7.68)	74.03 (5.70)	78.99 (8.30)
Questionnaire Scores			
Berlin Total Score	1.88 (0.64)	1.55 (0.86)	1.72 (0.77)
Berlin high risk *ƒ*	30 (73.2%)	22 (57.9%)	52 (65.8%)
Epworth Total Score ¶	2.32 (1.85)	2.39 (1.98)	2.35 (1.90)
Facco *et al.* Score	95.20 (15.27)	73.34 (12.91)	84.68 (17.87)
Facco *et al.* high Risk (≥ 75) **	36 (87.8%)	17 (44.7%)	53 (67.1%)
Sleep Study Results			
Positive Sleep Test (AHI ≥ 5 events/hr)	26 (63.4%)	13 (34.2%)	39 (49.4%)
Apnea-Hypopnea Index (AHI) events/hr	12.17 (14.65)	5.56 (8.37)	8.99 (12.42)
OSA severity (among those with AHI ≥ 5 events/hr)			
Mild (5 ≤ AHI < 15)	10 (38.5%)	11 (84.6%)	21 (53.8%)
Moderate (15 ≤ AHI < 30)	15 (57.7%)	1 (7.7%)	16 (41.0%)
Severe (30 ≤ AHI)	1 (3.8%)	1 (7.7%)	2 (5.1%)
Sleep Study Duration (hrs)	5.91 (1.41)	6.26 (1.45)	6.08 (1.43)
Oxygen Desaturation Index (events/hr)	6.13 (10.98)	2.08 (5.37)	4.18 (8.93)

Mean, SD; N (%); AHI (Apnea-hypopnea Index), OSA (obstructive sleep apnea)

* Missing for 1 patient

** Facco *et al.* score = Age + Pre-pregnancy BMI + 15 (if cHTN) + 15 (frequent snoring); High risk ≥ 75

ƒ Berlin considered high-risk if positive scores in 2 or more of 3 categories

¶The ESS is considered concerning for excessive daytime sleepiness if scores are in the 11-24 range.

TABLE. Demographic, sleep questionnaire and home sleep test data

Abstract #: F3D-151

Postpartum Uterine Contraction Pain After Vaginal Delivery: A Prospective Observational Study

Presenting Author: Weijia Du, MD
Presenting Author's Institution: Shanghai First Maternity and Infant Hospital - Shanghai, Shanghai
Co-Author: Xin Fang Bachelor of Medicine - Shanghai First Maternity and Infant Hospital
Yujie Song MD - Shanghai First Maternity and Infant Hospital
Zhendong Xu MD, PHD - Shanghai First Maternity and Infant Hospital
Zhiqiang Liu MD, PHD - Shanghai First Maternity and Infant Hospital

BACKGROUND: Postpartum uterine contraction pain (PUCP) is one of the most concerned issues for women after childbirth, but there is a lack of baseline research. The aim of this study was to assess the incidence, intensity and risk factors of PUCP.

METHODS: In this prospective observational study, singleton primiparous and multiparous women delivered vaginally were included; the numerical rating scale (NRS) score for uterine contraction pain at 6h, 12h, 24h and 48h after delivery was surveyed using a self-administered questionnaire. The primary outcome was the onset of uterine contraction pain within 48h after delivery. Subjects included in the final analysis were (1) the time to onset of PUCP; (2) the onset of significant PUCP (NRS score≥3); (3) PUCP assessed before, during and after breastfeeding by NRS and (4) the nature or feeling of PUCP. Univariate analysis was assessed by Kaplan-Meier curve and Log-Rank test, or univariate cox regression analysis with demographic, obstetric, and neonatal characteristics as candidate factors; followed by time-dependent cox regression analysis; in order to determine the factors associated with PUCP.

RESULTS: 265 primiparous women and 139 multiparous women were included in the final analysis. About 77.5% (313 of 404) of all women suffered from uterine contraction pain (NRS score≥1) within 48h after delivery. According to multivariate analysis, multiparous women had an increased risk of PUCP compared with primiparous women ($p<0.001$, HR=1.834, 95% CI=1.451-2.316). In addition, primiparous women who had a history of tocolytic therapy were more likely to suffer PUCP, and its hazard ratio decreased with delayed in the time to onset of PUCP [$p<0.001$, HR=EXP (2.182-0.101*t)]. The incidence of PUCP decreased with every degree of age (one degree is 5 years) of multiparous women ($p=0.007$, HR=0.758, 95% CI=0.620-0.926). Both primiparous and multiparous women had more intensive PUCP during breastfeeding at 12h, 24h and 48h postpartum ($p<0.001$). Primiparous women with labor analgesia had lower NRS score of PUCP compared with those without labor analgesia at 6h after delivery [0 (0-0) vs. 0 (0-2), $p=0.001$].

CONCLUSIONS: PUCP was common after delivery, but its' intensity was mild. Parity and tocolytic therapy were associated with the onset of PUCP. Primiparous women with labor analgesia had a lower NRS score of PUCP than those without labor analgesia in the early postpartum period. Therefore, it suggests that women at risk for PUCP may have personalized interventions.

Abstract #: F3D-425

Pro Re Nata or "Per Registered Nurse"? Observed Clinical Variation in PRN Analgesic Administration and Implications for Pain Research

Presenting Author: LeAnn Lam BS
Presenting Author's Institution: Vanderbilt University Medical Center - Nashville, Tennessee
Co-Author: Mallika S. Thampy MD - Vanderbilt University Medical Center
Sarah S. Osmundson MD - Vanderbilt University Medical Center
Michael G. Richardson MD - Vanderbilt University Medical Center

BACKGROUND: Inpatient PRN opioid analgesics (OAs) are intended to be administered "as needed" by the patient, not at standard time intervals. Total PRN opioid usage is the primary outcome chosen to assess efficacy of interventions in many post-operative pain studies, under the assumption that analgesics are administered upon patient request. Yet, non-patient specific factors clearly influence PRN opioid administration [1,2], including nurse administration behaviors.[3] We sought to determine whether post-cesarean delivery (CD) patients receive PRN OA primarily when they request them, when offered by their nurse, or a combination of both, and whether this affects total OA and ibuprofen use.

METHODS: Women who underwent uncomplicated CD were surveyed on post-op day 1 regarding inpatient analgesic use, including whether they received OAs when they requested, when their nurse offered them unsolicited, or both. Women were also asked whether they were receiving enough analgesic medication and whether they were intentionally limiting OA use. Total inpatient opioid MME and ibuprofen used between 24 and 48 hours post-CD were compared. Our institution's inpatient post-CD analgesic order set contains scheduled ibuprofen 600mg every 6 hours and "as needed" PRN opioid (hydrocodone 5mg or oxycodone 5mg) every 4 hours.

RESULTS: From 8/2018 to 1/2019, 193 women gave informed consent and completed the survey. Only 14 (7.3%) reported receiving OAs upon requesting them. 97 (50.3%) primarily received OAs when their nurse offered, and 82 (43.4%) reported that OAs were given both on request and when offered. Inpatient opioid use was lower among women who were offered OAs by a nurse (17.5 MME [IQR 5-30]) vs women who requested OAs (22.5 MME [15-30]) or women who both requested and were offered OAs (25.0 MME [10-35]), p=0.007. There were no differences in ibuprofen use between the three groups (2400mg [2400-2400] vs 2400mg [2400-2400] vs 2400mg [1800-2400]), p=0.92 and no differences in reported self-limiting of OAs or perception that patients were not receiving enough OAs.

CONCLUSION: Only a small proportion of women who were prescribed PRN OAs during inpatient hospitalization for CD received OA "as needed" by request. Our findings suggest inpatient medications written as PRN have variable nurse interpretations and may not necessarily reflect true pain needs as previously assumed. Lowest inpatient OA use in the nurse-offered group deserves greater scrutiny. Not requesting and nurse offering may simply result from low patient OA need or preference. Nonetheless, pain research that relies on PRN opioid use as the primary outcome should carefully define PRN orders and ensure consistent clinical interpretation to reduce confounding due to variation in nursing interpretation and executing PRN orders.

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2. Herzig et al. J Hosp Med 2014;9:73
3. Taylor et al. Orthoped Nurs 2017;36:392

Abstract #: F3D-104

Social determinants of health and their association with postpartum readmissions in patients with preeclampsia: a multi-state analysis, 2007-2014

Presenting Author: Jennifer L Wagner M.D.
Presenting Author's Institution: NewYork-Presbyterian Hospital/Weill Cornell Medicine - New York, New York
Co-Author: Robert S White M.D., M.S. - NewYork-Presbyterian Hospital/Weill Cornell Medicine
Virgnia Tangel M.A. - NewYork-Presbyterian Hospital/Weill Cornell Medicine
Soham Gupta B.A. - NewYork-Presbyterian Hospital/Weill Cornell Medicine
Jeremy S. Pick M.D. - NewYork-Presbyterian Hospital/Weill Cornell Medicine

Postpartum hospital readmissions lead to disruptions in childcare and early parenting, cause a significant emotional and societal burden, and are costly to the healthcare system.(1) In addition to delivery-related factors such as cesarean delivery, risk factors for postpartum readmission include maternal comorbidities such as hypertension, for which women with preeclampsia are at highest risk. (2) Certain social determinants of health are associated with increased readmission in postpartum patients, and understanding these is important for the development of postpartum readmission prevention programs.

Although socioeconomic, racial, and ethnic disparities are known to exist in postpartum readmissions, no study has specifically investigated these disparities among patients with preexisting preeclampsia. (3) Therefore we sought to replicate the findings of previous studies on the effects of social determinants of health on postpartum readmissions, as well as within a subpopulation of those with a present-on-admission diagnosis of preeclampsia.

We conducted a retrospective (2007-2014) analysis of all singleton deliveries in Florida, California, New York, and Maryland from the State Inpatient Databases, Healthcare Cost and Utilization Project. A total of 4,999,993 patients were included in our analysis, of which 182,651 had a present-on-admission diagnosis of preeclampsia. Our primary outcome was readmission up to 30 days after delivery. Among all postpartum patients and in subgroup analyses for preeclampsia patients only, readmission rates were higher for black patients, patients residing in the poorest quartile of median income, and patients with public insurance. After adjustment for patient and hospital-level factors, patients with preeclampsia insured by public insurance—either Medicare or Medicaid—were 105% and 23% more likely of being readmitted up to 30 days when compared to private insurance, respectively (Medicare OR: 2.05, 95% CI: 1.69-2.49; Medicaid OR: 1.23, 95% CI: 1.16-1.31). Preeclamptic patients with other insurance (OR: 1.21, 95% CI: 1.02-1.44) and patients without insurance (OR: 1.21, 95% CI: 1.03-1.42) were also more likely to be readmitted up to 30 days when compared to patients with private insurance. Black patients with preeclampsia were about 20% more likely to be readmitted up to 30 days post-delivery than white patients with preeclampsia (OR: 1.22, 95% CI: 1.14-1.31).

Our study found that social determinants of health are associated with postpartum readmissions, even among a high-risk preeclamptic population. Future research should elucidate potential interconnected relationships between social determinants of health in patients with preeclampsia.

References:

1. Aseltine RH, et al. Obstet Gynecol. 2015;126(5):1040-
2. Mogos MF, et al. J Hypertens. 2018;36(3):608-18.
3. Clapp MA, et al. Am J Obstet Gynecol. 2016;215(1):113 e1- e10.

Abstract #:F3D-194

The obstetric comorbidity index for maternal postpartum hemorrhage risk assessment

Presenting Author: Rochelle J. Molitor MD
Presenting Author's Institution: Brigham and Women›s Hospital - Boston, MA
Co-Author: Brian T. Bateman MD, MSc - Brigham & Women›s Hospital
Michaela K. Farber MD - Brigham & Women's Hospital
Julian N. Robinson MD - Brigham & Women's Hospital
Daniela A. Carusi MD, MSc - Brigham & Women's Hospital
Sarah Rae Easter MD - Brigham & Women's Hospital

Background: The obstetric comorbidity index (OB-CMI) is a maternal risk assessment tool that summarizes the burden of maternal comorbidities into a single numerical score (1). The OB-CMI can predict the risk of severe maternal morbidity (SMM) in clinical practice. Postpartum hemorrhage (PPH) is an important source of SMM. The OB-CMI incorporates many risk factors for PPH, but whether the OB-CMI can be used to identify patients at risk for PPH has yet to be evaluated.

Methods: We assembled a prospective cohort of pregnant patients admitted to Labor and Delivery at or beyond 23 weeks' gestation from February to July 2018. Each patient's OB-CMI score was calculated on admission and every 12 hours until delivery by the primary nurse. Our primary outcome of interest was PPH requiring transfusion. Secondarily, the presence of hemorrhage-associated SMM was determined by a multidisciplinary panel of clinicians blinded to OB-CMI score using contemporary criteria (2). We analyzed the association between OB-CMI and the aforementioned outcomes using logistic regression and calculated a c-statistic to determine the discrimination of the score.

Results: A total of 2,828 deliveries were included in the study, 53 of which were complicated by PPH requiring transfusion (1.87%). Women requiring transfusion had a higher OB-CMI score than those who did not (median 4, interquartile range (IQR) 2-6 vs. 1, IQR 0-3 p<0.01 respectively). The prevalence of transfusion increased with increasing OB-CMI score (Figure). Women with an OB-CMI of 0-1 had a 0.67% prevalence of transfusion compared to 17.6% for those with a score ≥ 10. The c-statistic for the association between the OB-CMI and transfusion was 0.75 (95% confidence interval (CI) 0.68-0.82) and the c-statistic for hemorrhage-associated SMM was 0.77 (95%CI 0.66-0.87) indicating strong discrimination for both outcomes.

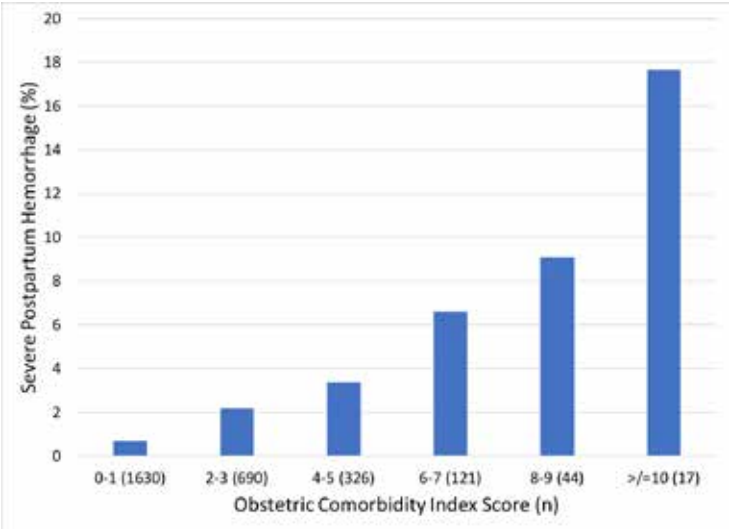

Figure 1. Prevalence of severe postpartum hemorrhage as a function of obstetric comorbidity index score (OB-CMI). Parturients with a higher OB-CMI were more likely to experience hemorrhage (*P*<0.01). The number of women (n) in each group is denoted in parentheses.

Conclusions: An increasing OB-CMI is associated with an increased risk of transfusion and hemorrhagic morbidity at the time of delivery. The OB-CMI may be useful to prospectively identify high-risk women at risk of PPH to ensure adequate resources are available at delivery.

References:

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Abstract #: F3D-531

Effect of Labor Stage Duration on Delivery Mode: A Retrospective Cohort Study After the 2014 ACOG Labor Management Consensus

Presenting Author: Jie Zhou MD, MS, MBA, FASA
Presenting Author's Institution: Brigham and Women›s Hospital, Harvard Medical School - Boston, MA
Co-Author: Li Wang MD - BWH
Qing Liu MD - BWH
Wenjie Qing MD - BWH
Min Wei MD - BWH

Background: In 2014, American College of Obstetricians and Gynecologists (ACOG) published a new labor management consensus with the intention to prevent the primary Cesarean Delivery (CD). It was proposed that the rate of CD could be lowered by additional allowance of first and second stages of labor trial. However, recent reports showed no reduction in CD rate, but increased maternal and perinatal morbidity with the practice of the new guideline. We examined the duration of labor in relation to the delivery modes.

Methods: Retrospective chart review of parturients delivered from 1/1/2017 to 12/31/2017 at the Brigham and Women's Hospital were collected. Paturients with elective CDs, VBACs, multiple gestations, and missing records of either stage of labor were excluded. The lengths of 1st, 2nd and total (1st + 2nd) labor stages duration were compared among different modes of delivery. Subgroup analysis was conducted according to nulliparous vs multiparous status with or without labor analgesia.

Results: Of 1721 parturients who were included, 864 were nulliparous and 857 were multiparous. Table 1 showed that the 1st stage, 2nd stage and total labor duration operative vaginal deliveries (OVDs) were longer than that of spontaneous vaginal deliveries (SVDs), but shorter than intrapartum cesarean deliveries (ICD), regardless the nulliparous (with or without labor analgesia) or multiparous status. The increase of the 2nd stage duration was significantly correlated with increased OVD and ICD. (Figure 1)

Discussion: The new ACOG guideline made two major modifications to the previous works of Friedman: active labor begins at 6 cm of cervical dilation; allowance of at least 1-hour additional to the 2nd stage of parturients (may allow more with epidural analgesia). Such practice recommendation has been criticized for lack of evidence. Our study demonstrated that OVDs and ICDs rates had already increased before reaching the 2014 guideline allow maximum hours. This indicated that extra time allowance probably is not helpful for reducing CD rate. Our study further demonstrated that the long the 2nd stage labor, the greater the risk of OVD and ICD. We advocate for large prospective study to further stratified the length limits of labor stages.

References:

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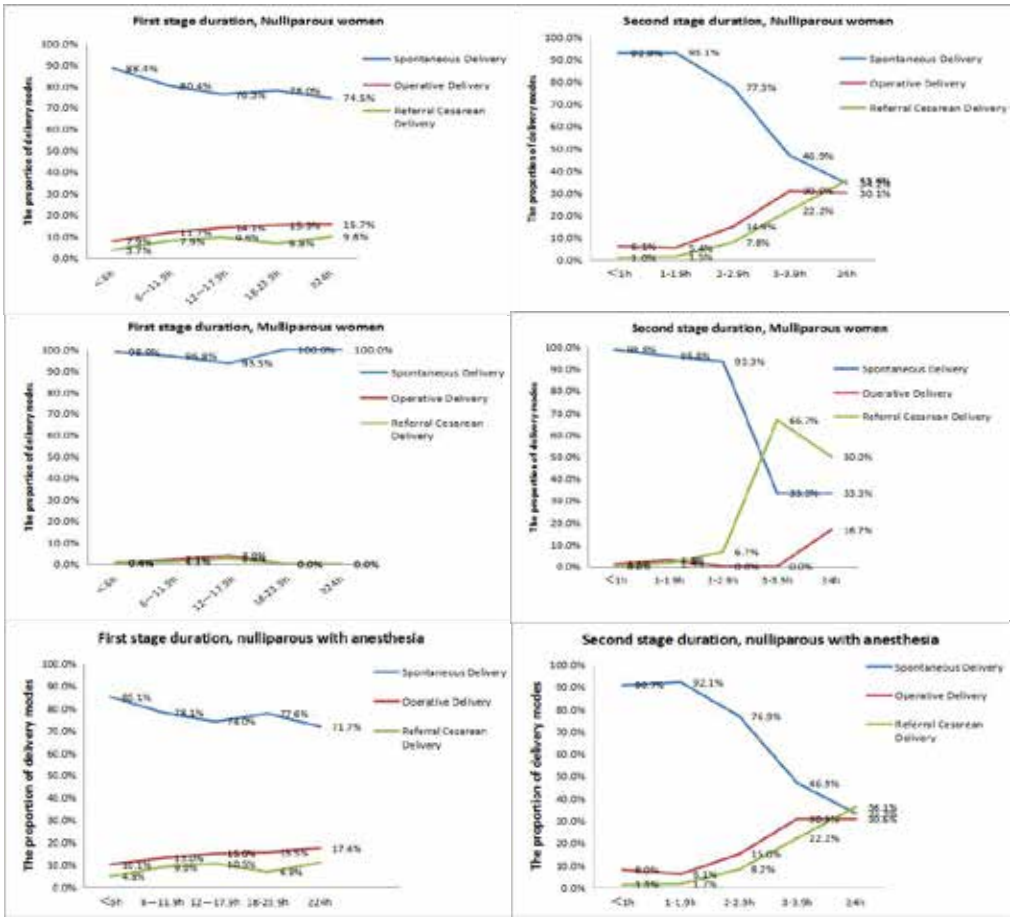
2. Rosenbloom, JI, et al. Am J Obstet Gynecol 2017; 217: 689
3. Cohen, SM, et al. Ultrasound Obstet Gynecol 2017; 50: 423

Abstract #: F3D-531

Table 1: Duration of labor in different delivery modes

		SVDs Median (10%,90%)	OVDs Median (10%,90%)	ICDs Median (10%,90%)	Z	P
Nulliparous	n(%)	699 (80.9)	102 (11.8)	63 (7.3)		
	First stage (h)	8.87 (3.25,18.92)	10.67 (3.97,21.46)	11.08 (5.35,22.48)	13.74	0.001
	Second stage (h)	1.27 (0.30,2.87)	2.64 (0.66,4.75)	3.55 (1.89,6.88)	151.48	<0.001
	Total stage (h)	10.20 (4.67,20.98)	14.59 (5.87,25.21)	14.43 (8.94,26.84)	41.67	<0.001
Multiparous	n(%)	838 (97.8)	12 (1.4)	7 (0.8)		
	First stage (h)	5.32 (1.92,12.89)	9.29 (1.52,16.50)	10.02 (4.07,-)	8.42	0.015
	Second stage (h)	0.25 (0.08,1.02)	0.35 (0.11,3.70)	3.93 (1.33,-)	22.02	<0.001
	Total stage (h)	5.76 (2.13,13.44)	9.79 (1.66,20.13)	11.50 (7.43,-)	14.84	0.001
Nulliparous with anesthesia	n(%)	590 (78.2)	101 (13.4)	63 (8.4)		
	First stage (h)	9.25 (3.76,19.42)	10.68 (3.96,21.52)	11.08 (5.35,22.48)	8.53	0.014
	Second stage (h)	1.40 (0.42,3.06)	2.67 (0.65,4.76)	3.55 (1.89,6.88)	129.63	<0.001
	Total stage (h)	10.76 (5.20,21.47)	14.68 (5.85,25.33)	14.43 (8.94,26.84)	30.41	<0.001

Figure 1: Changes in the proportion of delivery modes with different labor duration



Abstract #: F3D-562

Cesarean Delivery Interval Duration and Its Impact on Maternal and Neonatal Outcomes: A Retrospective Cohort Study

Presenting Author: Jie Zhou MD, MS, MBA, FASA
Presenting Author's Institution: Brigham and Women›s Hospital, Harvard Medical School - Boston, MA
Co-Author: Yao Zhang MD - BWH
Li Zhuan MD, PhD - BWH

Background: There are estimated six hundred and fifty thousand repeat cesarean deliveries (CD) per year in the United States, which accounts for almost 15% of all annual deliveries. It has been well established that repeat cesarean may increase unavoidable maternal risks regarding to uterine rupture and abnormal placental plantation. We hypothesize that the interval duration between CDs could have an impact to maternal and birth outcomes. The objective of this study was to evaluate the association between CD interval duration (CDID) and maternal and perinatal outcomes.

Methods: We selected a cohort of full-term parturients who had repeat CD after primary CD in Partner HealthCare System from May 2015 to January 2019. Parturients' demographical and characteristics data of repeat CD were reviewed and analyzed from case files of patients (Table 1).

Results: One hundred and ninety-nine parturients were included and divided into four groups according to the CDID between two CDs (12-18 months, 18-24 months, 24-30 months, >30 months) (Table 1). The priority of CDs and neonatal birth weights were significantly different between the four groups. The anesthesia type, estimated blood loss, operative time, and Apgar scores showed no difference between the four groups. Postoperative maximum pain in four groups showed an upward trend in 20 hours after CD (Figure 1). We are conducting more data analysis on this project.

Discussion: Our data indicated that long CDID (>24 months) was associated with increased risk of emergent CD and low birth weight of neonates. However, we suspected that CDID alone might not be an independent risk factor for maternal and perinatal outcomes. We would like to bring this new concept of CDID to the attentions of clinical practitioners of obstetrics and anesthesia.

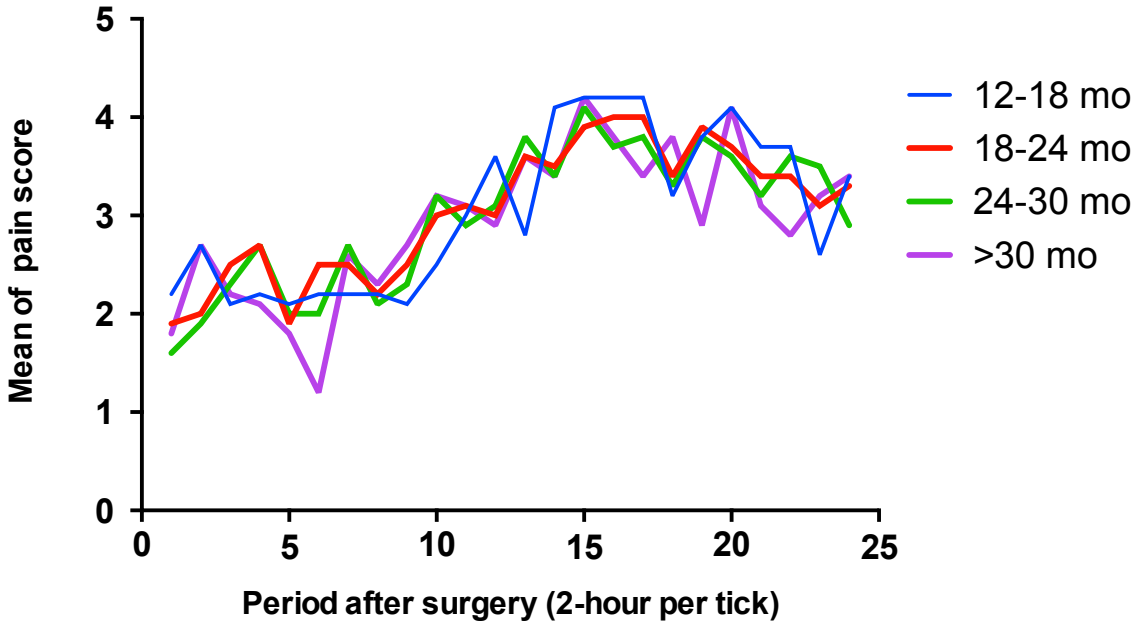
References:

1. Hanley GE, et al. 2017
2. Mburia-Mwalili A, et al. 2015

Table 1. Patients demographical data and characteristics of repeat cesarean

	12-18 mo	18-24 mo	24-30 mo	>30 mo	P value
Demographic and obstetric data					
Age (years)	31.9±4.8	33±4	33.3±3.2	35.7±3.3	<0.001
BMI(Kg/m^2)	30.6±6.7	29.9±6.6	33.5±17.8	31.4±7.8	0.291
Gestational age (weeks)	39±0.7	39.2±0.8	39.2±0.8	39.2±0.7	0.61
Anesthesia type					0.709
Spinal	29	55	50	17	
CSE	3	9	10	1	
Epidural	3	8	7	5	
General	0	1	1	0	
C/S Priority					0.022
Scheduled	31	57	45	16	
Unscheduled	4	15	19	5	
Emergent	0	1	4	2	
Procedure Duration(min)	46	53	55.5	50.5	0.544
EBL(ml)	800	750	700	800	0.461
Newborn					
Apgar 1min	8	8	8	8	0.369
Birth Weight (g)	3651.3±552.0	3635.6±414.1	3484.5±416.9	3492.3±314.9	0.019

Figure1. Postoperative Maxmium Pain Score



Abstract #: F3D-142

Pregnancy and delivery outcomes among women aged 40 and older who also delivered prior to age 40: A paired sample study

Presenting Author: Carolyn Weiniger MB ChB
Presenting Author's Institution: Tel Aviv Sourasky Medical Center - Tel Aviv, Israel
Co-Author: Aviva Reinitz-Green MD - Hadassah Hebrew University School of Medicine
Tali Bdolah-Abram PhD - Hadassah Hebrew University School of Medicine
David Mankuta MD - Hadassah Hebrew University Medical Center

Background: Morbidities and poor outcomes among women of advanced maternal age (AMA) are well reported. However outcomes of women who delivered both before and after age 40 have not been previously reported.

Methods: We searched medical records (2003-2014) to identify women who delivered at least once <40 and at least once ≥40 years of age. The primary outcome was cesarean delivery (CD) rate comparing the first and last delivery identified for each woman; we retrieved maternal and obstetric outcomes for all pregnancies and deliveries. Pregnancy-related complications recorded were diabetes, hypertension, placenta previa, varicose veins, hospitalizations during pregnancy, bleeding during pregnancy, anemia/thrombocytopenia, intrauterine growth restriction and preterm contractions. Risk for venous thromboembolism (VTE) was defined as hypercoagulable conditions and/or varicose veins. Categorical variables in the paired groups were compared using McNemar's test, and the p-value that presents the change over time (delivery <40 versus ≥40 versus years of age) is reported.

Results: Our cohort comprised 198 women and 645 individual births. Maternal age at first birth was mean(SD) 33.6(2.8) and last birth 41.3(1.5); parity was median(range) 2(0-9) and 4(1-14). The rate of CD was significantly higher in women ≥40, 10.6% versus 2.5% <40, p=0.002. This difference remained even after excluding all nulliparous births (11.1% ≥40 versus 2.2% <40, p=0.008). This rise in CD rate was affected by age but not by change in parity. More women ≥40 had co-morbidities (11.1% versus 0.5% <40, p<0.001) and more took medication during pregnancy (11.6% versus 2.5% <40, p=0.001). Pregnancy-related complications were reported more among women ≥40, 19.2% versus 9.6% <40, p=0.016. The frequency for VTE risk was 11.6% ≥40 versus 1% <40, p<0.001. Parity had a bigger effect on increased VTE risk than age (age-adjusted model, Odds Ratio=1.51, 95% CI 1.09-2.10, p=0.013). Second stage was shorter ≥40, 0.4±0.9 hours 95%CI (0.2-0.5), p< 0.001. For vaginal delivery, more women ≥40 did not receive neuraxial anesthesia even though they had used it in previous births, than women who labored without neuraxial anesthesia <40 and then received epidural ≥40 years (24.6% versus 4.9% respectively,
p<0.001).

Conclusions: AMA women have higher CD frequency delivering age ≥40 years compared to their deliveries <40 years of age. AMA women ≥40 suffer more from comorbidities, use more medication, have greater VTE risk, but use epidural analgesia less frequently even after using in previous deliveries. The increased complications among women ≥40 who delivered at least once <40 must be recognized. Shorter second stage may impact epidural accessibility, although the desire to receive epidural was not known in our cohort.

Abstract #: F3H-511

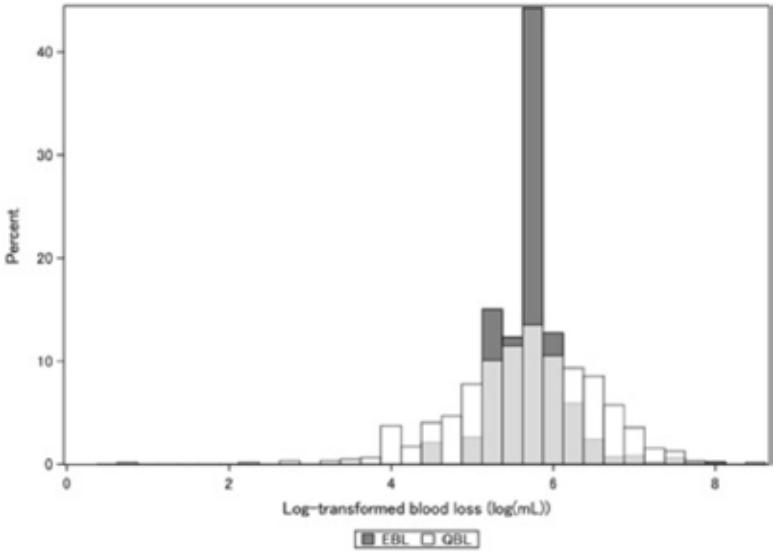
Introduction of a Novel System for Quantitating Blood Loss After Vaginal Delivery: A Retrospective Before-After Study

Presenting Author: Mario I Lumbreras-Marquez MBBS
Presenting Author's Institution: Brigham and Women›s Hospital - Boston, MA
Co-Author: Sharon C Reale MD - Brigham and Women's Hospital
Daniela A Carusi MD MS - Brigham and Women's Hospital
Julian N Robinson MD - Brigham and Women's Hospital
Kara G Fields MS - Brigham and Women's Hospital
Michaela K Farber MD MS - Brigham and Women's Hospital

Introduction: Postpartum hemorrhage (PPH) is the most common preventable cause of maternal mortality, and mechanisms to enhance quantitation are warranted (1). Both volumetric and gravimetric blood loss (BL) measurements are superior to visual estimation of blood loss (EBL), but a combination of these quantitative methods has not been evaluated. Here we compare PPH detection by EBL to a novel device for quantitation of BL (QBL) that combines both volumetric and gravimetric measurements.

Methods: After IRB approval, patients who had a vaginal delivery between October 1, 2017 and April 30, 2018 were identified. A QBL device was implemented on January 1, 2018. PPH and related outcomes were compared before (EBL) and after (QBL) device implementation. The primary outcome was incidence of PPH (BL > 500mL). Secondary outcomes were BL > 1000mL, mean BL, transfusion requirement, 2o uterotonic or vasopressor use, surgical procedures, and a composite outcome of interventions related to PPH. Post-hoc secondary outcomes assessed in the subgroup who had both pre- and post-delivery hematocrits (Hct) were nadir Hct, the incidence of postpartum Hct reduction > 10%, and the difference between EBL or QBL and calculated blood loss (CBL). Besides immediate post-delivery BL, all outcome comparisons were adjusted for potential confounders via inclusion of propensity score quintiles as covariates in multivariable regression models.

Results: PPH (BL > 500 mL) was detected in 26.5% (QBL) vs. 11.0% (EBL) of patients (aOR 2.94 (95% CI: 2.24, 3.87; p < 0.001)). BL > 1000 mL was identified in 6.7% vs. 2.0% of patients, respectively (aOR 3.28 (1.92, 5.78; p < 0.001)). There was no difference in other secondary outcomes. Median BL was 307 vs. 300 mL in QBL vs. EBL groups, with more even distribution by QBL (Figure). In the subgroup, mean difference between delivery BL and CBL was smaller in the QBL (mean ± SD: -301 ± 568 mL) vs. EBL group (-664 ± 631 mL; adjusted difference in means (95% CI): 353 mL (209, 497); p < 0.001).



Discussion: In this before-after study, use of comprehensive QBL increased PPH detection after vaginal delivery compared to EBL, but did not yield any difference in PPH-related interventions or outcomes. Closer proximity of QBL to CBL compared to EBL vs. CBL suggests accuracy of the QBL device. Further studies on the utility of QBL in different clinical settings are warranted.

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Abstract #: F3H-451

External validation of a multivariable prediction model for the diagnosis of placenta accreta in women with suspicion of placenta accreta spectrum

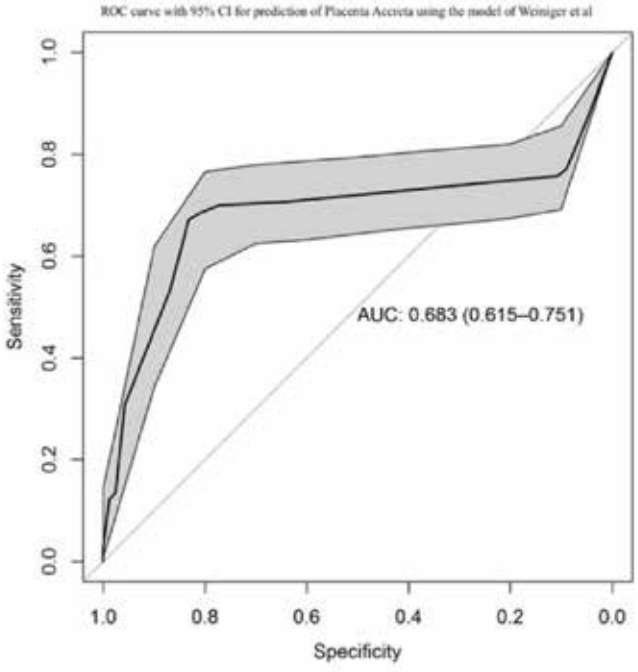
Presenting Author: Shubhangi Singh MBBS
Presenting Author's Institution: Brigham and Women›s Hospital - Boston, MA
Co-Author: Thomas D Shipp MD - Brigham and Women›s Hospital
Daniela A. Carusi MD - Brigham and Women's Hospital
Carolyn F. Weiniger MD - Tel Aviv Medical Center, Israel
Kara G Fields MS - Brigham and Women's Hospital
Michaela K Farber MD MS - Brigham and Women's Hospital

Background: Placenta accreta spectrum (PAS) is associated with major postpartum hemorrhage and increased morbidity. Anticipatory recognition is critical to minimize life-threatening hemorrhage from unexpected PAS. A previously published multivariable logistic regression model for the antenatal diagnosis of women with suspected PAS is based on 3 risk factors: prior cesarean delivery (CD), placenta previa, and ultrasound suspicion of PAS (1). We aimed to validate this prediction model.

Methods: Women who delivered at a single tertiary center between January 2007 and December 2017 with above risk factors were included in this analysis. Specifically, women with placenta previa and prior CD, and women with prior CD and/or placenta previa and ultrasound suspicion for PA. Women with prior CD or previa with a reassuring ultrasound were excluded. Risk scores for PA were calculated for each patient with the previously published prediction model. The ability of the model to discriminate between patients with and without PA was assessed by calculating the area under the receiver operating characteristic (ROC) curve (AUC). Sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) were calculated for the two probability cut-offs identified previously: 0.174 (corresponding to 100% sensitivity in model development sample) and 0.208 (corresponding to the optimal sensitivity/specificity tradeoff).

Results: Of 307 identified cases of suspected PAS, 140 (46%) were confirmed at the time of delivery. The model AUC when applied to our sample was 0.683 (95% CI: 0.615, 0.751) (Figure). The sensitivity, specificity, PPV and NPV for the probability cut-off of 0.174 in our sample were 75.7%, 10.8%, 41.6%, 34.6% respectively. The sensitivity, specificity, PPV and NPV for the probability cut-off of 0.208 were 70.7%, 64.1%, 62.3% and 72.3% respectively.

Conclusions: The current study offers validation of the prediction model for PAS described by Weiniger et al (1). As expected, the prediction model had a weaker ability to discriminate between patients with and without PAS in our external sample (AUC 0.683) than in the model development sample (AUC 0.846). Interestingly, specificity using the optimal cutoff was higher in our validation (64.1%) than in the original study (52.5%). Model discrimination may be improved by updating model coefficients and/or adding additional model predictors.



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1. Int J Obstet Anesth 2013;22:273-9.

Abstract #: F3H-177

Impact of Measuring Quantification of Blood Loss Versus Estimation of Blood Loss on Perioperative Resuscitation During Cesarean Deliveries

Presenting Author: Shamantha Reddy MD
Presenting Author's Institution: Montefiore Medical Center of the Albert Einstein College of Medicine
Co-Author: Akshay Bhatt MD - Montefiore Medical Center of the Albert Einstein College of Medicine
Singh Nair PhD - Montefiore Medical Center of the Albert Einstein College of Medicine
Takiyah Mitchell BS - Albert Einstein College of Medicine
Meleen Chuang MD - Montefiore Medical Center of the Albert Einstein College of Medicine

Background: Postpartum hemorrhage (PPH) is the leading cause of maternal morbidity and mortality. Delayed recognition of PPH from underestimation of blood loss is the major cause of PPH related maternal death.(1) Visual estimation of blood loss (EBL) is an unreliable measure of postpartum blood loss.(2) Quantification of blood loss (QBL), on the other hand, is an objective weight based technique to calculate blood loss. QBL is especially useful to quantify higher order blood loss compared to EBL.(3) The first aim of this study is to evaluate all cesarean deliveries (CD) at an academic medical center and determine if there is a statistically significant difference between QBL vs. EBL. The second aim is to determine whether the initiation of QBL led to increased recognition and intervention for PPH.

Methods: A retrospective review was conducted of all patients between Oct 2017 and Nov 2018 who underwent CD at an academic medical center. Since May 2018, the protocol for all CD included the documentation of EBL and QBL. Patient charts were reviewed for patient demographics, length of surgical procedure, pre and post-operative hematocrit, EBL, QBL (when documented), indication for CD, and peri-operative packed red blood cell transfusions.

Results: Out of a total of 749 CD, 369 CD had only EBL documented and 380 CD had EBL and QBL documented. The average EBL when documented alone (898cc ± 281cc) was significantly lower than the average EBL when documented with QBL (962cc ± 458cc), P = 0.020. For patients with both EBL and QBL documented, there was no statistically significant difference between the average EBL and the average QBL, P = 0.262. Furthermore, both EBL and QBL were poor predictors of post-operative hematocrit (r^2 = 0.033 and 0.021, respectively). CD with documented EBL and QBL had a significantly greater number of blood transfusions (40 CD, 9.5%) versus those with only EBL documented (18 CD, 4.9%), P = 0.012.

Conclusions: Our findings suggest that documenting QBL results in higher EBL and more frequent resuscitation with blood products, supporting the idea that quantitative measures may be more accurate in tracking intraoperative blood loss. These findings underscore the importance of integration of QBL into intraoperative evaluation in patients undergoing CD and it merits further study as a predictor of clinical outcomes.

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Abstract #: F3H-228

Intraoperative continuous noninvasive hemoglobin monitoring in patients with placenta previa undergoing Cesarean section: prospective observational study

Presenting Author: Sang-Hwan Do M.D., Ph.D.
Presenting Author's Institution: Seoul National University Bundang Hospital - Seongnam-si, Gyeonggi-do
Co-Author: Hyunsung Kim M.D. - Seoul National University Bundang Hospital
Sung-Uk Choi M.D., Ph.D - Korea University Anam Hospital
Sang-Tae Kim M.D., Ph.D - Chungbuk National University College of Medicine

Background: Obstetric patients with placenta previa are at risk for peripartum severe hemorrhage, which occur rapidly and unexpectedly. Early detection of anemia and following proper transfusion strategy are important for the management of obstetric hemorrhage. In this study, we assessed the utility and accuracy of noninvasive hemoglobin monitoring in patients with placenta previa during Cesarean section.

Methods: Parturients diagnosed with placenta previa and scheduled for Cesarean section under spinal anesthesia were enrolled. Noninvasive hemoglobin (SpHb) was measured by using the Radical-7 Pulse CO-oximeter (Masimo Corp., Irvine, CA, USA). Primary outcomes were the SpHb and Lab-Hb. Secondary outcomes were infused fluid volume, unit of transfusion, calculated blood loss during the operation, and urine output.

Results: Total 74 pairs of SpHb and Lab-Hb were collected from 39 patients. The correlation coefficient was 0.877 between the SpHb and Lab-Hb ($P < 0.001$). The Bland-Altman plot showed the mean difference ± SD as 0.3 ± 0.8 g/dl between noninvasive Hb and Lab-Hb, and the limits of agreement were -1.2 to 1.8 g/dl. The magnitude of the difference between the SpHb and Lab-Hb was < 0.5 g/dl in 64.9% of patients; however, 14.8% of measurements had a difference of > 1.0 g/dl.

Conclusion: Noninvasive Hb monitoring had good correlation with laboratory Hb. Small mean difference between the noninvasive SpHb and lab-Hb might not be clinically significant; however, the limit of agreements was not narrow. In particular, SpHb could be overestimated in anemic population. Based on our results, further studies investigating accuracy and precision of noninvasive Hb monitoring should be performed in parturient presenting Hb below 10 g/dl.

Abstract #: F3H-72

Peripartum Care of the Opioid Dependent Parturient: A Survey

Presenting Author: Melissa G Potisek MD
Presenting Author's Institution: Wake Forest University School of Medicine - Winston Salem, North Carolina
Co-Author: Lynnette Harris BSN - Wake Forest University
Laura Dean MD - Wake Forest University

Introduction: Opioid use and abuse is a national epidemic that deserves special attention in pregnancy. Opioid related deaths have quadrupled over the last 15 years, neonatal abstinence syndrome has increased by over 300% since year 2000, and maternal opioid use complicates 5.8/1000 hospital births. The unpredictability of delivery, inconsistency in prenatal care, and psychiatric and medical co-morbidities add complexity to the already difficult task of acute pain management in opioid dependent women. Since an ideal care pathway for these patients is not defined, we hypothesized that SOAP members would have variable practices/approaches to their care.

Methods: In order to define current approaches to this patient population, a survey was sent in spring of 2018 to all SOAP members regarding their personal and institutional practices around opioid dependent parturient. Respondents answered ten questions regarding the location and type of practice, practice patterns, and whether their institution approaches opioid dependent patients in an intentional way that is distinct from the care of an otherwise healthy parturient.

Results: We received 240 responses. Of these, 94 (38%) identified themselves as a section head or chair within their institution. Two hundred and nineteen (90%) of responders report almost always using intrathecal morphine for treatment of pain after cesarean section. Only 31 (12%) respondents reported that these patients are "always" seen by an anesthesiologist prior to delivery while others reported that this occurs sometimes (112, 45%), not usually (55, 23%), or almost never (44, 18%). Of responders, 162 (70%) reported buprenorphine or methadone are "almost always" continued as prescribed while the remaining 30% were unsure if the drugs are continued. Notably, 53 responders (22%) report having a standardized approach for opioid dependent patients around the time of delivery while 61 (25%) would like to have more guidance on how to approach these patients. Greater than 75% of respondents report using long acting neuraxial opioids, scheduled NSAIDs, and scheduled acetaminophen in their approach to this population, while less than half utilize post-operative epidural analgesia, patient controlled intravenous opioids, or transversus abdominis plane blocks. Less than 20% report utilizing intravenous ketamine and several responders free texted on the use of neuraxial clonidine, gabapentinoids, or lidocaine patches. Perceived contact with this patient population was as follows: 28 (10%) daily contact, 57 (23.3%) once per week, 71 (29%) once per month, 61 (25%) a few times per years, and 23 (9%) almost never.

Conclusion: This survey demonstrates variability within SOAP membership in the care of opioid dependent parturients. This survey data suggests the need for discussion, education, and expert consensus on the optimal care pathway for opioid dependent mothers.

Abstract #: F3H-71

Carbetocin as first line uterotonic in all categories of caesarean delivery? A five year retrospective analysis

Presenting Author: Flora Kormendy MD
Presenting Author's Institution: Hillingdon Hospital - Uxbridge, LONDON, Greater London
Co-Author: Flora K Kormendy MD - Hillingon Hospital
Con H Papageorgiou MB.ChB - Hillingdon Hospital

Introduction: Carbetocin is used to reduce the incidence of postpartum haemorrhage (PPH) in caesarean deliveries (CD). In vitro studies show its efficacy is reduced when it is used on pre-exposed myometrium therefore its use is only recommended in elective CD.1,2 We performed a retrospective analysis to assess whether the use of carbetocin in all categories of CD had any impact on rates and severity of PPH in our parturients.

Method: Data were extracted from the Euroking© database and patients were allocated into groups according to first line uterotonic, grade of CD and whether labour was augmented. Mean blood loss (MBL), incidence of major obstetric haemorrhage greater than 1000 mls (MOH) and the use of additional uterotonics were compared between groups. Variables such as age, body mass index (BMI) and parity were also collected. Data were analysed using student-T test and Chi-square test.

Results: 6040 caesarean deliveries were included in our analysis, of which 2098 (40.4% elective; 59.6% emergent) received oxytocin and 3942 (52.9% elective; 47.1% emergent) received carbetocin. In the emergent cohort, 34.2% had received augmentation. A statistically significant difference was found in emergent CD where carbetocin was superior to oxytocin (MBL: 655 mls vs 677 mls, p<0.01; MOH: 10.4% vs 13.7%, p<0.01).There was no difference between uterotonics in elective CD or when labour was augmented. Use of carbetocin significantly reduced the need for additional uterotonics both in elective (8.4% vs 15.9%, p<0.01) and emergent (10.4% vs 31.9%, p<0.01) CD (Table 1). Mean age was higher in the oxytocin group (35.3 vs 34.2, p<0.01) but BMIs were similar between the two groups (26.5 vs 26.7, p=0.54). There was a significant difference in the distribution of parity (oxytocin vs carbetocin: 21% vs 13% nulliparas, p<0.01; 43% vs 58% multiparas, p<0.01).

Conclusion: Our analysis indicates that carbetocin is non-inferior to oxytocin in preventing PPH in elective CD. However, in emergency CD, in contrast to in-vitro studies, carbetocin was found to be more effective than oxytocin in reducing MBL and incidence of MOH, although this may not be clinically significant. Carbetocin reduced the need for further uterotonics when compared to oxytocin in all CD.

References:

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Table 1.

	Elective			Emergency			Augmented labour		
	Oxy	Carb	p-value	Oxy	Carb	p-value	Oxy	Carb	p-value
MBL (mls)	586	599	0.51	677	655	<0.01	678	658	0.20
MOH (%)	6.3	7.4	0.26	13.7	10.4	<0.01	14.5	11.6	0.16
Extra Uterotonics (%)	15.9	8.4	<0.01	31.9	10.4	<0.01	35.3	14.7	<0.01

Abstract #: F3H-413

Impact of an Oxytocin Protocol on Secondary Uterotonic Use in Women Undergoing Elective Cesarean Delivery

Presenting Author: Paul Davis MD
Presenting Author's Institution: Mayo Clinic - Rochester, MN
Co-Author: Emily Sharpe MD - Mayo Clinic
Hans Sviggum MD - Mayo Clinic
Rochelle Molitor MD - Mayo Clinic
Andrew Hanson BS - Mayo Clinic
Katherine Arendt MD - Mayo Clinic

Background: Postpartum hemorrhage (PPH) complicates 2.9% of all deliveries and is associated with 19.1% of all in-hospital deaths after delivery. Prophylactic oxytocin immediately after delivery is recommended to prevent uterine atony. Potentially serious dose-dependent side effects from oxytocin have been described including hypotension, arrhythmias, and even cardiovascular collapse. In spite of this, the dose and rate of oxytocin administration varies widely across institutions. The utilization of a standardized oxytocin protocol has been shown to achieve adequate uterine tone with lower oxytocin doses compared to "free flow" oxytocin administration(1). In this study, we hypothesize the use of a standardized oxytocin protocol based on the "Rule of Threes"(2) will decrease secondary uterotonic use compared to an unmeasured oxytocin infusion.

Methods: In this single-center retrospective cohort study, we compared the effectiveness of a Rule of Threes oxytocin protocol (POST) to our previous oxytocin administration practice (PRE) in women undergoing elective cesarean delivery (CD). The PRE group underwent CD between 1/1/2010 through 12/31/2013, and received oxytocin (1 unit/100 cc) in a freely running infusion of one liter Lactated Ringer's. The POST group underwent CD between 1/1/2015 and 8/31/2017, and received between 1 and 3 separate 3 unit micro-boluses of oxytocin over 30 seconds 3 minutes apart followed by an oxytocin infusion per the Rule of Threes algorithm. Data regarding patient demographics, indication for CD, number of oxytocin micro-boluses, secondary uterotonic use, estimated blood loss, and transfusion requirements were collected. The primary outcome was secondary uterotonic use. Secondary outcomes included time to secondary uterotonic administration and estimated blood loss.

Results: There were 437 women in the PRE group and 415 women in the POST. There were no differences in patient demographics except higher pre-delivery magnesium use in the POST group (4% vs. 9%, P=0.01). There was no difference in frequency of secondary uterotonic use or time to secondary uterotonic administration. Estimated blood loss was significantly lower in the POST group.

*Table – Univariable summary of outcomes**

	Pre-protocol (N=437)	*Post-protocol (N=415)*	*P* Value
Any secondary uterotonic			0.44
. No	413 (95%)	397 (96%)	
. Yes	24 (5%)	18 (4%)	
Time to secondary uterotonic (m, n=24/18)	38 (13, 141)	76 (47, 161)	0.26
Estimated blood loss (mL)	878 (197)	821 (153)	<.001

* Continuous outcomes are presented as median (Q1, Q3) or mean (standard deviation) and compared with Wilcoxon rank-sum tests. Secondary uterotonic presented as n (%) and compared with a Pearson Chi-square test. Summary of time to secondary uterotonic is limited to those who required secondary uterotonic.

Conclusion: In spite of increased magnesium use, the use of a standardized oxytocin algorithm did not decrease secondary uterotonic medications but did decrease the estimated blood loss.

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2. Kovacheva V et al. Anesthesiology 2015; 123:92-100.

Abstract #: F3H-431

The Inter-Rater Reliability of a 0 to 10 Uterine Tone Score

Presenting Author: Ibrahim Abushoshah MD
Presenting Author's Institution: Brigham and Women›s Hospital - Boston, MA
Co-Author: Michaela K Farber MD - Brigham and Women›s Hospital
Kara G Fields MS - Brigham and Women's Hospital
Daniela A Carusi MD MS - Brigham and Women's Hospital
Brian T Bateman MD MPH - Brigham and Women's Hospital
Naida M Cole MD - Brigham and Women's Hospital

Introduction: Postpartum hemorrhage (PPH) complicates 3% of all deliveries in the United States and uterine atony is the etiology in the majority of cases1. Obstetricians assess uterine contractile tone immediately after each cesarean delivery (CD) before closing the hysterotomy; enhanced communication about uterine atony may improve PPH management. Several quantitative scales describing uterine tone have been utilized in research studies with a 0-10 scale most commonly reported2-5. However, no scale has been standardized or validated. We evaluated the inter-rater reliability of a 0-10 visual analog scale (VAS) used to quantify the adequacy of uterine tone as assessed by obstetricians during CD.

Methods: This was a single-center prospective observational study. After waiver of IRB consent, patients undergoing CD for any indication were enrolled in the study from August through November 2018. Using a VAS of 0-10 with \"0\" being no tone and \"10\" excellent tone, two obstetricians independently rated uterine tone at 3 and 10 minutes post-delivery. Obstetricians reported uterine tone VAS independently by silently pointing to a printed VAS held by the anesthesiologist through a clear sterile drape. To maintain blinding, the second participating obstetrician looked away during each rating. Inter-rater agreement was assessed by Bland-Altman analysis and reliability by interclass correlation coefficient (ICC) for average between two raters.

Results: Ninety-three patients were enrolled with 8 patients excluded from analysis due to discussion of uterine tone prior to VAS scoring; 82 and 84 scores were collected from pairs of 62 unique raters at 3 and 10 minutes, respectively. Scores obtained by each rater pair were within ±1 point of each other in 74.4% of cases at 3 minutes (95% CI: 64.0%, 82.6%) and 84.5% of cases at 10 minutes (95% CI: 75.3%, 90.7%). The mean difference in scores between rater 1 and rater 2 (95% CI) was 0.4 ± 1.4 at 3 minutes and 0.1 ± 1.1 at 10 minutes. For the lower tertile subset (mean scores of 4.7 ± 1.1 and 7.1 ± 1.1 at 3 and 10 minutes respectively), the mean difference in scores between rater 1 and rater 2 was 0.5 ± 1.5 at 3 minutes and 0.3 ± 1.3 at 10 minutes. Bland-Altman analysis indicated a 95% limit of agreement between raters of -2.4 (95% CI: -3.0, -1.9) to 3.1 (95% CI: 2.6, 3.7) at 3 minutes and -2.1 (95% CI: -2.5, -1.7) to 2.4 (95% CI: 2.0, 2.8) at 10 minutes. ICCs (95% CI) at 3 and 10 minutes were 0.80 (0.71, 0.87) and 0.76 (0.63, 0.84), respectively.

Conclusion: Reliability of the 0-10 VAS tone score was good when averaged across two raters at 3 and 10 minutes. This suggests that the score is a valid scale and can be used in clinical practice and research for quantifying uterine tone.

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5. Anesth Analg. 1997;84(4):753-6

Abstract #: F3H-438

Institution of Low-dose Oxytocin Protocol for Cesarean Delivery Without Antecedent Labor.

Presenting Author: Andrew Agoliati MD
Presenting Author's Institution: NYU School of Medicine - New York, NY
Co-Author: Andrew Agoliati MD - NYU School of Medicine
Ghislaine C Echevarria MD MS - NYU School of Medicine
Eli Zarkhin MD - NYU School of Medicine
Christina Dgheim DO - NYU School of Medicine
Gilbert J Grant MD - NYU School of Medicine

Introduction: Postpartum hemorrhage (PPH) is the leading cause of maternal morbidity and mortality worldwide[1]. Prophylactic post-delivery oxytocin administration is the most common practice used to prevent PPH. Untoward side effects of oxytocin are dose-dependent. The standard oxytocin regimen for cesarean delivery formerly used in our hospital was to administer a total 40 IU of oxytocin (20 IU per 1L crystalloid) following delivery of the placenta. After publication of the "Rule of Threes" [2], we decided to incorporate a lower dose oxytocin protocol into our practice. The change was made in November 2017, and was standard practice by January 1, 2018. Upon delivery of the placenta, we administer 3 IU of oxytocin i.v. and after 3 min the obstetrician assesses uterine tone. If the tone is not adequate, the cycle is repeated two more times, if necessary, up to a total of 9 IU. If uterine tone remains inadequate, we administer second-line uterotonics. Postoperatively, an infusion 2.5 IU/hour of oxytocin is started in the PACU, and continued for a total of 8 hours. The aim of this study was to evaluate the impact of this new low-dose oxytocin protocol on quantified blood loss (QBL) for planned cesarean delivery.

Methods: We retrospectively reviewed the electronic health records of 3,260 patients who underwent cesarean delivery from November 2015 to December 2018 at our institution. The months of November and December 2017 were excluded, as this was the interval when the new low-dose oxytocin protocol was being introduced. Our standard oxytocin regimen was in effect through October 2017, and the new protocol was in effect from January 2018 through December 2018. For each encounter we extracted demographic data, obstetrical information, and QBL. All patients with multiple gestations or those in labor prior to cesarean were excluded. Stepwise multiple linear regression was used to assess the association between the change in oxytocin protocol and QBL, adjusted for potential confounder variables (p value of <0.25 in the univariable analysis).

Results: There was a statistically significant association between the implementation of the new low-dose oxytocin protocol and QBL, adjusted for gestational age and birth weight (b coefficient [b] = -84 mL, 95% confidence interval [CI], -130 to -37, p value<0.001).

Discussion: Implementation of a new low-dose oxytocin protocol of at our institution was associated with a lower QBL, a proxy for uterine tone. While we recognize that other factors are involved with blood loss during cesarean delivery in addition to inadequate uterine tone, the introduction of this new oxytocin regimen at our hospital has resulted in a decrease in the dose of oxytocin administered and a concomitant reduction in QBL for planned cesarean deliveries.

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Abstract #: F3H-449

Institution of Low-dose Oxytocin Protocol for Cesarean Delivery After Labor Arrest.

Presenting Author: Ghislaine C Echevarria MD MS
Presenting Author's Institution: NYU School of Medicine - New York, NY
Co-Author: Ghislaine C Echevarria MD MS - NYU School of Medicine
Andrew Agoliati MD - NYU School of Medicine
Christina Dgheim DO - NYU School of Medicine
Jerome Lax MD - NYU School of Medicine
Gilbert J Grant MD - NYU School of Medicine

Introduction: Oxytocin administration augments myometrial contraction and decreases blood loss, but may also produce vasodilatation, hypotension and tachycardia [1]. Optimal oxytocin dosing should reduce blood loss while minimizing untoward systemic effects. After publication of the "Rule of Threes" [2], we decided to incorporate a lower dose oxytocin protocol into our practice. Upon delivery of the placenta, we administer 3 IU of oxytocin i.v. and after 3 min the obstetrician assesses uterine tone. If the tone is not adequate, the cycle is repeated two more times, if necessary, up to a total of 9 IU. If uterine tone remains inadequate, we administer second-line uterotonics. Postoperatively, an infusion of oxytocin at 2.5 IU/hour is started in the PACU, and continued for a total of 8 hours. Previously, our practice was to administer 40 IU of oxytocin i.v. during the interval from delivery of the baby to departure from the OR. This study evaluated the effect of this new low-dose oxytocin protocol on quantified blood loss (QBL) in unplanned cesarean delivery for labor arrest.

Methods: We analyzed the electronic medical records of cesarean delivery after labor arrest from November 2015 to December 2018. The months of November and December 2017 were excluded, as this was the interval when the new low-dose oxytocin protocol was being introduced. The "old" protocol was in effect through October 2017 and the new protocol was in effect from January 2018 through December 2018. For each encounter we extracted demographic data, obstetrical information (use of oxytocin either for induction and/or augmentation of labor, birth weight, gestational age, parity), and QBL. Propensity scoring (PS) methods (matching and inverse weighting) were used to compare the pre (n=917) and post intervention period (n=678), after controlling for selection bias.

Results: Based on the PS matched sample, the QBL during the new low-dose protocol was not statistically different than the "old" protocol (b coefficient [b] = 14 mL, 95% confidence interval [CI], -71 to 100, p=0.75). Similar results were obtained after PS weighting, using the average treatment effect on the treated [ATT] (b: -18 mL; 95%CI, -95 to 60, p=0.66).

Discussion: In cesarean deliveries for labor arrest, the implementation of a new low-dose oxytocin protocol was not associated with a decrease in QBL, compared to our "old" dosing regimen. We used QBL as a surrogate for uterine tone. The oxytocin dose needed to achieve adequate uterine tone is greater in patients who have been exposed to oxytocin during labor. This may be due to desensitization of uterine oxytocin receptors [3], and may explain why the low-dose oxytocin used in this population was insufficient to induce the necessary increase in uterine tone.

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Abstract #: F3I-550

Poverty Guideline and Its Association with Assisted Reproductive Technology in the United States

Presenting Author: Jie Zhou MD, MS, MBA, FASA
Presenting Author's Institution: Brigham and Women›s Hospital, Harvard Medical School - Boston, MA
Co-Author: Fan Li MS - BWH
Danran Zhou BS - BWH
Li Zhuan MD - BWH

Background: Approximately 15% of women of reproductive age who are infertile at any time worldwide. With the development of the assisted reproductive technology (ART), in 2015 alone, there was more than 66,000 ART infants born in Unite States. The affordability of the ART has been a concern. The aim of our study was to evaluate the correlation of poverty guideline and the outcomes of ART in the United States.

Methods: Data of ART outcomes from 2009 to 2015 were obtained from the Centers for Disease Control and Prevention system. ART procedures performed, ART embryo-transfer procedures, ART pregnancies, ART live-birth deliveries, ART singleton infants, ART multiple-birth infants and ART infants born were collected. The databases of poverty guideline of state were collected from Office of the Assistant Secretary for Planning and Evaluation. The correlation of poverty guideline and the outcomes of ART were compared across the seven years using Pearson's analysis. To assess the outcomes of ART practices, each outcome was calculated using the following formula: number of each outcome/ number of ART procedures performed, trends from 2009 to 2015 across different ART outcomes were also evaluated.

Results: The five ART outcomes differed significantly, the printout indicate that the strength of association between poverty guideline and the outcomes of ART are very high (r2>0.9), with the improve of poverty guideline of state, the number of ART procedures and infants born increased (Figure 1). Between 2009 and 2015, the total number of ART procedures performed has increased nearly 20 percentage, appeared a continued improvement. Data analysis further showed that the ART multiple live-birth deliveries decrease rate was 17%, ART singleton live-birth deliveries increase rate was 48%, and the ART infants born increase rate was 15%, which trends were statistically significant.

Discussion: With the raise of poverty guideline and greatly improved ART, there has been an increase of ART procedures performed. The number of ART infants born showed year-on-year growth trend. Currently, there are only 15 states offer health insurance coverage of ART. We advocate for state legislative support for better coverage of ART.

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Abstract #: F3I-550

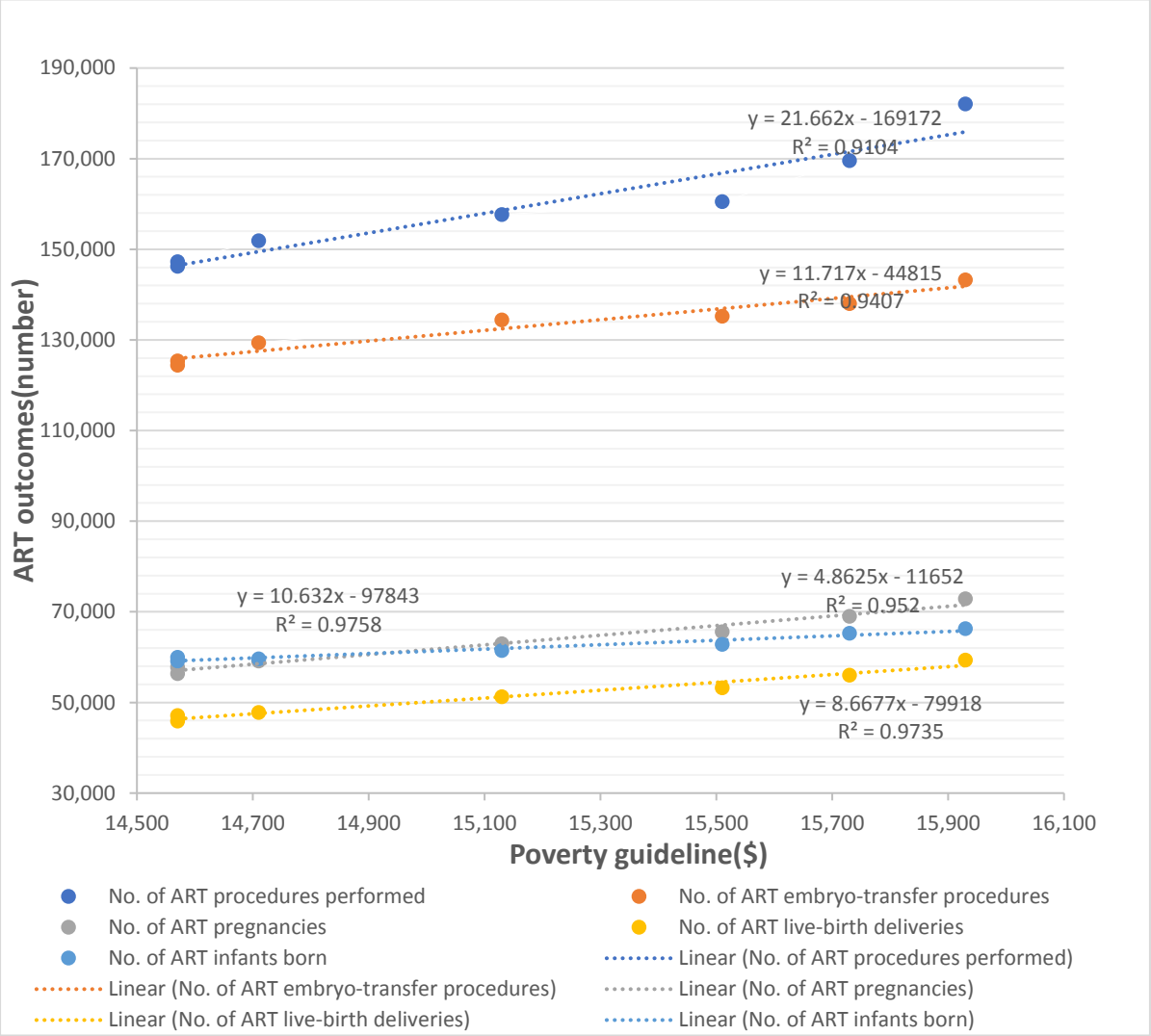

Figure1.The correlation of poverty guideline and ART outcomes

Abstract #: F3I-557

Correlation of State Political Party Strength and Performance of Assisted Reproductive Technology

Presenting Author: Jie Zhou MD, MS, MBA, FASA
Presenting Author's Institution: Brigham and Women›s Hospital, Harvard Medical School - Boston, MA
Co-Author: Danran Zhou BS - BWH
Fan Li MS - BWH
Li Zhuan MD, PhD - BWH

Background: As the primary medical procedure to address infertility, assisted reproductive technology (ART) has helped many to reach their dreams of parenthood. Aside from common success factors such as age, previous pregnancy, and fertility related problems, economic and political factors may also contribute to infertility. We hypothesized that the trend of ART performance rates might have influence from the state's political party strength.

Methods: Numbers of ART performances for 49 states from 2009 to 2015 were collected from the Center for Disease Control and Prevention. The District of Columbia and state of Nebraska were excluded from the study, since they have different party structures. Risk factors included state Growth Domestic Product (GDP), state insurance coverage for ART, and political party strength. We divided states into two groups according to their health insurance coverage legislation: the ones that require or offer infertility treatments (17 states), and the states do not offer coverage (32 states). With regards to the states' political party strength, we focused on the change of power of state control. A linear mixed effect model with a time dependent covariate was used for analyzing the interactions between the risk factors and the number of ART performances.

Results: Strong positive correlation between the state GDP and ART performances was found ($p<0.0000001$). The number of ART performances decreased if state control changed from Democratic to Republican or Divided ($p=0.02$), and increased if the shift was reversed in direction ($p=0.009$). States which do not offer healthcare with infertility treatments showed a significantly lower ART performance amount than those which do offer or require insurance coverage of infertility treatments ($p=0.008$). Among these figures, most of the states which offered infertility treatments are Democratic controlled (12 states). However, if no infertility treatment coverage offered or required, the number of ART performances from Republican controlled or divided states were higher than Democratic states ($p=0.004$).

Discussion: Our study demonstrated significant fluctuations in the number of ART performances when state political party strength shifted, which implied sociopolitical influence on medical performance in general. This result further suggested that political factors could be a component of the underlying mechanism triggering health inequality in the United States. Despite that Democratic controlled states might have provided better healthcare, which led to higher ART performance rates, states with Divided or Republican controlled tend to have more ART cases with no treatment coverage. This implied that those Republican controlled or divided states might have supplementary public welfare benefits or other factors promoting ART. Further study should be performed to explore this matter.

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1. Rodriguez JM. Int J Epidemiol 2014
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Abstract #: F3I-128

De-coding obstetric codes: a retrospective cohort study in a high-risk tertiary care centre.

Presenting Author: Jillian Taras MSc, MD
Presenting Author's Institution: University of Toronto - Toronto, Ontario
Co-Author: Mrinalini Balki MBBS, MD - Mount Sinai Hospital
Gita Raghavan MD - Mount Sinai Hospital

Background: The World Health Organization estimates that for every maternal death there are just over five near misses [1]. Obstetric specific rapid response teams (RRTs) have been developed for obstetric emergencies, but there is limited literature on their role and impact. This study aimed to better understand obstetric near misses by examining obstetric codes, RRT efficiency and patient outcomes.

Methods: We conducted a retrospective chart review on obstetric codes from Jan 1, 2014 to May 31, 2018. This included: "Code 77" (C77, obstetric emergency), "Code Blue" (CB, cardiopulmonary compromise) and "Code Omega" (CO, massive transfusion). Data on maternal, obstetric and RRT characteristics, etiology, resuscitation and maternal/neonatal outcomes was collected.

Results: 147 codes were identified in 29,862 deliveries (C77 n=110; CB n=12; CO n=25). The incidence of obstetric codes was 492 per 100,000 deliveries. The incidence of maternal and neonatal mortality after codes was 0.68% and 7%, respectively. The most common code etiologies were fetal bradycardia (63%) and cord prolapse (32%) for C77 and postpartum hemorrhage and amniotic fluid embolism for both CB (23%,23%) and CO (68%,16%) (Table 1). The most common obstetric conditions associated with C77 were premature rupture of membranes (28%) and preterm labor (18%); for CB were preeclampsia (36%) and placenta previa (18%); for CO were invasive placentation (43%), placenta previa (24%) and gestational diabetes (24%). 61% of codes were called after hours. The median (IQR) time (min) for RRTs to arrive was 2 (1,3) for C77, 3.5 (2,5) for CB and 6.5 (3,11) for the first blood product to arrive for CO. The decision to delivery interval was 8 (5,15) min after C77. An obstetrics and anesthesia staff/fellow, respiratory therapist/anesthesia assistant were present at least 80% of the time. Emergency cesarean delivery (CD) was performed after most (57%) codes and general anesthesia was administered in 62% of CDs. Five patients who had CB received chest compressions and four received defibrillation. Ten women required hysterectomy after CO. Major maternal morbidity was seen in 31%. Debrief was documented in only 4% of codes.

Conclusion: We have identified high-risk patients for various obstetric codes who may benefit from closer peripartum monitoring. Adequate staffing, education and debriefing of RRTs are essential to ensure safe and timely CD and resuscitation.

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Abstract #: F3I-128

Variable	Overall N=147	Code 77 N=110	Code Blue N=12	Code Omega N=25
Etiology of code, N (%)				
Fetal bradycardia	73 (49.6)	69 (62.7)	2 (16.7)	2 (8.0)
Cord prolapse	35 (23.8)	35 (31.8)	0 (0)	0 (0)
Postpartum hemorrhage	20 (13.6)	0 (0)	3 (25.0)	17 (68.0)
Placental abruption	13 (8.8)	12 (10.9)	0 (0)	1 (4.0)
Related to artifical rupture of membranes	13 (8.8)	13 (11.8)	0 (0)	0 (0)
Precipitous labor	13 (8.8)	13 (11.8)	0 (0)	0 (0)
Footling breech	9 (6.1)	9 (8.2)	0 (0)	0 (0)
Amniotic fluid embolism	8 (5.4)	1 (0.9)	3 (25.0)	4 (16.0)
Difficult fetal extraction	7 (4.8)	7 (6.4)	0 (0)	0 (0)
Cardiac arrest	5 (3.4)	1 (0.9)	2 (16.7)	2 (8.0)
Preeclampsia	4 (2.7)	2 (1.8)	2 (16.7)	0 (0)
Seizure	2 (1.4)	0 (0)	2 (16.7)	0 (0)
Atrial fibrillation	1 (0.7)	0 (0)	1 (8.3)	0 (0)
Uterine rupture	1 (0.7)	1 (0.9)	0 (0)	0 (0)
Timing of code, N (%)				
During labor	87 (59.2)	87 (79.1)	0 (0)	0 (0)
Postpartum	27 (18.4)	n/a	8 (66.7)	19 (76.0)
Antepartum	23 (15.6)	20 (18.2)	1 (8.3)	2 (8.0)
During delivery	12 (8.2)	3 (2.7)	3 (25.0)	6 (24.0)
Location of code, N (%)				
Labor and delivery	70 (51.5)	64 (60.4)	3 (33.3)	3 (14.3)
Operating room	33 (24.3)	10 (9.4)	5 (55.6)	18 (85.7)
Antenatal floor	23 (16.9)	22 (20.8)	1 (11.1)	0 (0)
Outside labor and delivery	10 (7.4)	10 (9.4)	0 (0)	0 (0)
Unknown	11 (7.5)	4 (3.6)	3 (33.3)	4 (16.0)
Personnel calling code, N (%)				
Obstetrician	59 (40.1)	54 (49.1)	3 (25.0)	2 (8.0)
Registered nurse	38 (25.9)	36 (32.7)	2 (16.7)	0 (0)
Anesthesiologist	27 (18.4)	1 (0.9)	6 (50.0)	20 (80.0)
Emergency medicine physician	5 (3.4)	5 (4.5)	0 (0)	0 (0)
Midwife	4 (2.7)	4 (3.6)	0 (0)	0 (0)
Hospital security	4 (2.7)	4 (3.6)	0 (0)	0 (0)
ICU team	2 (1.7)	0 (0)	0 (0)	2 (8.0)
General practitioner	1 (0.7)	1 (0.9)	0 (0)	0 (0)
Unknown	6 (4.1)	4 (3.6)	1 (8.3)	1 (4.0)
Personnel present at code, N (%)				
Obstetrics staff/fellow	143 (97.3)	108 (98.2)	10 (83.3)	25 (100.0)
Respiratory therapist	125 (85.0)	95 (86.4)	9 (75.0)	21 (84.0)
Anesthesia staff/fellow	122 (83.0)	87 (79.1)	10 (83.3)	25 (100.0)
Obstetrics resident	105 (71.4)	83 (75.5)	7 (58.3)	15 (60.0)
Neonatalogy resident	68 (46.3)	62 (56.4)	1 (8.3)	5 (20.0)
Anesthesia resident	63 (42.9)	42 (38.2)	7 (58.3)	14 (56.0)
Anesthesia assistant	61 (41.5)	41 (37.3)	6 (50.0)	14 (56.0)
Neonatalogy staff/fellow	29 (19.7)	28 (25.5)	0 (0)	1 (4.0)
ICU staff/fellow	12 (8.23)	2 (1.8)	5 (41.7)	5 (20.0)
ICU resident	10 (6.8)	2 (1.8)	5 (41.7)	3 (12.0)
Internal medicine physician	10 (6.8)	0 (0)	7 (58.3)	3 (12.0)
Midwife	7 (4.8)	6 (5.5)	0 (0)	1 (4.0)
ICU nurse	6 (4.1)	2 (1.8)	2 (16.7)	2 (8.0)
Emergency medicine physician	4 (2.7)	4 (3.6)	0 (0)	0 (0)
Hematology physician	3 (2.0)	0 (0)	1 (8.3)	2 (8.0)
Response time, minutes [Median,(IQR)]				
Code call to team arrival		2 (1,3)	3.5 (2.3,4.8)	6.5 (3.3,10.8)*
Code call to patient in operating room		2 (1,3)		
Operating room to skin incision		6 (4,9)		
Decision to delivery interval		8 (5,15)		
Maternal morbidity, N (%)				
ICU Admission	26 (18.4)	1 (0.9)	8 (72.3)	17 (81.0)
Post-code transfusion	17 (12.1)	6 (5.5)	4 (36.4)	7 (33.3)
Surgical site infection	11 (7.8)	5 (4.6)	1 (9.1)	5 (23.8)
Re-admission to hospital	10 (7.1)	6 (5.5)	1 (9.1)	3 (14.3)
Sepsis	6 (4.3)	2 (1.8)	2 (18.2)	2 (9.5)
Cardiac failure	3 (2.1)	0 (0)	3 (27.3)	0 (0)
Acute kidney injury	3 (2.1)	0 (0)	2 (18.2)	1 (4.8)
Pulmonary edema	2 (1.4)	0 (0)	1 (9.1)	1 (4.8)
Neurological impairment	1 (0.7)	1 (0.9)	0 (0)	0 (0)
Return to operating room	1 (0.7)	0 (0)	0 (0)	1 (4)
Matenal mortality, N (%)				
	1 (0.7)	0 (0)	1 (9.1)	0 (0)

*ICU=intensive care unit; IQR = interquartile range; *Time to first blood product arrival*

Abstract #: F3I-359

Geographic proximity to care in obstetric patients with morbidly adherent placenta: A population-based cohort study

Presenting Author: Rochelle J. Molitor MD
Presenting Author's Institution: Mayo Clinic - Rochester, Minnesota
Co-Author: Sarah Rae Easter MD - Brigham & Women›s Hospital
Brian T. Bateman MD, MSc - Brigham & Women's Hospital

Background: Morbidly adherent placenta (MAP) is associated with an increased risk of severe maternal morbidity (1). National guidelines recommend that women with MAP deliver at an experienced center with access to multidisciplinary care, which has been shown to improve outcomes (2, 3). Little is known about the availability of such centers, especially for women living in rural or remote areas for whom travel to an appropriate facility may be challenging. The aim of this study was to identify delivery patterns of women with MAP and determine whether geographic proximity to risk-appropriate care affects delivery location.

Methods: In this population-based cohort study, we utilized data from the Health Care Utilization Project's State Inpatient Database (SID), which included all hospital delivery admissions in six states (FL, NJ, NY, NC, OR, and WA) in 2014. We used a previously validated algorithm to identify all women with MAP who underwent a peripartum hysterectomy (1). Delivery location was characterized by linking the SID to the American Hospital Association's Annual Survey. We defined an experienced MAP center (EC) as a hospital that performed ≥ 10 annual peripartum hysterectomies based on reported case volumes from recognized ECs (2). The distance from patients' homes to the nearest EC was approximated using geodetic distance between zip codes. Associations were modelled using multivariable logistic regression.

Results: A total of 362 MAP cases were identified, 42.3% of which delivered at an EC. The median distance from the patients' homes to an EC was 16.1 miles (25th percentile 5.8 miles, 75th percentile 53.7 miles). Only 14.4% of women living in the farthest quartile from an EC delivered at one compared to 67.8% in the nearest quartile. Patients who lived in the farthest quartile from the nearest EC were 88% less likely to deliver at an EC compared to those living in the closest three quartiles, after adjusting for patient comorbidity burden, race, and income quartile (aOR 0.12, 95% CI 0.06, 0.25).

Conclusion: Women living farthest from an EC were least likely to deliver at a high-volume MAP center, suggesting that geographic location may impede access to appropriate care. Systems should be developed to ensure appropriate referral processes and adequate access to care for women with MAP who live in rural locations.

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Abstract #:F3I-476

Analysis of YouTubeTM Content Regarding Labor Epidurals and Pain Relief During Labor

Presenting Author: Jennifer Hong MD, MBA
Presenting Author's Institution: University of Colorado School of Medicine
Co-Author: Joy Hawkins MD - University of Colorado School of Medicine
Christina Wood MD, MS - University of Colorado School of Medicine
Rachel Kacmar MD- University of Colorado School of Medicine

Of the approximately 4.1 mil annual live deliveries, 60% of patients with vaginal deliveries elect neuraxial anesthetic for labor pain. Yet, the method in which patients learn about labor and analgesic options varies widely, ranging from health care providers, word of mouth from friends and family, and social media.

A wealth of information is available on the internet for understanding weekly changes in pregnancy and preparing for labor. YouTube™ is one social media platform with a large audience: greater than 1.9 bil registered viewers with approximately 5 billion videos viewed daily. Other studies have examined the quality of health-related topics on social media, specifically YouTube™ . However, no study has been performed to evaluate the quality and accuracy of information related to labor epidurals and pain relief options. In this presentation, we reveal our preliminary evaluation of YouTubeTM videos on labor epidurals.

We reviewed 150 YouTube™ videos, viewing the first 50 video results for the following search phrases: "obstetric epidural anesthesia," "labor epidural," and "labor pain." We used 2 tools for evaluating the content quality and understandability. The DISCERN instrument is a 15-question questionnaire that can be used to judge the reliability and quality of information discussing possible treatment choices offered in media. The scoring for each question can be rated on a scale of 1 (lowest) to 5 (highest) and averaged after the evaluation. The AHRQ Patient Education Material Assessment Tool (PEMAT) was used to assess the understandability and actionability of the content through a 26-question survey with rating choices of agree, disagree, and not applicable. Content was on a scale of 0-100%.

General characteristics of the YouTube™ videos are as follows: The average length of videos was approximately 11 minutes. Number of views ranged from teens to over 4 million. The subject of videos ranged from patient education materials, procedural videos, formal lectures, to personal vlogs (46% of "labor epidurals" captured personal YouTube™ channels). With preliminary evaluation of videos, the average rating of videos via the DISCERN instrument was low at 1.71, indicating that the majority of videos lack sufficient discussion of risks and benefits for patients to make an informed decision. Average PEMAT values were 57%, suggesting that most available resources are not appropriate for the general audience. We plan to present the full descriptive results at the SOAP meeting.

Overall, top results on YouTube™ contain very few videos with informative, accurate, and understandable materials for pregnant women seeking to learn about labor analgesia. This initial evaluation unsurprisingly reveals an opportunity for improved patient education through one of the most used social media platforms. Further studies will be needed to determine how best to capture viewing audiences and how SOAP could contribute meaningful patient education

Abstract #: F3I-485

Opioid Stewardship: A Quality Improvement Initiative

Presenting Author: Lacey Straube MD
Presenting Author's Institution: University of North Carolina - Chapel Hill, North Carolina
Co-Author: Christine P McKenzie MD - University of North Carolina
Brent Harkrider MD - University of North Carolina
Matthew Hallman MD - University of North Carolina
Sarah McShane BS - University of North Carolina
Clark McCall MHA - University of North Carolina

Introduction: Overprescription of opioids is common after CD and contributes to the opioid crisis. Our ongoing QI initiative focuses on CD analgesia, opioid prescribing, and patient education. The first phase aimed to reduce inpatient opioid use. The second phase aimed to reduce opioid overprescription.

Methods: Phase 1: Prior to Oct 2016, patients received variable PRN NSAID regimens, PRN opioid-acetaminophen tabs, and IV opioids. In Oct 2016, an anesthesia-created order set of scheduled NSAIDs and acetaminophen and PRN oral oxycodone was implemented. Outcome measures included opioid consumption 0-24, 25-48, and 49-72 hrs postpartum, length of stay (LOS), and proportion of patients using no opioids.

Phase 2: In Jun 2017, it was recommended providers standardly prescribe 20 tabs of oxycodone. In Nov 2018, select providers began using a simple algorithm to tailor opioid prescribing. At the time of discharge, the number of opioid tabs used in the last 24 hrs was multiplied by 5 to determine the amount to prescribe. To assess phase 2, we compared the number of tabs prescribed to all patients and a subgroup who did not use opioids in the 24 hrs prior to discharge for 4 groups. Baseline group (BG) = Mar 2017; Standardized group (SG) = Aug 2017; Standard provider group (SP) = Dec 2018 and Tailored prescribing group (TP) = Dec 2018. Other outcome measures included inpatient opioid consumption, LOS, and patient satisfaction.

Results: The pre-multimodal group (PMG) consumed a mean of 95.6 MME (SD 86.1) compared to a mean of 61.1 MME (SD 95.1) in the scheduled multimodal group (MG) in the first 48 hrs post-CD ($p<0.0001$). 3.0% (21 of 697) of the PMG did not receive opioids in the first 48 hrs compared to 18.3% (150 of 818) of the MG ($p<0.0001$).

The median number of tabs prescribed were: BG = 30 [11.25-45]; SG = 20 [20-30]; SP = 20 [20-20]; TP = 10 [5-20] ($p<0.05$). Table shows the prescribing pattern for a subgroup of patients who were not using opioids.

Discussion: Using a scheduled multimodal analgesic regimen significantly reduced inpatient opioid use. A tailored opioid prescribing practice reduced the overprescribing of opioids. QI initiative success relies on sustained buy-in from all disciplines which has been achieved by introducing phased changes, high-level communication, and demonstrating positive results. Moving forward we plan to extend tailored prescribing to all providers.

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Abstract #: F3I-485

Table. Prescribing Patterns for Patients who not did use Opioids in the 24 hours Prior to Hospital Discharge

Group	% of patients using zero opioids 24 hrs prior to discharge	% of patients who did not receive an opioid prescription	% of patients received ≤ 5 tablet opioid prescription
Baseline Group (n=79)	21.5%	5.1%	7.6%
Standardized Group (n=84)	41.7%	3.6%	3.6%
Standard Provider Group (n=58)	39.7%	8.6%	10.3%
Tailored Prescribing Group (n=57)	42.1%	15.8%$^{+}$	38.6%*

$^{+}$*p=0.24 compared to standard provider group; * p<0.05 compared to standard provider group*

Baseline Group = March 2017, six months after the implementation of a standardized multimodal order set
Standardized Group = August 2017, one month after implementing a 20-tablet prescribing recommendation
Standard Provider Group = December 2018, 17 months after implementing a 20-tablet prescribing recommendation, providers who did not implement tailored opioid prescribing
Tailored Prescribing Group = December 2018, 17 months after implementing a 20-tablet prescribing recommendation, providers who implemented tailored opioid prescribing
(Tailored Opioid Prescribing: The number of opioid tabs used in the last 24 hrs was multiplied by 5 to determine the amount of tabs to prescribe)

Abstract #: F3I-502

A retrospective review of anesthetic management and postoperative analgesic consumption of parturients on buprenorphine maintenance therapy undergoing cesarean delivery

Presenting Author: Cameron R Taylor MD
Presenting Author's Institution: Duke University Hospital - Durham, North Carolina
Co-Author: Jennifer Dominguez MD - Duke University Hospital
Ashraf Habib MBBCh - Duke University Hospital

Introduction: Parturients using buprenorphine maintenance therapy pose a unique challenge to the obstetric anesthesiologist when presenting for cesarean delivery (CD). We performed this retrospective study to assess postoperative opioid consumption (POC) and the analgesic regimens used in parturients on buprenorphine maintenance therapy at our institution.

Methods: A retrospective chart review was conducted to identify the medical records of patients taking buprenorphine who underwent CD at our institution from January 1, 2014 through December 31, 2018. We extracted demographic, obstetric, anesthetic and postpartum analgesic data to characterize our population. Total opioid consumption was measured in milligram morphine equivalents (MME) at 24-hour intervals following delivery. Descriptive statistics were used to describe our cohort. We also performed a regression analysis to examine the effect of daily dose of buprenorphine, the use of intrathecal clonidine, and the use of post-operative epidural analgesia on POC at 24 and 72 hours.

Results: We identified 34 patients taking buprenorphine maintenance therapy who underwent CD in the time period of interest. Ten patients in the cohort had an existing epidural catheter placed for labor analgesia prior to converting to CD, 13 had a single shot subarachnoid block, and the remaining 11 patients had a combined spinal-epidural anesthetic for planned CD. All patients in the cohort received neuraxial morphine and post-operative multimodal analgesia with scheduled acetaminophen and nonsteroidal anti-inflammatory drugs. Their daily buprenorphine dose was continued during the hospital stay. The characteristics of this population are summarized in the Table. In the regression analysis, total daily dose of buprenorphine was significantly associated with POC at both 0-24 hours ($p = 0.03$) and at 0-72 hours ($p < 0.0001$). The use of intrathecal clonidine and postoperative epidural analgesia were not associated with POC at those time points.

Conclusion: In this small retrospective study, women on buprenorphine maintenance therapy had high opioid requirements in the postoperative period. Higher amounts of pre-operative buprenorphine for chronic opioid dependence were associated with increased POC following CD. Additional research is required to identify the most effective pain management strategies for this patient population.

Age (years)	29 (25, 31)
Gestational Age (weeks)	39.0 (37.5, 39.5)
BMI (kg/m^2)	28.6 (25.5, 32.0)
Daily buprenorphine dose	16 (9, 24)
Intrathecal Clonidine (n)	11
Epidural for postoperative analgesia (n)	12
Regular gabapentin (n)	7
TAP blocks (n)	1
MME consumption 0-24 h	217.5 (147.5, 320.0)
MME consumption 24-48 h	255.0 (155.0, 315.0)
MME consumption 48-72 h	172.5 (115.0, 222.5)
MME consumption 0-72 h	617.5 (496.0, 810.0)

Results are reported as median (25th percentile, 75th percentile) unless otherwise specified
n = number of patients within cohort
BMI = body mass index
MME = milligram morphine equivalents

Abstract #: F3I-424

Impact of Enhanced Pre-Discharge Analgesic Counseling on Post-Discharge Knowledge Retention and Disposal of Unused Opioids Following Cesarean Delivery

Presenting Author: Mallika S. Thampy MD
Presenting Author's Institution: Vanderbilt University Medical Center - Nashville, Tennessee
Co-Author: LeAnn Lam BS - Vanderbilt University Medical Center
Sarah S. Osmundson MD - Vanderbilt University Medical Center
Michael G. Richardson MD - Vanderbilt University Medical Center

AIM: Opioids represent an important facet of multi-modal analgesia during recovery from Cesarean delivery, but there is concern that uninformed opioid use and misuse have contributed to the current public opioid abuse and diversion epidemic [1]. We aim to assess the impact of enhanced pre-discharge counseling targeting analgesic strategies and opioid safety on knowledge retention and on disposal of unused opioids after discharge.

METHODS: IRB approval and informed consent were obtained. Women who underwent uncomplicated CD were randomized to receive Enhanced post-discharge analgesic counseling (E), which emphasizes scheduled non-opioid analgesics as first choice, as-needed use and tapering of opioid analgesics (OA), and proper disposal of unused OA; or to Standard discharge counseling (S). A 10-question quiz designed to confirm understanding was administered to Group E after counseling E1, and to both groups 14 days after discharge (E2, S2). All participants were discharged with ibuprofen and 30 opioid tablets. The 14-day follow-up survey asked patients what they had done with unused OA. Test performance was compared between groups, as was reported disposal of OA.

RESULTS: From Aug 2018 to Jan 2019, 196 women provided consent, participated, and were randomized (97 E; 99 S). 97 (100%) completed E1, 82 (85%) E2, 83 (84%) S2. Knowledge retention was evident 2 weeks after discharge in the E group (95% total correct in E1 vs 92% E2, $p<0.05$), and E outperformed S at 14 days (92% E2 vs 78% S2, $p<0.05$). The greatest variance in correct responses related to recommended disposal of unused opioids 94%(E) vs 46%(S) and opioid addiction potential 99%(E) vs 73%(S). Of 149 subjects with leftover OA who reported disposition (E 76; S 73), the proportion of group E subjects that properly discarded leftover OA was greater than that of S (53% vs 29%, $p<0.05$). The proportion reporting keeping OA in an unlocked location was similar (21% E vs 32% S, $p>0.05$).

CONCLUSIONS: Pre-discharge counseling represents an important opportunity for education regarding safe and effective multi-modal analgesia, and appropriate disposal of unused OA. Our results demonstrate that enhanced, targeted pre-discharge counseling knowledge is retained 2 weeks after discharge, and is associated with a nearly 2-fold higher rate of proper disposal of leftover OA.

References:

1. www.cdc.gov/drugoverdose/pdf/pubs/2018-cdc-drug-surveillance-report.pdf, Aug 31 2018

Ten-item questionnaire used to assess patient knowledge regarding analgesic medication use and safety following Enhanced (E) and Standard (S) pre-hospital discharge counselling. The questionnaire was administered to the E group on post-op day 1-2 (E1, n=97) and to both groups 14 days after discharge (E2, n=82; S2, n=83).

	Question	E1 (n=97)	E2 (n=82)	S2 (n=83)
1	Ibuprofen or acetaminophen should be the first medication I take before taking an opioid.	97 (100%)	74 (95%)	68 (88%)
2	I should use all of the opioid in my bottle.	94 (97%)	77 (99%)	66 (86%)
3	Opioids should be the second medication I take after ibuprofen when the pain is still strong.	91 (94%)	70 (90%)	62 (81%)
4	I should use all the ibuprofen in my bottle.	83 (86%)	73 (94%)	**59 (78%)**
5	Opioids can cause nausea or constipation.	96 (99%)	68 (87%)	**51 (66%)**
6	Opioids can be addicting.	96 (99%)	78 (100%)	**56 (73%)**
7	I should use less and less opioid every day after discharge from the hospital.	96 (99%)	70 (90%)	71 (92%)
8	If I have any leftover opioid after my c-section, I should keep it in a closed cabinet in my house.	95 (98%)	74 (95%)	**35 (45%)**
9	Ibuprofen can be addicting.	75 (77%)	65 (83%)	**60 (78%)**
10	After discharge, it is best to use the least amount of opioid pain medication possible.	94 (97%)	72 (92%)	68 (88%)

Data are number (and percent) of correct responses to each question.

Abstract #: F3I-215

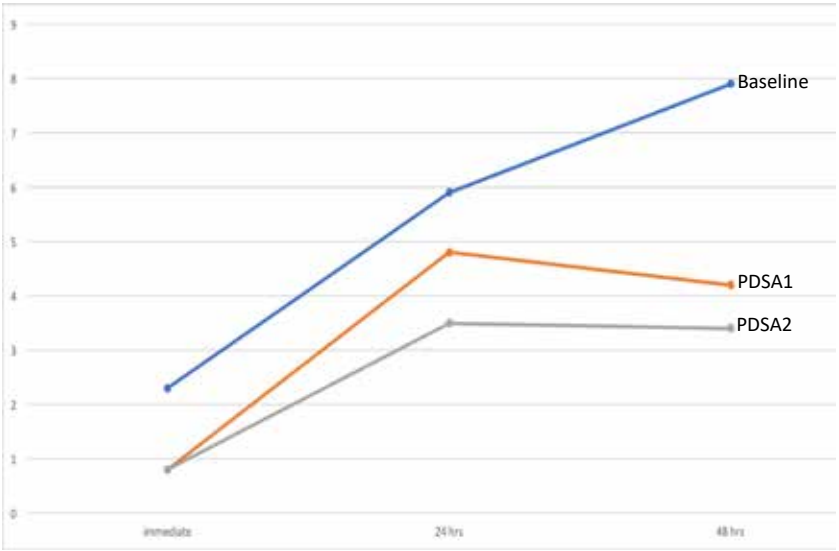
Post Cesarean Delivery Pain: A Quality Improvement Initiative

Presenting Author: Fatemah Qasem MBBCh, MD
Presenting Author's Institution: Maternity Hospital, Ministry of Health - Kuwait City , Asema
Co-Author: Ardeshir Algooneh MD - KIMS
Fatemah Qasem MBBCh, MD - Ministry of Health

Introduction: Cesarean delivery (CD) is the most common surgical procedure world wide and the incident is increasing.1 Pain management is crucial post CD to accelerate recovery of the mothers to go back to their normal daily activities. In addition, women with severe pain on the day after cesarean delivery have a 2.5- to 3-fold increased risk of postpartum depression and persistent pain 8 weeks later compared with those with mild pain.2 The rate of CD at our tertiary care academic obstetric center is 40%. Therefore, we conducted this quality improvement initiative to improve post operative pain management for patients undergoing elective CD, using the Plan-Do-Study-Act (PDSA) methodology.

Methods: Local REB approval was obtained for this study. Using numeric rating scale (NRS) for pain, we surveyed thirty five patients that underwent elective CD about their pain scores immediately after the procedure, at 24 hours and at 48 hours to determine our baseline data. Consequently, we conducted targeted interventions using the PDSA methodology to improve post cesarean delivery NRS. For PDSA cycle 1, we started with hospital staff education in regards pain management. This involved a weekly lecture for the nursing staff for a total of 4 weeks in addition to doing multidisciplinary rounds involving obstetricians and anesthesiologists, highlighting the importance and the deficits in the current pain management. For PDSA cycle 2, we implemented acute pain management service, where anesthesia would look after the patients' pain management, implement multimodal analgesia and then transfer the patients' care to the surgeons when appropriate. In addition,we looked at the overall analgesic consumption within 48 hours for all patients. We used a convenient sample to survey patients after each PDSA cycle to see if our interventions demonstrated any improvement in NRS. We recruited 37 and 35 patients in PDSA cycle 1 and 2 respectively.

Results: A total of 107 patients have been surveyed. At baseline measurement, mean NRS for pain at immediate, 24 hours and 48 hours were 2.3, 5.3 and 7.6,respectively. After implementing PDSA cycle 1, mean NRS were 1.8, 4.8 and 4.3 . In PDSA cycle 2, NRS were reduced substantially to 1.8, 3.5 and 3.5. at immediate ,24 hours and 48 hours compared to baseline group (Fig1).



Conclusions: Patients pain scores improved significantly after implementation of acute pain service and emphasizing the role of multimodal analgesia in pain management.

Abstract #: F310-514

Association of Obstetric and Neonatal Factors with Postpartum Depression in Parturients with Vaginal Delivery: A Case-Control Study

Presenting Author: Jie Zhou MD, MS, MBA, FASA
Presenting Author's Institution: Brigham and Women's Hospital, Harvard Medical School - Boston, MA
Co-Author: Min Wei MD - Brigham and Women's Hospital
Li Wang MD - Brigham and Women's Hospital
Sue Yuan PhD - Brigham and Women's Hospital
Danran Zhou BS - BWH

Background: Postpartum Depression (PPD) is a serious public health problem with harmful impact to both mother and child. Multifactorial psychological, physical, social, obstetric factors have been associated with the development of PPD. The period of childbirth is one of the most susceptible times for women in their lives. We performed this study to investigate the role of peripartum obstetric factors, fetal and neonatal outcomes that might be related to PPD.

Methods: We extracted the data from the records of term, singleton parturients who had a vaginal delivery at Partner Healthcare System from Jan 1, 2016 to Dec 31, 2018. PPD case group was defined as women with Edinburgh Postnatal Depression Scale (EPDS) ≥ 10. Non-PPD control group matched with 1:2 ratio using age, body mass index, race and parity. Demographic data, obstetrical interventions, duration from rupture of membrane to delivery, and durations of labor stages were recorded. Type of labor analgesia was also documented.

Results: A total of 378 parturients were included. The duration of second stage labor was more than the non-PPD group ($P<0.05$). The rate of augmentation in PPD group is less than in non-PPD group ($P<0.05$). The incidences of fetal macrosomia, growth restriction and neonatal asphyxia were different between two groups ($P<0.05$).

Discussion: Our study indicated that labor augmentation was potentially protective against PPD. It could be attributed to its augmented labor course. However, the length of the second stage of labor was positively associated with PPD, indicating the interaction between these two factors. Our study demonstrated in vaginal delivered parturients, fetal complications such as birthing weight, growth restriction and neonatal asphyxia were significantly associated with PPD. We advocate to secure early peripartum consultation for parturients who were diagnosed with fetal growth restriction.

References:

1. Youn, et al. J Psychosom Res.2017
2. Takács, et al. Arch Womens Ment Health.2018
3. Suhitharan, et al. Neuropsychiatr Dis Treat.2016

Abstract #: F310-514

Table 1. Obstetric and Neonatal Factors for Postpartum Depression

Characteristics	PPD Case Group N = 126	Non-PPD Control Group N = 252	*P* value
Maternal age (year), mean±SD	28.7 ± 6.2	28.8 ± 5.9	0.151
Maternal BMI, mean±SD	26.8 ± 5.7	26.7 ± 5.5	0.634
Gestational age (days), mean±SD	274.3 ± 7.9	276.9 ± 7.2	0.002
Induction Labor, n (%)			
Yes	31 (24.6)	74 (29.4)	0.322
No	95 (75.4)	178 (70.6)	
Augmentation, n (%)	56 (44.4)	141 (56.0)	0.03
Assisted delivery, n (%)	2 (1.6)	3 (1.2)	0.753
Estimated Blood Loss (ml), Median (Q1-Q3)	300 (200-400)	300 (200-400)	0.842
Postpartum Hemorrhage, n (%)	9 (7.1)	21 (8.3)	0.731
Episiotomy, n (%)	4 (3.2)	15 (6.0)	0.251
Rupture to delivery (min), mean±SD	409.4 ± 440.7	426.6 ± 491.2	0.837
Total Labor Length (min), mean±SD	593.4 ± 445.4	528.1 ± 375.1	0.172
Duration of First Stage Labor (min), mean±SD	542.2 ± 450.9	469.6 ± 357.6	0.135
Duration of Second Stage labor (min), mean±SD	62.8 ± 82.2	49.4 ± 56.4	0.04
Duration of Third Stage labor (min), mean±SD	8.7 ± 10.1	7.4 ± 5.9	0.111
Birth Weight (g), mean±SD	3208 ± 459.7	3415.2 ± 462	<0.001
Fetal Issues			
Fetal macrosomia, n (%)	3 (2.4)	24 (9.5)	
Fetal growth restriction, n (%)	11 (8.7)	11 (4.4)	0.026
Normal, n (%)	111 (88.1)	217 (86.1)	
Apgar score at 1 min, Median (Q1-Q3)	8.00 (8-9)	8.00 (8-9)	0.005
Apgar score at 5 min, Median (Q1-Q3)	9.00 (9-9)	9.00 (9-9)	0.002
Neonatal Asphyxia, n (%)	26 (20.6)	24 (9.5)	0.003
Labor Analgesia, n (%)			
Epidural	89 (70.6)	190 (75.4)	0.318
No	37 (29.4)	62 (24.6)	

Abstract #: F310-46

Genetic Associations of Perinatal Pain and Depression

Presenting Author: Grace Lim MD. MS
Presenting Author's Institution: University of Pittsburgh, UPMC Magee-Womens Hospital - Pittsburgh, PA
Co-Author: Lora McClain PhD - University of Pittsburgh
Lia M. Farrell BS - UPMC Magee-Womens Hospital
Kelsea R. LaSorda MPH - UPMC Magee-Womens Hospital
David Peters PhD - Magee-Womens Research Institute
Grace Lim MD, MS - UPMC Magee-Womens Hospital, University of Pittsburgh

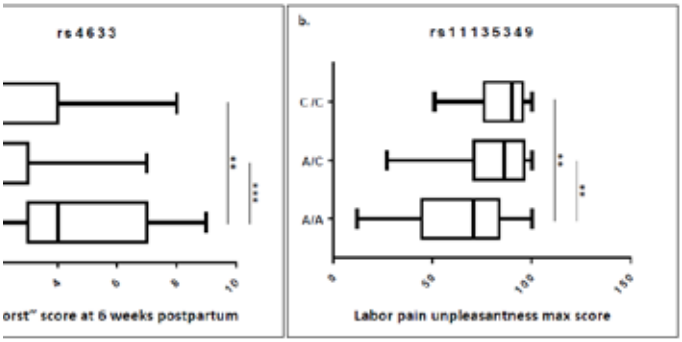
Introduction: Underlying biological factors, such as genetic influences, may significantly influence perinatal pain, postpartum depression, or both. We investigated the role of 59 single nucleotide polymorphisms (SNP) on 20 quantitative traits measured in perinatal women.

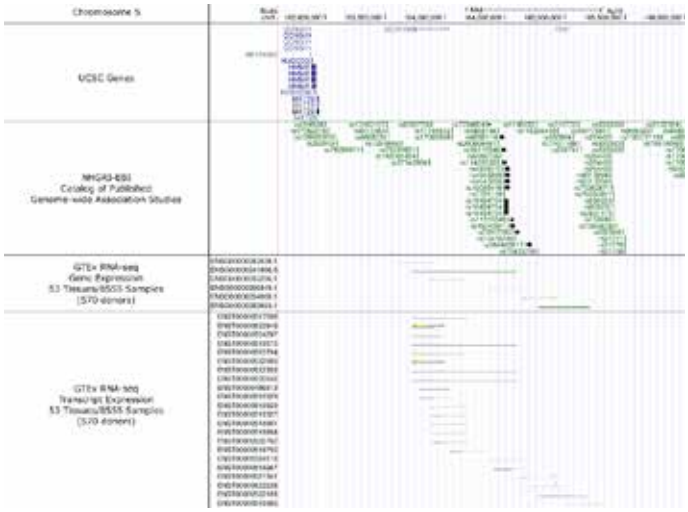
Methods: We prospectively enrolled and genotyped 184 pregnant women for 59 SNPs that had known prior associations with either pain or depression in non-pregnant populations. Prenatal biological (saliva) samples were collected between 28-37 weeks gestation. Phenotypic data were prospectively gathered during prenatal, labor and delivery, and postpartum (six weeks and three months) periods, capturing labor pain, Edinburgh Postnatal Depression Score, and Brief Pain Inventories. Following quality control, genotypes were used as predictors and phenotypes as dependent variables in multiple linear regression analyses to detect associations. Three statistical models were tested: additive allele effects, deviation from dominant allele effects, and the joint test of both. Multiple comparisons were addressed using the Benjamini and Hochberg false discovery rate (FDR).

Results: Associations were detected for rs4633 (a synonymous SNP in COMT) with "pain right now" scores at six-weeks postpartum from the Brief Pain Inventory, and for rs1135349 (a SNP within a small non-coding RNA that has many prior associations for depression) with the maximum pain unpleasantness score experienced during labor (a measure of the emotional valence of labor pain). Sensory dimensions of labor pain (i.e., pain intensity) and postpartum depression scores were not significantly associated with the genotyped SNPs.

Conclusions: SNPs in a non-coding RNA transcript associated with depression and in COMT, are linked to the emotional valence of labor pain and to pain at six weeks postpartum, respectively. Identifying genomic components of these perinatal complex disorders may produce insights into relevant pathways or novel treatment options.

Abstract #: F310-46





Abstract #: F310-47

Prenatal, Labor, and Postpartum Pain Are Predictors for Postpartum Depression Symptoms: A Prospective Observational Study

Presenting Author: Grace Lim MD, MS
Presenting Author's Institution: UPMC Magee-Womens Hospital, University of Pittsburgh, Magee-Womens Research Institute - Pittsburgh, PA
Co-Author: Kelsea R LaSorda MPH - UPMC Magee-Womens Hospital
Lia M Farrell BS - UPMC Magee-Womens Hospital
Ann M McCarthy MSN, CNM - The Midwife Center for Birth and Womens Health
Ajay D Wasan MD MSc - University of Pittsburgh

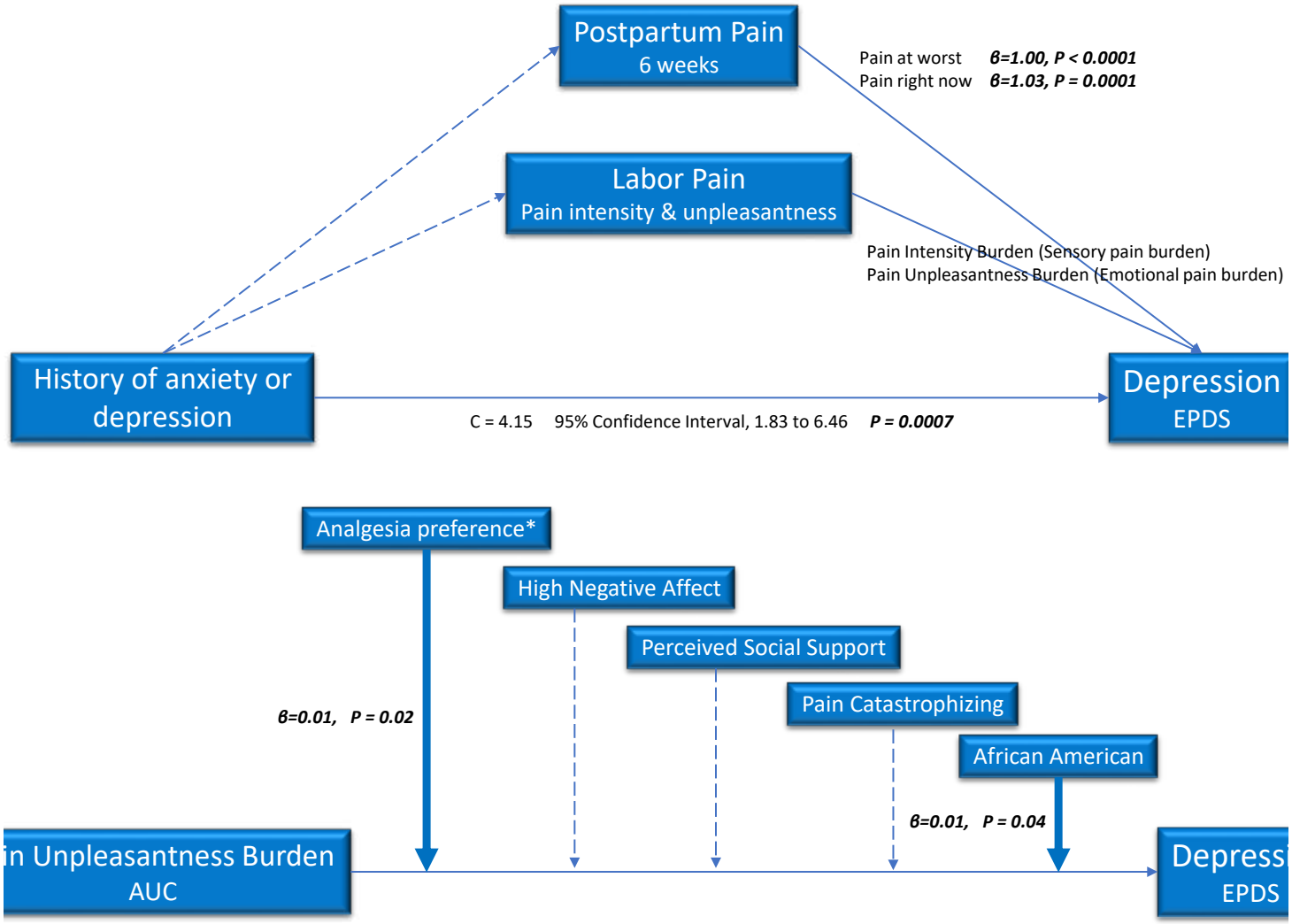
Introduction.: Data linking labor pain and postpartum depression are emerging. Robust, prospective evaluations of this relationship while factoring other important variables are lacking. We assessed perinatal pain and other factors predicting postpartum depression (PPD) symptoms.

Methods: Third trimester women (sub-stratified on a priori plan to receive or avoid labor epidural analgesia) were longitudinally followed from the prenatal period through labor and delivery, until six weeks and three months postpartum. Electronic labor pain data was collected hourly in real time, capturing pain unpleasantness, intensity, pain management satisfaction, and expectations. Prenatal and postpartum data included anxiety, depression, the Brief Pain Inventory (BPI), as well as surveys on pain catastrophizing, resiliency, and perceived social support and stress. The primary outcome was Edinburgh Postnatal Depression Score (EPDS) as a marker of PPD symptoms. The primary pain variable of interest was the emotional valence of labor pain (unpleasantness burden, area under the curve for entire labor duration). Single and multivariable linear regressions examined perinatal pain variables in relation to EPDS.

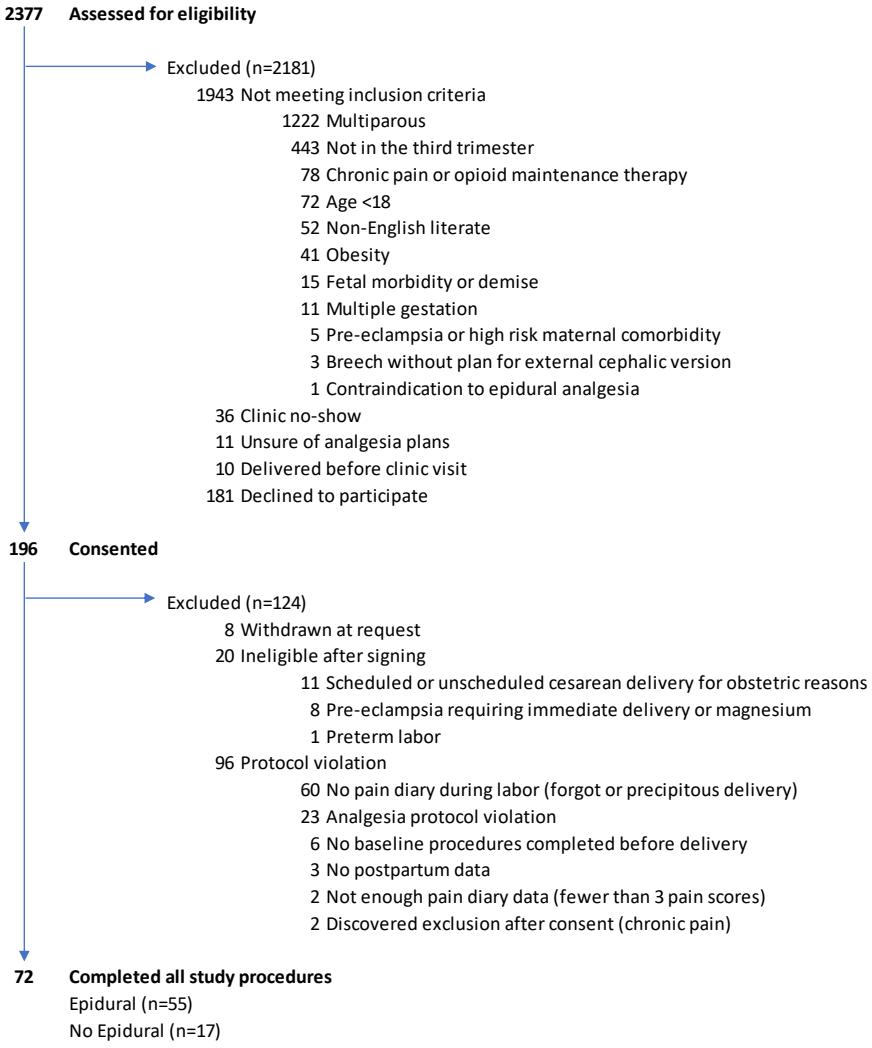
Results: Of 72 subjects recruited, 55 planned/received labor epidural analgesia and 17 planned avoidance/avoided it. Intrapartum pain management satisfaction and expectations did not differ between analgesia groups. In the planned epidural group, the emotional valence of labor pain independently predicted six-week EPDS (Labor pain unpleasantness burden, $R2=0.42$, $P = 0.002$). In addition to labor pain, prenatal and postpartum pain variables from the BPI independently predicted six-week EPDS. Three-month depression scores were linked to labor and acute pain (six weeks postpartum), but not to chronic (three months postpartum) pain variables.

Conclusion: Pain at all perinatal time points—prenatal, labor, and postpartum—are independent predictors of depression scores at six weeks postpartum. These data support the importance of labor and acute postpartum pain for both acute and long-term PPD symptoms.

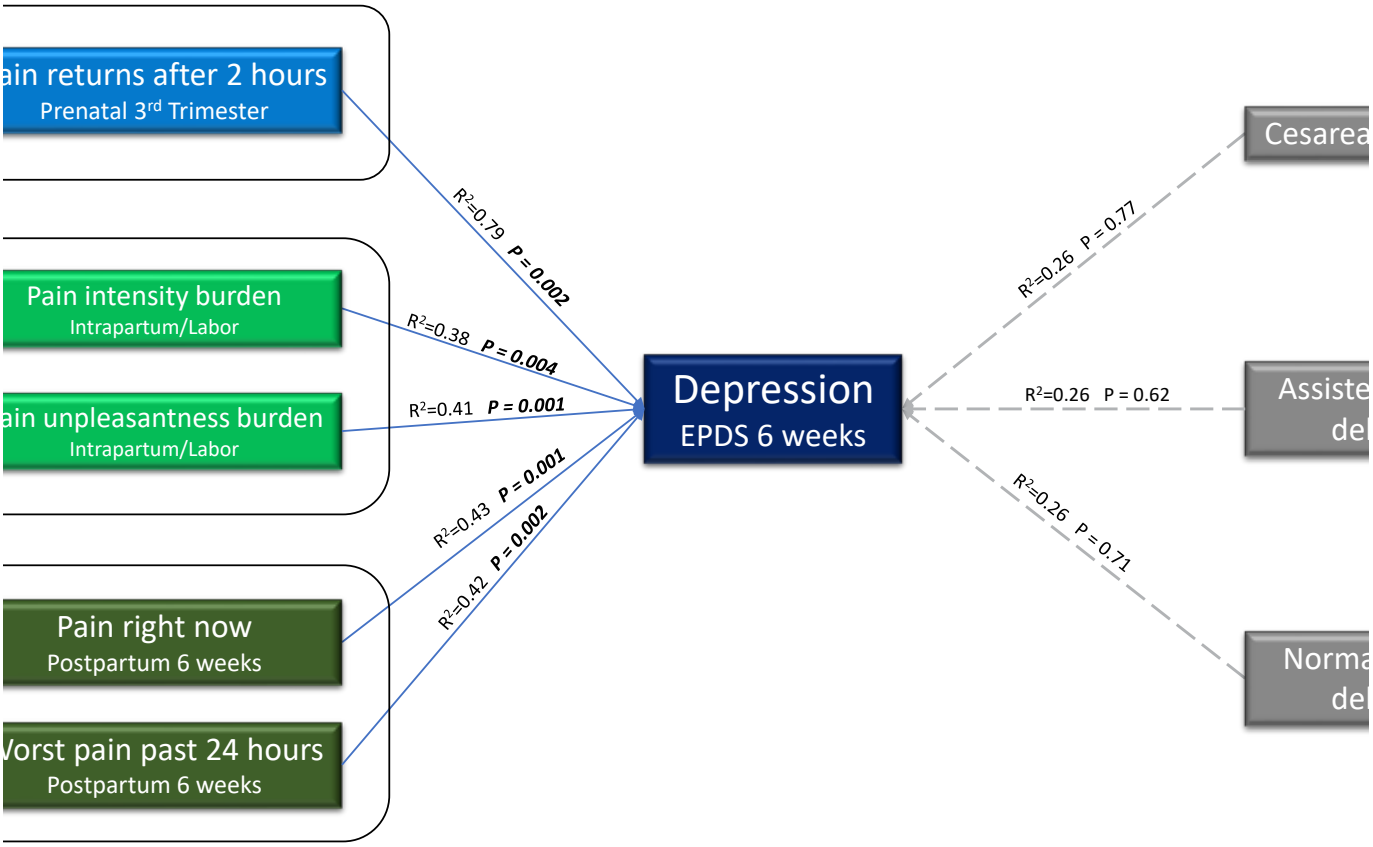
Abstract #: F310-47



Abstract #: F310-47



Abstract #: F310-47



Abstract #: F310-324

Racial/Ethnic Disparities in Hospital Admission for Postpartum Depression

Presenting Author: Avis Lailing Chan MBBS
Presenting Author's Institution: Stanford University School of Medicine - Palo Alto, California
Co-Author: Nan Guo PhD - Stanford University School of Medicine
Rita Ashok Popat PhD - Stanford University School of Medicine
Yair Blumenfeld MD - Stanford University School of Medicine
Alexander James Butwick MBBS, FRCA, MS - Stanford University School of Medicine

Introduction: Postpartum depression (PD) affects 13% women within 12 months after delivery (1). Although racial/ethnic differences have been reported for adverse pregnancy outcomes (e.g. pre-eclampsia, preterm birth), it is unclear whether the incidence of PD varies by race or ethnicity. Understanding racial disparities is important for identifying a high risk cohort that would benefit from early diagnosis and therapy.

Methods: We performed a retrospective population-based cohort study of primiparous women who underwent postpartum hospitalization for PD in California between 2008 and 2012. PD was identified by the presence of ICD-9-CM codes for depression (296.2x, 296.3x, 296.82, 296.90, 300.4, 309.0, 309.1, 309.28, 311) associated with a postpartum hospitalization upto 9 months after delivery. Race and ethnicity data were sourced from linked birth records or maternal discharge data. The cumulative incidence of PD was calculated by race/ethnicity (five groups: non-Hispanic White (NHW); non-Hispanic Black (NHB); Hispanic; Non-Hispanic Asian (NHA); and others). Incidences were calculated for women with a principal diagnosis of PD. Logistic regression was used to examine the risk of PD in racial/ethnic minority women compared to NHW. Sensitivity analysis was performed with PD identified as a principal or secondary diagnosis.

Results: Our study cohort comprises 984,167 delivery hospitalizations. The overall cumulative incidences for postpartum hospitalization with PD as a principal diagnosis only and PD as a principal or secondary diagnosis were 15.9 and 53.6 per 10,000 deliveries respectively. Cumulative incidences according to race/ethnicity are presented in Table 1. Compared to NHW women, NHB women had the highest risk (38.8 in 10,000 women) and NHA women had the lowest risk (6.6 in 10,000 women) of hospital admission for PD as a principal diagnosis. In our sensitivity analysis, the risk of PD was increased but to a lesser extent for NHB women compared to NHW women (Table 1).

Conclusion: Our findings suggest that racial/ethnic disparities exist in the risk of postpartum admission for PD, with NHB women incurring the highest risk. Further research is required to elucidate the psychosocial, environmental and medical factors that explain the elevated risk of PD admission in NHB women and the reduced risk of PD admission in NHA and Hispanic women.

Table 1. Cumulative Incidences and Odds Ratios for Postpartum Admission for Depression (within 9 months after delivery) According to Maternal Race and Ethnicity.

	Delivery hospitalizations (2008-2012) (n)	Cumulative Incidence of Postpartum Admission with Principal Diagnosis of Depression (per 10,000 women)	Odds Ratio for Postpartum Admission with Principal Diagnosis of Depression (95% CI)	Cumulative Incidence of Any Postpartum Admission including Depression (per 10,000 women)	Odds Ratio for Any Postpartum Admission including Depression (95% CI)
Non-Hispanic White	314,037	18.3	Referent group	74.7	Referent group
Non-Hispanic Black	59,754	38.8	2.3 (1.9-2.7)	95.1	1.3 (1.1-1.4)
Hispanic	448,770	14.1	0.8 (0.7-1.0)	43.9	0.6 (0.6-0.7)
Non-Hispanic Asian	150,855	6.6	0.4 (0.3-0.5)	20.3	0.3 (0.3-0.4)
Others	10,399	24.0	1.6 (1.0-2.4)	76.0	1.0 (0.9-1.5)

References:

1. AHRQ No.05-E006-2.

Abstract #: F310-513

A Novel Scale for Evaluation of Postpartum Depression (PPD): An Insight through Validation of PPD Using Combined Score

Presenting Author: Jie Zhou MD, MS, MBA, FASA
Presenting Author's Institution: Brigham and Women's Hospital, Harvard Medical School - Boston, MA
Co-Author: Danran Zhou BS - Brigham and Women's Hospital
Huihui Zhu MD - Brigham and Women's Hospital
Min Wei MD - Brigham and Women's Hospital

Background: Postpartum depression (PPD) particularly refers to the depression that occurs after childbirth. Our research group has been working on this subject for a few years. We often encountered problems of different PPD scales with no interoperability. In this study, we compared PPD parturients in subgroups with different scales of evaluation, explored potential conversion and combination and identified possible risk factors that could influence the severity of PPD.

Methods: Retrospective chart review of PPD parturients at Brigham and Women's Hospital between 1/1/2015 to 12/31/2018 were conducted. Demographic information, diagnosis, delivery and analgesia procedure were collected. Since Edinburgh postnatal depression scale (EDPS) and Patient Health Questionnaire (PHQ-9) are most used to evaluate PPD severity with similar severity ranges and maximum scores (30 and 27 respectively), we combined these two scores as a new measurement called Combined score (C-score). We divided the PPD parturients into three subgroups using the C-score: 1. Mild (0-8); 2. Moderate (8-12); and 3. Severe (13-15 and above). Other potential risk factors used as independent variables included mental history, body mass index (BMI), thyroid function, weeks of gestation, Para, and delivery methods. Ordinal Logistic Regression analysis was used for analyzing associations and interactions among these independent variables and C-score.

Results: A total 240 PPD cases were identified. A scatterplot showed the PHQ-9 score and EDPS score were strongly positively correlated. This supports our derived measurement for C-score. A proportional odds model for ordinal outcomes is fitted to test the association between the risk factors and the newly derived C-score. Our results indicate: there was a positive association between the Body Mass Index (BMI) and C-score ($p=0.11$); parturients with Major Depression Disorder (MDD) history had higher C-score ($p=0.20$) than Parturients with Generalized Anxiety Disorder (GAD) history ($p=0.31$); particularly, parturients with both MDD and GAD history tended to be more vulnerable to PPD ($p=0.05$). When Para was larger than 1, C-score was significantly lower than when Para was 1 ($p=0.04$).

Discussion: In the United States, there is no separate diagnosis criterion for PPD, but it follows the criteria for MDD, based on the diagnostic and statistical manual of mental disorder (DSM-5). Moreover, the international classification of diseases 10 (ICD-10) does not recognize PPD as a separate diagnosis. However, PPD has specificity related to female hormone changes during pregnancy. The combination of EDPS and PHQ-9 scores suggests a possible way to design a universal diagnosis criterion for PPD.

Reference:

1. McCabe-Beane JE, et al. J Reprod Infant Psych 2016

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Cardiac Disease Interdisciplinary Panel

Joan E. Briller, M.D.	Cardiologist	University of Illinois Chicago
Marie-Louise Meng, M.D.	OB & CV Anesthesiologist	Columbia University
Alexandria J. Hill, M.D.	Maternal-Fetal Medicine	High Risk Pregnancy Center Las Vegas, NV
Katherine W. Arendt, M.D.	Moderator	Mayo Clinic

Friday, May 3, 2019
10:30 a.m. - 12:00 p.m

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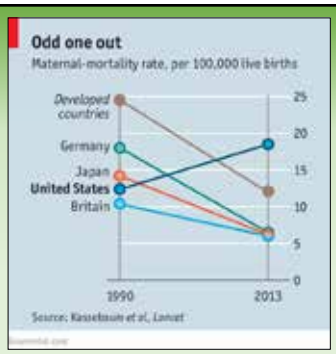
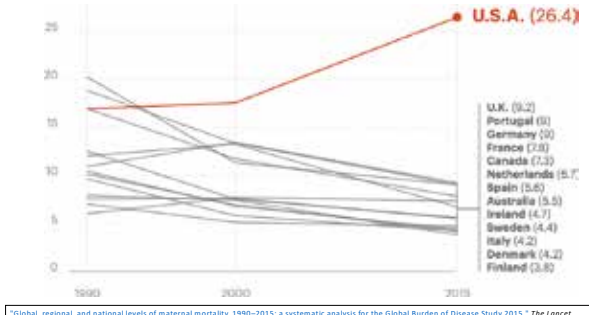
U.S. Pregnancy Related Mortality

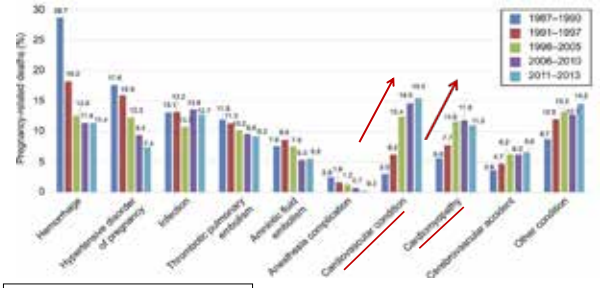
www.cdc.gov/reproductivehealth/maternalinfanthealth/pmss.html accessed 01-02-2017





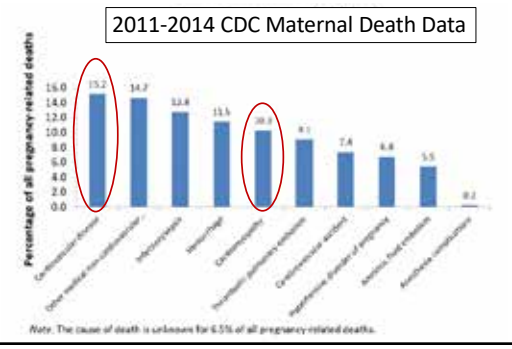
"Global, regional, and national levels of maternal mortality, 1990–2015: a systematic analysis for the Global Burden of Disease Study 2015." *The Lancet.*
Credit: Rob Weychert Propublica

How Pregnant Women Die: United States, 1987–2013



Creanga AA, et al. Obstet Gynecol 2017; 130:366-373

2011-2014 CDC Maternal Death Data



Maternal mortality is the tip of the iceberg

- **700-1000 U.S. women annually**
- **Each maternal death sentinel event**
- **Death the most severe outcome**
- **Continuum of morbidities and complications**

Prevalence of congenital heart disease in adults

1950 25% CHD neonates survived 1 year

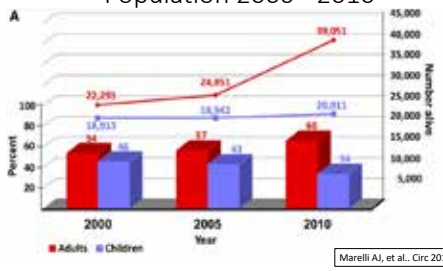
Improved surgical & medical management

2000 > 95% CHD neonates survive to adulthood

2019 *This population is entering reproductive age*

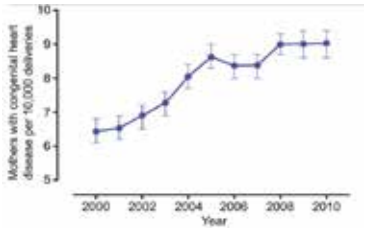
Warnes CA et al. JACC 2001; 37:1170-5.
Perloff JK, Warnes CA. Circ 2001; 84:1881-90

Lifetime Prevalence of CHD in the General Population 2000 - 2010



Marelli AJ, et al.. Circ 2014. 130:749-756.

Delivery hospitalizations among women with CHD per 10,000 deliveries



JL Thompson, et al. Obstet Gynecol, Aug 2015, 126: 346–354

Congenital Heart Disease & Delivery

California 2005-2011, n = **3,642,041 delivery admissions**

3189 non-complex CHD:
- Heart failure
- Atrial arrhythmia
- Fetal growth restriction
- Readmission

262 complex CHD:
- Ventricular arrhythmias
- **Maternal In-hospital Mortality aOR 79.1**
  (compared to no-CHD, 95% CI 23.9 - 261.8)

Hayward RM et al. JAMA Cardiology 2017. 2(6): 664-671

THE CV MORTALITY POPULATION

More likely to be:
- Black
- >35 years old
- Obese

More likely to have:
- Acquired heart disease (versus CHD)
- Cardiomyopathy
- *Late diagnosis, or no diagnosis of CV disease prior to pregnancy and prior to death*

Main EK et al. Obstet Gynecol. 2015; 125:938-47;
Briller J et al. Obstet Gynecol 2017;129:819–26
Hayward RM et al. JAMA Cardiology 2017. 2(6): 664-671

NEWS ESC 2018

Updated ESC Guidelines Introduce Concept of a Pregnancy Heart Team for Women With CVD

Multidisciplinary teams for women at risk for complications should include—at a minimum—a cardiologist, anesthetist, and obstetrician.

The American College of Obstetricians and Gynecologists

ACOG PRACTICE BULLETIN SUMMARY

Clinical Management Guidelines for Obstetrician–Gynecologists

Number 212

Pregnancy and Heart Disease

VOL. 133, NO. 5, MAY 2019 OBSTETRICS & GYNECOLOGY

The following recommendations and conclusions are based primarily on consensus and expert opinion (Level C):

- Patients with moderate and high-risk cardiovascular disease should be managed during pregnancy, delivery, and the postpartum period in medical centers with a multidisciplinary Pregnancy Heart Team that includes obstetric providers, maternal–fetal medicine subspecialists, cardiologists, and an anesthesiologist at a minimum.

VOL. 133, NO. 5, MAY 2019 OBSTETRICS & GYNECOLOGY

Our Pregnancy Heart Team

Alexandria J. Hill, M.D.	Maternal-Fetal Medicine	High Risk Pregnancy Center Las Vegas, NV
Marie-Louise Meng, M.D.	OB & CV Anesthesiologist	Columbia University New York, NY
Joan E. Briller, M.D.	Cardiologist	University of Illinois Chicago

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Alexandria J. Hill, MD

Circulation

AHA/ACOG PRESIDENTIAL ADVISORY

Promoting Risk Identification and Reduction of Cardiovascular Disease in Women Through Collaboration With Obstetricians and Gynecologists

A Presidential Advisory From the American Heart Association and the American College of Obstetricians and Gynecologists

Circulation. 2018;137:e843–e852.

Marie-Louise Meng, MD

Obstetric Anesthesia Fellowship Trained
Cardiovascular Anesthesia Fellowship Trained

Pulmonary Hypertension in Pregnancy

A Report of 49 Cases at Four Tertiary North American Sites

OBSTETRICS & GYNECOLOGY VOL. 129, NO. 3, MARCH 2017

COLUMBIA | NewYork-Presbyterian | ColumbiaDoctors

CARDIOLOGY

Joan E. Briller, MD

UI Health | UIC

CARDIOVASCULAR PROGRAM FOR WOMEN

Maternal Obesity Affects Cardiac Remodeling and Recovery in Women with Peripartum Cardiomyopathy

Electrocardiographic findings in peripartum cardiomyopathy

Myocardial Damage Detected by Late Gadolinium Enhancement Cardiac Magnetic Resonance Is Uncommon in Peripartum Cardiomyopathy

Maternal Cardiovascular Mortality in Illinois, 2002–2011 OBSTETRICS & GYNECOLOGY VOL. 129, NO. 5, MAY 2017

ORIGINAL ARTICLE

Heart Failure in Pregnant Women

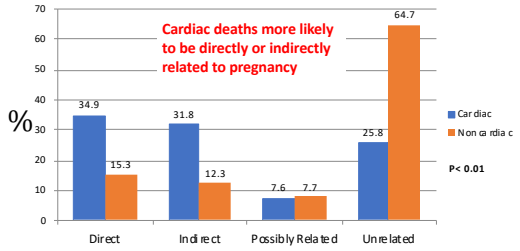
A Concern Across the Pregnancy Continuum

Circ Heart Fail. 2018;11:e004035.

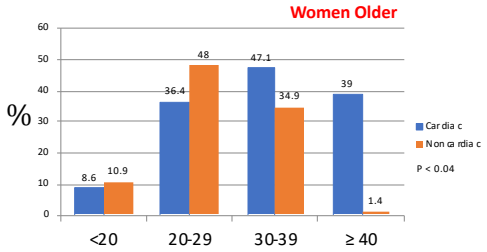
Role of review committees

- **Surveillance systems limited**
  - **Typically based on death certificates, icd 9 or 10 codes**
  - **Insufficient detail to inform prevention strategies**
- **MMRCs can assess if death pregnancy related**
  - **Can address contributing factors**
  - **Can address preventability**
  - **Can identify opportunities for prevention of future deaths**

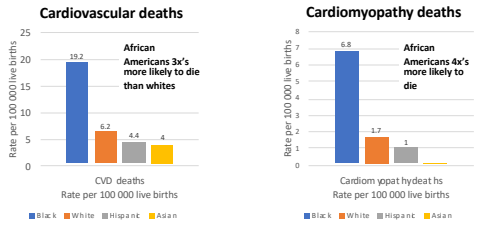
Illinois 2002-2011 Maternal Mortality: Relationship to Pregnancy



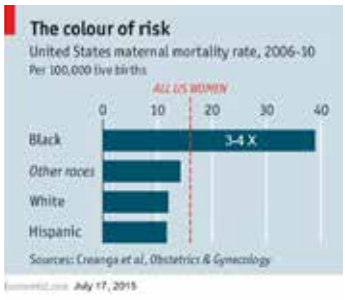
Maternal Mortality: Age at Death Illinois 2002-2011

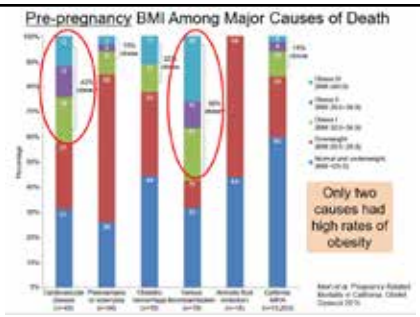


Illinois maternal cardiac mortality 2002-2011: Racial differences



Significant reductions in maternal mortality and morbidity cannot be accomplished without addressing gaps in maternity care for African American women.





What critical factors contributed to CV death?

Domain	Category	Description
Patient or family	Delay	Patient presented late for prenatal care
	Chronic	Patient had untreated medical condition (e.g. ↑ BP or obesity)
	Knowledge	Did not know warning signs
	Substance Abuse	Drug or alcohol use
	Adherence	Noncompliance with treatment plan
Community	Access	Health clinic shut down
Provider	Referral	Patient not referred to cardiologist or MFM
	Knowledge	Delay in diagnosis or treatment or incorrect treatment
Facility	Communication	ED did not notify L & D
Systems	Access	Level 3 hospital 2 hours away

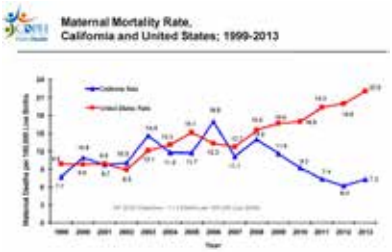
Preventability

Building US capacity to review and Prevent Maternal Deaths 2018
http://reviewtoaction.org/Report_from_Nine_MMRCs

Strategies for Reducing CV Mortality

- **State Perinatal Quality Collaboratives**
- **24 states supported by CDC and Alliance for Innovation on Maternal Health**
- **Safety bundles**
- **Quality tool kits**
- **Assessment Algorithms**

Improvement with Toolkits



https://www.cmqcc.org/resources-tool-kits/toolkits, accessed December 15, 2017

Risk Stratification in 2019

- Modified WHO Classification
- CARPREG II
- ROPAC 2019

ESC guidelines on the management of cardiovascular diseases during pregnancy. Eur Heart J 2011;32:3147–97.
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. 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

Modified WHO Classification

ESC guidelines on the management of cardiovascular diseases during pregnancy. Eur Heart J 2011;32:3147–97.

CARPREG II: Risk Score

Prospective database of 1,938 pregnancies in women in heart disease
Toronto (since 1994) and Vancouver (since 2005)
GOAL:

1. Examine cardiac complications during pregnancy and temporal trends
2. 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.

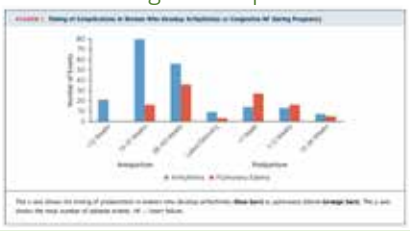
CARPREG II: Incidence of Cardiac Events

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.

CARPREG II: Timing of Complications



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.

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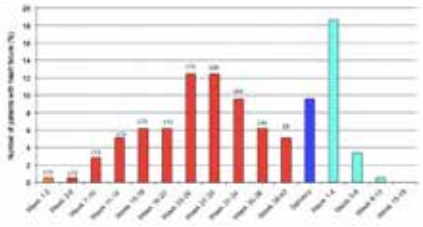
ROPAC: Timing of Heart Failure



ROPAC investigators: Ruys TPE, et al. Heart 2014;100:231–238.

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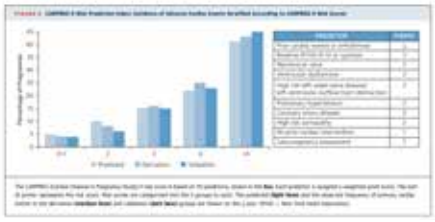
CARPREG II: Risk Score



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.

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ROPAC March 2019

Pregnancy outcomes in women with cardiovascular disease: evolving trends over 10 years in the ESC Registry Of Pregnancy And Cardiac disease (ROPAC)

ESC

- January 2007 → January 2018

- 5739 pregnancies
- 138 centers
- 53 countries

- Congenital
- Valvular heart disease
- Cardiomyopathy
- Ischemic heart disease
- Pulmonary arterial hypertension
- Aorta pathology

- 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

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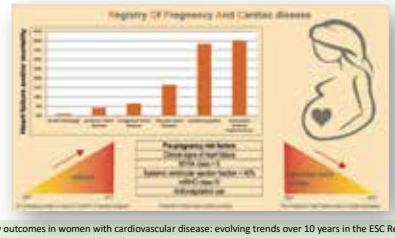
ROPAC March 2019



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

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SOAP 2019 Maternal Cardiac Disease Delivery Planning Algorithm/Framework

WHO: Patient and Pregnancy Heart Team

WHAT: Route of delivery or termination

WHEN: Target induction/delivery/procedure date

WHERE: Type of medical center, location within hospital

HOW: Peripartum plan
- Hemodynamic goals
- Peripartum risks
- Medications: vasopressors, inotropes, pulmonary vasodilators
- Anesthesia
- Monitoring/Access/ECMO
- Hemorrhage prevention/management
- Post care
- Recovery location
- Treatment goals: Diuresis, anticoagulation, stool softeners, sodium restriction

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Hemodynamics of Labor and Delivery

Blood Pressure = Cardiac Output * Systemic Vascular Resistance

Heart Rate * Stroke Volume Afterload & RBC viscosity

Rate & Rhythm Contractility & Preload

ISSUES:

- ↑ Catecholamines → ↑ Tachycardia & arrhythmias
- ↓ Systemic vascular resistance → ↓ Coronary perfusion = AoD - 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

In summary, "GO SLOW she's surviving right now, don't change much if you can help it" ~Richard Smiley, MD, PhD

Case #1 Aortopathy: WHO

PATIENT:

- 34 G1P0 at 36 weeks
- PMH: coarctation of the aorta & bicuspid aortic valve, coarct repair at 3 weeks old. Muscular VSD closed on its own.
- NYHA Class I
- PE: VSS, thin, good airway, CTAB
- BP: R: 138/78 L: 100/65
- Meds:
  - Asa 81
  - Metoprolol 25mg bid
- Holter: 4 NSVT at 170, and SVT and isolated PVCs, APC and vent bigeminy.
  - Symptomatic palpitations during NSR and ST
- TTE: Normal biventricular function. Bicuspid AV, mild AI. **Ascending aorta 3.9cm**
- Chest MRA:
  - **Aortic root 40-41mm**
  - Ascending 28x26mm
  - Proximal arch 20x19mm
  - Distal to L carotid 22x21mm
  - Proximal LSCA is not visualized
  - Mildly aneurysmal segment in the proximal descending aorta 25x21mm
  - Right innominate artery at origin 15x15mm

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Case #1 Aortopathy: WHO

All Patients:

- Strict BP control
- Continue β-blocker throughout pregnancy (risk of IUGR)
- Aortic evaluation throughout pregnancy to **monitor for enlargement**
  - each trimester but ESC guidelines say 4-12 weeks depending on aortic size
- Genetic counseling
- ↑ risk of obstetric complications (e.g. premature rupture of membranes)

Management of dissection:

Type A: If fetus viable → cesarean in CTOR → immediate type A repair

Type B: If fetus viable → cesarean in CTOR → medical management

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Aspirin 81mg Use in Pregnancy

Recommend aspirin use if ANY of the following:

- Prior pregnancy with preeclampsia
- Multifetal gestation
- Hypertension
- Diabetes (type I or II)
- Kidney disease
- Autoimmune disease such as lupus or APLS

Consider aspirin use if MORE than one:

- Nulliparous
- BMI above 30
- Preeclampsia in a first degree relative
- AMA
- Prior pregnancy of IUGR or SGA/LBW
- Last pregnancy >10 years ago
- Low socioeconomic status

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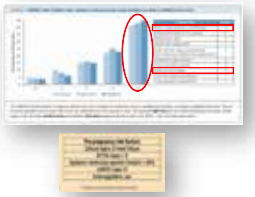
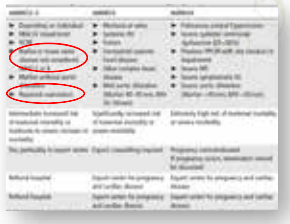
Risk Prediction





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Case #1 Aortopathy: WHO

Pregnancy Heart Team:

- Obstetrician/Maternal Fetal Medicine
- Anesthesiologist (Obstetric)
- Cardiologist
- Critical Care Obstetric Nurse

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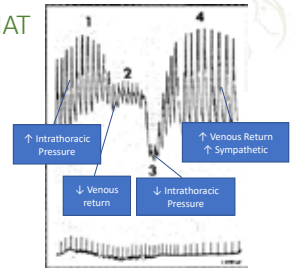
Case #1 Aortopathy: WHAT

WHAT: NSVD vs. assisted vaginal delivery vs. CD?

Labor down?



Nishimura RA, Tajik AJ. Mayo Clin Proc 1986. 61: 211-217. Int J Cardiol 144 (2010) 195–199

Case #1 Aortopathy: WHAT

WHAT: Assisted vaginal delivery vs. CD?

Regitz-Zagrosek V, Roos-Hesselink JW, Bauersachs J, et al. 2018 ESC Guidelines for the management of cardiovascular diseases during pregnancy. Eur Heart J. 2018;39(34):3165-3241.

Case #1 Aortopathy: WHEN, WHERE

WHEN: 39 weeks

WHERE: Referral hospital, L&D suite in "high risk" labor room

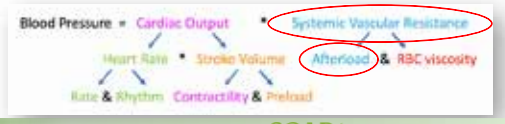
Case #1 Aortopathy: HOW (Delivery)

Hemodynamic goals:

1. Avoid sudden changes in shear stress:
   - Slow heart rate
   - Normal to lower blood pressure
   - Normal to lower systemic vascular resistance
2. Avoid pain/cataholamines

Peripartum risks:

1. Dissection
2. Rupture
3. Arrhythmias
4. Bicuspid AV additional risk of AS/AI (not a problem for her)



Case #1 Aortopathy: HOW (Delivery)

MEDICATIONS:
- Vasodilators: nicardipine, esmolol, nitroglycerine

ANESTHESIA: early, effective neuraxial labor analgesia

MONITORING:
- Blood pressure cuff
- Telemetry

VENOUS ACCESS: 1-2 large peripheral IVs

CT SURGERY: Not aware

HEMORRHAGE PREVENTION/MANAGEMENT:
- AVOID: methergine

Case #1 Aortopathy: HOW (Recovery)

RECOVERY LOCATION:
- Regular post partum unless arrhythmias and telemetry needed

TREATMENT GOALS:
- BP management
- Post partum imaging (6 months)

CONTRACEPTION:
- Progestin only (injectable, oral, implantable, IUD) safer

Contraception considerations

Progestin only (injectable, oral, implantable, IUD) safer than Progesterone/Estrogen (oral, patch, ring) in the following:

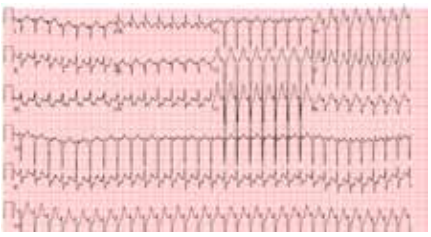
- History of VTE
- HTN / vascular disease >35yo
- Hypertriglyceridemia
- CAD
- CHF
- Migraines (especially with CNS symptoms)
- Smoking or obese >35yo
- SLE with vascular disease, nephritis, APL antibodies
- <3 weeks postpartum
- Cerebrovascular disease

Case #2 HOCM: WHO

PATIENT:

- 27 yo G3P2 (CDx2) referred @ 16 weeks
- NYHA 1
- PE: 3/6 SEM SB and Apex ± change with Valsalva
- Meds: β-blocker
- ECG: rate related RBBB
- Event recorder: SVT
- At 34 weeks sustained SVT (developed incidentally while seeing me in clinic) did not break with valsalva but did break with adenosine, begun on flecainide and metoprolol increased

Palpitations



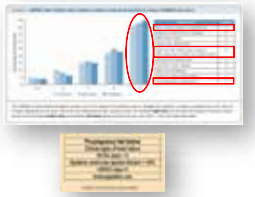
mWHO classification HOCM Pregnancy

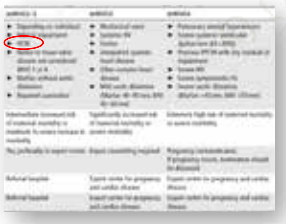
mWHO Class	Condition	Risk/maternal event rate	Care Level	Minimum Follow-up	Delivery location
II-III	Hypertrophic CMP	Event rate 10-19%	Referral hospital	Bimonthly	Referral hospital
II	Supraventricular arrhythmias	Event rate 5.7-10.5%	Local Hospital	Each trimester	Local Hospital
I	Asymptomatic mitral regurgitation	Event rate 2.5-5%	Local Hospital	1-2 times	Local Hospital
III	Ventricular arrhythmias	Event rate 19-27%	Expert center	Monthly to bimonthly	Expert Center
III	ICD		Expert center		Expert Center
IV	HCM with severe LVOTO	Event rate 40-100%	Pregnancy termination should be discussed	Monthly	Expert Center

HOCM OB/Cardiology Pearls

1. 1:200
2. Diastolic dysfunction/pressure overload
3. β-blocker risk for IUGR
4. All anti-arrhythmic risks (pro-arrhythmic)
   - Flecainide: QRS widening
5. Genetic transmission to offspring, likely autosomal dominant although has not had genetic testing results yet

Risk Prediction





ESC guidelines on the management of cardiovascular diseases during pregnancy. Eur Heart J 2011;32:3147–97.
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Case #2 HOCM: WHO

Pregnancy Heart Team:

Obstetrician/Maternal Fetal Medicine

Anesthesiologist (Obstetric and Cardiothoracic)

Cardiologist

Critical Care Obstetric Nurse

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Case #2 HOCM: WHAT, WHEN, WHERE

WHAT: VD vs. CD?

- Obstetric indication for cesarean
- VD in absence of severe LVOTO
- Avoid Valsalva to extent possible and keep volume loaded

WHEN: At term

WHERE: Referral hospital, L&D suite in "high risk" labor room

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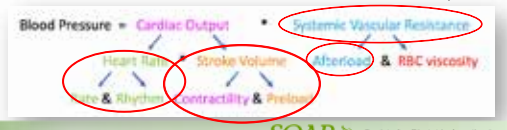
Case #2 HOCM: HOW (Delivery)

Hemodynamic goals:

1. Maintain intravascular volume
2. Minimize decreases in afterload
3. Minimize sympathetic stimulation

Peripartum risks:

1. Sensitive to preload changes, may not tolerate hemorrhage
2. Pressure in LV will be higher than pressure in Ao if LVOTO, which increases risk of pulmonary edema
3. SCD risk from ventricular arrhythmia



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Case #2 HOCM & Arrhythmia: HOW (Delivery)

MEDICATIONS:
- Vasopressor: phenylephrine

ANESTHESIA: early, effective neuraxial labor analgesia

MONITORING:
- Blood pressure cuff to start
- Telemetry with defibrillator pads
- Transthoracic echocardiogram

VENOUS ACCESS: Peripheral

HEMORRHAGE PREVENTION/MANAGMENT:
- NO contraindications

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Case #2 HOCM: HOW (Recovery)

RECOVERY LOCATION:
- High-risk maternal unit

TREATMENT GOALS:
- Minimize sympathetic stimulation
- Maintain intravascular volume
- Minimize decreases in afterload

CONTRACEPTION:
- No limitations

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Case #3 Cardiomyopathy: WHO

PATIENT:

- 33 G6P4 at 33 weeks SOB
- PMH: Cardiomyopathy LVEF 40→30%, RV mild reduced, PAF, pacemaker, life vest
- NYHA Class II→IV
- Meds:
  - Beta blocker
  - Enoxaparin 1mg/kg BID
- PE: VSS, thin, good airway, CTAB, no edema
- ECG: NSR
- TTE: LVEF 30%, mild reduced RV function, mild MR
- BNP: 25.0 [0.0-178.0 pg/mL]
- SOB in 3rd trimester

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Risk Prediction

ESC guidelines on the management of cardiovascular diseases during pregnancy. Eur Heart J 2011;32:3147–97.
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Case #3 Cardiomyopathy: WHEN

Warning signs of heart failure in the pregnant or laboring patient:

- Change in maternal symptoms
- Tachycardia
- Arrhythmia
- Hypotension
- Hypoxia (new oxygen requirement)
- Decreased urine output
- Decompensation of fetal tracing

Assessment:

- Physical exam
- Check BNP
- TTE

Clinical predictors suggestive of HF exacerbations

Symptom/Sign	0 Points	1 Point	2 Points
Orthopnea	None	Need to elevate head only	Need to elevate body > 45°
Dyspnea	None	When climb ≥ 8 stairs	Walking Level
Unexplained cough	None	Night time	Day and night
Pitting Edema	None	Below Knee	Above and below Knee
Weight Gain (9th Mo)	≤ 2 lb/week	2-4 lbs/week	> 4 lbs/week
Palpitations	None	When lying down	Any position day and night

Scoring and Action:
0-2 Low Risk, observe
3-4 mild risk, consider BNP
≥ 5 High Risk, BNP, Echo

Fett, J 2011

Goals of Guideline Directed Medical Therapy (GDMT) for cardiomyopathy

- Close Follow up
- Fluid Management
  - Diuresis/fluid restriction for volume overload
  - Salt restriction
- Vasodilators
- Beta blockade
- Treatment of hypertension
- Digoxin
- Inotropic/advance heart failure intervention if required

Case #3 Cardiomyopathy: WHO

PREGNANCY HEART TEAM:

ESSENTIAL PERSONNEL:
Obstetrician/Maternal Fetal Medicine
Anesthesiologist (Obstetric and Cardiothoracic)
Cardiologist
Critical Care Obstetric Nurse

INFORMED PERSONNEL:
ECMO surgeon
Perfusionist

Case #3 Cardiomyopathy: WHAT, WHEN, WHERE

WHAT: Vaginal delivery, possibly assisted

WHEN: At term

WHERE: Referral hospital, L&D suite in "high risk" labor room

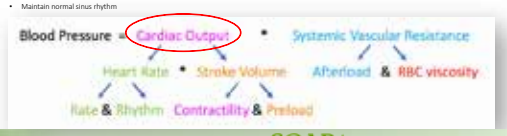
Case #3 Cardiomyopathy: HOW (Delivery)

Hemodynamic goals:

1. Maintain/augment contractility:
   - Cardiac output needs to increase during delivery
2. Support diastolic filling:
   - Maintain preload
   - Avoid sudden ↑ or ↓ in blood volume
3. Prevent tachycardia/arrhythmias:
   - Avoid sudden alterations in HR
   - Maintain normal sinus rhythm

Peripartum risks:

1. Worsening left ventricular function, possible right ventricular failure
2. Fall off starling curve with volume changes peripartum
3. Arrhythmia: SVT, VT, VF



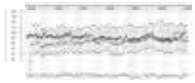
Case #3 Cardiomyopathy: HOW (Delivery)

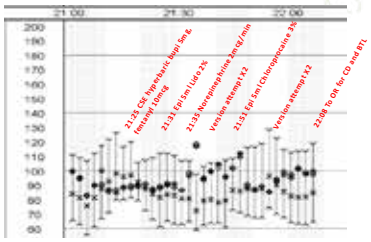
MEDICATIONS:
- Vasopressor: norepinephrine, vasopressin
- Inotrope: dobutamine
- Diuretic: furosemide at delivery

ANESTHESIA:
- Early, effective neuraxial labor analgesia

HEMORRHAGE PREVENTION/MANAGMENT:
- Uterotonics: oxytocin as usual

Case #3 Cardiomyopathy: HOW (Delivery)



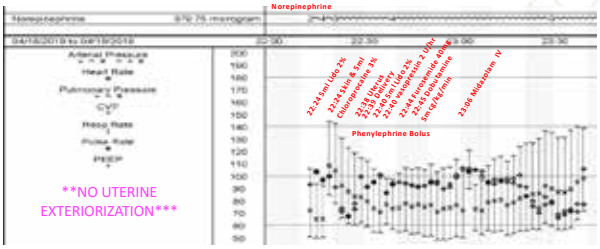


ANTICOAGULATION:
- Enoxaparin 1mg/kg wait 24h

MONITORING:
- Arterial line
- Central line
- Telemetry
- Transthoracic echocardiogram

ANESTHESIA:
- Combined spinal epidural

Case #3 Cardiomyopathy: HOW (Delivery)



NO UTERINE EXTERIORIZATION*

Case #3 Cardiomyopathy: HOW (Delivery)

CONTRACEPTION:
- Tubal ligation

RECOVERY LOCATION:
- High-risk maternal unit for acute recovery until stable from CD
- Requiring inotropes considered ICU

TREATMENT GOALS:
- Titrate vasopressors
- Titrate inotrope slowly
- Continue metoprolol for rate/rhythm control
- Diuresis for arrhythmia and heart failure prevention
- Anticoagulation for thrombosis prevention
- Stool softeners
- Low sodium diet

RECOVERY:
- D/C POD 5
- Metoprolol 12.5mg PO BID
- Enoxaparin 1mg/kg BID
- Cardiology follow up in 2-3 weeks
- Ace-I to start as out patient

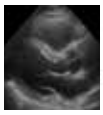
Anticoagulation for AF: CHA_2DS_2VASc

The Use of Transthoracic Echocardiography in Postpartum Hypertension

ANESTHESIA & ANALGESIA

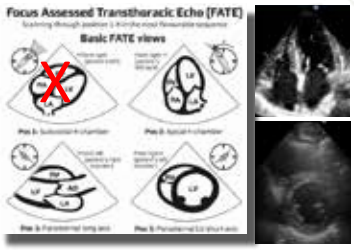
Favorable characteristics of pregnant women:

- Anterior & left lateral displacement
- Left lateral tilt position to avoid aortocaval compression
- Acceptance of ultrasound technology by women



Focus Assessed Transthoracic Echo (FATE)

Basic FATE views



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TTE Review

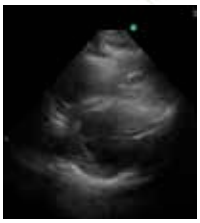
Ventricular wall motion:

- Systole: wall thickens, moves in toward center
- Diastole: wall thins, moves out

Filling:

- Normal LV: papillary muscles do not touch
- Empty LV: LVEDD <3cm

Parasternal Short Axis View



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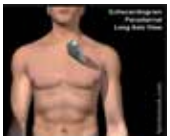
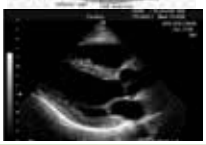
Parasternal Long Axis View



Pos 3: Parasternal long axis



ACQUISITION:

- Left lateral decubitus
- Near the sternum in the 3rd or 4th intercostal space
- Index marker to the right of the patient

USE:

- RV/LV function
- Volume status
- Ascending aorta

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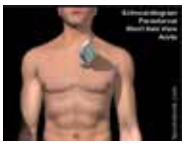
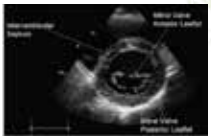
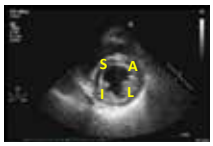
Parasternal Short Axis View



Pos 3: Parasternal LV short axis





ACQUISITION:

- Left lateral decubitus
- Near the sternum in the 3rd or 4th intercostal space
- Rotate probe clockwise 90 orthogonal to PLAX view
- Index marker to the left of the patient

USE:

- RV/LV function
- Volume status
- Septal changes: Volume/Pressure overload

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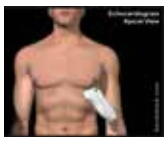
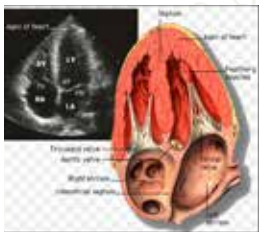
Apical 4 Chamber View



Pos 2: Apical 4-chamber



ACQUISITION:

- Left lateral decubitus
- Apical impulse
- 5th intercostal space, anterior axillary line
- Index marker to the left of the patient

USE:

- RV/LV size
- RV/LV function
- Flow across MV and TV
- Apical 5 Chamber: LVOT/AV

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Case #4 Arrhythmia: WHO

PATIENT:

- 31 G2P0 35 weeks
- PMH: ventricular ectopy, arrests, AICD, ablation, anxiety disorder
- NYHA Class II
- OB Hx: SAB, very painful
- Meds:
  - Sotolol 120mg BID
  - ASA 81mg
  - Magnesium
- PE: VSS, thin, good airway, CTAB
- Device records: PVCs, VT
- TTE: normal biventricular function

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Risk Prediction

ESC guidelines on the management of cardiovascular diseases during pregnancy. Eur Heart J 2011;32:3147–97.
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. 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

ICD/PPM Management

ICD (Defibrillate if VT/VF (VFIB = DFIB!)

Goals:

1. Prevent inappropriate shocks from oversensing cautery
   - >6" from ICD site
2. Maintain a way to defibrillate

Plan:

- Deactivate ICD (reprogram or use a magnet)
- Place defibrillator pads
- Use magnet to deactivate ICD
  - Tachy therapy deactivated with magnet
  - All parameters go back to initial values, no need to reevaluate
  - Magnet does not affect pacing

PPM

Goals:

1. Maintain pacing at appropriate rate for procedure

Plan:

- Pacemaker dependent:
  - Recommend short bursts of electrocautery to prevent pacing inhibition
  - Reprogram at higher rate for procedure
  - Reevaluate post procedure

Regitz-Zagrosek V, Roos-Hesselink JW, Bauersachs J, et al. 2018 ESC Guidelines for the management of cardiovascular diseases during pregnancy. Eur Heart J. 2018;39(34):3165-3241.

Case #4 Arrhythmia: WHO

TEAM:

Obstetrician/Maternal Fetal Medicine
Anesthesiologist (Obstetric and Cardiothoracic)
Cardiologist/Electrophysiologist
Critical Care Obstetric Nurse

Case #4 Arrhythmia: WHAT, WHEN, WHERE

WHAT: VD vs. **CD**

WHEN: Term (**38 weeks** to avoid spontaneous labor?)

WHERE: **L&D OR** v. CT OR

Case #4 Arrhythmia: HOW (Delivery)

Hemodynamic goals:

1. Prevent ectopy
2. Avoid QT prolonging agents
3. Mg>2, K>4

Peripartum risks:

1. VT requiring defibrillation/medications
2. Maternal anxiety

Case #4 Arrhythmia: HOW (Delivery)

MEDICATIONS:
- Vasopressor: Phenylephrine
- Anti-arrhythmics: sotolol, magnesium, lidocaine, amiodarone

ANESTHESIA: Spinal, clonidine?

MONITORING:
- Non-invasive blood pressure
- Telemetry with defibrillator pads
- Transthoracic echocardiogram
- ICD management

VENOUS ACCESS: peripheral

HEMORRHAGE PREVENTION/MANAGMENT:
- Uterotonics: oxytocin, methergine, carboprost, misoprostol

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Case #4 Arrhythmia: HOW (Recovery)

RECOVERY LOCATION:
- High-risk maternal unit or ICU/ telemetry bed

TREATMENT GOALS: prevent ectopy
- Antiarrhythmics
- Anxiolytics

CONTRACEPTION:
- No restrictions

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Case #5 Update on Last Year's Fontan Case

28 G1P0 (BREECH) at 33 weeks with a medical history of FONTAN circulation, OSA, morbid OBESITY, bad airway, presenting with severe PEC by blood pressure and renal failure with OLIGURIA now with HYPOXIC and HYPERCARBIC respiratory failure possibly due to pre eclampsia or systemic ventricular failure or pulmonary embolism?

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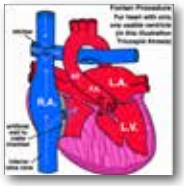
Case #5 Update on Last Year's Fontan Case

HEMODYNAMIC GOALS:
- Maintain passive preload gradient to pulmonary circulation
- Optimize CO (contractility, NSR, rate, volume)
- Maintain SVR (prevent worsening of AI or MR)



PERIPARTUM RISKS:
- Her: Hypoxia, Hypercarbia
- Fontan:
  - Poor filling (pulmonary edema, thrombosis)
  - Arrhythmia
  - Systemic ventricular failure

NO UTERINE EXTERIORIZATION

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Case #5 Update on Last Year's Fontan Case

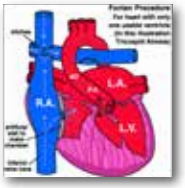
MEDICATIONS:
- Vasopressor: Norepinephrine
- Inotropes: Dobutamine

ANESTHESIA: Combined spinal epidural

MONITORING:
- Arterial line
- Central line/CVP
- Transthoracic echocardiogram

ECMO: VV and VA on standby

HEMORRHAGE PREVENTION/MANAGMENT:
- Oxytocin, Misoprostol, Massage, B-Lynch, Hysterectomy
- No: Methergine, Carboprost



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Case #5 Update on Last Year's Fontan Case

- MICU on VV ECMO for 6 days
- POD 2 Echo: severely limited study, LV function preserved. No valvular incompetence.
- CVVH from POD1 → POD 50

- POD 18-32 VV ECMO re-cannulation for hypoxia
- POD 19 CT scan: Large pulmonary embolus in the right lower lobe with additional pulmonary emboli in the left lower lobe and likely right upper lobe
- Anticoagulation with therapeutic heparin drip (PTT goal 68-112)

- POD 58 Transfer to floor
- POD 73 Discharged TO Sub-Acute nursing facility

- Post partum 7 months: hypoxemic respiratory failure 2/2 PEs and volume overload, ICH and IVH with intercranial HTN and ischemic strokes, trach/PEG, rehab
- Post partum 10 months death 2/2 ventilator associated pneumonia, shock, multisystem organ failure

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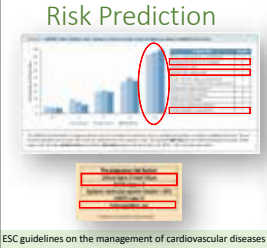
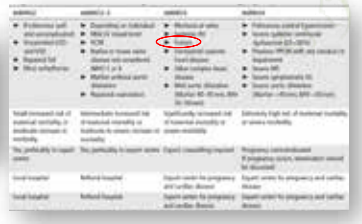
Risk Prediction





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Thank you!

Arendt.Katherine@mayo.edu
marielouisemeng@gmail.com
briller@uic.edu
texaslex4@gmail.com

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Abstract #: RF1AA-45

Anesthetic Management of a Parturient with Hodgkin's Lymphoma resulting in a Large Anterior Mediastinal Mass: A Case Report

Presenting Author: Casey Savage D.O., M.S.
Presenting Author's Institution: The University of Connecticut - Farmington, Connecticut
Co-Author: Adam Sachs M.D. - Hartford Hospital
Marbelia Cech M.D. - Hartford Hospital

Anterior mediastinal masses present many challenges to anesthesiologists. Respiratory and hemodynamic collapse upon induction represents two of the most critical situations we encounter during the care of these patients. We present a woman, at 36 weeks gestation, with new onset cough, shortness of breath, stridor, and palpitations. Upon workup a large anterior mediastinal mass (12 x 15cm), which compressed her bilateral bronchi, superior vena cava (SVC), and aortic arch was found. She was diagnosed by biopsy with Hodgkin\'s Lymphoma.

A multi-disciplinary discussion occurred and ultimately, the decision was made to proceed with cesarean delivery in order to expedite chemotherapy and radiation. Because of concern for total cardiovascular collapse if general anesthesia became necessary for cesarean section, prophylactic venous-arterial extracorporeal membrane oxygenation (VA-ECMO) catheters were placed by the Cardio-thoracic team.

A slowly dosed dural- puncture epidural was the anesthetic of choice for her cesarean section in order to allow for gradual loss of sensation with maintained hemodynamic stability. The intra-operative course was mostly uneventful aside from profound hypotension (60/40) which occurred with fundal pressure while trying to extract the fetus. The post-operative course was uncomplicated and on post-operative day one the ECMO catheters were removed. The patient received chemotherapy on post-operative day four and was discharged from the hospital on post-operative day 5.

This case highlights the challenges associated with anterior mediastinal masses in parturients and the importance of multi-disciplinary management of complex patients.

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Abstract #: RF1AA-49

Cesarean Section in A Parturient with Congenital Cardiomyopathy, Complicated by Ventricular Bigeminy

Presenting Author: Anna Sobilo M.D.
Presenting Author's Institution: RUSH University Medical Center - Chicago, IL
Co-Author: Michael Holland M.D. - RUSH University Medical Center

INTRODUCTION: In the vast majority of patients with congenital cardiomyopathy the etiology is unknown. Pregnancy stresses the cardiovascular system and is therefore poorly tolerated in this population, and it carries significant risk factors; risks include overt heart failure occurring during pregnancy, irreversible deterioration in ventricular function, and the most feared complication of fetal loss or maternal death(1).

CASE: A 23-year-old G4P3003 at 39w3d with a history of congenital cardiomyopathy for repeat cesarean section (CS). Home medications included bisoprolol and hydrochlorothiazide. A peripartum transthoracic echocardiogram revealed a mildly dilated left atrium, markedly dilated left ventricle, diffuse hypokinesis and an ejection fraction of 35 %. Patient endorsed dyspnea on exertion as well as shortness of breath; NYHA Class III.
Decision was made to proceed with CS under a combined spinal epidural (CSE). Prior to CSE 2 large bore IV's were placed, as well as left radial arterial line for hemodynamic monitoring. Two units of packed red blood cells were readily available, and a 1-liter bolus of lactated ringer's solution was initiated. In the operating room, a CSE was placed at L4-L5. 1.2 mL of bupivacaine 0.75 %, morphine 100 mcg, and fentanyl 15 mcg were injected intrathecally. Upon placement of spinal a phenylephrine infusion was initiated. When the patient was placed supine, she became hypertensive and EKG tracing was consistent with ventricular bigeminy. Phenylephrine infusion was stopped and led to the resolution of bigeminy, which was hypothesized to be secondary to a stretch-induced arrhythmia due to the increased afterload. Patient received a one-liter bolus in lieu of vasopressors and blood pressure was maintained with a mean arterial pressure above 70. Upon delivery of the fetus patient was requiring intermittent boluses of lidocaine 2% due to increasing sensation during the procedure. The epidural was dosed slowly without hemodynamic changes and patient remained comfortable for the remainder of the CS.

DISCUSSION: There is scant information in the literature regarding the anesthetic management of parturient with congenital cardiomyopathy(1). Principles of anesthetic management are: maintenance of normal to low heart rate to decrease oxygen demand and prevention of swings in blood pressure. Upon review of literature there have been case reports describing bigeminy during phenylephrine infusion after neuraxial anesthesia, all of these resolved with discontinuation of the vasopressor(2). As women with congenital heart disease now have a higher life expectancy and are becoming pregnant, this case is an excellent example of anesthetic management in a patient who was told to avoid pregnancy due to significant morbidity and mortality.

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Abstract #: RF1AA-75

Anesthetic Management of a 38 year old G3P0 Woman with a History of Mechanical Heart Valve, Third Degree Heart Block Treated with a Biventricular Pacemaker, and Paroxysmal Atrial Fibrillation and Atrial Flutter who Presents for Induction of Labor

Presenting Author: Georgina M. Kolcun M.S.
Presenting Author's Institution: Texas A&M Health Science Center College of Medicine - Bryan , TX
Co-Author: Jessica Ehrig M.D. - Baylor Scott & White Health
Sara Cooper M.D. - Baylor Scott & White Health
Cameron Hess M.D. - Baylor Scott & White Health
Bryan Rondeau M.D. - Baylor Scott & White Health
Michael P Hofkamp M.D. - Baylor Scott & White Health

Introduction: The American Society of Regional Anesthesia and Pain Medicine has guidelines to determine when it is safe to perform neuraxial anesthesia after cessation of anticoagulation. A clinician caring for a parturient with a mechanical heart valve must weigh the risks and benefits of stopping anticoagulation in the peripartum period with the benefits of labor analgesia; an issue often managed by a multidisciplinary team.

Case: A 38-year old G3P0020 woman with a history of aortic valve replacements in 2005 and 2017, third degree heart block managed with a biventricular pacemaker, and paroxysmal atrial fibrillation and atrial flutter was admitted to a telemetry monitored floor at 36w5d gestation prior to induction of labor for medical optimization. A multidisciplinary team consisting of Maternal Fetal Medicine, Cardiology, and Obstetric Anesthesiology formulated a management plan prior to admission. At 37w0d, she was transferred to the Medical Intensive Care Unit where an arterial line was placed for improved monitoring of blood pressures. Cervical ripening was begun with misoprostol and eventually a foley balloon. A heparin infusion was initiated after the last scheduled dose of therapeutic enoxaparin and was stopped six hours after initiation of an oxytocin infusion. It took ten hours for the activated partial thromboplastin time to reach a level (below 40 seconds) that was safe for neuraxial anesthesia after the heparin infusion was stopped; fentanyl and remifentanil patient-controlled anesthesia were employed for labor analgesia in the interim. A labor epidural catheter was placed and dosed in 3 ml increments to ensure hemodynamic stability. A pudendal block was performed just prior to delivery and a forceps-assisted vaginal delivery was performed in the MICU with neonatal intensive care unit team members in attendance. APGAR scores were 7 and 8 at 1 and 5 minutes, respectively.

The patient expressed desire for permanent sterilization and a postpartum tubal ligation was performed immediately after delivery and the labor epidural was successfully activated for surgical anesthesia. The patient was discharged from the hospital in good condition on the fourth postpartum day and anticoagulation was resumed with warfarin.

Discussion: Due to our patient's cardiac arrhythmias, she had continuous telemetry monitoring throughout her hospitalization; this required coordination between telemetry, MICU, and labor and delivery nursing staff as our labor and delivery unit was not capable of telemetry monitoring. We were aggressive about minimizing the amount of time without anticoagulation and it unexpectedly took ten hours after stopping the heparin infusion for the aPTT to normalize; delayed neuraxial labor analgesia was an unintended consequence. We extended our resources to provide the patient a timely postpartum tubal ligation during the late evening hours due to her comorbidities and the burden another pregnancy would cause.

Abstract #: RF1AA-81

Paying it forward: Anesthetic management of the parturient post heart transplant

Presenting Author: Rachel E Jacobs M.D.
Presenting Author's Institution: UT Southwestern Medical Center - Dallas, Texas
Co-Author: Alexa Kaminski M.D. - UT Southwestern Medical Center
Kalechi Anyaehie M.D. - UT Southwestern Medical Center

Introduction: Pregnancy after heart transplantation is becoming increasingly common due to advances in heart disease and transplant medicine. However, anesthetic reports of such cases are exceedingly rare. The pathophysiological changes in the heart transplant parturient pose maternal, fetal and neonatal risks that the anesthesiologist must consider.

Case report: A 17-year-old G1P0A0 with history of dilated cardiomyopathy eleven years status post heart transplant, was admitted at 30w1d to the antepartum unit after endomyocardial biopsy indicated acute cellular and antibody mediated rejection. Immunosuppressive therapy consisted of azathioprine and tacrolimus after a history of rejection six years prior. Most recent echocardiogram revealed a new pericardial effusion and depressed left ventricular ejection fraction (LVEF) of 37%. Cardiology recommended intravenous immunoglobulin (IVIG) in addition to immunosuppression. After completion of IVIG, routine labs and observation demonstrated elevated 24-hour total protein and hypertension, consistent with preeclampsia without severe features. Continued in-house management included biweekly IVIG, weekly echocardiogram and serial brain natriuretic peptide (BNP). Three weeks after admission, patient developed new onset headache and elevated creatinine with mild weight gain, despite improved heart function. Thus, induction of labor (IOL) was favored due to concern for preeclampsia with severe features. Given her preserved LVEF, patient was cleared for spontaneous vaginal delivery (SVD) per cardiology. Following initiation of oxytocin and prophylactic magnesium infusion, dural puncture epidural was performed and initiated at a programmed intermittent bolus infusion of 0.0625% bupivacaine with 2 ug/cc fentanyl. Patient progressed to complete with artificial rupture of membranes (AROM) and was transported to the operating room for delivery. After spontaneous vaginal delivery (SVD) of infant with Apgars 8/8, the initial 24-hour postpartum period was complicated by postpartum hemorrhage and acute kidney injury (AKI) requiring fluids, one unit packed red blood cells (pRBC) and diuresis. Remainder of postoperative course remained uneventful, including postpartum echocardiogram and blood pressure control.

Conclusion: With appropriate multidisciplinary care including transplant physician, maternal fetal medicine and obstetric anesthesiologist, pregnancy post heart transplantation is a viable and reasonably safe option. Risk of graft rejection, hypertension, infection, and other fetal and maternal complications are real and should be carefully monitored to optimize outcomes.

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Abstract #: RF1AA-82

The utility of transthoracic echocardiogram in a 40-year-old female with obstructive hypertrophic cardiomyopathy under neuroaxial anesthesia for cesarean delivery

Presenting Author: Tiffany M.N. Otero B.S., M.D.
Presenting Author's Institution: University of Arizona - Tucson, AZ
Co-Author: Mandinanisa Chinyadza M.D. - University of Arizona
Yan Yang M.D. - University of Arizona
Michelle DaCosta M.D. - University of Arizona

Introduction: Obstructive hypertrophic cardiomyopathy (HOCM) carries a significant risk of mortality during pregnancy.1

Case Presentation: A 40-year-old 80 kg G5P3 female with a history of syncopal HOCM presents for elective primary cesarean section (c/s) at term. Initial transthoracic ECHO (TTE) was notable for left ventricular hypertrophy (LVH) without evidence of systolic anterior motion (SAM) or mitral regurgitation (MR). At 14 weeks gestation age (GA) TTE was positive for SAM and mild MR; at 24 weeks TTE was notable for mild resting left ventricular outflow (LVOT) obstruction and worsening LVH; at 34 weeks GA TTE showed moderate MR and severe diastolic dysfunction. During her pregnancy the patient (pt) required two hospitalizations for worsening LVOT obstruction symptoms due to dehydration and was followed by obstetrics, cardiology and anesthesia.

At 37 weeks GA the pt underwent a scheduled primary c/s with TTE and arterial line guidance. A combined spinal-epidural (CSE) was placed and hyperbaric bupivacaine, fentanyl and morphine was given. Concurrently, a phenylephrine infusion started and fluid boluses were administered. The patient remained hemodynamically stable; incision to delivery time: 6 minutes; estimated blood loss: 800ml.

Discussion: Pre-pregnancy symptoms are significant in predicting the deterioration of women with HOCM.2 Given our pts history of syncope and severe diastolic dysfunction her risk of maternal complications was > 20%.3 Accordingly TTE was used to visualize our pts cardiac function and aid in resuscitation after the placement of a combined-spinal. Previously, the use of CSE was avoided in women with HOCM due to the blockade of sympathetic tone.1 Recent reports however have shown CSE-associated hypotension can be minimized when TTE is used to assist in clinical decisions. 1 This case provides additional evidence that CSE is a safe approach for women with HOCM and further highlights the utility of intraoperative TTE.

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Abstract #: RF1AA-82

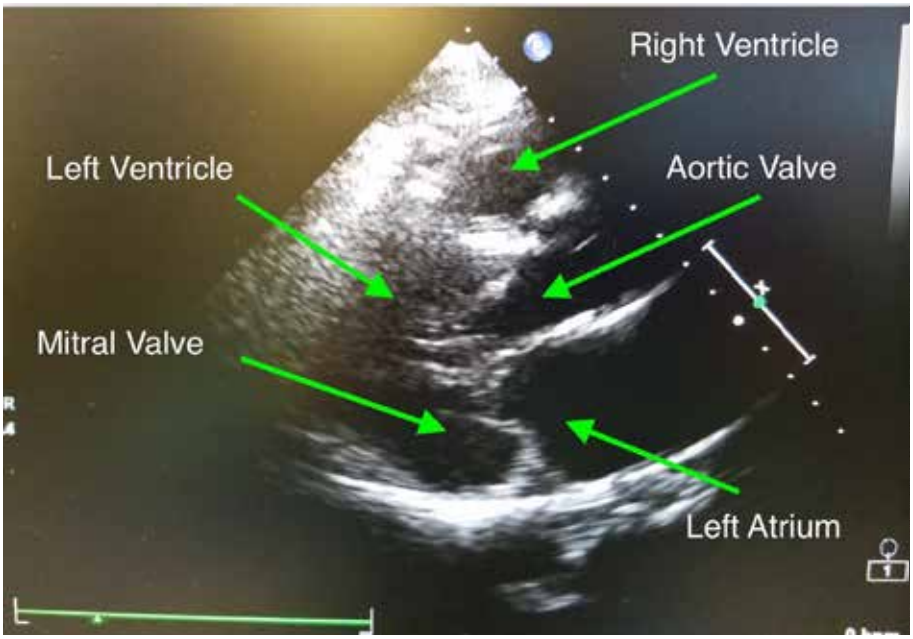

Figure 1: Transthoracic echocardiogram image of the parasternal long axis view taken after combined spinal-epidural placement (CSE)

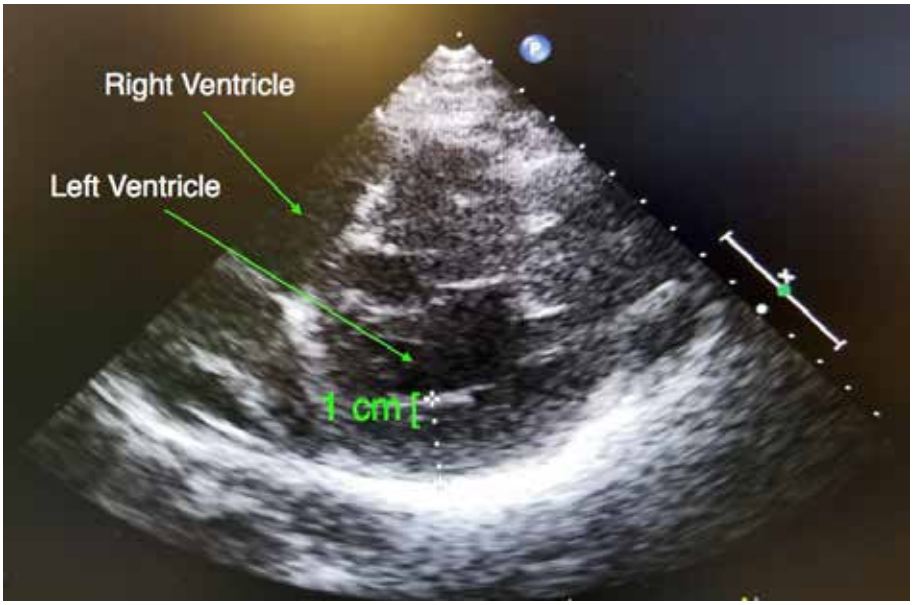

Figure 2: Transthoracic echocardiogram image of the parasternal short axis view taken after CSE placement. Left ventricular wall was measured and was noted to be > 30mm in thickness

Abstract #: RF1AA-101

Peripartum Cardiomyopathy requiring LVAD complicated by Embolic Stroke

Presenting Author: Benjamin B Whiddon MD, PhD
Presenting Author's Institution: University of Washington Medical Center - Seattle, WA
Co-Author: Carlos Delgado MD - University of Washington Medical Center

Introduction: The incidence of peripartum cardiomyopathy (PPCM) has increased (1), as well as in-hospital mortality rates from PPCM despite an increased utilization of mechanical circulatory support (MCS)(2). MCS is not a benign intervention; complications can include bleeding, thrombosis, infection, or stroke (3). We report a case of severe PPCM treated with MCS complicated by significant morbidity.

Case description: A previously healthy 36-year-old woman with an uncomplicated pregnancy presented to a community hospital 3 months postpartum with dyspnea on exertion and orthopnea. She was treated for an upper respiratory infection with no improvement of her symptoms. An echocardiogram was performed and showed dilated LV with EF 20%. Heart failure therapy was started with lisinopril, carvedilol, spironolactone, and furosemide. She became dyspneic with minimal activity and hypotensive, and she was transferred to our center. On arrival, right heart catheterization evidenced cardiogenic shock (elevated R-sided filling pressures, severely elevated L-sided filling pressures, reduced CO and EF 11%). Neurological and renal function were preserved. PPCM was diagnosed. Decision was made to place R- and L-sided Impella devices. The procedure was uneventful, and heparin infusion was started. On POD1, she was found to have L-sided hemiplegia. CT/CTA demonstrated acute dissection of the right internal carotid artery with no ICA filling and M1 segment occlusion concerning for subacute MCA stroke. She was not a candidate for tPA or embolectomy. Craniotomy was not performed due to improving neurological status. R-sided Impella was weaned on POD4. L-sided Impella remained until POD20. She was then transitioned to a Heartmate3 LVAD. Intraoperatively she presented complete heart block and asystole requiring chest reopening, cardiac massage, and placement of a transvenous pacer. Anticoagulation was started with heparin infusion and transitioned to warfarin. On POD39 she had two syncopal episodes. Head CT revealed hemorrhagic conversion. Her anticoagulation was held and reversed. Follow-up imaging revealed no further hemorrhage. Low dose heparin infusion was restarted with serial neurological examination. Patient was transitioned to low dose LMWH. She was transferred to rehabilitation, discharged home, remained LVAD-dependent, and listed for heart transplant.

Discussion: Most cases of PPCM occur during the first weeks after delivery. The late yet catastrophic presentation in our patient highlights the need for a low index-of-suspicion regarding PPCM. A low ejection fraction predicts worse outcomes (4), including need for transplantation, and the use of MCS as bridge therapy can have critical adverse effects and complications.

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Abstract #:RF1AA-111

Anesthetic Management of a Parturient with a Stenotic Right Ventricle to Pulmonary Artery Conduit

Presenting Author: Emery H McCrory MD
Presenting Author's Institution: Northwestern University - Chicago, IL
Co-Author: Howard P Lee MD - Northwestern University
Thomas R Gruffi MD - Mount Sinai
Samir K Patel MD - Northwestern University

The patient is a 21-year-old nulliparous female at 34 weeks gestation with history of a repaired Tetralogy of Fallot (TOF) who presented to our institution in preterm labor. Her condition was complicated by pulmonary atresia with a stenosed interface of the right ventricle to pulmonary artery (RV-PA) conduit, pulmonary arterial hypertension secondary to vascular remodeling, and chronic RV systolic failure. The extent of her disease placed her in the WHO class IV maternal risk stratification. A collaborative discussion between anesthesiology, maternal-fetal medicine, cardiology, and pulmonology determined that the safest plan was for the patient to avoid painful labor contractions and Valsalva maneuvers by implementing early epidural analgesia for a forceps-assisted vaginal delivery (FAVD). A lumbar epidural was placed and tested with 5 mL of 1% lidocaine to rule out intrathecal placement and 100 mcg of fentanyl to rule out intravascular placement, and a fentanyl 2mcg/mL-bupivacaine 0.0625% infusion was started. A right radial arterial catheter was placed for hemodynamic monitoring, and a right internal jugular central line was placed for central venous pressure monitoring and resuscitation. Defibrillating pads were placed on the patient and ACLS equipment and drugs were readily available. The patient underwent FAVD in the operating room after 10 hours of labor. Estimated blood loss was 550 mL. The patient received a total of 3000 mL of crystalloid. Post-partum, the patient remained hemodynamically stable without any signs or symptoms of right heart failure.

This case demonstrates that the optimal approach to managing a laboring cardiac obstetric patient often involves the utilization of neuraxial analgesia as pain control to prevent catecholamine surges and increased cardiac stress. Avoiding an intrathecal dose limits a sudden decrease in systemic vascular resistance which can cause decreased preload, leading to decreased cardiac output. Epinephrine-containing solutions are avoided during the test dose to avoid the potential risk of tachyarrhythmias. Nitrous oxide is not an acceptable alternative as it increases pulmonary vascular resistance. Afterload increases can also be prevented by utilizing FAVD without Valsalva, or Cesarean delivery with an epidural. Strict fluid management in these patients is essential as further fluid loading may lead to worsening of right ventricular function. Our case report illustrates that as advancements develop for congenital heart disease, anesthesiologists need to be prepared to manage these patients in any perioperative setting.

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Abstract #:RF1AA-120

Use of resuscitative endovascular balloon occlusion of the aorta (REBOA) in the management of hemorrhagic shock during pregnancy.

Presenting Author: Elysha Dinh MD
Presenting Author's Institution: Virginia Commonwealth University - Richmond, Virginia
Co-Author: Rishi Patel MD - Virginia Commonwealth University
Brian Cocchiola MD - Virginia Commonwealth University

Introduction: During pregnancy, the uterus receives an average of 700 mL blood flow/min, placing pregnant women with uterine bleeding at unique risk of rapid blood loss, hemorrhagic shock, and death. In these patients, REBOA should be considered as an adjunct for quick hemorrhage control during resuscitation.

Case report: 41 year old G1 at 33 weeks by IVF dating presented with abdominal & back pain. Patient reported acute onset severe back pain and abdominal cramping associated with shortness of breath and blurred vision while having a bowel movement. There was no associated vaginal bleeding or LOF.

Upon arrival the patient was hypotensive and tachycardic with a positive FAST scan. Therefore, she was taken immediately to the OR with trauma surgery and obstetrics. The team initiated massive transfusion protocol. The OB service did a stat c-section via midline laparotomy followed by uterine closure and administration of intramuscular oxytocin and rectal misoprostol. The trauma surgery service then explored the abdomen, but found no obvious source of bleeding. The patient continued to be unstable despite receiving 21 units of PRBC, 9 FFP, 2 PLT and 1 Cryo, therefore the decision was made to place a REBOA via the left groin. The patient was transported to interventional radiology for angiography and possible embolization. In the IR suite, pelvic and abdominal angiography showed no evidence of active extravasation. However, empiric embolization of the bilateral uterine arteries was done as this was thought to be the most likely source. Following embolization, patient remained hemodynamically stable in the ICU and was able to return to the OR on POD 1 for re-opening laparotomy and primary fascial closure. Patient was discharged home on POD 22.

Discussion: REBOA is most often performed emergently to control blood flow proximal to the suspected bleeding focus and to provide circulatory support to bridge patients to definitive hemorrhage control. It is most commonly used in trauma surgery for hemorrhage control and as a resuscitation adjunct in patients with hemorrhagic shock at risk of circulatory collapse. However, its use is not limited to trauma alone; REBOA use has been reported in five major types of hemorrhage: postpartum, upper gastrointestinal, pelvic (during pelvic/sacral tumor surgery), abdominopelvic trauma, and ruptured AAA.

Interestingly, some cases have also described prophylactic REBOA placement in hemodynamically stable patients at risk of significant hemorrhage including patients undergoing pelvic and sacral tumor resection and high risk obstetric cases where bleeding would be rapid and difficult to quickly control.

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Abstract #: RF1AA-121

Management of New-Onset Refractory Ventricular Tachycardia in Pregnancy

Presenting Author: Jessica M. Meister Berger MD, JD
Presenting Author's Institution: Medical College of Wisconsin - Milwaukee, WI
Co-Author: Paul S. Pagel MD, PhD - MCW
Lonnie Dye III MD - MCW

Case: A 34-year-old G4P1021 parturient presented at 25-weeks' gestation with palpitations, fatigue, and tachycardia (HR=160 beat/min) without hypotension. An electrocardiogram demonstrated sustained monomorphic ventricular tachycardia (VT). She was treated with lidocaine and amiodarone. Cardiac MRI demonstrated left ventricular (LV) systolic dysfunction and multiple areas of LV wall thinning in a coronary distribution. Transthoracic echocardiography (TTE) confirmed an enlarged LV; the ejection fraction was 36%. Coronary angiography was unremarkable. The patient was treated with metoprolol and furosemide. An AICD was placed at 29-weeks' gestation. Three weeks later, she developed recurrent palpitations and dyspnea. Repeat TTE showed further deterioration of LV function and severe pulmonary hypertension. The patient underwent a cesarean section in a hybrid OR under epidural anesthesia with invasive radial and pulmonary artery catheter monitoring. Cardiothoracic surgery was available for ECMO in case her condition worsened. The operation was uneventful: a 1340-gram infant was delivered with Apgar scores of 5,7, and 8. The patient required postoperative diuresis and pharmacologic rate control in the ICU. Extensive workup did not reveal a clear etiology; ultimately her VT was attributed to myocardial scarring from recurrent coronary vasospasm.

Discussion: VT during pregnancy is rare and is an independent predictor of adverse maternal and fetal outcome1. Predisposing risk factors for VT during pregnancy include congenital heart disease, prolonged QT syndrome, aberrant conduction, pulmonary embolism, and electrolyte abnormalities2. VT during pregnancy may be also attributed to increased sympathetic nervous system activity3. The most common arrhythmogenic focus for idiopathic VT during pregnancy is the RV outflow tract caused by hormonal fluctuations of myocardial norepinephrine concentration4. Management of VT during pregnancy depends on hemodynamic stability: rate control with a selective beta1-adrenoceptor antagonist is considered first-line therapy in stable patients5, whereas cardioversion is recommended regardless of gestational age in the presence of hemodynamic instability or fetal compromise6.

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Abstract #: RF1AA-138

Dural Puncture Epidural & Congenital Heart Disease: A Case and Reappraisal of Labor Complicated by Maternal Tetralogy of Fallot

Presenting Author: Robert S Ackerman MD
Presenting Author's Institution: University of Texas Southwestern Medical Center - Dallas, TX
Co-Author: Michelle M Eddins MD - University of Texas Southwestern Medical Center

BACKGROUND: Congenital heart disease (CHD) presents a challenge to safe delivery of anesthesia to a parturient. Complications such as mechanical ventilation and mortality are reportedly increased in mothers with CHD than those without (1). Adequate peri-obstetric anesthesia is critical to optimizing hemodynamics and minimizing cardiac stress (2, 3). We present an interesting case of a parturient with a history of repaired tetralogy of Fallot (TOF) who underwent forceps-assisted vaginal delivery after successful dural puncture epidural (DPE).

CASE DESCRIPTION: A 25-year-old G2P1 woman at 36 weeks gestation presented to labor and delivery for induction of labor. She had a past medical history of TOF with significant pulmonic regurgitation and right ventricular enlargement status-post Rastelli procedure at age 6 months and bio-prosthetic pulmonic valve replacement at age 21 years. She had a fair functional status with greater than 4 metabolic equivalents and negative cardiac and respiratory review of systems. She was evaluated by cardiology in her first trimester and deemed appropriate for potential vaginal delivery. Pre-operative transthoracic echocardiogram showed a left ventricular ejection fraction of 65%, moderate pulmonary regurgitation and normal left ventricular systolic function; electrocardiogram showed right bundle branch block and sinus bradycardia. The primary obstetric and anesthesia plan consisted of pre-induction of labor arterial line placement, two large-bore peripheral IV lines, continuous telemetry and ICU level monitoring, readily available central access kits and vasoactive agents, and planned vaginal delivery with accelerated second stage of labor. She underwent successful placement of a dural puncture epidural, amniotomy and oxytocin infusion to augment labor, and delivered with forceps assistance in the operating room. She delivered a vigorous female infant with Apgar scores of 4 and 9. She was monitored closely in the ICU following delivery and had no diagnosed complications during her labor hospitalization or postpartum visits.

DISCUSSION: Prior studies have demonstrated safe deliveries of parturients with TOF under general and neuraxial anesthesia - epidural, spinal, or combined spinal-epidural (CSE) (2). The DPE technique has been described to have improved block quality compared to standard labor epidurals and decreased hypotension and uterine hypertonus compared to the CSE technique (4). This case introduces an alternate method to providing adequate analgesia to this population while limiting the stresses of labor and potential suboptimal fluid shifts and hemodynamic fluctuations.

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Abstract #: RF1AA-140

Multidisciplinary Management of a Pregnant Patient Undergoing Cesarean Section on Dual Antiplatelet Therapy (DAPT) within 1 Month of Intracranial Stent Placement on Cangrelor

Presenting Author: Laura L Gershon MD
Presenting Author's Institution: UPMC Magee-Womens Hospital - Pittsburgh, Pennsylvania
Co-Author: Chad T Dean MD - UPMC Magee-Womens Hospital
Jonathan H Waters MD - UPMC Magee-Womens Hospital

Introduction: The recommended duration of DAPT after intracranial stent placement presents a dilemma for pregnant patients with recent stenting who require urgent or emergent obstetrical surgery. If DAPT is discontinued, the risk of stent thrombosis is increased, which could result in stroke or death (1). We present the case of a pregnant patient with recent stent placement (less than 1 month) on DAPT who underwent successful c-section with DAPT therapy bridged using cangrelor, an IV P2Y12 receptor inhibitor antiplatelet agent.

Case: A 34-year-old G1P0 at 31.4 weeks presented to the emergency department with a sudden onset headache and left hemiparesis and neglect. She had a history of polycystic ovarian syndrome and morbid obesity. A non-contrast brain MRI revealed findings concerning for a right MCA stroke. An MRA of the patient's head and neck showed an occlusion of the M1 branch of the MCA. The patient was taken to the angiography suite where thrombectomy was performed and two balloon mounted stents were deployed in the right ICA communicating branch for successful recanalization. Aspirin and clopidogrel were started to prevent stent thrombosis. The patient's symptoms resolved.

During the patient's hospitalization her blood pressure was noted to be elevated and her platelet count dropped from the 120s to 90s, concerning for cHTN with SIPE with severe features versus gestational thrombocytopenia. Given the inability to distinguish between the two diagnoses, the decision was made to deliver the baby at 35.3 weeks. The patient elected to have a general anesthetic, as she did not want to labor without a neuraxial block.

A multidisciplinary team consisting of anesthesiology, MFM, neurology, and hematology met, and the decision was made to discontinue the patient's clopidogrel 5 days prior to delivery while bridging her with cangrelor, an IV P2Y12 receptor inhibitor with a 6-minute half-life. On the day of the patient's c-section, the cangrelor infusion was discontinued during induction. A live male infant was delivered with APGARs of 8 and 9. The cangrelor infusion was restarted when hemostasis was achieved, and the uterus was noted to have good tone. EBL was 400 cc. The patient underwent continuous intraoperative EEG and EMG to monitor neurological status. A stroke team was notified and available in the event that a change in neurological status was seen. Postoperatively the patient was loaded with clopidogrel and the cangrelor infusion was discontinued. The patient was discharged on post-op day 3.

Discussion: This case is the only report of a c-section performed in the setting of aspirin and cangrelor use in a patient with stent placement. It highlights the importance of a multidisciplinary approach to the pregnant stroke patient. Our strategy is a potential option for pregnant patients on DAPT who are high thrombotic and high bleed-risk, yet require obstetrical surgery.

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Abstract # :RF2AB-141

Cesarean Delivery in a Parturient with Repaired Aortic Coarctation and Subaortic Stenosis

Presenting Author: Morgan A Welch D.O.
Presenting Author's Institution: University of Illinois at Chicago - Chicago, IL
Co-Author: Heather C Nixon M.D. - University of Illinois at Chicago

Introduction: Aortic coarctation accounts for roughly 7% of congenital heart disease. Following repair, recurrent coarctation and subaortic stenosis can occur putting patients at risk for heart failure, and aortic dissection. Parturients with corrected aortic coarctation with subaortic stenosis may be at significant risk for morbidity if they are unable to compensate for the increased cardiac demands of pregnancy. In addition, anesthetic planning for delivery must consider how to minimize the rapid changes in hemodynamics that may occur during neuraxial anesthesia or fluid shifts following delivery. A full understanding of the post-surgical anatomical cardiac changes and current functional status will impact the level of care required for anesthetic planning. Other considerations include utilizing L arm pressure (post-ductal) as a metric of MAP and therefore a measure of uterine blood flow. We present a case of the successful management of a parturient undergoing cesarean delivery with congenital aortic coarctation s/p repair with residual subaortic stenosis.

Case: 24 yo Spanish-speaking G1P0 at 39 weeks presented for scheduled cesarean delivery. She had an extensive cardiac history including; congenital coarctation with bicuspid aortic valve and VSD s/p four surgical repairs (no records available for review) and angioplasty for residual subaortic stenosis. At the time of her delivery, she was a NYHC II with mild dyspnea on exertion and mild peripheral edema. TTE showed intact LV function, mild LVH and elevated PA pressures (40mmHg). On the day of surgery, BPs were measured bilaterally and found to be congruent. A narcotic only CSE (15 mcg fentanyl and 150 mcg morphine PF) was performed and 2% lidocaine with epi via epidural catheter was slowly titrated to a T4 sensory level. Blood pressure (measured on L arm) was tightly controlled with IV doses of phenylephrine and epinephrine to maintain systolic BP over 110mmHg and HR <100 BPM. Estimated blood loss was 600mL, 1.2L lactated ringers was administered. Patient tolerated procedure well without any intraoperative or postoperative complications. Discussion: Pregnancy in patients with repaired congenital coarctation of the aorta is generally tolerated well but may be complicated by an increased risk of left heart failure and aortic dissection when subaortic stenosis is present. Information regarding left ventricular function and anatomy, current functional status and bilateral blood pressures may influence anesthetic management. Dual arm blood pressure monitoring, especially in cases where discordance exists may help providers manage both preload and afterload. Intraoperatively during cesarean delivery, anesthesia providers should maintain preload, (measured via BP cuff on right arm), as well as prevent afterload increases (measured via BP cuff on left arm). Fluid resuscitation should be limited to avoid LV overload in symptomatic patients and heart rate control may allow for adequate ventricular emptying. In our case, we chose to utilize an intrathecal narcotic only CSE technique with slow titration of epidural anesthesia to maintain systemic and placental blood flow and to minimize the required fluid resuscitation and possible hemodynamic stability.

Abstract #: RF2AB-147

Severe Mitral Stenosis with Severe Pulmonary Hypertension - Anesthesia Management for Labor and Cesarean Delivery

Presenting Author: Laura Puertas Ocio Md, PhD
Presenting Author's Institution: Ohio State University - Columbus, Ohio
Co-Author: Tery Gray MD - Ohio State University
Robert H Small MD - Ohio State University

Case: 21 year old G1P0 at 36w6d, PMH of AV canal defect s/p repair at 6 months of age and follow-up surgery at age 5, sub aortic membrane s/p repair and small residual VSD who was unknown to the anesthesia team, presented for induction of labor due to PPROM. Echocardiogram after admission showed severe pulmonary hypertension (PHTN) (RVSP 65-70 mm Hg), severe mitral stenosis (MS) (mean gradient 23 mm Hg), mild mitral regurgitation, and mild aortic valve insufficiency. Hydromorphone-only epidural infusion initially reduced the patient's pain, but it was changed to bupivacaine with fentanyl due to increasing pain. To minimize abrupt changes in the patient's SVR and preload, initiation of bupivacaine 0.625% with fentanyl 2 mcg/mL was completed by administering 20 mL over one hour, followed by an infusion rate of 14 mL/hour. She underwent cesarean delivery due to arrest of descent. General anesthesia was planned due to urgency, hemodynamic concerns, and patient preference. Midazolam was titrated during pre-induction a-line insertion to minimize hypercarbia and increasing PA pressure. Phenylephrine infusion was administered to avoid the decline in SVR and arterial blood pressure secondary to sevoflurane in a patient with preload dependence. Post-operatively, an epidural hydromorphone infusion was continued for pain management. The patient recovered in our cardiac ICU and discharge 3 days later. Discussion: The management of a parturient with severe mitral stenosis and severe pulmonary hypertension is challenging. Due to the large intrapartum and postpartum volume shifts expected, volume status must be carefully managed to avoid both sudden decreases in preload and volume overload leading to pulmonary edema or RV failure (1). In addition to avoiding hypoxia, hypercarbia, hypotension and acidosis in a patient with PHTN, it is important to decrease sympathetic stimulation from pain in order to avoid increasing PVR (2). This goal also improves hemodynamics in the setting of MS by preventing pain-related tachycardia, therefore optimizing LV filling (1). Pregnant women with PHTN have a significantly high risk of morbidity and mortality, particularly during the third trimester and the postpartum period (3). Consensus guidelines recommend pregnancy prevention and early termination due to the high risk of maternal mortality, and education regarding risks and benefits of birth control methods remains fundamental for women of childbearing age with PHTN (3).

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Abstract #: RF2AB-152

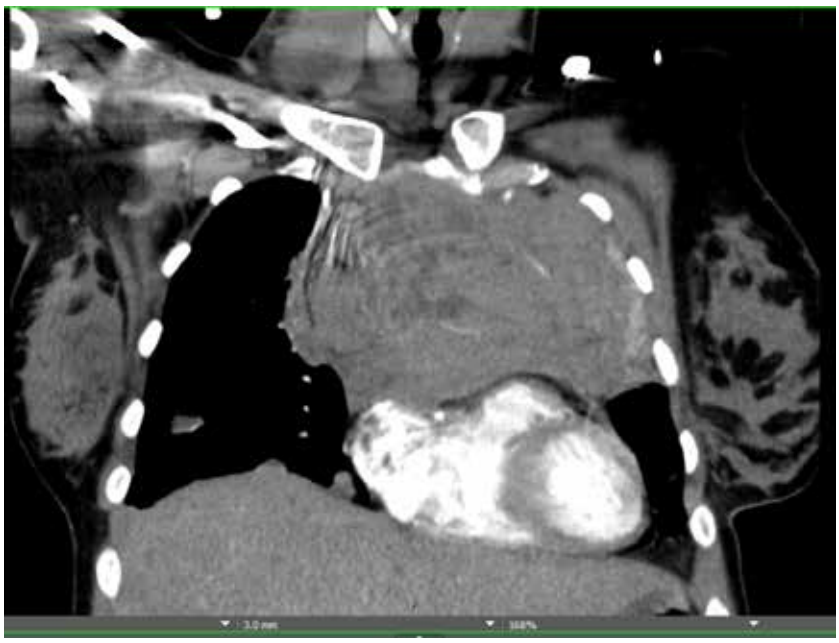
Mediastinal Mass in a Parturient

Presenting Author: Daniel Carlyle MD, BS
Presenting Author's Institution: Yale School of Medicine - New Haven , CT
Co-Author: Antonio Gonzalez-Fiol MD - Yale School of Medicine
Aymen Alian MD - Yale School of Medicine

Mediastinal mass in a parturient is a rare but often incidental finding during workup of dyspnea. A large mediastinal mass encasing major vessels and the bronchial tree poses a potential risk of airway and cardiovascular collapse secondary to compression, particularly in the non-spontaneously breathing patient.[1-2]

A 29-year-old G1P0 at 32 gestational weeks with past medical history of Factor V Leiden mutation (heterozygote) presented with dyspnea and oxygen saturation in high 80's. A computed tomography scan revealed a mediastinal mass (16 cm x 11cm x 14 cm) involving the middle, anterior, and superior mediastinum, surrounding the great vessels, ascending aorta and extending into the right paratracheal and aortopulmonary window with multiple pulmonary nodules (Figure 1). Lymph node biopsy revealed nodular sclerosis classic Hodgkins lymphoma and a diagnosis of stage IV disease was made. The patient was started on prophylactic enoxaparin, steroids, and chemotherapy consisting of Adriamycin, Bleomycin, Vinblastine and Dacarbazine (ABVD) which resulted in excellent clinical response.

Delivery at 37 gestational weeks was planned. A multidisciplinary meeting was held to discuss the delivery method. Given the risk of cardiopulmonary collapse in the peripartum period, a scheduled primary cesarean delivery (CD) seemed preferable, given the intricacies related to the coordination between multiple teams. Prophylactic arterio-venous extracorporeal membrane oxygenation (ECMO) cannulation before delivery was recommended. The patient discontinued enoxaparin 24 h prior. An arterial line was placed; epidural was performed at the L3-L4 level. After confirming our ability to obtain a T4 surgical level, ECMO cannulas were placed and heparin 1000 U IV was administered 1 h after epidural placement to avoid clotting of cannulas. Her intraoperative course was unremarkable, ECMO sheaths were removed and the patient was transferred to the ICU for observation overnight. Currently, the patient is still undergoing chemotherapy for her Hodgkin's lymphoma (restaged IIB).



Patients with mediastinal mass poses many challenges to anesthesiologists. Although neither general anesthesia nor neuraxial anesthesia has been proven superior, a catheter-based technique has found preferable in case studies to avoid impairing spontaneous ventilation, which could lead to inability to ventilate and cardiovascular collapse.1-2

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Abstract #: RF2AB-156

Designing a Plan for the Parturient with an Anterior Mediastinal Mass

Presenting Author: Kaitlyn Brennan DO MPH
Presenting Author's Institution: Mayo Clinic - Rochester, MN
Co-Author: Emily Sharpe MD - Mayo Clinic
Marissa Kauss MD - Mayo Clinic

Introduction: The parturient with an anterior mediastinal mass poses a unique challenge to the anesthesiologist. A physical exam, assessing for shortness of breath when supine and any rescue position that provides symptom resolution, combined with imaging that shows any vascular or pulmonary compromise can help to predict anesthetic risk.1 We present a case of a woman with a newly diagnosed anterior mediastinal mass at 19 weeks gestational age (GA).

Case: A 32 year old G2P1 at 19 weeks GA presented to the emergency room with neck swelling. Ultrasound revealed a right internal jugular vein thrombus, and anticoagulation therapy was initiated with enoxaparin. Further imaging showed a large (16.2 cm x 5.2 cm) anterior mediastinal mass with encasement of the right innominate, subclavian, and bilateral carotid arteries, a pericardial effusion, and bronchial compression. Biopsy confirmed Hodgkin's lymphoma, and she was started on an abbreviated course of bleomycin-containing chemotherapy. A multidisciplinary team planned for repeat cesarean delivery and bilateral tubal ligation at 36 2/7 weeks to coincide with a gap in her chemotherapeutic regimen.

Given the complexities inherent in managing this patient, detailed plans were made for a number of scenarios. Our system has multiple locations, with service lines important for this patient's care located in different hospitals. Separate plans addressed emergent presentation with maternal compromise, fetal compromise, or both. The obstetric and cardiac anesthesia teams met with the patient, and worked with maternal fetal medicine, oncology, otolaryngology, and the extracorporeal membrane oxygenation (ECMO) teams to ensure that care could be provided in a safe, timely, and organized fashion. Planning was complicated by therapeutic anticoagulation, important to consider given the peril of managing this patient emergently.

Fortunately the patient presented as scheduled. She received a combined spinal-epidural, with 6 mg bupivacaine, 15 mcg fentanyl, and 150 mcg morphine. She was gradually moved from sitting to supine with an incline of 20 degrees, and 2% lidocaine was dosed through the epidural in 2-3 mL aliquots to obtain a T5 level. A perfusionist was available for initiation of ECMO. During the procedure, she developed chest pain and shortness of breath, which resolved by increasing her incline.

Discussion: An extensive pre-anesthetic workup and multidisciplinary approach is essential when caring for a parturient presenting with an anterior mediastinal mass. Knowledge of the anatomic implications of the mass, previous treatment, delivery plan, and rescue position are keys to success.2 Intimate knowledge of the processes in place at our health system allowed our team to design detailed plans in advance for several of the most likely delivery scenarios, which we then disseminated to her care team.

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Abstract #: RF2AB-176

ANESTHETIC CONSIDERATIONS FOR A PARTURIENT WITH PULMONARY HYPERTENSION

Presenting Author: Julie F Harvey MD
Presenting Author's Institution: Medical College of Wisconsin Affiliated Hospitals - Milwaukee, WI
Co-Author: Ayse O Kula MD - Medical College of Wisconsin Affiliated Hospitals
Steven Ropers MD - Medical College of Wisconsin Affiliated Hospitals

Case: A G2P1001 woman at 32 weeks gestation with obesity, OSA, asthma, thrombocytopenia, and severe pulmonary hypertension (PH) secondary to ASD requiring 2.5 L O2 via nasal cannula presents for delivery planning. Her prior right heart catheterization and echocardiograms demonstrated a D-shaped septum, systolic pulmonary artery pressure (PAP) up to 92 mmHg, and right ventricular hypertrophy. Given the 30-50% risk of mortality for parturients with PH, providing a safe anesthetic required extensive pre-delivery planning. Ultimately, we placed a central line, arterial line, and an epidural for cesarean delivery. Anesthesia included slowly titrating 2% lidocaine via epidural. Her intra- and post-operative courses were uncomplicated.

Discussion: Anesthesia for a parturient with PH included many considerations. Overall, the goal was to avoid increased pulmonary vascular resistance leading to right heart overload and possible cardiac collapse. To prepare for possible cardiopulmonary compromise, we involved cardiac anesthesiology and CT surgery. We had the OR set up for ECMO and TEE if needed. Choice of anesthetic method was highly debated. Spinal was ruled out as it is contraindicated due to associated hemodynamic instability. Therefore, we debated epidural vs general anesthesia (GA). Both methods may lead to undesirable physiologic changes. The disadvantages of GA included increased PAP with positive pressure ventilation, decreased contractility, and the possibility of a difficult airway in a patient with OSA, obesity, and pregnancy-related airway edema. To avoid those issues, epidural was chosen for this patient. However, we also debated the practicality of an epidural given the inability of our patient to lie flat, platelet count of 89, and possible need for intra-op TEE and/or heparinization for ECMO. Given those possibilities, we had to plan for possible conversion to GA. In that case, induction would need to be slow to minimize hemodynamic changes and difficult airway cart would be available. Monitoring and vascular access were additional considerations of pre-delivery planning. We chose to admit the patient to the ICU the day prior to delivery for line placement and further optimization. Arterial line is standard so blood pressure changes can be avoided or addressed quickly. Given the high chance of hemodynamic compromise, central line was placed to facilitate rapid fluid infusions and vasopressors. Because patients with PH have an increased risk of PA rupture and thrombosis, it is reasonable to forgo PA catheter placement as we did. Overall, due to such high mortality, and because several aspects of management for PH parturients are still debated, pre-delivery planning is a crucial process to create an individualized plan and provide the safest anesthetic.

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Abstract #: RF2AB-192

Cesarean Delivery for Patient with Single Ventricle Physiology

Presenting Author: William M Hart MD, MBA
Presenting Author's Institution: University of North Carolina - Chapel Hill, NC
Co-Author: Lacey Straube MD - University of North Carolina
David Mayer MD - University of North Carolina

The number of parturients with single-vessel physiology is rising as nearly 85% of individuals born with congenital heart disease (CHD) are surviving into adulthood. 25% of maternal cardiac deaths are now related to CHD. The hemodynamic changes of pregnancy raise concerns for women with this altered physiology and creates unique challenges for the anesthesiologist.

A 21 year old G1P0 at 34 weeks gestation presented with intrauterine growth restriction and preeclampsia with severe features. She had a history of congenital tricuspid valve atresia treated with a lateral tunnel Fontan procedure with an intracardiac baffle. She had normal ventricular function and unobstructed Fontan flow without cyanosis or dysrhythmias. Two large bore IVs and an arterial line were placed on admission. The fetus did not tolerate a contraction stress test, so induction of labor was deferred. Maternal Fetal Medicine, Pediatric Cardiology, Obstetric Anesthesia, and Pediatric Cardiac Anesthesia discussed her care before proceeding with cesarean delivery. An epidural was placed and a total of 30 ml of 2% lidocaine with epinephrine was injected in 3 ml increments over 45 minutes until a T4 dermatomal level was achieved. The cesarean was completed with 500 ml of blood loss. Supplemental oxygen was provided throughout the case. After delivery, oxytocin was initiated at 15 units/hour. Intravenous fluid was restricted to 400 ml. She was admitted to the cardiac intensive care unit postoperatively for close monitoring. A post-partum echocardiogram was unchanged from prior and discharge was on post-operative day four.

Safe delivery in CHD patients is guided by their altered cardiac physiology. Cardiac output is dependent upon sinus rhythm, adequate preload and low-normal afterload and pulmonary vascular resistance (PVR). Cautious fluid boluses and left uterine displacement maintain preload. While bleeding and hypovolemia will decrease cardiac output, fluid overload can cause pulmonary edema. Excessive valsalva during labor should be minimized to avoid sudden changes in venous return. Telemetry, large bore IV access, and invasive blood pressure monitoring should be utilized. Supplemental oxygen and avoidance of acidosis prevent increased PVR. The sympathectomy of neuraxial anesthesia dilates the venous system and decreases the potential for large volume fluctuations but also decreases systemic vascular resistance and should be initiated gradually. In the setting of general anesthesia, positive pressure ventilation should be minimized to avoid reduced preload and cardiac output. Cardiodepressant induction agents should be avoided. In this patient, multi-disciplinary care, slow development of adequate epidural anesthesia, and appropriate monitoring allowed for a safe peripartum course.

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Abstract #: RF2AB-206

Aortic Stenosis with Worsening Aortic Root Dilation and Severe Range Blood Pressures Requiring Urgent Cesarean Delivery

Presenting Author: Samantha Lu MD
Presenting Author's Institution: Northwestern University Feinberg School of Medicine - Chicago, IL
Co-Author: Nakia Hunter MD - Northwestern University Feinberg School of Medicine
Elizabeth Lange MD - Northwestern University Feinberg School of Medicine

Introduction: Parturients with an aortic root enlargement greater than 4 cm have an increased risk of aortic dissection.1 Risk factors for aortic dissection include chronic hypertension, bicuspid aortic valve, and connective tissue disorders.2 Pregnancy itself is associated with a 25-fold increased risk of aortic dissection in young women.2 We report a case of a parturient with significant aortic disease who underwent an urgent cesarean delivery under neuraxial anesthesia for progressive aortic root dilation in the setting of severe preeclampsia.

Case Presentation: A 32-year old G3P2 female at 26 and 4/7 weeks gestation presented to our labor and delivery unit as a transfer for management of preeclampsia with severe features and progressive aortic root dilation. She had a significant history of chronic aortic root dilation, unicuspid aortic valve with moderate aortic stenosis, asthma, and systemic lupus erythematosus. A 2D echocardiogram performed prior to transfer showed an aortic root dilation to 4.7 cm from her baseline of 4.4 cm, which had been stable since 2012. Upon presentation, patient had severe range blood pressures despite increasing doses of intravenous labetalol, prompting arterial line placement and initiation of a nicardipine infusion. Although fetal heart rate tracings remained reassuring, the decision was made to pursue urgent primary low-transverse cesarean delivery given uncontrolled blood pressures with evidence of worsening aortic root dilation. The patient underwent an uncomplicated cesarean delivery under dural-puncture epidural anesthesia, incrementally dosed with 15mL of 2% lidocaine with 1:200,000 epinephrine and sodium bicarbonate and 100mcg fentanyl. A low dose phenylephrine infusion was used to maintain systolic blood pressures between 120-140 mmHg. Epidural infusion was maintained for post-operative pain control. On post-operative day one, a thoracic aorta CT angiogram showed further progression of her aortic root to 5.2 cm. She ultimately underwent a Bentall procedure at ten weeks postpartum.

Discussion: The majority of dissections during pregnancy occur during the third trimester or peripartum.2 Marked hypertension should be prevented in patients at risk for aortic dissections; however, our patient had a competing hemodynamic goal of maintaining adequate preload due to her history of aortic stenosis. A dural-puncture epidural was deemed the safest anesthetic plan to achieve these hemodynamic parameters.

Abstract #: RF2AB-209

Management of Peripartum Cardiomyopathy: A Case Report

Presenting Author: Andrew Bennett MD
Presenting Author's Institution: Maimonides Medical Center - Brooklyn, New York
Co-Author: Kim Lam MD - Maimonides Medical Center

Introduction: Peripartum cardiomyopathy (PPCM) is a cause of pregnancy-associated heart failure. It typically develops during the last month of, and up to 6 months after pregnancy in women without known cardiovascular disease.

Case Report: Preop: LR was a 41 year old female at 36w3d gestation, presenting for elective C-section (repeat X1). Patient presented with shortness of breath for 2 days, lower and upper extremity swelling (2 months), and shortness of breath when lying flat. Patient was seen and evaluated by cardiology. Echo and EKG were performed and showed sinus tachycardia with HR up to 140s, global cardiomopathy, and EF of 21-25%. Troponin 0.09. BNP 528. Multidisciplinary meeting held with OB, Cardiology, and Cardiac anesthesiology teams in attendance.

Intraop: C/S under GA because patient would not tolerate lying supine for prolonged period. Intraop TEE showed EF of 10-15% with large bilateral pleural effusions. APGAR at 1 min and 5 min were 1 and 8 respectively. Post-op TEE showed EF of 20%. Patient failed trial of extubation with desaturation on pulse oximetry and ABG showing low pO2 and retained pCO2. Patient taken to CICU for post-op management.

Postop: LR had a tumultuous course in the ICU with prolonged intubation, recurrent desaturations, hypotension, development of a septic picture, renal failure, and questionable preeclampsia. About 2 weeks after delivery, an IABP was placed and about a month after delivery an Impella device was placed for continued cardiogenic shock. EF improved after Impella device. A week later, Impella was removed and EF was again 20%. Decision was made to place LVAD and Heartmate 3 was placed. Patient was discharged to rehab shortly thereafter.

Discussion: Pathophysiology of PPCM is poorly understood. Current theories include development of myocarditis, abnormal immune response to pregnancy, and a pathological response to the hemodynamic stresses of pregnancy. Treatment is usually supportive since about 50% of women have return of baseline LV function by 6 months to 5 years. Mechanical circulatory support may be required for \"bridge\" or \"destination\" therapy,\" and outcomes in these cases are generally positive. PPCM patients who require heart transplants tend to have worse outcomes than other cardiac transplant patients.

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Abstract #: RF2AB-256

Management of Parturient with Refractory Atrial Flutter

Presenting Author: James M Urness MD
Presenting Author's Institution: Henry Ford Hospital - Detroit, MI
Co-Author: Ami Attali D.O. - Henry Ford Hospital
Joshua Younger D.O. - Henry Ford Hospital
Kevin Spencer M.D. - Henry Ford Hospital
Yoshihisa Morita M.D - Henry Ford Hospital

Introduction: The cardiovascular system undergoes significant changes during pregnancy including increased heart rate, plasma catecholamines, and adrenergic sensitivity. It is not surprising that more than 50% of pregnant women develop palpitations during pregnancy.[1] Sustained tachycardias in these patients are rare.[2] Patients who develop arrhythmias are challenging to manage for all teams involved and require a multidisciplinary approach for safe and appropriate management.

Case: Our patient is a 39-year-old female G1P0 with past medical history significant for super morbid obesity (BMI 58) and chronic hypertension who presented at 22 weeks with complaints of dyspnea and chest pain. An EKG was obtained showing a narrow complex tachycardia with a rate of 170bpm without ST or T wave changes. Rate control with beta blockers was unsuccessful. Adenosine was then administered which revealed atrial flutter with a 2:1 conduction. She was started on diltiazem without improvement. Echo was significant for an ejection fraction (EF) of 30%. Despite medical therapy, the patient continued to be in atrial flutter. After 48 hours of anticoagulation, she underwent direct current cardioversion (DCCV). Anesthesia was induced with rapid sequence intubation (RSI) and maintained with propofol infusion. Successful cardioversion was achieved with an improvement in her EF to 55%. She was sent home on sotalol and enoxaparin.

One month later, the patient presented again with atrial flutter. A second DCCV was done; however, the patient failed permanent conversion. Her case was reviewed by our multidisciplinary team and it was agreed, she should undergo cardiac ablation. Anesthesia was induced with RSI and maintained with propofol and remifentanil infusions. Given her history, it was recommended she continue sotalol for the duration of pregnancy and had no further symptomatology. She was induced at term and ultimately had a cesarean section for arrest of labor under epidural anesthesia without complication.

Discussion: The presentation of atrial flutter during pregnancy is the same as in nonpregnant patients. Palpitations may be associated with syncope, dyspnea, and chest pain. Pharmacologic conversion is initially attempted in stable patients whereas DCCV should be the initial treatment of unstable patients. Management during pregnancy has traditionally relied heavily on pharmacological interventions as procedural interventions carry higher risk. This paradigm is changing as newer techniques of cardiac ablation are being found to be safe and effective during pregnancy. The most important factor in safe and effective care for these patients is a multidisciplinary approach across numerous specialties.

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Abstract #: RF2AB-257

Cesarean in a Parturient with a Complicated Tetralogy of Fallot Repair

Presenting Author: Alex Y. Chung MD
Presenting Author's Institution: Ochsner Health System - New Orleans, LA
Co-Author: Colleen Martel MD - Ochsner Health System
Roneisha A McLendon MD, MS - Ochsner Health System

Introduction: Congenital heart defects (CHD) are susceptible to complications such as arrhythmias, endocarditis, heart failure, pulmonary hypertension and valvular disease. In this case report we discuss a 28-year-old female with a history of Tetralogy of Fallot (TOF) repaired with right ventricle (RV) to pulmonary artery (PA) valve conduit complicated by stent re-stenosis.

Case Presentation; The patient is a 28 yo G2P1 with history of TOF complicated by pulmonary atresia repaired with a Blalock-Thaussig shunt followed by three sternotomies including a RV to PA valve conduit. This conduit stenosed and required balloon valvuloplasty with stent placement during her first pregnancy nine years prior. During this pregnancy, at 20 weeks EGA she reported dyspnea with minimal exertion and was found to have moderate to severe RV outflow obstruction with RV hypertrophy and preserved systolic function on echocardiogram. Pulmonary transcatheter valve replacement was deferred at that time and a Holter monitor noted no significant arrhythmias. At 31 weeks EGA she was evaluated by obstetric anesthesiology with a plan for admission at 37 weeks EGA for a repeat cesarean section at our tertiary care facility. For delivery, an epidural catheter and radial arterial line were placed. 8mL of 1.5% lidocaine with 1:200,000 epinephrine and 100mcg of fentanyl were then administered slowly via epidural over 10 minutes. Hypotension was treated with phenylephrine and an uneventful delivery occurred 13 minutes after incision. Blood loss was 1100mL and the patient received 800mL of lactated Ringer's. She was admitted to the surgical intensive care unit and discharged on postop day 3. She is now being evaluated for potential intervention of the re-stenosed valve conduit.

Discussion: Cardiovascular events in pregnant women with corrected TOF occur at a rate of 12%, most commonly arrhythmias1. Maternal use of cardiovascular medication is the best predictor for cardiovascular events2. Our patient did not experience a heart failure exacerbation during her pregnancy, most likely attributed to her valve conduit stenosis being compensated by right ventricular hypertrophy and preserved systolic function.

Previous case reports show that elective cesarean sections can be performed safely with a slow sequential CSE or gradual epidural dosing3. This avoids sharp decreases in SVR caused by spinal or general anesthesia, however phenylephrine should be available to treat decreases in SVR. Patients need close fluid management for optimal preload to the right ventricle and a vigilant eye must be kept on blood loss. Continuous blood pressure monitoring allows the anesthesiologist to respond quickly to hemodynamic changes.

Communication between provider teams is essential. Cases should be performed at an institution where obstetric anesthesiology, cardiology, maternal fetal medicine, critical care, and neonatology teams are readily available.

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Abstract #: RF2AB-267

PARTURIENT WITH INTERSTITIAL LUNG DISEASE COMPLICATED BY PULMONARY HYPERTENSION UNDERGOING CESAREAN DELIVERY

Presenting Author: Ayodeji Omosule, M.D
Presenting Author's Institution: Henry Ford Hospital - Detroit, Michigan
Co-Author: Himabindu gandam MD - Henry Ford Hospital
Ami Y Attali MD - Henry Ford Hospital
Joshua Younger MD - Henry Ford Hospital

INTRODUCTION: Interstitial lung disease (ILD) is the term given to a group of diseases causing inflammation and thickening of the alveoli eventually leading to pulmonary hypertension and cor pulmonale1 Patients with ILD, hypoxemia, and secondary pulmonary hypertension are at increased risk during pregnancy and require careful, multidisciplinary planning to ensure safe peripartum care.

CASE: A 37 year old female G1P0 at 34weeks of gestation with obesity, hypoventilation syndrome, interstitial pulmonary fibrosis, pulmonary hypertension on home oxygen, preeclampsia, anemia, and gestational diabetes was admitted for imminent delivery. Given her worsening hypoxia and hypercapnia, she was being maintained with BiPAP . The operative plan was discussed with a multidisciplinary team that included obstetrics, maternal fetal medicine, obstetrical anesthesia, pulmonology, and critical care. Decision was made to use a low dose combined spinal epidural anesthetic with a pre-procedure arterial line and PICC line.Close monitoring of her respiratory status was undertaken and BiPAP was employed intra operatively. Use of an extra corporeal membrane oxygenator (ECMO) and pulmonary artery catheter were discussed and on standby. Pre-operative oxygen saturation 96% on BiPAP . In the operating room standard ASA monitors were attached and an arterial line was placed. A combined spinal epidural anesthetic was employed at L3-4 level and 1 ml of 0.75% hyperbaric bupivacaine with 10 mcg of fentanyl was placed intrathecally. The epidural catheter was then judiciously bolused to achieve a T4 level. Vasopressin and norepinephrine infusion were used to bring the blood pressure back to baseline. No desaturation or significant hypotension occurred intraoperatively. Post-operative pain control was maintained via a continuous epidural infusion.

DISCUSSION: Women with severe restrictive lung diseases such as interstitial lung disease were historically advised to avoid pregnancy. However in light of recent advances in medicine, more flexibility and options exist for patients desiring pregnancy. There is no specific anesthesia type for the patient with ILD, however the CSE technique was chosen for our patient to allow for surgical anesthesia and in taking in consideration of a high risk of postoperative pulmonary complications

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Abstract #: RF3AC-271

A MULTIDISCIPLINARY TEAM APPROACH ENSURES THE SAFE DELIVERY OF A PREGNANT WOMAN WITH PERIPARTUM CARDIOMYOPATHY

Presenting Author: Aaron C Cannon D.O.
Presenting Author's Institution: The Ohio State Wexner Medical Center - Columbus, OH
Co-Author: Kasey K Fiorini M.D. - The Ohio State University Wexner Medical Center
Victoria M Olatunji M.D. - The Ohio State University Wexner Medical Center

A 30-year-old G5P4004 at 37w0d with PMH of peripartum cardiomyopathy (PPCM) was admitted for scheduled induction of labor (IOL) for her fifth pregnancy. At three months postpartum after her third pregnancy an echocardiogram (echo) showed her EF 20%. Heart failure (HF) medication and a LifeVest was prescribed for primary prevention of sudden cardiac death. Seven months postpartum, LV systolic function recovered and LifeVest and medications were discontinued. The following year, a preoperative evaluation for a bilateral partial salpingectomy (BPS) revealed an unintended pregnancy and EF 35%. Metoprolol was restarted. Her fourth vaginal delivery was without complication. Nine months postpartum and in the first trimester of her fifth pregnancy, EF remained 40%. EF decreased to 25% in the third trimester, resulting in a referral to MFM and anesthesiology. For scheduled IOL, she was admitted to the cardiac ICU and titrated up on dobutamine. Echo showed EF 45%. Intrapartum monitoring included an arterial line with cardiac output monitoring, pulse oximetry, and continuous telemetry. A labor epidural was placed and dosed to prevent significant hypotension. She underwent an uneventful vaginal delivery and BPS. Dobutamine was continued to augment EF during expected fluid shifts. She was transitioned to standard HF medications and bromocriptine to prevent prolactin induced cardiac remodeling. EF was 30% after dobutamine cessation. Patient was sent home with a LifeVest and plans for ICD placement.

Although PPCM is rare in the United States, cardiac disease remains the most common cause of death in pregnant women in the developed world (1). Management of a pregnant woman with PPCM is focused on treating the patient's HF symptoms, while avoiding teratogenic medications. If the HF is stable, then medications are used to optimize LV function while a safe plan for delivery is made (2). Furosemide, digoxin, hydralazine and amlodipine (substituted for ACE inhibitors/ARBs which are known teratogens), and beta-blockers (excluding atenolol) are all safe during pregnancy (1, 2). Dobutamine, dopamine, and milrinone have not shown evidence of risk during pregnancy (2). Lastly, some studies have reported bromocriptine as beneficial in PPCM when added to HF regimen (1, 2, 3). A multidisciplinary team approach is needed to develop a safe delivery plan (1, 2, 3). Neuraxial anesthesia is the technique of choice in patients with PPCM as it provides afterload reduction and blunts the hemodynamics response to labor and delivery (2, 3). General anesthesia is used only in emergent situations as volatile agents can decrease SVR, RSI can lead to hemodynamic instability, and the highest risk of mortality occurs during induction and intubation (2). HF medications and monitoring are continued postpartum, and if EF <35%, a LifeVest is warranted (3).

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Abstract #: RF3AC-310

Perioperative Pain Management Plan for Cesarean Hysterectomy in a Patient with Placenta previa/ accreta on Extremely High Dose Medication Assisted Therapy (MAT) for Substance Use Disorder

Presenting Author: Jennifer L Harris M.D.
Presenting Author's Institution: Thomas Jefferson University Hospital - Philadelphia, PA
Co-Author: H. Jane Huffnagle D.O. - Thomas Jefferson University
Suzanne L. Huffnagle D.O. - Thomas Jefferson University
John T. Wenzel M.D. - Thomas Jefferson University

Introduction: Medication assisted therapy (MAT) is an established treatment option for opioid dependence; methadone has been used since the 1950s for this purpose. With the exponential increase in opioid-related deaths and addiction rates, MAT has become more prevalent in the perioperative population. Unfortunately, there is little data and few published reviews addressing acute pain management strategies. Moreover, methadone dosage escalates during pregnancy (1). We present the anesthetic management and challenging perioperative pain control of a parturient on an extremely high dose of methadone with placenta previa/accreta undergoing urgent cesarean hysterectomy.

Case: A 40 y/o G5P2022 at 35 2/7 wks gestation presented for cesarean hysterectomy for placenta accreta with complete previa. PMH included HIV, Hepatitis C liver disease, non-sustained V-tach, prolonged QT, MSSA endocarditis, seizure disorder, asthma, depression/anxiety, polysubstance abuse (benzodiazepine abuse this pregnancy) and cigarette smoking. Surgical history consisted of C/S x 2 and multiple I&Ds for skin infections. Home medications included methadone 460 mg daily (split dosing), gabapentin, ipratropium-albuterol, levetiracetam, mirtazapine, dolutegravir, and emtricitabine/tenofovir. Preoperatively, a lumbar epidural was placed and a T6 anesthetic level obtained. A ketamine infusion was started and she received her regular doses of methadone and gabapentin. The procedure began promptly as she was bleeding; a baby girl was delivered 8 minutes later. Our patient remained hemodynamically stable but experienced progressive discomfort requiring supplemental IV fentanyl and increasing doses of ketamine as the procedure lasted 2.5 hours. Postoperatively, her pain was moderately controlled continuing the epidural and ketamine infusions, regular dosing of methadone and gabapentin, and adding hydromorphone, acetaminophen, ibuprofen, and transdermal clonidine. After careful consideration, enoxaparin was started with the epidural still in place (2). Hydromorphone was discontinued POD#2, the epidural removed POD#3 and she was discharged POD#4 with methadone, gabapentin, acetaminophen, and ibuprofen.

Discussion: A successful outcome in this complicated patient was achieved using 4 crucial aspects of care: early preoperative evaluation, patient involvement in and agreement to the anesthetic plan, multimodal analgesia, and multidisciplinary teamwork. Patients on methadone should be referred for early pre-anesthetic evaluation to discuss expectations, limitations of pain management, and to formulate a plan together. A multimodal analgesic strategy incorporating various classes of medications is essential for reasonable postoperative pain control (3). Lastly, teamwork and communication across disciplines is fundamental and may improve patient outcomes/satisfaction.

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Abstract #: RF3AC-352

Anesthetic Management for Cesarean Delivery in Morbidly Obese Parturient With Enlarged Goiter

Presenting Author: Nathalia Torres Buendia MD
Presenting Author's Institution: University of Miami/Jackson Memorial Hospital - Miami, FL
Co-Author: Daria Moaveni MD - University of Miami/Jackson Memorial Hospital
Selina Patel MD - University if Miami/Jackson Memorial Hospital

A 33 year old G3P2002 woman was transferred at 37.5 weeks gestation for delivery planning. Her medical history was significant for super morbid obesity (BMI 63), untreated chronic hypertension and large multinodular goiter causing supine orthopnea. On physical exam, she had a palpable midline goiter without apparent tracheal deviation and a Mallampati 3 airway. Neck CT showed diffuse thyroid enlargement measuring 9.7 cm x 9.7 cm, multiple large nodules and airway narrowing with AP diameter of 5-6 mm at the narrowest point, 7 cm above the carina. Flexible nasal endoscopy showed no masses in upper aerodigestive tract and narrowing of trachea below vocal cords due to external compression.

The case was discussed at multidisciplinary meeting including OB, OB anesthesia, ENT, cardiothoracic surgery/ECMO team and ICU. Cesarean delivery (CD) was planned at 38 weeks. One day prior to surgery, aspiration of 55 mL cystic fluid was done for maximal decompression. Premedication with sodium citrate 30 mL, metoclopramide 10 mg, ondansetron 4 mg, dexamethasone 10 mg and glycopyrrolate 0.2 mg were given. Vascular access included PICC line, 18g and 14g peripheral IVs and left radial arterial line. An intentional intrathecal catheter (ITC) was placed. The airway was anesthetized with nebulized and topical lidocaine. Sedation was provided with a remifentanil infusion. A 6.5 cm endotracheal tube was placed via fiberoptic. The ECMO team was available for pre-emptive femoral vessel cannulation in the event that the airway could not be secured. The ENT team also present as backup. After successful intubation, 1.5 ml of 0.75% hyperbaric bupivacaine, 15 mcg fentanyl, and 0.1 mg morphine were titrated through the ITC to achieve a T4 anesthesia level. Remifentanil infusion was given throughout surgery for endotracheal tube tolerance. Pressure support ventilation was required once the neuraxial block was established due to increased work of breathing. She remained awake and aware with full recall of the delivery and was extubated in the OR once the neuraxial block receded and adequate respiratory parameters were achieved. She was monitored in ICU postoperatively.

This case was complicated by severe morbid obesity and an enlarged goiter causing severe airway obstruction. The use of neuraxial anesthesia avoided the risks of general anesthesia for a patient with BMI 63, allowed the mother to be awake for the delivery, and provided optimal postoperative analgesia with intrathecal morphine. Continuous spinal anesthesia allowed for careful titration of anesthetic level, minimizing the risk of high spinal in a patient with limited respiratory reserve. Electively securing the airway allowed for delivery of pressure support when the anesthetic level reached thoracic levels and allowed for easy conversion to general anesthesia if that became necessary.

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Abstract #: RF3AC-356

The importance of a multidisciplinary approach in caring for a pregnant patient diagnosed with Creutzfeldt-Jakob Disease

Presenting Author: Lynn Squires MD
Presenting Author's Institution: University of Alberta - Edmonton, Alberta
Co-Author: Adrian Koziak MD, MSc, FRCPC - University of Alberta
Valerie Sim MD, FRCPC - University of Alberta
Allison Thiele MD, PhD, FRCSC - University of Alberta

Introduction: Sporadic Creutzfeldt-Jakob Disease (CJD) is a rare degenerative prion disease affecting one per million people annually(1). While it typically affects people later in life, there have been seven reported case studies of CJD in pregnant women(2). We present a case of a 35 year old G2P1 woman diagnosed with CJD at 14+3 weeks gestation. We will outline the successful multidisciplinary approach to her care.

Patient History: The patient initially presented with new onset memory deficits and challenges with daily tasks. CJD was suspected due to characteristic MRI findings and confirmed with CSF testing. As the patient's cognitive status had declined, her family made the decision to undertake all lifesaving interventions until delivery. She was managed at home until 28 weeks gestation when she was admitted for fetal and maternal monitoring, as well as nasogastric feeds. At 32 weeks she developed autonomic instability manifested as maternal fever and tachycardia. At time of delivery, the patient was non-communicative, deconditioned, bedridden with contractures, and had developed intermittent trismus.

Discussion: Multidisciplinary meetings occurred from 17 weeks gestation onward to ensure clear communication and preparation. This included representatives from obstetrics, maternal fetal medicine, neonatology, anesthesia, intensive care, neurology, palliative medicine, infection control and ethics. Protocols were developed for both emergent and elective delivery, along with readily available kits containing disposable anesthesia and OR equipment.

The scheduled cesarean section proceeded under general anesthesia at 36+3 weeks gestation. Personal protective equipment was donned by all staff and non essential equipment and personnel were removed from the operative theatre. After a slowly titrated induction maintaining spontaneous ventilation and avoiding depolarizing neuromuscular blockade, the patient's airway was secured with the aid of a bite block. A healthy neonate was delivered and uterine tone established.

The patient was transferred to a private room after reversal of all anesthetic medications and extubated while spontaneously breathing in the company of her family and newborn. This successful outcome was made possible through extensive communication with all staff involved in her care. This case demonstrates how patients with advanced CJD present unique anesthetic, ethical, and infection control challenges which require multidisciplinary approaches to fully optimize care.

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Abstract #: RF3AC-360

Neuraxial labor analgesia in a parturient with Lyme disease

Presenting Author: Nwadiogo Ejiogu MD, MA
Presenting Author's Institution: Northwestern University - Chicago, Illinois
Co-Author: Nakia Hunter MD - Northwestern University
Nicole Higgins MD - Northwestern University

Introduction: Lyme Disease (LD), a zoonosis caused by Borrelia burgdorferi, is the most common tick-borne infection in the United States (1). While studies on LD have not confirmed an association between B. burgdorferi and adverse birth outcomes (2), this multi-system disease process has clinical manifestations that impact peripartum management. Patients with LD require careful assessment of cardiac and neurologic systems, as known complications include carditis, radiculitis and meningitis (3). CNS involvement is an important consideration when deciding to perform neuraxial blocks in these patients (3). We report a rare case of LD in a parturient presenting for induction of labor.

Case report: 34-y.o. G4P0 at 36 weeks gestation presented to her primary physician with flu-like symptoms. She reported a 3-day history of fever (100.6 F), malaise and generalized myalgia, for which she was prescribed oseltamivir for presumed influenza. The patient defervesced, however two days later developed bilateral hand swelling, polyarthralgia (hands, shoulders, neck and jaw) and a diffuse erythematous targetoid rash. She reported several insect bites after recent travel to upstate New York. The patient was referred to outpatient Dermatology who prescribed cefuroxime 500mg PO BID for presumed early disseminated LD. The patient was then admitted for formal workup by the Infectious Disease (ID) service. LD was confirmed by positive IgG and IgM antibodies to B. burgdorferi. The patient was started on IV ceftriaxone for 2 days, then transitioned to cefuroxime 500mg PO BID to complete a 21-day course of antibiotics. She was discharged on hospital day 2 after a confirmed clinical response and absence of a Jarisch–Herxheimer reaction to the antibiotics. She had near complete symptom relief after 5 days of therapy.

The patient presented to L&D for induction of labor at 39.3 weeks. ID cleared the patient for neuraxial analgesia given the completed 21-day course of antibiotics and symptom resolution. She had an uncomplicated vaginal delivery under combined-spinal epidural.

Discussion: Anesthetic management of the parturient with disseminated LD can be challenging. Cardiac involvement requires close monitoring for carditis-induced heart failure and atrioventricular blocks, as both can be fatal if unrecognized. Neuraxial blockade may be contraindicated in LD patients due to the concern for introduction of the infective agent into the CNS. The impact of neuraxial techniques on disease progression in known CNS involvement is also unclear. Given the lack of evidence of adverse outcomes related to neuraxial procedures in LD patients (3), we believe that it is safe to perform in parturients with known CNS involvement, and those who have completed antibiotic therapy and confirmed symptom resolution.

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Abstract #: RF3AC-365

Posterior Reversible Encephalopathy Syndrome Causing Catatonia in a Complex Parturient

Presenting Author: Etty Sims M.D.
Presenting Author's Institution: Thomas Jefferson University Hospital - Philadelphia, PA
Co-Author: John T. Wenzel M.D. - Thomas Jefferson University
H. Jane Huffnagle D.O. - Thomas Jefferson University
Suzanne L. Huffnagle D.O. - Thomas Jefferson University

Introduction: Posterior reversible encephalopathy syndrome (PRES) is a reversible neurologic syndrome associated with hypertension, preeclampsia, eclampsia, and renal failure. MRI shows cortical and subcortical edema in posterior cerebral regions. Treatment is aimed at the underlying trigger.

Case: A 24 y/o G2P0 with h/o sickle cell disease, DVT/PE (anticoagulated), and opioid abuse was admitted at 31 wks for sickle cell crisis and anemia (Hgb 5.4 g/dl) requiring transfusion. She developed fever, hypoxia, and bacteremia from a PICC.

Pregnancy was complicated by pre-eclampsia with severe features, transaminitis, nephrotic range proteinuria, and direct bilirubinemia. Blood pressure was controlled with labetalol; magnesium was administered.

The patient became progressively non-cooperative, non-verbal, stopped following commands and ceased interactions. Psychiatry and neurology were consulted for catatonia. Her mother assumed decision making. CT was negative for CVA. MRI revealed edema in bilateral parieto-occipital and fronto-parietal lobes and cerebellar hemispheres. PRES was diagnosed and multidisciplinary delivery planning began.

Concerns for performing cesarean section (c/s) included hemorrhage, anticoagulation, DVT/PE, positive antibody screen, and acute chest syndrome. Concerns for inducing labor included inability to participate or convey pain and need for operative vaginal delivery. Induction of labor with epidural analgesia was recommended and anticoagulants held. Despite catatonia, epidural was placed with mother's consent. Pain was difficult to assess, but no signs of uncontrolled pain were seen.

Mental status improved quickly postpartum and returned to baseline by 48 hours. Abnormal lab values resolved and enoxaparin was restarted. She was discharged home with her newborn, satisfied with her care.

Discussion: Pathophysiology of PRES is not well understood, and theories include endothelial dysfunction or cerebral vessel spasm. Though PRES is usually reversible when diagnosed and treated, irreversible damage has been described with delayed or missed diagnosis.

PRES in pregnancy is usually diagnosed postpartum, with treatment aimed at blood pressure and seizure control. In our patient, delivery was seen as definitive treatment. The team felt induction of labor carried less risk than c/s.

Multidisciplinary care was beneficial to manage her co-morbidities. We considered vaginal delivery without epidural, but were concerned for uncontrolled pain and its hemodynamic effects, inability to communicate, and further exacerbation of sickle cell crisis. Placing an elective epidural in a patient who could no longer give consent or participate in the procedure raised an ethical concern and required agreement of the family. With the cooperative teamwork of several specialties and the family, our patient had a favorable outcome.

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Abstract #: RF3AC-377

Maternal Flash Pulmonary Edema During Fetoscopic Laser Ablation for Twin-Twin-Transfusion Syndrome

Presenting Author: James D. Weinberg M.D., M.S.
Presenting Author's Institution: University of Michigan - Ann Arbor, MI
Co-Author: Emily Naoum M.D. - University of Michigan
Baskar Rajala M.B.B.S. - University of Michigan

Introduction: As rates of fetal surgery increase, so does the recognition of risk associated with these highly complex procedures. Incidence of maternal post operative pulmonary edema during fetal myelomeningocele (MMC) surgery has varied incidence of 3.3%-6% (2-4); with few case reports of pulmonary edema with cases involving twin-twin-transfusion syndrome (TTTS) (1,4). We present a case of maternal flash pulmonary edema during fetoscopic laser ablation for TTTS.

Case Report: 33 year old female G6P1 at 21 weeks with monochorionic diamniotic twins with stage 3 TTTS, and a past medical history notable for depression and former tobacco use. Preoperative physical exam was unremarkable. Her surgery was planned under epidural anesthesia and catheter placement was uncomplicated. Operation was initiated with notable difficultly in fetoscope trochar placement. Port site fluid leakage required higher than usual infusion rates with Belmont infuser. Roughly 90 minutes into the case, the patient complained of shoulder pain which was treated with fentanyl. Shortly after, she had persistent desaturation to 85-90% despite supplemental oxygen. Lung auscultation was initially clear bilaterally. Following the operation, she developed tachypnea and tachycardia when sitting upright. Lungs exam was repeated, now with bilateral crackles. She was given 40mg IV furosemide. Intraoperative chest x-ray was obtained and demonstrated bilateral pulmonary edema. Total intrauterine fluid given via Belmont was 11L with 2L suspected to have been lost to suction/leakage. Total IVF given was 1500 mL LR with UOP of 875ml in OR. She had significant improvement in respiratory status following furosemide and was weaned of supplemental oxygen that day. She was discharged on POD#1 without pulmonary symptoms.

Discussion: While fetal surgery is classified as minimally invasive surgery, there are a number of associated anesthetic complications. Among them, post-operative pulmonary edema remains a serious concern. The incidence during fetal MMC surgery is well-described with a higher incidence with increased volume of amniotic infusion (2-4). Fetal TTTS laser cases typically require smaller amniotic infusion rates, however this case illustrates that flash pulmonary edema can occur. One must remain vigilant in the early recognition and treatment in addition to minimizing amnioinfusion rates as feasible.

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Abstract #: RF3AC-385

Anesthetic Considerations for a Parturient with Noonan Syndrome, Severe Mitral Stenosis, and TIUP Presenting for Unplanned Cesarean Section

Presenting Author: Etty Sims M.D.
Presenting Author's Institution: Thomas Jefferson University Hospital - Philadelphia, PA
Co-Author: Jaime L. Baratta M.D. - Thomas Jefferson University
Suzanne L. Huffnagle D.O. - Thomas Jefferson University
John T. Wenzel M.D. - Thomas Jefferson University
H. Jane Huffnagle D.O. - Thomas Jefferson University

Introduction: Noonan Syndrome is an autosomal dominant disorder (incidence 1:1000) that includes a variety of congenital malformations (1). These patients are a unique challenge to the anesthesiologist due to their dysmorphic facial features, difficult airway, spine abnormalities, coagulation disorders, and congenital heart disease. We present a woman with Noonan Syndrome, TIUP, rheumatic mitral stenosis (MS), and preterm labor requiring C/S.

Case: A 35 yr old G1P0 female with no prior anesthetic evaluation presented at 33 2/7 weeks' gestation with malpositioned di/di twins (baby A transverse) in preterm labor. PMH included Noonan Syndrome, bicornuate uterus, rheumatic fever, VSD (closed spontaneously), and severe MS. PSH included pectus excavatum repair, knee arthroscopy, appendectomy, and bowel malrotation repair. Her airway was Mallampati III with micrognathia, high arched palate, and severe gingival hyperplasia. She c/o worsening edema and dyspnea; TTE showed severely elevated mitral valve gradient (peak 39 mmHg) and tachycardia (120 bpm). She received nifedipine and betamethasone but labor progressed quickly and C/S became necessary. Anesthetic plan was a preoperative arterial catheter, HR control using esmolol, and titrated epidural anesthesia (coags nl). She recovered in the ICU and was discharged POD 4.

Discussion: Noonan Syndrome patients may present with short stature, webbed neck, pectus carinatum /excavatum, and cardiac abnormalities including pulmonic stenosis (2). Facial features include hypertelorism, epicanthal folds, down slanting palpebral fissures, high arched palate, micrognathia, low-set, posteriorly rotated ears, malar hypoplasia, ptosis, and short neck (3). They may have cervical spine fusion and scoliosis making regional anesthesia (RA) challenging (1) and edema of the hands and feet, making IV access difficult (2). They bruise easily, having multiple vasculitides, thrombocypenia (4) or Von Willebrand's disease. In addition, clotting factor defects are seen in up to 50% of patients (prolonged APTT, Factor VIII:C, XI:C, XII:C, XI deficiency), so a coagulation profile is necessary prior to RA. Patients with severe MS may decompensate during labor and delivery (tachycardia, fluctuations in SVR) and they may not tolerate spinal anesthesia for C/S. We chose epidural anesthesia since we were able to titrate the anesthetic level and support maternal hemodynamics, while avoiding a potentially difficult airway. Esmolol is used with caution in pregnancy as it may cause prolonged FHR decelerations (5), however our patient was delivered expediently and the FHR remained stable. Early pre-anesthetic evaluation, would have been extremely valuable to optimize the management of this complicated patient.

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Abstract #: RF3AC-386

Management of Parturient with Hypertrophic Obstructive Cardiomyopathy

Presenting Author: Landon Coldiron M.D.
Presenting Author's Institution: University of Texas Southwestern Medical Center - Dallas, TX
Co-Author: Michelle Eddins M.D. - Assistant Professor, UT Southwestern

Background: Hypertrophic obstructive cardiomyopathy (HOCM) is an autosomal dominant genetic disease caused by mutations in sarcomere genes resulting in defective contractile components within cardiac myocytes. It is characterized by asymmetric hypertrophy of left ventricle, resulting in left ventricular outflow tract (LVOT) obstruction that is exacerbated by decreases in preload. Given the hemodynamic changes that occur during pregnancy and labor, parturients with HOCM must be carefully medically managed to minimize morbidity and mortality to the mother and fetus [1].

Case: A 37 year-old G5P2 patient with a history of chronic hypertension treated with metoprolol, and echocardiogram findings concerning for HOCM presented to L&D at 37w5d for planned vaginal delivery. Physical exam notable for 3/6 systolic ejection murmur at right sternal border. Cardiology following for HCOM management who recommended forceps assisted vaginal delivery with epidural to decrease straining which would worsen LVOT obstruction, continuing home metoprolol, and treating episodes of hypotension with fluid boluses and phenylephrine while avoiding inotropes.

At 38w, an epidural catheter was placed and labor was induced with oxytocin. Shortly after induction, patient began complaining of SOB with contractions, associated with episodes of tachycardia with HR in 110s and SBPs of 170s. EKG revealed signs of LVH with strain/ischemia and inverted T-waves in inferior leads. Decision was made to take patient to OR for urgent cesarean section.

An arterial line and central line were placed, and a continuous epidural with bupivacaine and fentanyl provided adequate analgesia. Normal cesarean section followed. Epidural was kept in place for an additional 24 hours to minimize episodes of tachycardia secondary to pain. Patient transferred from ECU to floor on POD#1 and was discharged home on POD#4 with instructions to follow up with cardiology.

Discussion: Expectant mothers with hypertrophic obstructive cardiomyopathy have a higher risk of perinatal morbidity and mortality compared to the general population [1]. However, the risks to the mother and fetus can be minimized with appropriate medical management, particularly with the use of negative inotropic agents (e.g. beta blockers or nondihydropyridine calcium channel blockers), avoiding vasodilators, using neuraxial anesthetics to minimize tachycardia and straining secondary to pain, and phenylephrine to maintain SVR [2,3].

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Abstract #: RF3AC-388

Anesthetic Management for Cesarean Delivery in a Parturient with Unrepaired Coarctation of the Aorta

Presenting Author: Patsy J McGuire BA, MD
Presenting Author's Institution: Tufts Medical Center - Boston, MA
Co-Author: Andrea St Cyr MD - Tufts Medical Center
Virgil Manica MD - Tufts Medical Center

Background: A 24 year-old G2P1 female at 39/0 presented to the Labor and Delivery floor of our tertiary care center for a scheduled repeat cesarean delivery. She was diagnosed as a child in the Dominican Republic with coarctation of the aorta (CoA) which was never surgically corrected. Her previous cesarean delivery took place under presumed spinal anesthesia due to failure to progress and without complications per patient.

Case Report: Prior to presentation to the Labor and Delivery floor, the patient was sent by her obstetrician to both cardiology and obstetric anesthesiology for pre-operative consultation. Cardiology noted that she had coarctation of the descending thoracic aorta distal to the takeoff of the left subclavian artery. It was mild with a normal ejection fraction, normal wall motion and no valvular disease. Peak velocity was 4.4 m/sec and mean gradient was 34 mmHg. She did not have a blood pressure differential by Doppler in her upper and lower extremities. Cardiology had obtained records from the Dominican Republic and confirmed that her first delivery occurred under spinal anesthesia. Given their evaluation, Cardiology was in favor of proceeding with regional anesthesia for her repeat cesarean delivery. After an extensive discussion in anesthesiology pre-operative clinic which included both obstetric and pediatric anesthesiologists, the decision was made to proceed with epidural anesthesia for secondary cesarean delivery. On the day of her scheduled delivery, the patient was brought to the operating room and standard monitors were applied. An epidural was placed without issue and slowly dosed to an adequate level while the patient's blood pressure was frequently measured and supported by low dose phenylephrine. The fetal heart rate was also monitored closely during this time. Once adequate anesthesia was obtained, the cesarean delivery proceeded without complication.

Discussion: CoA accounts for 6 to 8 percent of all congenital heart defects with a reported prevalence of approximately 4 per 10,000 live births (1,2). CoA is frequently corrected prior to childbearing age. When uncorrected in pregnant women they prompt evaluation and discussion between a number of consultants including obstetrics, cardiology and anesthesiology to formulate the safest delivery plan for both mother and baby. In this case, the patient presented with adequate time to obtain appropriate consultation and determine an interdisciplinary plan for a healthy delivery.

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Abstract #:RF3AC-390

Bundle Branch Block Following Lidocaine and Neuraxial Anesthesia

Presenting Author: Hilary Gallin MD, MBA
Presenting Author's Institution: Massachusetts General Hospital - Boston, MA
Co-Author: Hilary Gallin MD, MBA - Massachusetts General Hospital
Jared Wortzman MD - Massachusetts General Hospital
Christine Warrick MD - University of Utah Hospital
Jaime Daly MD - Massachusetts General Hospital

INTRODUCTION: Transient bundle branch blocks (BBB) are rare and usually occur in patients with known cardiac risk factors.(1) We present a healthy patient who experienced a LBBB following lidocaine administration during neuraxial anesthesia.

CASE: A 37 y/o G2P1 BMI 42.5 at 39.1 weeks gestation presented for scheduled repeat cesarean delivery (CD) with planned combined spinal and epidural. Her pregnancy was via IVF with third trimester polyhydramnios. She had an uncomplicated CD 23 years prior and controlled hypothyroidism.

Pulse oximeter and blood pressure cuff were applied in the operating room. EKG lead placement was deferred until after CSE placement. We decided to proceed solely under epidural anesthesia because CSF flow was not obtained despite easy identification of anatomic landmarks. Initial test dose of 3cc 1.5% lidocaine with 1:200,000 epinephrine was notable for tachycardia without hypertension. A second test dose was negative. She was positioned supine, EKG leads were applied, and a surgical level of anesthesia was obtained with 3% chloroprocaine.

Following placement of EKG leads, the patient was noted to be in normal sinus rhythm (NSR), but quickly developed a LBBB, confirmed by 12 lead EKG. The patient denied pain or dyspnea. Her rhythm converted between LBBB and NSR without ST changes. Troponins were sent, cardiology was consulted for post-operative assessment, and an uncomplicated CD proceeded. Troponins and post-operative echocardiogram were unremarkable. Over the next 24 hours, the patient spontaneously reverted to NSR.

DISCUSSION: Transient BBBs have been reported with lidocaine and neuraxial anesthesia, usually in patients with cardiac risk factors.(2) Here it occured in a healthy parturient. Because this patient had no indication for preoperative cardiac testing and it is not our routine practice to apply EKG leads before neuraxial anesthesia, we could not confirm if this was a new conduction abnormality or the discovery of an underlying rhythm. New LBBB raised concerns for peri-partum cardiomyopathy, local anesthetic toxicity, and ischemia.(3) While early recognition, interdisciplinary communication, and low pre-test probability of a cardiac event allowed us to proceed, the identification of this phenomenon will help inform decision making in more complicated patients.

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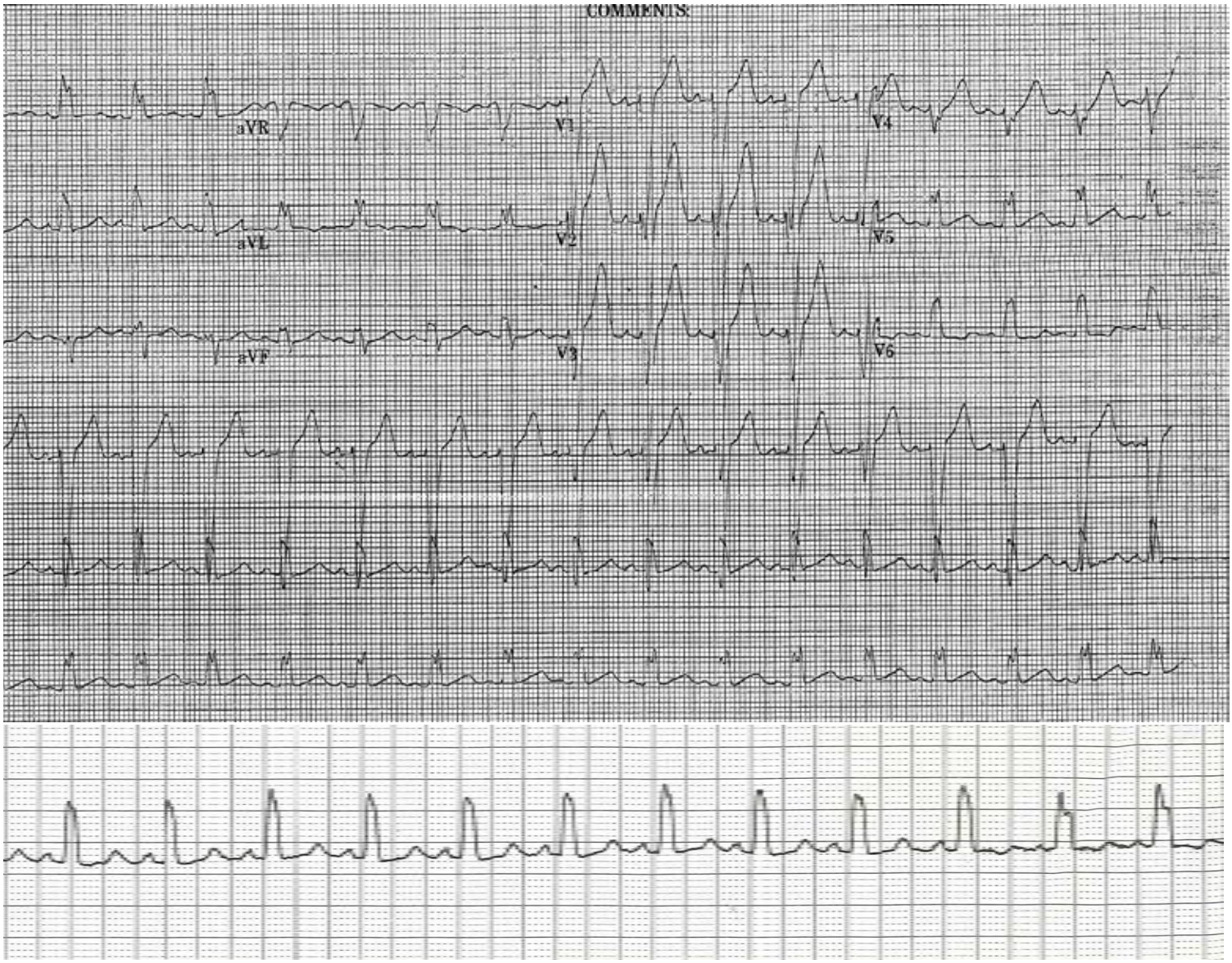
Abstract #:RF3AC-390



Abstract #: RF3AC-210

Delayed Presentation of Amniotic Fluid Embolism - 2 Days Postpartum

Presenting Author: Won Lee MD, ScM
Presenting Author's Institution: University of California San Francisco - San Francisco, CA
Co-Author: Tina Yu MD - UCSF
Stephanie Lim MD - UCSF
Willie Du MD - UCSF
Peter Yeh MD - UCSF

Introduction: Amniotic fluid embolism (AFE) is a life-threatening obstetric emergency that is rare but deadly with high mortality rate1. Thought to be due to abnormal proinflammatory response to amniotic debris in maternal circulation, most case reports depict AFEs occurring in laboring and immediate postpartum patients2,3. We present an unusual case of AFE that occurred 46 hours postpartum.

Case Report: 33-year-old G1P0 at 39w1 had spontaneous vaginal birth following induction of labor for severe preeclampsia. Her course was complicated by labial hematoma requiring vaginal packing, but CT scan did not reveal active extravasation. She was hemodynamically stable, afebrile throughout, and packing was removed subsequently. She received Cefoxitin for 24 hours post procedure. 46 hours postpartum, patient reported sudden onset of shaking and shortness of breath while breastfeeding. She was tachycardic, tachypneic, and O2Sat 97% on 2L NC. Within minutes, she became progressively altered, with thready pulse and wheezing requiring urgent intubation. Shortly after, she experienced pulseless electrical activity (PEA) arrest with evidence of disseminated intravascular coagulation (DIC). Despite 85 minutes of ACLS and massive transfusion protocol, patient expired. Postmortem autopsy did not demonstrate pulmonary emboli, tamponade, coronary occlusions, internal hemorrhage, stroke or anaphylactic edema. Emboli of amniotic fluid squamous cells were not seen. No bacteria in specimen and 16S ribosomal RNA sequencing was also negative. Furthermore, there was no sign of labial purulence or fasciitis, and placenta showed no signs of infection.

Discussion: The diagnosis of AFE remains clinical and that of exclusion, after eliminating other potential causes of maternal cardiopulmonary and hemostatic derangement4. Typical presentations of AFE include sudden onset cardiorespiratory compromise, DIC, and seizure that can rapidly progress. Amniotic debris is ubiquitously present in all maternal circulation, therefore, AFE occurs in at risk mom-fetal pair5. What is unclear, however, is how long fetal/amniotic tissue remains in maternal circulation. Furthermore, it's unknown if vaginal manipulation for packing triggered proinflammatory response that then lead to this delayed presentation of AFE 47 hours postpartum.

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Abstract #: RF4AD-292

Management of a Complex Case of Treatment Induced Neuropathy of Diabetes in a Primigravida Female with Poorly Controlled Type II Diabetes Mellitus and HELLP Syndrome.

Presenting Author: Yamin A Noor MD, MS
Presenting Author's Institution: Feinberg School of Medicine - Northwestern University - Chicago, IL
Co-Author: Matthew G Hire MD - Feinberg College of Medicine - Northwestern University
Nicole Higgins MD - Feinberg College of Medicine - Northwestern University

Introduction: Treatment induced neuropathy of diabetes (TIND), previously known as insulin neuritis, is characterized by peripheral or generalized allodynia and paresthesias starting within 2-4 weeks after initiation of antihyperglycemic treatment [1,2]. The neuropathic pain is often described as sharp or stabbing [2]. The pathophysiology is attributed to rapid changes in the glycemic level after diabetes treatment initiation [3]. TIND may be refractory to usual treatments for diabetic neuropathy, including antidepressants, anticonvulsants, and SSRIs, and can be especially hard to treat in pregnant and breastfeeding women.

Case Report: The patient is a 37 year old primigravida female with poorly controlled type II diabetes who was found to have a HbA1c of 12.7% at time of pregnancy diagnosis for which she started insulin. Three months after initiation of insulin, patient presented to the ED with sharp, stabbing upper back and shoulder pain radiating to the chest. Computed tomography was performed to rule out pulmonary embolus. Her symptoms remained refractory to lidocaine patches, wellbutrin, gabapentin, duloxetine, and biofreeze. The patient had as many as 20 encounters during pregnancy attributed to pain. During a hospital admission for hypokalemia at 24 weeks EGA, her HbA1c was 5.6% and she was diagnosed with TIND by neurology. Antihyperglycemic regimen was reduced to metformin, but pain crises continued with patient requesting narcotic medication. At 30 weeks EGA, patient developed HELLP syndrome requiring cesarean delivery. The postpartum course was further complicated by persistent TIND, hyperalgesic response to incision wounds, episodes of muscle twitching, and hypnagogic hallucinations for which psychiatry diagnosed an adjustment disorder. Three months postpartum, patient reported resolution of her generalized pain, but continued to have peripheral neuropathy.

Discussion: This case demonstrates the unique challenge of acute pain management in an already high risk pregnancy with HELLP syndrome during labor and delivery. We successfully managed this patient with conservative diabetic management, preterm delivery, and multimodal pain therapy with gabapentin, duloxetine, ibuprofen, lidocaine patch, and low dose opioids. This case further illustrates the need for more awareness among healthcare providers regarding TIND to avoid confusion with psychiatric disorders and malingering, such as drug seeking behavior.

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Abstract #: RF4AD-391

Point of care ultrasonography: (POCUS): An efficient tool for maternal cardiac evaluation during operative delivery

Presenting Author: Allison M. Berken M.D., MPH
Presenting Author's Institution: Yale School of Medicine - New Haven, CT
Co-Author: Antonio Gonzalez MD - Yale School of Medicine
Aymen Alian MD - Yale School of Medicine

Point of care ultrasonography (POCUS) has proven to be a useful diagnostic tool in the evaluation of an increasing number of obstetric patients with complex congenital heart disease and cardiovascular risk.1-2 We present a case in which a single handheld probe was utilized for neuraxial guidance and for cardiac ultrasonography in a patient with a mechanical prosthetic mitral valve.

A 22-year-old G1P0, with a past medical history of rheumatic heart disease, and mechanical heart valve was admitted for a scheduled cesarean delivery (CD) secondary to fetal malpresentation. At 37 wks, external cephalic version was attempted but proved unsuccessful. At this point, she was transitioned from warfarin to heparin (UFH). A dose of 19,000 Units three times a day was needed to achieve therapeutic goal. After a multidisciplinary meeting between cardiology, maternal fetal medicine and anesthesiology, the plan was to stop anticoagulation 24h before cesarean delivery time.

Given normal coagulation profile the morning of the surgery, spinal anesthesia was deemed safe. The Butterfly iQ ultrasound was utilized to mark the desired interspace at L3-L4 level. A Spinal anesthesia with bupivacaine 0.75% 1.6 ml, fentanyl 15 mcg and preservative free morphine 0.1 mg was performed. In addition, a parasternal long axis, short axis, and an apical view were obtained without needing to bring additional equipment into the operating theatre. The intra-operative course was uneventful. Intravenous UFH was started 6 h after cesarean delivery. Her post-operative course was complicated by the development of bilateral rectus sheath hematoma on post-operative day 3 in the setting of anticoagulation. After adjusting the anti-coagulation regimen, the patient had a satisfactory recovery without further surgical intervention and was discharged home on post-operative day 13.

As cardiovascular disease continues to be a leading cause of maternal mortality1, the addition of a handheld transthoracic echocardiogram (TTE) to our diagnostic toolbox seems opportune. The implementation of POCUS is often limited by a lack of accessibility to training opportunities and the resources necessary to learn new effective skills (i.e. TTE). At our institution, we propose an algorithm in conjunction with cardiology to improve our imaging acquiring and interpreting skills (See Figure below).

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Abstract #: RF4AD-391

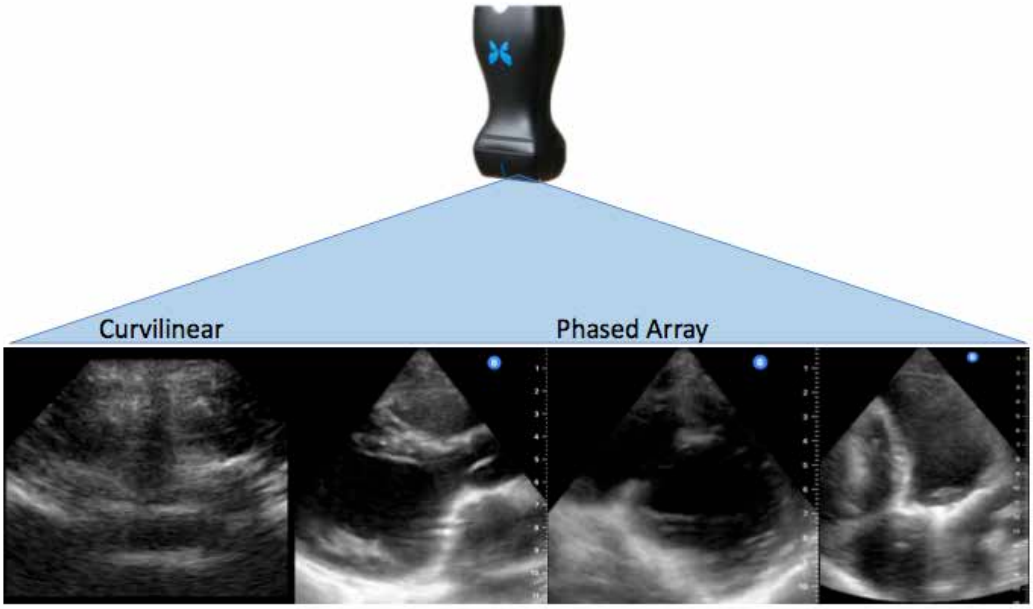
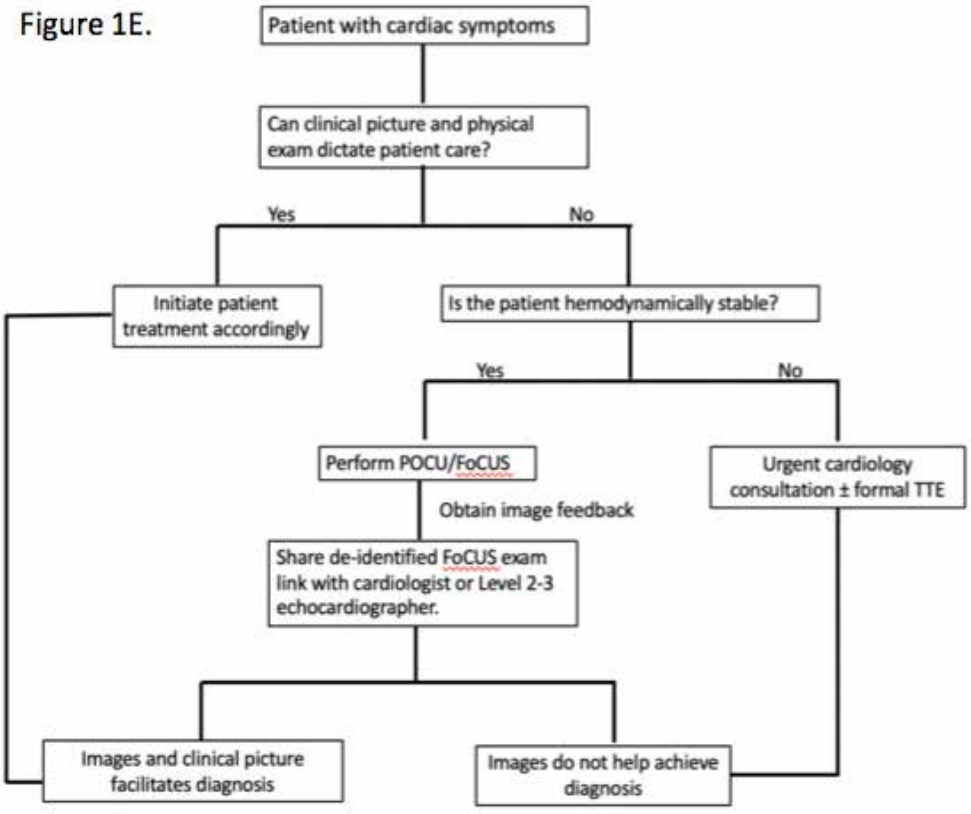


Figure 1A - Spine Figure 1B – Parasternal long axis Figure 1C– Parasternal short axis Figure 1D - Apical

Figure 1E.



Abstract #: RF4AD-406

Management of a laboring patient with Addison's disease and antiphospholipid syndrome: a case report

Presenting Author: Danielle Leahy M.D.
Presenting Author's Institution: University of Vermont Medical Center - Burlington, Vermont
Co-Author: Lydia Grondin M.D. - University of Vermont Medical Center

Patient Presentation: A 34 year-old G1P0 at 37w0d with a history of Type 1 diabetes, Addison's disease, hypothyroidism due to papillary thyroid cancer s/p thyroidectomy, and antiphospholipid syndrome (complicated by pulmonary embolism), presented to labor and delivery for scheduled induction of labor (IOL).

Her prenatal course was complicated by hospital admission at 16 weeks gestational age (wga) for Addisonian crisis for which she received stress dose steroids and again at 35 wga for hyponatremia and emesis for which she repeated stress dose steroids and an increase of fludrocortisone. Therapeutic anticoagulation was maintained during pregnancy with enoxaparin and diabetes was controlled on insulin pump.

Intrapartum Course: Labor was induced with cervical ripening balloon, misoprostol, and oxytocin. Addison's disease was managed with stress-dosed hydrocortisone, fludrocortisone and fluid restriction for hyponatremia. She was transitioned to an insulin drip. Enoxaparin was stopped and prophylactic subcutaneous heparin started. Labs were notable for INR 0.9, PLT 322, HCT 32.9, Na+ 130. Early epidural was placed between doses of heparin. During second stage of labor she had 1 hour of passive descent followed by 2.5 hours of pushing, epidural was too dense and rate was decreased. Recurrent late decelerations of the fetus with prolonged time to recovery of baseline developed. Vacuum assisted delivery failed and she was taken emergently for cesarean section. Epidural was bolused with 2% lidocaine and 100mcg of fentanyl but failed to achieve surgical block, therefore general anesthesia was induced. After delivery she received methergine and tranexamic acid for an estimated blood loss of 1000mL. Oxytocin use was limited due to potential for worsening hyponatremia.

Postpartum course: Postpartum she developed ileus and urinary retention thought to be related to recent surgery. Enoxaparin was restarted 6 hours after delivery for a course of 30mg Q6H for 36 hours then placed back on therapeutic dosing of 70mg BID with plan to follow up with hematology.
She was transitioned back onto insulin pump for which was complicated due to hypoglycemia. For Addison's disease, stress dosed steroids were continued for 24 hours and then tapered.

Discussion: Multispecialty coordination is important in patients with medical issues, this case involved endocrinology, hematology, obstetrics, and anesthesiology. The decision to place the epidural early was due to new ASRA guidelines suggesting a wait of 4-6 hours after heparin. The epidural was placed despite lack of labor pain due to need for continuing heparin prophylaxis in a high risk patient. Though the epidural worked well for labor, it was inadequate for surgery. She was not a candidate for a spinal due to recent dosing of subcutaneous heparin which lead to general anesthesia. General anesthesia, heparin and the need to limit oxytocin likely all contributed to the increased blood loss at delivery.

Abstract #: RF4AD-411

Labor epidural placement in a 35 year old parturient with Sézary syndrome

Presenting Author: Patrick Musau MD
Presenting Author's Institution: UTsouthwestern Medical Center - Dallas, Texas
Co-Author: Alexa Kaminski MD - UTsouthwestern

Sézary Syndrome is an aggressive form of cutaneous T-Cell leukemia. Mycosis fungoides and Sézary syndrome represents a spectrum of cutaneous T-cell lymphoma. The clinical manifestation consists of flat patches that may evolve into raised, infiltrated plaques and nodules with involvement of lymph nodes and the viscera. Patients present with erythroderma, lymphadenopathy and leukemic evidence in the peripheral blood. Other common signs of the condition consist of alopecia, intense pruritus of the lesions (1). It was first reported in a case report by Dr. Sézary, a French dermatologist in 1938 (2). Although Sézary syndrome can affect patients of any age, it is commonly seen in patients age 50 and over. Advanced disease carries a poor prognosis, with median survival years averaging 3.8 years.

A 35 year-old G5P3A2 with a history of Stage IV Sézary Leukemia with plaques and lymph nodes involvement, presented with contractions. Patient was diagnosed a year ago with Sézary leukemia, but she has been noncompliant with the recommendations from her dermatologist and oncologist. She has not received any treatment since her diagnosis. Upon presentation to Labor and delivery, she had diffuse pruritis, hypopigmented lesions on upper extremities, face, lower extremities. No visible lesions noted in the trunk. She was evaluated by MFM and a trial of labor was started with Misoprostol. After thorough assessment and discussion with the patient, specifically risks of infection and potential spread of malignant cells into epidural or intrathecal space, the patient decided to proceed with epidural placement and had an uncomplicated vaginal delivery.

Sézary syndrome is a rare condition encountered during pregnancy. Research on the safety of the placement of neuraxial anesthesia is scarce in the literature. A particular concern is the spread of malignant cells systemically through the epidural space or intrathecally. We were able to find one case report in the literature of a patient with Sézary syndrome who received neuraxial anesthesia without any complications (3).

A careful physical exam and review of patient chart has to be performed before the decision of placement of neuraxial anesthesia. Any lesions over the area of needle insertion should preclude neuraxial anesthesia and concerns should be addressed with patient and obstetrical team.

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Abstract #: RF4AD-416

The Harbinger of DIC- Hypofibrinogenemia in a patient with IUFD and Pre-eclampsia

Presenting Author: Kar-Wei Leung MD
Presenting Author's Institution: University of New Mexico School of Medicine - Albuquerque, New Mexico
Co-Author: Kathleen Reyes MD - The University of New Mexico School of Medicine
Katherine Seligman MD - The University of New Mexico School of Medicine
Tim Petersen PhD - The University of New Mexico School of Medicine

We present a patient with disseminated intravascular coagulopathy (DIC) secondary to intrauterine fetal demise (IUFD), with hypofibrinogenemia as sole indicator prior to massive hemorrhage.

A 24 year old G1P0 female at 37 weeks and 2 days presented with abdominal pain and no fetal movement for 1 day. IUFD was diagnosed due to absent fetal heart tones, leading to induction for vaginal delivery. Labs were positive for cocaine, fibrinogen 145 mg/dL, and platelets 166x103/µL. She completed vaginal delivery with EBL of 1500cc, receiving misoprostol, oxytocin, and Hemabate. Postdelivery labs showed fibrinogen 52 mg/dL and platelets 91x103/µL, with new gingival bleeding. We initiated massive transfusion protocol (MTP) with concern for coagulopathy.

She received 2 units pRBC, 1 of FFP, 1 of pooled platelets, 5 of cryoprecipitate, and 1g TXA. After transfusion, fibrinogen rose to 303 mg/dL. Platelets and hemoglobin/hematocrit levels reached nadirs 43x103/µL and 7.6/22 respectively 8h post delivery. The postpartum course was complicated by pre-eclampsia with severe features, elevated creatinine, and endometriosis. Magnesium, Ca+ channel blockers, and antibiotics were administered. She was stabilized by postpartum day 1 and discharged 3 days after initial presentation.

Placental abruption was the suspected etiology of fetal demise in the setting of known active cocaine use, and is responsible for 10-20% of IUFD (1). There is no laboratory test both specific and sensitive for DIC; diagnosis is based on history, risk factors, clinical presentation, and lab data. Third-trimester fibrinogen levels are typically >300mg/dL and levels <200 mg/dL had 100% positive predictive value for progression to severe post-partum hemorrhage in a study of 128 patients (2). Our patient experienced severe PPH, consistent with that study. Thrombocytopenia is typically the first finding in DIC (3). Our patient presented with normal third-trimester platelet levels. Per literature, platelets typically fall to <100x103/µL before critical fibrinogen drops. In our case, however, fibrinogen drop preceded acute thrombocytopenia. Patients with suspected abruption or IUFD should be screened for coagulopathy at admission. Fibrinogen < 200 should alert the physician to a possible impending hemorrhage or DIC.

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Abstract #: RF4AD-442

TTP- not short for Time To Panic: A Multidisciplinary Approach to Managing Thrombotic Thrombocytopenic Purpura in Pregnancy

Presenting Author: Advaita Punjala-Patel MD
Presenting Author's Institution: Augusta University Medical Center - Augusta, Georgia
Co-Author: Lauren Griswold MD - Augusta University Medical Center
Angela Stephens MD - Augusta University Medical Center
Efrain Riveros MD - Augusta University Medical Center
Linda Street MD - Augusta University Medical Center
Paul Browne MD - Augusta University Medical Center

Background: Thrombotic thrombocytopenic purpura (TTP) is a rare thrombotic microangiopathy characterized by hemolytic anemia, thrombocytopenia, and varying degrees of end-organ dysfunction. When present in pregnancy, it can mimic other conditions in the general population, such as hemolytic uremic syndrome, and those unique to the puerpartum, such as preeclampsia. Rapid and appropriate diagnosis is important, as delay in care can be life-threatening. We present the case of a multigravida with a rare hereditary form of TTP, Upshaw Schulman syndrome. Her pregnancy was further complicated by HELLP syndrome and an emergent cesarean delivery illustrating the importance of a multidisciplinary team in the timely management of an acutely complicated patient.

Case Report: 39 yo G11.P4.3.3.6 at 25.3 wks EGA with a history of thrombotic thrombocytopenic purpura (TTP) complicating two prior pregnancies, pulmonary embolism, and chronic hypertension. At the time of her initial presentation, she had a platelet count of 7,000/mm3 and ADAMSTS13 of 9% with a positive inhibitor screening suggestive of hereditary TTP or Upshaw Shulman syndrome Physical exam was notable for diffuse petechiae, altered mental status, and tea-colored urine. She was subsequently admitted to the intensive care unit for daily plasma exchange, and responded to 7 rounds of plasma exchange, after which her platelets improved to 183,000 giving her sufficient time for magnesium sulfate and betamethasone to be administered. At 26.6 wks EGA, however, platelet count started dropping to 20,000 and was refractory to 9 additional rounds of plasmapheresis, raising concern for HELLP. Rituximab could not be used intrapartum due to increased risk of neonatal B cell lymphoma and an emergency cesarean section was called for thrombocytopenia unresponsive to treatment. General anesthesia was administered using a rapid sequence induction. Intubation attempts were traumatic due to upper airway edema and poor glottis visualization. Nitrous oxide was used for maintenance to minimize the dose of halogenated agents and Pitocin and Hemabate were all given prophylactically to decrease risk of uterine atony and postpartum hemorrhage. The patient remained intubated for two days until upper airway edema subsided. To minimize bleeding risk, the patient was transfused with 2 units of platelets and 2 units of pRBCs due to a preoperative Hgb of 6.6. Postpartum, her platelet count improved to 254,000/mm^3 after receiving 13 additional plasmapheresis treatments, prednisone, and solumedrol.

Conclusion: While the diagnosis of Upshaw Schulman is rare, emergency management is essential in the proper care of parturients presenting with platelet disorders and thrombocytopenia. When recognized a multidisciplinary approach of obstetricians, obstetric anesthesiologists, maternal-fetal medicine specialists, hematologists, and neonatologists is necessitated for safe and timely care.

Abstract #: RF4AD-467

Management of Severe Pulmonary Stenosis in Tetrology of Fallot Parturient

Presenting Author: Jennifer Hong MD, MBA
Presenting Author's Institution: University of Colorado School of Medicine - Aurora, CO
Co-Author: Cristina Wood MD, MS - University of Colorado School of Medicine

Tetralogy of Fallot (TOF) is the most common congenital heart disease (CHD) with an incidence of 4 in 10,000 live births (1). From a reported 30-yr survival of 77% in a cohort of 106 pts in 1954 (2), the surgical technique has substantially improved 25-yr survival rate to 94.5% (3). The number of adults with CHD continues to grow as therapies and surgical interventions become more effective. The majority of women with CHD reach reproductive years, and despite the moderate to high risks associated with pregnancy, recommendations are available to navigate these parturients through pregnancy (4). In this case report, we describe the management of a TOF pt with severe pulmonary stenosis.

22 yo G4P0030 with history of TOF with pulmonary atresia s/p Ross procedure with prosthetic valve replacement in 2007 presents to the hospital at 34w3d for her 4th cordocentesis and PUBS procedure in the setting of persistently elevated MCA dopplers and IUGR with anti-Kell and anti-S antibodies. Complicating her medical history are late care at 21w GA, autism with learning disabilities, chromosomal 19p13.11 2.2m deletion (present in three generations, including fetus), severe anxiety, and PSA.

Her pre-pregnancy TTE, approximately 6 months prior, revealed peak gradient across her homograft of 65mmHg and a RVSP of 42mmHg. Her first pregnancy TTE occurred at 26w1d with peak gradient of 71mmHg and RVSP of 100mmHg. With each subsequent ECHO, she continued to have further accentuation of her pulmonary stenosis: at 34w2d a peak gradient of 116mmHg and RVSP 135mmHg and at 37w0d a peak gradient unobtainable due to positioning and RVSP 149mmHg.

She was admitted to the L&D unit at 37w0d for early neuraxial placement via DPE technique and arterial line placement after midazolam 4mg and fentanyl 100mcg. Her labor course was unremarkable and she was transferred to the OR for FAVD after 36 hours. She received a bolus of 2% lidocaine with epinephrine 10mL and required support with phenylephrine gtt and vasopressin boluses. However, immediately after delivery with 1.2L EBL, the pt became tachycardic to the 130s. A central line was placed, 1u PRBC was administered, a Nexplanon was implanted and pt was transferred to the CICU. 6 weeks postpartum, the pt had a repeat TTE showing a peak gradient of 89mmHg with RVSP 100mmHg. She received a replacement 23mm SAPIEN transcatheter valve with a subsequent gradient of 20mmHg across the new valve and RVSP 28mmHg.

While the medical management of this pt is remarkable, her psychosocial situation offered additional challenges questioning her ability to offer informed consent for her labor and postpartum contraception. She required hours of coaching before each neuraxial placement and developed PTSD related to the multiple procedure required in the setting of fetal anemia. This poses an interesting discussion of pre-conception counseling in high risk patients associated with significant mental health and cognitive impairment.

Abstract #: RF4AD-469

Anesthetic Management of a Parturient with Reversible Cerebral Vasoconstriction Syndrome

Presenting Author: Jack M Peace M.D.
Presenting Author's Institution: McGaw Medical Center of Northwestern University - Chicago, IL
Co-Author: Adithya Bhat M.D. - McGaw Medical Center of Northwestern University
Feyce M Peralta M.D. - McGaw Medical Center of Northwestern University

Introduction: Reversible cerebral vasoconstriction syndrome (RCVS) is a rare group of vascular disorders characterized by severe headache with or without other neurological symptoms.(1) Little is known about the clinical course or management of RCVS in the peripartum period. We describe the anesthetic management of a patient with RCVS admitted for induction of labor.

Case: A 29-year-old, G2P1 female with a past medical history notable for migraines and preeclampsia with her first pregnancy developed new onset headache, right sided vision loss, right hand numbness, and word finding difficulty at 26w gestation. MRA study demonstrated possible focal stenosis of the left posterior cerebral artery without evidence of ischemia. After spontaneous resolution of her symptoms, subsequent imaging demonstrated vascular recovery and prompted discharge with nimodipine maintenance therapy.

Patient was admitted at 37w3d for induction of labor for preeclampsia in the setting of recurrent neurological complaints. Magnesium sulfate therapy was initiated given concerns that nimodipine might mask the blood pressure manifestations of preeclampsia. In line with neurology consult recommendations for close hemodynamic control and maintenance of systolic blood pressure between 100-140mmHg, a radial arterial line was placed under ultrasound guidance. An early combined spinal-epidural procedure was performed with intrathecal dosing of bupivacaine 2.5mg and fentanyl 15mcg. Nicardipine infusion was started during the late first stage of labor in response to worsening hypertension with headache, and additional 200-400mcg nicardipine boluses were administered prior to each valsalva during the second stage of labor. A healthy 3150g fetus was delivered vaginally. The patient's post-partum course was notable for a 10-minute episode of monocular visual changes on PPD#1 that resolved spontaneously. Follow-up MRA was stable and transcranial dopplers demonstrated improvement in cerebral blood flow. The patient was discharged on PPD#2 with close follow up.

Discussion: While the pathophysiology of RCVS remains unclear, the relationship between intermittent dysregulated vasoconstriction on symptomatology mirrors that seen with vasospasm after subarachnoid hemorrhage and guided our strategy for intrapartum management. Patients with RCVS are at risk for sudden deterioration, especially in response to hemodynamic swings. In addition to pharmacologic vasodilation and early neuraxial analgesia, our strategy for preventing worsening symptoms included strict hemodynamic stability and euvolemia. Anesthesia presence at bedside throughout the second stage of labor facilitated timely administration of nicardipine boluses and quick response to changing symptomatology. A multidisciplinary approach to patients with RCVS is recommended to characterize the severity of neurological involvement and implications on both mode of delivery and intrapartum care.

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Abstract #: RF4AD-475

Acute Respiratory Failure During Urgent Cesarean Section After Dosing A Previously Functioning Labor Epidural

Presenting Author: Elizabeth A Snow M.D.
Presenting Author's Institution: University of North Carolina - Chapel Hill, NC
Co-Author: Jennifer D Allan M.D. - University of North Carolina
Andres Rojas M.D. - University of North Carolina

Introduction: Acute respiratory failure is a serious perioperative complication for cesarean sections with a wide differential. We will discuss a case of acute respiratory failure during urgent cesarean section, likely from a complication of neuraxial anesthesia.

Case: We discuss the case of a 26 year old G1P0 female at 41 weeks of gestation who developed acute respiratory failure during an urgent cesarean section. The patient was admitted for post dates induction of labor. She requested epidural placement for labor analgesia. Placement was difficult, requiring 4 attempts. The epidural was initially loaded with 14 mL of bupivacaine 0.125% and 50 mcg of fentanyl. The patient required treatment for hypotension 1.5 hours after epidural placement but was otherwise comfortable with an epidural infusion of bupivacaine 0.083% and fentanyl 10 mcg/mL at 12 mL/h. She was taken to the operating room 16 hours after epidural placement for urgent cesarean section due to arrest of descent and a non-reassuring fetal tracing. The epidural was dosed on the way to the operating room with 10 mL of 2% lidocaine with epinephrine and bicarbonate in divided doses following negative aspiration of the catheter. Upon transfer to the OR bed, the patient started to mouth "I can't breathe" without making any sound and holding her hands to her throat. She desaturated to the 60s and became cyanotic and unresponsive. She was mask ventilated and general anesthesia was induced for STAT delivery. Intubation with a C-MAC D blade was unsuccessful and an LMA was placed with adequate ventilation and rapid improvement in saturation. She began initiating breaths 4 minutes after LMA placement. She required methylergonovine maleate and tranexamic acid for uterine atony but remained hemodynamically stable. The remainder of her procedure was uneventful, and the LMA was removed with no issues. She was initially transferred to the SICU following delivery but was quickly moved back to the floor. An extensive workup was undertaken that included non-contributory lab studies, chest radiograph, and transthoracic echocardiogram.

Discussion: Our differential included a high spinal, subdural injection, laryngospasm or other upper airway obstruction, anaphylactoid syndrome of pregnancy, anaphylaxis, and pulmonary embolism. In the absence of any definitive reason for her respiratory failure, we believe that either a dural tear resulting from a challenging epidural placement or subdural placement of the epidural can explain her sudden apnea. The patient's ability to move her arms while being apneic and her rapid recovery of spontaneous ventilation are features that we cannot fully explain but make this case even more challenging and interesting.

During this case presentation, we highlight the differential diagnosis of acute respiratory failure during labor and cesarean section and the airway challenges of pregnancy. We also review the literature and discuss the use of LMAs for cesarean section.

Abstract #: RF4AD-493

Surgical Abortion in the Super Morbid Obese: A Case Report

Presenting Author: Ronvir Sangha MD
Presenting Author's Institution: University of Illinois at Chicago - Chicago, IL
Co-Author: Corinne Weinstein MD - University of Illinois at Chicago
Jacqueline Galvan MD - University of Illinois at Chicago

Introduction: Surgical abortion is among the most common procedures performed in the United States. Traditionally, there has been concern for increased risk of aspiration in parturients past the first trimester, and therefore the need for endotracheal intubation. Recent data has suggested sedation and/or a regional technique to be a safe alternative in pregnant women who are otherwise healthy undergoing this procedure.1 There is conflicting data as to whether this technique may extend to obese women.2 When faced with a patient with multiple risk factors for aspiration and airway complications such as the morbidly obese, those with difficult airways, and an inappropriate NPO status, there is even less data to guide clinical management. We present our approach to the challenges posed by a woman with risk factors for aspiration and difficult airway for elective surgical abortion.

Case Report: Our patient is a 26 yo G2P0 @ 16+5 wga with a PMH of OSA, and class III obesity (BMI 56) presenting for dilation and evacuation. Mallampati class 3 airway was noted on exam. The patient endorsed eating a large meal 5 hours prior to presentation, therefore the decision was made to delay surgery until the full 8 hour fasting period could be observed.

To minimize IV sedation, airway instrumentation, and aspiration, a catheter based neuraxial technique with the ability for titration was selected for anesthesia. Once appropriately NPO, the patient was premedicated with 2mg midazolam and then brought to the OR where an opioid-free CSE technique was performed. 7.5mg of hyperbaric bupivacaine was injected intrathecally, achieving a T-8 level bilaterally. The patient was then sedated with 20mcg dexmedetomidine and a total of 50mcg remifentanil given in divided doses as necessary. The patient was comfortable throughout.

The surgical procedure lasted 40 minutes, requiring dosing of the epidural with 100mg of lidocaine to maintain patient comfort. No surgical or anesthetic complications were noted, and the patient was discharged from the hospital that same day.

Discussion: Surgical abortions for the super-obese parturient present a distinct challenge, particularly from a respiratory standpoint. Over-sedation for this highly emotional procedure can precipitate lost or difficult airway and subsequent aspiration. While sedation with or without a regional technique has been described in low risk populations, there is a paucity of safety data for the super morbidly obese or 2nd trimester elective terminations. We employed an opioid-free lumbar epidural technique to facilitate moderate onset regional anesthesia that provided reliable patient comfort and obviated the need for airway support or instrumentation in this patient with risk factors for difficult airway. This anesthesia technique, along with moderate sedation, can be an excellent alternative to general anesthesia.

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Abstract #: RF4AD-518

Optimizing the Neuraxial Approach in a Patient with a History of Cardiomyopathy and Repeated Hemodynamic Instability during Previous Cesarean Delivery.

Presenting Author: Cory R Deburghgraeve M.D.
Presenting Author's Institution: University of Illinois Chicago - Chicago, Illinois
Co-Author: Heather C Nixon MD - University of Illinois Chicago
Corinne Weinstein MD - University of Illinois Chicago

Introduction: Viral cardiomyopathy results in both direct destruction of cardiomyocytes and an immune dysregulation response which may lead to cardiac failure and significant morbidity. While 50-57% of patients who present with the symptomatology of viral cardiomyopathy spontaneously resolve,14-52% will develop dilated cardiomyopathy although with a 5-year survival of 83%. Parturients with a history of viral cardiomyopathy undergoing cesarean delivery present a unique challenge to the anesthesia provider, as resolution of symptoms does not preclude these patients from subsequent cardiac complications.

Case Presentation: Our patient is a 39 yo G4P2 at 39 weeks with a remote PMH of viral myocarditis. The patient experienced two prior cesarean deliveries which were both complicated by hemodynamic instability including hypotension and ventricular tachycardia following standard doses of intrathecally administered medications. After her second cesarean delivery she suffered an NSTEMI and was found to have an EF of 30-35% with otherwise normal cardiac vasculature via cardiac catheterization. Her LV function recovered subsequently and she remained an NYHA Class I. In preparation for her third cesarean delivery, a multidisciplinary approach was utilized, receiving input from OB/GYN, cardiology, and anesthesia teams. On the day of her planned cesarean delivery, invasive monitoring, vasopressors, cardiac ultrasound and a cardiac defibrillator were readily available. Cardiology was on standby during delivery. For operative anesthesia, an a-line was placed and a dural puncture epidural was utilized with slow and careful titration of 2% lidocaine, epinephrine, and bicarbonate and supplemental fluids and vasopressor boluses. The patient delivered via cesarean uneventfully, with stable vital signs and was monitored post-operatively with telemetry. She was discharged on POD #3 without cardiac dysfunction or symptoms.

Discussion: Parturients with a known history of viral cardiomyopathy may be at significant risk for hemodynamic instability and possible arrhythmia following neuraxial anesthesia. Our patient's history of an NSTEMI, profound hypotension, and acute decompensated heart failure after prior spinal anesthetics necessitated a multidisciplinary approach to her care. In order to mitigate rapid changes in blood pressure and heart rate, we decided to perform a dural puncture epidural with slow and careful titration of neuraxial agents. While this resulted in an uneventful delivery with minimal use of pressors, we were prepared for the treatment of potential hemodynamic collapse. Despite our patient appearing to fully recover normal cardiac function after an episode of acute viral myocarditis, it is possible that the heart may be sensitized to changes during pregnancy and the administration of neuraxial anesthetics potentially leading to significant morbidity and mortality.

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Abstract #: RF5AH-102

Anesthetic Management of a Parturient with Advanced Amyotrophic Lateral Sclerosis Undergoing Dilation and Curettage: A Case Report and Review of the Literature

Presenting Author: Benjamin Morey M.D.
Presenting Author's Institution: UC Davis Medical Center - Sacramento, CA
Co-Author: Cristina Chandler M.D. - UC Davis Medical Center

Background: Amyotrophic lateral sclerosis (ALS) is a progressive neurodegenerative disease that results in > 50% of patients passing away within 3 years of symptom onset. Anesthesia presents a unique challenge, as these patients are susceptible to multiple adverse outcomes. The physiologic changes associated with pregnancy can further increase this risk. Here, we discuss the management of a pregnant woman with ALS presenting for dilatation and curettage (D&C) for an incidental pregnancy.

Case Description: Our patient is a 38-year-old G6P4014 female who presented with abdominal and flank pain. Her history was significant for advanced ALS and recurrent urinary tract infections. She was quadriplegic, and also required the use of BiPAP. Workup confirmed a diagnosis of pyelonephritis and also revealed a 13 week incidental pregnancy. A multidisciplinary team recommended termination of the pregnancy given the substantial risk of exacerbating her already debilitating ALS symptoms. For the case, we opted for para-cervical local anesthesia (30 mL of lidocaine 1%) supplemented with low doses of midazolam and dexmedetomidine. This decision was taken due to our concern for aspiration and post-operative respiratory decompensation with general anesthesia given the patient's bulbar symptoms. The procedure was without incident, and the patient maintained her pre-operative level of comfort and stable vital signs throughout. She had an uneventful post-operative course and was discharged home the next day.

Discussion: Descriptions of ALS in pregnancy are rare, not least because it primarily affects middle-aged males. While neonatal outcomes are generally positive, the same cannot be said of the parturient herself, as patients with advanced ALS have experienced clinical deterioration from the increased ventilatory requirements of pregnancy. While the successful application of both general and neuraxial anesthesia has been reported, there are known risks to both. Post-operative respiratory depression and aspiration remain the chief concerns surrounding general anesthesia, with neurologic injury often precluding neuraxial. In the case of our patient, we have demonstrated a method in which both general and neuraxial anesthetic risks could be avoided. As evidence in favor of any specific anesthetic technique in this population is lacking, continued reliance on multidisciplinary panels is likely the best system for preventing deleterious patient outcomes.

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Abstract #: RF5AH-103

Management of a Parturient with Spinal Muscle Atrophy Type III

Presenting Author: Chantal L . Mendes M.D.
Presenting Author's Institution: Maimonides Medical Center - Brooklyn , NY
Co-Author: Jared Kafer D.O. - Maimonides Medical Center
Kalpana Tyagaraj M.D. - Maimonides Medical Center

Introduction: Spinal Muscle Atrophy (SMA) is an autosomal recessive, neuromuscular disorder associated with degeneration of spinal anterior motor neurons with an incidence of 1/10,000 births. We present a parturient with history of SMA Type III, who underwent a Cesarean section.

Case presentation: We describe the perioperative management of a wheel chair bound 28-year-old female, G1P0, with SMA Type III. History was significant for intrahepatic cholestasis of pregnancy, anemia, controlled asthma, PCOS, and an MRI of the brain revealing multiple white matter plaques, suspicious of multiple sclerosis. Patient had severe thoracic and lumbar dextro-scoliosis and underwent surgical spinal fusion without any instrumentation. Initially, the obstetric care team planned to perform labor induction at 37 weeks gestation for intrahepatic cholestasis of pregnancy. A multidisciplinary discussion was held involving obstetric care team, anesthesiologists and neonatologists, and the decision was made to perform a C-Section in anticipation of difficult vaginal delivery due to her wheel chair bound status and pelvic insufficiency. The patient received spinal anesthesia with hyperbaric bupivacaine and fentanyl. Patchy analgesia existed on the left lower abdominal quadrant which was successfully supplemented with intravenous ketamine. Following C-Section and ligation of left uterine artery, the patient was admitted to surgical intensive care unit for postoperative care. Patient received hydromorphone PCA for pain management. On postpartum day two, she was transferred to the floor and transitioned to oral pain medication. Patient was discharged on postpartum day three.

Discussion: SMA is a genetic defect due to a homozygous deletion of exon 7 in survival motor neuron 1 gene resulting in a lack of SMN protein in spinal anterior motor neurons. Its classification, types 0-IV, is based on age of onset and severity of symptoms. Classic findings include progressive muscle weakness, joint contractures, restrictive pulmonary disease, scoliosis, and dysphagia. Anesthetic management goals include a multidisciplinary discussion for successful outcomes. A comprehensive history and physical exam are essential with complete assessment of pulmonary function, severity of muscle weakness and spinal deformities. If neuraxial anesthesia is planned, previous spinal surgery and severe scoliosis can result in incomplete block. Local anesthetic dose needs to be lowered to prevent a high block, which can worsen compromised respiratory function. If general anesthesia is chosen, difficult intubation due to limited cervical spine mobility, avoiding succinylcholine due to upregulation of acetylcholine receptors and cautious use of nondepolarizing muscle relaxants are anticipated.

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SMA type	Age of onset	Maximum milestones achieved	Natural life span without treatment	Symptoms
SMA 0	Prenatal/birth	No motor	Fatal at Birth	Extreme weakness, ventilator support
SMA I	Birth-6 months	Sits with support	2 years	Rapidly progressive muscle weakness, respiratory failure, hypotonia, Reduced bulbar function
SMA II	6-12 months	Never stands or walks	70% reach adulthood	proximal limb weakness in infancy, Scoliosis, Joint contractures, average or above Intellectual skills
SMA III	>18 months	Stands	Normal	proximal weakness in childhood, scoliosis, lumbar lordosis, increased risk for fractures
SMA IV	>30 years	Normal	Normal	proximal leg weakness in adulthood

Abstract #: RF5AH-165

Postdural Puncture Headache Or Cerebral Venous Thrombosis?: A Headache For Anesthesiologist

Presenting Author: Vrajesh Mehta MD
Presenting Author's Institution: Rutgers Robert Wood Johnson Medical School - New Brunswick, NJ
Co-Author: Ushma Thomas MD - Rutgers Robert Wood Johnson Medical School
Shaul Cohen MD - Rutgers Robert Wood Johnson Medical School
Danielle Levin BA - Rutgers Robert Wood Johnson Medical School

Introduction: Headaches are a common neurological complain during pregnancy and the postpartum period. About 90% of headaches are primary and benign, but some rare types of headaches can be life-threatening and difficult to diagnosis. When a woman develops a positional headache after an inadvertent dural puncture, she often receives post-dural-puncture headache (PDPH) management. However, it is also important to consider the possibility of Dural venous sinus thrombosis (DVST), a cerebrovascular disease that may present with a headache, affecting approximately 0.002% of women, and accounting for 0.5% of strokes. This is the first report of a woman experiencing partial headache relief following sphenopalatine ganglion block (SPGB) and epidural blood patch (EBP) treatments and then being readmitted two days later with right-sided paralysis. Written informed consent was obtained from the patient for publication of this report.

Case description: A 23-year-old woman at 39 weeks' gestation underwent epidural placement for labor analgesia. CSF was aspirated on the first attempt and the needle was reinserted at L3-L4. She had an uneventful delivery of a healthy male infant approximately 4 hours after catheter insertion. On postpartum day (PPD1), she reported a positional headache worse in the posterior region associated with nausea only. Oral medications, including Acetaminophen/Butalbital/Caffeine, SPGB and EBP treatments provided minimum relief. She was discharged on PPD 3 after reporting moderate symptom relief with oxycodone-acetaminophen. Several hours later, she presented to ED with a severe headache, and word finding difficulty. Non-contrast CT head was negative, and she received IV morphine and was discharged. About 24 hours after ED discharge, she presented to the ED with similar symptoms and new right-sided weakness. On physical exam, she had minimal strength in her right upper and lower extremities. A repeat head CT revealed multiple thrombi in the cerebral venous and arterial systems. She was started on IV heparin for anticoagulation and her weakness and headache improved dramatically. She was discharged to rehabilitation center four days after treatment with IV heparin.

Discussion: This case emphasizes the importance of including DVST in the differential diagnosis of a headache after a dural puncture in the puerperium not responding to standard treatments. Such a diagnosis requires a high clinical suspicion. DVST in this patient can be attributed to the post-partum hypercoagulable state.

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Abstract #: RF5AH-165

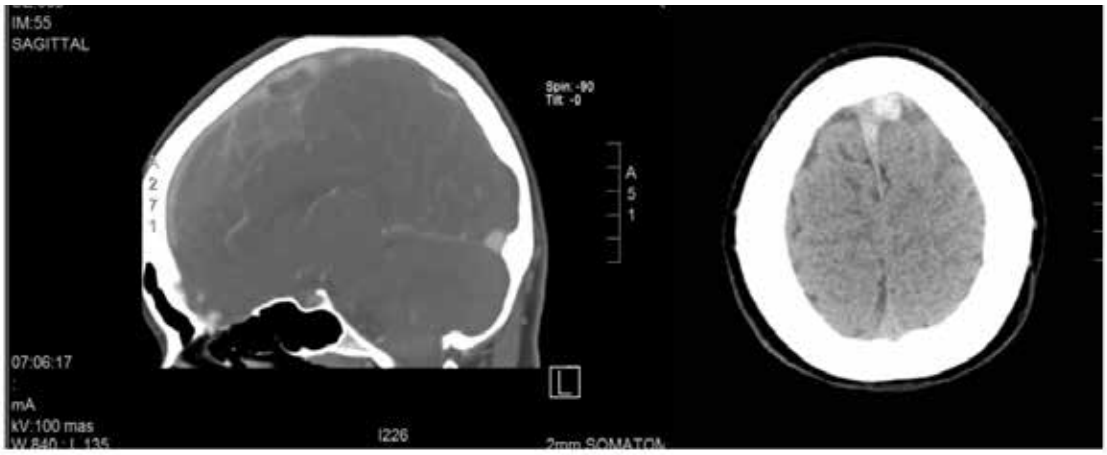


Fig 1,2 . CT scan of head (sagittal and axial views) with contrast showing thrombus extending in superior sagittat sinus

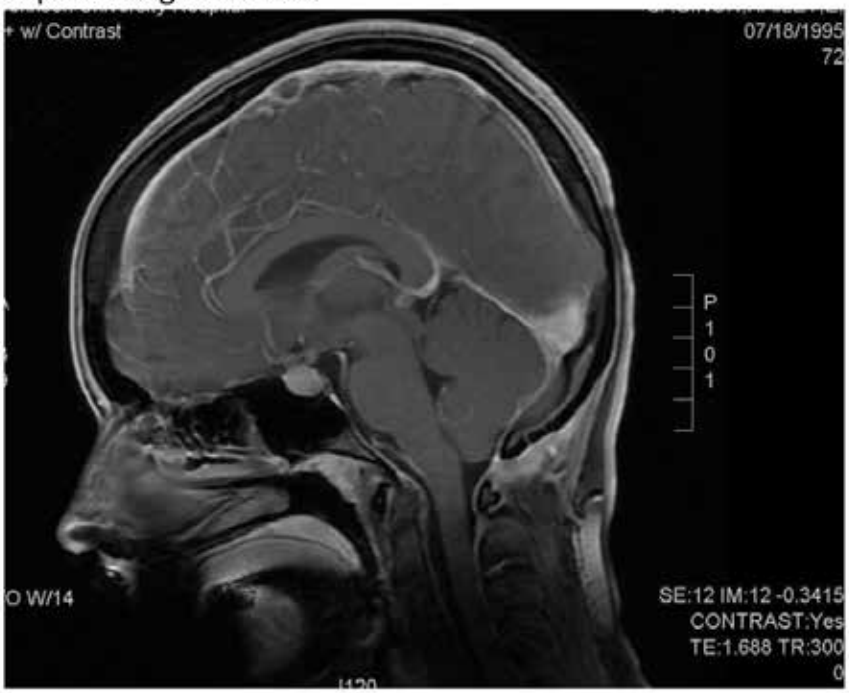


Fig 3: MRI of head with contrast (sagittal view) showing thrombus in Superior sagittal sinus

Abstract #: RF5AH-188

A Case of Post- partum Sub Dural Hematoma (SDH) : A Diagnostic Dilemma Following Epidural Analgesia… Is Epidural the Cause?

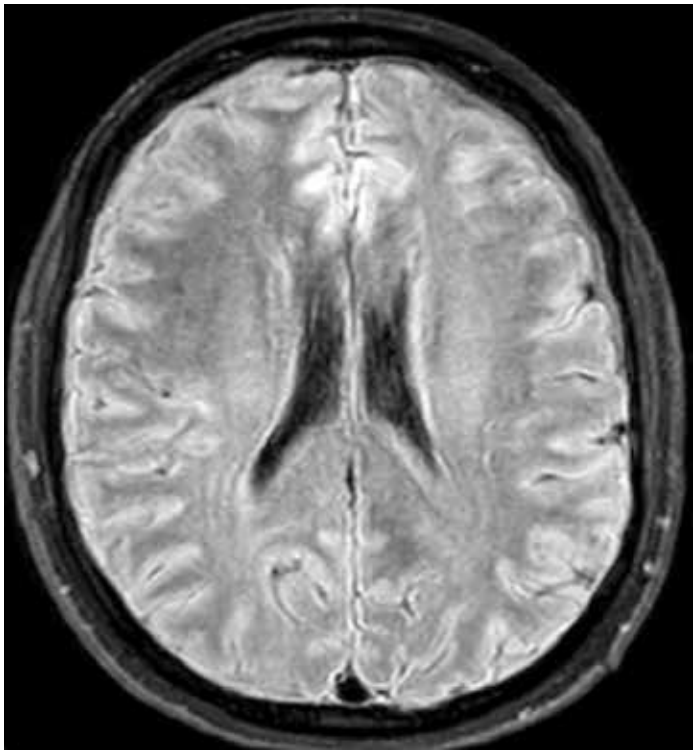
Presenting Author: Mercades Meuli D.O
Presenting Author's Institution: Albany Medical Center - Albany, New York
Co-Author: Manju Prasad MD - Albany Medical Center
Cheryl Desimone MD - Albany Medical Center

Post-partum headaches are a common entity encountered in obstetric patients. In the setting of epidural analgesia, often the most common cause of headache is often attributed to be a PDPH.

Acute SDH is attributed to rupture of bridging cerebral veins. Predisposing factors could be a previous history of head trauma, decrease in CSF pressure with dural puncture, post-op hypotension and physiologic increase in venous pressure such as while coughing, defecating or pushing during a vaginal delivery.

We present a case of an essential prima gravida patient with previous history of head trauma and thoraco-lumbar spinal surgery who developed a headache after her delivery. She had an uneventful labor epidural for her vaginal delivery but did have a prolonged second stage of active labor. Four hours after her delivery, she complained of a significant headache. Although the headache was atypical and non-positional in nature it was initially assumed to be a PDPH. The symptoms were refractory to conservative management and was compounded by the patient's refusal of certain medications. Due to severe persistent headache, neurology was consulted and an MRI was obtained which demonstrated bilateral subdural hematomas. Neurosurgery was consulted and non-surgical intervention was indicated.

In the setting of an epidural, the most common cause of headache is a often a PDPH. In the presence of an atypical postpartum headache following an uneventful epidural analgesia, the anesthesiologist should consider other intracranial etiologies and should seek immediate clinical and radiologic diagnoses. We will discuss anesthetic consideration of this patient, the differential diagnosis of postpartum headache and the predisposing factors for a subdural hematoma.



Abstract #: RF5AH-196

Just a C/S in a morbidly obese patient, What about her strokes, heparin and bad heart valve?

Presenting Author: Riley J Woolford DO
Presenting Author's Institution: University of Kentucky - Lexington, Kentucky
Co-Author: Lauren Hampton MD - University of Kentucky
Regina Fragneto MD - University of Kentucky

A 35-year-old morbidly obese (177 kg) woman, G1P0, at 26 weeks gestation, presented to triage after an ultrasound showed absent end diastolic flow. A repeat ultrasound confirmed this diagnosis and the patient was admitted to L&D where magnesium and antenatal corticosteroids were started. The patient's medical history was complex. In 2004 the patient was diagnosed with rheumatic heart disease and underwent a mechanical mitral valve replacement. In the following years, she had multiple ischemic strokes resulting from non-compliance with anticoagulation. In October of 2018, a large thrombus was found on her mitral valve which caused critical mitral stenosis, acute diastolic heart failure and a new stroke. It was deemed necessary at this time for the patient to undergo a redo-mitral mechanical valve replacement at 12 weeks gestation. The patient was admitted again in November 2018 for atrial flutter which required multiple cardioversions and initiation of metoprolol and flecainide. On admission to L&D cardiology was consulted for management of anticoagulation and a heparin drip was started. She reported good fetal movement and her fetal tracings were category 1. Over the following week, fetal tracings worsened with multiple prolonged decelerations. A multidisciplinary meeting was held, and it was agreed that the safest plan for the patient and baby would be a primary cesarean delivery under general anesthesia. Anticoagulation was discontinued for 6 hours and anti-Xa and PTT laboratory values returned to normal. On hospital day six the patient was taken to the operating room where an awake arterial line, central line and pulmonary artery catheter were inserted. A cardiac anesthesiologist was present during insertion of lines and induction of anesthesia and a cardiothoracic surgeon was available in case advance circulatory support was needed. The patient was started on a norepinephrine drip and the patient was induced with propofol, ketamine and etomidate. She received succinylcholine and a secure airway was obtained by way of video laryngoscopy. The patient tolerated induction and incision well, with no hemodynamic issues. The obstetricians were able to dissect down to the uterus with little bleeding and a viable baby boy was delivered. On delivery of the placenta, the patient became hypertensive and her pulmonary artery pressures became severely elevated. The patient was given a dose of milrinone and over the next 10 minutes her pulmonary pressures equalized to baseline. The obstetricians were able to control hemostasis quickly and closed the uterus and abdomen with no significant complications. At the end of the case, she was reversed with glycopyrrolate and neostigmine and was transitioned to pressure support ventilation. The patient was found to meet extubation criteria and was extubated in the OR with no pulmonary complications. The patient was taken to the CVICU for further monitoring and was able to leave the ICU the following day.

Abstract #: RF5AH-200

Postpartum Subarachnoid Hemorrhage in a Patient with History of Migraines and Seizures

Presenting Author: Jebran Haddad M.D.
Presenting Author's Institution: Baylor College of Medicine - Houston, TX
Co-Author: Amy Lee M.D. - Baylor College of Medicine

Case Report: An 18-year-old G1P0 at 38 weeks gestation with history of migraines and epilepsy was admitted for category II fetal heart tracing and planned induction. She soon developed an unrelenting headache with elevated blood pressures and a magnesium infusion was started for seizure prophylaxis. An epidural was placed after multiple attempts without immediate complication for labor analgesia. The headache persisted with minimal improvement despite pharmacological intervention and she had one episode of emesis. After vaginal delivery she developed postpartum hemorrhage treated with oxytocin, misoprostol and carboprost. Her headache suddenly worsened and developed right-sided facial droop, ptosis and blood pressure of 180/110 controlled with IV boluses of labetalol and hydralazine as well as nicardipine infusion. A CT scan showed a small subarachnoid hemorrhage over the left parietal area. Angiography showed no evidence of aneurysms or arterio-venous malformations. Repeat CT showed stable SAH and magnetic resonance venogram negative for venous sinus thrombosis. She was discharged the fourth day postpartum after resolution of symptoms. The patient denied severe headaches at her three-month follow-up with neurology but reported word-finding difficulty, new-onset stuttering and forgetfulness. The neurologist noted slight right-arm pronator drift and scheduled no further follow-up, expecting self-resolution. Her symptoms completely resolved with no evidence of hypertensive disease at 8 months.

Discussion: The incidence of subarachnoid hemorrhage (SAH) is estimated at 4-10/100,000 pregnancies with a 10-fold increase in pre-eclampsia and accounts for roughly 15% of maternal deaths(1–3) Patients typically present with a sudden onset "thunderclap" headache that must be immediately recognized. Prompt neurosurgical, hemodynamic and obstetric interventions are necessary to reduce the risk of maternal death and permanent neurological injury. We use this case to highlight the key feature of malignant headaches and to educate providers on the evidence suggesting history pre-eclampsia as an independent risk factor for future hypertension, cerebrovascular accidents, and ischemic heart disease (1-4).

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Abstract #: RF5AH-258

Cervicothoracic Synringomyelia in a Parturient

Presenting Author: Gustavo Diaz-Mercado MD
Presenting Author's Institution: Ochsner Health System - New Orleans, LA
Co-Author: Colleen Martel MD - Ochsner Health System
Roneisha McLendon MD, MS - Ochsner Health System

Introduction: Syringomyelia is characterized by the formation of one or more expanding fluid-filled cavities within the spinal cord. Due to its rarity and associated neurological conditions, there is a lack of consensus regarding its anesthetic management during labor and delivery1. We present a case of a parturient with syringomyelia.

Case Report: A 31 yo G2P1 with known diagnosis of cervicothoracic syringomyelia presented for obstetric anesthesia consultation at 22 weeks EGA with symptoms of upper back pain, left upper extremity paresthesia with loss of temperature sensation and intermittent left lower extremity paresthesia. In her previous pregnancy, she had a cesarean delivery at term due to failure to progress in labor. General anesthesia was performed due to the concern for neurologic symptom exacerbation with CSF and intracranial pressure fluctuations from neuraxial anesthetics. Postpartum evaluation with Neurosurgery revealed mild improvement in syrinx size on interval MRI (Fig. 1).

She was again pregnant seven months later and surgical intervention was postponed due to imaging improvement, symptom profile and risk-benefit stratification. In the interim new literature had been published supporting the safety of neuraxial anesthesia in these patients and neurosurgery agreed with this plan for her delivery2.

The patient presented at 39 3/7 weeks EGA for elective repeat cesarean delivery with plans for neuraxial anesthesia via combined spinal-epidural. Neuraxial placement was technically difficult with inadvertent intrathecal catheter placement. The catheter was dosed and utilized for delivery without intraoperative complications. Her postoperative course was complicated by a post-dural puncture headache on POD#3, which resolved with conservative therapy. The patient was discharged in stable condition without neurological symptom exacerbation on POD#4.

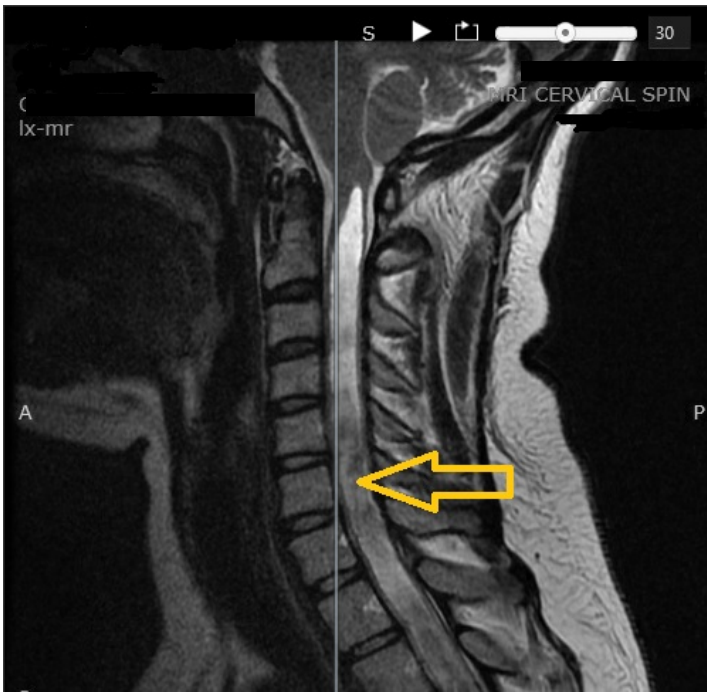

Figure 1. Cervical syrinx

Discussion: Due to its rare occurrence, anesthetic management of syringomyelia in the parturient remains controversial. Despite the lack of extensive literature support, neuraxial anesthetic safety has been limited only to case reports and small retrospective case series; however, no major neurologic complications have been reported1,3. As demonstrated in this case, neuraxial anesthetics were used safely without any neurologic complications, despite inadvertent intrathecal catheter placement.

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Abstract #: RF5AH-323

An opioid-free cesarean delivery in the opioid addicted parturient with the use of the quadratus lumborum block: A Case Report

Presenting Author: Justin C Swengel MD
Presenting Author's Institution: University of Tennessee - Knoxville, Tennessee
Co-Author: Craig Towers MD - University of Tennessee
Carrie Polin MD - University of Tennessee

An opioid-free cesarean delivery in the opioid addicted parturient with the use of the quadratus lumborum block: A Case Report

Opioid addiction is a major issue affecting many parturients across the United States. Classic thoughts on opioid abuse in pregnancy led to the practice of maintaining parturients on opioid therapy, however, more recent studies have shown parturients can successfully be weaned off opioids without risk to the mother or fetus.[1] At our institution, many parturients who are weaned from opioids are transitioned to naltrexone maintenance therapy. These patients desire to remain opioid free after cesarean delivery in order to prevent relapse; however historically have required opioids to manage their pain postoperatively. The quadratus lumborum block (QL block) has been shown to provide postoperative analgesia following cesarean delivery.[2] These case reports demonstrate patients on naltrexone maintenance therapy who received a QL block in addition to multimodal analgesia for postoperative pain management.

Case 1: A 38 y/o G5P3 at 39 weeks gestation presented for repeat cesarean delivery with bilateral tubal ligation. Her medical history included obesity (BMI 44) and prior opioid abuse being maintained on naltrexone 50mg daily. For her cesarean delivery, she received a spinal anesthetic with 12mg bupivacaine, 15mcg fentanyl, 150mcg of morphine, and 60mcg clonidine. At the end of the case, bilateral QL blocks were placed with 30cc (each side) of 0.33% ropivicaine. In the postoperative period, the patient's pain was controlled with scheduled acetaminophen, ketorolac and ibuprofen. No opioids were utilized in post-operative period and the patient was able to receive intramuscular naltrexone prior to discharge.

Case 2: A 27 y/o G5P4 at 39 weeks gestation presented for repeat cesarean delivery with bilateral tubal ligation. Her medical history was pertinent for depression, GERD, anemia, and prior substance abuse on maintenance naltrexone 50mg daily. She underwent a spinal anesthetic with 12mg bupivacaine, 15mcg fentanyl, 150mcg morphine, and 60mcg clonidine. At the end of the surgical case, the patient received bilateral QL blocks with 30cc (each side) of 0.33% ropivicaine. Her postoperative pain was managed with ketorolac, ibuprofen, and acetaminophen. At the end of her hospital stay, the patient was reinitiated on her naltrexone and was able to receive intramuscular naltrexone prior to leaving the hospital.

These two cases illustrate the use of QL blocks to allow parturients on naltrexone maintenance therapy to remain opioid free in the perioperative period after major abdominal surgery. In this patient population, avoiding opioids during this time period can allow continuation of their naltrexone with possible prevention of relapse into drug abuse.

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Abstract #: RF5AH-343

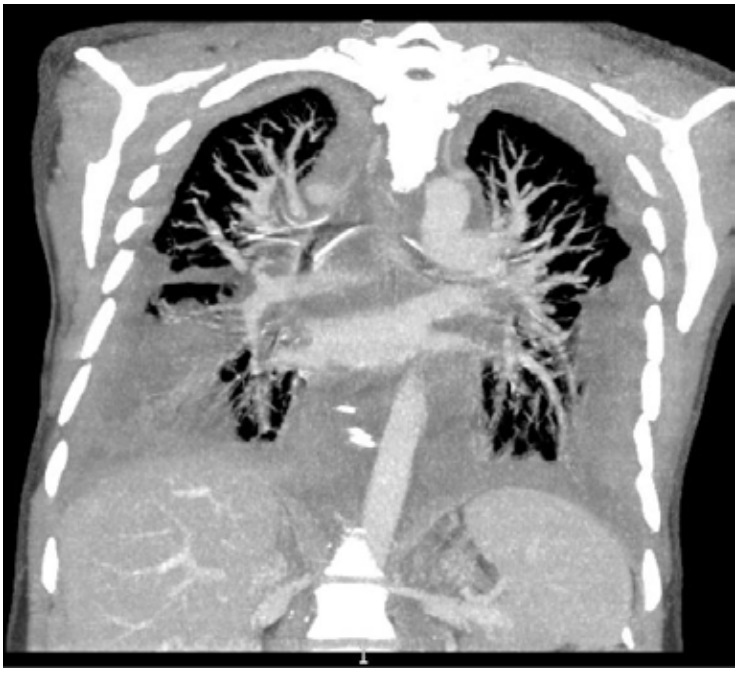
Peripartum Management of a Patient with Symptomatic Lymphangiomatosis

Presenting Author: Brooke LeBlanc MD
Presenting Author's Institution: Ochsner Medical Center - Jefferson, Louisiana
Co-Author: Scott Rooney MD - Ochsner Medical Center
Adrienne Ray MD - Ochsner Medical Center

Introduction: Lymphangiomatosis (LYMF) is a rare disease of abnormal lymphatic development with multiorgan involvement. We report a case of a patient with LYMF who presented with worsening disease progression during pregnancy.

Case presentation: The patient is a 29 year old G2P1 with known LYMF who presented at 31 6/7 weeks EGA with worsening dyspnea, hypofibrinogenemia, and thrombocytopenia. She was hypoxemic with SpO2 90% on room air on admission and was placed on BiPAP. Her clinical picture failed to improve after 48 hours and decision was made to proceed with cesarean delivery. On the day of surgery, platelets were 61K and fibrinogen was 134 mg/dL. 1 dose of platelets was transfused preoperatively and spinal anesthesia was performed. The patient was ramped at 30 degrees and placed on continuous BiPAP throughout the case. She received 40mg of furosemide IV with judicious fluid administration intraoperatively. She tolerated the procedure well and delivered a viable female infant. She was transported back to the ICU in stable condition and was weaned from BiPAP on POD #1. Her post-surgical course was complicated by multiple factors including wound dehiscence requiring wound exploration on POD #5, hypofibinogenemia and anemia requiring transfusion of cryoprecipitate and pRBCs, and worsening dyspnea requiring diuresis. She was discharged home on POD #6 but returned on POD #9 with respiratory distress and low grade fever. She was hospitalized for 21 days treating her acute on chronic respiratory failure. CT revealed bilateral pleural and interstitial septal thickening, worse than previous scan. Hypoxia was presumed secondary to disease progression, and she was discharged with supplemental oxygen and BiPAP at night.

Discussion: There are multiple variants of LYMF and a rarer, more aggressive variant, Kaposiform Lymphangiomatosis, (KLA) has been described. KLA demonstrates parenchymal involvement, hematologic abnormalities, and hemorrhagic symptoms. It is a generalized lymphatic anomaly with an abnormal coagulation profile resembling that of DIC. Although our patient has a diagnosis of LYMF, type unspecified, her clinical course does certainly resemble that of KLA. Regardless of specific diagnosis, LYMF can have many anesthetic implications. With no standard treatment, any management plan would be experimental, aimed at reducing symptoms associated with effusions and coagulopathic derangements.



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Abstract #: RF5AH-357

Slowly Titrated Spinal Anesthesia for Cesarean Delivery (CD) in a Super-Morbidly Obese Parturient with Peripartum Cardiomyopathy

Presenting Author: Stefan R Trela MD
Presenting Author's Institution: Geisinger Medical Center - Danville, PA
Co-Author: Pankaj Jain MD - Geisinger Medical Center

Peripartum cardiomyopathy and super-morbid obesity are associated with significant morbidity in pregnancy. There are few cases reporting the use of spinal catheters for CD in patients with heart disease or morbid obesity (1-4). We report on the use of slowly titrated spinal anesthesia in a super-morbidly obese patient who presented with peripartum cardiomyopathy at risk for acute decompensation requiring repeat CD.

A 28 year-old G2P1 female, at 36 weeks and 5 days gestation, presented after a fall. The patient had reassuring fetal status, however, she also reported dyspnea over the last month. Medical history included hypertension, asthma, tobacco use, super-morbid obesity (BMI 81), gestational diabetes mellitus type A2, and previous CD for failure to progress. Physical exam was significant for dyspnea, excessive somnolence, snoring, and wheezing. A chest CT showed a massively dilated main pulmonary artery with right heart dilation, concerning for pulmonary hypertension. TTE showed an ejection fraction of 30-34% compared to 60-64% at 28 weeks gestation suggestive of peripartum cardiomyopathy. A multidisciplinary meeting with obstetrics, maternal-fetal medicine, anesthesiology, and critical care teams recommended CD at 37 weeks. A radial arterial line was placed. A spinal catheter was inserted at L3-4 level and confirmed by CSF aspiration. 20mcg fentanyl and 0.1mg morphine were injected intrathecally and 0.25% isobaric bupivacaine was titrated slowly using 0.5mg boluses every minute over 20 minutes (total 10mg) to achieve a T4 sensory level. An additional 1.25mg of 0.25% bupivacaine was injected over 3 minutes 20 minutes later. Phenylephrine and epinephrine infusions were titrated as needed. Total IV fluids were 450ml. Postoperative course was uneventful.

Peripartum cardiomyopathy is defined as development of heart failure between 1 month before delivery and 5 months postpartum in patients without prior heart disease and in the absence of another cause of heart failure. We chose to slowly titrate local anesthetic to avoid spinal-induced hypotension. Phenylephrine and epinephrine were used for hemodynamic and inotropic support and to prevent worsening of pulmonary hypertension. This case presents an alternative method of anesthesia for CD in high risk patients with heart disease and morbid obesity.

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Abstract #: RF5AH-99

Previously Undiagnosed Intraoperative Placenta Increta in a Patient With Atypical Von Willebrand Disease

Presenting Author: David A Gutman M.D.
Presenting Author's Institution: Medical University of South Carolina - Charleston, SC
Co-Author: Anne Wanaselja M.D. - Medical University of South Carolina
Maxie Phillips D.O. - Medical University of South Carolina

Introduction: Morbidly adherent placentation is associated with maternal morbidity including massive blood loss, intraoperative hysterectomy, and prolonged hospitalizations. Risk factors include placenta previa, prior cesarean deliveries, advanced maternal age, and uterine surgeries. When diagnosed antenatally, these cases typically require additional resources and preparation including large bore intravenous access for massive transfusion, additional personnel, cell savage, and various other resources.

Case Report: An obese 40 year old G9P5 female at 34w6d with history of Von Willebrand disease, 4 previous c-sections, and type 2 diabetes mellitus presented for repeat cesarean in setting of worsening diabetes and polyhydramnios. She was given one dose of DDAVP preoperatively, a combined spinal/epidural anesthetic was placed, and appropriate T4 level was achieved. Soon after incision, the surgeons unexpectedly found a previously undiagnosed placenta increta. A brief intra-op huddle was conducted, additional help was called and the appropriate resources were procured.

During the 30 minutes that it took Gyn-Onc to arrive, the baby was monitored in sterile fashion via trans-uteral ultrasound, an awake right internal jugular introducer was inserted, a radial arterial line was placed, a rapid infuser was brought in and assembled, and 2 units of PRBCs were pre-emptively administered. Induction of general anesthesia occurred just prior to hysterotomy, and the baby was promptly delivered. Massive blood loss was encountered necessitating activation of the massive transfusion protocol. Uterotonics were administered without much improvement and Tranexamic acid was given. Hematology was consulted intraoperatively who recommended Antihemophilic Factor / VWF Complex be given. Total EBL was 10 liters and a total of 43 units of blood products were transfused through the newly placed lines. At the end of the case, the abdomen was packed due to swelling and the patient was transported to the STICU intubated but off vasopressors. She went back for surgical closure 2 days later and was extubated shortly after.

Discussion: With the rate of cesareans increasing nationwide, we are seeing an increase in rates of morbidly adherent placentation. This increases the challenge on the obstetricians and anesthesiologists taking care of these patients while also increasing the rate of patient morbidity and mortality. Diagnosis prior to hysterotomy can provide time to obtain adequate access and obtain additional personnel and blood products.

Conclusion: Clinicians should remain vigilant to the possibility of morbidly adherent placentation when patients have risk factors, even in the setting of negative ultrasound findings and should be able to formulate a new plan intraoperatively should the diagnosis be made then.

Abstract #: RF6AI-108

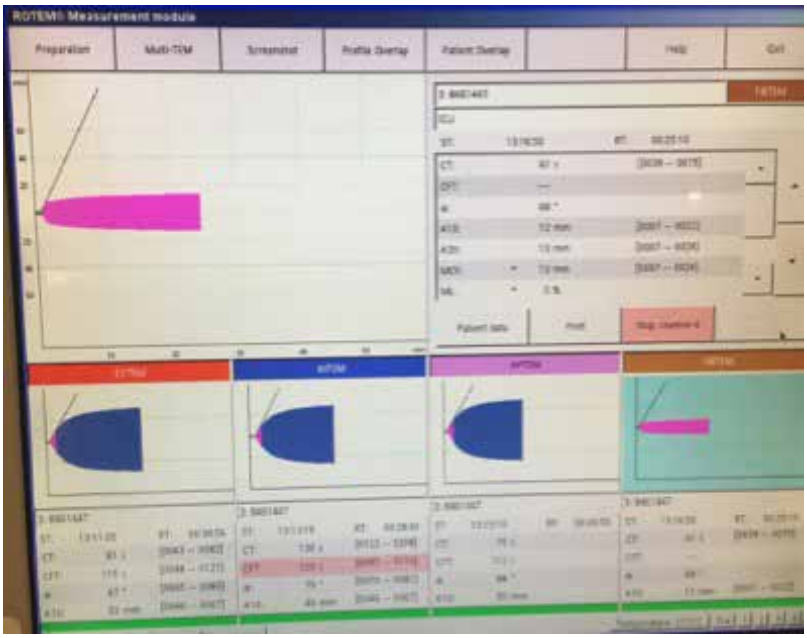
Utility of ROTEM results in a patient with biphasic bleeding during Cesarean hysterectomy for placenta perceta

Presenting Author: Rebecca Havlir Martinez MD
Presenting Author's Institution: Columbia University Medical Center and New York Presbyterian Hospital - New York, NY
Co-Author: Xiwen Zheng MD - Columbia/NYP
Lawrence Ring MD - Columbia/NYP

A 31-year-old G4P3 woman 3 prior cesarean deliveries and imagining suggestive of placenta percreta presented at 32 weeks' gestational age for cesarean section. In preparation for delivery, a combined spinal epidural, central venous line, and an arterial line were placed. An Interventional Radiology team placed inflatable catheters in the internal iliac arteries and a Urology team placed ureteral stents. With exposure of the uterus, the surgical team noted extensive placenta percreta, involving both broad ligaments, with strong suspicion of left sided pelvic sidewall involvement. Delivery was uncomplicated, but immediately after, large volume of blood loss occured. The patient was dosed with tranexamic acid and the internal iliac artery balloons were inflated. She was placed on high dose vasopressor infusions and rapid transfusion was initiated expeditiously.

After 37 minutes, 6 units of RBCs and FFP were transfused, surgical hemostasis appeared to be achieved, and pressor requirements decreased. However, more bleeding was expected; the hysterectomy had not been completed, and the site of the most significant placental invasion remained in situ. In standard massive transfusion protocol, a 6-pack of platelets was administered. A simultaneous ROTEM performed suggested normal clotting parameters (Figure 1). Indeed, with complete resection of the uterus, the patient experienced a second instance of postpartum hemorrhage. Transfusions and vasopressors were reinitiated to good effect. The patient received 2 units more of FFP and RBCs. At the conclusion of the case, she was transferred to the SICU. She was discharged home on POD#6.

Placenta percreta patients are at risk for hemorrhage, the etiology of which may evolve during the course of the surgery leading to multiple phases of bleeding (1, 2). Multi-phasic bleeding can be from arterial bleeding, venous oozing, or consumptive coagulopathy among other etiologies. Times of decreased hemorrhage should cue evaluation of the adequacy of transfusion. In this case, ROTEM results between times of profuse bleeding helped guide resuscitation and assure our readiness for an expected repeat bleed. In cases where significant bleeding is encountered, the option to evaluate the efficacy of transfusion efforts via ROTEM is a useful tool clinicians have at their disposal(3).



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Abstract #: RF6AI-124

Ruptured Appendicitis in the Parturient

Presenting Author: Mackenzie S Laurila DO
Presenting Author's Institution: University of Nebraska Medical Center - Omaha, Nebraska
Co-Author: James Sullivan MD - Associate professor
Cathleen Peterson-Layne MD, PhD - Chief division of obstetric anesthesiology, program director obstetric anesthesiology fellowship

Acute appendicitis occurs in approximately 1/500 pregnancies, making it the most common non-obstetric surgical problem encountered in pregnancy. Of these patients, 20% will develop peritonitis, which increases their risk of preterm delivery to 34.5%. This is a report of a 32 year old parturient with successful VBAC whose pregnancy was complicated by antepartum surgical treatment for ruptured appendicitis at 31 weeks gestation. In addition to purulent peritonitis, her clinical course was significant for metabolic acidosis (pH 7.02) consistent with a state of starvation in the setting of acute abdomen.

At 31 weeks gestation patient presented to an outside hospital with abdominal pain and was discharged with diagnosis of gastritis. Three days later she returned with worsening symptoms. Upon diagnosis of appendicitis she was transferred to our tertiary medical center. Assessment was concerning for ruptured appendicitis. Symptoms included chills, nausea, vomiting, and abdominal pain due to irregular contractions. History significant for poorly controlled reflux, tobacco use, and palpitations with no formal diagnosis due to lack of insurance. Obstetric history included two spontaneous vaginal deliveries and one cesarean delivery for prolapsed umbilical cord. Physical exam notable for a Mallampati III. Pulse 92, blood pressure 127/72, afebrile. Initially, the general surgery team planned for non-operative management with intravenous antibiotics. After discussion with the obstetric team, it was later agreed that she should go to the operating room for an open appendectomy with continuous monitoring of fetal heart rate and uterine activity. Obstetrics and NICU were on standby in case fetal status was non-reassuring and a stat cesarean section was indicated. Anesthetic plan included a rapid sequence induction with 200 mg propofol (titrated), 250 mcg fentanyl, and 100 mg succinylcholine. Video laryngoscopy was performed with a D blade, arytenoids visualized. 6.5 mm endotracheal tube placed. Maintained with sevoflurane (0.5 MAC) with 50:50 nitrous oxide and oxygen, and rocuronium; BIS was 36-42. Following intubation, ETCO2 21 mmHg; tidal volume 490 mL, respiratory rate 14. Radial arterial line placed for lab draws. Initial intraoperative labs significant for pH 7.02, base deficit 20.8, consistent with metabolic acidosis. During the 2.5 hour procedure, urine output 30 mL, EBL minimal, crystalloid 2.8 L. Surgical findings consistent with ruptured appendicitis, accounting for sepsis. The patient was transferred to the SICU intubated and sedated. Post operative labs significant for lactic acid of 0.7 mmol/L and beta hydroxybutyric acid 4.6 mmol/L revealing a mixed acidosis secondary to a combination of sepsis and starvation ketoacidosis. Transferred out of SICU POD# 1, discharged from hospital POD# 12; returned six days later in preterm labor at 33 weeks 5 days for uncomplicated spontaneous vaginal delivery of healthy neonate.

Abstract #: RF6AI-148

Two Life-Threatening Cases of Subcapsular Liver Hematoma in Parturients

Presenting Author: Merry Colella MD
Presenting Author's Institution: Beth Israel Deaconess Medical Center - Boston, MA
Co-Author: Lior Levy MD - Beth Israel Deaconess Medical Center
Bijan Teja MD - University of Toronto
Yunping Li MD - Beth Israel Deaconess Medical Center
Philip Hess MD - Beth Israel Deaconess Medical Center

Introduction: HELLP (Hemolysis, Elevated Liver enzymes, and Low Platelet count) syndrome is considered to be a complication of preeclampsia (PEC). 0.9% of patients with HELLP develop subcapsular liver hematoma (SLH), a life-threatening complication (1).We present two cases of SLH due to PEC.

Case #1: A 41-year-old woman was admitted at 30 weeks gestation for complete placenta previa and PEC. On day 4, she developed severe range pressures, transaminitis, and right upper quadrant (RUQ) pain. Bedside abdominal ultrasound was unremarkable. An urgent cesarean section (CS) was performed without issue. Within two hours, she became severely hypotensive, with a hematocrit drop from 36.7 to 20. Repeat ultrasound by the anesthesia team showed free abdominal fluid concerning for ruptured SLH. Massive transfusion protocol was activated, and trauma surgery performed an emergent laparotomy, hematoma evacuation and packing. She recovered uneventfully and was discharged on postpartum day 9.

Case #2: A 34-year-old woman at 39 weeks gestation admitted in labor reported new RUQ pain, prompting a diagnosis of severe PEC. RUQ and shoulder pain persisted despite placement of a labor epidural, leading to a bedside ultrasound by the anesthesiologist, revealing a large SLH (Fig.1). Her hematocrit quickly dropped from 35.7 to 28.3, with worsening transaminitis. A formal ultrasound showed a 800 mL hematoma in the right hepatic lobe. Massive transfusion protocol was activated, and trauma surgery performed an emergent laparotomy and hematoma evacuation, revealing liver capsular defects and a one liter hemoperitoneum. A CS was then performed. Her total estimated blood loss was 5L. Postpartum course was uneventful and she was discharge on day 6.

Discussion: SLH occurs in patients with PEC and/or HELLP syndrome when blood accumulates between the liver parenchyma and the capsule of Glisson. Maternal mortality in SLH rupture may be as high as 50% (2). Patients typically present in the third trimester with nonspecific findings, including RUQ pain, transaminitis, and anemia. Stable patients can be managed conservatively, but urgent surgery is required if unstable. High suspicion by the anesthesia provider can prompt early diagnosis, with bedside ultrasound as a valuable, noninvasive tool for timely recognition.

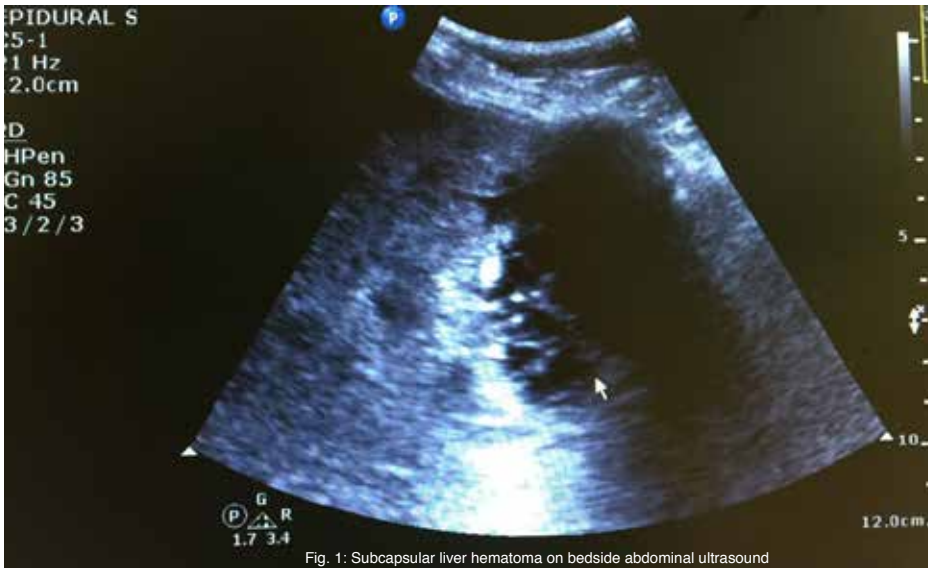

Fig. 1: Subcapsular liver hematoma on bedside abdominal ultrasound

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Abstract #: RF6AI-150

MEDICAL TERMINATION OF PREGNANCY IN THE PRIMARY PULMONARY HYPERTENSION SETTING: UNIQUE CONSIDERATIONS OF OPIOID-ONLY SPINAL ANESTHESIA

Presenting Author: GAURAV CHAUHAN MD
Presenting Author's Institution: HERY FORD HEALTH SYSTEM - DETROIT, MICHIGAN
Co-Author: JOSHUA D YOUNGER MD - Henry Ford HEALTH SYSTEM
DONALD HENRY PENNING MD - Henry Ford HEALTH SYSTEM
AMI Y ATTALI DO - Henry Ford HEALTH SYSTEM

INTRODUCTION: Pregnancy-induced pathophysiological changes exacerbate a parturient's pulmonary hypertension (PH) PH, It has significant negative effect on most organ systems but specifically, the patient's cardiopulmonary well-being.1 This case demonstrates the successful management of a dilation and curettage at 10 weeks of gestation, in a patient with idiopathic PH, which was complicated by uterine atony leading to a significant hemorrhage.

CASE: A 22-year old- G-P- at 10 weeks gestation and a known history of idiopathic PH presented for elective termination of pregnancy. She was diagnosed with idiopathic PH during her previous pregnancy three years back. The patient was prescribed 3 liters. min-1 of home oxygen by nasal cannula at night time and was being considered for eventual heart and lung transplantation. The patient presented with mild to moderate dyspnea and orthopnea. Her vital signs were a heart rate of 70 beats/min, blood pressure of 100/60 mmHg, respiratory rate of 20 breaths/min with an oxygen saturation of 92% on 3L. min-1 via nasal cannula. A spinal anesthetic using just 25mcg of fentanyl was instilled at the L3-4 interspace using a 27-gauge pencil-point needle. She was then placed in stirrups in the lithotomy position and a paracervical block was performed by the obstetrician using 10 ml of 1% Lidocaine, without epinephrine. The surgical procedure was completed within 10 minutes and the products of gestation were completely evacuated. Immediately thereafter, the patient began to hemorrhage secondary to uterine atony. The obstetrician requested for the attending anesthesiologist to administer a bolus of 10 units oxytocin followed by an infusion. A calculated risk/benefit assessment was made, and the authors elected for administering an oxytocin infusion in escalating dosage as opposed to a bolus method. The oxytocin infusion with 60 units in 1 liter of lactated ringer's solution was carefully titrated to an infusion rate of 500 ml.hr-1, until the bleeding subsided. At this time, the estimated blood loss was noted to be 600 ml. The patient remained hemodynamically stable throughout the 15-min event of increased uterine bleeding and had an uneventful recovery.

DISCUSSION: Our observations reveal that spinal opioids, in conjunction with a paracervical block, are an effective and safe anesthetic approach during elective termination of pregnancy in the parturient with pulmonary hypertension in need of stringent hemodynamic control.2 Furthermore, the use of oxytocin infusion in escalating doses was successful in terminating the uterine atony.3 In case of PH patients, the physician should always anticipate and have a therapeutic algorithm in place for every complication that may occur in the perioperative period.

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Abstract #: RF6AI-155

Successful Elective Dilation and Evacuation (D&E) in a Patient with Univentricular Heart with Fontan Palliation

Presenting Author: Nitish Gupta MD
Presenting Author's Institution: Montefiore Medical Center - Bronx, New York
Co-Author: Yelena Spitzer MD - Montefiore Medical Center

Case: 24 year old female with history of Tricuspid Atresia type II, Pulmonary Atresia and Transposition of the Great who underwent bilateral Blalock-Taussig shunt followed by Fontan procedure at 5 years of age was admitted for elective termination of pregnancy (D&E) at 21 weeks. Procedure was planned with multi-disciplinary approach between Anesthesiology, Cardiology, Maternal Fetal Medicine and Family Planning teams.

Due to coexisting history of Scoliosis with Harrington rods, neuraxial anesthesia was not preferred. After a pre-induction Arterial-line, she was intubated with Rapid Sequence Induction with 2mg Midazolam, 1 mcgs/kg Fentanyl, 0.3 mgs/Kg Etomidate and 1.5 mg/kg Succinylcholine. Patient was maintained on spontaneous breathing on 100% FiO2 without pressure support and anesthesia was maintained with 125-175 mcg/kg/min Propofol infusion, also requiring low dose phenylephrine infusion (10-20 mcgs/min). She received Infective endocarditis prophylaxis and oxytocin bolus. Procedure was uneventful and she was discharged to home on postoperative day 2.

Discussion: Patients with Fontan physiology are largely preload dependent, hypovolemia, increases in Pulmonary Vascular Resistance (PVR) and depression of ventricular function should be avoided. Factors that increase PVR include inadequate analgesia or anesthesia, hypercarbia, acidosis, vasoactive drugs, and increased mean intrathoracic pressure.

Gradual titration of Epidural anesthesia or low dose spinal anesthesia after adequate fluid loading could be preferred as it will minimize changes in PVR and preserve cardiac function. When proceeding with general anesthesia, induction agents that depress myocardial contractility should be avoided. High dose volatile anesthetic agents can increase the likelihood of arrhythmias.

An increase in oxygen requirements will be indicative of increasing right to left shunting through a fenestration or intrapulmonary shunts, due to a decrease in ventricular function, decreased pulmonary blood flow, or ventilation-perfusion inequalities. When controlled ventilation cannot be avoided, use of Low respiratory rates, short inspiratory times, low PEEP, and tidal volumes of 5–6 ml/kg will allow adequate pulmonary blood flow, normocarbia, and a low PVR.

When warranted, Transesophageal echocardiography, Esophageal Doppler device and/or Arterial line can be useful in assessing preload, ventricular function, cardiac output, responsiveness to fluid challenge, and allow repeated measurement of blood gases and continuous blood pressure monitoring.

Patients with Fontan physiology are predisposed to decreased functional status. As a large number of children are undergoing successful palliation for complex congenital heart defects, knowledge of managing such patients should be achieved to minimize morbidity in non-cardiac procedures.

Abstract #: RF6AI-248

Early onset preeclampsia at 23 weeks in a teenager with a history of traumatic brain injury, drug use and scoliosis: a post-cesarean debacle

Presenting Author: Patrick Hussey MD
Presenting Author's Institution: Columbia University Medical Center - New York , NY
Co-Author: Zuhair Siddiqui MD - Columbia University Medical Center
David Cassagnol MD - Columbia University Medical Center
Hanna Hussey MD - Columbia University Medical Center
Ruth Landau MD - Columbia University Medical Center

Introduction: Early onset preeclampsia (EOP) poses challenges with regards to timing of delivery. We describe here the management of an urgent cesarean delivery (CD) for EOP with severe features in a developmentally delayed teenager.

Case Presentation: A 16-yo G1P0 diagnosed at 23-24 weeks with EOP was advised to terminate the pregnancy due to the combination of traumatic brain injury at age 10 with developmental delay, drug use during pregnancy, and foster care with minimal care by her 33-yo mother, but she had refused. She was now admitted at 28 weeks "feeling weak", BP 147/103mmHg and massive anasarca in the setting of HELLP and positive amphetamine urine drug screen. Abdominal US showed bilateral pleural effusions, ascites, cholelithiasis with gallbladder edema and wall thickening. IV labetalol and MgSO4 were started. Obstetrics, anesthesia, psychiatry, social work and legal were convened to discuss appropriate steps for urgent CD in the setting of HELLP. Consent for neuraxial anesthesia (CSE) with possible GA was obtained after discussing with her and legal guardian via FaceTime (grandmother), although she was 'afraid of a spinal because of scoliosis'.

In the OR, she became uncooperative, and in lieu of CSE, single shot spinal (hyperbaric bupivacaine 12mg, fentanyl 15mcg, morphine 300mcg, clonidine 40mcg) was swiftly done while giving 2mg midazolam. CD was started with patient awake, 4 liters of ascites were removed upon entering peritoneum, delivery was simple (baby girl 1280g, Apgar 2/8/9). Oxytocin infusion was started and 1g TXA given. Blood loss was 700ml; 3L of lactated ringers, 500ml 5% albumin and phenylephrine ensured stable hemodynamics (Fig).

Postpartum recovery was initially uneventful, pain was well controlled with minimal oral medication. On day 3, TTE to evaluate persistent tachycardia showed a large pericardial effusion, right atrial diastolic invagination and right ventricle compression, which was drained (520ml serous fluid) and colchicine was started. On day 5, Tamiflu was started for a positive Influenza test. On day 10, persistent leukocytosis was attributed to a rectus sheath abscess, and drainage was performed under GA. With resolution of acute kidney injury and antibiotic completion, she was medically cleared for discharge on day 14.

Discussion: Neuraxial anesthesia for CD proved to be optimal in the context of EOP with anasarca, but the PP course was an unusual trifecta of pericardial effusion, the flu and abdominal abscess.

Abstract #: RF6AI-248

Figure A. Laboratory tests upon admission (at 28 weeks gestation and 2 days)

- Platelets 139 μ/L
- Hemoglobin 13.6 and hematocrit 40.7%
- Creatinine 1.09 mg/dL, (on admission) , increased to 1.85 mg/dL postpartum day 1
- AST 81 IU/Land ALT of 75 IU/L
- Alkaline phosphatase 419 μkat/L
- Fibrinogen 234 mg/dL
- PT/PTT 13/37.6 sec

Figure B. Screenshot of the Anesthetic Monitor

Showing hemodynamic parameters under spinal anesthesia, with phenylephrine infusion (50-100mcg/ml)

- Large red arrow showing spinal anesthetic administration
- Yellow arrow showing delivery

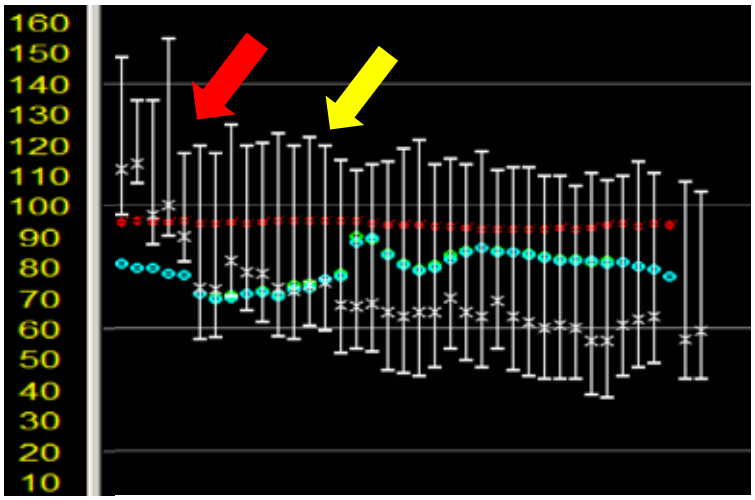


Figure C. Ascites

Over >4000ml ascites were suctioned upon entrance into peritoneal cavity

Abstract #: RF6AI-344

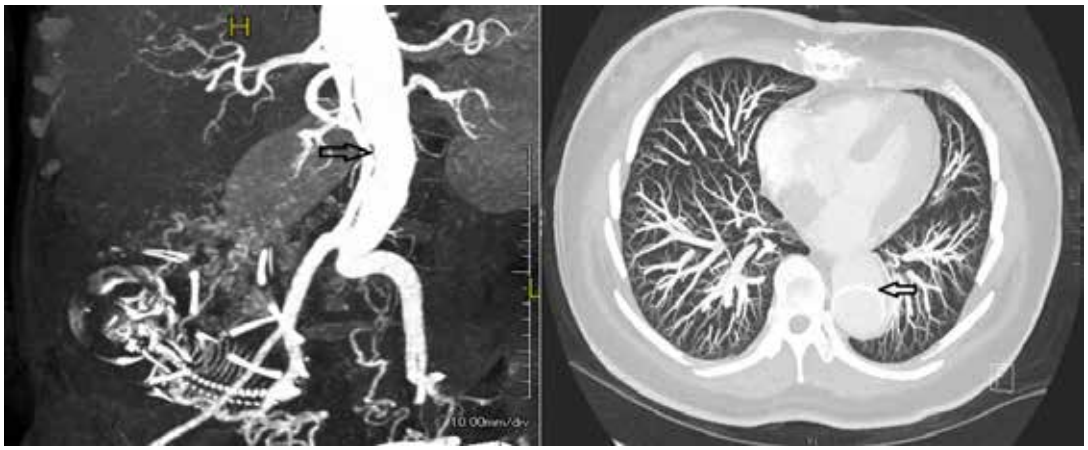
Anesthetic Management of Parturient with Type 1 Endovascular leak after TEVAR

Presenting Author: Olamide Ifaturoti MD
Presenting Author's Institution: University of Maryland Medical Center - Baltimore, MD
Co-Author: Omar Alyamani MBBS - University of Maryland School of Medicine
Amar Bhavsar MD - University of Maryland Medical Center
Bhavani Shankar Kodali MBBS, MD - University of Maryland School of Medicine
Shobana Bharadwaj MBBS - University of Maryland School of Medicine

A 28yo G4P3013 presented with precordial pain and palpitations at 12 weeks gestation. She had a history of repair of Type A Aortic Dissection distal to the aortic root extending to the level of the iliac bifurcation and a 6.5 cm aneurysm of the ascending aorta, a year prior to this presentation. During this admission, a CT angiography of the chest revealed increase in the aneurysmal dilation of the distal aortic arch, consistent with a type B descending thoracic aortic aneurysm. She underwent a Thoracic EndoVascular Aortic Repair (TEVAR) with a carotid-subclavian artery bypass and discharged home. During early third trimester, the patient re-presented with chest pain and Type 1 Endoleak of the graft was detected. Cardiac Surgeons evaluated the patient and discharged her home as the vital signs and serial CT-Scans were stable. A multidisciplinary team was convened to plan delivering the fetus at 35weeks gestation via cesarean section to prevent worsening of 1B Endoleak consequent to hemodynamic stress and strain of labor and delivery. Her other medical history was significant for hypothyroidism as a result of thyroidectomy and a central line associated deep venous thrombosis requiring anticoagulation.

For elective cesarean delivery, pre-induction arterial catheter and large-bore intravenous catheters were placed. Combined Spinal-Epidural neuraxial technique was used, after ensuring appropriate anticoagulation timing, with 10mg of Isobaric Bupivacaine, 10mcg of fentanyl, 200mcg of preservative free morphine as the spinal dose. Transient hypotension after induction of spinal anesthesia was normalized using titrated boluses of phenylephrine. Esmolol infusion was used as adjuvant to control contractility and blood pressure in the intraoperative and immediate postoperative period. Patient remained hemodynamically stable and delivered a healthy neonate. Subsequent course of the patient was unremarkable and was discharged home on postoperative day three.

Anesthetic goals for this parturient with endovascular leak include avoiding fluctuation in blood pressure so that the transmural pressure does not increase, while maintaining adequate feto-placental and coronary perfusion. This criteria should be strictly adhered to during entire perioperative period. The obstetricians should be gentle in delivering the baby with vacuum assist as deemed necessary. Cardiovascular surgeons should be available on site if complications arise due to vascular disruption.



Abstract #: RF6AI-380

Anesthetic Management in Cesarean Hysterectomy for a Parturient with Morbidly Adherent Placenta and Intracranial Aneurysm

Presenting Author: Alexa Kaminski M.D.
Presenting Author's Institution: University of Texas Southwestern Medical Center - Irving, Texas
Co-Author: Frederick C Li M.D. - University of Texas Southwestern Medical Center
Michelle Eddins M.D. - University of Texas Southwestern Medical Center

Case: A 37 year old, G9P6 at 36 weeks gestation presented for a scheduled Cesarean hysterectomy for suspected morbidly adherent placenta (increata/percreta). She had a complex medical history including recurrent and unruptured cerebral aneurysms, known ruptured cerebral aneurysms with subarachnoid hemorrhage, severe asthma/COPD overlap syndrome (ACOS), chronic hypertension, seizures, and mood disorder. Preoperative workup included a multidisciplinary approach with neurosurgical and pulmonary consultations. Patient's airway was carefully assessed. Pre-induction arterial and central venous catheters were placed and general endotracheal anesthesia was performed with a rapid sequence induction. The patient was maintained with sevoflurane with remifentanil infusions, kept normotensive and hemodynamically stable intraoperatively using a phenylephrine infusion and other vasoactive medications. The patient required one unit of packed red blood cells. A male infant was delivered and did well postoperatively. The patient had an uneventful surgical ICU stay postoperatively. She was discharged on postpartum day 5.

Discussion: The prevalence of cerebral aneurysms in the general population in the United States is estimated to be 4% to 6%, and the incidence is increased during late gestation(1). SAH has a somber prognosis during pregnancy, and predisposing factors for rupture include pregnancy, a history of previous rupture, and an elevated transmural pressure gradient(1). The transmural pressure gradient is influenced by the difference between the pressure inside the aneurysm (mean arterial pressure [MAP]) and the pressure outside the aneurysm (intracranial pressure [ICP]). Thus, sudden increases in MAP and/or reduction in ICP elevates transmural pressure, which may lead to aneurysmal rupture.

Neuraxial anesthesia has been successfully described for parturients with unruptured intracranial aneurysms(2), but our parturient had a concurrent morbidly adherent placenta. We decided on performing general anesthesia given the potential for major blood loss, concern for inability of the patient to tolerate being awake during surgery, and the risk for dural puncture potentially causing aneurysmal rupture which has been described previously in literature. A remifentanil infusion was chosen to lessen volatile anesthetic requirement to avoid cerebral vasodilation and subsequent increase in ICP.

We conclude that pregnancy with intracranial aneurysms and morbidly adherent placenta is a rare and complex clinical situation, and management of these patients requires a multidisciplinary team approach. This patient had a stable peripartum course and delivered a healthy infant despite many potential problems.

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Abstract #: RF6AI-441

Approaching Complex Management Decisions for a Pregnant Patient Presenting with NSTEMI

Presenting Author: Jeffrey B Yu MD
Presenting Author's Institution: The Ohio State University Wexner Medical Center - Columbus, OH
Co-Author: Teri Gray MD - The Ohio State University Wexner Medical Center
Kasey Fiorini MD - The Ohio State University Wexner Medical Center

A 39 y.o. AA G11P5237 at 29w3d with PMHx of HTN and GDM presents with chest pain, headache, BP 215/120, and troponin elevation to 0.32. She was admitted for hypertensive urgency, superimposed pre-eclampsia with SF, and concern for demand ischemia. BP was controlled with labetalol, hydralazine, nifedipine, and magnesium. Cardiology was consulted and echo showed LVH and normal LVEF with no evidence of RWMAs. She later developed substernal chest pain with troponin elevation to 2.11 and was started on heparin gtt, ASA 325mg, and atorvastatin 40mg. Coronary angiography was considered, however patient had non-reactive NST and BPP 6/10 concerning for worsening placental function, so we proceeded with cesarean delivery prior to angiography/potential PCI. Uncomplicated CD was performed under GA with pre-induction arterial line. Post-operatively, LHC was performed showing normal coronaries, and patient was discharged to home on ASA, Coreg, Cardizem, and HCTZ.

Discussion: Acute myocardial infarction (AMI) during pregnancy is rare, estimated at 3-100 per 100,000 women in the US, but carries significant morbidity and mortality (estimated 11% maternal and 9% fetal fatality). In addition to standard risk factors for AMI, factors specific to pregnant women include pre-eclampsia and physiological changes of pregnancy such as increased cardiac output, dilutional anemia, and hypercoagulable state. Pregnant women are also at increased risk of spontaneous coronary artery dissection, possibly due to progesterone-induced degeneration of connective tissue in the coronary intima and media(1).

Management of AMI in pregnant women follows the same principles as in the general population, though fetal risk adds additional complexity to decisions. Some common AMI treatments, including ACEi/ARBs and statins, are contraindicated in pregnancy due to risk of teratogenicity(1). Coronary angiography also presents teratogenic risks from ionizing radiation and risk of fetal hypothyroidism from iodinated contrast agents, as well as the need for DAPT if PCI is performed(2). Our patient most likely had a type 2 NSTEMI secondary to hypertensive crisis precipitated by severe pre-E. Monitors showed signs of poor uteroplacental perfusion and fetal distress, indicating that the fetus was no longer tolerating pregnancy. Additionally, anticoagulation during angiography, and the possibility of PCI and DAPT, would complicate an already urgent delivery. Thus, the decision was made to deliver prior to angiography.

This case illustrates the complexity of decision-making when approaching AMI in pregnant patients. Though AMI in pregnancy carries significant morbidity, collaboration between obstetrics, anesthesiology, and cardiology in shared decision-making increase the patient's chance for a good outcome.

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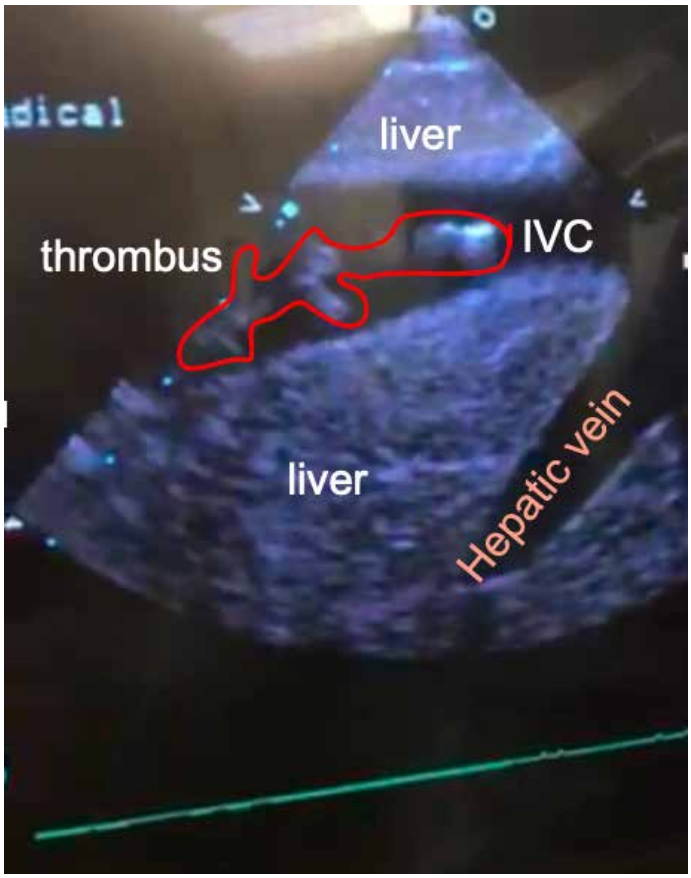
Abstract #: RF6AI-523

Severe complications during dilation and evacuation at 20 weeks: massive hemorrhage from unanticipated placenta percreta and venous thromboembolism

Presenting Author: M. Waseem Athar MBBS, DESA, MCAI
Presenting Author's Institution: Stanford University School of Medicine - Stanford, CA
Co-Author: Neil S. Kalariya MD - Stanford University School of Medicine
Brendan Carvalho MBBCh, FRCA, MDCH - Stanford University School of Medicine
Jessica R. Ansari MD - Stanford University School of Medicine

Introduction: Second trimester abortions are generally considered safe procedures with rates of severe complications estimated at 0.4% [1]. Even in women with placenta previa, second trimester dilation and evacuation (D&E) is not contraindicated. However, placenta previa increases the risk of transfusion (3% versus 1%) [2]. We present a case of a woman at 20-week gestation with placenta previa whose D&E was complicated by massive hemorrhage due to unanticipated placenta percreta, as well as inferior vena cava (IVC) thrombus necessitating intraoperative filter placement.

Case Presentation: 30-year G9P5 at 20w3d with one prior cesarean delivery, newly diagnosed lethal fetal anomalies and complete placenta previa presented for D&E. Ultrasound 3 days prior showed no evidence of placenta accreta. During the D&E, after cervical dilator removal, the procedure was rapidly converted to an exploratory laparotomy due to massive hemorrhage and inability to extract the placenta. The patient was found to have placenta percreta with extension into the urinary bladder. She underwent hysterectomy, bladder repair, and right ureteral stent placement. Estimated blood loss was 10L, and she received 6L crystalloid, 17u pRBCs, 8u FFP, 3 packs platelets, 2g fibrinogen concentrate, and 2g tranexamic acid. During resuscitation, a transthoracic echocardiogram (TEE) exam was performed to guide transfusion, which revealed a large mobile IVC thrombus (Figure). Given the risk of pulmonary embolus and inability to anticoagulate, interventional radiology performed intraoperative IVC filter placement guided by TEE through the neck 9Fr introducer sheath (inserted during resuscitation). Postoperatively, the patient was transferred to the ICU intubated and ventilated. She was extubated the next day, started on anticoagulation at 48 hours, and discharged home on day 8.



Discussion: Second trimester D&E is generally considered safe, however major life-threatening hemorrhage may occur. The immediate availability of a massive transfusion protocol and intraoperative TEE allowed for rapid resuscitation, as well as diagnosis and prevention of a thromboembolic event. The case highlights the potential for hemorrhage from abnormal placentation in high risk D&Es, and suggests these cases should be performed in settings that can manage these unanticipated life-threatening conditions.

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Abstract #: RF6AI-545

Anesthetic management of patients post cardiac transplantation undergoing cesarean delivery: a case study and literature review

Presenting Author: Magdalena M Terlecki M.D.
Presenting Author's Institution: Schulich School of Medicine and Dentistry - London, Ontario
Co-Author: Yahui Tammy Symons MD FRCPC - Schulich School of Medicine and Dentistry
Indu Singh MD FRCPC - Schulich School of Medicine and Dentistry
Ian McConachie MB ChB FRCA FRCPC - Schulich School of Medicine and Dentistry

BACKGROUND: Rates of pregnancy post heart transplantation (HT) are increasing. Cesarean delivery (CD) rate post HT is 30%.1 Reports of anesthetic management of these patients are rare. We report the anesthetic management of CD in a patient post HT and review similar published cases.

CASE REPORT: A 36 y G1P0 presented with a history of post viral dilated cardiomyopathy requiring orthotopic HT at age 30. Post-transplant course was complicated by sepsis, acute kidney injury and chronic kidney disease, and bowel resection for ischemic colitis. Graft sinus dysfunction required permanent pacemaker insertion. In pregnancy, the patient had a pulmonary embolus requiring therapeutic anticoagulation. She was admitted at 35+3 weeks gestation for increasing exertional dyspnea and anxiety. Elective CD was performed at 36+2 weeks gestation due to severe patient anxiety. ASA monitors were applied; arterial line was deferred due to poor radial artery perfusion from prior cannulation. Aspiration prophylaxis, Lactated Ringer's (LR) co-load, and a phenylephrine infusion were administered as combined spinal-epidural (CSE) anesthesia was performed under strict asepsis. Anesthesia was achieved with Bupivacaine 0.75% 0.9 mL, morphine 200 mcg, and fentanyl 15 mcg intrathecally. Surgical block was achieved and a female infant was delivered uneventfully. Carbetocin 100 mcg was given. Close hemodynamic parameters were followed. Two doses of 5 mL Lidocaine 2% with 1:200000 Epinephrine and one dose of 5 mL bupivacaine 0.25% were given via epidural. Blood loss was 500 mL and I L of LR was given. The patient had a planned admission to the ICU for 24 hour hemodynamic monitoring and was transferred to post-partum ward in stable condition. She was discharged on post-operative day 4.

METHODS: We screened case reports from literature to review CD anesthetic management in parturients with HT.

RESULTS: Three case reports were identified describing 5 cases.2,4,5 All received neuraxial anesthesia, two of which were spinals, two were epidurals, and one was a CSE. Only one patient had an arterial line. None had central venous access. Post-operatively, three had a planned ICU admission.

CONCLUSION: The pathophysiological changes post HT compounded by the physiology of pregnancy make anesthetic management challenging. Preload dependence, the need for direct vasoactive drugs, immunocompromise, and additional comorbidities must be recognized.3,5 Most deliver vaginally but no consensus exists for CD anesthesia. With careful titration, neuraxial anesthesia appears to be well tolerated in parturients with HT undergoing CD. Standard monitoring is usually adequate, but invasive monitoring may facilitate management. Facilities for close post-partum monitoring should be available. A multidisciplinary approach is needed.

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Abstract #: RF7A10-59

Expectant management of a parturient with serotonin syndrome

Presenting Author: Brandon Hammond MD, MBA
Presenting Author's Institution: University of North Carolina – Chapel Hill - Chapel Hill, NC
Co-Author: Benjamin Cobb MD - University of North Carolina – Chapel Hill
Lacey Straube MD - University of North Carolina – Chapel Hill

Introduction: Serotonin syndrome is an uncommon but potentially fatal condition caused by serotonin excess in the central nervous system.1 To our knowledge, there are no reports of serotonin syndrome in pregnancy.

Case: A 36-year-old G3P1011 at 36w6d with a history of bipolar disorder type I, generalized anxiety disorder, postpartum depression, and substance abuse presented with intractable nausea, vomiting, diarrhea, tremor and hypertension. Psychiatric medications included lurasidone (increased dose one month prior), buspirone, and clonazepam. During a routine prenatal visit, the patient reported symptoms of hopelessness and fatigue for which she was prescribed sertraline. The following day, the patient developed intolerance of oral intake with worsening nausea, vomiting and diarrhea which continued over the next six days. During this time, she self-administered ondansetron and reported taking caffeine pills for increasing fatigue.

On initial presentation she was tremulous without muscle rigidity, BP 173/78, QT interval 490 ms, and labs were concerning for ketonuria, hypokalemia, metabolic acidosis, and a leukocytosis. Fetal heart rate (FHR) was 167 with a BPP of 6/8.

All serotonergic medications were held due to suspicion for serotonin syndrome. Her nausea and vomiting were treated with diphenhydramine and prochlorperazine, and she was rehydrated with 2.5 L lactated ringers followed by 4 L normal saline with 5% dextrose and electrolyte repletion. Her lab abnormalities normalizing by hospital day (HD) 3 and BPP improved to 8/8. However, she continued to have mild range blood pressures which met criteria for gestational hypertension. She subsequently underwent induction of labor on HD 4 and an L2/3 early labor epidural analgesic was placed. The catheter was loaded with 5 ml of bupivacaine 0.125% with a maintenance infusate of 0.1% bupivacaine. During labor the catheter was replaced with a combined spinal epidural (CSE) one level lower due to sacral sparing unresponsive to top-ups. CSE initiation was complicated by hypotension (79/46) responding to vasopressor administration and a fluid bolus. The epidural infusate was also changed to bupivacaine 0.083% with fentanyl 2 mcg/ml with the new epidural catheter. Her labor course was otherwise uncomplicated, and she delivered a healthy neonate at 37w3d on HD 4. The patient's recovery was unremarkable, and she was discharged to home on HD 6, postpartum day 2.

Discussion: The principles of managing serotonin syndrome in pregnancy focus on maternal optimization. In addition to discontinuation of offending agents and treatment of hemodynamic derangements, anesthetic planning should include avoidance of triggering agents. In general, delivery should be avoided pending resolution of serotonin syndrome. However, an early labor epidural analgesic without opioid should be considered in a parturient in labor with serotonin syndrome.

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Abstract #: RF7A10-80

Anesthetic Considerations for a Parturient with Freeman-Sheldon Syndrome

Presenting Author: David G DePinto DO
Presenting Author's Institution: University of Texas Southwestern Medical Center - Dallas, TX
Co-Author: Michelle Eddins MD - University of Texas Southwestern Medical Center

Intro: Freeman-Sheldon syndrome (FSS) is rare genetic disorder associated with malformations of the face, oral cavity, and musculoskeletal system. This case presents the anesthetic considerations of a parturient with FSS.

Case: A 23 y/o F G1P0 at 38 weeks gestation with a past medical history of hypertension and FSS presents to labor and delivery unit for trial of labor. Surgical history was pertinent for multiple upper and lower extremity surgeries, as well as T2-T12 scoliosis correction with Harrington rods. Physical exam was notable for short stature 4'7" and BMI 32. A midline longitudinal scar extended throughout her thoracic spine. Airway exam revealed a flat nose, small mouth opening, short inter-incisor distance, webbed neck, and a limited range of motion of the cervical spine. Outside hospital anesthetic records documented a previous difficult airway but detailed airway management was unobtainable. The patient was concerned about the risks of neuraxial anesthesia, but after informed consent, the patient elected epidural analgesia for labor.
An epidural catheter was successfully placed at L3-L4 using a loss of resistance technique to air. An intentional dural puncture with a 25 gauge spinal needle was performed to confirm placement. The patient delivered via an uncomplicated spontaneous vaginal delivery and the epidural catheter was removed postpartum.

Discussion: Anesthetic considerations for patients with FSS include neuaxial anesthesia, airway management, and IV access. These patients have scoliosis and musculoskeletal contractures that require surgical correction making neuraxial placement more difficult. Surgical interventions may result in a compromised/completely obliterated epidural space resulting in patchy spread of local anesthetics or an inadvertent dural puncture. Bone grafting and fusions create limited areas of needle placement. Dural puncture epidural (DPE) may be used to confirm successful midline entry into the epidural space. A study by Chau et al. found DPE result in a statistically significant reduction in unilateral epidural analgesia, improved caudal spread of analgesia, and reduction in provider top-offs compared to standard epidurals. In addition, abnormal anatomy (small mouth opening, micrognathia, webbed neck with limited range of motion) puts the patient at risk for difficult ventilation and oral intubation. Limited nasopharyngeal space in this population may limit the feasibility of a nasal approach to endotracheal intubation. Awake Fiberoptic intubation is indicated. Finally, Restrictive movement of extremities secondary to joint deformities/contractures and scar tissue from previous surgery can make IV placement difficult

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Abstract #: RF7A10-89

A Near-Fatal Case of HELLP and Other Peripartum Complications in a Complex Multiple Pregnancy

Presenting Author: Douglas Brack Mulliner DO
Presenting Author's Institution: Saint Louis University Hospital - St. Louis , MO
Co-Author: Natalie Wong MD - Mercy Hospital St. Louis

A 29 yo G4P1021 at 28w6d gestation presented to labor and delivery with elevated blood pressure and peripartum course complicated by prior triplet gestation (baby A ectopic in uterine scar, previously reduced at 12 weeks and baby C spontaneously aborted), with later development of persistent trophoblastic tissue from the uterine scar ectopic and suspected placenta accreta. Patient admitted to L&D with elevated BPs and over course of next week she progressed from preeclampsia without severe features to HELLP syndrome with epigastric pain and elevated LFTs and severe thrombocytopenia. Patient proceeded to cesarean-hysterectomy after placement of fogarty balloons in bilateral iliac arteries. Intraoperative course significant for estimated blood loss of 10 L and transfusion of 11 units PRBCs, 8 units platelets, 8 units FFP, 4 units cryoprecipitate,factor VIIa, 6 L crystalloid, tranexamic acid. Evidence of ongoing DIC so abdomen packed and patient taken to IR for embolization *** where she received another 3 units PRBCs. Magnesium toxicity occurred 12 hours post operatively. She returned to the OR next day for exploratory laparotomy and removal of abdominal packing and was noted to have old clot but no continued bleeding, though another 2 units PRBCs, 2 units platelets, and 2 units FFP were transfused. Post operatively a vaginal cuff bleed was noted and patient taken to IR once again and underwent bilateral internal iliac artery embolization and received another 2 units PRBCs, 2 units platelets, 2 units FFP and 4 units cryoprecipitate. Patient then stable for transfer to major transplant center for availability of liver transplant given ongoing liver dysfunction and DIC. Further hospital course complicated by renal failure necessitating hemodialysis, liver failure due to shock liver and HELLP syndrome recovered, E. Coli peritonitis, multiple pulmonary embolisms necessitating IVC filter, developed HIT while being anticoagulated and ARDS. Patient eventually recovered from all hospital problems, did not need liver transplant, no longer needs hemodialysis, and mom and baby are doing well. Patient did eventually have a hepatocellular adenoma removed and is recovering well. It is imperative for the obstetric anesthesia team to be intimately involved in and understand the specific pathophysiology in the care of these complex parturients due to the emergent nature of placental complications, including; severe preeclampsia, HELLP, trophoblastic disease, placental invasion, DIC and generalized end organ failure. This case stands as a reminder that physiologic changes and disease processes that occur with pregnancy make the parturient unique and the consumptive coagulopathy that can develop with HELLP syndrome must be understood differently and treated more aggressively than that of a typical massive hemorrhage patient.

Abstract #: RF7A10-119

Perioperative management of a parturient with long-chain 3-hydroxyacyl-CoA dehydrogenase (LCHAD) deficiency

Presenting Author: Dean Thorsen D.O, PhD.
Presenting Author's Institution: Washington University - St Louis, MO
Co-Author: Matthew Reschke M.D. - Washington University
Amber Benhardt M.D. - Washington University

Long chain 3-hydroxyacyl CoA dehydrogenase deficiency (LCHAD) is a rare, autosomal-recessive fatty acid oxidation disorder. Due to this enzyme deficiency, the patient is incapable of metabolizing long chain fatty acids efficiently and is unable to fast. LCHAD is a potentially life-threatening condition especially when patients undergo stress, illness or processes that required high metabolic demand. Patients with LCHAD can also have cardiomyopathy and rhythm disorders, especially in the setting of acute onset chest pain (1).

There is very little data on pregnancy, pregnancy related complications and perioperative management of females with long-chain 3-hydroxyacyl-CoA dehydrogenase (LCHAD). During pregnancy the caloric intake should be gradually increased by increasing both carbohydrate (simple and complex) and medium chain fatty acid (MCT) intake. The mainstay of treatment is the use of intravenous (IV) glucose as an energy source, treatment of cardiac rhythm disturbances, and monitoring of rhabdomyolysis (1).

Our case involves a patient admitted for nausea and vomiting in setting of medication non-compliance. Her pregnancy was complicated by poor caloric intake, prolonged QTc, rhabdomyolysis and transient transaminitis. Our patient was a 22 year old F G1P1001 @ 37 weeks with LCHAD deficiency, blindness due to pigmentary retinopathy, major depression, and acquired long QT syndrome with torsades. On admission, her CK and transaminases were found to be elevated. Her initial symptoms began a week before admission with lower leg weakness/cramping that progressively got worse and later developed nausea/vomiting two days prior to admission. Our patients symptoms were likely due to her pregnancy placing a high metabolic demand on her body which was causing her to go into a catabolic state. Because of her lack of appropriate caloric intake and decreased intake of MCT oil she was at higher risk for rhabdomyolysis even in absence of exercise or exertion.

During her admission her caloric status was optimized by providing high calorie content fluids (10% dextrose) and providing MCT supplementation. Important anesthetic considerations included limiting fasting periods, reducing surgical stress, avoiding large amounts or prolonged propofol infusions and avoiding QT prolongating medications (2). She was managed expectantly but during her stay she delivered via emergent cesarean delivery due to fetal decelerations. Her IV dextrose infusion was continued intraoperatively and a spinal anesthetic was performed without post partum complications.

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Abstract #: RF7A10-135

Pulmonary Embolism and Occult Metastatic Pancreatic Cancer in a Parturient with Pre-Eclampsia: A Case Report

Presenting Author: Marguerite Hoyler MD
Presenting Author's Institution: Weill Cornell Medical Center - New York, NY
Co-Author: Marguerite Hoyler MD - Weill Cornell Medical Center
Jon D. Samuels MD - Weill Cornell Medical Center
Danielle McCullough MD - Weill Cornell Medical Center

Case: A healthy 40yo G1P0 with remote history of tobacco and alcohol abuse was admitted for management of pre-eclampsia at 28w6d gestation. She was treated with magnesium and labetolol. On hospital day (HD) 4, she developed new-onset shortness of breath, with desaturations to 93% on room air (RA). Hemodynamics were unchanged (HR 70s-80s, BP 140s/90s). CXR showed pulmonary edema. The patient received 20mg IV furosemide with no clinical improvement.

On HD 5, the patient underwent emergent cesarean delivery for non-reassuring fetal heart tracings. There were no adverse intra-operative events. The patient received a spinal anesthetic and 200cc IVF. EBL was 800cc. HR was 60-80bpm and BP 120-155/80-110, with 1.1mg phenylephrine infused. Oxygen saturation ranged 92-96% on RA, and was 95% on transfer to PACU. In PACU, the patient desaturated to 88% on RA. There was no associated tachycardia or hypotension. Pulmonary embolism (PE) workup was initiated. Lower extremity dopplers confirmed femoral DVT. CT chest showed bilateral PEs, as well as numerous hepatic hypodensities. Anticoagulation was initiated. The patient was transferred to the ICU.

Subsequent MRI showed diffuse hepatic nodules, lymphadenopathy, and a pancreatic mass. Biopsy confirmed metastatic pancreatic adenocarcinoma. The patient was discharged home on HD10 without further complications related to pregnancy or PE, with close oncology follow-up.

Discussion: Pancreatic cancer is a rare but morbid disease, with 5 year survival rates below 5%.1 Modifiable risk factors include tobacco use, obesity, and possibly alcohol consumption.1 Among women, reproductive history has not been shown to affect pancreatic cancer risk.2 The medical literature contains few reports of pancreatic cancer in pregnancy.3 Here, we describe a parturient with metastatic pancreatic cancer discovered incidentally during workup for PE.

Pregnancy is a known thrombophilic state. However, in some parturients, attribution of PE to the physiologic changes of pregnancy is insufficient because there are other risk factors present. This case is a reminder that occult malignancy should be considered in the differential diagnosis for PE etiology. Although malignancy in pregnancy is rare,4 patient history often reveals risk factors. The patient described here had a history of tobacco use and alcohol abuse.

Regardless of identifiable risk factors for thrombophilia or malignancy, PE should be entertained early in the differential diagnosis of acute-onset dyspnea in the parturient, both due to the urgency of the diagnosis and its prevalence in this vulnerable population.5 PE may not present with tachycardia; particularly in pre-eclamptic patients on beta-blockade.

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Abstract #: RF7A10-144

Labor and Delivery of a Parturient with Alpha-Gal Syndrome

Presenting Author: Takashi Sakano M.D., Pharm.D
Presenting Author's Institution: Columbia University Medical Center - New York, New York
Co-Author: Artem Gindin M.D. - Columbia University Medical Center
Suzanne Mankowitz M.D. - Columbia University Medical Center

Introduction: Alpha Gal syndrome, also known as mammalian meat allergy, is an allergy to galactose-alpha-1,3-galactose. This carbohydrate, often called alpha-gal, is a component of mammalian meat. Those sensitized to alpha-gal often manifest IgE-mediated responses after ingesting meat or medications containing animal by-products. Interestingly, the geographic distribution of Alpha Gal syndrome mimics that of the lone star tick. In fact the bite from this tick, as well as the monoclonal antibody cetuximab, has been implicated in triggering Alpha Gal syndrome.

Methods: This case describes a 38 year old primagravida with Alpha Gal syndrome, with associated allergies to gel-tabs and leather products developed following a tick bite. Her other medical history is notable for asthma, gestational diabetes requiring insulin, and placenta previa. At 39 weeks gestation, the patient was admitted for an elective cesarean section which was performed under spinal anesthesia with intrathecal bupivacaine, fentanyl, and morphine. Despite pre-treatment with nearly a 1 liter of crystalloid fluids, the patient developed significant hypotension following spinal placement, unlikely related to her Alpha Gal syndrome, and was successfully treated with boluses of ephedrine and a high dose infusion of phenylephrine. The patient tolerated the remainder of the surgery without further issue, and synthetic sutures were chosen by the obstetric team, rather than collagen derived Plain Gut and Chromic sutures, for wound closure. Heparin was avoided post-operatively, and replaced with intermittent lower extremity venous compression devices, along with aggressive early ambulation. She was discharged home on post-operative day three.

Conclusion: There is limited literature on obstetric patients with Alpha Gal syndrome, however, both vaginal and cesarean section as modes of delivery appear safe. While this patient tolerated her intra-partum, delivery, and post-partum course without issue, careful planning and avoidance of products containing animal by-products is necessary. Furthermore, immediate availability of IV epinephrine, H1 and H2 blockers, and steroids are necessary in the event a severe allergic reaction should develop.

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Abstract #: RF7A10-298

Retained Placenta After Termination of Pregnancy Requiring Hysterotomy in a Patient with Large Uterine Fibroids

Presenting Author: Sapna Satyanarayan-Victor M.D., M.P.H.
Presenting Author's Institution: University of Michigan Health System - Ann Arbor, Michigan
Co-Author: Thomas T Klumpner M.D. - University of Michigan Health System

Introduction: Retained placenta complicates 2-3% of vaginal deliveries, leading to an increased incidence of postpartum hemorrhage and endometritis. Abnormal uterine anatomy is a risk factor for retained placenta.

Case: A 40 year old G2P0 with multiple leiomyomata, and no other significant medical history, presented for induction of labor for termination of pregnancy at 16 weeks EGA for suspected Trisomy 21. Labor progressed unremarkably, however delivery of the fetus was complicated by retained placenta. Multiple maneuvers to deliver the placenta manually were unsuccessful as a ten centimeter cervical leiomyoma obscured access to the uterine cavity. Twenty-four hours after delivery, the patient was taken to the OR for ultrasound-guided dilation and extraction of the placenta via transcervical approach under general anesthesia. Neuromuscular blockade and a high end-tidal concentration of sevoflurane optimized pelvic floor and uterine relaxation. Unfortunately, the uterine cavity could not be accessed vaginally. Expectant management was continued with the placenta in situ until forty-eight hours after delivery when the patient developed fever, leukocytosis, and uterine tenderness concerning for endometritis and worsening anemia from ongoing vaginal bleeding. To avoid morbidity anticipated with a hysterectomy, and to accommodate the patient's desire to preserve fertility, a transuterine suction curettage via mini laparotomy was planned. The patient was transferred to the main hospital and taken to the OR. In anticipation of significant hemorrhage and potential emergent hysterectomy, blood products were made available, and two large bore IVs were inserted after induction of general anesthesia with propofol, succinylcholine, and fentanyl. Because the patient was hemodynamically stable, a central venous catheter (CVC) was not placed, though equipment for CVC placement and vasoactive medications to manage septic shock were available. Broad spectrum antibiotics were continued intraoperatively. Fortunately, the placenta was evacuated uneventfully with minimal blood loss. Postoperatively, the patient was counseled extensively about her risk of serious morbidity with future pregnancies. The patient is considering a hysterectomy on an elective basis.

Discussion: This report describes a unique case of retained placenta due to mechanical obstruction from uterine leiomyomata. Despite optimization of pelvic floor and uterine relaxation with general anesthesia, the placenta could not be extracted via the cervix, and was ultimately removed via an uncommon transuterine approach. Though preparations were made to treat severe hemorrhage and septic shock, placental extraction via hysterotomy proceeded uneventfully and the patient's postoperative course was uncomplicated.

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Abstract #: RF7A10-372

Two Sisters with Moyamoya and Sickle Cell

Presenting Author: Joseph Reno MD
Presenting Author's Institution: Ohio State University Wexner Medical Center Department of Anesthesiology - Columbus, Ohio
Co-Author: Meghan I Cook MD - Ohio State University Wexner Medical Center Department of Anesthesiology

Moyamoya disease is known to have an association with Sickle Cell Disease (SCD), but no reports of parturients with both are known. Moyamoya is least rare in those of Japanese and Korean descent while SCD is most common in Africans. We discuss two African American sisters with moyamoya and SCD, who safely gave birth with different anesthetics.

Patient A, a 21 year-old G1P0 at 38w6d, presented in an acute pain crisis the day prior to her scheduled induction of labor (IOL). She underwent exchange transfusion and subsequent IOL. Her echocardiogram was normal as were blood counts and coagulation panel. She was on therapeutic dose enoxaparin for SVC thrombus (last dose day prior to admission). An epidural catheter was placed and bupivacaine 0.125% with fentanyl loaded. Patient controlled epidural analgesia was run with bupivacaine 0.0625% and fentanyl. Instrument-assisted delivery was considered but not implemented before delivery. Patient B, a 20 year-old G2P1 at 38w0d, presented with IUGR, desiring TOLAC. Her history was notable for prior successful cesarean delivery. She had no echocardiogram. Her blood counts and coagulation panel were normal, excepting mild anemia. She was also on prophylactic dose enoxaparin for history of deep vein thrombosis (last dose prior to admission). Oxytocin IOL resulted in fetal intolerance of labor, so she was taken for cesarean delivery. A spinal was dosed with 12 mg bupivacaine 0.75%, fentanyl 15 mcg, and morphine 100 mcg. Concurrently she received crystalloid bolus and a phenylephrine infusion. Cesarean delivery was without complication.

Both patients had no peripartum complications, including no neurologic symptoms. Neither received invasive monitoring. Both had evaluations by hematology and neurology during pregnancy, which recommended no special management other than continued adequate pain and hemodynamic control, hydration, and anticoagulants for their previous thrombotic complications. Neither had a recommendation for intracranial bypass. Obstetric anesthesia management for SCD is well described: normothermia, euvolemia, ensuring adequate analgesia, consideration of cardiovascular complications of sickling, and advance preparation for transfusion with multiple antibodies likely. Peripartum anesthetic management for moyamoya focuses on similar goals of normocarbia, normothermia, and normotension. Epidurals, CSE, and general endotracheal anesthesia have all been safely performed. Conservative reports favor cesareans with slowly-dosed epidurals, but more series with vaginal deliveries (usually instrument-assisted) and CSE cesareans are known. Our cases highlight this trend toward liberalization of delivery method and anesthetic as long as the goals are met.

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Abstract #: RF7A10-437

Multidisciplinary Approach: NEURAXIAL ANESTHESIA IN THE SETTING OF CVST

Presenting Author: Maria Betances, MD
Presenting Author's Institution: Henry ford Hospital - Detroit , Michigan
Co-Author: Snigdha Parikh Hon. BS, DO - Henry Ford Hospital
Christine Acho D.O - Henry Ford Hospital
Ami Attali D.O - Henry Ford Hospital
Joshua Younger M.D - Henry Ford Hospital
Kevin Spencer M.D - Henry Ford Hospital

Introduction: Cerebral venous sinus thrombosis is a rare, but serious condition occurring more commonly in females, with increased incidence during the peripartum period owing to inherent physiologic changes during pregnancy. Patients are managed with anticoagulation and may require other symptomatic treatments for complications such as seizure and headache. Peripartum anesthetic options often raise concern with regards to safety, given potential complications caused by intracranial pressure gradients resulting in potentially life-threatening complications [2].

Case: 25 year old female with no significant past medical history, G6P2214 @ 8 weeks by LMP presented with a 5-day history of right-sided headache, nausea/vomiting, and new-onset tonic-clonic seizure. MRI/MRV of the brain revealed revealed superior sinus venous thrombosis extending distal to the coronal suture into the proximal transverse sinuses bilaterally, with small right parietal hemorrhage. She was treated with a unfractionated heparin drip, loaded with levetiracetam 2g, and discharged on enoxaparin 1 mg/kg BID and levetiracetam 500 mg BID. Hypercoagulability/ autoimmune workup notable for decreased protein S (24, range 50-144), normal protein C, positive ANA (1:320, homogenous pattern), negative antiphospholipid antibodies, and normal antithrombin III activity. MRV brain performed three months after initial diagnosis revealed partial resolution of superior sagittal sinus thrombus, retained thrombus in portion of right transverse sinus, and dominant/patent left transverse sinus. Our patient was offered labor epidural, but ultimately delivered successfully without anesthesia.

Discussion: Perioperative management for patients with recent CVST often revolves around mitigating potential complications related to elevated intracranial pressure. This is a topic of discussion in similar situations where there is elevated ICP, such as IIH, neoplasm, or other space-occupying lesion, as well as in situations where subtle shifts in intracranial structures risks harm, such as with an AVM. Data are limited in these cases, complicating the decision-making process. Future studies may investigate risks of similar patients who have incomplete resolution of CVST or other factors influencing ICP at the time of delivery to determine the safest means of peripartum anesthetic management [1]. In these cases, the choice of using epidural/spinal or general anesthesia would each infer a unique risks and benefits, understanding of which would undoubtedly influence decision making.

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Abstract #: RF7A10-504

Is this the oral boards? Anesthetic management for cesarean delivery in a patient with h/o IV drug use, active endocarditis with severe tricuspid regurgitation and preeclampsia with severe features.

Presenting Author: Paul M Scott MD
Presenting Author's Institution: University of Colorado School of Medicine - Aurora, CO
Co-Author: Rachel Kacmar MD - University of Colorado School of Medicine
Jennifer Hong MD - University of Colorado School of Medicine

Case Report: 37 year old G5P3013 at 22w5d GA with a history of IV drug use including heroin and meth, presented from an outside hospital for sepsis and a newly diagnosed pregnancy. On initial evaluation found to have tricuspid valve MSSA endocarditis, bacteremia, and septic emboli to the lungs and kidneys. TTE on admission was significant for severe tricuspid regurgitation and tricuspid septal leaflet vegetation. Initial management included IV antibiotics for the endocarditis and buprenorphine for the IVDU. Over the next three weeks her course was complicated by persistent tachycardia, gestational diabetes, recurrent fevers with positive blood cultures, line associated VTE, worsening tricuspid regurgitation and preeclampsia with severe features with elevated LFTs. At 26w4d GA the decision was made to proceed with cesarean delivery (CD) for breech presentation and worsening preeclampsia with severe features.

In the OR, a pre-induction arterial line was placed for hemodynamic monitoring followed by a CSE. The IT dose was 7.5 mg hyperbaric bupivacaine, 500 mcg PF morphine and 25 mcg fentanyl. After positioning and hemodynamic stability achieved with a phenylephrine infusion, the epidural was incrementally dosed with an additional 10 mL of 0.5% bupivacaine. 15 minutes after dosing the epidural, assessment of the block was determined to be inadequate for surgery. An additional 10 mL of 3% Chloroprocaine was given via the epidural, however 10 minutes later the block was still inadequate for surgery. Due to the inadequate surgical block and patient anxiety it was decided to convert to general anesthesia.

Rapid sequence induction with etomidate, ketamine and succinylcholine and tracheal intubation were uncomplicated. During the CD a continued phenylephrine infusion was required for hypotension and sinus tachycardia was persistently in the 140s. Quadratus lumborum blocks were performed for post-operative analgesia prior to emergence and extubation. The patient was transported to the surgical ICU for post-operative monitoring. In the ICU the patient continued to have a vasopressor requirement after resolution of spinal and epidural complicated by low urine output. Dobutamine was started for inotropic support, the patient quickly responded with diuresis and resolution of vasopressor requirement within eight hours. Postpartum pain management was adequately achieved with scheduled acetaminophen, NSAIDs, gabapentin and buprenorphine.

This case presented challenges in antepartum optimization as well as peripartum anesthetic management. A slow neuraxial anesthetic was preferred, however the IT bupivacaine and subsequent epidural dosing were inadequate for surgical anesthesia. It is possible the patient had hyperalgesia due to her IVDU, but this highlights the need for back-up plans given not only the co-morbidities of this particular patient but the frequent drug shortages we currently face.

Abstract #: RF7A10-506

Two Cases of Uterine Rupture in Low-Risk Patients

Presenting Author: Benjamin Stix MD
Presenting Author's Institution: Columbia University Medical Center - New York, NY
Co-Author: Bahaa Daoud MD - Columbia University Medical Center
Laurence Ring MD - Columbia University Medical Center

We present two cases of low-risk, young and otherwise healthy parturients that required cesarean-hysterectomies to control hemorrhage secondary to uterine rupture without prior uterine surgery.

Case 1: A 40-year-old G2P0 woman presented with hypertension (166/96 mmHg) at 36 weeks and 4 days gestation. She had a history of two posterior-corpus fibroids, and a spontaneous abortion, a recent ultrasound found a posterior placenta and a vertex fetus with EFW of 2826 grams. She was diagnosed with preeclampsia with severe features, started on a magnesium infusion and induced with misoprostol. A combined spinal-epidural technique was performed unremarkably for labor analgesia.

Case 2: A 37-year-old G8P2 woman presented for induction of labor at 39 weeks 6 days. She notably had 5 prior elective abortions and a history of abdominoplasty. Her sonogram estimated the fetal weight at 3946 grams. Her induction consisted of placement of dinoprostone, and subsequently, a cervical Foley balloon catheter. An epidural was placed for labor analgesia.

Both cases proceeded in a remarkably similar fashion. In both cases, labor was augmented with an oxytocin infusion. 12-14 hours after the infusion was started, the both patients had severe abdominal pain, fetal bradycardia and fetal loss of station. In each case, an emergent cesarean delivery was called and the patients were transported to the operating room.

General anesthesia was induced in both cases and the babies were delivered emergently. APGARs were 8/9 and 2/9 respectively. Both patients were found to have uterine rupture with hemorrhage – posterolateral and right lateral respectively. In each case, the uterine damage was so severe that hemostasis was not possible and a cesarean hysterectomy was performed as a life-saving measure. Both patients received large-bore vascular and arterial access. Both cases received significant blood transfusions , ultimately, both had unremarkable post-partum courses and were discharged on postoperative days 4 and 3 respectively.

The risk of uterine rupture without previous uterine manipulation is less than 0.006% of pregnancies. The major risk factors for uterine rupture are existing uterine abnormalities, previous surgical manipulation e.g. cesarean delivery and myomectomy, increased age, multiparity, malpresentation and excessive induction with oxytocin. Signs and symptoms are acute and include increased uterine pain or lack of breakthrough pain relief with epidural analgesia, severe fetal bradycardia, increased uterine contractions, vaginal bleeding and loss of fetal station.

These cases could help clinicians have increased suspicion for uterine rupture in patients without previous uterine manipulation. The cause of rupture in these cases is not clear. One possibility could be a combination of increased uterine contractions from the oxytocin infusion as well as uterine wall abnormalities from existing fibroids.

Abstract #: RF1BA-191

Transversus Abdominal Plane Block Using Liposomal Bupivacaine in an Obstetric Patient on Chronic Buprenorphine Therapy Undergoing Cesarean Section

Presenting Author: Christopher R Jones Doctor of Osteopathy
Presenting Author's Institution: Geisinger Medical Center - Danville, PA
Co-Author: Caleb Hodge DO - Geisinger Medical Center
Anasuya Vasudevan MD - Geisinger Medical Center

Patients with a history of opioid abuse and chronic pain are often managed with chronic buprenorphine therapy. The partial agonist properties of buprenorphine prohibit full activation of the opioid receptor even when full agonists are used. This presents a challenge to the anesthesiologist because opioid-based analgesic regimens for perioperative pain are often the mainstay. With the growing opioid epidemic, the need for opioid-free analgesic adjuncts is increasingly evident. The transversus abdominis plane (TAP) block utilizing liposomal bupivacaine represents one such adjunct. We present a case in which liposomal bupivacaine was used in a TAP block performed on a patient on chronic buprenorphine therapy undergoing Caesarean section and provided 3 days of excellent pain control.

A 28 year old G3 P1011 at female with a history of IV heroin abuse presented to Labor and Delivery for an elective repeat Cesarean section at 39 weeks and 1 day gestation. She had been on chronic buprenorphine therapy since the first month of her pregnancy and had not used heroin since that time. She underwent an uneventful Caesarean delivery and received bilateral TAP blocks with liposomal bupivacaine post-operatively. During the first three post-operative days she reported good pain control and required no intravenous opioid. She received only one dose of oral opioid during this time.

Several studies have shown the effectiveness of TAP blocks in providing analgesia and decreasing need for post-operative opioids1-4. There have not been any large studies investigating TAP blocks using liposomal bupivacaine specifically in patients on buprenorphine undergoing Caesarean section. In this case, we were able to limit post-operative opioid use and still provide adequate analgesia for 72 hours post-operatively. We believe that the technique described in this case shows promise as a way to provide opioid-free analgesia to this opioid-vulnerable population.

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Abstract #: RF1BA-213

Neuraxial analgesia after high dose unfractionated heparin

Presenting Author: Katharine Thompson MD
Presenting Author's Institution: Columbia University Irving Medical Center - New York, NY
Co-Author: Richard Smiley MD, PhD - Columbia University Irving Medical Center

Introduction: Morbidity and mortality associated with deep venous thrombosis (DVT) and pulmonary embolism has become a more recognized problem in obstetrics; utilization of thromboprophylaxis and anti-coagulation has increased. Due to pharmacokinetic and pharmacodynamic effects in pregnancy, high doses of unfractionated heparin (UFH) and low-molecular weight heparin (LMWH) are often used near term. This can be challenging to anesthesia providers considering neuraxial procedures.

Case :A 38-year-old G2P0 with a history of lupus and anti-phospholipid syndrome complicated by prior DVT presented at 41wk gestation for induction of labor. Throughout the pregnancy, she had been managed with warfarin and transitioned to 15000 UFH q12h at 37 weeks gestation. On the day of her admission, she self-dosed heparin ~ 15 hours prior to anesthesia consultation for epidural analgesia, at a cervical dilation of 3 cm. No coagulation studies were available; the anesthesiologist recommended determining the aPTT. The aPTT was 40.6 seconds, approximately 17% above the lab's upper limit of normal (34.5 sec). Given the elective nature of analgesia, it was recommended to wait 2-3 hours and recheck the aPTT. Approximately 150 minutes later, now 19 hours after the heparin dose, the aPTT was 35.3 seconds. Although just above the upper limit of normal, the decision was made to proceed with epidural placement. The procedure and her labor were uneventful.

Discussion: Unlike LMWH, recommendations for management of patients on high-doses of UFH are unclear. For example, in the recent SOAP consensus statement (1) it is noted that in patients receiving > 10000U/dose or > 20000U daily there is "minimal data to guide risk assessment" and it is only after 24 hours have passed since dosing AND with a normal aPTT that it is assumed to be "likely low risk to proceed with neuraxial." Despite the time since her last UFH dose being < 24hr, and acknowledging that the aPTT does not reveal everything about UFH effect, we decided that with an aPTT near normal limits and decreasing, reasonable assumptions could be made about elimination of UFH and a low risk of procedurally-related bleeding. While this is only one case, there are few if any other reports of actual coagulation test trends in pregnant women receiving high dose UFH at term. As anticoagulation in pregnant patients becomes more commonplace, further studies need to be aimed at determining more accurate UFH pharmacologic profiles, and how to assess complication risk in these patients (ex. aPTT, thromboelastography). Thromboelastography was not available to us, and its role in assessing UFH effect in this context is unclear. While it is recognized that earlier communication between the obstetric and anesthesia teams may have avoided this issue by delaying induction, we believe that determining the aPTT trend under the circumstances was a reasonable method to assess whether to proceed.

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Abstract #: RF1BA-242

Optimal pain management in a patient on suboxone after a planned repeat cesarean delivery turning into an unexpected cesarean/hysterectomy for morbidly adherent placenta (accreta)

Presenting Author: Katharine Thompson MD
Presenting Author's Institution: Columbia Medical Center - New York , NY
Co-Author: Jaclyn Snikeris MD - Columbia Medical Center
Ruth Landau MD - Columbia Medical Center

Background: Despite an alarming increase in the number of pregnant women on methadone or buprenorphine, there are no specific recommendations guiding postpartum pain management, and balancing the risks of poorly managed pain and withdrawal with that of respiratory depression is challenging in opioid-tolerant women. We present the case of a woman with OUD requiring a cesarean hysterectomy (C/Hyst) in the setting of an unexpected placenta accreta.

Case Presentation: A 39 yo G3P1 with OUD following a motor vehicle accident was scheduled for a repeat CD at 36 weeks in the setting of placenta previa; there was no evidence of parametrial invasion of the placenta on MRI. The patient was maintained on Suboxone® 2mg daily throughout pregnancy. During pre-anesthesia consult, she appeared depressed and anxious, and expressed the desire to avoid systemic opioids after CD. She agreed with plan for a CSE for CD and opioid-sparing multimodal analgesia with prolonged epidural analgesia (48-72h). After delivery (3195g baby girl; APGAR 9/9), the placenta was found to be morbidly adherent and a hysterectomy was decided (under GA, with arterial line and additional peripheral access). Hemodynamic status was stable despite EBL of 2500ml (4 units of pRBCs & 2 units of FFP). The patient was extubated at the end of case and transferred to the high-risk unit. Post-operative pain management was carried as planned with prolonged epidural analgesia (see Table). The epidural catheter was removed on postpartum day 3. The patient did not take oral opioids and was discharged on postpartum day 4.

Discussion: Reviewing the scarce available literature on post-cesarean pain management in women on Suboxone, there seems to be 2 opposing approaches with regards to using neuraxial fentanyl or morphine. In some reports, neuraxial opioids are omitted under the premise that the high binding affinity of buprenorphine will result in limited u-opioid receptor availability and neuraxial opioids will 'not work' and IV hydromorphone is proposed, others suggest maximizing neuraxial local anesthetics with opioids (possibly at even higher doses ± clonidine with appropriate monitoring) in combination with non-opioid adjuvants. Since our patient was highly motivated to avoid systemic opioids, repeated dosing of epidural morphine proved effective and the patient was very satisfied. To our knowledge this is the 1st report of an unexpected C/Hyst in the setting of Suboxone® use.

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Table. Anesthesia and pain management after C/Hyst until discharge on postpartum day 4

	Day 0 (C/Hyst)	Postpartum day 1	Postpartum day 2	Postpartum day 3	Postpartum day 4
Pre-Spinal Anxiolysis	IV Clonidine 50mcg				
Spinal Anesthesia	Bupivacaine 12mg Fentanyl 15mcg Morphine 150mcg	-	-	-	-
General Anesthesia	IV Propofol 200mg IV Succinylcholine 120mg IV Fentanyl 200mcg	-	-	-	-
Epidural Analgesia (post-CD)	Lidocaine 2% 15mL bolus Bupivacaine 0.1% & fentanyl 2mcg/ml infusion: 10ml/h, PCEA 5ml/q15min	Morphine 3mg	Morphine 3mg	Morphine 3mg	-
NSAIDs	-	Ibuprofen 600mg q6h	Ibuprofen 600mg q6h	Ibuprofen 600mg q6h	Ibuprofen 600mg q6h
Acetaminophen	PO 975mg q6h	PO 975mg q6h	PO 975mg q6h	PO 975mg q6h	PO 975mg q6h
Lidocaine Patch	5% Transdermal q24h	5% Transdermal q24h	5% Transdermal q24h	5% Transdermal q24h	5% Transdermal q24h
Oxycodone	0	0	0	0	0
Benzodiazepines	IV Midazolam 4mg	-	-	-	-
Suboxone	SL 2mg daily	SL 2mg daily	SL 2mg daily	SL 2mg daily	SL 2mg daily

Abstract #: RF1BA-253

Lumbar Epidural Catheter Placement for Control of Labor Pain in a Patient with Spinal Cord Stimulator

Presenting Author: William Smisson MD
Presenting Author's Institution: University of Mississippi Medical Center - Jackson , Mississippi
Co-Author: William B Smisson MD - University of Mississippi Medical Center
Sara R Novotny MD - University of Mississippi Medical Center
Hyung W Kim MD - VAMC
Rache Roberts MD - VAMC
Yieshun M Chan MD - University of Mississippi Medical Center

Introduction: Spinal Cord Stimulators (SCS) are used in the treatment of chronic pain. Its periprocedural management is sparsely commented on in literature, and what is available is confusing.1 Some anesthesiologists may be unfamiliar with SCS management particularly when complicated by pre-existing device-related problems. We present the care of a laboring parturient with implanted SCS and percutaneous leads for complex regional pain syndrome type 1 (CRPS type 1).

Case Report: 30-year-old female G1P000 with 3-year history of CRPS type 1 of right ankle from traumatic sprain presents to L&D suite for induction of labor at 38 weeks & 6 days. SCS was implanted 3 years prior followed by incision & drainage of the generator pocket for infection. This resulted in significant scarring and atypical anatomy. On exam, paramedian scar extended well below L5-S1. The SCS generator is mobile, dangling in the pocket, and can be flipped from side-to-side. At night, patient's husband moves her SCS off her spinous process as she lay supine. Outside records were unavailable. Patient requested epidural catheter (EC) for labor analgesia. Other options for pain management were unavailable or patient-declined.

After extensive discussion with patient and consultation with pain management specialists, an anteroposterior (AP) x-ray was ordered and reviewed. EC was placed uneventfully using real-time ultrasound identification of the path of extension wires. Satisfactory pain control was achieved. EC was removed without complication after vaginal delivery and she was discharged home.

Discussion: Successful management of labor pain using epidural analgesia is possible in parturient with implanted SCS. Gathering pertinent data and learning takes time and reiterates the importance of pre-operative assessment, record obtaining, and plan formulation by a multidisciplinary team.2 Of primary importance is locating the hardware and wire entry points. Some authors avoided neuraxial technique if extension wires were near L3-L4 intervertebral space.2 AP x-ray and ultrasound can be used to locate and avoid critical components if patient records are unavailable.3 Generic recommendation to "insert below the scar" was unhelpful; her scar extended to just above her intergluteal cleft. Other recommendations for parturient with SCS include SCS inactivation over concerns of teratogenicity and avoidance of monopolar electrocautery.2,3

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Abstract #: RF1BA-276

Continuous Epidural Hydromorphone Infusion for Post-Cesarean Delivery Analgesia in a Patient Maintained on Methadone

Presenting Author: Mellany A Stanislaus MD
Presenting Author's Institution: The Ohio State University Wexner Medical Center - Columbus, Ohio
Co-Author: Robert H Small MD - OSUMC
Avery Meyer N/A - OSUMC
Mona Prasad DO - Riverside Methodist Hospital
Julie H Coffman MD - Riverside Methodist Hospital
John C Coffman MD – OSUMC

A 30-year-old G2P0102 with PMH of obesity, chronic HTN and polysubstance abuse, maintained on daily methadone, presented for repeat cesarean delivery (CD) at 38w2d.

About 2.5 years prior, she underwent CD of di-di twins at 35w6d due to superimposed preeclampsia. Combined spinal-epidural (CSE) was performed at L4/5 with 0.5% bupivacaine 1.8mL, morphine 0.2mg, fentanyl 10mcg and epinephrine 200mcg (spinal), and incremental epidural dosing of 2% lidocaine + epinephrine 13mL during the procedure. Postoperative management included methadone 165mg daily, PO oxycodone as needed, IV ketorolac (0-24 hrs), PO ibuprofen (24 hrs until discharge) and PO acetaminophen as needed. Pain control was difficult, reflected by an average of oxycodone 85 mg/24h and average maximum daily pain scores of 8/10. Discharge occurred 3d 22h after delivery.

For her current CD, an L3/4 epidural was placed and incrementally dosed with 0.5% ropivacaine 25mL, morphine 2mg and fentanyl 85mcg. About 30 minutes after delivery, epidural hydromorphone was initiated at 140mcg/h with PCEA 20mcg, 30 minute lockout for a total dose of 3.36mg/24hrs. Postoperative management also included methadone 190mg daily, PO oxycodone as needed, IV ketorolac, PO ibuprofen and PO acetaminophen. Compared to her previous delivery, average 24h oxycodone use decreased to 2.5mg, pain scores improved to 4-5/10 daily, and she was able to ambulate. She was discharged 2d 4h after delivery. The epidural was removed 12 hours prior to discharge. Her overall satisfaction was much greater after her second CD.

Discussion: Since 1999, the prevalence of opioid use disorder (OUD) has quadrupled in pregnant women (1). Among recommended opioid agonist pharmacotherapies, buprenorphine results in lower incidences of fetal and neonatal morbidity, although pregnant women are still sometimes maintained on methadone (2).

Despite therapy, management of postpartum pain in women with OUD remains a formidable challenge for obstetric anesthesiologists. Meyer et al. found that after CD, 33 women on maintenance methadone therapy had higher pain scores and as much as a 70% increase in opiate use, averaging 91.6mg oxycodone/24hrs (3). Institutional data also reveals similar trends among 46 women, requiring 83.3mg oxycodone/24hrs.

Prior studies have compared single dose neuraxial hydromorphone to morphine in postpartum women without findings of statistical or clinical significance (4). Although continuous epidural hydromorphone has been used after thoracotomy (5), no studies explore its postpartum efficacy in opioid dependent or abusing women. We propose that utilization of continuous epidural hydromorphone may serve as a viable approach in women with OUD on methadone, evidenced by decreased pain scores and shorter hospital stay in this case report.

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Abstract #:RF1BA-322

Neuraxial Anesthesia for Caesarean Section in a Patient with Anti-NMDA-Receptor Encephalitis

Presenting Author: Anna Martin MD
Presenting Author's Institution: University of Texas Southwestern Medical Center - Dallas, Texas
Co-Author: Alexa Kaminski MD - University of Texas Southwestern Medical Center
Stephanie Byerly MD - University of Texas Southwestern Medical Center
Tristyn St. Thomas-Achoja MD - University of Texas Southwestern Medical Center

Anti-N-methyl-D-aspartate encephalitis (anti-NMDARE) is an autoimmune disorder that predominately affects females (1). Common clinical manifestations include psychotic symptoms, neurologic symptoms, and autonomic instability (2). One of the only case reports of neuraxial anesthesia for an anti-NMDARE patient documents failure of spinal block but success after epidural dosing. The following case may help provide insight when considering neuraxial anesthesia for anti-NMDARE patients (3).

A 20-year-old G1 female at 10 weeks and 6 days presented with new onset refractory status epilepticus, necessitating intubation for airway protection and prolonged ICU care. A diagnosis of anti-NMDARE was made based on detection of NMDA antibodies. She received multiple immunomodulary treatments (steroids, PLEX, IVIG, cyclophosphamide and rituxan). She subsequently suffered respiratory failure, underwent a tracheostomy and eventually decannulated. She was discharged after five months and continued to follow with neurology and MFM. A scheduled induction was planned for 39 weeks and 2 days but rescheduled when she was readmitted at 38 weeks and 4 days for a general tonic clonic seizure. During this admission, she continued to have breakthrough seizures, tachycardia secondary to autonomic dysfunction, impaired mobility from contractures, torticollis, limited spinal flexion, and anxiety/PTSD.

Based on the position of the fetus (transverse lie), the obstetric service scheduled a caesarean section for 38 weeks and 6 days. She was pre-treated with sodium citrate 30 ml PO, famotidine 20 mg IV, and ondansetron 8 mg IV. A combined spinal epidural was successfully placed via midline approach. Intrathecal injection was performed utilizing 1.3 mL of 0.75% hyperbaric bupivacaine, 20 mcg of fentanyl, and 150 mcg of preservative free morphine. A bilateral T6 surgical block was obtained and surgery commenced. A phenylephrine drip was started after incision and titrated to achieve desirable blood pressures. A healthy male was delivered 7 minutes after incision and oxytocin was given after placental delivery. An epidural test dose of 3 mL of 1.5% lidocaine with 1:200,000 epinephrine was given at approximately one hour after spinal injection. Additionally, 10 mL of 3% chloroprocaine and 80 mcg of fentanyl were injected into the epidural space. Acetaminophen and ketorolac were administered for additional post-operative analgesia. Estimated blood loss was 1000 ml. Post-op course was uncomplicated and she was discharged home on POD#4.

Our case shows that neuraxial anesthesia can be a safe and effective form of anesthesia for parturients with anti-NMDARE. While anti-NMDARE is rare during pregnancy, it is commonly associated with ovarian teratomas, which often necessitate resection (4).

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Abstract #:RF1BA-341

Between a Rock and a Hard Place: Labor Analgesia in a Patient with Congenital Pulmonic Stenosis and a new onset intracranial lesion.

Presenting Author: Robert Kerris MD
Presenting Author's Institution: Johns Hopkins Medicine - Baltimore, MD
Co-Author: Oleg Turkot MD - Johns Hopkins Medicine
Gillian Isaac MD - Johns Hopkins Medicine

Introduction: Epidural anesthesia is often utilized in patients with heart disease, pulmonary hypertension or severe pre-eclampsia. Its benefits include a decrease in maternal catecholamine release thus reducing the stress on the maternal cardiorespiratory system. An often-cited contraindication to neuraxial anesthesia is the presence of an intracranial tumor. Patients with intracranial tumors are assumed to have an increase in intracranial pressure (ICP) and inadvertent dural puncture during epidural placement can have catastrophic consequences.

Case Report: 21 yo F G2P0 who presented at 37 weeks for induction of labor for gestational hypertension with a PMH of HFpEF, congenital pulmonic stenosis s/p balloon valvuloplasty, anomalous right coronary artery s/p unroofing procedure, kyphoscoliosis s/p T3-T12 fusion, asthma, Wilm's tumor s/p right nephrectomy and new onset seizures from a lesion of the medial left parasagittal parietal lobe. Her most recent TTE was significant for an EF estimated at 50-55%, abnormal septal motion and moderate pulmonary regurgitation. A MRI showed a T2 FLAIR hyperintense lesion with mild mass effect without midline shift. A multidisciplinary team was consulted to evaluate options for labor analgesia. Based on the absence of evident brain herniation or midline shift and patent basal cisterns the patient was deemed suitable for epidural catheter placement. An epidural block was performed by a senior anesthesiologist at the L4-5 interspace using a 17G Tuohy needle. Epidural analgesia was achieved with careful titration of PCEA. The patient tolerated the procedure well with no untoward events. The patient had a spontaneous vaginal delivery without complications.

Discussion: Intracranial lesions are cited as contraindications to neuraxial anesthesia due to the possibility of inadvertent dural puncture and subsequent brain herniation through the foramen magnum. However, a benefit of neuraxial anesthesia is the reduction of maternal catecholamine release during labor thus reducing the strain on the heart. Due to the history of HFpEF in our patient, we preferred to utilize an epidural block for labor analgesia. Given the concomitant presence of a brain lesion, it was necessary to seek expert opinion by neurosurgery with regards to the safety of epidural placement. After a review of the imaging and a neurological examination it was determined the patient likely did not have an increase in ICP thus making her a candidate for epidural placement. Careful titration of the epidural and avoidance of hypotension were paramount to reduce the stress response and associated catecholamine release.

Conclusion: An epidural block for labor analgesia may be a suitable option for labor analgesia in a patient with cardiac dysfunction and an intracranial lesion. A thorough review of the patient's imaging, history and clinical exam and consultation with a multidisciplinary team should guide decision making.

Abstract #:RF1BA-433

Low Dose Combined Spinal Epidural in Preterm Parturient Requiring Urgent Cesarean Delivery with Severe Preeclampsia, Pulmonary Edema, and Chronic Kidney Disease

Presenting Author: Jarna R Shah MD
Presenting Author's Institution: University of Illinois Hospital and Health Sciences System - Chicago, IL
Co-Author: Edina S Kim MD - University of Illinois Hospital and Health University of Illinois Hospital and Health Sciences System
Jacqueline M Galvan MD - University of Illinois Hospital and Health Sciences System

Introduction: Preeclampsia affects 3-5% of all pregnancies, contributes to 15% of preterm deliveries, and remains a leading cause of maternal morbidity and mortality. In addition, parturients with diabetic nephropathy are at higher risk for preterm delivery and preeclampsia. Patients who present with early onset preeclampsia may manifest with more severe symptomatology that necessitates a higher level of anesthetic planning for delivery. Exaggerated physiologic response to full dose spinal technique for cesarean delivery (CD) may be poorly tolerated in this cohort. Therefore, an alternative technique such as low dose combined spinal epidural (CSE) may be useful. We report the successful use of low dose CSE to facilitate a urgent cesarean delivery in a young primiparous parturient who presented with preeclampsia with severe features, pulmonary edema, and acute on chronic kidney injury.

Case: Patient is a 24yo G1P0 admitted at 24w gestation who presented with PMH type 1 diabetes in acute DKA with worsening creatinine function, CKD stage 3, cHTN, and asthma. Fetal complications included polyhydramnios and absent umbilical arterial end diastolic flows on Dopplers. Three days later, despite medical management of her chronic systemic disease, she developed acute abdominal pain and dyspnea, escalating her diagnosis to preeclampsia with severe features. A beside transthoracic echocardiogram confirmed a diagnosis of pulmonary edema. Given worsening maternal pulmonary status, the decision was made to proceed with urgent CD. Anesthetic goals included adequate onset of anesthesia and avoidance of a rapid sympathectomy. A reduced dose of 7.5 mg of hyperbaric bupivacaine was injected intrathecally as part of a CSE. Additional epidural fentanyl was administered to attenuate the visceral pain associated with uterine manipulation, and the patient reported adequate analgesia during CD.

Discussion: This case illustrates the challenges in facilitating an urgent CD in a parturient with early onset preeclampsia with severe features in the second trimester. Point of care ultrasound reaffirmed the importance of avoiding excessive fluid administration which would traditionally be given to treat hypotension after full dose spinal for CD. The urgent preterm delivery in the setting of severe preeclampsia required rapid onset of neuraxial anesthesia. The sympathectomy associated with a traditional spinal dose, typically treated with intravenous fluids, would be deleterious in a patient with pulmonary edema. A low dose CSE (7.5-9 mg hyperbaric bupivacaine) is a technique that has been used in parturients in whom avoidance of hemodynamic perturbation is desirable.

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Abstract #: RF1BA-517

The Best Laid Plans with a Suspected Right Atrial Mass and Pulmonary Hypertension

Presenting Author: Michael Y. Williams MD
Presenting Author's Institution: University of Illinois at Chicago - Chicago, IL
Co-Author: Corinne Weinstein MD - University of Illinois at Chicago
Heather Nixon MD - University of Illinois at Chicago

Introduction: The mortality of pregnant patients with pulmonary arterial hypertension (PAH) remains high, with some reports of 35-50% (1). Newer therapies and clinical strategies may be improving outcomes, however, this remains a dangerous diagnosis to carry especially in the setting of additional complex medical issues which inhibit the diagnostic performance of right heart catheterization (RHC) such as a right atrial mass (2). In the adult population, atrial masses can be due to a primary cardiac tumor, an intracardiac thrombus or endocarditis vegetation, all of which carry physiologic consequences including intracardiac flow obstruction, pulmonary embolism, and arrhythmia (3,4). Even though parturients with pulmonary hypertension are rare, the combination of PAH and right atrial mass makes the creation of an effective and safe labor plan especially challenging. Unfortunately, in spite of the best laid plans, unexpected circumstances present themselves. We describe such a case where a carefully constructed plan involving advanced, multidisciplinary planning was aborted due to a precipitous delivery.

Case Presentation: AN was a 33 yo G4P3 @ 37+4 with PMH of obesity (BMI 39), HTN, suspected RA mass and PAH, restrictive lung disease, scoliosis, gDM, anemia, and anxiety who presented to L&D two days prior to starting her IOL for medical optimization. Over the previous month multidisciplinary meetings were held to discuss the labor plan and further workup including a cardiac CT (cCT) and RHC to evaluate both her suspected right heart mass and PAH. Even though the cCT confirmed the absence of a right heart mass, the patient refused a RHC. Preparations were made for delivery with the assumption of the presence of PAH including invasive monitoring and inhaled NO. Despite extensive preparation and resource utilization, the patient precipitously delivered without further intervention. She was transferred to the MICU where NO was discontinued within hours without further complications.

Discussion: RA masses are rare in any population, but this diagnosis in the presence of pulmonary hypertension borders on the frequency of a unicorn sighting. This case highlights that while multidisciplinary planning is critical, providers should remain vigilant to avoid over treating, especially in a stable patient.

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Abstract #:RF1BA-548

Amiodarone for Refractory Fetal Supraventricular Tachycardia Complicated by Hydrops Fetalis – A Case Report

Presenting Author: Mellany A Stanislaus MD
Presenting Author's Institution: The Ohio State University Wexner Medical Center - Columbus, Ohio
Co-Author: Courtney James MD - OSUMC
Robert H Small MD - OSUMC
Kasey Fiorini MD - OSUMC

A 25-year-old G1P0 with PMH of cHTN and GERD presented from an outside hospital at 28w6d for fetal tachycardia with HR in the 250s. Upon presentation, there was no evidence of hydrops on ultrasound. Digoxin was initiated with a loading dose of IV 500mcg x1, followed by IV 250mcg Q6h x3 doses. After 48h, FHR remained >200 bpm and PO flecainide 100mg TID was started. On HD 4, Cardiology was consulted as FHR continued to be refractory. Fetal ultrasound now revealed hydrops with pericardial and pleural effusions and ascites. Maternal ECG also showed QT prolongation. The following day, flecainide was discontinued, PO amiodarone 600mg TID was initiated and PO digoxin was decreased to 125mcg QD. Maternal echo revealed a normal EF. On HD 6, amiodarone was increased to 800mg TID. On HD 7, pleural effusions mildly worsened. Maternal TSH was WNL. She was maintained on amiodarone 800mg TID and digoxin 125mcg QD through HD 10, when FHR converted for one hour. On HD 11, sustained conversion was achieved with FHR maintained between 120-130 bpm. Medication totals were digoxin 2500mcg, flecainide 1000mg and amiodarone 14.2g. There were no structural abnormalities detected on fetal echo. The patient was discharged home at 30w3d on an amiodarone taper: 400mg BID x1 week, 400mg BID x4 weeks, 200 mg QD until delivery.

At 39w4d the patient underwent a scheduled cesarean delivery having completed nine weeks of amiodarone totaling 35g. Preoperatively, an epidural was placed, incrementally dosed with 0.5% ropivacaine 20mL total, fentanyl 100 mcg and morphine 2mg. Intraoperative course was uncomplicated. She delivered a 3780g infant, APGARs 8/9. She was discharged on POD3. The baby was transferred to a local children's hospital for cardiac monitoring.

Discussion: Fetal arrhythmias occur in 1-2% of pregnancies. Of these, supraventricular tachycardia (SVT) is the most common tachyarrhythmia (1). Nonimmune hydrops fetalis (NIHF) is a complication of fetal SVT. SVT with NIHF is associated with an intrauterine or neonatal mortality of 20-46% despite treatment (2).

Digoxin and flecainide are first-line therapies used to treat fetal SVT (2). For SVT with NIHF, digoxin is rarely effective (3), but successful conversion has been reported with flecainide (2). Amiodarone has been used for refractory cases of fetal SVT. A downside of the medication is its long half-life and fetal complications including hypothyroidism (3).

Standard amiodarone dosing is loading with 1600-2400mg/day, usually halved every 24h; maintenance dose 200-400mg/day (3). Sridaran et al. report successful conversion of SVT after six days with a loading strategy of 12-13g over one week with digoxin continued for the duration of gestation (2). We describe successful treatment of refractory SVT complicated by NIHD with amiodarone and maintenance of fetal HR with a monotherapy taper.

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Abstract #:RF2BB-61

Bedside Cesarean Section in Trauma Bay: A Lesson on Emergency Management and Hypertensive Crisis

Presenting Author: Allison Mullins MD
Presenting Author's Institution: The University of Texas Medical Branch - Galveston, Texas
Co-Author: Mohamed Ibrahim MD - The University of Texas Medical Branch
Rakesh Vadhera MD, FRCA, FFARCSI - The University of Texas Medical Branch
Michelle Simon MD - The University of Texas Medical Branch
Rovnat Babazade MD - The University of Texas Medical Branch

Background: Obstetric emergencies can present suddenly. Hypertension complicates 5-10% of pregnancies in the United States and along with cardiovascular conditions, is amongst the top causes of pregnancy related deaths [1, 2]. Hypertensive emergency during pregnancy can cause complications necessitating urgent evaluation and intervention.

Case report: A 33 year old G1 at 36 weeks with a PMH of chronic hypertension and acute methamphetamine use presented to the Emergency Department (ED) as a transfer from an outside hospital for superimposed preeclampsia. During transfer she developed worsening hypoxic respiratory failure with confusion and hemoptysis. Upon arrival her BP was 198/126, HR 118, RR 28 and SpO2 40%. She was placed on non-rebreather with improvement to 78%. She was intubated by the ED physician using midazolam and succinylcholine with improved SpO2 90%. Upon arrival of the Labor and Delivery team, the FHR was in the 80-90s and the decision was made to perform an emergent bedside cesarean section for terminal deceleration and risk of decompensation during transfer to the OR. Anesthesia was managed with a propofol infusion and rocuronium. Monitoring included an arterial line and she received a nicardipine infusion with BP improvement to the 160s/80s. The fetus was delivered after 6 minutes with Apgars of 2 and 7 at 1 and 5 minutes. The infant taken to NICU on NCPAP and weaned to room air over 12 hours. Patient's ABG with FiO2 of 100% was pH 7.07, pCO2 47, pO2 76, HCO3 13, BE -16 and lactic acid 4.4. She was given 1 ampule of bicarbonate. Post-op CT chest showed diffuse alveolar hemorrhage and pulmonary edema. CT head showed a small hypodensity in the left occipital lobe. She was transferred to the ICU with SpO2 90% and placed on APRV mode with SpO2 improvement to the upper 90s. Bedside TTE was done showing LVH with left atrial dilation. IV Lasix was added. She was extubated on postpartum day 1, transitioned from nicardipine infusion to nifedipine and discharged on postpartum day 4.

Discussion: The patient likely experienced acute LV dysfunction secondary to hypertensive emergency due to acute methamphetamine use, however superimposed preeclampsia with severe features, pulmonary embolism and CVA were considered. The decision to perform bedside cesarean delivery versus in the OR is a debated topic and choice of location varies depending on the hospital layout and patient situation. Benefits of delivery in the OR include sterile conditions, familiar surroundings, access to necessary equipment and personnel including Neonatologists while the benefit of performing a bedside delivery includes faster time to delivery [3].

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Abstract #: RF2BB-87

Postpartum Renal Failure: What's the Diagnosis?

Presenting Author: Christina Dgheim DO
Presenting Author's Institution: New York University - New York , New York
Presenting Author Status:
Co-Author: Ghislaine Echevarria MD - New York University
Eli Zarkhin MD - New York University
Gilbert Grant MD - New York University

34 y.o. G1P0 at 36 weeks gestation was admitted for planned cesarean delivery of twins for malpresentation. Her current obstetrical course was significant for cholestasis of pregnancy. Her platelets were noted to be 60,000 10*3/uL; other laboratory studies and vital signs were unremarkable. The decision was made to proceed with cesarean delivery under general anesthesia.

The case proceeded uneventfully, and the quantitative blood loss was 800 mL. Approximately 30 minutes after arrival in the PACU, the uterus was found to be atonic and when expressed, an additional 800 mL of blood loss was noted. The patient was returned to the OR for an exam under anesthesia. General anesthesia was induced, and a Bakri balloon was placed. Cumulative quantitative blood loss was 2200 mL. The patient remained hemodynamically stable throughout and received 1 unit of packed red blood cells, a thromboelastogram was sent which was within normal limits. She was extubated and brought to the PACU.

In the PACU her urine output decreased to <0.5mL/kg/hr. Lab tests were re-assessed 6 hours later and it was noted that creatinine had increased from 0.98 to 1.7 mg/dL. Other lab abnormalities were a decrease in platelets to 28,000 10*3/uL, AST/ALT 133/44 U/L, K 5.3 mmol/L, fibrinogen 121 mg/dL, total bilirubin of 2.3 mg/dL and LDH of 480 Units/L. The decision was made to transfer the patient to SICU for closer observation.

In SICU her signs and symptoms were attributed to atypical HELLP and she was treated with intravenous magnesium sulfate at 1g/hr. However, her creatinine continued to rise up to 7 mg/dl, and LDH increased to 1700 Units/L.

Schistocytes were seen on her peripheral blood smear, and a diagnosis of Thrombotic Thrombocytopenic Purpura and Hemolytic-Uremic Syndrome (TTP-HUS) was considered.

An ADAMTS13 level was sent STAT, and methylprednisolone plus plasmapheresis were started emergently. Her platelet count began to increase, and her creatinine slowly began to decrease. Seventy-two hours after the beginning of the plasmapheresis, the ADAMTS13 levels came back normal (38%). Decision was made to stop the plasmapheresis and to start eculizumab. Finally her laboratory tests gradually improved, and she was discharged home on POD 7 on eculizumab and steroids, with the presumed diagnosis of atypical HUS.

TTP-HUS is a rare complication of pregnancy. TTP-HUS may occur for the first time during the postpartum period for reasons that are unclear, presenting with microangiopathic hemolytic anemia, thrombocytopenia, central nervous system abnormalities, fever and renal impairment. All the above clinical presentations overlap with that of the more common HELLP syndrome. It is important to consider both diseases in the differential diagnosis for a woman presenting with the above features, as the management of the two syndromes differ.

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Abstract #: RF2BB-100

Management of Cholangiocarcinoma in Pregnancy: A Case Report.

Presenting Author: Dung T Pham M.D.
Presenting Author's Institution: Mount Sinai West - New York , NY
Co-Author: Deborah Stein M.D. - Mount Sinai West
Julio Marenco M.D. - Mount Sinai West
Barbara Orlando M.D. - Mount Sinai West
Migdalia Saloum M.D. - Mount Sinai West

Introduction: Cholangiocarcinoma is the second most common primary hepatic malignancy [1]. Treatment includes surgical resection, orthotopic liver transplantation, and chemotherapy [1]. This is a case of metastatic cholangiocarcinoma diagnosed during pregnancy.

Case Presentation: A 37-year-old female, G7P2042, at 29 weeks gestation with a history for heroin abuse on methadone who presented with progressive right upper quadrant pain, nausea, vomiting, and jaundice for 2 months. A RUQ ultrasound with subsequent MRCP was performed with results of distal common bile duct obstruction and two liver lesions with concern for malignancy. The patient was started on hydromorphone PCA with addition of home methadone dose, supplemental ketorolac and oxycodone ER. She was transitioned to morphine PCA for trial of opioid rotation given her continued complaint of severe pain. Soon after, the patient underwent an IR-guided liver lesion biopsy with final pathology of intrahepatic cholangiocarcinoma. Of note, INR increased from the beginning of admission.

An interdisciplinary meeting was held, and the decision was made to proceed with imminent delivery due to maternal concerns out weighing fetal concerns, given the patient\'s consumption of numerous drugs, including heroin, the ongoing intractable pain, and deteriorating liver function including coagulation.

Prior to initiation of the planned delivery, the patient noted spontaneous preterm premature rupture of membranes. She received two doses of vitamin K 10mg with subsequent normalization of coagulation including INR and prothrombin. Induction of labor was started and a combined spinal epidural was placed for analgesia, at L2-L3 interspace without any complications. The patient had an uncomplicated vaginal delivery. Eventually, pain management consisted of morphine PCA, IV morphine prn, methadone, gabapentin, and ketorolac.

ERCP with stent placement was accomplished on postpartum day 3. The patient underwent endoscopic ultrasound guided celiac plexus neurolysis on postpartum day 5 given her persistent abdominal pain. The patient was weaned off of IV-PCA and transitioned to methadone, gabapentin, oxycodone, flexeril, diclofenac, fentanyl patch, and lidocaine patch. Inpatient chemotherapy was started on postpartum day 10. The patient was discharged on postpartum day 17 with plan for outpatient chemotherapy and palliative care.

Discussion: Cholangiocarcinoma is an uncommon and aggressive malignancy associated with a median survival of 3-6 months and an incidence of 0.58 per 100,000 [2]. This case highlights the potential anesthetic challenges in a pregnant patient with cholangiocarcinoma including potential contraindication to regional anesthesia/analgesia and difficult pain control in the peri-partum period.

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Abstract #: RF2BB-123

An Intrapartum Epidural Blood Patch

Presenting Author: David G DePinto DO
Presenting Author's Institution: University of Texas Southwestern Medical Center - Dallas, TX
Co-Author: Nwamaka Nnamani MD - University of Texas Southwestern Medical Center

Introduction: Post-dural puncture headache (PDPH) is a common unintentional consequence of epidural placement, spinal anesthesia, and therapeutic lumbar puncture. Treatment includes autologous lumbar epidural blood patch (EBP). This case presents a unique clinical situation where a patient required a labor epidural two hours after receiving a therapeutic epidural blood patch for a post-dural puncture headache.

Case: 32 year old G3P2 at 37 weeks gestation with PMH of cervical insufficiency presents with contractions and headache. Two days prior, patient underwent an uneventful cerclage removal under epidural anesthesia. During placement of the epidural, dural puncture was inadvertently obtained at L3-4 interspace and a second attempt at L2-3 interspace was uneventful. Patient's symptoms were consistent with post-dural puncture headache. Discussion with obstetricians revealed that the patient was not in active labor. A blood patch was performed with 14 mls of autologous blood and her headache was relieved. One hour after the blood patch, her cervical examination changed and she was in active labor and subsequently requested an epidural for labor analgesia. The epidural was placed two hours after the blood patch without complication. Patient had SVD and epidural catheter was removed postpartum.

Discussion: PDPH generally present with severe headaches that are usually orthostatic and EBP is the treatment of choice. Fresh blood in the epidural space comes with limitations to immediate neuraxial placement and efficacy that include: inconsistent analgesia profile, possible arachnoidits and possible high spinal2. We report one of the shortest time interval between epidural blood patch and labor analgesia.

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Abstract #: RF2BB-160

Hereditary Hemorrhagic Telangiectasia Type I in Pregnancy

Presenting Author: Peter Cardone D.O.
Presenting Author's Institution: University of Connecticut - Farmington, CT
Co-Author: Adam Sachs M.D. - University of Connecticut

Introduction: Hereditary Hemorrhagic Telangiectasia Type I (HHT) is an autosomal dominant vascular disorder, which usually manifests as epistaxis, GI bleeding, pulmonary arteriovenous malformations (AVMs), and mucocutaneous telangiectasias. Serious complications such as paradoxical emboli through the right to left shunt created by pulmonary AVMs, hemorrhage and high output cardiac failure can develop in these patients. Prevalence is estimated at 1:5000 to 1:8000.

Case Report: Our patient was a 27 year old G3P0 with a history of HHT and pulmonary AVMs which were coiled/ablated in 2003, 2009 and 2013. A CT scan in 2015, however, showed persistence of multiple pulmonary AVMs. She had significant hypoxia with a baseline oxygen saturation of 86% and an exertional saturation as low as 77%. The Maternal Fetal Medicine team wanted to deliver her by cesarean section (CS) at 37 weeks due to her worsening dyspnea and hypoxia. An MRI during pregnancy did not show any spinal AVMs or lumbar abnormalities, but did show vertebral body hemangiomas at T2, T6, T8, and T11. The patient underwent CS at 37 weeks with spinal anesthesia using 1.8mL of 0.75% PF bupivacaine with 15mcg fentanyl and 0.15mg morphine without incident. She was maintained on 3L by nasal cannula throughout the procedure and saturations ranged from 83-96%. She recovered well and was discharged home on POD#3.

Discussion: While the safety of neuraxial anesthesia in patients with HHT is unclear, it is especially precarious in patients with spinal pathology. This patient was particularly challenging because not only was she at a high risk of neuraxial bleeding, she was also at a high risk of pulmonary complications. Although it was reassuring the spinal hemangiomas were in the vertebral bodies remote from the area of spinal placement and no large spinal AVMs were noted, it was unclear whether some smaller, abnormal vasculature may be present in the lumbar spine. The major concern was spinal bleeding, but this patient was also at increased risk of paradoxical embolism from her right to left shunting, and worsening hypoxemia due to increasing metabolic demands during pregnancy. This hypoxemia would not be amenable to supplemental oxygen due to her shunt pathology.

Even though no anesthetic was ideal, after multidisciplinary discussion, it was decided that a spinal would impart the lowest risk of complications. There is no evidence that the sympathectomy that occurs with a spinal would increase flow through a pulmonary AVM and result in further desaturation. In addition, a spinal had a lower risk of neuraxial bleeding because of the smaller needle size as compared to an epidural, and avoiding general anesthesia would be highly advantageous because of the high risk of prolonged post-operative intubation and pulmonary complications. It was believed the chances of the CS lasting longer than the duration of the spinal was unlikely and not worth the increased risk of an epidural.

Abstract #: RF2BB-181

Acute Hypertriglyceridemia Pancreatitis in Term Pregnancy: a case report

Presenting Author: Tina M Yu MD
Presenting Author's Institution: University of California San Francisco - San Francisco, CA
Co-Author: Mina Khorashadi MD - University of California San Francisco
Katherine Shea MD - University of California San Francisco
Peter Yeh MD - University of California San Francisco

Introduction: Acute pancreatitis (AP) is rare in pregnancy but can cause serious maternal and fetal morbidity. Patients with familial hypertriglyceridemia (HTG) can develop acute gestational pancreatitis (4-56%) due to increased triglycerides (TG) during pregnancy.

Case Report: 40 y female G2P0 at 36w1d presented with severe epigastric abdominal pain radiating to the back found to have AP. She had a family history of HTG, but had never been tested herself. Her initial labs revealed elevated TG of 7000mg/dl, lipase of >400 U/L and absence of gallstones on ultrasound. She was transferred to the ICU due to the severity of her epigastric pain, compensated anion gap metabolic acidosis with a pH of 7.29 and associated hypocalcemia. Fetal heart rate (FHR) on admission was 130bpm with moderate variability and accelerations.

She was managed with aggressive fluid resuscitation and an insulin drip with dextrose. Apheresis to rapidly lower HTG was discussed, but not initiated as TG began to decline with conservative management. The FHR tracing began to show minimal variability, with a category 3 tracing. This was felt to represent developing fetal acidemia despite improved maternal acidemia.

A multidisciplinary decision was made to proceed with urgent cesarean delivery under general anesthesia using nitrous oxide with remifentanil infusion, and avoiding Propofol, which could potentially worsen her HTG. She required two vasopressors and additional fluid resuscitation intraoperatively. She remained intubated postop for volume overload and suspected acute lung injury. She was extubated postoperatively day 1 and started on a low fat, semi-elemental tube feed, improving her TG levels. Her neonate was diagnosed with hypoxic ischemic encephalopathy, transitioned to comfort care and died on day two of life. The patient was hospitalized for an additional 8 days for diuresis (10L), HTG and diet management.

Discussion: No formal treatment recommendations exist for gestational HTG pancreatitis. Initial management of all AP should focus on stabilizing maternal hemodynamics, acidosis and pain. Fetal intrauterine distress is more commonly seen with HTG pancreatitis and severe pancreatitis. However, until the maternal condition has stabilized, proceeding with emergent cesarean section for fetal indications can lead to further maternal and fetal morbidity. In severe cases of maternal gestational HTG pancreatitis, insulin infusion, heparin and apheresis have shown clinical improvement but with limited and conflicting reports. Aggressive maternal resuscitation should not be delayed for unproven treatment options. In addition, risks and benefits regarding use of continuous versus intermittent FHR monitoring should be addressed with the patient especially if emergent delivery could compromise maternal stability.

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Abstract #: RF2BB-182

Coagulopathy and Vitamin K Deficiency in a Parturient with Intrahepatic Cholestasis of Pregnancy

Presenting Author: Alexa K Ron MD
Presenting Author's Institution: Vanderbilt University Medical Center - Nashville, TN
Co-Author: Mallika Thampy MD - Vanderbilt University Medical Center
Holly Ende MD - Vanderbilt University Medical Center

Intrahepatic cholestasis of pregnancy (IHCP) is a well-described condition in the peripartum period and is associated with multiple adverse pregnancy outcomes including preterm delivery, meconium staining, and fetal demise (1). While it is reported in the literature, cases of significant Vitamin K deficiency and severe coagulopathy resulting from IHCP are rare (2). We report a case of a 24-year-old primigravida with a medical history of systemic lupus erythematosus, autoimmune hepatitis on chronic immunosuppressant therapy, chronic hypertension secondary to lupus nephritis, exercise-induced asthma, and alpha 1-antitrypsin deficiency heterozygosity who presented for routine prenatal check at 25+4 weeks gestational age (GA) with new symptoms of generalized pruritus. Bile acids were found to be 124 mcmol/L (ref 0-7), confirming a diagnosis of IHCP. The patient was initiated on ursodeoxycholic acid with initial improvement in symptoms. However, at 30+4 weeks GA, upon development of scleral icterus, repeat labs were significant for total bilirubin 4.2, INR 2.2, and normal transaminases. Hepatology consultation favored a diagnosis of worsening IHCP over a flare of autoimmune hepatitis. Furthermore, the patient's normal albumin levels in addition to a recent liver biopsy without significant fibrosis made liver synthetic dysfunction unlikely. Ultimately, her clinical and laboratory findings were attributed to IHCP with resultant fat-soluble vitamin deficiency leading to elevated INR. After multidisciplinary discussions between maternal fetal medicine, hepatology, and obstetric anesthesia, a plan was made to admit the patient for IV Vitamin K infusion prior to a planned 35 week induction of labor. The patient presented to triage at 34+1 weeks GA with vaginal bleeding which ultimately resolved spontaneously, and repeat labs at that time demonstrated total bilirubin 6.3 and INR 3.6. She received 2 doses of IV Vitamin K during this hospital admission, and coagulation studies following Vitamin K infusions demonstrated normalization (PT 13.7, INR 1.1, PTT 22.6). She was discharged, but presented 3 days later with pre-term labor (34+4 weeks GA). Following confirmation of normal coagulation studies and thromboelastography, the patient received a combined spinal-epidural and had an uneventful vaginal delivery. She was discharged on postpartum day 2. In the postpartum period, MRCP and liver biopsy were performed—neither of which could demonstrate an alternate etiology for a significant coagulopathy and hyperbilirubinemia during pregnancy. This case emphasizes the importance of evaluating for severe coagulopathy in patients who present with IHCP in order to avoid serious adverse outcomes for mother or fetus.

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Abstract #: RF2BB-201

REBOA- Magic Bullet for Obstetric Hemorrhage

Presenting Author: Jasper Cumbee MD
Presenting Author's Institution: Medical University of South Carolina - Charleston, South Carolina
Co-Author: Joel Sirianni MD - Medical University of South Carolina
Robert Harvey MD - Medical University of South Carolina
Latha Hebbar MD, FACS - Medical University of South Carolina

Resuscitative Endovascular Balloon Occlusion of the Aorta (REBOA) is a minimally invasive technique to temporarily occlude the aorta in situations of anticipated or on-going hemorrhage. We report a case of placenta increta with REBOA deployment. 31yoF G2P1 at 35w0d BMI 26 (1 previous cesarean delivery [CD] for placental abruption) with suspected abnormal placentation involving bladder dome and cervix, was scheduled for a CD with possible hysterectomy. Preoperative Labs: Plts 178/Hgb10.6/Hct 30.9/WBC 7.95. Anesthesia plan included 8.5 Fr RIC x2, radial A-line and CSE for fetal delivery followed by induction of GA in the event of hysterectomy. Following placement of a 7F arterial sheath into the right common femoral artery, the balloon catheter was floated into Zone 3 of the aorta by the trauma surgeon and the arterial tracing was transduced. After placement of bilateral ureteral stents, CD commenced. Placenta increta was noted, with no invasion into the bladder and the fetus was delivered through a classical fundal hysterotomy. GA was induced and maintained with TIVA and pitocin commenced. Within 6 minutes of delivery, blood loss was 2L. REBOA was deployed and remained inflated for 16 minutes while the surgeons performed the hysterectomy in an expedited manner. Patient remained stable during REBOA deflation. Total EBL was 4 L with transfusion of 8 units of PRBC and 8 units of FFP, 1 gm TXA and 1.5 GM calcium chloride. Patient was extubated at the end of the case, transferred to STICU for observation of perfusion of her right extremity and had an uneventful postoperative course. Discussion: REBOA involves placement of an endovascular balloon in the aorta to control hemorrhage and to augment afterload in hemorrhagic shock states. Advantages include less physiological disturbance and higher rates of technical success than aortic cross clamping. The aorta is divided into three separate zones for the purposes of REBOA. Zone I extends from the origin of the left subclavian artery to the celiac artery, Zone II from the celiac artery to the most caudal renal artery, and Zone III (target Zone for OB cases) from the most caudal renal artery to the aortic bifurcation. Contraindications in the obstetric population includes femoral vessels not immediately identifiable on ultrasound, cardiac arrest due to causes other than exsanguination, PEA arrest >10 minutes, high suspicion of proximal traumatic aortic dissection. Complications include bleeding, infection, abscess, injury to adjacent structures, vascular complications (dissection, occlusion, pseudoaneurysm), and post-deflation cardiopulmonary compromise. While high quality evidence for decrease in hemorrhage-related mortality with REBOA in trauma settings is currently lacking, it is probably a practical interventional accessory in high-risk OB cases with abnormal placentation to reduce morbidity/mortality.

Abstract #: RF2BB-207

Obstetrical considerations and management of labor and delivery of a G1P0 woman with a history of multiple liver transplants.

Presenting Author: John R Gburek MD
Presenting Author's Institution: Rush University Medical Center - Chicago, Illinois
Co-Author: Laurie O Mark MD - Rush University Medical Center
Michael Holland MD - Rush University Medical Center
Patricia Perry MD - Rush University Medical Center

INTRODUCTION: From 1988 until the present time, approximately 4000 women in the United States 18 to 34 years of age have received a liver transplant (2). Key issues when counseling and managing a parturient post liver transplantation include optimal timing of pregnancy, contraception methods, and management of immunosuppression. Liver transplant parturients have higher rates of pre-term labor and cesarean delivery. It is hypothesized that increased rates are secondary to increased fetal distress in addition to higher levels of gestational hypertension and pre-eclampsia (1).

CASE REPORT: A 28-year-old G1P0 Jehovah's Witness (consented for transfusion) presented at 36w6d gestation with PMH of liver transplant (2006) for type IV choledochal cyst with granular cell tumor of common bile duct, chronic rejection, a second liver transplant (2009) complicated by post-transplant diabetes mellitus, elevated liver enzymes, and post-transplant lymphoproliferative disorder with anemia, and thrombocytopenia secondary to immunosuppression. On the patient's second day of induction fetal heart tones showed minimal variability with late decelerations which changed to a category two tracing with re-positioning. Decision was made for Cesarean section for failed induction and abnormal fetal heart tones greater than one hour. Labor epidural was placed and dosed to a T4 bilateral level with 15 ml of 2% lidocaine with epinephrine 1:200,000. Primary low transverse Cesarean section was uncomplicated and resulted in delivery of a 2940 g female child with Apgars 1 min: 8 and 5 min: 9. During the delivery 1100 ml of plasmalyte was used, 200 ml of urine output produced, and estimated blood loss was 880 ml. The patient did not require a PRBC transfusion and received neuroaxial preservative free morphine and IV ketorolac for postoperative analgesia.

CONCLUSION: Timing of conception is important to reduce complications from immunosuppression. A two-year gap between liver transplantation and pregnancy is recommended to prevent medication induced rejection of the pregnancy. Parturients should meet with subspecialists prior to delivery. More frequent follow up should be considered especially if gestational complications arise. Patient's should be encouraged to have a two-year gap between liver transplantation and pregnancy to prevent medication induced rejection of the pregnancy; in particular a suppression of NK cells necessary for trophoblast invasion of the uterus. Providers should monitor for gestational hypertension and diabetes along with anticipating a Cesarean delivery with intrabdominal adhesions requiring repletion with blood products.

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Abstract #: RF2BB-222

Dermatomyositis and Pregnancy: Inflaming An Already Complicated Situation

Presenting Author: Imoh Z. Ikpot M.D.
Presenting Author's Institution: The Ohio State University - Columbus, Ohio
Co-Author: Goran Ristev M.D. - The Ohio State University
Blair H Hayes M.D. - The Ohio State University

Case: We present a 35yo G3P1011 parturient at 26 and 2 GA with decreased fetal movement. Her medical history is remarkable for severe dermatomyositis and myopathy with progressive dysphagia, dysarthria, proximal muscle weakness, restrictive lung disease, asthma and poor functional status, multiple psychiatric illnesses, and cleft palate repair as a child. Her pregnancy was complicated by an acute pulmonary embolism, treated with Lovenox 1mg/kg twice a day. Upon admission for monitoring, she was transitioned to a heparin infusion to treat her pulmonary embolism. Uterine ultrasound exam showed breech fetus, IUGR and absent umbilical artery diastolic flow. Clinical course included category two fetal heart tracings, therefore, on hospital day 3, urgent cesarean delivery was indicated. Heparin was held for four hours in an attempt to allow possibility for neuraxial blockade. General anesthesia was reserved for non reassuring fetal well being. After heparin hold, PTT normalized, and she received a combined spinal epidural as primary anesthetic. The mother tolerated the procedure and delivery without complication. On assessment he was 0.45 kg, APGAR scores were 5 and 8. He was hemodynamically stable and transferred to the NICU. Of note, the mother's hospital course was complicated by aspiration pneumonia and acute hypoxic respiratory failure not related to anesthesia.

Discussion: Dermatomyositis is an inflammatory myopathy with systemic effects including esophageal dysfunction, restricted temporomandibular joint and decreased cervical spine mobility. These risks factors combined with pregnancy create the potential for difficult airway and aspiration. Dermatomyositis is associated with prolonged weakness after general anesthesia and there are not contraindications to succinylcholine or volatile agents (1). Our patient's cleft palate repair, lung disease and concerning fetal status made general anesthesia undesirable. Neuraxial anesthesia was performed, however, anticoagulation in the setting of a pulmonary embolism can be a relative contraindication. The current recommendations advice to hold high dose low molecular weight heparin for 24 hours prior to neuraxial anesthesia and intravenous heparin infusion for 4-6 hours(2). We transitioned our patient to a heparin infusion in order to treat the pulmonary embolism and decrease the wait time in anticipation of an elective procedure(3). We detail a careful balance between anticipating complications and multiple competing risk factors in a multidisciplinary fashion for safe delivery of a compromised infant.

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Abstract #: RF2BB-274

Intramuscular Ketamine in an Acutely Psychotic Parturient

Presenting Author: David G DePinto DO
Presenting Author's Institution: University of Texas Southwestern Medical Center - Dallas, Texas
Co-Author: Nwamaka Nnamani MD - University of Texas Southwestern Medical Center
Hooman Heravi MD - University of Texas Southwestern Medical Center
Dawood Nasir MD - University of Texas Southwestern Medical Center

Introduction: More women with psychotic disorders are having children and these pregnancies are at higher risk than the average parturient. There is an even greater compromise on both mother and baby's health when a manic or psychotic episode complicates the intrapartum period. This case presents unique ethical and medical challenges to anesthesiologists, obstetricians, and hospital administrative teams of an acute psychotic parturient.

Case: A 32 y/o G1P0 at 38 weeks with PMH of bipolar disorder and no prenatal care presented to labor and delivery from jail with oligohydraminos in the setting of premature rupture of membranes. On exam, she was agitated, physically abusive to staff and uncooperative, refusing any treatment including fetal heart monitoring, pelvic exam, vital signs, and IV access. It was evident that she was experiencing an acute psychotic episode. As she would not be able to safely tolerate labor, the obstetricians decided to perform an urgent C/S. Medical ethics was consulted due to the critically endangered fetus and declared that she lacked capacity to make an informed decision regarding her medical care. Given her state of uncontrolled agitation, it was evident that regional anesthesia was not a feasible option for her and the plan was to proceed with general anesthesia. With the assistance of police, two 150mg Intramuscular (IM) ketamine injections in each deltoid muscle were administered. The patient was then rushed to the operating room on a stretcher and an IV was placed. She was induced with propofol and succinylcholine, ET was placed and patient underwent an unremarkable caesarean section. On emergence, 5mg of haloperidol and 50 mg of diphenhydramine were administered intramuscularly for further anxiolysis. Despite her prolonged emergence from general anesthesia of 45 mins, she was successfully extubated in the OR and was transported to the recovery room. Her post-partum care involved the psychiatry team and she was discharged on POD4.

Discussion: Alterations in hormone level and the physiological demands of pregnancy can temporally unmask subclinical disease in patients with a psychiatric history. Psychotic parturient are at higher risk of having challenging labor and complications including adverse obstetric and neonatal outcomes. This case looked at the management of a parturient with acute psychotic episode which required emergency cesarean delivery. Due to her mental state, regional anesthesia, rapid sequence induction, and intravenous induction was not possible. Ketamine has been used as a sole anesthetic due to its minimal neonatal depression. In rare cases, it has been associated with intraoperative awareness, and for this reason, intravenous and inhalational agents were supplemented.

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Abstract #: RF3BC-243

Undetected Uterine Rupture During Induction of Labor for Intrauterine Fetal Demise Using Epidural Anesthesia: A Case Report

Presenting Author: William E Lane M.D.
Presenting Author's Institution: Duke University Hospital - Durham, NC
Co-Author: Julien Cobert M.D. - Duke University Hospital
Charles R Horres M.D. - Duke University Hospital
Zaneta Strouch M.D. - Duke University Hospital
Jennifer Mehdiratta M.D - Duke University Hospital

Uterine rupture is a rare, but serious complication of pregnancy defined as a full-thickness separation of the uterine wall and overlying serosa occurring in 0.035% of all deliveries. We present a case in which effective diagnosis was clouded by fetal demise in a patient with a functioning epidural. While much debate exists regarding the potential for epidural anesthesia to mask uterine rupture, this presentation shows that a high index of suspicion is required for the pathology.

Case: A 29 year-old G6P1132 woman was admitted at 22 weeks and 4 days gestational age for induction of labor for fetal demise. Her medical history was notable for two prior low transverse cesarean sections, insulin-dependent type 2 diabetes mellitus and obesity with a BMI of 36 kg/m2. She initially presented to the obstetric clinic at 16 weeks' gestation with vaginal bleeding, and fetal echocardiogram confirmed diagnosis of fetal demise.

Induction of labor was initiated with misoprostol and labor pain was treated with patient-controlled analgesia with intravenous fentanyl. On hospital day 2, she began having increasing tachycardia with normal blood pressures. On hospital day 3, an epidural at the level of L3-4 was placed by the anesthesia team. A mixture of ropivacaine 0.1% with fentanyl 2mcg/mL, as per protocol, was infused through the epidural catheter. On hospital day 4, the patient developed new upper abdominal pain despite effective epidural coverage, fundal tenderness with foul-smelling discharge, temperature of 37.5 Celsius, and leukocytosis with increase in white blood count to 11.7 103/µL. The patient was diagnosed with chorioamnionitis and was initiated on antibiotic therapy with ampicillin and gentamicin. She was subsequently scheduled for D&E.

After cervical dilation in the operating room, the surgical team began the evacuation of fetal tissue with forceps. However, during a second pass with their instruments, the team identified small bowel being pulled through the cervix. Subsequently, uterine rupture was quickly diagnosed and the decision was made to convert the procedure to an exploratory laparotomy with the assistance of a general surgery team to assess the bowel injury. General anesthesia was induced and the patient was intubated with an endotracheal tube in rapid sequence fashion. Laparotomy revealed a 100-cm section of small bowel avulsed from the mesentery. She was extubated and recovered uneventfully in the post-anesthesia care unit

Conclusions: Uterine rupture is a rare but catastrophic complication of pregnancy. Its initial presentation can be as subtle as persistent sinus tachycardia, as in this case. Despite controversy surrounding epidural anesthesia and its potential to mask uterine rupture, neuraxial analgesia did not impede in the diagnosis in this case and can be of potential benefit when used with a mixture of low concentrations of local anesthetic and opioid medications.

Abstract #: RF3BC-259

Use of Thromboelastography to Guide the Perioperative Management of a Parturient with Antithrombin Deficiency and Factor XI Deficiency

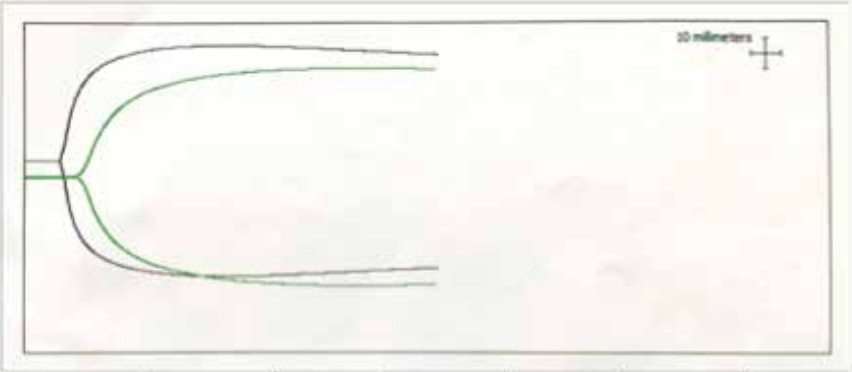
Presenting Author: Lindsay K Sween MD, MPH
Presenting Author's Institution: Beth Israel Deaconess Medical Center - Boston, MA
Co-Author: John Kowalczyk MD - Beth Israel Deaconess Medical Center
Yunping Li MD - Beth Israel Deaconess Medical Center

Introduction: Deficiency in Factor XI, a plasma serine protease that contributes to thrombin generation, may result in excessive postoperative bleeding (1). Antithrombin (AT) inhibits the coagulation cascade's serine proteases, and deficiency leads to thrombophilia (2). Thromboelastography (TEG) has been shown to be superior to routine coagulation tests (RCT) in predicting postoperative bleeding after cardiac surgery and to confer a survival advantage over RCT when guiding product transfusion in massive transfusion protocol in trauma patients (3,4). Concurrent Factor XI and AT deficiency is extremely rare. We report the use of TEG to guide management for a parturient with these conditions.

Case: A 32 year old G4P1 at 37 weeks gestation with deficiencies in AT (activity 32%) and factor XI (level 7%) presented for primary cesarean delivery (CD) due to complete placenta previa. She lost two prior pregnancies. Her third pregnancy was a term vaginal delivery. She received an epidural after normal TEG result without complications. She underwent molar extraction and tonsillectomy without excessive bleeding. Given absence of venous thromboembolism history and factor XI deficiency, antepartum anticoagulation was deferred.

Anesthetic management for her CD posed many challenges. A team approach was applied with consults by hematology and obstetric anesthesiology in her third trimester. RCT and TEG were normal at the consult. Repeat TEG on the day of surgery was also normal (Fig 1). Given her surgical history without excessive bleeding, concurrent AT deficiency was thought to limit her tendency to bleed, so FFP or factor XI concentrate was not prophylactically transfused. Due to a normal TEG and lack of bleeding history, spinal anesthetic was planned after discussion with the patient and obstetric team. Spinal placement and CD were uneventful. Postoperative neurological status was closely monitored. She was discharged home on postpartum day 4.

Discussion: While no literature exists to quantify the risk of epidural or spinal hematoma following neuraxial anesthesia in such a patient, TEG provided point of care information about coagulation status and helped to inform the choice of neuraxial or general anesthesia for CD in a patient with factor XI and AT deficiencies.



Sequence	Channel	R (min)	K (min)	Angle (deg)	MA (mm)	LY30 (%)
CK	1	6.0	1.1	76.4	71.2	0.5
CKH	2	9.4	2.3	58.2	65.8	0.0
	Mean	7.7	1.7	67.3	68.5	0.2
	SD	2.4	0.8	12.9	3.8	0.4

Fig. 1 TEG Tracing and Analysis Results
R: reaction time; K: coagulation time; MA: maximum amplitude; LY30: percent reduction in amplitude 30 minutes after reaching MA.

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Abstract #: RF3BC-261

Abnormal TEG pattern in a patient with antiphospholipid antibody syndrome (APS) undergoing cesarean delivery: does it really matter?

Presenting Author: Akira Kojima
Presenting Author's Institution: Saitama Medical Center, Saitama Medical University - Kawagoe-shi, Saitama
Co-Author: Shohei Noguchi resident - Saitama Medical Center, Saitama Medical University
Yuuki Ohashi assistant professor - Saitama Medical Center, Saitama Medical University
Katuo Terui professor - Saitama Medical Center, Saitama Medical University

Anti Introduction: APS is associated with prolonged aPTT despite its prothrombotic state. This laboratory abnormality is caused by the interaction of antiphospholipid antibody such as lupus anticoagulant with phospholipid which is included as a reagent in aPTT test. As TEG reagent in CK test does not contain phospholipid, we measured TEG and ROTEM, expecting that normal tracings may give us some reassurance to offer regional anesthesia for her cesarean delivery (CD). However, these tests showed grossly abnormal pattern, and we were confronted with dilemma in choosing anesthesia method for her CD.

Case presentation: She a 26-year-old G3P1 woman with history of SLE, APS (positive lupus anticoagulant (LA) and anticardiolipin antibody (aCL)), and s/o Sjogren syndrome, as well as asymptomatic primary biliary cirrhosis. In her previous cesarean delivery due to hypertensive disorders of pregnancy, general anesthesia was chosen because of thrombocytopenia (49K) and clinical bleeding tendency. During this pregnancy, she was placed on subcutaneous heparin 5,000u SQ BID as well as aspirin 100mg daily. At the time of anesthesia consultation at 32 weeks gestation, aPTT was prolonged to 100 seconds. We evaluated both TEG and ROTEM. The following are the TEG results with reference ranges (not for pregnancy, but by the manufacturer). CK R: 21.9 min (4.6-9.1), K: 4.0 min (0.8-2.1), Ang: 49.8 degrees (63-78), MA: 60.2 mm (52-69), LY30: 3.3% (0.0-2.6). CRT R: 1.9 (0.3-1.1), K: 1.2 (0.8-2.7), otherwise normal. CKH R: 14.7 (4.3-8.3), K: 3.3 (0.8-1.9), Ang: 53.2 (64-77), MA: 59.9 (52-69). ROTEM also showed prolonged clot formation. Her platelet count, PT, and fibrinogen level were normal. The day before elective repeat CD at 38 weeks, while aspirin had been discontinued for 2 weeks, she was found to have hematoma at SQ heparin injection site. Platelet count was decreased to 67K on the morning of CD. Considering clinical bleeding tendency, TEG abnormality, and thrombocytopenia, we opted for general anesthesia with fresh frozen plasma ready. Her CD went uneventfully with estimated blood loss of 650ml, including amniotic fluid, which was a small amount in our institution.

Discussion: Even though APS is known to cause prolonged aPTT, it is occasionally associated with acquired factor II deficiency, causing LA-hypoprothrombinemia syndrome. Her TEG and ROTEM results were abnormal enough for us to suspect this syndrome. In addition, her thrombocytopenia with undetermined etiology, made us give up regional anesthesia for her CD. However, small intraoperative blood loss was puzzling. The value of point-of-care device such as TEG is still debatable as a guide in choosing anesthesia method, especially in patients with APS.

Abstract #: RF3BC-280

Anesthetic Management of a Parturient with Jarcho-Levin Syndrome Undergoing Cesarean Delivery

Presenting Author: Nathalia Torres Buendia MD
Presenting Author's Institution: University of Miami/Jackson Memorial Hospital - Miami, FL
Co-Author: Daria Moaveni MD - University of Miami/Jackson Memorial Hospital
Reine Zbeidy MD - University of Miami/Jackson Memorial Hospital

Jarcho-Levin Syndrome (JLS) is a rare autosomal recessive condition with two subtypes: spondylothoracic and spondylocostal dysostosis. Abnormal number and/or structure of vertebrae and costal arches create a short torso with "crab-like" thorax, short neck and disproportionate dwarfism. Several congenital malformations may coexist in JLS.

This case presents a 30 year old G2P1 woman with JLS who underwent cesarean delivery (CD) at 37 weeks gestation due to a congenital heart defect in the fetus. Her medical history was also significant for repeated pneumonias throughout childhood, asthma and history of difficult intubation in a previous CD. The patient presented with tachypnea, subcostal retractions and did not tolerate lying supine. Her height was 120 cm, weight 49 kg. She had a short neck with limited extension, macroglossia and Mallampati 4 airway. Her thorax was short, protruding and "crab-like" shaped. Her back and spine were distorted. No recent spine imaging was available. Pulmonary function tests showed severe restrictive lung disease. Echocardiogram showed preserved biventricular function with mildly increased right ventricle systolic pressure.

Following a multidisciplinary discussion, which included pulmonology, CD under general anesthesia with awake intubation was planned. Preoperatively, albuterol nebulization followed by 4% lidocaine nebulization and gargles were done. Once in the OR, patient was positioned with blankets to support her kyphosis. Vocal cords were sprayed with 1 ml of 4% lidocaine using a laryngotracheal topicalization anesthesia kit. Sedation with remifentanil infusion was started. Using a video laryngoscope, an endotracheal tube size 6.0 was placed with excellent tolerance by the patient. She was subsequently induced with propofol. Lung protective ventilation strategy was used in the context of restrictive lung disease in pregnancy, parameters were adjusted after delivery due to the change in lung mechanics. Estimated blood loss was 1 L, thus 1 unit of PRBC was administered based on hemodynamics and considering her low body weight. She was monitored postoperatively in ICU and extubated 24 hours later. Postoperative course was uneventful.
Patients with JLS present challenges for management of the airway, positioning, and ventilation.

Traditionally, awake fiberoptic intubation was indicated for potential difficult airway management. This case demonstrates that thorough topicalization of the airway can also allow for awake intubation with video laryngoscopy, which may be easier and more familiar to anesthesia providers. Highly complex cases such as this one should be performed in centers with expertise in high risk obstetric anesthesia care and availability of maternal fetal medicine and pulmonology specialists. The successful outcome of this case is attributed to thorough multidisciplinary planning and management.

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Abstract #: RF3BC-286

Anesthetic Management of a Parturient with an Anterior Mediastinal Mass

Presenting Author: Nathalia Torres Buendia MD
Presenting Author's Institution: University of Miami/Jackson Memorial Hospital - Miami, FL
Co-Author: Daria Moaveni MD - University of Miami/Jackson Memorial Hospital
Selina Patel MD - University of Miami/Jackson Memorial Hospital

A 27 year old G1P0 woman with a history of Hodgkin's lymphoma at 35.6 weeks of gestation was transferred to our institution for delivery planning. She had been in remission for three years, however it recurred during this pregnancy and she developed a pericardial effusion requiring a pericardial window two months prior. She developed mild right neck and face edema, persistent dry cough, and her functional status worsened from NYHA class II to III. Chest imaging showed a 6.1 x 8.6 x 8.0 cm anterior mediastinal mass compressing the superior vena cava and the brachiocephalic vein. Echocardiogram showed preserved biventricular function with trace pericardial effusion. EKG showed sinus tachycardia.

The case was discussed with a multidisciplinary team that included OB, OB anesthesia, cardiac anesthesia, cardiothoracic surgery, hematology-oncology and ECMO teams. The case was scheduled in the main operating room given the immediate availability of resources and support personnel. Modified combined spinal epidural anesthesia was planned; cardiac anesthesia and ECMO were available in case of conversion to general anesthesia. Peripheral intravenous access included 16g and 20g in the upper extremities and 18g in the left foot. A radial arterial line was placed. Intrathecal medication included 3.75 mg of 0.75% hyperbaric bupivacaine, 15 mcg fentanyl, and 100 mcg morphine. A total of 380 mg of 2% lidocaine were slowly titrated through the epidural catheter to obtain an adequate anesthetic level. Femoral arterial (16g) and venous (6 Fr) introducers were placed for rapid access in case emergent ECMO was required. Intraoperative course was uneventful.

The primary concern for this case was the risk of cardiovascular collapse and impossibility to ventilate due to distal airway extrinsic obstruction if general anesthesia was needed. Concerns for neuraxial anesthesia included changes in respiratory mechanics secondary to a T4 level block with already compromised lung function, as well as hemodynamic stability due to vascular compression. ECMO has been described as the strategy of choice to optimize gas exchange in patients with large anterior mediastinal masses. For pregnant patients, intraoperative emergent cannulation may be more challenging due to the gravid uterus and surgery site. This case highlights the value of prophylactic femoral vascular access as a route to guide emergent ECMO cannulation. No guidelines are available on the management of parturients with anterior mediastinal mases and case reports vary on their anesthetic approach. The anesthetic plan must be elaborated on a case by case basis.

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Abstract #: RF3BC-303

A Case of Gravid Uterine Incarceration Resolved with Spinal Anesthesia

Presenting Author: Kara M Joseph MD
Presenting Author's Institution: Northwestern University Feinberg School of Medicine - Chicago, IL
Co-Author: Matthew G Hire MD - Northwestern University Feinberg School of Medicine
Jason R Farrer MD - Northwestern University Feinberg School of Medicine

Uterine incarceration is a rare obstetric complication that impacts approximately 1 in 3,000 pregnancies1. Women typically present with pelvic pressure and pain, however severe cases can cause urinary retention, constipation, bowel ischemia, bladder atony, and possible impaired placental blood flow with unclear effects on fetal outcomes2. Diagnosis is made with ultrasound in many cases, though MRI may be necessary. There is currently no consensus on first line treatment, however reduction of the incarceration is important to avoid potential significant morbidity.

Case: The patient presented with pelvic pain and urinary retention in the setting of a 12-week gestation incarcerated uterus. Attempts at manual reduction were performed in the outpatient setting by several providers without success. The patient was admitted to labor and delivery for attempted reduction with anesthesia support. An ultrasound performed immediately prior to initiation of anesthesia confirmed a sharply retroverted, incarcerated uterus (see figure 1). Our institution's standard labor analgesic dose of 2.5 milligrams of 0.5% bupivacaine with 15 micrograms of fentanyl was administered intrathecally and an epidural catheter was placed to facilitate surgical anesthesia in the event that further measures, such as laparotomy, were necessary. Spinal anesthesia was successful, and provided the patient with complete pain relief. An ultrasound performed immediately prior to the manual reduction attempt showed full resolution of uterine incarceration.

Conclusion: Despite the variable anesthetic techniques described in the literature for reduction of uterine incarceration, combined spinal-epidural analgesia may be a reasonable first line option as it provides quick onset of analgesia to facilitate intravaginal manual reduction, the potential for conversion to surgical anesthesia if necessary, as well as avoidance of systemically administered sedatives and analgesics. Furthermore, as evidenced in our case, spinal anesthesia may also promote spontaneous resolution, potentially through abdominal muscular relaxation.

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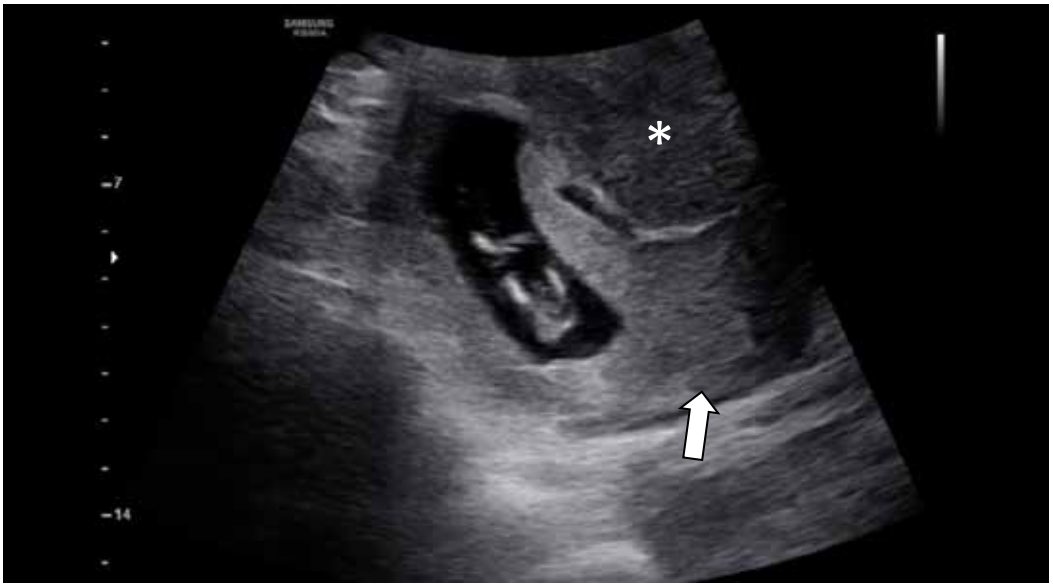

Abstract #: RF3BC-417

Neuraxial Anesthesia for Assisted Vaginal Delivery in Parturient with Autosomal Dominant Tuberous Sclerosis Complex

Presenting Author: Shikha Sharma MD, PhD
Presenting Author's Institution: University of California, San Francisco - San Francisco, CA
Co-Author: Tina Yu MD - University of California, San Francisco
Stephanie Lim MD - University of California, San Francisco

Tuberous sclerosis complex (TSC) is an autosomal dominant multiorgan disease, resulting from mutations in TSC1 or TSC2 genes, that cause benign hamartomas. CNS lesions cause epilepsy and learning disabilities. Large, vascular renal angiomyolipomas (AMLs) are second leading cause of premature death. Ventricular rhabdomyomas are highly specific and often seen in prenatal ECHO of an affected fetus. Other affected organs include lungs (Lymphangioleiomyomatosis/LAM, cystic parenchymal disease), lymphatic system and retina. (1) (2)

Literature on pregnancy outcomes in TSC patients is limited but increased risk of preeclapmsia, preterm labor, fetal growth restriction, oligo/poly-hydramnios, and fetal demise has been observed (3) (4). Other possible complications include rupture of large renal AMLs during labor or worsening of underlying pulmonary disease or seizure disorder (5) (6).

We present a case of 34 year old G2P1 with TSC complicated by CKDIII secondary to large bilateral renal AMLs with near complete replacement by fatty tissue, seizures (on Levetiracetam), and pulmonary LAM. MRI brain showed multiple hamartomas but no mass effect, hydrocephalus or hemorrhage. Maternal TTE was normal but fetal ECHO at 30w4d revealed multiple rhabdomyomas (largest 2.6 cm) with moderate tricuspid regurgitation, in addition to CNS and renal lesions. From multidisciplinary meeting, IOL was recommended with assisted second stage to avoid maternal Valsalva due to concern for spontaneous rupture of renal AMLs. We decided to avoid GETA and PPV in setting of known cystic parenchymal disease. MRI lumbar spine was obtained to rule out spinal AVMs which showed multiple sclerotic spinal lesions. Neuroradiology was consulted and recommended L paramedian approach at L4-5 for neuraxial anesthesia. Actual induction was at 36w5d, earlier than originally planned, due to concern for atypical preeclampsia with transaminitis and rising Creatinine. IR and Cell Saver were consulted for possible emergent embolization. Inpatient Nephrology followed patient closely. CSE was performed on hospital day 3. Nitrous oxide was avoided for reasons discussed above. Patient progressed to complete on day 4, followed by uncomplicated FAVD (EBL 100 cc) and Apgar scores of 8 and 8.

Overall, a thorough evaluation of risks associated with labor and anesthesia in this patient with extensive multi-organ disease was performed. A safe anesthetic plan with multidisciplinary involvement was developed that resulted in successful vaginal delivery.

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Abstract #: RF3BC-448

Single Dose of Metoclopramide Resulted in Acute Dystonia during Cesarean Section

Presenting Author: Danielle Levin BA
Presenting Author's Institution: Rutgers - Robert Wood Johnson Medical School - New Brunswick, New Jersey
Co-Author: Shaul Cohen MD - Rutgers - Robert Wood Johnson Medical School
Scott Mellender MD - Rutgers - Robert Wood Johnson Medical School
Ushma Thomas MD - Rutgers - Robert Wood Johnson Medical School
Geza Kiss MD - Rutgers - Robert Wood Johnson Medical School

Introduction: Acute dystonia has been reported to occur several days after the initiation of treatment with metoclopramide. We would like to present what we believe is the first report of severe acute dystonic reaction after just a single administration of metoclopramide during cesarean section (CS) under combined spinal epidural anesthesia(CSE).

Case Presentation: 30yo female with a PMH of IV drug abuse on methadone maintenance therapy and untreated hepatitis C infection presented at 39wks gestation for a scheduled r/p CS. 1hr prior to the procedure, a scopolamine patch was placed behind the Pt's right ear. Pt had uneventful CSE placement. Several minutes prior to delivery of baby, the Pt experienced sudden nausea and vomited 2X. Once baby was delivered, the Pt's uterus was everted, and she vomited 2 more times. A bolus of 10mg of IV metoclopramide and 8mg of IV ondansetron were given. The Pt's nausea was relieved, but 2min later, she became unresponsive, had rapid eye blinking, and uncontrollable movement of the head. Treatment with 50mg IV diphenhydramine bolus followed by a 10cc saline flush was administered. The symptoms resolved immediately. She was again orientedX3. There was no effect on her vital signs, and she had no recollection of the symptoms that she had just experienced. The Pt remained symptom free for the rest of the hospital stay and was discharged 4 days later.

Discussion: Nausea and vomiting (N&V) during CS may cause distress for the Pt, increase the difficulty of peritoneal closure, increase the risk of inadvertent viscus perforation, lengthen the duration of surgery, and lead to aspiration pneumonitis. Various antiemetic treatments are available for intraoperative N&V during CS, but none of them are entirely effective. When a woman is actively vomiting intraoperatively, a pharmacological medication with a rapid onset of action is necessary, such as IV metoclopramide. Dopaminergic receptor antagonists exert an antiemetic effect by blocking the electrical potential transmission within the chemoreceptor trigger zone, which coordinates the physical movements during emesis. However, blocking the chemoreceptor trigger zone may not only stop emesis, but it can also prevent other purposeful movements in individuals. 1 in 500 Pts experience the adverse reaction of life-threatening involuntary body movements, called acute dystonic reaction, after the administration of 30-40mg of metoclopramide per day. Severe acute dystonic reaction occurring intraoperatively during a CS with CSE after administration of just one dose of metoclopramide is very rare, but it is important to be aware of such possibility. Prompt treatment with IV diphenhydramine can reverse such reaction if it occurs.

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Abstract #: RF3BC-489

It takes a village: a multidisciplinary approach to caring for a parturient with pulmonary AVMs

Presenting Author: Kymberlee Royals MD
Presenting Author's Institution: Maine Medical Center - Portland, Maine
Co-Author: Bryn Carpenter MD - Maine Medical Center

Parturients with hereditary hemorrhagic telangiectasia are rare and can manifest with arteriovenous malformations (AVMs) in the lungs, brain, and spine. This complexity warrants forethought, and will require additional time and collaboration for successful anesthetic management. We present a case of a 29 year-old female G4P3002 at 29w0d presenting to labor and delivery triage with acute onset dyspnea, transient aphasia, and right hand weakness. On exam she was hypoxic with a grossly normal neurological exam. Pulmonary work-up included a computed tomography angiography, which revealed multiple AVMs. Neurological workup revealed old cerebral infarcts and tortuosity of the anterior communicating artery. She underwent IR embolization of the two pulmonary AVMs prior to an uneventful vaginal delivery at full term without anesthetic intervention. This case emphasizes the importance of developing a multidisciplinary team approach to optimize the management plan in complex clinical cases.

Abstract #: RF3BC-515

Labor Management of a Parturient with an Existing Intrathecal Opioid Pump: A Case Report

Presenting Author: Syed S Jaffery M.D.
Presenting Author's Institution: University of Texas Southwestern - Dallas, Texas
Co-Author: Syed S Jaffery M.D. - University of Texas Southwestern
Tristyn St. Thomas-Achoja M.D. - University of Texas Southwestern
Weike Tao M.D. Ph.D. - University of Texas Southwestern
Stephanie Byerly M.D. - University of Texas Southwestern
Enas S Kandil M.D. Msc - University of Texas Southwestern

Introduction: Intrathecal pump (ITP) therapy has been utilized in chronic pain patients since the early nineties. Pregnancy in patients with ITP is not a common occurrence. The majority of reported cases are baclofen pumps for spasticity. There are only two case reports of pregnancy and labor management in patients with opioid ITP [1,2]. This case report discusses the anesthetic management of a parturient with a hydromorphone ITP which was in place for treatment of complex regional pain syndrome (CRPS).

Case Report: A 27 yo G1 with a past medical history of anxiety, dyslexia, PTSD, high-functioning autism spectrum disorder and CRPS Type I due to congenital hemivertebra kyphoscoliosis presented at 34 weeks for an acute exacerbation of chronic lower back and leg pain. Her chronic pain was managed with an ITP placed at an outside hospital containing hydromorphone with recent dose escalation to 1.75 mg/day. Chronic pain management was consulted to assist in optimizing her pain regimen without further increasing the dose. Cyclobenzaprine, acetaminophen, and alternating topical lidocaine and capsaicin were recommended. Trigger point injections to her thoracic and lumbar paraspinal muscles were also performed for myofascial pain. This regimen allowed her pain to return to baseline. At 37 weeks and 5 days, she went into spontaneous labor but required a cesarean delivery for non-reassuring fetal heart rate tracings. A combined spinal epidural was successfully placed with 13.5 mg of bupivacaine and 20 mcg of fentanyl. There were no complications for her and her baby. She was discharged home on POD#3 after meeting postpartum goals.

Conclusion: Neuraxial anesthesia can be safely used in parturients with ITP. Parturients with ITP should be discussed with pain management providers, anesthesiologists and obstetricians to ensure effective neuraxial analgesia or anesthesia if desired.

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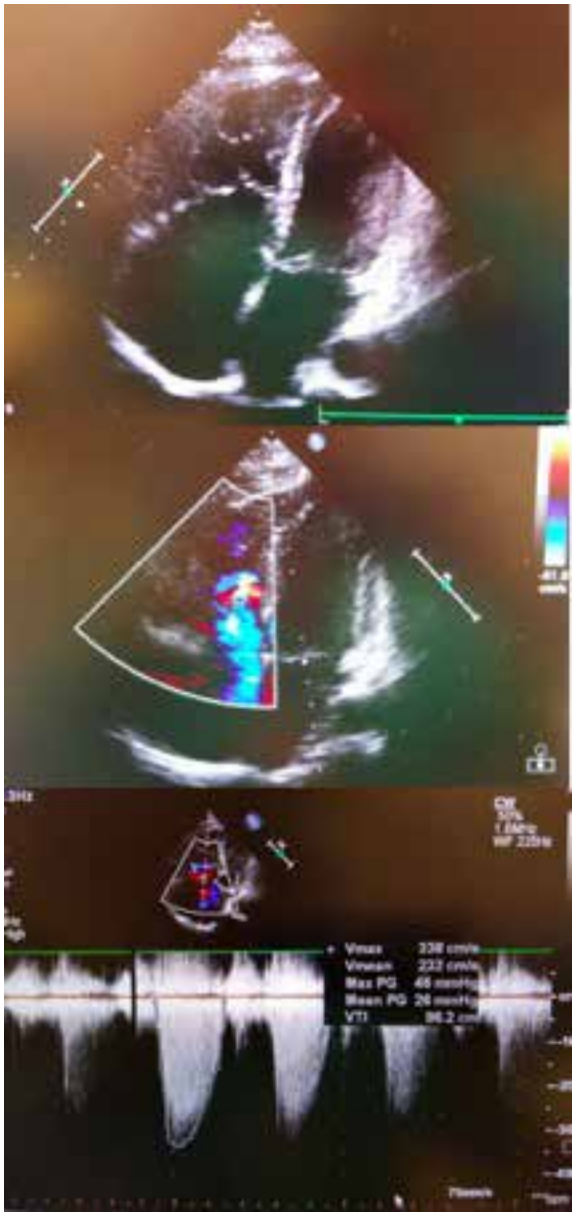
Abstract #: RF4BD-48

CSE for Cesarean Section in a Parturient with Ebstein's Anomaly

Presenting Author: Sultana Peffley B.S., M.D.
Presenting Author's Institution: University of Arizona - Tucson, Arizona
Co-Author: Michelle DaCosta M.D., MBA - University of Arizona
Greg Mozdyniewicz B.S. - University of Arizona

Case Presentation:33 yo G2P1 female at 39 weeks gestation with Ebstein's anomaly(EA) presents for a repeat cesarean section (c/s) and bilateral tubal ligation.Patient was diagnosed with EA during her first pregnancy at 27 weeks gestation. During this current pregnancy she experienced intermittent episodes of SOB which resolved on their own.TTE showed 3.1 cm apical displacement of the tricuspid valve, RVSP was 40-45 mmHg during the first trimester. Third trimester TTE showed RVSP of 30 mmHg and EKG showed RBBB.We placed two large bore IVs and an a-line preoperatively. A low dose combined spinal epidural (CSE) with 7.5 mg bupivacaine, 25 mcg fentanyl, and 0.2 mg morphine was administered for the c/s.A phenylephrine gtt was started at the time of intrathecal injection. We monitored her cardiac function intraoperatively during the c/s with TTE.Overall, both patient and her baby did well and no long-term complications were identified postoperatively.



Discussion: EA consists of an anatomically abnormal tricuspid valve, which results in atrialization of the right ventricle with concomitant tricuspid regurgitation(1).Associated abnormalities include ASD, PFO, and tachyarrhythmias(1).Clinical presentation varies by age and degree of symptoms; diagnosis is made by echocardiography.Patients with EA have an assorted clinical course and many women who attain childbearing age desire pregnancy.Vaginal delivery is recommended, however there is a higher risk for these patients to require cesarean section(2). There is limited data regarding anesthetic techniques for obstetric patients with EA undergoing cesarean section. We showed low dose CSE to be safe and effective; CSE may be favorable for these patients, especially when a shorter onset is desired. Of note, our patient did not have an ASD.Patients with both EA and an ASD develop right to left shunt and subsequent hypoxemia with decreases in afterload. CSE may be tolerable in that subset of patients, but as of now it is unknown.

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Abstract #: RF4BD-118

Considerations for Neuraxial Anesthesia in a Pregnant Patient with Scabies

Presenting Author: Jesse J Morrison MD
Presenting Author's Institution: University of Illinois Hospital and Health Sciences - Chicago, Illinois

Introduction: Scabies is a highly infectious dermatitis involving the mite, Sarcoptes scabei. Its prevalence is worldwide and affects people of all social classes. The female mites burrow into a patient\'s skin and lay eggs, creating lesions causing an immune reaction. Lesions are mostly found on warmer areas of the body, such as the webbing of fingers and folds of joints. If not treated properly, the lesions can evolve into bacterial infections. The consequences of active infection in patients undergoing surgery is unknown. Even after treatment, there is risk of introducing mite particles into the epidural or intrathecal space during neuraxial placement and this may elicit an allergic response of unknown consequences. Therefore, a systematic approach to neuraxial placement and surgical incision risk in parturients with scabies infections is needed.

Case Presentation: A 21 year-old female G2P1 presented to Labor and Delivery for a repeat cesarean delivery. The patient had a medical history significant for scabies on her abdomen diagnosed two weeks prior while at a routine visit with her obstetrician. She was prescribed permetherin cream and instructed to apply this cream all over her body and rinse off the cream after 8-14 hours.

Anesthesia providers met with the patient on admission and discovered that she had only applied a small amount of cream over her excoriated areas every six hours since diagnosis. On physical exam, the patient was found to have two excoriated areas on her abdomen. The patient had no other excoriations on her body, including her back. The anesthesia providers discussed with the patient about concerns with neuraxial anesthesia with an active scabies infection. Dermatology was consulted and recommended that the cesarean delivery be postponed for a day and that the patient receive adequate treatment. The patient completed the treatment as directed and presented the next day for scheduled cesarean delivery. The anesthesia provider placed an epidural without difficulty and the obstetric team conducted a successful repeat cesarean delivery after chlorhexidine antiseptic was applied. Follow-up with the patient after delivery revealed no concerning signs of an adverse reaction to the neuraxial procedure.

Discussion: Several cases have been published detailing safely administering neuraxial anesthesia in patients diagnosed with scabies, yet guidelines for patients with active scabies infection undergoing neuraxial anesthesia have yet to be established. Most providers emphasized completing a thorough exam of the patient\'s lower back and sterilizing the patient's back prior to the procedure, although there is no guidance on the optimal skin antiseptic in these patients. In scheduled cases, thorough discussion and risk assessment for complications with skin incision and neuraxial placement may be warranted.

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Abstract #: RF4BD-227

Interscapular Pain associated with Epidural Anesthesia for Labor & 2 Different Outcomes

Presenting Author: Brendan T Sheehy MD
Presenting Author's Institution: Ohio State Wexner Medical Center - Columbus, Ohio
Co-Author: Yun Xia MD - Ohio State Wexner Medical Center
Blair Hayes MD - Ohio State Wexner Medical Center

Interscapular pain associated with medication administration may complicate the management of epidural anesthesia. Knowing how to effectively manage this complication can help provide effective analgesia to laboring patients.(1,3) We present two patients who had severe interscapular back pain associated with epidural anesthesia with different outcomes.

Patient A was a 24 yo G4P3 who presented at 39w1d. Patient B was a 34 yo G1P0 who presented at 38w0d. Epidural anesthesia with patient controlled epidural analgesia (PCEA) was initiated in both patients in anticipation of spontaneous vaginal delivery. In both patients, the epidural space was found with loss of resistance to saline. Each had adequate labor analgesia for the first 8 hours of their labor until developing interscapular pain. Management strategies following the onset of pain in these patients included adjusting epidural infusion rates, bolus injections of local anesthetics and opioids via epidural catheter, and ultimately replacing their epidurals with a combined spinal epidural (CSE). Patient A had resolution of pain symptoms following replacement with CSE and had adequate epidural analgesia for cesarean section. Interestingly patient B, had initial relief of labor pain following replacement with CSE, but redeveloped interscapular pain and had inadequate analgesia. She ultimately underwent general anesthesia for cesarean. There were no long term adverse outcomes associated with either patient.

It is critical to treat all types of pain in the peripartum period as this may help avoid adverse outcome to the mother and fetus. Interscapular pain associated with epidural analgesia is uncommonly reported and little is understood on the mechanism of this anesthetic complication. It is important to understand the different management strategies for epidurals that are not giving patients pain relief and may actually be causing more harm than benefit.(1,2,3) Proposed mechanisms include increased epidural pressure from increased volume or poor compliance, visceral pain that may not be related to the epidural itself, loss of resistance technique with saline versus air.(1,2,3) Patient positional changes, replacement of epidural, and delivery of infant have been reported to relieve pain in some cases.(3) Further investigation into patients who are at risk may find patients who experienced prior episodes of interscapular pain, prior complication with epidural, prolonged labor with epidural. Understanding when to adjust medications, dosing and rates, the epidural catheter versus replacing the epidural catheter, can help avoid undesired labor outcomes and may provide more effective epidural anesthesia for our patients.

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Abstract #: RF4BD-239

Perioperative Management of a Parturient with a Spinal Cord Stimulator

Presenting Author: Zahid Sunderani MD FRCPC
Presenting Author's Institution: B.C. Women›s Hospital and Health Centre - VANCOUVER, British Columbia
Co-Author: David Lea MD FRCPC - BC Women›s Hospital
Vit Gunka MD FRCPC - BC Women's Hospital
Trevor Kavanagh MB BCh BAO FCAI FRCPC - BC Women's Hospital
Jill Osborn PhD MD FRCPC - St. Paul's Hospital
Anthony Chau MD FRCPC MMSc - BC Women's Hospital

Introduction: Parturients with in-situ spinal cord stimulators (SCS) have unique considerations for neuraxial analgesia and anesthesia. Needle insertion can potentially damage the SCS components or impede the epidural spread of neuraxial medication leading to an inadequate block. Furthermore, there are theoretical concerns that an epidural catheter may entangle with or displace SCS wires.[1] We report a parturient with a SCS who successfully received an epidural for labor analgesia and conversion for operative delivery.

Case: A 30 yo G1P0 at 38+4 weeks with an in-situ lumbar SCS presented in active labor requesting epidural analgesia. The SCS was placed for complex regional pain syndrome (CRPS) following a crush injury to her left foot from a motor vehicle accident. No contraindications were identified for epidural placement during her antenatal clinic visit, but she was advised of the possibility of inadequate analgesia. During the pregnancy, the SCS was turned off due to the unknown effects of neuromodulation on fetal development, and her CRPS was well controlled. Previous operative notes showed the SCS leads were inserted at L2-3, positioned in the epidural space at T10 with the generator in the right flank. The electrode loops were at the 4th lumbar vertebrae crossing over the L3-4 interspace, but the L4-5 and L5-S1 interspaces remained vacant. No markers of a difficult airway were found.

For the epidural placement, ultrasound was used to determine the L4-5 interspace for needle entry. A standard epidural solution of 0.08% bupivacaine with 2mcg/mL of fentanyl using programmed intermittent bolus regimen provided adequate analgesia without any physician intervention during labor. Due to dystocia, the patient required operative delivery and her epidural was successfully converted to surgical block using a total of 15mL of 2% lidocaine with 1:200,000 epinephrine and 100mcg epidural fentanyl. Post-operatively, analgesia was controlled with 2.5mg of epidural morphine, tylenol, naproxen, and oral hydromorphone PRN. She was discharged home on postoperative day 2 and the pain clinic detected no change in her neurostimulation mapping.

Discussion: In collaboration with an interventional pain specialist, a parturient with a SCS can be effectively managed perioperatively using a standard epidural technique for labor analgesia and caesarean delivery. There is a theoretical risk of SCS damage with placement of a neuraxial technique, although the risk is reduced with prior knowledge of the generator, lead locations and precise land-marking of the lumbar spine.[2] Also, epidural catheters are unlikely to cause migration of SCS wires as fibrous deposits anchor the wires to the supraspinous ligament.[1] SCS are becoming more common for patients of child-bearing age [3] and anesthesiologists should become familiarized with implications of the device.

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Abstract #:RF4BD-277

SLOWLY TITRATED COMBINED SPINAL-EPIDURAL IN A PATIENT WITH T6 SPINAL CORD INJURY AND TRACHEAL STENOSIS UNDERGOING CESAREAN DELIVERY

Presenting Author: Peter E Khoury D.O.
Presenting Author's Institution: The Ohio State University Wexner Medical Center - Columbus, OH
Co-Author: John C Coffman M.D. - The Ohio State University Wexner Medical Center

Spinal Cord Injury (SCI) poses many challenges in obstetric anesthesiology. In these patients, both labor and cesarean delivery are potent stimuli of autonomic hyperreflexia (AH), which carries risk of significant morbidity and mortality. It is thus critical to achieve adequate neuroblockade, even with absence of pain. Monitoring of blockade in these patients can be unreliable due to limited sensory discrimination. We report on a patient with known AH from T6 SCI in the setting of tracheal stenosis, requiring careful neuraxial titration.

A 19 year-old G3P1 with a history of T6 SCI, presented at 39w1d for repeat cesarean delivery. Of note, she had full upper extremity motor & sensory function, with little to no motor or sensory function below T6. She had a known history of AH with bladder distension and other lower body stimuli. Additional history included current upper respiratory tract infection and tracheal stenosis, for which she did not comply with outpatient evaluation and imaging. Slowly titrated combined spinal-epidural (CSE) approach was selected in order to minimize risk of high neuroblockade or respiratory compromise that could necessitate endotracheal intubation. A low dose spinal, consisting of 1 ml of 0.75% hyperbaric bupivacaine, morphine 100mcg, and fentanyl 15mcg was used along with L3-4 epidural catheter. She was initially placed at 45°, gradually lowering the head of the bed to ~20-30° while monitoring respiratory status and neuroblockade level. An epidural catheter test dose (1.5% lidocaine with 1:200K epinephrine 3mL) was given, followed by two doses of 3 ml of 2% lidocaine with epinephrine at 30 minute intervals. Her poor sensory feedback prompted assessment of neuroblockade onset via temperature probe placed at the T8 level. In the first five minutes after the spinal dose, skin temperature rose by 2°C, where it then plateaued. Adequate surgical anesthesia was attained, and her intraoperative course was uneventful, without signs or symptoms of AH. EKG and SpO2 were monitored in the PACU for two hours and postpartum unit for 24 hours, without exhibiting any cardiopulmonary issues. She was discharged on post-op day 3.

In managing chronic SCI for cesarean delivery, adequate neuroblockade is needed to prevent AH, as neuraxial anesthesia causes inhibition of its afferent sensory component. Monitoring increased skin temperature as an indicator of sympathetic blockade allows for assessment of blockade level. With mid-thoracic SCI, pulmonary considerations, such as atelectasis and poor respiratory reserve, make avoidance of a general anesthetic preferred, particularly in our patient with tracheal stenosis and upper respiratory tract infection. Slow epidural titration after low dose spinal allows cautious blockade advancement to the level of patient detection.

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Abstract #: RF4BD-306

Postpartum Spontaneous Coronary Artery Dissection (SCAD)

Presenting Author: David M Janiczek M.D.
Presenting Author's Institution: University of Illinois-Chicago - Chicago, Illinois
Co-Author: Peter Milonas M.D. - University of Illinois-Chicago
Heather C Nixon M.D. - University of Illinois-Chicago

Introduction: Pregnancy associated myocardial infarction (PAMI) is defined as MI occurring during pregnancy or during the first 6-12 weeks postpartum. (1) Among various etiologies for PAMI, spontaneous coronary artery dissection (SCAD) is the most common cause. SCAD is defined as non-iatrogenic dissection of an epicardial coronary artery that is not associated with atherosclerosis or trauma. The impact of SCAD in the peripartum period is immense and prompt recognition and treatment are key to outcomes.

Case Presentation: 29 yo otherwise healthy G2P2 female presented with a 2-week history of chest pain (CP), and dyspnea following an uneventful SVD 3-weeks prior. After discharge from SVD on POD #8, the patient experienced severe substernal chest pain and called EMS. On evaluation, the patient's vitals were normal and episode was attributed to anxiety by EMS providers and no further workup was completed. On POD# 14, (at 2 wk f/u with obstetric service) the patient was tearful about continued CP. Her EKG showed small TWIs, but no other abnormalities. She was sent home. On POD #21 she again presented to ED and workup demonstrated troponin leak (5.7ng/mL), NSTEMI with LVEF- 40-45% and hypokinesis of inferolateral wall. Left heart catheterization showed multiple stenoses of LMA (60%), LCx (100%) and distal LAD (90%). On POD#23, the pt underwent three vessel CABG with intraoperative findings highly suggestive of P-SCAD (significant clot edema). Pt currently in cardiac rehabilitation with continued wall motion abnormalities.

Discussion: Pregnancy associated SCAD (P-SCAD) is a dangerous condition that can lead to significant cardiac morbidity and mortality. P-SCAD is estimated to occur in only 1.8 per 100,000 pregnancies, but the incidence is rising. It is thought to be caused by due to changes in estrogen and progesterone levels predisposing women to vasa vasorum rupture (2). Clinically, women with P-SCAD generally presents with chest pain, dyspnea and STEMI, predominantly left main involvement, multivessel involvement and severe left ventricular dysfunction. Our patient was atypical in presentation with NSTEMI diagnosis although she did have multi-vessel involvement and classic symptomology. In general, the diagnosis of PAMI is made utilizing clinical symptoms, cardiac biomarkers and EKG changes.

Unfortunately, as in this case, the diagnosis can be delayed due to low suspicion in healthy patients and attribution of symptoms to anxiety. In addition, cardiac biomarkers are not specific to the diagnosis, as 4% of healthy women have elevated troponins in 8-24 hr postpartum period Therefore, severe consistent CP in the peripartum period must be thoroughly evaluated and include considerations for PAMI and SCAD in order to provide timely therapy.

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Abstract #: RF4BD-355

A CASE OF A BRONCHIAL ARTERIOVENOUS MALFORMATION PRESENTING AS HEMOPTYSIS DURING PREGNANCY

Presenting Author: Maria Betances Fernandez MD
Presenting Author's Institution: Henry Ford Hospital - Detroit, MI
Co-Author: Rowaa Ibrahim MD - Henry Ford Hospital
Mark Giska MD - Henry Ford Hospital
Christina Fidkowski MD - Henry Ford Hospital
Joshua Younger MD - Henry Ford Hospital
Ami Attali MD - Henry Ford Hospital

INTRODUCTION: Airway management in the pregnant patient poses a challenge for the anesthesiologist as well as a significant risk for both the parturient and the baby [1]. This risk is exaggerated in patients with pathological variations in airway anatomy such as arteriovenous malformations due to a combination of anatomical airway changes including engorgement of mucosal capillaries and edema from fluid retention [2].

CASE: Our patient is a 44 year-old G5P4A0 female who presented at 29 weeks gestation with sudden onset hemoptysis after returning from Congo. She had no medical history and an uncomplicated pregnancy. She was tachycardic but otherwise stable. Initial labs showed anemia but diagnostic tests did not point to a clear diagnosis. Chest x-ray was unremarkable and a CT scan for pulmonary embolism was inconclusive due to an inadequate contrast load.

She was initially started on a heparin infusion which was later stopped after worsening hemoptysis and closer review of her imaging with the radiologists. She was intubated and underwent bronchoscopy with the interventional pulmonology (IP) team which revealed a large clot occluding the proximal right main stem but no obvious source of active bleeding. Pulmonary angiography demonstrated a hypertrophied right bronchial artery with 2 large branches supplying an abnormal region of hypervascularity in the right lower and middle lobes which were embolized. Repeat bronchoscopy demonstrated an old clot at the same location, therefore, after discussion with the IP, intensive care and anesthesia teams, the decision was made to keep the patient intubated due to concern for re-bleeding.

On hospital day 7, a non-reassuring fetal heart rate pattern was observed and the patient was taken for an emergency cesarean section under general anesthesia given she was already intubated. A fiberoptic scope, double-lumen endotracheal tube and bronchial blocker were kept available in case of rebleeding. Careful attention was paid to maintain airway pressures between 17–20 cmH2O. Delivery was successful and the patient was extubated 5 days later with no recurrence of hemoptysis.

DISCUSSION: Early involvement of a multidisciplinary team is critical in the timely diagnosis and management of rare pulmonary pathology. In our pregnant patient particularly, this was exemplified in the efforts of the radiology, interventional pulmonology, anesthesia, obstetrics and critical care team which led to a safe delivery despite a complex presentation [3].

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Abstract #: RF4BD-362

Niemann-Pick Disease Type B in the Peripartum Patient

Presenting Author: Michael G Taylor MD
Presenting Author's Institution: Northwestern University McGaw Medical Center - Chicago, Illinois
Co-Author: Adithya D Bhat MD - Northwestern University McGaw Medical Center
M. James Lozada DO - Vanderbilt University Medical Center
Feyce M Peralta MD - Northwestern University McGaw Medical Center

Niemann-Pick Disease (NPD) is a rare autosomal recessive lysosomal storage disorder with a wide range of clinical phenotypes which may pose unique challenges to the management of obstetrical patients. Affected patients may develop hepatosplenomegaly, interstitial lung disease, and thrombocytopenia, with quantitative and qualitative platelet dysfunction. NPD Type B is a less severe, later-onset phenotype; however, few women with the diagnosis are known to have delivered children. We describe the management of a patient with NPD-B admitted for induction of labor.

A 22-year-old G2P0 at 35 weeks EGA with PMH of toxic multinodular goiter, gestational hypertension, and NPD-B experienced multiple episodes of epistaxis and new-onset gum bleeding. Serial platelet counts remained between 80-100K/mcL until 37 weeks EGA. Concern for further platelet decline and potential development of immune thrombocytopenia at term prompted hematology consultation and a five-day course of prednisone. The patient presented at 38 weeks for induction of labor for preeclampsia. Laboratory studies on admission were notable for platelets 83K/mcL, hemoglobin 11.6 g/dL, and fibrinogen 415 mg/dL. To further evaluate for qualitative platelet dysfunction, platelet function assay (PFA) revealed closure time 135 s and thromboelastogram (TEG) revealed R 5.8 min, K 2.3 min, α-angle 59.8°, and MA 54.4 mm. Peripheral blood smear demonstrated thrombocytopenia without evidence of hemolysis. A combined spinal-epidural technique was subsequently performed for labor analgesia. A healthy female was born via vacuum-assisted vaginal delivery with an EBL of 780 mL following administration of oxytocin, misoprostol, and carboprost. Her postpartum course was complicated by preeclampsia with severe features requiring magnesium and antihypertensive therapy. She was discharged home on postpartum day seven in stable condition.

While rarely encountered in parturients, NPD can result in life-threatening complications. Limited data from two case reports describe postpartum hemorrhage after cesarean delivery. One patient required massive transfusion after not responding to vasopressin, and another resulted in maternal death despite resuscitative efforts. Our case describes a patient with NPD-B who received neuraxial analgesia for an uncomplicated vacuum-assisted vaginal delivery. While PFA and TEG are not validated to predict spinal epidural hematoma risk, her preprocedural values, combined with unremarkable serum coagulation studies, helped reassure and guide neuraxial planning, vascular access, and blood product availability. A multidisciplinary approach to patients with NPD is recommended to characterize the risks of bleeding complications and develop a safe peripartum plan.

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Abstract #: RF4BD-421

A multimodal approach to perioperative analgesia in a patient with CRPS undergoing cesarean delivery

Presenting Author: Katherine S Becker MD
Presenting Author's Institution: Jackson Memorial Hospital-University of Miami - Miami, Florida
Co-Author: Nathalia Torres Buendia MD - Jackson Memorial Hospital-University of Miami
Maria R Suarez MD - Jackson Memorial Hospital-University of Miami
Daria M Moaveni MD - Jackson Memorial Hospital-University of Miami

Complex regional pain syndrome (CRPS) is a chronic pain condition with multifactorial pathophysiology, including peripheral and central nervous system, autonomic, and inflammatory changes. Symptoms can be acute or chronic and can recur after surgery. CRPS symptoms following spinal anesthesia has been reported. This case highlights perioperative pain management strategies that were used in a parturient with a history of CRPS to in order to prevent recurrence.

A 39 year old G3P1 woman with a history of CRPS and one previous cesarean delivery (CD) presented with concerns of triggering a recurrence of CRPS after surgery or neuraxial anesthesia. She had developed CRPS 17 years prior after fracturing her right 5th metatarsal, with symptoms spreading to her left leg and upper extremities. After multiple unsuccessful procedures, she finally achieved remission after treatment with a ketamine induced coma, followed by intensive physical therapy. Her previous delivery was at our institution, for which she received a labor epidural and then epidural anesthesia for CD.

The anesthetic technique for scheduled CD was combined spinal epidural (CSE). Dexamethasone 8 mg premedication was given to prevent inflammation. After loss of resistance, 5 mL lidocaine 1.5% was injected through the Tuohy needle prior to dural puncture. She received intrathecal fentanyl 15 mcg and morphine 0.1 mg, followed by epidural fentanyl 85 mcg and epidural lidocaine 2% until a T4 level was obtained. After delivery, ketamine infusion 2.5 mg/kg/h was started. Ketorolac 30 mg IV and acetaminophen 1000 mg IV were also given. Two subcutaneous catheters were placed the by surgeons in the incision at skin closure. Postoperatively, the patient was maintained on a ketamine infusion at 30 mg/h for 24h and an epidural infusion of bupivacaine 0.0625% + fentanyl 2 mcg/mL at 12 mL/h for 24h. She received ropivacaine 0.2% at 8 mL/h through each incisional catheter for 48h postoperatively. She was also started on celecoxib 200mg BID postpartum. She did not require additional PRN opioids. The patient was discharged with the recommendation to take ibuprofen 800 mg TID, acetaminophen 1g TID and oxycodone 5 mg Q6h PRN for 3 days. She did not experience recurrence of CRPS symptoms.

A multimodal approach to analgesia for obstetric patients with a history of CRPS may be effective in preventing recurrence. In this case, a steroid, neuraxial anesthesia, intraoperative and postoperative ketamine infusion, postoperative epidural infusion, surgical site local anesthetic infusion, and oral pain medications were effective in preventing recurrence of symptoms after CD.

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Abstract #: RF4BD-440

"Pregnant and Starving to Death": A Case of Starvation Ketoacidosis

Presenting Author: Jeffrey B Yu MD
Presenting Author's Institution: The Ohio State University Wexner Medical Center - Columbus, OH
Co-Author: Goran Ristev MD - The Ohio State University Wexner Medical Center
Blair H Hayes MD - The Ohio State University Wexner Medical Center

A 22 yo AA G1P0 at 32w6d with twin gestation presents with 3 days' refractory abdominal pain, n/v, and PO intolerance. HR was 114 and BP was 160/89. Labs were notable for Cr 1.11, anion gap 27, glucose 52, and UA with large ketones. She was admitted for pre-eclampsia with severe features. Hypoglycemia was treated with dextrose without improvement. Starvation ketoacidosis of pregnancy was suspected. Her BP normalized after labetalol, but later that day fetal distress was noted on monitors and she was taken emergently to OR for cesarean delivery under GA-ETT with post-induction A-line. Neonates' APGARs were 5, then 6. Initial ABG was: pH 7.13/bicarb 14.3/base deficit 14/lactate 3.06. She received 150 mEq bicarb and 4L crystalloid during the case. EBL was 1L. She remained intubated and was admitted to SICU postoperatively. After 24h of fluid and electrolyte resuscitation, metabolic derangements resolved. She discharged on POD5.

Discussion: Starvation ketoacidosis of pregnancy (SKP) is an uncommon complication, most often seen in the 3rd trimester. Data from DKA patients show that metabolic acidosis is strongly associated with IUFD; mortality rates estimated at 9-35%. The pathogenesis involves ketoacids crossing the placenta, volume depletion, and electrolyte derangement(1).

In ketoacidosis, a state of low glucose utilization (eg: starvation or insulin deficiency) forces the body to generate acetyl CoA from beta-oxidation of fatty acids to use in the citric acid cycle. Excess acetyl CoA is converted to ketone bodies, which accumulate to induce acidosis. Hormonal changes of pregnancy are implicated in the pathogenesis. Glucagon and human placental lactogen secreted by the placenta lead to a relative state of insulin resistance during pregnancy, making parturients susceptible to ketosis. 12-24 hrs of starvation (most often related to a period of severe vomiting, as in our patient) may be sufficient to induce ketoacidosis in otherwise healthy pregnant patients, compared to 14 or more days in the general population(1).

The differential for metabolic acidosis in pregnancy is broad, and SKP is a relative diagnosis of exclusion. Most cases are managed by emergent delivery as acidosis begins to induce fetal distress(2). However, some case reports suggest that aggressive early treatment with dextrose and fluid may reverse the acidosis and allow normal progression of pregnancy(3). Having high clinical suspicion may reduce the number of cases requiring emergent delivery. Working with OB colleagues to develop a protocol facilitating early recognition of acidosis is the next step in reducing maternal and fetal morbidity from SKP.

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Abstract #:RF4BD-457

Prophylactic intraaortic balloon pump placement prior to induction of labor in a patient with peripartum cardiomyopathy and severe mitral regurgitation

Presenting Author: David E Arnolds Md, PhD
Presenting Author's Institution: University of Chicago - Chicago, IL
Co-Author: Richa Dhawan MD - University of Chicago
Jennifer Banayan MD - University of Chicago

A 30 yo G7P6 patient of unknown gestational age (GA) but approximately in the third trimester presented with chest and abdominal pain. She had a history of peripartum cardiomyopathy (PPCM) diagnosed after her most recent delivery. She did not seek prenatal care and continued her heart failure medications, including lisinopril, during this pregnancy. Ultrasound was consistent with GA of 32-35 weeks and revealed anhydramnios. Transthoracic echocardiography demonstrated dilated cardiomyopathy with a left ventricular ejection fraction (EF) of 38% and severe mitral regurgitation (MR). She was recognized as being at high high risk of peripartum decompensation due to her severe MR and low EF. Cardiology was consulted and recommended prophylactic placement of an intraaortic balloon pump (IABP). After multidisciplinary discussion, a subclavian IABP was placed and the patient underwent induction of labor with a transcervical catheter and oxytocin. The patient was managed on labor and delivery with a cardiac intensive care unit (ICU) nurse to manage the IABP. A dural puncture epidural was placed for labor analgesia, as well as to minimize cardiac stress during delivery and further reduce afterload. The patient remained hemodynamically stable throughout labor and delivered a vigorous infant. After postpartum tubal ligation, the patient was transferred to the cardiac ICU. On postpartum day 1 her intraaortic balloon ruptured. She remained hemodynamically stable and the IABP was removed. On postpartum day 2 she was transferred to the floor and was subsequently discharged on postpartum day 4.

Cardiac disease is the leading cause of pregnancy-related mortality in the United States (1). Pregnancy is particularly high risk in women with severe mitral or aortic valve disease, history of PPCM, EF < 40%, aortopathy, cyanotic congenital heart disease, or pulmonary hypertension (2). Late prenatal care is additionally associated with poor cardiac outcomes (3). IABPs are primarily used as mechanical support for patients in cardiogenic shock, but have also been used prior to high-risk procedures. Case reports describe IABP use in pregnancy for patients with peripartum cardiomyopathy (4, 5), although we are unaware of prior reports of prophylactic IABP placement prior to labor and vaginal delivery. Our patient suffered rupture of her intraaortic balloon, which is a rare but recognized complication of IABPs (6). The overall major complication rate associated with IABPs is approximately 3% (6). Our case highlights the challenges of caring for parturients with severe cardiac disease as well as the need to balance risks and possible benefits of mechanical circulatory support for vaginal delivery.

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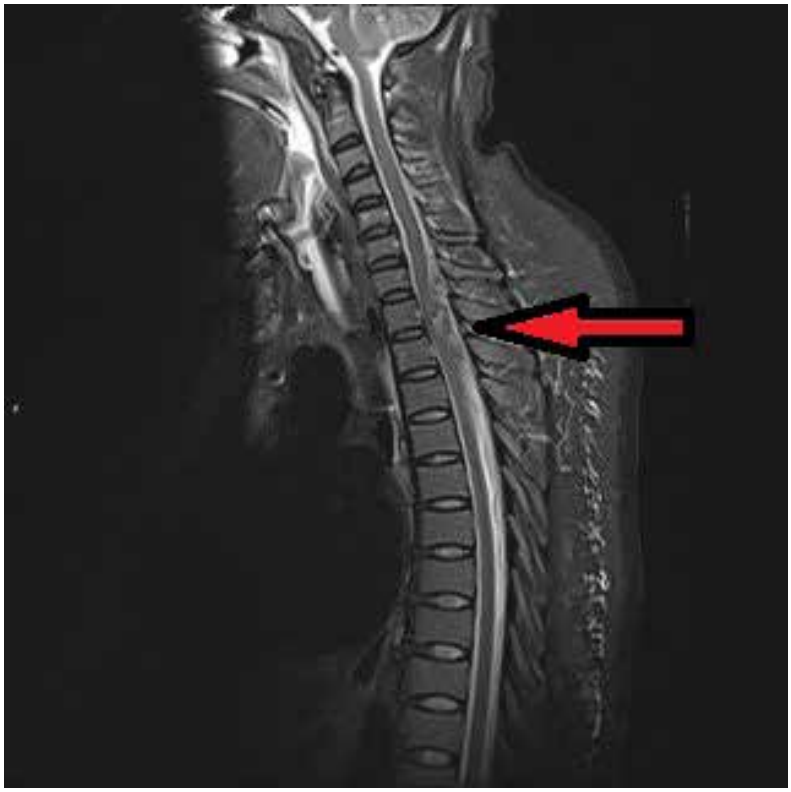
Abstract #: RF5BH-44

Not all Sub Arachnoid Hemorrhages in Pregnancy are Intra cranial in origin

Presenting Author: Amar Bhavsar MD
Presenting Author's Institution: University of Maryland Medical Center - Baltimore, Maryland
Co-Author: Allison Shannon MD - University of Maryland Medical Center
David Schreibman MD - University of Maryland Medical Center
Francois Aldrich MD - University of Maryland
Bhavani Shankar Kodali MD - University of Maryland

A 41 year old, G3P2, at 38.5 weeks, while undergoing induction of labor for severe pre-eclampsia developed significant posterior head, neck and shoulder pain with no neurological deficit. A head CT showed subarachnoid (SAH) and intraventricular hemorrhage in the posterior fossa suspicious for ruptured aneurysm, and transferred to this facility. A repeat contrast CT confirmed blood in the craniocervical region with extension into the supravermian, prepontine and intrapeduncular cisterns and into the fourth ventricle. SAH was also seen in the posterior, temporal and occipital lobes with sulcal effacement. No intracranial aneurysm or AV malformation was noted (figure A) The obstetric team recommended primary cesarean delivery for severe preeclampsia. She was alert, no obvious neurological deficit was observed except head and neck pain. A pre-induction arterial line was placed before rapid sequence induction with propofol, 100 mg succinylcholine and 40 mcg nitroglycerin to keep blood pressures below 140 mm Hg. Her procedure was uncomplicated, and she was brought back to the Neuro ICU intubated and sedated. Hemodynamically, her blood pressures were in the range of 120 to 140 mm systolic during the entire procedure. Upon recovery in the Neuro ICU, she was unable to move lower extremities with intact sensory function, and MRI showed a 5 mm thick intradural extramedullary collection posteriorly at C7-T2 causing moderate to marked spinal stenosis (figure B). She underwent C7-T4 laminectomy. At surgery, hematoma was subdural in origin secondary to vascular malformation in the subdural space. Her lower extremity weakness showed modest improvement.

The findings in this case suggests two possibilities. First, SAH and subdural AV malformation, two independent entities occurring coincidently. But, isolated spontaneous SAH unrelated to intracranial aneurysm, or AV malformation is rare. Second, the epicenter of the bleeding was primarily AV malformation in the cervico thoracic subdual space. The blood initially migrated via foramen magnum and via breaches in subarachnoid membrane into the cranium presenting as cervico cranial subarachnoid hemorrhage. Subsequently continued bleeding from AV malformation resulted in the accumulation of blood in the cervico thoracic region contributing to lower extremity motor deficit. This case demonstrates that cervico thoracic region should be included in the evaluation of SAH if no obvious intracranial lesion is demonstrated



Abstract #: RF5BH-67

Cesarean Delivery in a Patient with Headache and Neurological Deficits with Cerebrospinal fluid Lymphocytosis (HaNDL)

Presenting Author: Alexander J Service MD
Presenting Author's Institution: Northwestern Memorial Hospital - Chicago, IL
Co-Author: Jason R Farrer MD - Northwestern Memorial Hospital

Introduction: Obstetric anesthesia requires an understanding of neurologic diseases due to the potential impact on neuraxial anesthesia. One such condition is headache and neurological deficits with cerebrospinal fluid lymphocytosis (HaNDL). HaNDL presents with severe headaches and symptoms of aphasia, sensory loss, and/or motor weakness (1). Neurologic workup in these patient is unrevealing except for elevated white blood count on lumbar puncture (LP) (1). It is extremely rare with an incidence of 0.2 per 100,000 (1). There are a paucity of case reports describing HaNDL in the general or pregnant patient populations, with no reports on the use of neuraxial anesthesia for labor and delivery (2,3). The following case discusses the safe and effective use of epidural anesthesia for Cesarean delivery in a patient with HaNDL.

Case Presentation: A 39 y.o. female with a history of prior Cesarean delivery, HaNDL, colitis, and anxiety presented for repeat Cesarean at 41 weeks gestation. The patient was diagnosed with HaNDL following her first pregnancy after experiencing severe headaches, left arm numbness, blurred vision, and slurred speech. Workup including MRI, CT, LP, and EEG showed no abnormalities except for an elevated WBC on LP. On presentation for delivery, the patient was asymptomatic. She underwent lumbar epidural placement without complication. A total of 15 mL of lidocaine 2% with 1:200,000 epinephrine was administered to achieve a T4 anesthetic level. Delivery was uncomplicated and the patient recovered well. She experienced no neurologic sequelae or relapse of her symptoms in the immediate post-partum period.

Discussion: Our case provides an example of safe and effective use of epidural analgesia in the rare neurologic disorder of HaNDL. This report is of importance since there have been few cases in the literature of HaNDL in pregnancy, and none to our knowledge that describe the safety of neuraxial anesthesia in this patient population. Future questions of importance are the safety of spinal anesthesia, as well as the use of neuraxial anesthesia in a symptomatic patient. We decided to avoid spinal anesthesia due to the theoretical risk associated with intrathecal local anesthetic administration and potential for neurotoxicity or exacerbation of HaNDL symptoms. No literature exists, however, that contraindicates spinal anesthesia in patients with HaNDL.

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Abstract #: RF5BH-68

Polydipsia and Ureteral Obstruction Causing Hyponatremic Acute Encephalopathy

Presenting Author: Priyanka Patel B.A., M.D.
Presenting Author's Institution: University of Kansas Medical Center - Kansas City, Kansas
Co-Author: Molly B. Cason M.D. - University of Kansas Medical Center

Maternal hyponatremia quickly affects the fetus since, "placental homeostasis determines electrolytes equilibrium between mother and fetus"1. There are few reports of severe maternal hyponatremia presenting as neonatal seizure.1,2 We present a unique case of polydipsia during labor and urinary tract obstruction from a large fetus resulting in maternal encephalopathy and neonatal seizure.

A 29-year-old G1P0 at term presented to labor and delivery after failed home delivery with a midwife. Labor duration was 16 hours with ruptured membranes and 4 hours of active pushing. She appeared exhausted on arrival and barely responded to questions. Pre-delivery catheterization drained < 50 mL of urine. Forceps-assisted vaginal delivery of a 4965g viable infant was complicated by shoulder dystocia and postpartum hemorrhage of 1L. She underwent laceration repair in the operating room where 1 L of urine was drained. Light sedation was discontinued when she became unresponsive to verbal and tactile stimulation. Vital signs were normal, and labs resulted in normal glucose and hemoglobin of 9.4 g/dL. Unresponsiveness was presumed to be from exhaustion. An hour after surgery, the patient became combative and tachycardic. It was reported that her newborn seized in the setting of a sodium of 114 mEq/L. Maternal labs were significant for hyponatremia at 124 mEq/L and a lactate of 11.0 mmol/L. Retroactive testing of the OR sample revealed a sodium level of 116 mEq/L. A CT scan showed a dilated bladder with hydroureteronephrosis. Placement of a catheter drained copious urine. She was transferred to intensive care for treatment of sepsis from endometritis and hypervolemic hyponatremia. It was discovered that she had consumed several liters of water with electrolyte additive during labor but had not urinated. Her hyponatremia autocorrected over several hours and encephalopathy resolved with no memory of delivery. Hyponatremia was presumed to be due to polydipsia during labor with hypervolemia developing from urinary tract obstruction from her large fetus.

In one study, 26% of mothers who consumed > 2500 mL of fluids during labor were hyponatremic at a sodium ≤ 130 mEq/L after delivery.3 Several case reports describe ureteral obstruction by the uterus during pregnancy.4,5 This case illustrates the unique combination of polydipsia during labor leading to severe hyponatremia with ureteral obstruction by a large fetus causing hypervolemia. As fluid intake during labor becomes more common, intake and output should be noted so that electrolyte imbalances may be anticipated.

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Abstract #: RF5BH-90

Emergent decompressive craniotomy in a 27-week parturient with intracranial AVM rupture and refractory elevated intracranial pressure

Presenting Author: Leslie J Matthews MD, PharmD
Presenting Author's Institution: University of North Carolina - Chapel Hill, NC
Co-Author: Christopher A. Huber MD - University of North Carolina
Samuel N. Blacker MD - University of North Carolina

A 35-year-old G2P1 female at 26 weeks and 3 days' gestation, with no past medical history, presented to an outside hospital emergency department with headache, expressive aphasia and left hemiparesis. Initial CT imaging revealed a large left parietal hemorrhage with intraventricular extension, so the patient was transferred to a tertiary care center for further management given significant pathology with concomitant pregnancy. Further workup revealed the large hemorrhage was likely related to a previously undiagnosed bleeding arteriovenous malformation (AVM). Due to malignant cerebral edema and refractory intracranial pressures, which peaked at 68 mmHg despite maximum medical management, patient was taken to the operating room for emergent decompressive hemicraniectomy with AVM resection. Obstetric teams were immediately available for resuscitative cesarean section in case of maternal hemodynamic compromise. The decision was made not to deliver emergently for fetal distress, thus fetal heart tones were obtained pre- and post-operatively. Intraoperatively, the patient was resuscitated using the massive transfusion protocol as it was a brisk and uncontrolled bleed. Total blood loss was 2.5 liters. After surgical hemostasis was achieved, the patient was maintained in a pentobarbital coma for five days, and after neurological improvement, was eventually extubated on hospital day #13. She continued to improve and was discharged to acute inpatient rehab on hospital day #30, then home on hospital day #58 at 34 weeks and 4 days gestation. Remarkably, she recovered nearly completely neurologically, with her only residual deficits being impaired short term memory, occasional mild expressive aphasia, and a right sided visual field deficit. She re-presented at 39 weeks and 0 days' gestation, and underwent scheduled repeat cesarean section under spinal anesthesia without complications. She was discharged home on post-partum day 3 with a healthy baby girl.

Abstract #:RF5BH-98

Anesthetic Management for a Parturient with Splitting of the Spinal Cord—Diastematomyelia

Presenting Author: Stephanie K Woodward MD
Presenting Author's Institution: UNC Hospitals - Chapel Hill, NC
Co-Author: Stephen Acosta MD - UNC Hospitals
Lacey E Straube MD - UNC Hospitals
Willaim H Goodnight MD - UNC Hospitals
Gina Silverstein MD - UNC Hospitals
David C Mayer MD - UNC Hospitals

Background: Diastematomyelia is a rare congenital disorder characterized by longitudinal splitting of the spinal cord. Parturients with diastematomyelia are poor candidates for neuraxial anesthesia due to unusual vertebral/spinal cord anatomy, propensity for tethered cord, and prior surgical management. To our knowledge management of parturients with diastematomyelia has not been previously described.

Case: A 33-year-old 4' 9" G2P0010 at 37w0d with diastematomyelia was admitted for primary cesarean delivery (CD) for breech presentation and gestational hypertension. Her history was notable for back pain, bicornuate and bicollis uterus, and idiopathic tachycardia (baseline 110-120 BPM). She was status-post multiple vertebral operations including tethered cord repair, resulting in a shortened thorax. Her neurological exam prior to pregnancy was normal apart from bilateral hand/right foot numbness and bilateral leg weakness with prolonged supine positioning. She had a Mallampati 1 airway and no history of airway complications.

The patient was positioned awake on the operating table using blankets with patient feedback. She was uneventfully intubated with direct laryngoscopy after rapid sequence induction. Tachycardia slightly above baseline (130-150 BPM) persisted intraoperatively. Delivery was uncomplicated. A bicornuate uterus was confirmed. Mild uterine atony resolved with oxytocin and one dose of methylergonovine. Estimated blood loss was 800mL.

The patient was extubated uneventfully. Post-operative pain control was suboptimal despite 400mg fentanyl, 1mg hydromorphone, and 8mg morphine. Ultrasound-guided bilateral transversus abdominal plane (TAP) blocks were placed with 60mL 0.25% bupivacaine. Although placement was somewhat challenging given her short thorax, this provided 12 hours of pain control. Pain was then controlled using acetaminophen, NSAIDs, and oxycodone.

Postoperative telemetry showed sinus tachycardia intermittently up to 180 BPM. She was treated with pain control and esmolol. Bleeding was negligible, electrolyte and thyroid function were normal, and cardiology consult recommended no further workup. Her heart rate returned to baseline prior to discharge on post-operative day 4.

Discussion: Parturients with diastematomyelia require special consideration for the anesthesia and obstetric providers. CD may be more common in this population due to cephalopelvic disproportion with significant spinal malformations. This patient would not have tolerated prolonged lithotomy positioning. She was not a candidate for neuraxial anesthesia given her anatomy and prior surgical interventions; TAP blocks and multimodal analgesia were very beneficial. In patients who are candidates for trial of vaginal delivery, nitrous oxide or IV remifentanil may be adjuncts for labor analgesia.

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Abstract #: RF5BH-373

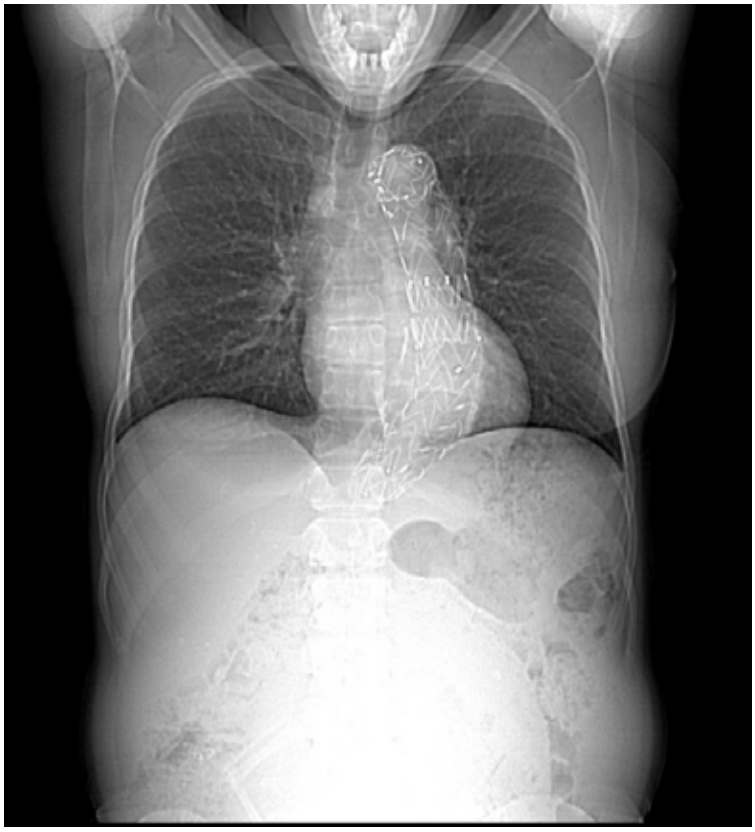
Spontaneous vaginal delivery in a parturient with thoracic aortic aneurysm

Presenting Author: Rustin Roberts MD
Presenting Author's Institution: Ochsner Medical Center - Jefferson, LA
Co-Author: Melissa Russo MD - Ochsner Medical Center

Introduction: Aortic aneurysm is a rare risk of pregnancy complicated by aortic dissection and may lead to maternal and or fetal morbidity and mortality. Herein we present the management of a multiparous parturient with pregnancy complicated by descending thoracic aortic aneurysm (TAA).

Case Report: A 37 yo G3P2 at 37 3/7 weeks EGA with history of 2 prior vaginal deliveries presented for scheduled induction of labor. Past medical history was significant for tobacco abuse and descending thoracic aortic aneurysm with associated type B dissection s/p endovascular repair 1 year prior to her current presentation. CT angiography confirmed 5.7 X 4.2 cm TAA with stent graft and without evidence of endoleak. A radial arterial line was placed for close hemodynamic monitoring and she underwent uneventful dural puncture epidural (DPE) placement. She remained comfortable throughout her labor and a forceps-assisted vaginal delivery (Apgars 9/9) was performed to minimize maternal effort. Her postpartum course was uneventful and she was discharged home on postpartum day 3.

Discussion: The incidence of an acute aortic dissection in women of childbearing age is approximately 2.6-3.5 cases per 100,000. Risk factors include tobacco abuse, hypertensive disorders, advanced maternal age, inherited connective tissue disorders, bicuspid aortic valve, coarctation, and aortitis. Although the physiological changes of pregnancy do not directly cause dissections, these changes in addition to an inherited defect or previously compromised arterial wall increase the risk of dissection. Unfortunately, most aneurysms and or dissections are inadvertently discovered in the third trimester of pregnancy due to the maximal hemodynamic stress during pregnancy (increased HR, SV, CO, left ventricular mass, and end diastolic dimensions), which results in increased maternal and fetal mortality. This case is unique due to the paucity in the literature regarding pregnancy management and outcomes in women with previous endovascular repair. There was significant concern for a dissection during labor or the postpartum period and therefore, after input from cardiology, maternal fetal medicine, & obstetric anesthesia, she was allowed to labor with close hemodynamic monitoring and excellent labor analgesia.



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Abstract #: RF5BH-382

Dural Puncture Epidural Technique for Cesarean Delivery in Parturient with Postural Orthostatic Tachycardia Syndrome

Presenting Author: Scarlett V Marshall D.O.
Presenting Author's Institution: The Ohio State University - Columbus, Ohio
Co-Author: Blair H Hayes MD - OSU
Robert H Small MD - OSU

A 23-year-old nulliparous patient at 39w0d gestation with complex medical history including debilitating postural orthostatic tachycardia syndrome (POTS) with associated daily episodes of vertigo and syncope presented for scheduled cesarean. Past medical history includes hypermobility type Ehler-Danlos (ED), platelet storage pool deficiency, severe asthma and nighttime hypoxia, mitochondrial disease, and gastroparesis with recent requirement for TPN and enteral feeding access. Despite mild-range HTN, her day of surgery labs were reassuring. Per hematology recommendations for her platelet disorder, she received DDAVP 1 hour prior to case and TXA during her hospitalization.

Dural puncture epidural (DPE) with 25-g spinal needle was performed without issue with simultaneous normal saline and IV phenylephrine infusions, with frequent noninvasive blood pressure monitoring (every 1-2 minutes). Eight minutes later, after epidural was dosed with 8 mL of 2% lidocaine with epinephrine, the patient became symptomatically hypotensive with systolic blood pressure of 50 mmHg. This was treated with additional phenylephrine and the epidural was successfully dosed to a T4 level for the case. Surgery was typical with the delivery of a healthy neonate, and mother and infant were discharged to home as expected after planned postoperative observation.

Postural orthostatic hypotension syndrome includes a heterogeneous group of conditions without clear definition and is often associated with underlying conditions. Annually 500,000 Americans are diagnosed, with a strong predominance for females aged 15-50. Diagnostic criteria include a heart rate increase of 30 bpm or to >120 bpm within 5-30 minutes of standing, and may include the presence of hypotension. Other reasons for tachycardia should be excluded, and tilt-table testing or measurement of upright plasma norepinephrine concentration may be utilized for diagnosis(1). Preferred treatment of hypotension in obstetric patients is IV phenylephrine, and this appears to be useful therapy for patients with POTS and hypotension(2).

We focus on the anesthetic selection for cesarean delivery in severe POTS and using DPE technique, and include discussion of the perioperative management of the patient's comorbidities. We predicted that hemodynamic changes would be minimized by avoiding spinal anesthesia, while improving the density of analgesia and speeding the onset of surgical blockade as described for labor analgesia(3). While the patient did develop hypotension soon after dosing epidural, careful monitoring of blood pressure allowed for rapid detection and treatment, and the remainder of the operative courses was uneventful.

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Abstract #: RF5BH-397

One Lung and Triple Digit PA pressures during Cesarean on a repaired Tetralogy of Fallot

Presenting Author: Matthew Reschke D.O
Presenting Author's Institution: Washington University in St. Louis - St. Louis, Missouri
Co-Author: Amber Benhardt M.D. - Washington University in St. Louis
David Monks MBChB, FRCA, MSc - Washington University in St. Louis

29 year old female at 34+3 gestation sent from clinic for worsening heart failure symptoms. Significant past medical history that included tetralogy of fallot with multiple surgical interventions that were complicated by severe pulmonary hypertension and SVT. PFT demonstrated 100% pulmonary blood flow to right lung after left PA occluded during repair of left PA pseudoaneurysm. Patient medically noncompliant with follow up or appointments.

She was admitted to cardiac ICU for optimization. Right heart catherization performed with placement of Swan-Ganz catheter by interventional cardiology via right internal jugular vein. RHC demonstrated PAP 102/34 (PVR 11.4 Wood Units) with some PA systolic pressures noted in the 120s. Epidural placed overnight to help manage contraction pain.
The plan was to perform the procedure in the Cardiac OR with CT and OB anesthesia, CTS and MFM. Round table discussion prior to patient transport was completed to discuss contingencies. Patient had PA catheter placed by cardiology at the time of the RHC. Plan included arterial line, low dose CSE, CMAC in the room along with inhaled nitric in case of GETA. Cardiac drips were prepared and the ECMO machine was in the room along with cannulation equipment that would be placed prior to delivery.

Upon arrival patient was nauseous and vomiting in hospital bed with 6L face mask with inhaled epoprostenol. Arterial line was placed followed by a low dose CSE (3.75mg hyperbaric bupivacaine + 15mcg fentanyl + 100 mcg morphine) at L3-4. Patient remained seated for 10 minutes to allow caudal spread. Phenylephrine started and the patient was placed supine in LUD for foley catheter placement. Epinephrine infusion was started prior to bolusing epidural. Patient was nauseous again and no longer tolerating facemask. Saturations dropping to 80s and SVT noted with rate 160-220 shortly thereafter. Decision to convert to GA and cannulate emergently. Patient had suprasystemic pulmonary artery pressures and decision was made to go onto VA ECMO. Cesarean delivery was performed immediately after. Baby delivered with APGARS 2/6/8 and was initially only required PPV but did end up intubated prior to transport to NICU however was extubated later that day and has had an uncomplicated NICU stay. Intrauterine oxytocin administered and EBL during the case was 600mL. She was brought to the ICU and remained on VA ECMO which she remains on at this time. Her ICU course to date has been complicated by ventilator associated pneumonia and DIC. Patient has now been unable to wean from ECMO after two weeks. It was an educational case as even with the best possible planning the unexpected might happen. It was a case where maternal safety took precedent over fetal wellbeing in the decision to transport the patient out of L&D to the cardiac tower and to be on ECMO prior to delivery.

Abstract #: RF5BH-477

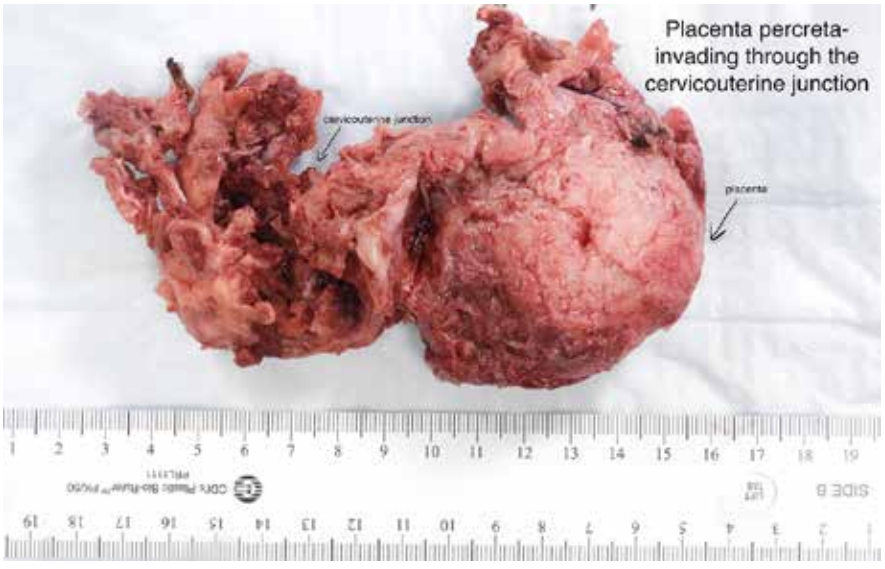
Placenta Percreta- How to Effectively and Efficiently Manage a Massive Hemorrhage of 40 liters

Presenting Author: Advaita Punjala-Patel MD
Presenting Author's Institution: Augusta University Medical Center - Augusta, Georgia
Co-Author: Lauren Griswold MD - Augusta University Medical Center
Efrain Riveros MD - Augusta University Medical Center
Linda Street MD - Augusta University Medical Center
Paul Browne MD - Augusta University Medical Center
Bunja Rungruang MD - Augusta University Medical Center

Background: The placenta accreta spectrum is a complex obstetric complication associated with abnormal placentation and is becoming a common occurrence as the cesarean delivery rate increases. Given the increased morbidity and mortality associated with this condition, it is important for institutions to put forth multidisciplinary protocols to manage these patients in a controlled manner. Here we present a case of placenta accreta complicated by massive hemorrhage that was successfully managed by an interdisciplinary team of OBGYN, anesthesia, critical care, general surgery, vascular surgery, and interventional radiology (IR).

Case Presentation: 37 yo patient G6P4115 with a history of four prior cesarean sections presented for planned cesarean hysterectomy secondary to complete placenta previa with possible percreta documented by antepartum MRI. In preparation for the OR, bilateral hypogastric artery balloons were placed by IR and ureteral stents were attempted without success by urology due to possible anatomic distortion secondary to placental erosion into the bladder. Intraoperatively, it was noted that the placenta invaded the entire posterior bladder with excessive collateral vessels feeding the placenta from the bladder, pelvic sidewalls and vagina, demonstrating a placenta percreta with massive hemorrhage. To control the bleeding, the uterus had to be amputated at the cervicouterine junction with a cystotomy to remove portions of the placenta. Her operation was further complicated by DIC with bleeding from the left common iliac artery that needed intervention from vascular surgery. The patient was taken to IR for embolization of the hypogastric vessels. During this course, patient's blood loss was estimated to be 40 liters, wherein a massive transfusion protocol was called. She received 118 units pRBC, 61 units FFP, 2 units of cryoprecipitate and 3000 mL of cell saver volume. On POD 1, in the SICU, the patient required a reintervention for fascial release due to abdominal compartment syndrome. Her postoperative course was further complicated by Clostridium infection leading to micro-perforations in the rectosigmoid requiring diverting loop colostomy. Patient was successfully extubated and discharged from the hospital on POD 28 with minimal additional complications.

Conclusion: The importance of multidisciplinary collaboration in placenta accreta spectrum is highlighted by the successful resuscitation of the patient presented above.



Additional Files:

Abstract #: RF5BH-500

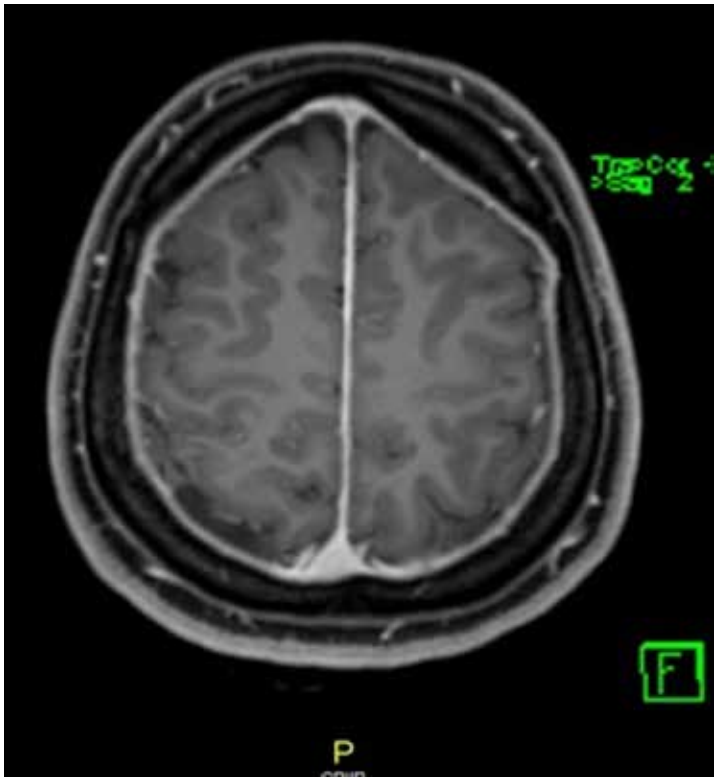
Cortical Vein Thrombosis after Lumbar Epidural and PDPH: A Case Report & Literature Review

Presenting Author: M. Waseem Athar MBBS, DESA, MCAI
Presenting Author's Institution: Women Wellness and Research Center, Qatar - Doha, Qatar
Co-Author: Umar Mushtaq MBBS, DESA - Women Wellness and Research Center, Qatar
Roshan G Fernando MBBS, FRCA - Women Wellness and Research Center, Qatar

Introduction: Complications of labor epidural analgesia include an accidental dural puncture (ADP) which can lead to headache in 50-80% patients. Cortical vein thrombosis(CVT) is an uncommon condition in pregnancy with the incidence quoted as 1:10 000 to 1:25 000. Headache is the commonest presentation of CVT but it is difficult to pick up with a background of ADP. We describe the case of a woman who had labor epidural complicated by an ADP, and subsequently developed PDPH.

Case Report: 24 Years old healthy G2P1 admitted to labor room requested labor epidural analgesia. CSE was done after multiple attempts and suspected ADP. Next day, patient complained of headache which was occipitofrontal and aggravated by sitting up. There was no neurological deficit. History and examination were very much suggestive of PDPH so she was started on regular analgesics without any improvement in a day. After discussing options of conservative management and blood patch, patient opted for pharmacological management. On 3rd day post-delivery, her headache was relieved, and she was discharged home. She came back on 6th post-delivery day with complaints of headache with typical postural variation & occasional tinnitus. EBP was offered which she accepted. EBP was done and 19ml of blood given at L3/L4 & headache was relieved immediately. Around 7 hours after EBP, patient had tonic clonic convulsions. On examination, patient was awake, not oriented with GCS 13. Patient became oriented in 10 minutes. Pupils were equal in size and reacting to light. There was no neurological deficit and no neck stiffness. Her vital signs were normal except tachycardia 115/min. Differential diagnosis considered included intracranial events, epilepsy, eclamptic fit, vasovagal syncope. CT head done 4 hours after that event showed thrombosis in the superficial cortical vein. Patient was started on anticoagulant therapy. MRV showed thrombosed dilated tortuous cortical vein in the high right frontal lobe region. She was discharged home on 11th post-delivery day. Her workup showed mutation for factor V Leiden putting her on 2-10 fold increased risk for VTE. Pt was counseled for lifelong anticoagulant therapy.

Discussion: This case highlights complications in the diagnosis of CVT in the setting of PDPH. Patients presenting with persistent headaches with confusion or motor weakness even after EBP may indicate a more concerning diagnosis of CVT.



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Abstract #: RF5BH-501

When He Presents In Labor

Presenting Author: MacKenzie Quale M.D.
Presenting Author's Institution: Mayo Clinic - Rochester, Minnesota
Co-Author: Emily Sharpe MD - Mayo Clinic
Leigh Hickerson MD - Standford
Alexandra Anderson MD - Mayo Clinic

Introduction: Caring for transgender patients in the peripartum and intraoperative period requires unique, population-specific considerations involving anatomical, physiological, psychological and pharmacological aspects.1 Research is lacking in terms of optimal care specific to the needs of transgender patients. However, we do know that they experience a great deal of misunderstanding, rejection, and discrimination; all of which lead to poor healthcare outcomes.2

Case: A 33-year-old G2P1 transgender male presented for postdates induction and requested an epidural. The patient had a past medical history of depression and gender dysphoria. Prior obstetrical history included an uncomplicated pregnancy and vaginal delivery of a son, four years prior. The patient recently moved from out-of-state after coming out as male transgender to family, with plans for top surgery approximately one year after chest feeding. Documentation from several social work and obstetric clinic appointments used mixed pronouns throughout his chart. Social work documented the patient preferred to go by his male name, as well as he/his/him pronouns. Throughout his care on the L&D floor, there were mixed use of pronouns and his legal, more feminine name, both in person and in charting. Despite this, during a postpartum visit, the patient noted better experience with this delivery compared with his first.

Discussion: Sensitive and respectful interaction and care of the transgender patient is an important knowledge and skill set for anesthesiologists. Although, the need for affirmation of gender identity is variable in transgender individuals, participants in one study described the use of their preferred name and pronouns as essential to feeling safe.3 Providing safe care to the transgender patient consists of cultural competency, psychosocial comfort, maintaining good medical care and judgment, and being open to your patients' expertise. In addition to the medical knowledge specific to transgender patients, familiarity and comfort with navigating patients' gender identity in a respectful manner will expand our ability to care for all patients.

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Abstract #: RF6BI-64

To Place or Not to Place an Epidural - A Case Report of Prothrombin, MTHFR , and Factor XI Deficiency in a Parturient

Presenting Author: Zachary T Henderson MD
Presenting Author's Institution: New York Presbyterian Hospital, Columbia University Medical Center - New York , NY
Co-Author: Susanne KW Mankowitz MD - Columbia University Medical Center

Background: Factor XI (FXI) deficiency is an autosomal recessive disorder that contributes to bleeding as thrombin cannot be generated. Bleeding tendency does not correlate well with factor levels, making the potential for bleeding unpredictable. Levels of factor XI and XIII naturally decrease during pregnancy, especially in 2nd and 3rd trimesters, while many other factors increase. Homozygotes have severe deficiency (< 20 IU/dL) while heterozygotes have a mild deficiency (20 – 70 IU/dL). Methylene tetrahydrofolate reductase (MTHFR) is an enzyme that converts homocysteine to methionine. MTHFR deficiency has been linked to an increased risk of thromboembolism. Prothrombin G20210A is a thrombin gene mutation of guanine to adenine at position 20210 that increases the risk of thromboembolism, similar to MTHFR deficiency

Case: A 31-year-old G6P3 presented for anesthesia consultation with Prothrombin G20210A, MTFHR deficiency, and Factor XI deficiency to evaluate the safety of neuraxial anesthesia during labor and delivery.

The patient's sister was found to carry Prothrombin G20210A after a loss of pregnancy at 6 months. Because of the sister's mutation, the patient, father and remaining siblings were tested and found to carry the same mutation. The family denied a history of venous thromboembolism. Throughout her first pregnancy, the patient used enoxaparin for thromboprophylaxis. During her second pregnancy, thromboprophylaxis was used only during the first half and heparin was given postpartum. During her third pregnancy no thromboprophylaxis was given. The patient had 2 pregnancies complicated by early loss. During her prior 3 deliveries, the patient had epidurals placed. The only complication reported was a PDPH, which was treated with an EBP without complication.

Also during testing, the patient was found to be heterozygous for both MTHFR and FXI deficiency (E135X mutation), measuring 40% of normal levels. Since the patient was asymptomatic with no family history of venous thromboembolism, anticoagulation during pregnancy or postpartum was not recommended. Due to her slightly decreased Factor XI levels, factor replacement at delivery or prior to neuraxial anesthesia was deemed unnecessary given her comorbid hypercoagulable conditions. Hematology believed that the combination of her conditions could possibly reduce the risk of hemorrhage and venous thromboembolism, but to prove this more testing would be required. Anesthesia and OB teams were also alerted to the increased risk of postpartum hemorrhage with simultaneously higher risk for venous thromboembolism.

Conclusion: In a patient with asymptomatic Prothrombin G20210A and heterozygosity for MTHFR and FXI deficiency, thromboprophylaxis was not recommended during pregnancy or after delivery and neuraxial anesthesia was used safely during labor and delivery without need for factor replacement.

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Mankowitz SKW, 2018. Consults in Obstetric Anesthesia, Springer, New York City, 699 p.

Abstract #: RF6BI-167

Castor Oil as an Instigator of Peripartum DIC?

Presenting Author: Simon A Martin MD
Presenting Author's Institution: Vanderbilt University Medical Center - Nashville, TN
Co-Author: Laura L Sorabella MD - Vanderbilt University Medical Center
Anna J Hartzog MD - Vanderbilt University Medical Center

Peripartum hemorrhage is an all too common and deadly event. The timely and accurate diagnosis of peripartum hemorrhage is paramount for initiation of life-saving treatment and limitation of sequala. We describe the case of a 33 y/o G3P0 female at 41 weeks and 6 days who presented from a birthing center. Prior to transfer, the patient received a Foley bulb cervical catheter and oral castor oil for labor induction. Upon arrival a lumbar epidural was placed. Following epidural placement, uterine contraction pattern appeared irritable raising concern for abruption. Vital signs remained stable with no vaginal bleeding. Pre-delivery coagulation labs showed: Fibrinogen <60, INR 2.9, PTT 66.5, PT 30.1, and platelets 187. PRBCs, FFP, tranexamic acid, and cryoprecipitate were obtained. Patient did not have excessive bleeding from large bore IV placement, but minor bleeding from her gums was noted. Pre-eclampsia labs were negative and blood pressure was mildly elevated at 141/76.

Within an hour a healthy infant and intact placenta were delivered. Tone was adequate in the fundus, but hemorrhage ensued from lack of lower uterine segment tone and a small vaginal laceration. Methergine, carboprost, FFP, and cryoprecipitate were rapidly administered. Patient then had one liter of coffee ground emesis and an increase in vaginal bleeding. General anesthesia was induced and after initial cryoprecipitate, plasma, pRBCs, and TXA failed to rectify the patient's disseminated intravascular coagulopathy (DIC), fibrinogen concentrate was administered. OB team performed a hysterectomy as blood loss was too severe for Bakri placement and vaginal packing.

The patient received a total of 13 units FFP, 12 units pRBCs, 6 packs of cryoprecipitate, and 3 packs of platelets. Blood pressure increased intraoperatively with SBPs reaching 160s-180s while PPVs 8-10. Magnesium was eventually initiated. Postoperative labs were: Fibrinogen 421, INR 1.2, PTT 29.5, PT 14.9, platelets 187, HCT 22. Patient was extubated, and epidural was removed on POD1 after coagulation labs remained normal. Preeclampsia with severe features was ultimately diagnosed as SBPs remained in 160s-170s post-operatively, but HELLP labs remained normal throughout. She was discharged home on POD 7 with oral nifedipine.

Castor oil is a commonly used home remedy to hasten birth by causing uterine contractions. A case has been described in the literature of DIC after amniotic fluid embolus (AFE) in association with castor oil. Castor oil is known to increase systemic concentration of prostaglandin E, a uterotonic, and it has been hypothesized that the strong contraction elicited by this substance could cause irregular, strong uterine contractions potentially leading to an AFE. Although pre-eclampsia/HELLP is the most likely cause of this patient's DIC, the recommended dose of oral castor oil is 1-2 tbsp, and this patient consumed several hundred times this dose.

Abstract #: RF6BI-229

Molar pregnancy and peri-operative thyroid storm

Presenting Author: Russell Shults MD
Presenting Author's Institution: University of Vermont Medical Center - Burlington, VT
Co-Author: Lydia Grondin MD - University of Vermont Medical Center

A 34 yo G3P1011 at 16+4 weeks pregnancy with a history significant for a PDA closure as an infant and previous C-section presented with contractions and heavy vaginal bleeding at an OSH. Prior to transfer, labs were notable for a HCT of 28 and B-HCG of ~1,000,000 mIU/ml. Molar pregnancy was suspected and patient was transferred for further treatment. During transport, the patient was tachycardic into the 120's and hypertensive with SBP's in the 140's. One unit of packed red blood cells was transfused, along with 100 mcg fentanyl, 4 mg ondansetron and 1 g of acetaminophen. On arrival to the ED, labs were notable for a HCT of 22.4 and B-HCG of > 300,000 mIU/ml. Blood pressure was 142/70 with a heart rate of 112. Two large bore IV's were placed prior to transfer to the OR for emergent dilation and evacuation.

Intra-operative course: In the operating room, standard ASA monitors were applied and a 20g arterial line was placed. Initial blood pressure was 232/126 mm Hg (MAP 155) with a heart rate of 125. For blood pressure control, general anesthesia was induced with 150 mcg of fentanyl, 1 mg midazolam, 200 mg Propofol, and 50 mg rocuronium with modified rapid sequence. Laryngoscopy with a Macintosh #3 blade revealed a grade 1 view and a 7.5 cuffed endotracheal tube was placed, end tidal CO2 was noted. Transexamic acid 1g and 2g of cefazolin were administered. Blood pressure fell to 152/74 mm Hg. General Anesthesia was maintained with sevoflurane. Two units of uncross matched packed red blood cells were given. A total of 60 mg of esmolol was administered in divided doses, achieving a heart rate of 112 and a blood pressure of 160/80 mm Hg. The patient was extubated after the procedure and transferred to the PACU in stable condition.

Post-operative course: In the recovery area blood pressure had dropped to 133/63 without any additional medication. Labs were drawn, revealing a HCT of 20.0. An additional unit of packed red blood cells was given. Post-transfusion HCT was 22.4. There was no evidence of on-going bleeding and vital signs were stable with no vasoactive medications. The patient was stabilized in PACU and transferred to the floor. At discharge, her B-HCG had down trended to 154,900 mIU/ml. Weekly B-HCGs were drawn until this value was 0.

Discussion: Molar pregnancy occurs at a rate of roughly 1 in 1,000 pregnancies, as a result of genetic error during fertilization. Classically, a "snowstorm" appearance is seen on ultrasound. The B-HCG subunit has a similar structure to TSH. Therefore, exceptionally high levels of B-HCG can produce overt thyrotoxicosis. This can lead to elevated T3 and T4, with a decreased TSH. Thyroid studies of this patient showed an elevated T4 of 24.6 ug/dl (ref 5.5-11.0 ug/dl) and a TSH of < 0.02 uIU/ml (ref 0.47-4.68 uIU/ml). Treatment for molar pregnancy is immediate evacuation of products of conception and treatment with B-blockers for sympathetic symptoms.

Abstract #: RF6BI-367

Delivery time and anesthestic planning for a term parturient with Acute Intracranial Hemorrhage (ICH) Undergoing Urgent Cesarean Delivery

Presenting Author: David Betancourth MD
Presenting Author's Institution: University of Illinois at Chicago - Chicago, IL
Co-Author: David Betancourth MD - University of Illinois at Chicago
Heather C. Nixon MD - University of Illinois at Chicago
Jacqueline M. Galvan MD - University of Illinois at Chicago

Introduction: Acute hemorrhagic stroke during pregnancy may lead to significant morbidity or mortality for both mother and fetus. One reason may be lack of clear guidelines for the timing of obstetric treatments/delivery relative to neurosurgical intervention and anesthetic management options. Multidisciplinary planning must consider the status of the mother including radiation exposure, degree of neurological impairment and symptoms as well as fetal status and well-being. In an acute hemorrhagic stroke that requires delivery prior to neurosurgical intervention, anesthesia providers must weigh the risk of neuraxial techniques with risk of general anesthesia. We present a case of successful use of a dural puncture epidural (DPE) technique for a term parturient with acute ICH requiring urgent cesarean delivery (CD).

Case: 37 yo Spanish speaking G4P3 at 39 weeks presented with an acute ICH, mild altered mental status and word finding difficulty. No extremity weakness or focal neurological deficits noted. Imaging was significant for left inferior posterior temporal lobe hemorrhage with no evidence of midline shift. Past obstetric history of two SVDs and unknown CD scar. After initial plan for cerebral angiogram, patient was noted to have contractions and an interdisciplinary meeting concluded to undergo urgent CD prior to neurosurgical intervention.

Intraop: DPE was utilized (lidocaine test dose, 75 mcg fentanyl, 2-chloroprocaine 3% in slow divided doses) for anesthesia. Right radial arterial line was placed prior to DPE dosing. Following fetal delivery, furosemide and esmolol were administered to minimize the increased cardiac output anticipated from autotransfusion. No new neurologic deficits noted during delivery and patient remained hemodynamically stable.

Postop: POD #1, pt underwent diagnostic cerebral angiogram with embolization of a pseudoaneurysm within L temporal AVM and required a complete pseudoaneurysm resection. Following resection, the patient neurologically returned to baseline.

Discussion: Caring for parturients with acute ICH poses unique challenges for the anesthesiologist regarding timing of delivery relative to neurosurgical and obstetric procedures. With an unsecured acute intracranial hemorrhage, anesthesia providers should devise plans to minimize perturbations in cerebral perfusion by preventing abrupt hypotension or hypertension. The degree of neurologic symptoms and the status of the fetus may influence anesthetic technique. We used a neuraxial technique given that the hemorrhage was stable, no deterioration of neurologic symptoms or significant mass effect. Intraoperatively, we avoided hemodynamic changes with slow titration of medications and diuresis following fetal delivery. Utilizing a DPE technique allowed us to control hemodynamics while assessing the patient's mental status and ultimately resulted in a good outcome for patient and fetus.

Reference:
Leffert, L., Schwamm.L. (2013) Anesthesiology 119(3): 703-718

Abstract #: RF6BI-384

Anesthetic management of an obstetric patient with Ehler-Danlos Syndrome type III associated with postural orthostatic tachycardia syndrome

Presenting Author: Shuchi Jain DO
Presenting Author's Institution: Henry Ford Hospital - Detroit, Michigan
Co-Author: Michael Isley MD - Henry Ford Hospital
Kevin A Spencer MD - Henry Ford Hospital
Ami Attali DO - Henry Ford Hospital

INTRODUCTION: Ehlers-Danlos syndrome is a hereditary disease affecting connective tissue that causes joint hypermobility, skin elasticity, and bruising. There are eleven types of Ehler-Danlos syndrome. Classical types, I and II, are most often related with increased tissue distensibility and fragility. Type III, familial hypermobility, is associated with musculoskeletal and autonomic symptoms, but rarely causes life-threatening complications. Type III is often associated with dysautonomia in the form of postural orthostatic tachycardia syndrome (POTS). POTS causes orthostatic intolerance in patients due to abnormal baroreceptor activity. This can pose a serious threat to patients during labor and delivery and requires careful monitoring of hemodynamics.

CASE: Our patient is a 32-year-old G2P0010 with past medical history of Type III Ehlers-Danlos, who presented for induction of labor at 39 weeks. The patient endorsed a history of POTs, gastroparesis, obstructive sleep apnea, and generalized dystonias. She was well managed for POTS prior to pregnancy. Cardiology closely followed the patient and had started her on fludrocortisone and metoprolol secondary to fluctuating heart rate and blood pressure. After discussion with multidisciplinary team, patient was planned to receive early epidural for postoperative pain management. This decision was made as POTS patients are often noted to have tachycardia with increased pain and stress. Early epidural placement reduced the risk of tachycardia secondary to pain or stress. A labor epidural was successfully placed on first attempt without hemodynamic changes. Epidural block was established with 5 mL of 0.125% bupivacaine and maintained with a 5cc autobolus, delivered every 30 minutes, of 2 mcg/mL-0.125% fentanyl-bupivacaine epidural solution. The patient tolerated progression of labor well with adequate anesthesia. She delivered vaginally and was discharged home two days later.

DISCUSSION: Ehler-Danlos syndrome is often associated with bleeding tendency in patients (2). These concerns are more pronounced with vascular types. In patients with vascular types of Ehler-Danlos syndrome, cesarean section is often recommended to reduce the risk of vessel rupture or dissection (2). However, in patients with hypermobility Ehler-Danlos syndrome, vaginal delivery is often recommended with the assistance of instruments to reduce the risk of Valsalva (2). There are several concerns for patients with POTS- pain and stress can increase tachycardia (2). Additionally epidural anesthesia may cause vasodilation and resultant hypotension. There is some evidence to support the use of fluid preloading and left lateral recumbent position for blood pressure control. Phenylephrine may also allow for reduced risk of hypotension associated with epidural anesthesia.

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Abstract #: RF6BI-392

Successful Use of Low Dose CSE for a Parturient with Super Morbid Obesity, Preeclampsia with Severe Features and Anasarca for Urgent Repeat Cesarean Delivery

Presenting Author: Morgan A Welch D.O.
Presenting Author's Institution: University of Illinois at Chicago - CHICAGO, IL
Co-Author: Jacqueline M Galvan MD - University of Illinois at Chicago

Introduction: Parturients with both medical and obstetric comorbidities present a unique challenge when an urgent cesarean delivery (CD) is indicated. Concurrent obstetric disease and non-reassuring fetal status may require timely onset of anesthetic blockade for urgent CD, but maternal comorbidities (such as extreme obesity and kidney disease) may complicate spinal dosing strategies. For example, in parturients with increased intraabdominal pressure (super morbid obesity, multiple gestation, ascites), traditional spinal anesthesia but may result in higher than expected sensory block levels or exaggerated hypotension. However, it is unclear whether reducing the spinal dose in this cohort is beneficial to mother and baby. In acute situations, obstetric anesthesia providers may utilize a hybrid technique: low dose CSE for patients in whom both timely blockade onset and avoidance of high spinal is desirable. We present a case utilizing a low dose CSE in a high risk parturient for urgent repeat CD.

Case: A 35 yo G3P2 at 34 wga with a PMH of CD x2, super morbid obesity (BMI 55), cHTN, nephrotic syndrome and anasarca presented with symptoms concerning for superimposed preeclampsia with severe features (headache and severe range blood pressures). Maternal fetal medicine recommended urgent repeat CD due to difficulty assessing fetal status. Prior to arrival to OR, patient received IV labetalol and magnesium 4 mg bolus. A CSE with IT dose of 1 mL 0.75 % hyperbaric bupivacaine + 15 mcg fentanyl + 150 mcg morphine was given. A T6 sensory and motor block was achieved within 11 minutes of the IT dose. No vasopressor medication or additional IVF was needed for blood pressure support. The patient reported adequate analgesia at start of case and required epidural bolus 100 mg 2% lidocaine with 1:200,000 epinephrine 62 minutes following the intrathecal dose. Maternal and fetal status outcome was stable.

Discussion: The constellation of super morbid obesity, preeclampsia with severe features, and nephrotic range proteinuria with anasarca in this parturient complicated IT dosing strategies for an urgent, repeat CD in which fetal status was potentially compromised. Full dose spinal or CSE, while providing reliable anesthetic conditions, may result in high spinal in parturients with increased intraabdominal pressure (i.e. extremes of obesity, anasarca) or exaggerated hypotension with resultant placental hypoperfusion. Further, iatrogenic efforts to control the blood pressure (IVF, vassopressors) may be poorly tolerated in mothers with tenuous IV volume and vasomotor tone. In this medically complicated preeclamptic patient, a low dose CSE permitted rapid delivery of the fetus while avoiding high spinal and iatrogenic efforts to control the blood pressure. Low dose CSE (7.5 - 9 mg bupivacaine) technique may accomplish rapid anesthesia without high levels necessitating airway or hemodynamic support for highly complicated parturients for urgent CD.

Abstract #: RF6BI-396

Obstetric anesthesia for a parturient with congenital insensitivity to pain: a case report

Presenting Author: Elizabeth Emhardt M.D.
Presenting Author's Institution: Indiana University School of Medicine - Indianapolis, IN
Co-Author: Christina Stinnette M.D. - Indiana University School of Medicine
Amy McCutchan M.D. - Indiana University School of Medicine
Ji H Lee M.D. - Indiana University School of Medicine

Introduction: Hereditary sensory and autonomic neuropathy type IV (HSAN IV) or congenital insensitivity to pain with anhidrosis (CIPA syndrome) is a rare phenotypic disease stemming from a number of genetic mutations. It may present in infancy as self-inflicted cuts, bruises, or burns due to insufficient temperature and pain perception. Anhidrosis may lead to altered thermoregulation and often death. We present a cesarean delivery case with CIPA that was successfully managed with neuraxial anesthesia.

Case: A 26-year-old G2P1 female at 37 weeks of gestation presented for a scheduled repeat cesarean delivery. Her medical history included CIPA, diagnosed at 2 months of age. She exhibited decreased pain perception and hyperthermia, which had led to all-limb amputations and extraction of all dentition. Her anesthetic history included uncomplicated general anesthesia for non-obstetric surgeries. She underwent the prior cesarean delivery under spinal anesthesia due to maternal co-morbidities in 2011 when she still had lower extremities.

On physical exam, her left arm to distal forearm remained, suitable for peripheral IV placement. Her right arm was amputated from the shoulder level, and both lower extremities were amputated above the knee. Airway exam was MPI with adequate thyromental distance. Labs were all within normal limits.

Dural puncture epidural technique was employed for the gradual and careful achievement of the surgical block. She received a total of 15 mL of 2% lidocaine with 1:200,000 epinephrine over 10 minutes, titrated to T4 level bilaterally using ice packs as guides. She remained hemodynamically stable in the perioperative period, received no neuraxial opioids, and was discharged home uneventfully on postoperative day 3.

Discussion: Due to its rarity, there are few case reports of the successful use of neuraxial anesthesia in CIPA patients undergoing cesarean delivery. Our patient's particular condition with altered limb anatomy increased concern for possible unpredictable response to neuraxial anesthesia. Furthermore, studies on CIPA patients' autonomic nervous systems show varying degrees of catecholamine responsiveness. Dose adjustment might be necessary in these patients when neuraxial anesthesia is considered. Checking the successful level of block can also be challenging in CIPA patients. Some patients can experience the very extremes of temperature, such as ice, and this can aid in testing neuraxial anesthesia levels.

Since CIPA patients present various symptoms of differing severity, careful review of the physical exam, medical and surgical histories as well as individually customized preoperative planning is recommended.

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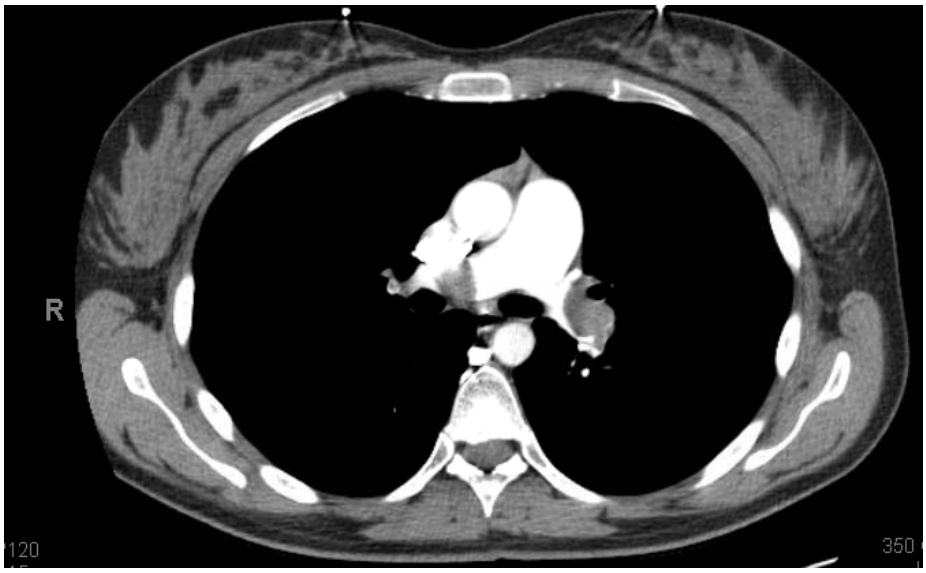
Abstract #: RF6BI-453

The Wrong Kind of Saddle Block

Presenting Author: Monisha S Parikh M.D.
Presenting Author's Institution: UTMB - Galveston, TX
Co-Author: Shreya Aggarwal D.O.
Rakesh Vadhera M.D.
Alyssa Janousek M.D.
Andrew Dinh M.D.
Rakesh Subnani M.D.

We present a complex obstetric medically challenging case of a 27 year old G1P0 Caucasian female at 33 weeks and 3 days, who presented with an unprovoked massive saddle pulmonary embolism leading to intrauterine fetal demise, complicated by disseminated intravascular coagulopathy requiring emergent thrombolysis. The patient's case was further exacerbated by respiratory failure and cardiac arrest necessitating a perimortem caesarean section and ultimately VA ECMO.

She presented to an outside hospital with chest pain, shortness of breath, and abdominal cramps that began several hours prior. The patient had a history of asthma, depression, and drug abuse, without a personal or family history of coagulopathy. She was found to have a "large pulmonary embolism noted in both main pulmonary arteries extending into the bilateral lobar, segmental, and subsegmental branches, particularly involving the right lower, middle, lingula, and left lower lobes with severe right heart strain." Reassuring fetal heart tones were noted prior to transfer to our facility for a higher level of care. Upon arrival, she became hemodynamically unstable, cyanotic, tachycardic, and tachypneic requiring fluid resuscitation and pressor support. No fetal heart tones were noted at that time. She was emergently taken to interventional radiology for chemical thrombolysis and mechanical thrombectomy. The decision was made to delay intubation initially due to concern for progressive right heart failure and cardiovascular collapse, but was later intubated. Soon after partial retrieval of the emboli, the patient went into PEA. ACLS was initiated requiring fifteen rounds of chest compressions. A perimortem caesarean section was performed sixteen minutes after ACLS initiation. One minute after incision, baby was delivered and fascia was closed within two minutes. Almost immediately following the perimortem caesarean section, ROSC was achieved. The patient\'s course was further complicated by DIC with the timing and relation to the events unknown. Subsequently, the patient was started on VA ECMO and transported to SICU in a critical state. The patient was decannulated from VA ECMO on day 6 after the initial insult, extubated on day 10, and discharged from the hospital on day 17, without any neurological deficits. An extensive hematologic and obstetric workup followed.



Abstract #: RF6BI-470

Anesthetic Considerations for a Parturient with Aortic Stenosis and Coarctation of the Descending Aorta

Presenting Author: Alexander E Lewis MBA, MPH
Presenting Author's Institution: St. George›s University - French Camp, California
Co-Author: Onkar Judge MD - Director of Anesthesiology and Perioperative Services

Introduction: Presented here are anesthetic considerations for a patient with morbid obesity, aortic valve stenosis and coarctation of the descending aorta that underwent repeat cesarean section. Aortic valve stenosis and coarctation of descending aorta were discovered during the pre-op history and physical and confirmed by a bedside echo. Anesthetic options included: Slowly titrated epidural with GA as backup. The patient underwent C-section uneventfully, was observed in the ICU overnight after discharge from hospital referred to a higher level of care for further intervention on her aorta.

Case Description: A 31 y/o morbidly obese G2P1 with a hx of bicuspid aortic valve (BAV) lost to follow up presented with minimal prenatal care for repeat cesarean section. Upon further investigation of the patient's shortness of breath it was discovered that she was diagnosed with a BAV as a child, however in adulthood was lost to follow up. An echocardiogram revealed an AVA of 1.15cm2 and mean gradient of 48mmHg. In addition, turbulent blood flow was seen in her descending thoracic aorta with a narrowing lumen, concerning for coarctation. After a multidisciplinary discussion, decision was made to proceed with repeat C-section under a slowly titrated epidural anesthetic.

The patient was brought back to the OR, standard ASA monitors and a pre-induction right radial arterial line were placed. A L3-4 epidural was placed uneventfully, titrated slowly. A phenylephrine infusion was used to maintain SVR and a bedside TTE was used to assess fluid status. The patient underwent a successful cesarean delivery. The patient was transferred to the ICU under the Anesthesia service for further monitoring.

Discussion: Bicuspid aortic valve has two instead of the normal three leaflets, is the most common congenital heart defect. BAV is usually asymptomatic and often found incidentally on auscultation and confirmed on echo. BAV is reported in about 50% of individuals with coarctation of the aorta.

BAV results in turbulent flow through the valve, which can increase the likelihood of calcium deposits on the valve and subsequent AS. In addition, turbulent flow causes shear stress on the aortic root and ascending aorta leading to aortic dilation and potential ascending aortic dissection and rupture. Therefore, continued monitoring of the patient is needed to evaluate aortic root ascending aorta diameters.

Severity of AS is defined using mean pressure gradients, jet velocity and valve area on echo. Anesthetic goals of AS are to maintain sinus rhythm, preload and SVR. Although spinal anesthesia is considered the best anesthetic for non-emergent C-section, it is non-titratable anesthetic and can cause SVR to drop precipitately leading to cardiovascular collapse. Therefore, epidural anesthesia is preferred. In addition, we used bedside TTE to guide fluid management of the patient.

Abstract #: RF6BI-495

Anesthetic Considerations for End Stage Amyotrophic Lateral Sclerosis in Pregnancy

Presenting Author: Vibha Mahendra MD
Presenting Author's Institution: Baylor College of Medicine - Houston, TX
Co-Author: Trang Ha MD - BCM
Divya Janardhanan MD - BCM
Christian Du Mont MD - BCM
Uma Munnur MD - BCM
Maya S Suresh MD - BCM

Amyotrophic Lateral Sclerosis is a progressive neuromuscular disease that usually presents in the fifth decade of life or later, with only 3.2% of cases diagnosed before the age of 40. This case report describes a 42 year old G9P6117 with history of 7 vaginal deliveries and advanced ALS (diagnosed at age 39), quadriplegia, dysarthria, dysphagia, severely restricted pulmonary mechanics (FVC 26%, FEV1 21%) and chronic venous stasis who presented for induction of labor at 33 weeks, 5 days, due to worsening pulmonary function and lower extremity edema.

Upon arrival, the patient received betamethasone and the fetus was found to be in transverse lie. Prior to external cephalic version (ECV), two peripheral IVs and an arterial line were placed. In the OR, an epidural was placed in the lateral position at L3-4 and bolused with 2% lidocaine with epinephrine. The ECV was performed successfully with a T8 sensory block, and the patient returned to labor and delivery where an epidural solution of 0.1% ropivacaine + 2mcg/mL fentanyl was infused at a rate of 6mL/hr. After 6 hours of labor and AROM, the fetus returned to the transverse position, requiring Cesarean section under epidural analgesia. Delivery was complicated by moderate post partum hemorrhage requiring transfusion, and post-operative pain was managed with a multimodal approach, including an epidural infusion of 0.2% ropivacaine.

ALS is rarely seen in pregnancy, though scattered case reports exist describing parturients in various stages of the disease. Afflicted women may deliver vaginally, as the disease does not affect the smooth muscle of the uterus, and the pelvic floor is relaxed. Our patient's disease course was typical, beginning with weakness of the intrinsic muscle of the hands and progressing over four years to bulbar weakness and quadriplegia.

Patients with ALS have restrictive pulmonary physiology, but maintain FRC, RV and gas exchange. The respiratory demands of pregnancy may precipitate acute respiratory failure in these patients. Our patient required BiPAP to maintain oxygenation > SpO2 92%. Parturients with ALS are also at high risk for aspiration due to oropharyngeal dysphagia, and benefit from early scheduled IV GI prophylaxis.

Epidural anesthesia has been used successfully in parturients with ALS, but local anesthetics and narcotics must be dosed cautiously due to the risk of exacerbating weakness. Though sometimes necessary, general anesthesia poses several challenges. First, patients with significant respiratory involvement may decompensate with opioid administration. Rapid sequence induction and endotracheal intubation should be performed to avoid aspiration, though there is a risk of prolonged intubation depending on the severity of respiratory involvement. Non-depolarizing paralytics should be avoided if possible (ALS patients may not require paralytics for intubation) while succinylcholine is contraindicated due to the risk of hyperkalemia and cardiac arrest.

Abstract #: RF6BI-497

When Respect for Patient Autonomy Conflicts with your Medical Judgement: A Case of Informed Refusal in a High Risk Parturient

Presenting Author: Erin Haggerty MD
Presenting Author's Institution: University of Illinois Chicago - Chicago, IL
Co-Author: Corinne Weinstein MD - University of Illinois Chicago
Heather Nixon MD - University of Illinois Chicago

Introduction: The foundations of modern informed consent were first laid early in the twentieth century, and current medical practice has swiftly moved away from paternalism towards shared decision making. Central to this construct is respect for patient autonomy and self-determination. However, when a patient's autonomous decision making rejects what might be considered the "standard of care", it creates not only a medical and ethical dilemma, but a potentially hostile environment. Fostering care and trust with the patient, while challenging, is critical for the obstetric team to develop in these situations. We describe a case of a high risk parturient in whom shared decision making proved difficult.

Case Presentation: A 31yo G1P0 at 38w+3 with a PMH of sickle cell disease, asthma, avascular necrosis of the hip, and marijuana abuse presented for IOL. During pre-operative assessment, the patient vehemently declined general anesthesia under any circumstance secondary to extreme aversion to having a sore throat. She stated "I would rather die or have my baby die than have a sore throat." She had no other fears concerning general anesthesia. Alternatives were offered including local anesthesia in an emergency circumstance, with caution that this might provide inadequate anesthesia. Further attempts to clarify her medical decision-making resulted in the patient becoming verbally abusive towards staff and refused to discuss the matter further. Despite NPO restrictions, she repeatedly ate while on the labor unit and would not sign an against medical advice (AMA) form regarding her refusal of NPO or general anesthesia. Although her birthing plan included possible epidural analgesia for labor, she would not agree to early placement during her induction. She verbalized her understanding of the risks and her wishes were meticulously documented in the EMR. During a multidisciplinary team huddle, a collaborative plan was developed with the help of the ethics team. Early triggers were put in place regarding the decision for cesarean delivery in order provide time for neuraxial anesthesia if fetal monitoring became concerning. A combined spinal-epidural was ultimately placed and she safely delivered without incident.

Discussion: Many obstetric anesthesia providers likely feel passionate about his/her duty when it comes to providing care to parturients, particularly in those deemed as high risk. This patient posed a unique challenge to her healthcare team as most providers consider a sore throat to be an acceptable risk in the case of emergency general anesthesia. As she had full decision making capacity, she had the right to refuse any procedure based on risks. In cases where anesthetic informed consent is problematic, providers must be prepared to work with the obstetric team to convey potential problems and devise alternative delivery and emergency strategies.

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Abstract #: RF7B10-96

Rapid Respiratory Decompensation, Altered Mental Status and Atony: A Case of Suspected Atypical Amniotic Fluid Embolism

Presenting Author: Jacquelyn Francis MD
Presenting Author's Institution: Albert Einstein College of Medicine/Montefiore Medical Center - Bronx, New York
Co-Author: Steven Diaz MD - Albert Einstein College of Medicine/Montefiore Medical Center
Yelena Spitzer MD - Albert Einstein College of Medicine/Montefiore Medical Center
Shamantha Reddy MD - Montefiore Medical Center
Alexandra Mazur, MD - Montefiore Medical Center

An estimated 5–15% of all maternal deaths in Western countries are due to amniotic fluid embolism (AFE) [1]. We present a case of severe respiratory compromise, altered mental status, and hemorrhage during emergency cesarean delivery (CD) in a parturient with prolonged labor and chorioamnionitis thought to be atypical AFE.

A healthy 23 year old primigravida at 40w6d presented in active labor with spontaneous rupture of membranes (SROM). Her medical history was uncomplicated and labs were normal. One hour after arrival, a lumbar epidural was placed for labor analgesia using standard sterile technique. Pitocin was initiated for labor augmentation. At 8 hours post arrival, patient was noted to be tachycardic to 120 with low grade fever to 100.4°F. Ampicillin and gentamicin were initiated for suspected intra-amniotic infection and 2.5L of intravenous fluid (IVF) was given. At 14 hours post arrival, patient reported a singular episode of shortness of breath, with desaturation to low 90's. Patient placed on non-rebreather with good response. EKG showed sinus tachycardia. At 26 hours post- arrival, decision was made to proceed to CD for arrest of dilation.In the OR, the epidural was loaded with 20cc of lidocaine 2% + epinephrine to a T4 level. Delivery was uneventful. Upon externalization of the uterus, atony was noted. Patient began to exhibit mental status changes and confusion. Patient then became hypertensive and tachycardic to the 180s.

Desaturation to the low 80s was noted. Uterotonics were administered and help was called. The patient became more altered and continued to desaturate to the 60's even with supplemental O2. There was concern for ongoing hemorrhage. Massive transfusion protocol (MTP) was activated. The patient was intubated with video laryngoscope and lung protective ventilation strategy was employed. Additional large bore IV access and arterial line were placed. Initial labs demonstrated a lactic acidosis and coagulopathy (Lactate 3.4 INR: 1.9. fibrinogen 393). Blood loss was significant for 2500mL. Patient received 3L crystalloid, 2U prbcs and 2 units FFP. Urine output was 750mL. The patient was transferred to the ICU and was extubated late on POD#1. Chest XR showed bilateral pulmonary infiltrates and CT was inconclusive for pulmonary embolism. She was continued on her antibiotic regimen and was able to go home on POD#3. Mother and baby have continued to do well.

This case highlights the rapid respiratory deterioration that can occur in parturients. Atypical amniotic fluid embolism (AFE) was highest on the differential for this patient. The timing of the decompensation coupled with the atony, hemorrhage and coagulopathy place AFE high on the list. There are no consistent clinical predictors of AFE, although chorioamionitis is clinically associated with its occurrence [3]. Pulmonary edema and pulmonary embolism were also considered. Regardless of the etiology, prompt recognition and treatment resulted in a positive outcome.

Abstract #: RF7B10-115

A Spinal Anesthetic with a Platelet Count of 7,000 x 109/L in a Patient with Undiagnosed Acquired Thrombotic Thrombocytopenic Purpura

Presenting Author: Lacey E Straube MD
Presenting Author's Institution: University of North Carolina - Chapel Hill, NC
Co-Author: Christopher A Huber MD - University of North Carolina
Samuel N Blacker MD - University of North Carolina

A 24-year-old G2P1 at 35w4d underwent urgent cesarean delivery (CD) for suspected placental abruption and non-reassuring fetal status. Obstetric history included one uncomplicated vaginal delivery. The platelet count was pending at the time of CD but was recently 285,000 x 109/L. A spinal was inserted on first attempt. Despite confirming abruption, estimated blood loss was only 500 mLs. After delivery and placental separation, the platelet count returned at 7,000 x 109/L. Due to good hemostasis, labs were redrawn and she went to recovery. One unit of platelets was transfused after a repeat set of labs revealed a platelet count of 11,000 x 109/L. Hourly neurologic exams were performed. She never developed signs of a spinal hematoma and had a normal recovery of neurologic function after receiving neuraxial anesthesia while severely thrombocytopenic.

Hematology was immediately consulted. A hemolytic screen (undetectable haptoglobin, LDH 4085 U/L, reticulocyte count 92 109/L, hemoglobin 9.3 g/dl, and blood smear with schistocytes) confirmed the diagnosis of a microangiopathic hemolytic anemia (MAHA). ADAMTS13 was low at 16%, and the ADAMTS13 inhibitor was present, leading to a diagnosis of acquired thrombotic thrombocytopenic purpura (TTP). She developed acute kidney injury and transient altered mental status. Steroids and plasmapheresis were initiated. Sequential compression devices were used for DVT prophylaxis until pharmacologic anticoagulation was initiated at a platelet count of 50,000 x 109/L. The patient was discharged on post-CD day 11 with a platelet count of 190,000 x 109/L but was readmitted twice for relapse requiring plasmapheresis and Rituximab.

Thrombotic microangiopathies (TMAs) are MAHAs with thrombocytopenia and end-organ damage and can be inherent to pregnancy (preeclampsia, HELLP, placental abruption) or precipitated by pregnancy (lupus, hemorrhage, TTP, hemolytic uremic syndrome). TTP is often misdiagnosed as preeclampsia or HELLP because of the overlapping symptoms of hypertension, proteinuria, renal impairment, and liver dysfunction. A high index of suspicion is necessary to distinguish TTP from the TMAs more commonly seen in pregnancy. TTP differs by persistent profound thrombocytopenia (platelets often less than 30,000 x 109/L), anemia, markedly elevated LDH, absent coagulopathy, and lack of resolution with delivery. ADAMTS13, a substance that cleaves Von Willebrand multimers, is deficient in TTP, and an inhibitor is present in the non-congenital form. Its absence leads to platelet aggregation and microemboli formation, which is most likely why intraoperative blood loss was less than expected with severe thrombocytopenia. Treatment of acquired TTP consists of plasmapheresis to remove the ADAMTS13 inhibitor from circulation, steroids and Rituximab for immunosuppression, avoidance of platelet transfusion to prevent exacerbation, and DVT prophylaxis because of the hypercoagulable state.

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Abstract #: RF7B10-163

Management of Cervical Ectopic Pregnancy

Presenting Author: Dustin Duracher MD
Presenting Author's Institution: Ochsner Clinic Foundation - Jefferson, LA
Co-Author: Allison Clark MD - Ochsner Clinic Foundation

Introduction: Cervical ectopic pregnancy is a rare form of extrauterine pregnancy, often complicated by massive hemorrhage. We present a case of a multiparous parturient with cervical ectopic pregnancy diagnosed at 13 weeks EGA.

Case presentation: An otherwise healthy 33 yo G2P1 with history of 1 prior cesarean delivery presented at 10 2/7 weeks EGA with vaginal bleeding. Ultrasound performed at that time was suspicious for threatened abortion. Follow up ultrasound performed at 13 1/7 weeks EGA was suspicious for cervical pregnancy. MRI of the pelvis was then performed and showed an empty uterus, dilated cervix, and gestational sac within the cervical canal, consistent with the diagnosis. After consultation with gynecology-oncology and interventional radiology, the patient was admitted for pregnancy termination. Uterine artery embolization (UAE) was performed successfully, however post-procedure the patient became febrile to 102.8 and broad spectrum antibiotic coverage was initiated. Fetal cardiac activity remained present, and ultrasound-guided KCl injection was administered into the fetal thorax until asystole was achieved. Due to continued fevers, the patient underwent suction D & C under general endotracheal anesthesia. Large bore IV access and invasive arterial monitoring were placed due to potential for massive hemorrhage. The patient tolerated the procedure well and remained hemodynamically stable, with estimated blood loss of 621 mL. She received 2 units pRBC on POD #1 for Hb 5.8. Her hospital course was otherwise uncomplicated and she was discharged home on POD #5.

Discussion: Cervical ectopic pregnancy is rare and constitutes an estimated < 1% of ectopic pregnancies (1,2). Ultrasound findings include diffuse intrauterine echoes, an empty but enlarged uterus, and gestational sac located within the cervical canal with cervical dilation (3). The most common presentation is first trimester vaginal bleeding (5), and therefore the diagnosis may initially be confused with threatened abortion, as was the case with our patient. Risk factors include prior cesarean delivery, prior D&C, and infertility (3). Cervical ectopic pregnancy has been managed successfully with methotrexate, UAE, ligation of cervical branches of the uterine arteries, foley balloon tamponade, intracervical vasopressin injection, and D&C. Hysterectomy should be reserved for cases of life threatening hemorrhage. (1,2,3,4)

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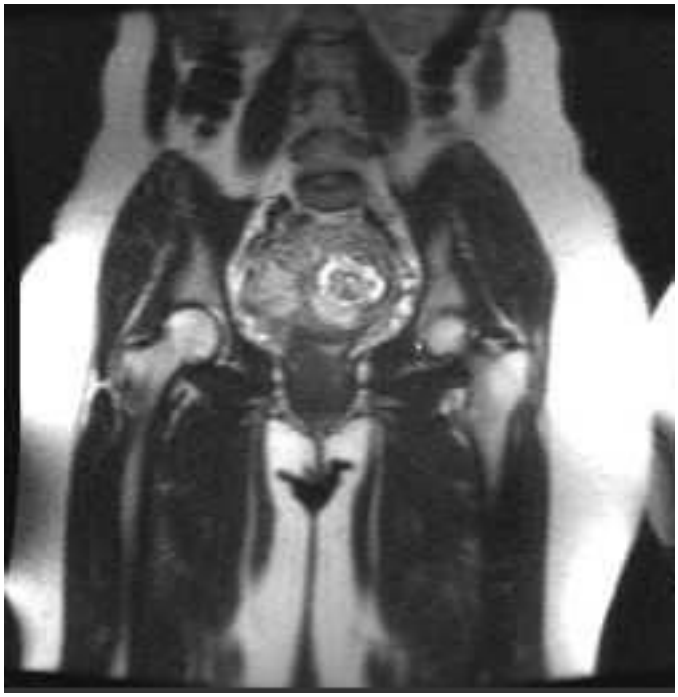

Abstract #: RF7B10-217

Successful Spinal Anesthesia for Cesarean Section in a Parturient with Spondyloepiphyseal Dysplasia Congenita

Presenting Author: Chahait Singh MD
Presenting Author's Institution: St. Joseph›s University Medical Center - Paterson, New Jersey
Co-Author: Seth Landa MD - St. Joseph›s Univesity Medical Center
Daria Costa DO - St. Joseph's Univesity Medical Center
Sakowitz-Cohen Noreen MD - St. Joseph's University medical Center

Introduction: Patients with short limb dwarfism are known to be at a higher risk for anesthetic complications.We report the successful use of spinal anesthesia for cesarean section in a patient with Spondyloepiphyseal Dysplasia Congenita (SEDc),a rare type of dwarfism caused by a mutation in the COL2A1 gene.

Case Report: A 31yo G3P0110 at 31+3 weeks presented with palpitations, SOB, vomiting and diarrhea.History remarkable for SEDc and anxiety, treated with venlafaxine. Surgical history: neck fusion, ankle surgery, R hip replacement, cleft palate repair,10 skeletal surgeries for bone lengthening. Two prior pregnancies had resulted in terminations due to lethal congenital anomalies. EKG showed sinus tachycardia. Lab tests, including thyroid studies, PFTS and Echo were unremarkable. CTA was negative for PE. The tachycardia was attributed to dehydration, anxiety, and SNRI use. The decision was made for cesarean section due to the HR and concern for maternal compromise. PE:Ht 132cm,Wt 65 kg, BMI 37.6, HR 97-152,BP 142/95. She had typical features of disproportionate dwarfism with short limbs, lumbar lordosis, short trunk,and thoracic kyphoscoliosis; limited neck ROM, Mallampati IV. After preload with 1000 ml. LR, spinal anesthesia was easily administered in sitting position at L3-4 using 25G Pencan needle,8.25 mg of 0.75% hyperbaric bupivacaine with 10ug fentanyl and 0.15 mg morphine. T4 level achieved. Male child was delivered, Apgars 7/8.Surgery proceeded uneventfully. EBL 800ml. Patient continued to have tachycardia post-op in the 120s and was started on metoprolol prior to discharge.

Discussion: SEDc is a rare genetic entity characterized by a disruption in Type II collagen production and delayed ossification of the epiphyses resulting in disproportionate dwarfism. It may be inherited as an autosomal dominant or resulting from a de novo mutation; incidence:1/100,000 births. Findings include kyphoscoliosis with possible cord compression, increased lumbar lordosis, narrowed intervertebral disc spaces, platyspondyly with posterior wedging of vertebral bodies, and occasionally, laryngotracheal stenosis. Due to a hypoplastic odontoid, patients may develop atlantoaxial instability and cervical vertebral body changes. Restrictive lung disease may be present due to kyphoscoliosis and may be associated with chronic hypoxia and pulmonary HTN. C/section is indicated due to a narrow pelvis. Given these features, both GA and neuraxial techniques pose unique challenges. GA,spinal,CSE and epidural anesthesia have all been described(1,2). An SED patient information site specifically contraindicates spinal anesthesia and recommends GA(3). Despite this contention,we achieved successful, uncomplicated spinal anesthesia with a bupivacaine dose based on a recommendation of 0.06 mg/cm(4). A continuous technique might be advantageous due to unpredictable spread.

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Abstract #: RF7B10-240

Management of a Parturient with Scimitar Syndrome

Presenting Author: Emily Turner DO
Presenting Author's Institution: University of Texas Southwestern Medical Center - Dallas, Texas
Co-Author: Michelle Eddins MD - Assistant Professor

Background: Scimitar syndrome is a rare congenital cardiopulmonary anomaly occurring in 1/100,000 births, which include partial or total anomalous pulmonary venous connection from the right lung to the inferior vena cava, right lung hypoplasia which causes dextrocardia or dextroposition of the heart, and variable systemic arterial right lung blood supply. The anomalous pulmonary venous return causes a left-to-right shunt and is most commonly associated with an atrial septal defect. [1] The adult form tends to be asymptomatic or carries vague symptoms of fatigue, dyspnea and recurrent upper respiratory infections. The infantile form is characterized by severe tachypnea, failure to thrive, and cyanosis that is typically coupled with pulmonary hypertension. [2]

Case: A 34 year old G1P0 was evaluated by cardiology at 37w3d for shortness of breath and orthopnea. A TTE revealed an EF of 70%, a dilated RA and RV, and atrial shunting. CXR was notable for a positive Scimitar sign indicating anomalous pulmonary venous return, as well as dextrocardia vs. dextroposition. EKG indicated right superior axis deviation, incomplete RBBB, and pulmonary disease pattern. The cardiology team diagnosed the patient with Scimitar syndrome and cleared the patient for a normal vaginal delivery. The patient presented to L&D at 40w5d with complaints of increased shortness of breath and 10 pillow orthopnea. The obstetric workup was diagnostic of severe preeclampsia and, therefore, induction of labor was initiated. An epidural was placed uneventfully for labor analgesia. A repeat TTE, CXR, and EKG were obtained. TTE showed an EF of 60-65% and was otherwise unchanged from her previous echo. CXR revealed signs of mild congestive heart failure and increased vasculature of the lower lobes. EKG remained unchanged. The patient was taken for a cesarean section due to an arrested labor course. Surgical anesthesia was unobtainable via the epidural catheter which resulted in conversion to general anesthesia. The cesarean section was complicated by increased blood loss due to uterine atony. Post-operatively, the patient became hypotension and tachycardic. She was evaluated by the obstetric team and was found to have post-partum hemorrhage, with an estimated blood loss of 1750ml. Two units PRBC's was administered. The patient's post-operative course was complicated by pulmonary edema requiring diuresis and severe orthopnea. She was discharged on POD #5.

Conclusion: Patients with Scimitar syndrome who survive into adulthood are usually well compensated and are often asymptomatic. [3] However, with the increase in intravascular volume associated with pregnancy, the incidence of congestive heart failure and volume overload increases. [1] It is possible for women with Scimitar syndrome to have an uncomplicated pregnancy and delivery. However, it is important to be aware of the risks and anesthetic implications associated maternal Scimitar syndrome.

Abstract #: RF7B10-251

Anesthetic Considerations in a nulliparous patient with Klippel-Feil Syndrome

Presenting Author: Judah E Weiss M.D.
Presenting Author's Institution: Henry Ford Hospital - Detroit, Michigan
Co-Author: Ami Attali D.O. - Henry Ford Hospital
Christine Acho D.O. - Henry Ford Hospital
Joshua Younger M.D. - Henry Ford Hospital
Kevin Spencer M.D. - Henry Ford Hospital
Jaime Garzon M.D. - Henry Ford Hospital

Introduction: Klippel-Feil syndrome describes a triad of low hairline, short neck, and restricted neck motion. In addition to this triad, many patients have severe lumbar scoliosis and cervical spine immobility which can lead to unsuccessful neuroaxial analgesia and difficult airway. These features present significant challenges to anesthesiologists caring for obstetric patients where neuroaxial analgesia is commonly used and in a patient population who otherwise is already considered a difficult airway.

Case Report: Our patient is a 25-year-old nulliparous female, with a past medical history significant for Klippel-Feil syndrome and repaired double outlet right ventricle, who presented for induction of labor at 39 weeks. Physical exam findings were significant for characteristic short neck, limited neck extension and rotation, and moderate scoliosis with palpable bony landmarks. She had full strength in all four extremities without evidence of clonus. Cervical x-rays demonstrated several abnormalities including incomplete fusion at multiple levels. Lumbar x-rays were not available.

Given the complexity of the case, a multidisciplinary team convened and a plan to proceed with epidural placement was made to afford the patient the best possible outcome. Two attempts with a 17-gauge Touhy needle were made at L3-L4. On the first attempt, the patient reported right lower extremity paresthesia and the needle was immediately withdrawn. The second attempt was made slightly more cephalad and to the left of the palpated midline within the same space. Loss of resistance was achieved at 9 cm without complication. Adequate analgesia was achieved for the duration of labor.

Discussion: There are many factors to consider when deciding on an anesthetic plan in a parturient with Klippel-Feil syndrome. Both neuroaxial and general anesthesia can be problematic in this patient population. Given that our patient had only moderate scoliosis we decided attempting to place an epidural would be in the patient's best interest. If successful, the epidural could be dosed to provide adequate surgical anesthesia should she require a cesarean section. This would avoid general anesthesia in a patient with a potentially difficult airway.

Epidural placement in any patient with scoliosis is more technically challenging. Additionally, the extent and distribution of local anesthetic spread is variable in these patients. However, risks and benefits must be weighed accordingly as was done with our patient. Attempts for neuroaxial analgesia in high risk patients should be considered when reasonable.

References:

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2. Kavanagh T, Jee R, Kilpatrick N, Douglas J. Elective cesarean delivery in a parturient with Klippel–Feil syndrome. International journal of obstetric anesthesia. 2013 Nov 1;22(4):343-8.

Abstract #: RF7B10-252

CESAREAN DELIVERY FOR A PATIENT WITH FREEMAN-SHELDON SYNDROME

Presenting Author: Marc Murinson MD
Presenting Author's Institution: Henry Ford Health System - Detroit, MI
Co-Author: Rebekah Shievitz MD - Henry Ford Health System
Mark Giska MD - Henry Ford Health System
Joshua Younger MD - Henry Ford Health System
Attali Ami DO - Henry Ford Health System

INTRODUCTION: Freeman-Sheldon is a rare genetic condition. This condition is so rare that in the early 1990's only 65 cases were reported.. It is characterized by abnormalities of the face, hands, and feet. Features include microstomia, microglossia, micrognathia, and high-artched palates (1) These can lead to problems in speech development and swallowing. Joint deformities include camptodactyly, scoliosis, and talipes equinovarus (2). Those affected have an increased risk of malignant hyperthermia (3). Inheritance patterns vary, although an autosomal dominant pattern is common.

CASE: A 34 year-old G1P0 at 27 weeks and 4 days with a history of Freeman-Sheldon syndrome, acute pulmonary embolism, and preeclampsia with severe features underwent a cesarean section. She had a history of scoliosis with Harrington rods that extended from her thoracic to lumbar spine. Due to preeclampsia with severe features and deteriorating respiratory status requiring BIPAP with settings of 25/5, she underwent a classical cesarean section with general anesthesia.

Our patient had a difficult airway, which included a mallampati III, limited neck extension, a thyromental distance of 2, and micrognathia. We wanted to ensure a successful intubation and minimize any hypoxia, hypercarbia, and hypotension that could worsen her already compromised respiratory status. Our patient agreed to an awake intubation. We anesthetized her airway with viscous 4% lidocaine, administered 100 mg of I.V. lidocaine, and 0.2 mg of glycopyrrolate to improve intubating conditions. She did not react when we tested her airway with a tongue blade.

We successfully performed an awake video laryngoscope intubation, and then induced with propofol and ketamine. We employed a propofol infusion and utilized EEG monitoring to keep our patient deeply anesthetized and reduce awareness under anesthesia. We avoided any agent that could potentially trigger MH in this susceptible patient. She was successfully extubated in the I.C.U. after further management of her pulmonary embolus.

DISCUSSION: Sheldon-Freeman syndrome is incredibly rare. Care must be taken to minimize the risk of malignant hyperthermia by avoiding any triggering agents. One must be prepared with alternative modalities for securing the airway, which included in our case a fiberoptic intubation and a setup for a possible surgical airway. The patient above and her premature infant did well postoperatively. This patient was an emergency case that required careful and prudent anesthetic management to optimize intubating conditions, prevent malignant hyperthermia, and safely and expeditiously deliver using a general anesthetic for cesarean delivery.

References:

1. Stevenson, DA et al. (2006) Pediatrics. 117: 754-762.
2. Cruickshanks, G, et al. (1999) Canadian Journal of Anesthesia. 46: 783-787.
3. Fisher, K. (2016) International journal of obstetric anesthesia. 27: 81-84

Abstract #: RF7B10-407

Noninvasive Cardiac Output Monitoring in Fontan Parturient

Presenting Author: Roniel Weinberg M.D.
Presenting Author's Institution: New York Presbyterian - Weill Cornell Medical Center - New York, New York
Co-Author: Daniel Thomson M.D. - New York Presbyterian - Weill Cornell Medical Center
Robert Bowen M.D. - New York Presbyterian - Weill Cornell Medical Center
Alaeldin Darwich M.D. - New York Presbyterian - Weill Cornell Medical Center

Background: Non-invasive cardiac output monitoring (NICOM), utilizing bioreactance, provides for a lower risk alternative to an invasive pulmonary artery catheter (PAC) in monitoring cardiac function. (1,2). The Fontan procedure is a staged procedure allowing the pulmonary circulation to adjust to increased volume in palliation of congenital heart conditions presenting with univentricular physiology. While often delivering prematurely secondary to IUGR, these patients are at high risk for complications, such as arrhythmias and worsened heart failure. We present a case using NICOM in a parturient undergoing emergent cesarean section with a history of Fontan procedure.

Case: The patient is a 29 year-old parturient gravida 1, with heterotaxy syndrome, dextrocardia, repaired transposition of the great arteries with large ventricular-septal defect (VSD) and tricuspid atresia status post Fontan procedure. She was admitted at 31 weeks after fetal sonogram showed intrauterine growth restriction (IUGR), with planned cesarean section (CS) at 34 weeks. Baseline transthoracic echocardiogram (TTE) showed an ejection fraction (EF) of 40%, and a right-sided left ventricle connected via a VSD to the right ventricle. TTE at 32 weeks revealed reduced EF to 30%, prompting CS.

With the patient in the operating room, a lumbar epidural catheter was placed and dosed slowly with 2% lidocaine, while a radial arterial line and femoral central line were inserted. Using a Cheetah NICOM, baseline values were cardiac index (CI) 3.3, stroke volume variation (SVV) 44, and stroke volume index (SVI) 13. NICOM values were trended during the case, down to nadir of CI 2.4, SVV 35, SVI 14. CI was responsive to fluid boluses, with ending NICOM values notable for CI 3.2, SVV 44, SVI 16. The case was uneventful and the patient was brought to ICU.

Discussion: NICOM aids with close intraoperative monitoring of intravascular volume. Maintaining euvolemia in Fontan patients is vital as their cardiac output (CO) is entirely dependent on pulmonary blood flow. Hypovolemia results in decreased CO, while hypervolemia often precipitates heart failure symptoms. The anatomy of Fontan patients prohibits use of a PAC. Our case exhibits the utility in the use of NICOM is managing the complex physiology of parturients with congenital cardiac abnormalities.

References:

1. Marik, P.E. (2013). Noninvasive Cardiac Output Monitors: A State-of-the-Art Review. J Cardiothorac Vasc Anes. 27(1):121-134
2. Mehta Y, Arora D. Newer methods of cardiac output monitoring. World J Cardiol. 2014;6(9):1022-9.
3. Monteiro, R.s., et al. "Anaesthetic Management of Parturients with Univentricular Congenital Heart Disease and the Fontan Operation." Int J Obst Anes, vol. 28, 2016, pp. 83–91., doi:10.1016/j.ijoa.2016.08.004.

Abstract #: RF7B10-415

Decompensated heart failure in a parturient with multivalvular rheumatic heart disease

Presenting Author: Michael Jauregui MD
Presenting Author's Institution: UT Southwestern Medical Center - DALLAS, TX
Co-Author: Stephanie Byerly MD - UT Southwestern Medical Center

Pregnancy can present challenges for women who have had previous repair of prosthetic heart valves as valve dysfunction may lead to the development or exacerbation of heart failure. Prosthetic valve dysfunction may include valve stenosis, regurgitation or both. Bioprosthetic valves have a significantly higher risk of failure than mechanical valves, which can pose challenges for women of child bearing age with a history of valve replacement.

Our patient is a 37 year old Vietnamese female with a history of rheumatic aortic, mitral, and tricuspid valve disease who underwent AVR/TVR/MVR with bioprosthetic valves in 2003. She had been doing well for years and underwent IVF in 2018. Her pregnancy was uncomplicated until the 3rd trimester when she presented to a cardiologist with symptoms of acute heart failure. A TTE revealed aortic, mitral, and tricuspid valve stenosis. She was referred to MFM and was well compensated on her initial visit. However, during a cardiology follow-up she was noted to be in atrial fibrillation with rapid ventricular response and in decompensated bi-ventricular heart failure with an EF of 30%. She was admitted to the L&D high risk service where an arterial and central line was placed by the OB Anesthesia team. She was subsequently started on esmolol, furosemide, digoxin, and heparin. After diuresing 13 liters she spontaneously reverted back to sinus rhythm. A repeat TTE revealed normalized LV/RV function with an EF of 55%. She then underwent elective CS-BTL at 32 weeks with a slow dose labor epidural in the cardiac OR with cardiac anesthesia. Cardiothoracic surgery was also present in case of an emergency necessitating immediate placement on ECMO. Her intraoperative and postoperative course was uncomplicated and she was discharged with plans for elective valve surgery once she had fully recovered from pregnancy.

Repeat valve replacement during pregnancy should be delayed given the fetal risks. Although experience during pregnancy is limited, a valve-in-valve intervention is a potential alternative to valve surgery [1]. Women with high-risk valvular lesions should have prenatal care as well as delivery at a center with the resources available to care for both the patient and the infant [2]. A labor and delivery plan should be prepared in advance with a multidisciplinary care team. These patients should have continuous telemetry, and if possible, intra-arterial monitoring during the labor and delivery period. They may also require this continued monitoring post-partum in an ICU setting. It is suggested that a vaginal delivery with appropriate analgesia and minimization of Valsalva in these women is ideal.

References:

1. Double Trouble: A Case of Valvular Disease in Pregnancy. Circulation. 2016;133(22):2206.
2. Guidelines on the management of cardiovascular diseases during pregnancy: the Task Force on the Management of Cardiovascular Diseases during Pregnancy of the European Society of Cardiology (ESC). Eur Heart J. 2011;32(24):3147.

Abstract #: RF7B10-553

Pulmonary Carcinoid in Pregnancy Treated with IR Embolization and Surgical Resection

Presenting Author: Christopher Cosden MD
Presenting Author's Institution: University of California - San Francisco - San Francisco, CA
Co-Author: Tina Yu MD - UCSF
Peter Yeh MD - UCSF
Stephanie Lim MD - UCSF
Jennifer Lucero MD, MA - UCSF

Background: Carcinoid tumors are slow growing neuroendocrine tumors. The incidence of pulmonary carcinoid in pregnancy is unknown. Management of carcinoid tumors in the pregnant patient has no clear guidelines and can be complex given the variability in location, symptoms, and treatment preferences for these rare tumors.

Case report: We report the case of a 33 year old primigravid woman who presented at 25 weeks gestation with large volume acute on chronic hemoptysis, found to have a 2.5 x 1.4 cm mass in the right lower lobe bronchus concerning for carcinoid. Patient had no carcinoid symptoms (flushing, wheezing, diarrhea) or evidence of metastases. Initial management consisted of IR embolization of the bronchial artery supplying the mass to reduce risk of further hemoptysis and pulmonary compromise. Based on perinatology's recommendation to place maternal wellbeing first, the cardiothoracic tumor board recommended definitive surgical resection. We proceeded with urgent surgery at 27 weeks gestation to decrease risk of further physiologic changes of pregnancy compromising maternal morbidity and preterm labor. The patient underwent a right open thoracotomy with right lower lobe lobectomy under general anesthesia with single lung ventilation and thoracic epidural. Anesthetic goals included maintaining maternal and placental perfusion, uterine relaxation and optimizing surgical exposure. The patient received pre-induction fetal monitoring, hourly intraoperative monitoring of FHR and uterine tone, and continuous fetal heart monitoring for 4-6 hours post-op. Indomethacin PR was given prior to extubation for post-op tocolysis. Patient tolerated the procedure well and post-op fetal monitoring was unremarkable. Post-op course was unremarkable, with the patient planning a vaginal delivery. Intraoperative pathology was consistent with carcinoid and negative margins.

Discussion: This case highlights the need for multidisciplinary discussion (perinatology, CT surgery, pulmonology and IR) for management of complex patients. Our multi-site, university affiliated hospital posed a challenge regarding perioperative care as the maternal and pediatric units are greater than 1 mile from the primary CT surgery site. L&D and neonatal teams were on stand-by in the event of emergent peri-operative delivery.

Indications for peri-operative delivery need to be extensively discussed with patients and conveyed to all care teams involved. In this situation, continuous fetal monitoring was deferred because of the patient's wishes for emergent delivery only for maternal indications. Intermittent intra-op fetal monitoring every hour was used to help guide anesthetic management, with the idea that fetal bradycardia or contractions may be signs of inadequate placental perfusion or need for additional uterine relaxation.

Program Material

Saturday, May 4, 2019

- **Scientific Poster Summaries**
  Moderators: Paloma Toledo, M.D., M.P.H.; Hans P. Sviggum, M.D.
- **Obstetric Hemorrhage**
  Speaker: Alexander Butwick, M.B.B.S., M.S., F.R.C.A.
- **Drug Shortages: What Can I Do For My Patients?**
  Speaker: Heather C. Nixon, M.D.
- **Special Lecture: Patient Perspectives**
  Moderator: May C. Pian-Smith, M.D., M.S.
  Speakers: Stephanie Arnold, Author and Amniotic Fluid Embolism Survivor; Tracey M. Vogel, M.D.
- **Gerard W. Ostheimer Lecture**
  What's New in Obstetric Anesthesia?
  Introduction: Ashraf S. Habib, M.B., B.Ch., M.H.Sc., FRCA
  Speaker: Carolyn Weiniger, M.B., Ch.B.
- **What's New in Neonatology?**
  Introduction: Joy L. Hawkins, M.D.
  Speaker: Alan D. Bedrick, M.D.
- **Management of Neuraxial Labor Analgesia**
  Speaker: Kenneth E. Nelson, M.D.
- **Substance Use Disorder**
  Speaker: Britany L. Raymond, M.D., B.S.
- **Fred Hehre Lecture - Dogmas in Obstetric Anesthesia: The Balance Between Evidence, Common Sense, Habit and Fear**
  Introduction: Cristian Arzola, M.D., M.Sc.
  Speaker: Jose C.A. Carvalho, M.D., Ph.D., FANZCA, FRCPC
- **Oral Presentations II**
  Moderators: Emily E. Sharpe, M.D.; Cynthia A. Wong, M.D.
- **Post Dural Puncture Headache**
  Speaker: Barbara M. Scavone, M.D.
- **My Two Cents - Controversial Topics**
  Speaker: Lawrence C. Tsen, M.D.
- **Why Should You Care About Maternal Levels of Care?**
  Moderator: Brian T. Bateman, M.D., M.Sc.
  Speakers: Brendan Carvalho, M.B.B.Ch., FRCA, M.D.C.H.; Sarah J. Kilpatrick, M.D., Ph.D.; Jamie D. Murphy, M.D.

Disclosures

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- **Consulting / Honoraria:**
- **Instrumentation Laboratory, Cerus Corporation**

Objectives

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1. Assess the importance of postpartum hemorrhage as a leading cause of maternal morbidity and mortality
2. Review critical approaches for the clinical management of postpartum hemorrhage
3. Discuss whether pharmacological adjuncts should be incorporated into postpartum hemorrhage protocols.

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What is the Incidence of Maternal Death & Morbidity from Obstetric Hemorrhage?

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Hemorrhage: Maternal Death USA

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Maternal **Mortality** rate from hemorrhage:
est. 1.9 / 100,000 **births**
Butwick Guess

Rate of PPH + **Transfusion**:
300 / 100,000 **births**
Kramer. Am J Obstet Gynecol 2013; 209: 449.e1-7

Mortality rate among women with PPH:
est. 38 / 100,000 **PPHs**
Marshall Am J Obstet Gynecol 2017;217:344.e1-6.

Rate of **Transfusion** among women with PPH (Australia):
13,500 / 100,000 **PPHs**
Patterson. Obstet Gynecol 2014;123:126–33

Creanga. Obstet Gynecol 2017; 130: 366-73

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Solutions

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Readiness & Preparedness

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Consensus Statement

National Partnership for Maternal Safety

Consensus Bundle on Obstetric Hemorrhage

Elliott K. Main, MD, Dena Goffman, MD, Barbara M. Scavone, MD, Lisa Rene Low, PhD, CNM, Debra Bingham, DrPH, RN, Patricia L. Fontaine, MD, MS, Jed B. Gorlin, MD, David C. Lagrew, MD, and Barbara S. Levy, MD

Obstet Gynecol 2015;126:155–62

COUNCIL ON PATIENT SAFETY IN WOMEN'S HEALTH CARE

https://bit.ly/2H1ZPBa

CMQCC California Maternal Quality Care Collaborative

https://bit.ly/1RTQ3NJ

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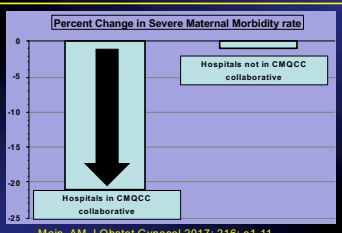
Are PPH Bundles Effective?

CMQCC California Maternal Quality Care Collaborative



Denominator = All women with PPH

Main. AM J Obstet Gynecol 2017; 216: e1-11.

Similar trends in single centers / hospital networks:
Einerson Am J Obstet Gynecol 2015; Shields Am J Obstet Gynecol 2011 and 2015; Smith Eur J Obstet Gynecol 2019

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The Joint Commission

Proposed Standards for Patient Safety

Hemorrhage risk assessment → Remains a challenge

Written protocol for stage-based PPH management

Hemorrhage kit

Regular education

Drills

Case review

Educate patients

https://bit.ly/2vj7cNZ

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PPH Management Challenges

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Uterotonics

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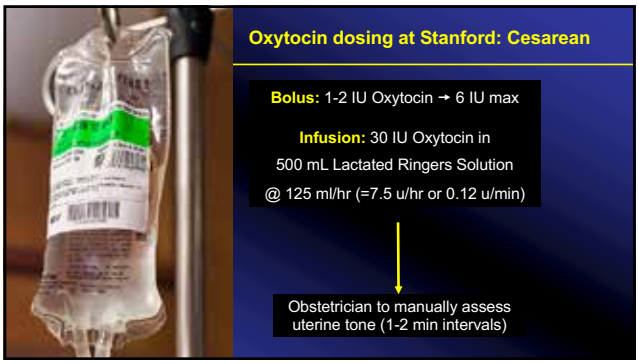
Oxytocin Prophylaxis

- **Oxytocin vs. no uterotonics** [1]
  - Lower Risk: PPH and more uterotonics
- **Initiate uterine tone:**
  - Bolus: 0.3 - 0.5 u – elective cesarean [2 - 3]
  - Bolus: 2 - 4 u – intrapartum cesarean [4]
  - Infusion: 0.3 u / min [5 – 6]
- **Prescribed regimens:** 'Rule of 3s'

1. Cotter AM. Cochrane 2001: CD001808
2. Carvalho J. Obstet Gynecol 2004; 104: 1005-10
3. Butwick. Brit J Anaesth 2010; 104: 338-43
4. Balki Obstet Gynecol 2006; 107: 45-50
5. George R. Can J Anesth 2010;57: 578-82
6. Lavoie A. Anesth Analg 2015; 121: 159-64
7. Kovacheva VP. Anesthesiology 2015; 123: 92-100


Oxytocin dosing at Stanford: Cesarean
Bolus: 1-2 IU Oxytocin → 6 IU max
Infusion: 30 IU Oxytocin in
500 mL Lactated Ringers Solution
@ 125 ml/hr (=7.5 u/hr or 0.12 u/min)
Obstetrician to manually assess uterine tone (1-2 min intervals)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Uterotonics:
The Future
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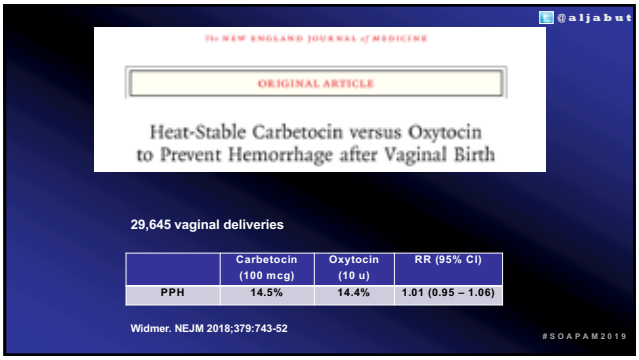
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The NEW ENGLAND JOURNAL of MEDICINE
ORIGINAL ARTICLE
Heat-Stable Carbetocin versus Oxytocin to Prevent Hemorrhage after Vaginal Birth
29,645 vaginal deliveries
Carbetocin (100 mcg)
Oxytocin (10 u)
RR (95% CI)
PPH
14.5%
14.4%
1.01 (0.95 – 1.06)
Widmer. NEJM 2018;379:743-52
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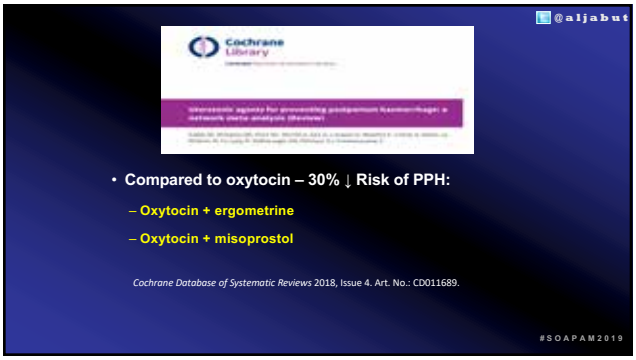
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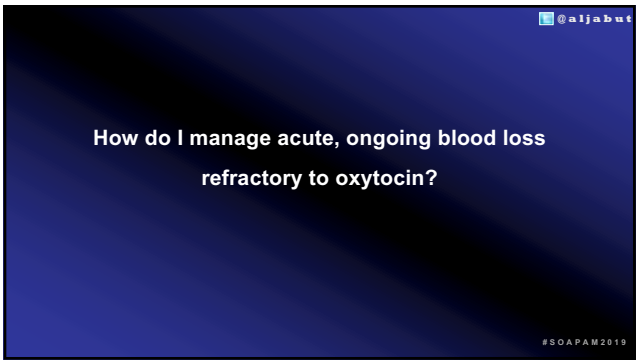
Cochrane Library
• Compared to oxytocin – 30% ↓ Risk of PPH:
– Oxytocin + ergometrine
– Oxytocin + misoprostol
Cochrane Database of Systematic Reviews 2018, Issue 4. Art. No.: CD011689.
#SOAPAM2019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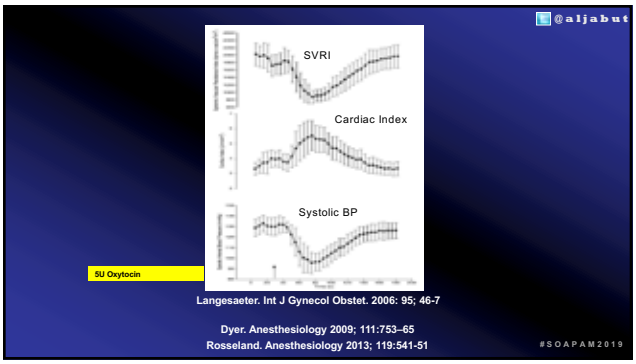
How do I manage acute, ongoing blood loss refractory to oxytocin?
#SOAPAM2019


@aljabut
SVRI
Cardiac Index
Systolic BP
5U Oxytocin
Langesaeter. Int J Gynecol Obstet. 2006: 95; 46-7
Dyer. Anesthesiology 2009; 111:753–65
Rosseland. Anesthesiology 2013; 119:541-51
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2nd Line Uterotonics

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- 15- Methyl prostaglandin $F_{2\alpha}$ (Carboprost)
  - 250 mcg IM
- Ergot alkaloid (Methylergonovine maleate)
  - 200 mcg IM

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Methergine vs. Hemabate

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TABLE 3
Risk of hemorrhage-related morbidity in women receiving carboprost as compared to women receiving methylergonovine

Variable	Carboprost, n (%)	Methylergonovine, n (%)	Relative risk* (95% CI)
Hemorrhage-related morbidity			
Unadjusted	81/465 (17.4)	76/870 (8.7%)	2.0 (1.5–2.7)
Propensity score matched	59/369 (16.0)	34/369 (9.2%)	1.7 (1.2–2.6)

Butwick AJ. Am J Obstet Gynecol 2015; 212: 642.e1-7

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Misoprostol

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Misoprostol as an adjunct to standard uterotonics for treatment of post-partum haemorrhage: a multicentre, double-blind randomised trial

	Misoprostol	Placebo	RR (95% CI)
PPH	14%	14%	1.0 (0.8 – 1.3)
Fever	58%	19%	2.1 (1.9 – 2.3)

Widmer M. Lancet 2010; 375: 1808-13

Postpartum hemorrhage in the developed world: whither misoprostol?

Am J Obstet Gynecol. 2013; 208: 181-3.

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How Do I Manage Major Bleeding?

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Massive Transfusion Protocol

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- Massive Transfusion Pack
- 6 units Red Blood Cells
- 4 units FFP
- 1 apheresis Platelet unit

1. *Burtelow M. Transfusion 2007;47:1564–72.*
2. *Goodnough LT. Transfusion 2011;51:2540–8.*
3. *Gutierrez MC. Int J Obstet Anesth 2012;21:230-5.*

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Unanswered questions

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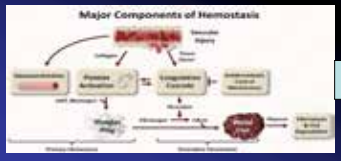
- Transfusion:
  - Formula driven vs goal-directed?



Decision Making: PPH Management

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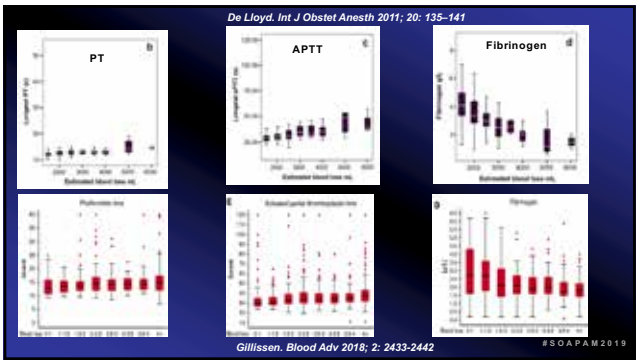
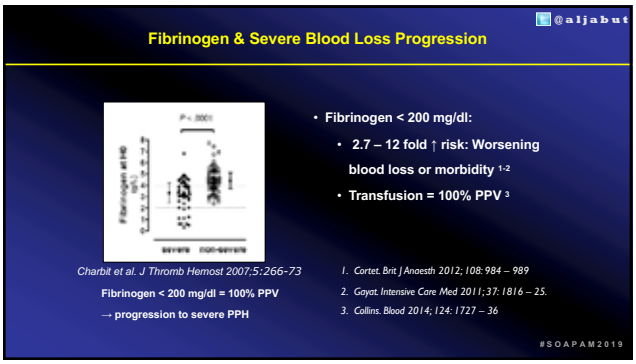
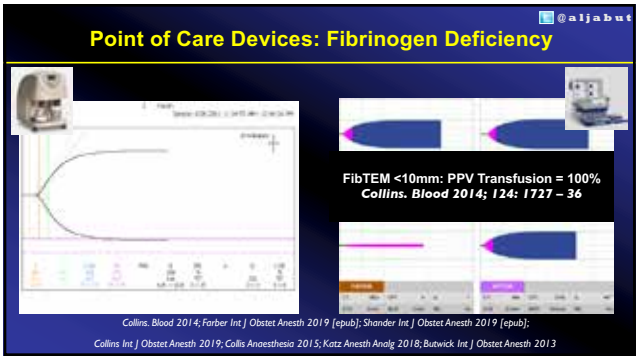

De Lloyd. Int J Obstet Anesth 2011; 20: 135–141
PT
APTT
Fibrinogen
Gillissen. Blood Adv 2018; 2: 2433-2442
#SOAPAM2019


@aljabut
Fibrinogen & Severe Blood Loss Progression
• Fibrinogen < 200 mg/dl:
• 2.7 – 12 fold ↑ risk: Worsening blood loss or morbidity 1-2
• Transfusion = 100% PPV 3
Charbit et al. J Thromb Hemost 2007;5:266-73
Fibrinogen < 200 mg/dl = 100% PPV
→ progression to severe PPH
1. Cortet. Brit J Anaesth 2012; 108: 984 – 989
2. Gayat. Intensive Care Med 2011;37: 1816 – 25.
3. Collins. Blood 2014; 124: 1727 – 36
#SOAPAM2019


@aljabut
Point of Care Devices: Fibrinogen Deficiency
FibTEM <10mm: PPV Transfusion = 100%
Collins. Blood 2014; 124: 1727 – 36
Collins. Blood 2014; Farber Int J Obstet Anesth 2019 [epub]; Shander Int J Obstet Anesth 2019 [epub];
Collins Int J Obstet Anesth 2019; Collis Anaesthesia 2015; Katz Anesth Analg 2018; Butwick Int J Obstet Anesth 2013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If we treat a low fib level, are outcomes improved?
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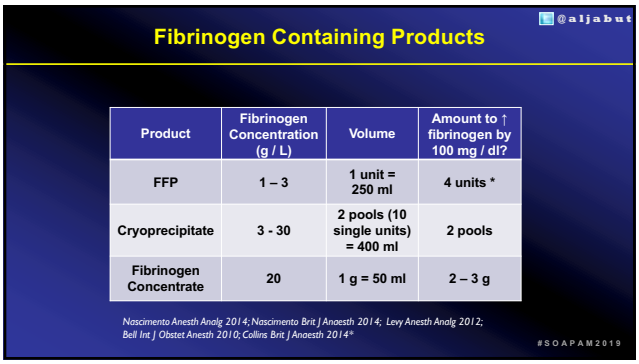
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Fibrinogen Containing Products
Product
Fibrinogen Concentration (g / L)
Volume
Amount to ↑ fibrinogen by 100 mg / dl?
FFP
1 – 3
1 unit = 250 ml
4 units *
Cryoprecipitate
3 - 30
2 pools (10 single units) = 400 ml
2 pools
Fibrinogen Concentrate
20
1 g = 50 ml
2 – 3 g
Nascimento Anesth Analg 2014; Nascimento Brit J Anaesth 2014; Levy Anesth Analg 2012;
Bell Int J Obstet Anesth 2010; Collins Brit J Anaesth 2014*
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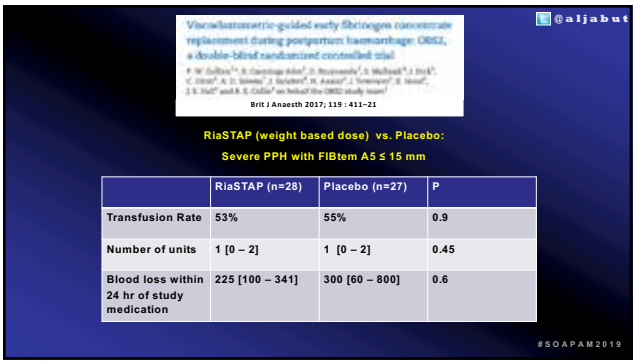
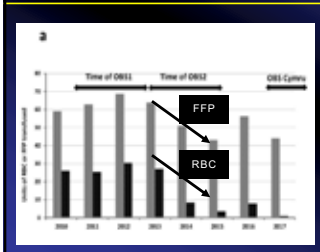
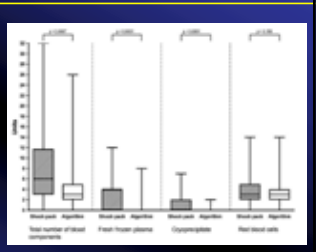

@aljabut
Viscoelastometric-guided early fibrinogen concentrate replacement during postpartum haemorrhage: OBS2, a double-blind randomized controlled trial
Brit J Anaesth 2017; 119 : 411–21
RiaSTAP (weight based dose) vs. Placebo:
Severe PPH with FIBtem A5 ≤ 15 mm
RiaSTAP (n=28)
Placebo (n=27)
P
Transfusion Rate
53%
55%
0.9
Number of units
1 [0 – 2]
1 [0 – 2]
0.45
Blood loss within 24 hr of study medication
225 [100 – 341]
300 [60 – 800]
0.6
#SOAPAM2019

@aljabut

But





Collins. Int J Obstet Anesth 2019; 37: 106-117.

McNamara. Anaesthesia 2019 [epub]

@aljabut

Tranexamic Acid

woman
World Maternal Antifibrinolytic Trial

Lancet 2017; 389: 2105–16

BIG STUDY

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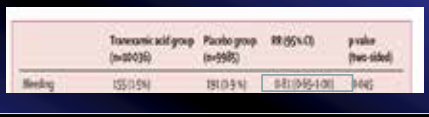
Outcomes



TRANSFUSIONS:

5461 (54%) TXA vs. 5426 (54%) placebo

Among those transfused:
No diff mean number of blood units transfused

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The effect of tranexamic acid on blood loss and maternal outcome in the treatment of persistent postpartum hemorrhage: A nationwide retrospective cohort study

N = 1261 – severe PPH

	Early TXA	Late / No TXA	aOR (95% CI)
Maternal Morbidity	8.1%	9.8%	0.9 (0.7 - 1.3)

Gillisen A. PloS ONE 2017;12: e0187555.

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@aljabut

When to use RiaSTAP & TXA?

MAJOR ACTIVE BLEEDING

TXA:
- Evidence of hyperfibrinolysis (TEG/ROTEM)
- Abruption; AFE; severe DIC
- Algorithms/Protocols

RiaSTAP:
- Fibrinogen ≤ 250 mg / dl
- ROTEM: FibTEM A5 ≤ 10 mm
- TEG: Alpha Angle < 45°
- *Probably* if no lab / POC value

RiaSTAP (2 – 4 g)

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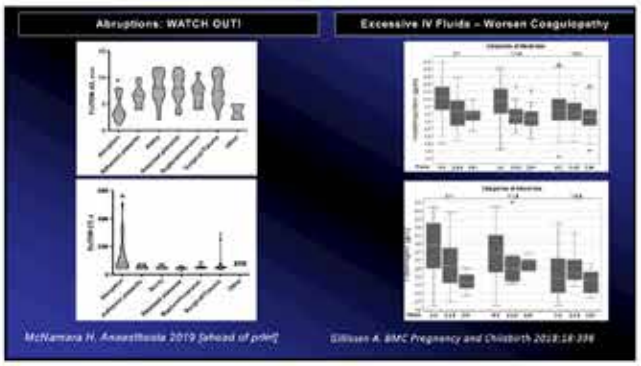
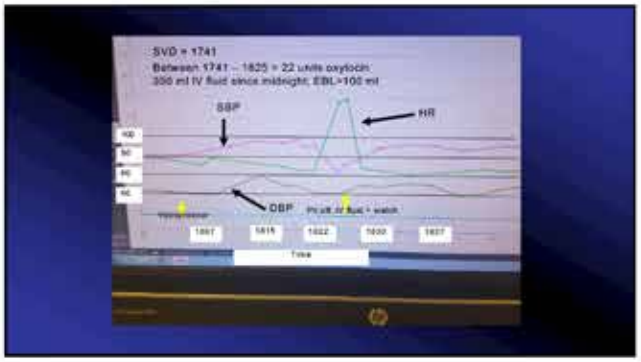
HOT OFF THE PRESS


Abruptions: WATCH OUT!
Excessive IV Fluids – Worsen Coagulopathy
McNamara H. Anaesthesia 2019 [ahead of print]
Gillissen A. BMC Pregnancy and Childbirth 2013;13:206


Many Thanks
@aljabot
Email = ajbot@stanford.edu
@ aljabot
https://www.facebook.com/obstetricanesthesia


SVD = 1741
SBP
HR
DBP

SOAP
Society for Obstetric Anesthesia and Perinatology

Advancing the pregnancy-related health and outcomes of pregnant women and their newborn.

www.soap.org

@hnixon147

SOAP Society for Obstetric Anesthesia and Perinatology

Heather Nixon, MD
University of Illinois at Chicago

Disclosure Statement:

I have no disclosures for this presentation

Learning Objectives:

Understand how drug shortages, particularly of sterile injectable medications occur frequently and may impact patient safety and healthcare workflow

Consider how to work with pharmacists and other providers to allocate medications on shortage to appropriate patient populations

Employ drug shortage management strategies that increase drug availability and safety

Scope of Drug Shortages

Dangers to Patient Safety

Strategies to Manage Shortages

SOAP Society for Obstetric Anesthesia and Perinatology

Drug Shortage Statistics:

https://www.ashp.org/Drug-Shortages/Shortage-Resources/Drug-Shortages-Statistics

Drug Shortage Statistics:

https://www.ashp.org/Drug-Shortages/Shortage-Resources/Drug-Shortages-Statistics

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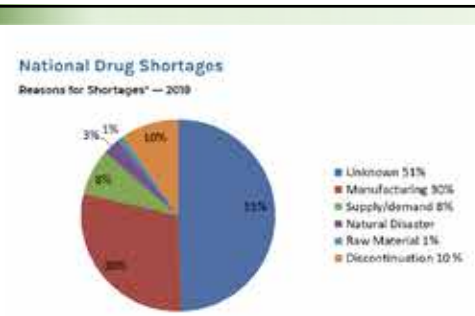
https://www.ashp.org/Drug-Shortages/Shortage-Resources/Drug-Shortages-Statistics



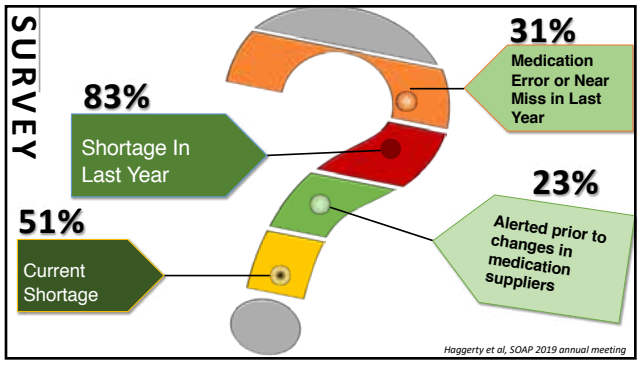
https://www.ashp.org/Drug-Shortages/Shortage-Resources/Drug-Shortages-Statistics

Lack of redundancy

71% of sterile injectables – produced by only three manufacturers

Most sterile injectables have one manufacturer that produces at least 90% of the drug

United States Government Accountability Office Report Drug Shortages: FDA 's ability to respond should be strengthened. Nov 2011



Haggerty et al, SOAP 2019 annual meeting

Volume 12, Number 3 **ISMP Canada Safety Bulletin** March 20, 2012

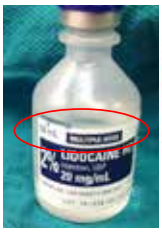
Drug Shortages and Medication Safety Concerns

Potential for patient harm:

- **Inadequate treatment**
- **Unsafe medication administration production and practices**
- **Medication errors**

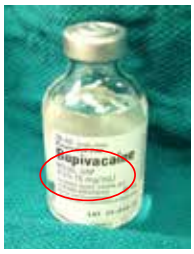
ismp HIROC

Medication Errors Due to Drug Shortages



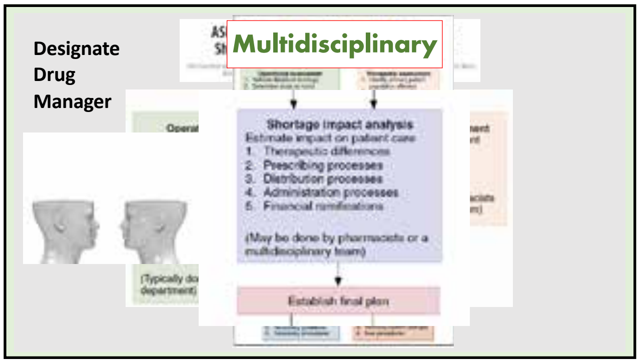
Medication Errors Due to Drug Shortages

Medication Errors Due to Drug Shortages



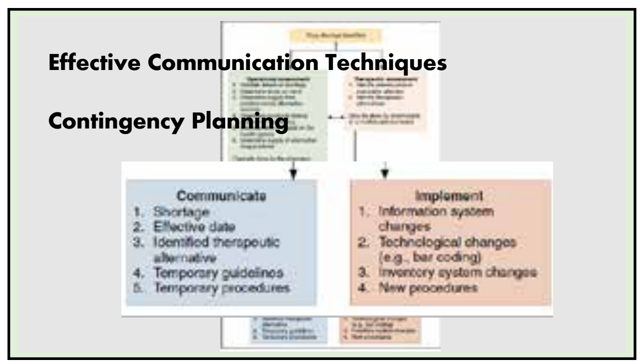
What Can I Do For My Patient?

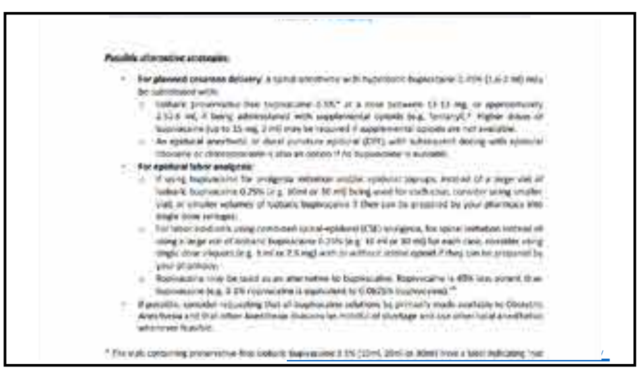
Two Strategies:


Designate
Drug
Manager
Multidisciplinary
Shortage impact analysis
Estimate impact on patient care
1. Therapeutic differences
2. Prescribing processes
3. Distribution processes
4. Administration processes
5. Financial ramifications
(May be done by pharmacists or a multidisciplinary team)
Establish final plan


Ondansetron
Injection, USP


Pharmacy :
Single Dose Medications


Effective Communication Techniques
Contingency Planning
Communicate
1. Shortage
2. Effective date
3. Identified therapeutic alternative
4. Temporary guidelines
5. Temporary procedures
Implement
1. Information system changes
2. Technological changes (e.g., bar coding)
3. Inventory system changes
4. New procedures




Contingency Planning for Drugs on Shortage
Cesarean Delivery:

Medication Templates

Intravenous Medications

Neuraxial Medications

Culture of Safety and Reporting

Drug Shortage Management Strategies

- **Designated Drug Manager**
- **Limit drugs available from different suppliers**
- **Preparation of Single-dose Medications by Pharmacy**
- **Effective Communication Strategies**
- **Available Alternative Algorithms and Education**
- **Standardized Medication Placement**
- **Reporting System**

Two Must Reads....

1. The Society for Obstetric Anesthesia and Perinatology (SOAP) Advisory in Response to Shortages of Local Anesthetics in North America – https://soap.org/wp-content/uploads/2018/04/2018-bupivacaine-shortage-statement-1.pdf

2. Erin R. Fox, Milena M. McLaughlin, ASHP guidelines on managing drug product shortages, *American Journal of Health-System Pharmacy*, Volume 75, Issue 21, 1 November 2018, Pages 1742–1750, https://doi.org/10.2146/ajhp180441

CASE

Audience Poll……

Based on this information……which would be the most reasonable course of action?

a. Deliver via Cesarean Delivery and then Cerebral Angiogram
b. Perform Cerebral Angiogram and then Delivery via Cesarean Delivery

SOAP Society for Obstetric Anesthesia and Perinatology

CASE

Audience Poll……

On Fetal Monitors - Intermittent Late Decelerations

Based on this information…… your anesthetic plan would be?

a. Spinal anesthesia
b. Combined spinal anesthesia
c. Epidural anesthesia
d. General Anesthesia

SOAP Society for Obstetric Anesthesia and Perinatology

Questions for the Panelist:

SOAP Society for Obstetric Anesthesia and Perinatology

Panelist Pearls:

Not all intracranial pathology precludes neuraxial procedures

Management of intracranial pathology in pregnancy is similar to non-pregnant patients

Timing of obstetric and neurosurgical interventions reliant on maternal and fetal status

Multi-disciplinary planning when possible is key

SOAP Society for Obstetric Anesthesia and Perinatology

????

Audience Questions and Comments

Why do you need a consult with anesthesia? Because it will save your life!

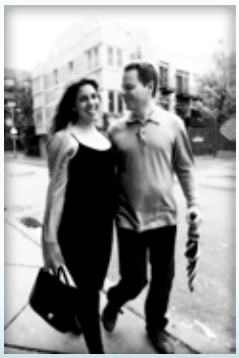
Stephanie Arnold
AFE Survivor

Disclosure

I have no relevant financial relationships to disclose.

Learning Objective

To better understand the role and value of the patient's perspective in shared decision making.



AFE Foundation

AFESUPPORT.ORG

Advancing Research

- *Amniotic Fluid Embolism Registry™*
- Largest database of AFE cases
- Retrospective case review
- Prospective specimen collection
- Various publications
- Only active international registry

If you have a case, call 1-307-END-AFES ASAP to submit specimens.

Common Misunderstandings

- AFE is not survivable
- Autopsy is the only way to diagnose AFE
- Fetal squames in vasculature confirms AFE

Receive Clinical Updates

Text **AFE** to 444999

AFE FOUNDATION

The Empowerment Equation

Understanding trauma survivors and facilitating shared decision making

Tracey M Vogel MD

@TraceyVogelMD
#SOAPAM2019

Learning Objectives

- Realize the widespread impact of childhood trauma
- Recognize signs and symptoms of unresolved psychological trauma in patients
- Understand the consequences of a traumatic birth on the trauma survivor and her child
- Understand the importance of shared decision making to improve outcomes in this patient population

An Interesting Situation

A patient admitted to our labor and delivery suite was diagnosed with pre-eclampsia. Her clinical status was deteriorating quickly, yet standard treatment options were challenging due to complicating factors. The patient, transferred from a midwife service, was now refusing medications, epidural pain relief, and surgical delivery, even at the risk of harming her child. This patient's "irrational" behavior prompted requests for emergency consultation with social services, psychiatry, the ethics committee, and the hospital's legal department.

She had no other medical or psychiatric history that would explain her current behavior, except for a mention of "possible abuse" in her past. No one had attempted to elucidate the reason behind her fear of a cesarean section.

Implications

- Possible harm to life for herself and her child
- Extensive utilization of resources (all the consultations)
- Calls into question the legal rights of this mom- do fetal rights trump maternal rights?
- The majority of providers are ill-equipped to identify the risks, signs and symptoms of psychological disease processes

Trauma from the Past

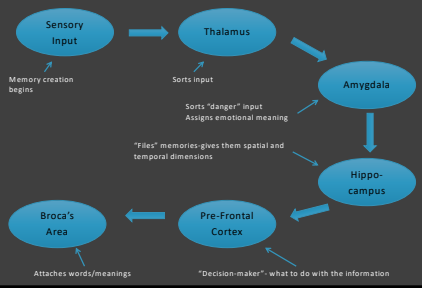
- DSM V Definition
  - The person was exposed to: death, threatened death, actual or threatened serious injury, or actual or threatened sexual violence, in the following way(s):
    - Direct exposure
    - Witnessing the trauma
    - Learning that a relative or close friend was exposed to a trauma
    - Indirect exposure to aversive details of the trauma, usually in the course of professional duties (e.g., first responders, medics)

Childhood Sexual Trauma

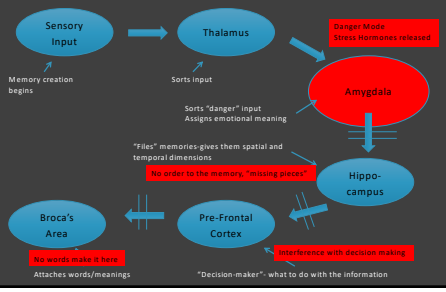
- Approximately 20-33% of females will be the victims of childhood sexual trauma[1]
- 9% will meet criteria for a diagnosis of PTSD when they present to an obstetric provider during pregnancy [2]
- Many adult survivors have unresolved trauma issues

1 US Department of Justice, Sobel et al 2018, Seng et al 2013, Felitti et al 1998
2 Seng et al 2009

Normal Brain Response to Events



The Brain on "Trauma"



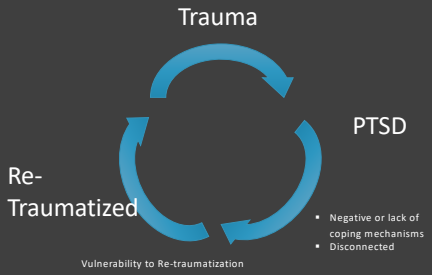
Posttraumatic Stress Disorder (PTSD)

- Definition- a disorder that originates from the maladaptive persistence of appropriate and adaptive responses present during traumatic stress (failure of neurobiological system to extinguish the fear-conditioned response)

DSM Diagnostic Criteria

Criteria	Real life Behaviors
Stressor	
Re-experiencing	Flashbacks/nightmares/triggers
Avoidance &Numbing	Passive, "check out/dissociate" No attention to danger Often the victims in relationships People pleaser, sacrifices their own feelings
Arousal	Hypervigilant Hostile Panic behaviors Paranoid
Negative cognitions and mood	
Duration, Disability	

TRAUMA CYCLE



- Negative or lack of coping mechanisms
- Disconnected

Adverse Childhood Experience (ACE) Study

- Physical abuse
- Sexual abuse
- Emotional abuse
- Physical neglect
- Emotional neglect
- Mother treated violently
- Household substance abuse
- Household mental illness
- Parental separation or divorce
- Incarcerated household member

Felitti et al 1998

ACE Study Results

- Smoking
- Obesity
- Physical Inactivity
- Depression
- Suicide
- Alcoholism
- Illicit Drug Use
- Injected Drug Use
- 50+ sexual partners
- STDs

Felitti et al 1998

Long term Effects of Unresolved Trauma

- Sleeping difficulties
- PTSD
- Dissociation
- Substance Use Disorders/Addictive behaviors/Eating disorders
- Anxiety/depression
- Decreased Self Esteem
- Suicidal ideation
- Fatigue
- Physical issues- hypertension, gastrointestinal problems, migraines, chronic pain, poor immune function

What happens when survivors get pregnant and present for delivery?

Prior Sexual Trauma and the Parturient

- Intrinsic Triggers
  - Painful contractions
  - Nausea and vomiting
  - Bloody excretions
  - Instinctual reactions (moaning, grunting)
  - Change in appearance

Simpkin P, Klaus P. *When survivors give birth.* Seattle, Washington: Classic Day Publishing, 2004

Prior Sexual Trauma and the Parturient

- Extrinsic Triggers
  - Sights, smells, sounds of the hospital environment
  - Hospital environment, beeping equipment, bright lights
  - Lack of privacy
  - Lack of respect for the woman's modesty
  - Separation from loved ones
  - Vaginal exams, injections, arm straps, physical restraint

Simpkin P, Klaus P. *When survivors give birth.* Seattle, Washington: Classic Day Publishing, 2004

Prior Sexual Trauma and the Parturient

What might we see as providers?

- Anxiety/depression
- Substance Use Disorders
- Fear of losing control or of being strapped down
- Resistance to vaginal exams
- Refusal of care
- Anger and hostility
- Phobias
- Unusual affect
- Request for no male providers

Prior Sexual Trauma and the Parturient

- Qualitative Studies
  - Trusting environment
  - Communication of disclosure
  - Concise, but specific birth plans outlining shared decision making expectations
  - Clear explanations when and how procedures are to be done
  - Acknowledgement that women have control over timing, pace, termination of exams
  - Minimal number of examinations and examiners

- Sobel et al 2018, Roller et al 2011

Prior Sexual Trauma and the Parturient

- Qualitative Studies
  - Respect for privacy- knock before entering
  - Ability to wear their clothes/ minimize bodily exposure
  - Consider elective cesarean section after appropriate counseling
  - Recognize some women are comfortable with male providers, but routine assessment is important
  - Some women with a history of sexual abuse may choose not to breastfeed

- Sobel et al 2018 ,Roller et al 2011

Re-victimization

- Consequences of a traumatic birth experience on the trauma survivor:
  - Dissociation with no memory of the childbirth experience
  - Hyper-arousal with agitation/ anger with caregivers/ hostility
  - Psychological harm impairing the maternal-fetal, and maternal-neonatal bond
  - Increased risk for maternal mental health complications

Trauma Informed Care

- **Realizes** the widespread impact of trauma and understands potential paths for recovery
- **Recognizes** the signs and symptoms of trauma in patients, families, staff, and others involved with the system
- **Responds** fully integrating knowledge about trauma into policies, procedures, and practices
- Actively seeks to **resist re-traumatization**

Substance Abuse and Mental Health Services Administration

What does Trauma Informed Care look like on L&D?

- A shift in practice paradigms from "what I am going to do *to you*" to "what do you need *from me*"
- Multidisciplinary planning/ on site discussions
- Focus on giving the patient some sense of control of the situation
- Alterations in care that are mutually agreed upon

An Interesting Situation (cont.)

Although the details of our patient's prior trauma was not revealed, it was clear through our discussions that her intense fear of surgery stemmed from childhood sexual trauma and subsequent re-traumatization later in life. She also had been re-traumatized during two prior orthopedic surgeries in which she remembers being "strapped down" and having an oxygen mask that "suffocated her".

Ultimately she did have a cesarean section. She had her significant other in the room the entire time, the arm boards were removed from the operating room table and she kept her arms on her chest throughout the case, she received small doses of midazolam upon her request, and had no face mask. She enjoyed "skin-to-skin" bonding with her baby, and was tremendously grateful for what we helped her to do.

Gerard W Ostheimer Syllabus

What's New in Obstetric Anesthesia in 2018

Presented at SOAP 2019, Phoenix Arizona

Carolyn F. Weiniger, MB ChB

Tel Aviv Sourasky Medical Center, Tel Aviv, Israel

#SOAPAM2019

During the SOAP Annual conference, the What's New in Obstetric Anesthesia Lecture presents novel and relevant publications from the preceding year. This Lecture was first given in 1975 and since 1995 has been named in honor of Gerard W Ostheimer. The 2019 Ostheimer Lecture and the enclosed accompanying Syllabus present articles published throughout the 2018 calendar year.

Objective: Readers will identify novel and updated areas of research related to maternal care during pregnancy, labor and the postpartum period. Significant themes in this Syllabus are maternal morbidity and mortality; spinal hypotension; and postpartum care.

Journal Selection: The highest impact journals in Obstetrics and Gynecology, Anesthesia, General Medicine, Critical Care, Pain and Healthcare Services were selected for monthly review of the Table of Contents (see List below) throughout 2018. Additional Journals were searched according to keywords "maternal" and "pregnancy" to identify relevant publications during 2018. Finally this search was supplemented using Obstetric Anesthesia Digest, Joanne Douglas's Monthly OB Division News, F1000, Twitter, and other media sources. Almost 1200 articles published in 2018 were downloaded and managed using Windows folders.

Manuscript Selection: Priority was given to Original Articles in high impact journals, particularly those that present a novel finding, impact clinical practice, represent a technical advance, an interesting hypothesis (F1000 recommendation classifications) or "grabbed my attention". Given the huge number of high quality Original Articles published in the highest ranking medical journals during 2018, the selection was a major challenge. Manuscripts selected are mostly Original Articles, plus Important Guidelines and must-read Review Articles. They are accompanied where available by Editorials, Practice Guidelines and Infographics. In some cases a related Supplementary Commentary from a prominent general medical journal is also presented. Studies are presented with design, dates, primary outcome, and for prospective studies, n=number of patients analyzed for the primary outcome. Hyperlinks to relevant webpages are in blue font.

Manuscript Topic Categories are listed in descending order according to the number of downloaded manuscripts: Maternal Morbidity & Mortality; Hypertensive Disorders of Pregnancy and Preeclampsia; Neonatal Outcomes; Cesarean Delivery; Delivery Outcomes; Hemorrhage and Hematological Disease; Postpartum Period; Infectious Diseases; Labor Analgesia; Cardiovascular Morbidity; Opioids and Cannabis; Placenta Accreta Spectrum; Spinal Hypotension; Venous Thromboembolism; Ultrasound in Obstetric Anesthesia; Simulation.

I am grateful to all the authors of the manuscripts published in 2018 that relate to Obstetric Anesthesia, to the care of women and their optimal passage through pregnancy, labor and the postpartum period. The time and effort invested by all authors in pursuit of better care for pregnant women and their babies is manifest and wonderful. I regret all the work that could not be included in this focused Syllabus and the accompanying Lecture, despite their novelty, impact and importance to our specialty.

Journals searched using Table of Contents (*denotes Journals searched according to Keywords "maternal"; "pregnancy")

ANESTHESIA: Anesthesiology; British Journal of Anaesthesia (BJA); Pain; Anaesthesia; Regional Anaesthesia and Pain Medicine; European Journal of Anaesthesiology
Anesthesia and Analgesia (A & A); International Journal of Obstetric Anesthesia (IJOA); Canadian Journal of Anesthesia (CJA); Clinical Journal of Pain; European Journal of Pain; Pain Medicine; Acta Anaesthesiologica Scandinavica; Current Opinion in Anesthesiology; Journal of Pain

OBSTETRICS and GYNECOLOGY: American Journal of Obstetrics and Gynecology; Obstetrics and Gynecology; British Journal of Obstetrics and Gynecology (BJOG); Acta Obstetrica et Gynecologica Scandinavica

GENERAL MEDICINE: New England Journal of Medicine (NEJM); The Lancet; Journal of the American Medical Association (JAMA); British Medical Journal; Annals of Internal Medicine*

CARDIAC: European Journal of Heart*; Journal of American College of Cardiology*; Hypertension; Circulation; Heart*; Stroke; Journal of the American Heart Association; JAMA Heart*

CRITICAL CARE: Critical Care Medicine*; Intensive Care Medicine*; Resuscitation; Critical Care*; Annals of Emergency Medicine*

PEDIATRICS: JAMA Pediatrics*; Pediatrics*; American Journal of Perinatology

PSYCHIATRY: American Journal of Psychiatry*

HEMATOLOGY: Blood; British Journal of Hematology; Transfusion

SIMULATION: Simulation in Healthcare; British Medical Journal Simulation; Advances in Simulation; British Medical Journal Quality and Safety; BMJ Simulation and Technology Enhanced Learning

OTHERS: The Cochrane Library; Lancet Global Health*; MMWR morbidity mortality weekly report; Journal of Clinical Epidemiology*

Pain journals searched by Sharon Orbach-Zinger; **Simulation** journals searched by Gill Abir

SYLLABUS TABLE OF CONTENTS

ABBREVIATIONS

ACOG American College of Obstetricians & Gynecologists
ADP accidental dural puncture
AFE amniotic fluid embolism
AGA appropriate for gestational age
AHI apnea hypopnea index
AMB automatic mandatory bolus
aOR adjusted Odds Ratio
ART assisted reproductive therapy
ASRA American Society of Regional Anesthesia & Pain Medicine
AUC area under the curve
bd twice daily
BMI body mass index
BP blood pressure
CBC complete blood count
CD cesarean delivery
CDC Center for Disease Control
CEI continuous epidural infusion
CI confidence intervals
CNS central nervous system
CO cardiac output
COX-2 cyclooxygenase-2
CTPA computerized tomography pulmonary angiogram
CPR cardiopulmonary resuscitation
CROWN Core Outcomes in Women's and Newborn Health
CSF cerebrospinal fluid
CSRD clinically significant respiratory depression
CVA cerebrovascular accident
CVD cardiovascular disease
CVS cardiovascular system
DB David Bogod
DIC disseminated intravascular coagulation
DTI decision-to-incision time
EBC Each Baby Counts
EBL estimated blood loss
EBP epidural blood patch
ECG electrocardiography
ECV external cephalic version
EPDS Edinburgh postpartum depression score
ESA European Society of Anaesthesiologists
ER emergency room
EV epidural volume
FHR fetal heart rate
FIGO International Federation of Gynecology & Obstetrics
FXI Factor XI
GA general anesthesia
HIE hypoxic ischemic encephalopathy
HR heart rate
ICU intensive care unit
IM intramuscular
IONV intraoperative nausea and vomiting
IR invasive radiology
IUGR intrauterine growth retardation
IV intravenous
LAST local anesthetic systemic toxicity
LMWH low molecular weight heparin
MD mean difference
MFMU Maternal-Fetal Medicine Units
MMR Maternal Mortality Review
MRI magnetic resonance imaging
NAP national audit project
NE neonatal encephalopathy
NICU neonatal intensive care unit
NPV negative predictive value
NSAID non-steroidal anti-inflammatory agent
od once daily
OR Odds Ratio
ORII operating-room-to-decision intervals
OSA obstructive sleep apnea
PAS placenta accreta spectrum
PCA patient controlled analgesia
PCEA patient controlled epidural analgesia
PDPH postdural puncture headache
PE pulmonary embolism
PIEB programmed intermittent epidural bolus
PIP percent change in pain
PlGF placental growth factor
POCUS point of care ultrasound
PPD postpartum depression
PPH postpartum hemorrhage
PPV positive predictive value
PTT partial thromboplastin time
QL quadratus lumborum
QST quatitive sensory testing
RCT randomized controlled trial
RD respiratory depression
ROC receiver operated curves
RCOG Royal College of Obstetricians & Gynaecologists
RD risk difference
ROSC return of spontaneous circulation
RR Relative risk
SBP systolic blood pressure
SD standard deviation
SEH spinal epidural hematoma
sFlt-1 soluble fms-like tyrosine kinase 1
SMFM Society of Maternal Fetal Medicine
SOB shortness of breath
SOMA Slow Off-rate Modified Aptamer
SPG sphenopalatine ganglion block
SQ subcutaneous
SSI surgical site infection
TAP transabdominus plane
TGCS Ten-Group Classification System
TPR total peripheral resistance
TXA tranexamic acid
UA umbilical artery
UFH unfractionated heparin
UK United Kingdom
US United States
VD vaginal delivery
VTE venous thromboembolism
WHO World Health Organization

MATERNAL MORTALITY

1.The California Pregnancy-Associated Mortality Review. Report from 2002-2007 Maternal Death Reviews. *Sacramento: California Department of Public Health, Maternal, Child and Adolescent Health Division* 2017, Spring 2018

California Maternal Mortality Review (2002-07)
Women presented in this maternal mortality review died during labor and up to 1 year postpartum in California (n>1000). According to data identified through the in-depth review, many maternal mortality cases would have been attributed to preeclampsia if only death certificates were used to attribute cause of death. Clinical warning signs were ignored or recognized late, and institutions were not ready for obstetric emergencies. Although most women who died were considered "not low risk" meaning they had some comorbidities, the review committee considered that 41% of the deaths were potentially preventable. Examples of potentially preventable deaths included untreated hypertension, delayed recognition of PPH, and no VTE prophylaxis. Importantly, recognition of the rise in maternal death rates from 1999 led to strategies to tackle maternal deaths through investments in maternal public health care and toolkits. Subsequently a decline in maternal death rate was reported from 2008.

2.Illinois Maternal Morbidity and Mortality Report. *Illinois Department of Public Health*: October 2018

Illinois Maternal Mortality Review (2015)
Deaths related to pregnancy (n=37) and to violent causes (n=28) were reviewed in this first MMR from the State of Illinois. Advanced maternal age, higher BMI, high school education only, and Medicaid insurance were associated with higher likelihood of maternal death. The death certificate listed a cause of death that was considered by the review to be incorrect in 61% of cases. Therefore if only death certificates are used, the cause of death would be wrongly attributed. Need for a continuum of care throughout the antenatal and postpartum periods, non-fragmented care between the different providers and a high index of suspicion postpartum were emphasized.

3.McCaw-Binns AM, Campbell LV, Spence SS. **The evolving contribution of non-communicable diseases to maternal mortality in Jamaica, 1998-2015: a population-based study**. *BJOG* 2018, 125(10): 1254-1261

Jamaica Maternal Mortality Review (1998-2015)
Jamaica, a middle income country, has performed MMRs based upon the UK confidential enquiries since 1998. This report compared three periods: 1998-2003, 2004-9 and 2010-15, and found that maternal deaths are rising, mainly attributed to indirect disease such as cardiac comorbidity, while hypertensive disease of pregnancy is an important yet decreasing cause of maternal mortality in Jamaica. The report highlights the importance of surveillance for late deaths (up to 365 days after pregnancy) that revealed additional cases of maternal death that would otherwise be missed.

ACCOMPANIED BY EDITORIAL: Stokes MJ, Wilkinson JP. **The causes of maternal mortality are changing and preventable**. *BJOG* 2018, 125(10): 1262

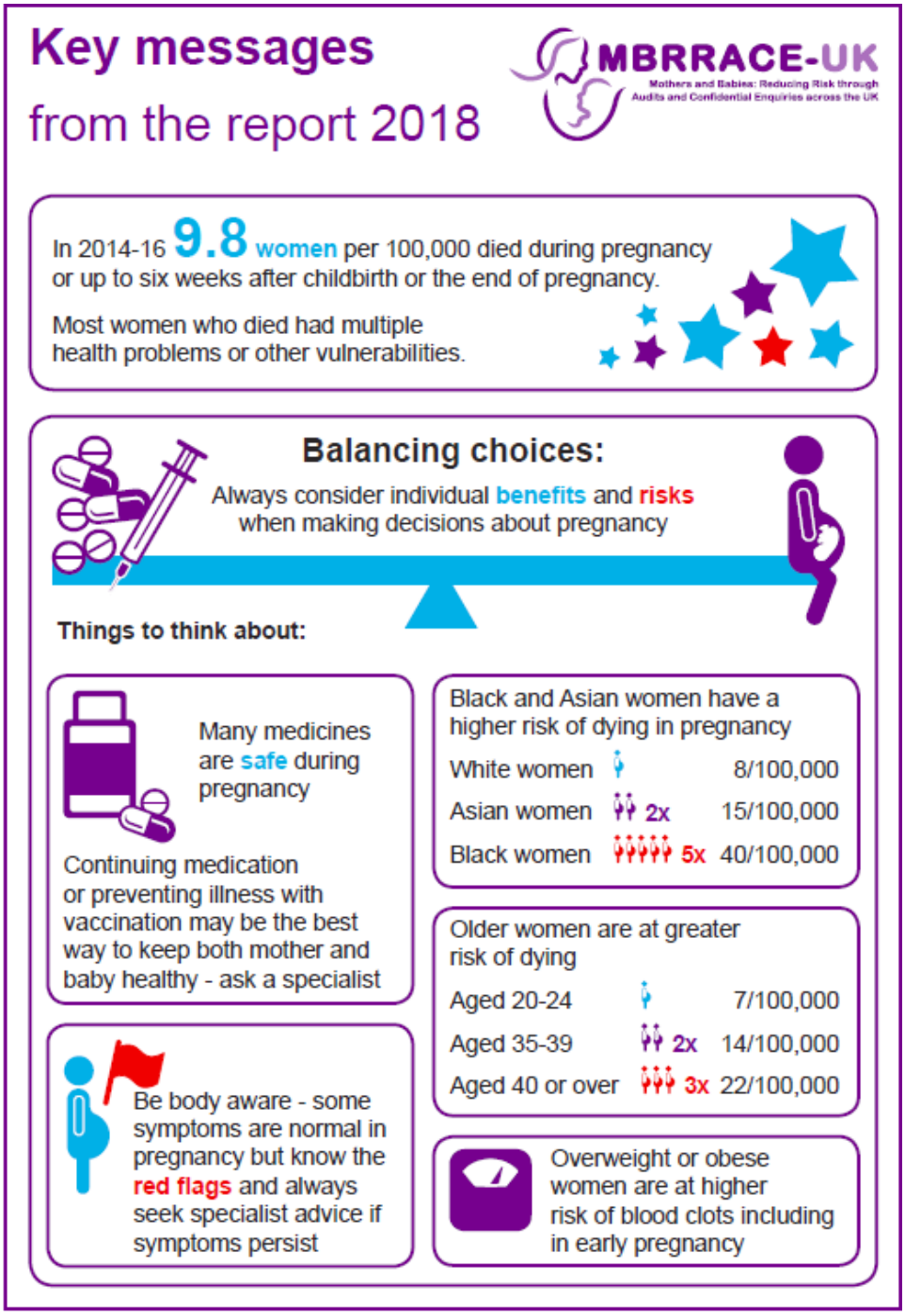
4.Pasha O, McClure EM, Saleem S, Tikmani SS, Lokangaka A, Tshefu A *et al.* **A prospective cause of death classification system for maternal deaths in low and middle-income countries: results from the Global Network Maternal Newborn Health Registry**. *BJOG* 2018, 125(9): 1137-1143

Prospective population based observational study (2014-16)
MMR (diagnostic autopsy) is the optimal method to assign cause of death (COD), yet this is challenging to perform. In 7 low-to middle income countries, COD for maternal death is recorded by the health worker (often untrained in clinical diagnosis). This COD was compared to an algorithm-COD applied by trained registry staff. The algorithm has 9 diagnostic options, and assigns COD according to clinical signs and symptoms. The highest level of agreement between health worker and the algorithm-COD was for hemorrhage and the lowest was for infection. 22 women had COD assigned as anemia by the health worker (not a WHO recognized COD). This study provides insight into the challenges to verify maternal COD.

ACCOMPANIED BY EDITORIAL: Mathai M. **To reduce maternal mortality, we must know and respond to women's personal stories.** *BJOG* 2018, 125(9): 1144

5.Knight M, Nair M, Tuffnell D, Kenyon S, Shakespeare J, Brocklehurst P, Kurinczuk JJ (Eds.) 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 2014–16**. *Oxford: National Perinatal Epidemiology Unit, University of Oxford, 2018*:

Maternal death rates from direct causes in the UK were unchanged in this MBBRACE report 2018. Cardiac disease remains the primary and VTE was the second highest cause of maternal death. Suicide is the leading case of maternal death up to one year postpartum. Despite free health care available in the UK, ethnic disparities were highlighted in this report.



The anesthesiologist can impact mortality and morbidity outcomes

6.McQuaid E, Leffert LR, Bateman BT. **The role of the anesthesiologist in preventing severe maternal morbidity and mortality**. *Clin Obstet Gynecol* 2018, 61(2): 372-386

The role of the obstetric anesthesiologist in crises situations includes airway management, vascular access, blood product administration and transthoracic echocardiography. This excellent and clear review presents updates on difficult airway and pulmonary aspiration, and neuraxial complications including (headache, total spinal, intravascular local anesthesia injection, epidural hematoma, epidural abscess and meningitis.

Maternal Mortality: What Can **#OBAnes** Do?

CARDIOVASCULAR DISEASE

Quick Stats

- Leading cause of maternal death in the US
- Risk Factors for Mortality: Pre-existing disease, substance misuse, African American race
- 15% of presenting patients have no prior conditions

What Can We Do?

- Be an active member of the multidisciplinary team in the perinatal period
- Recognize and respond to symptoms
- Explore the utility of point of care TTE for this patient population

HEMORRHAGE

Quick Stats

- Defined as cumulative blood loss of at least 1000mL or blood loss accompanied by signs/symptoms or hypovolemia within 24 h following the birth process
- Mortality is often deemed preventable
- Structured based team response improves outcomes

What Can We Do?

- Design/implement a stage based hemorrhage plan with other disciplines
- Provide early and aggressive management
- Examine effectiveness of laboratory-guided transfusion for improved maternal outcome

HYPERTENSIVE DISORDERS

Quick Stats

- Sixth leading cause of maternal mortality
- Uncontrolled hypertension is the most important risk factor for stroke in patients with preeclampsia
- Hypertensive crisis and failed airways are more common in women with preeclampsia

What Can We Do?

- Consider developing a Severe Pre-eclampsia-Eclampsia Box with emergency medications
- Use neuraxial analgesia when possible
- Research pathophysiologic mechanisms of disorders and their physiologic effects

VENOUS THROMBOELMBOLISM

Quick Stats

- Cause specific mortality ratio has increased by 50% over the past 20 years
- DVT is 15 times more likely to occur in the postpartum period than in pregnancy
- Thromboprophylaxis is the most important modifiable strategy to reduce death

What Can We Do?

- Collaborate with care team to develop strategies for prophylaxis that do not impede the use of neuraxial analgesia/anesthesia
- Provide invasive monitoring and critical care support when needed
- Investigate the hematologic effects of anticoagulants in pregnancy and postpartum

ANESTHESIA RELATED

Quick Stats

- Most cases occur in cesarean deliveries
- Most airway disasters occur in the peri-extubation period and in the recovery unit
- Often deemed preventable: medication error, miscommunication, inadequate supervision, and inadequate monitoring as root causes

What Can We Do?

- Identify latent safety threats; participate in multidisciplinary performance improvements
- Ensure optimal communication between personnel by using techniques such as check backs and closed loop communication
- Evaluate monitoring strategies and decision tree algorithms for post-partum care

Abir G, Mhyre J. Maternal mortality and the role of the obstetric anesthesiologist. Best Pract Res Clin Anaesthesiol 2017;31:91–105.
McQuaid E, Leffert LR, Bateman BT. The Role of the Anesthesiologist in Preventing Severe Maternal Morbidity and Mortality. Clin Obstet Gynecol 2018.
Hameed AB, Lawton ES, McCain CL, et al. Pregnancy related cardiovascular deaths in California: beyond peripartum cardiomyopathy. Am J Obstet Gynecol 2015;213:379.e1e379.e10
ACOG. reVITALize obstetric data definitions. 2016 [23 December 2016]. Available from: http://www.acog.org/About_ACOG/ACOG_Departments/Patient_Safety_and_Quality_Improvement/reVITALize_Obstetric_Data_Definitions. [Accessed 3/15/2018]
Wilkinson H, Trustees and Medical Advisers. Saving mothers' lives. Reviewing maternal deaths to make motherhood safer: 2006 2008. BJOG 2011;118:1402 3 4.
Creanga AA, Berg CJ, Syverson C, et al. Pregnancy related mortality in the United States, 2006e2010. Obstet Gynecol 2015; 125:5e12.
Mhyre JM, Riesner MN, Polley LS, et al. A series of anesthesia related maternal deaths in Michigan, 1985e2003. Anesthesiology 2007;106:1096e104.

Infographic
@dkatz621

Amniotic fluid embolism

7.Bonnet MP, Zlotnik D, Saucedo M, Chassard D, Bouvier-Colle MH, Deneux-Tharaux C *et al.* **Maternal death due to amniotic fluid embolism: A national study in France**. *Anesth Analg* 2018, 126(1): 175-182

French Maternal Death Review (2007-11)
A review of 36 women with AFE comprising 1:10 maternal deaths in France, 0.95/100, 000 live births. SMFM criteria for AFE are hemodynamic/respiratory compromise, DIC, no fever, and within 30 mins of labor/placental delivery. Only 1/3 women exhibited all 4 SMFM criteria; 1 woman had autopsy consistent with AFE despite the cardiac arrest occurring 4 days postpartum. Collapse was the first sign of AFE in 50% of cases and occurred in all but one case. Importantly, although not an SMFM criteria to diagnose AFE, premonitory signs (neurological signs, fainting, and sense of doom) occurred in three-quarters of the women. This review demonstrates that AFE remains a clinical diagnosis.

Cardiac arrest in pregnancy

8.Zelop CM, Einav S, Mhyre JM, Lipman SS, Arafeh J, Shaw RE *et al.* **Characteristics and outcomes of maternal cardiac arrest: A descriptive analysis of Get with the guidelines data**. *Resuscitation* 2018, 132: 17-20

Quality improvement audit (2000-16)
This audit of a non-mandatory reporting system identified maternal cardiac arrests (n=462) among all in-hospital cardiac arrests in the US. Most arrests, 94%, were witnessed, 31% occurred in the delivery suite, and 32% occurred among women without preexisting conditions. Given the high proportion of witnessed arrests, a surprize finding was that the first identified rhythm was PEA in 51% of cases, and VF in only 7%. ROSC occurred in 74% but only 41% survived to hospital discharge.

9.Zelop CM, Einav S, Mhyre JM, Martin S. **Cardiac arrest during pregnancy: ongoing clinical conundrum**. *Am J Obstet Gynecol* 2018, 219(1): 52-61

This review summarizes etiologies and management of maternal cardiac arrest, with emphasis on modifications in pregnant women: multidisciplinary team, aortocaval compression relief by manual uterine displacement, smaller endotracheal tube, and early neonatal delivery (uterine evacuation) after 4-5 minutes of CPR for improved maternal survival after 20 weeks gestation. Finally the role of medical simulation to optimize management for this rare yet catastrophic event is discussed.

MATERNAL MORBIDITY and CO-MORBIDITIES

Rise in maternal morbidity

10.Fingar KR, Hambrick MM, Heslin KC, Moore JE. **Trends and disparities in delivery hospitalizations involving severe maternal morbidity, 2006-2015: Statistical Brief #243**. *Healthcare Cost and Utilization Project (HCUP) Statistical Briefs* 2006

US Statistical Brief (2006-15)
According to the Healthcare Cost and Utilization Project (HCUP) Statistical Brief, severe maternal morbidity in the US from 2006-15 increased 45%. The most common morbidities were blood transfusion, DIC and hysterectomy. Severe morbidity was highest in women aged >40 years, however at all ages, Black mothers had a 115% higher rate of maternal morbidity and this did not change over time. This Statistical Brief corroborates the concerning rise of maternal morbidities and mortalities reported from other US data sources.

Obstetric triage in a low income country

11.Goodman DM, Srofenyoh EK, Ramaswamy R, Bryce F, Floyd L, Olufolabi A *et al.* **Addressing the third delay: implementing a novel obstetric triage system in Ghana**. *BMJ Glob Health* 2018, 3(2): e000623

Impact study (2012-15)
In Accra Ghana, institutional delivery was encouraged for pregnant women, through a government program supported by Kybele. On arrival to the referral hospital women waited in line on a bench, regardless of disease acuity. An obstetric triage system reduced waiting times for initial triage assessment from median (IQR) 40 min (15-100) to 5 min (2-6) ($p<0.001$) over the 5-year intervention. This enabled rapid triage to identify acute cases.

Cardiovascular disease in pregnancy

12.Owens A, Yang J, Nie L, Lima F, Avila C, Stergiopoulos K. **Neonatal and maternal outcomes in pregnant women with cardiac disease.** J Am Heart Assoc. 2018, 7: e009395

Population database (2000-14)
Outcomes for acquired cardiac disease of pregnancy are less well studied than adult congenital heart disease (ACHD). Pregnancies of women with (n=3871) versus without (n=2, 280, 173) cardiac disease were compared. Among women with cardiac disease, four categories of cardiac disease were presented: valvular heart disease (40%), ACHD (35%), cardiomyopathy (17%), and pulmonary hypertension (8%). The primary outcome, maternal major adverse cardiac events (MACE), occurred in 16% of women with cardiac disease and 0.4% without cardiac disease. Among the four cardiac disease categories, 46% of women with cardiomyopathy, 25% with pulmonary hypertension, 10.1% with valvular heart disease and 6.1% with ACHD had MACE.

13. Silversides C, Grewal J, Mason J, Sermer M, Kiess M, Rychel V *et al*. **Pregnancy outcomes in women with heart disease**. J Am Coll Cardiol 2018, 71(21): 2419-2430

Multi-center prospective observational study (1994-2014)
This study included n=1, 938 women with cardiac disease and pregnancies >20 weeks' gestation. The primary study outcome, adverse cardiac events, occurred in 16% of the women; the most common event being arrhythmias. Most cardiac events occurred antepartum. Arrhythmias were most frequently seen in the 2nd trimester, whereas heart failure was more frequent in the 3rd trimester and postpartum. Over the study period, the incidence of arrhythmias was unchanged, however pulmonary edema became less frequent, attributed to better care. The authors updated their risk index, CARPREG II, using a derivation and a validation set from the study cohort.

14.Regitz-Zagrosek V, Roos-Hesselink JW, Bauersachs J, Blomstrom-Lundqvist C, Cifkova R, De Bonis M *et al.* **2018 ESC Guidelines for the management of cardiovascular diseases during pregnancy**. *Eur Heart J* 2018, 39(34): 3165-3241

These guidelines discuss management of CVD during pregnancy. They are substantial, encompassing the description of the pathologies, the effects of pregnant physiology on CVD, and anesthesia considerations. Important sections presented include arrhythmias and their management, and the medication challenges of mechanical valves during pregnancy. VTE considerations are also discussed. Medications administered to these women are presented with the Level of evidence, specifying the updates since the previous 2011 guidelines. This is a well-referenced valuable resource and a supplementary "Ten Commandments" is provided.

ACCOMPANIED BY SUMMARY: Regitz-Zagrosek V. **'Ten Commandments' of the 2018 ESC Guidelines for the management of cardiovascular diseases during pregnancy**. *Eur Heart J* 2018, 39(35): 3269

Cardiovascular disease after pregnancy

15.Brouwers L, van der Meiden-van Roest AJ, Savelkoul C, Vogelvang TE, Lely AT, Franx A *et al.* **Recurrence of pre-eclampsia and the risk of future hypertension and cardiovascular disease: a systematic review and meta-analysis**. *BJOG* 2018, 125(13): 1642-1654
16.Abbasi J. **To Prevent Cardiovascular Disease, Pay Attention to Pregnancy Complications**. *JAMA* 2018, 320(17): 1741-1743

Systematic review and meta-analysis (22 studies) of the CVD risk for women who experienced pregnancies with recurrent preeclampsia versus women with only one pregnancy complicated by preeclampsia. After recurrent preeclampsia, the risk of heart failure was 3-fold higher, the risk of hypertension and ischemic heart disease was 2-3 fold higher, and the risk of CVA 2-fold higher. An Editorial in JAMA commented on the postpartum cardiac risk for women who had gestational hypertension and preeclampsia. Attention to postpartum cardiac morbidities is an important feature of the ACOG "fourth trimester" bulletin.

ACCOMPANIED BY EDITORIAL: Theilen LH. **Pre-eclampsia and cardiovascular risk: comparing apples with apples**. BJOG 2018, 125(13): 1655

ACCOMPANIED BY VIDEO ABSTRACT: https://vimeo.com/rcog/authorinsights15394

Anemia in pregnancy

17.Daru J, Zamora J, Fernandez-Felix BM, Vogel J, Oladapo OT, Morisaki N *et al.* **Risk of maternal mortality in women with severe anaemia during pregnancy and post partum: a multilevel analysis**. *Lancet Glob Health* 2018, 6(5): e548-e554
18.Pasricha S-R, Colman K, Centeno-Tablante E, Garcia-Casal M-N, Peña-Rosas J-P. **Revisiting WHO haemoglobin thresholds to define anaemia in clinical medicine and public health**. *The Lancet Haematology* 2018, 5(2): e60-e62

WHO multinational cross-sectional survey (2010-11)
Severe anemia may contribute to maternal morbidity and mortality, however among antenatal interventions, anemia management is not a priority. This survey was performed across 29 countries using a multistage cluster-sampling strategy detailed in the manuscript (n=12, 470). Women were more likely to die if suffering severe anemia (Hb<7g/dl), adjusted OR 2.36 95%CI 1.60 to 3.48. This relationship between death and severe anemia was strengthened when PPH was removed from the model, OR 4.58 95%CI 2.87 to 7.31. This paper highlights that antenatal anemia management should be a priority in pregnant women. A commentary in another *Lancet* journal discussed the need to update hemoglobin threshold definitions for anemia, because current thresholds (>11 = not anemic; <7 severe anemia) were coined over 50 years ago.

ACCOMPANIED BY EDITORIAL: Young MF. **Maternal anaemia and risk of mortality: a call for action**. *The Lancet Global Health* 2018, 6(5): e479-e480

Cancer in pregnancy

19.de Haan J, Verheecke M, Van Calsteren K, Van Calster B, Shmakov RG, Mhallem Gziri M *et al.* **Oncological management and obstetric and neonatal outcomes for women diagnosed with cancer during pregnancy: a 20-year international cohort study of 1170 patients**. *The Lancet Oncology* 2018, 19(3): 337-346

Multi-national registry (1996-2016)
This study describes obstetric, oncological and neonatal data from an international registry (16 countries, 37 centers) of pregnant women with cancer (n=1170); breast cancer was the most common malignancy. Treatment (chemotherapy and/or surgery) was administered to 67% of pregnant women. Platinum-based and taxane chemotherapy were associated with IUGR and NICU admission respectively. The frequency of fetal malformations was similar to that in the general population. Over the 20-year period chemotherapy was increasingly used during pregnancy for women with cancer, and the live-birth rate increased. Need for NICU admission appears to depend on the

malignancy type. Preterm birth decreased over the study period, attributed to decreased induced early labor. The accompanying Editorial highlights selection bias of women reported to the registry and that oncologic management guidelines cannot be construed from these data.

ACCOMPANIED BY EDITORIAL: Köhler C, Marnitz S. **Cancer in pregnancy: evidence, or still empiricism?** *The Lancet Oncology* 2018, 19(3): 272-274

Diagnosing sleep apnea in extremely obese pregnant women

20.Dominguez JE, Grotegut CA, Cooter M, Krystal AD, Habib AS. **Screening extremely obese pregnant women for obstructive sleep apnea**. *Am J Obstet Gynecol* 2018, 219(6): 613 e611-613 e610

Single-center prospective study (2015-17)
This study aimed to evaluate OSA screening questionnaires in extremely obese pregnant women (n=80). Women with BMI≥40kg/m^2 completed a home sleep test and AHI≥5 events per hour was considered as OSA. Nineteen (24%) extremely obese women had OSA diagnosed using the home sleep test. Questionnaires were not useful to screen for OSA in this extremely obese pregnant population, thus alternative screening strategies are required.

Thrombocytopenia <100, 000 is not gestational

21.Reese JA, Peck JD, Deschamps DR, McIntosh JJ, Knudtson EJ, Terrell DR *et al.* **Platelet counts during pregnancy**. *N Engl J Med* 2018, 379(1): 32-43

Single-center retrospective study (1999-2012)
The occurrence and severity of gestational thrombocytopenia are not known. Women with at least two CBC performed during pregnancy (n=7351) were identified: uncomplicated pregnancies (n=4568), pregnancy complications (n=2586) and preexisting diseases predisposing to thrombocytopenia (n=197). The women with uncomplicated pregnancies were further compared to non-pregnant patients (n=8885). The incidence of platelet count <100,000 per cubic millimeter at any period during pregnancy or labor was 1% in women with uncomplicated pregnancy, 2.3% in women with pregnancy complications, and 18.2% in women with preexisting thrombocytopenia. The incidence of platelet count <80,000 per cubic millimeter at any time during pregnancy or labor was 0.26% in women with uncomplicated pregnancy, 1.2% in women with pregnancy complications, and 9.65% in women with preexisting thrombocytopenia. In most women with uncomplicated pregnancies who had thrombocytopenia of <100,000, this chart review found an alternate reason for thrombocytopenia.

IVF and maternal morbidity

22.Cromi A, Marconi N, Casarin J, Cominotti S, Pinelli C, Riccardi M *et al.* **Maternal intra- and postpartum near-miss following assisted reproductive technology: a retrospective study**. *BJOG* 2018, 125(12): 1569-1578

Prospective cohort study (2005-16)
Women with ART (n=650) were compared to women without ART (22, 803). The frequencies of WHO-defined outcomes: potentially life threatening events; and near misses were significantly higher among women with ART, 27.1% versus 5.7% without; and 2.6 with ART versus 0.3% without respectively. Even after adjusting for confounders including maternal age, multiple gestation, parity and medical comorbidities, ART remained a significant contributor to these outcomes. There were many unknown confounders, however use of a prospective database allowed identification of conditions associated with the primary outcomes that cannot be identified in a population database using ICD-9 codes.

Fathers are involved too

23.Khandwala YS, Baker VL, Shaw GM, Stevenson DK, Lu Y, Eisenberg ML. **Association of paternal age with perinatal outcomes between 2007 and 2016 in the United States: population based cohort study**. *BMJ* 2018, 363: k4372

Retrospective population study (2007-16)
Advanced maternal age has reported associations with adverse maternal and neonatal outcomes. In a population of over 40 million births in the US, fathers aged 45 and older had a 14% increased likelihood that their offspring delivered preterm and the mother had an increased risk of gestational diabetes but not preeclampsia or eclampsia. Analyses were adjusted for the unsurprising collinearity between maternal and paternal age.

Anesthesiologists can impact maternal and neonatal outcomes

24.Lim G, Facco FL, Nathan N, Waters JH, Wong CA, Eltzschig HK. **A review of the impact of Obstetric Anesthesia on maternal and neonatal outcomes**. *Anesthesiology* 2018, 129(1): 192-215

This fantastic thoroughly referenced review updates the reader on labor analgesia and best practice in all areas of anesthesiology involved in the labor process, from labor outcomes, anesthesia interventions for ECV, aspiration risks, CD anesthesia, to postpartum pain and analgesic effects on the fetus, breastfeeding, and depression. The impact of anesthesiology practices on maternal morbidity and mortality are discussed. This is a highly recommended update for contemporary practice of Obstetric Anesthesia.

HYPERTENSIVE DISORDERS of PREGNANCY

International guidelines for hypertensive disorders in pregnancy

25.Brown MA, Magee LA, Kenny LC, Karumanchi SA, McCarthy FP, Saito S *et al.* **Hypertensive disorders of pregnancy: ISSHP classification, diagnosis, and management recommendations for international practice**. *Hypertension* 2018, 72(1): 24-43

Practice recommendations from the International Society for the Study of Hypertension in Pregnancy that summarize the latest clinical practice guidelines. A great repository of acknowledged information and a very useful source. There are several visual aids, including management of hypertensive crisis, classifications of hypertensive disorders of pregnancy and definitions of preeclampsia, and BP follow-up recommendations for postnatal care.

Hypertension treatment in pregnancy

26.Cleary KL, Siddiq Z, Ananth CV, Wright JD, Too G, D'Alton ME *et al.* **Use of antihypertensive medications during delivery hospitalizations complicated by preeclampsia**. *Obstet Gynecol* 2018, 131(3): 441-450

Insurance company database (2006-15)
High blood pressure should be treated during pregnancy to optimize maternal outcomes. The use of antihypertensives among women with preeclampsia (all severities) was investigated during delivery hospitalizations. Among 239,454 women with preeclampsia, 105,409 received an antihypertensive. The most important finding was a decrease in risk of pregnancy associated stroke, contemporaneous to increased antihypertensive use. The range of antihypertensive drugs used included labetalol (oral and IV), hydralazine, nifedipine, and multiple agents. The authors presume that the 2013 ACOG guidelines encouraged use of antihypertensives but noted that the changes predate these.

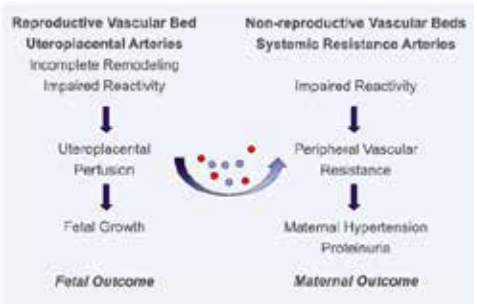
Postpartum stroke occurs among women without hypertensive disorders of pregnancy

27.Too G, Wen T, Boehme AK, Miller EC, Leffert LR, Attenello FJ *et al.* **Timing and Risk Factors of Postpartum Stroke**. *Obstet Gynecol* 2018, 131(1): 70-78

Population database (2013 & 2014, Jan–Oct)
This study identified 1, 505 readmissions within 60 days for postpartum stroke. Most readmissions occurred within 10 days. The risk of postpartum stroke readmission was 24/100, 000 deliveries. An important finding was that only 19% of postpartum strokes occurred in women with known pregnancy associated hypertension.

What's new in preeclampsia?

28.Editors. **Hypertension editors' picks: Preeclampsia, pregnancy, and hypertension.** *Hypertension* 2018, 72(1): e1-e18



The July 2018 issue of *Hypertension* was dedicated to pregnancy, blood pressure and preeclampsia. The issue summarized an array of original articles published in *Hypertension* since 2016 that include the diverse proposed mechanisms, management strategies, disease patterns, subsequent morbidities following pregnancy with preeclampsia, and the elusive hunt for a biomarker or algorithms to reliably predict preeclampsia. The different topics covered are illustrated in the infographic.

Can we predict preeclampsia?

29.Euliano TY, Michalopoulos K, Singh S, Gregg AR, Del Rio M, Vasilopoulos T *et al.* **Photoplethysmography and Heart Rate Variability for the Diagnosis of Preeclampsia**. *Anesth Analg* 2018, 126(3): 913-919

Single-center observational study (dates not reported)
This small study used changes seen in ECG and pulse oximetry waveforms to identify features that may be consistent with preeclampsia. Their model was derived from women with severe preeclampsia (n=37), women with hypertension (n=28) and normotensive women (n=43). Their proposed model had a PPV 0.993 and false-positive rate 0.101. Although no reliable predictor of hypertension and preeclampsia has yet been identified, this study could generate interesting future research and may be useful in lower resource settings.

30.Cerdeira AS, Agrawal S, Staff AC, Redman CW, Vatish M. **Angiogenic factors: potential to change clinical practice in pre-eclampsia?** *BJOG* 2018, 125(11): 1389-1395

This review article discusses angiogenic factors that may be used to predict preeclampsia and an angiogenic state. Measurable angiogenic biomarkers may enter maternal circulation, for example sFlt-1, PlGF, and soluble Endoglin. Clinical biochemistry panels measuring sFlt-1 and free PlGF can reliably exclude preeclampsia (specificity 99%), however positive predictive values are low. It is now 15 years after the

landmark paper (Karumanchi SA; 2003) that first outlined the relationship between the anti-angiogenic sFlt1 and the onset of preeclampsia. This huge leap in understanding has not yet changed clinical practice. This excellent review provides a clear and comprehensive review of the current status of these potential biomarkers in the detection, or prediction of preeclampsia.

ACCOMPANIED BY EDITORIAL: Karumanchi SA. **Angiogenic factors in pre-eclampsia: implications for clinical practice**. *BJOG* 2018, 125(11): 1396

Genetics and preeclampsia

31.Gray KJ, Kovacheva VP, Mirzakhani H, Bjonnes AC, Almoguera B, DeWan AT *et al.* **Gene-Centric Analysis of Preeclampsia Identifies Maternal Association at PLEKHG1**. *Hypertension* 2018, 72(2): 408-416

Multi-national gene-centric case-control study (dates not reported)
The genetic disposition for preeclampsia was investigated among women of European origin with preeclampsia (n=498) and normotensive women (n=1864) from 5 sites in the US. Genetic samples were genotyped according to known cardiovascular genes. One large gene locus, PLEHG1 was identified as a focus for future research. This may be of interest for researchers seeking a genetic predisposition to preeclampsia.

32.Gray KJ, Saxena R, Karumanchi SA. **Genetic predisposition to preeclampsia is conferred by fetal DNA variants near FLT1, a gene involved in the regulation of angiogenesis**. *Am J Obstet Gynecol* 2018, 218(2): 211-218

This review presents some genetic characteristics associated with preeclampsia, such as variants in the Flt-1 focus in the fetus. This is an excellent summary, and provides a good basis to understand future developments in the search for a genetic predisposition to preeclampsia.

Updates in genetics (back to medical school)

33.**ACOG technology assessment in Obstetrics and Gynecology No. 14: Modern Genetics in Obstetrics and Gynecology**. *Obstet Gynecol* 2018, 132(3): e143-e168

ACOG have provided this summary of modern genetics for clinicians caring for women. Although it is primarily intended as a tool to enable counselling and to understand updated concepts, this document explains genetic terminology and models that may relate to preeclampsia and other diseases, in a clear manner.

The brain and the placenta

34.Ciampa E, Li Y, Dillon S, Lecarpentier E, Sorabella L, Libermann TA *et al.* **Cerebrospinal fluid protein changes in preeclampsia**. *Hypertension* 2018, 72(1): 219-226

Single-center prospective observational study (dates not reported)
Data were obtained from CSF in 14 preeclamptic and 14 control women at the time of spinal anesthesia for CD. None of the women had eclampsia. The study used SOMAscan, a proteomic test capable of capturing >1300 proteins from a biological sample for quantitative analysis at a wide range of concentrations. Data are presented as heat maps. Disregarding the huge number of proteins and the small number of subjects, this novel study presents a possible window into the CNS manifestations of preeclampsia. In current clinical practice we lack access to the CSF until performing neuraxial block for CD or labor analgesia, thus limiting the time-window for access to CSF.

ACCOMPANIED BY EDITORIAL: Staff AC, Dechend R. **Preeclampsia: What does the brain tell us? Can we blame the eclampsia risk on a malperfused placenta?** *Hypertension* 2018, 72(1): 65-67

Phenotypes of hypertensive disorders of pregnancy

35.Ferrazzi E, Stampalija T, Monasta L, Di Martino D, Vonck S, Gyselaers W. **Maternal hemodynamics: a method to classify hypertensive disorders of pregnancy**. *Am J Obstet Gynecol* 2018, 218(1): 124 e121-124 e111

Single-center cohort study (secondary analysis) (2009-13)
Maternal CO is typically decreased in early-onset preeclampsia and often associated with poor placentation and IUGR. Conversely in late-onset preeclampsia, CO is typically higher. Women with new onset hypertension (>20 weeks pregnancy) were investigated using bioimpedance cardiac output measurements in the standing position. Hypertensive women were classified according to AGA (n=142) and IUGR (n=41), and a normotensive group (n=33) acted as controls. The primary study outcome was maternal hemodynamics according to AGA and IUGR phenotypes. CO was significantly reduced and TPR was significantly higher for women with IUGR versus AGA, while BP was similar. The authors speculate that women with AGA and IUGR have different hemodynamics; the former having low CO and high TPR while the latter have the opposite. The different phenotypes may require different management strategies.

36.McLaughlin K, Scholten RR, Kingdom JC, Floras JS, Parker JD. **Should maternal hemodynamics guide antihypertensive therapy in preeclampsia?** *Hypertension* 2018, 71(4): 550-556

Not all preeclampsia has the same phenotype. This review discusses the rationale for hemodynamic guided management for women with preeclampsia according to different phenotypes: high TPR/low CO and low TPR/high CO. Some evidence for this differentiation in management strategies is presented, although further research in this area of preeclampsia management according to phenotype is required.

VENOUS THROMBOEMBOLISM

Diagnostic paradigm for pulmonary embolus

37.Righini M, Robert-Ebadi H, Elias A, Sanchez O, Le Moigne E, Schmidt J *et al.* **Diagnosis of pulmonary embolism during pregnancy: A multicenter prospective management outcome study**. *Ann Intern Med* 2018, 169(11): 766-773

Multicenter European multinational prospective study (2008-16)
Validated models to diagnose PE have excluded pregnant women, therefore specific and sensitive tests to confirm PE in pregnancy are lacking. D-dimer is not currently recommended to diagnose PE due to unreliability in pregnant women. This study screened all pregnant women (n=395) with acute onset or worsening SOB/chest pain of unknown cause, for suspected PE. Women with low/intermediate risk score (using the Geneva score) and negative D-dimer (<500 mcg/L) were defined as negative for PE, were excluded from further testing, and did not receive anticoagulant therapy. Women with high pretest probability or positive D-dimer underwent sequential tests for PE. Bilateral compression leg ultrasound was the first test performed, and if negative, a CTPA was performed, and if inconclusive a lung V/Q scan was performed. The primary outcome, VTE risk for women with low pretest probability for PE, was 0.0% (95%CI 0.0% to 1.0%). The authors suggest starting with the Geneva score and D-dimer test for women identified with clinical suspicion for PE, to eliminate women without PE. High risk women should undergo sequential diagnostic tests for PE. This study is notable for the use of D-dimer in pregnancy to exclude women with clinical suspicion for PE. Future research should evaluate standardized combinations of clinical patterns with sequential tests to reliably exclude or diagnose PE.

ACCOMPANIED BY EDITORIAL: Valente AM, Economy KE. **Diagnosing pulmonary embolism during pregnancy: Which test is best?** *Ann Intern Med* 2018, 169(11): 810-811

SOAP consensus statement for venous thromboembolism prophylaxis

38.Leffert L, Butwick A, Carvalho B, Arendt K, Bates SM, Friedman A *et al.* **The Society for Obstetric Anesthesia and Perinatology Consensus Statement on the anesthetic management of pregnant and postpartum women receiving thromboprophylaxis or higher dose anticoagulants**. *Anesth Analg* 2018, 126(3): 928-944

Venous thromboembolism in pregnancy

39.**ACOG Practice Bulletin No. 196: Thromboembolism in pregnancy**. *Obstet Gynecol* 2018, 132(1): e1-e17
ACOG Practice Bulletin No.196: **Thromboembolism in pregnancy: Correction.** *Obstet Gynecol* 2018,132(4):1068

Use of LWMH for VTE prophylaxis is increasingly used for pregnant women. These SOAP guidelines emphasize early assessment of women receiving VTE prophylaxis to enable timely decisions regarding neuraxial block for labor and delivery. Prophylactic doses (≤40 mg od or 30 mg bd) should be stopped 12 hours prior to performing a block; therapeutic doses require a 24 hour stopping period. A 4-6 hour waiting period is recommended after UFH 5000 U SQ bd (previously there was no waiting period). Risk assessment according to 36 experts' opinions of clinical scenarios are presented in the guidelines. Over 75% would perform neuraxial block within 6 hours of UFH 5000U SQ dose, but barely 10% would perform labor epidural within 10 hours of 60 mg od LMWH heparin dose.

ACCOMPANIED BY EDITORIAL: Banayan JM, Scavone BM, Mhyre JM. **Consensus statement on pregnant women receiving thromboprophylaxis: An essential tool to guide our management**. *Anesth Analg* 2018, 126(3): 754-756

40.Horlocker TT, Vandermeuelen E, Kopp SL, Gogarten W, Leffert LR, Benzon HT. **Regional anesthesia in the patient receiving antithrombotic or thrombolytic therapy: American Society of Regional Anesthesia and Pain Medicine evidence-based guidelines (Fourth Edition)**. *Reg Anesth Pain Med* 2018, 43(3): 263-309

These revised guidelines present anticoagulants and management considerations for regional and neuraxial blocks. The guidelines report the very low risk of SEH in the obstetric population; the increased use of VTE prophylaxis; and the protective effect of hypercoagulability in pregnancy. Section 15.2 specifically states that the risk of general anesthesia required in light of the ASRA guidelines may be higher than potential risks of SEH. Thus ASRA guidelines may be modified by clinical necessity to enable neuraxial block in the obstetric population.

41.Ducloy-Bouthors AS, Baldini A, Abdul-Kadir R, Nizard J, for the ESA VTE Guildeines Taskforce. **European guidelines on perioperative venous thromboembolism prophylaxis: Surgery during pregnancy and the immediate postpartum period**. *Eur J Anaesthesiol* 2018, 35(2): 130-133
42.Afshari A, Ageno W, Ahmed A, Duranteau J, Faraoni D, Kozek-Langenecker S *et al.* **European Guidelines on perioperative venous thromboembolism prophylaxis: Executive summary**. *Eur J Anaesthesiol* 2018, 35(2): 77-83

This document is one of ten guidelines for VTE prophylaxis revised in 2018 by the ESA. This guideline focuses on recommendations for women undergoing surgery during and after pregnancy. The ESA recommend that all women undergoing non-obstetric surgery during pregnancy receive VTE prophylaxis until fully mobile (Grade 1C). They recommend that all women undergoing CD (except low risk women undergoing elective CD) receive VTE prophylaxis (duration depends on risk), Grade 2C evidence. 2015 RCOG guidelines recommend that women without VTE history and 2 minor risk factors be *considered* for prophylaxis; and 2018 ACOG guidelines recommend surveillance for low risk women.

ANAPHYLAXIS in PREGNANCY

43.McCall SJ, Bunch KJ, Brocklehurst P, D'Arcy R, Hinshaw K, Kurinczuk JJ *et al.* **The incidence, characteristics, management and outcomes of anaphylaxis in pregnancy: a population-based descriptive study**. *BJOG* 2018, 125(8): 965-971

44. **Overdiagnosis of penicillin allergy leads to costly, inappropriate treatment.** *JAMA* 2018, 320(18): 1846-1848

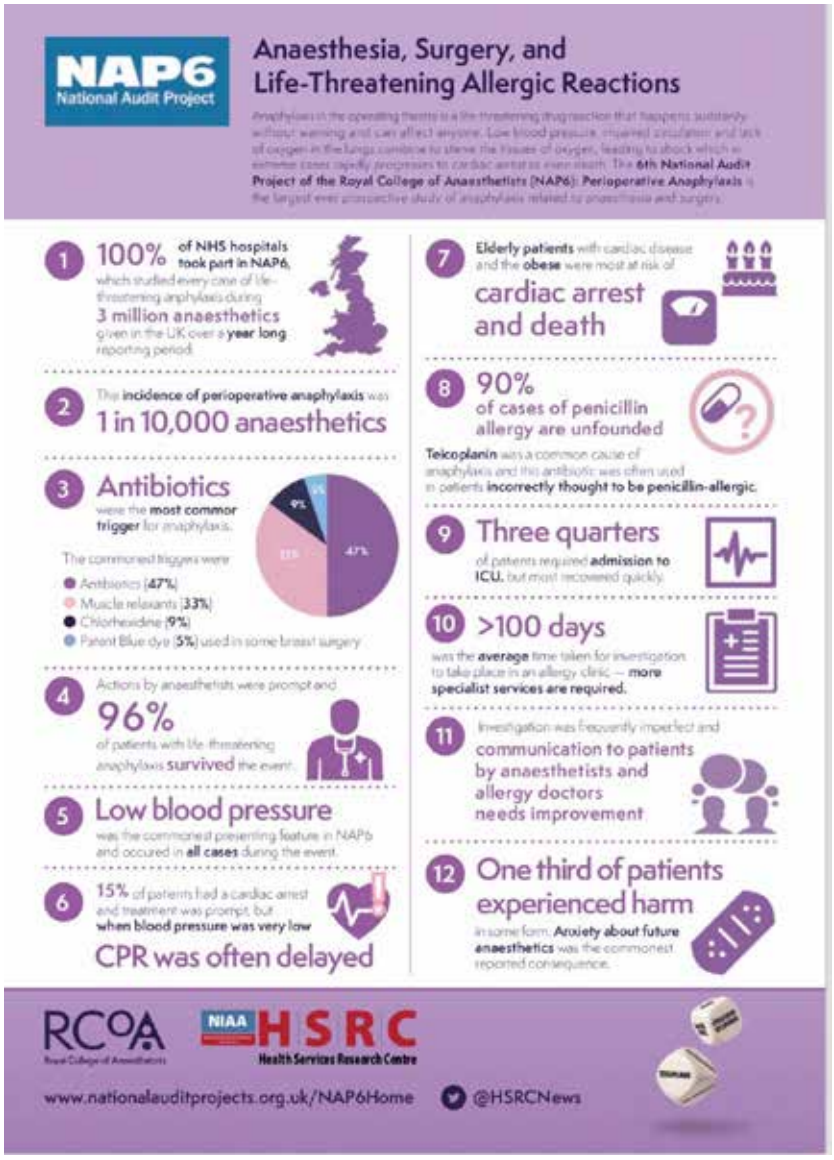
Population-based study (2012-15)
Using a reporting system (UKOSS), 37 cases of anaphylaxis among pregnant women were identified. Ten women had reported penicillin allergy, and 12 women had a reaction to the antibiotic given during the CD. Two of the anaphylaxis cases related to antibiotics were in women with known penicillin allergy. An opinion piece in JAMA reported that 10% of patients are labelled as penicillin allergic but the vast majority are actually not allergic. Since alternatives to penicillin are associated with higher SSI rates, this issue is becoming increasingly important. However, obstetric anesthesiologists may hesitate to test whether a woman is truly penicillin allergic at the time of a CD given the risk of anaphylaxis.

ACCOMPANIED BY EDITORIAL: Eschenbach DA. Obstetricians' awareness associated with better outcomes. *BJOG* 2018, 125(8): 972

No obstetric anaphylaxis cases attributed to antibiotics in the NAP-6 audit

45.Harper NJN, Cook TM, Garcez T, Farmer L, Floss K, Marinho S *et al.* **Anaesthesia, surgery, and life-threatening allergic reactions: epidemiology and clinical features of perioperative anaphylaxis in the 6th National Audit Project (NAP6)**. *Br J Anaesth* 2018, 121(1): 159-171

National audit project (2016)
Chapter 20 of this UK audit of anaphylaxis during surgery specifically discusses obstetric patients and reports a rate of 1.6 per 100, 000 maternities. Among the eight obstetric cases with severe anaphylaxis, six occurred during CD and of the four cases with an identified trigger, none were caused by antibiotics. Although antibiotics were the most frequent cause of anaphylaxis in the NAP-6 report, 90% of the suspected cases of penicillin anaphylaxis were unfounded once testing was done.



INFECTION and ANTIBIOTICS

Infection and antibiotics for cesarean delivery

46.**ACOG Practice Bulletin No. 199: Use of prophylactic antibiotics in labor and delivery**. *Obstet Gynecol* 2018, 132(3): e103-e119

This bulletin outlines recommended antibiotic prophylaxis (not treatment) for laboring women. All women undergoing CD should receive optimally a first generation cephalosporin (1G up to 80 kg, 2G up to 120 and 3G >120 kg) within 60 mins prior to skin incision, and azithromycin should be added to standard regimen if CD is urgent. Women with known penicillin allergy should receive clindamycin plus aminoglycoside.

47.Kawakita T, Huang CC, Landy HJ. **Choice of prophylactic antibiotics and surgical site infections after cesarean delivery**. *Obstet Gynecol* 2018, 132(4): 948-955

Single-center retrospective study (2012-17)
Antibiotics have enabled a reduction in wound complications. Women who received first generation cephalosporin (n=6163) were compared to women who received non-cephalosporin (n=421) antibiotics for CD. Use of non-cephalosporin antibiotics was associated with increased odds of SSI. In addition, use of non-ACOG recommended alternative to cephalosporins further increased the odds of SSI. Women who are penicillin allergic should be thoroughly queried, as use of a non-beta-lactam alternative antibiotic is associated with increased SSI rates.

48.Hermanides J, Lemkes BA, Prins JM, Hollmann MW, Terreehorst I. **Presumed beta-lactam allergy and cross-reactivity in the operating theater: A practical approach**. *Anesthesiology* 2018, 129(2): 335-342

This review summarizes the differences between beta-lactams and the most commonly used alternatives. Cephalosporins have a cross-reactivity with penicillin of around 5.5%. Concerns of anaphylaxis leads to administration of non beta-lactam alternatives such as clindamycin, potentially leading to SSI and Clostridium Difficile. A suggested algorithm is presented in the manuscript for anesthesiologists faced with a patient with suspected or known penicillin sensitivity, and in most cases cefazolin may be administered.

Rise of Clostridium Difficile in obstetric patients

49.Ruiter-Ligeti J, Vincent S, Czuzoj-Shulman N, Abenhaim HA. **Risk factors, incidence, and morbidity associated with obstetric Clostridium Difficile infection**. *Obstet Gynecol* 2018, 131(2): 387-391

Population database (1999-2013)
Antibiotics are administered in labor and delivery to decrease infections, however they may increase the risk of Clostridium Difficile. All women with a birth registered in the NIS with an ICD-9 code for Clostridium difficile were identified (n=2757) and compared to women without a recorded Clostridium Difficile code. The frequency of Clostridium Difficile has increased over the past 15 years among pregnant women.

Vaginal antiseptic preparation prior to cesarean delivery

50.Haas DM, Morgan S, Contreras K, Enders S. **Vaginal preparation with antiseptic solution before cesarean section for preventing postoperative infections**. *Cochrane Database Syst Rev* 2018, 7: CD007892

This updated Cochrane review included 11 trials that evaluated whether vaginal cleaning was associated with lower post-CD infectious morbidity (n=3403). The stronger evidence in this updated review show that vaginal cleansing with antiseptic solutions prior to CD likely reduces the incidence of endometritis. This effect seems to be greater in women who undergo CD after ruptured membranes in labor. Currently neither chlorhexidine nor iodine appear to have superiority.

NEONATAL OUTCOMES

Are maternal medications safe for the fetus?

51.Berard A, Sheehy O, Girard S, Zhao JP, Bernatsky S. **Risk of preterm birth following late pregnancy exposure to NSAIDs or COX-2 inhibitors**. *Pain* 2018, 159(5): 948-955

Population database (1998-2009)
This Canadian cohort study investigated the relationship between premature births, and NSAID and COX-2 inhibitor exposure in the 3 months prior delivery. 156, 531 pregnancies were analyzed: 448 (0.3%) women received NSAIDS/COX-2; naproxen n=215, ibuprofen n=129 were the most frequent. 11, 087 (7%) pregnancies had premature birth; 51 (11%) in the NSAID/COX-2 exposed versus 11, 036 (7%) unexposed pregnancies. After adjustment for confounders (social factors, comorbidities, maternal autoimmune disease), only COX-2 inhibitor use during late pregnancy was associated with a 2-fold increased risk of prematurity, especially celecoxib (OR 3.18, 95% CI 1.64-6.15).

52.Huybrechts KF, Hernandez-Diaz S, Straub L, Gray KJ, Zhu Y, Patorno E *et al.* **Association of maternal first-trimester ondansetron use with cardiac malformations and oral clefts in offspring**. *JAMA* 2018, 320(23): 2429-2437

Population database (2000-12)
Ondansetron may be used in pregnancy, and evidence regarding potential congenital malformations is contradictory. Among 1, 816, 414 pregnant women, 88, 467, 4.9% were exposed to ondansetron in the first trimester and the risk of congenital malformations per 10, 000 births were compared to unexposed pregnancies. The risks for cardiac malformations were similar for exposed and unexposed women. A small increased risk of oral clefts, corresponding to 5 additional cases per 10, 000 exposed births, was noted.

ACCOMPANIED BY EDITORIAL: Haas DM. **Helping pregnant women and clinicians understand the risk of ondansetron for nausea and vomiting during pregnancy**. *JAMA* 2018, 320(23): 2425-2426

53.**ACOG Practice Bulletin No. 189: Nausea And vomiting of pregnancy**. *Obstet Gynecol* 2018, 131(1): e15-e30

This ACOG Bulletin presents effective pharmacologic therapies including ondansetron, phenothiazines for nausea and vomiting during pregnancy. Use of antiemetics seems to be increasing in pregnant women. Insufficient data exist regarding the safety of ondansetron, and women should consider use before 10 weeks only if essential. Ginger is a useful non-pharmacological option.

54.Bateman BT, Heide-Jorgensen U, Einarsdottir K, Engeland A, Furu K, Gissler M *et al.* **Beta-blocker use in pregnancy and the risk for congenital malformations: An international cohort study**. *Ann Intern Med* 2018, 169(10): 665-673

Population databases (Nordic cohort 1996-2010; US cohort 2000-10)
This population database investigated a Nordic and a US cohort, to examine associations between first-trimester β -blocker use and neonatal outcomes including cardiac defects, oral clefts and CNS malformations 1 year after birth. Hypertensive pregnancies with β -blocker exposure versus no antihypertensive drug exposure were examined in the first trimester. A total of 682 (19%) in the Nordic and 1668 (11%) in the US cohort were exposed to β -blockers during pregnancy. The pooled adjusted relative risk (RR) and risk difference (RD) per 1000 persons exposed associated with β-blockers were 1.07 (95% CI, 0.89 to 1.30) and 3.0 (CI, -6.6 to 12.6), respectively, for any major malformation. This suggests that the RR increase for congenital malformations is more modest than previous studies suggested. The accompanying Editorial reiterates that β -blockers should be used in pregnancy as maternal health is vital to fetal health, and untreated hypertension can cause fetal abnormalities.

ACCOMPANIED BY EDITORIAL: Ray JG. **To beta or not to beta? Very likely OK to beta**. *Ann Intern Med* 2018, 169(10): 718

Effects of anesthesia agents on the developing brain: monkey business

55.Raper J, De Biasio JC, Murphy KL, Alvarado MC, Baxter MG. **Persistent alteration in behavioural reactivity to a mild social stressor in rhesus monkeys repeatedly exposed to sevoflurane in infancy**. *Br J Anaesth* 2018, 120(4): 761-767
56.Jevtovic-Todorovic V. **Exposure of developing brain to general anesthesia: what is the animal evidence?** *Anesthesiology* 2018, 128(4): 832-839)

Observational study in primates
Parents may be concerned about the effects of anesthetics on their young children, given the strong evidence in rats of apoptosis and in primates of behavioral disturbances. Monkeys exposed to 3 sevoflurane anesthetics were compared to monkeys separated 3 times from their mother at 2 week intervals from aged 7 days. After 1-2 years monkeys exposed to sevoflurane exhibited similar characteristics except for subtle behavioral changes. The results of the "GAS study" (due in 2019) may establish whether short anesthetic exposure at a young age is safe in young children regarding long term behavioral outcomes.

ACCOMPANIED BY EDITORIAL: Vutskits L, Sneyd JR. **Quest for new drugs: a way to solve anaesthesia neurotoxicity?** *Br J Anaesth* 2018, 120(4): 619-621

Stillbirth subsequent pregnancy outcomes

57.Gravensteen IK, Jacobsen EM, Sandset PM, Helgadottir LB, Radestad I, Sandvik L *et al.* **Healthcare utilisation, induced labour and caesarean section in the pregnancy after stillbirth: a prospective study**. *BJOG* 2018, 125(2): 202-210

Nationwide population cohort study (1999-2008)
Women after stillbirth (n=174), and 2 reference groups: women after live-birth (n=362) and women nulliparous at the birth (n=365) were investigated for healthcare utilization, induced labor and CD. Women after stillbirth had more antenatal visits, ultrasound scans and hospital admissions. Induced labor and CD were more frequent among women after a previous stillbirth. Fear of childbirth was also a significant concern for women after stillbirth. Anesthesiologists have an opportunity to support women during this sensitive time of delivery after a previous stillbirth.

ACCOMPANIED BY EDITORIAL: Silver RM, Siassakos D,Dudley DJ. **Pregnancy after stillbirth: anxiety and a whole lot more.** *BJOG* 2018, 125(2): 211

Fetal cardiotocography does not predict poor neonatal outcomes

58.Frey HA, Liu X, Lynch CD, Musindi W, Samuels P, Rood KM *et al.* **An evaluation of fetal heart rate characteristics associated with neonatal encephalopathy: a case-control study**. *BJOG* 2018, 125(11): 1480-1487

Retrospective case-control study (2006-15)

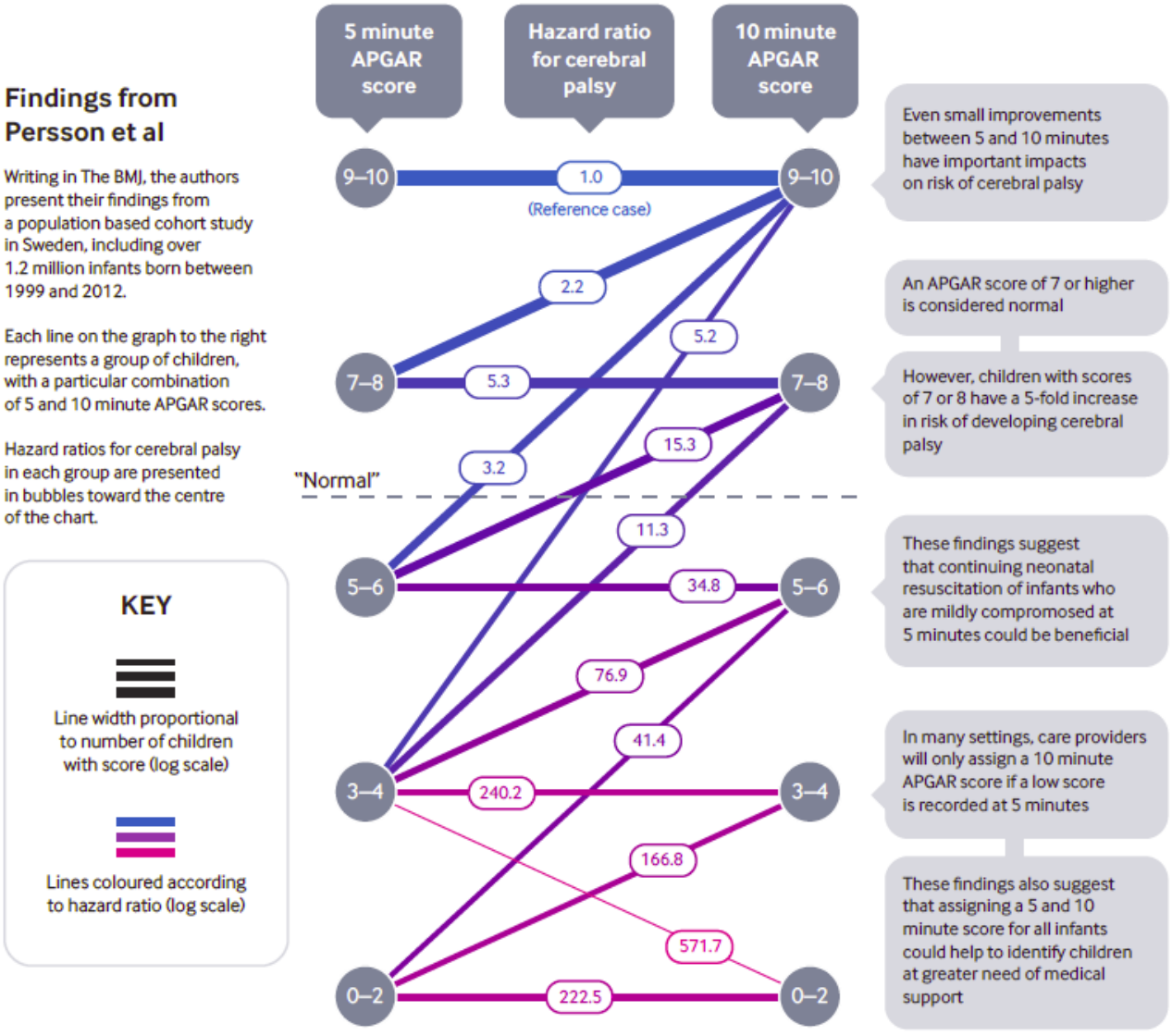
Continuous FHR monitoring tracings during the 30 mins prior to delivery were classified as Category I, II and III according to ACOG guidelines. Newborns with NE (n= 109) were compared to normal newborns (n=233). The primary outcome was aOR, 95% CI for the presence of specific FHR categories and characteristics. Category 1 tracings overall occurred in 42% with NE vs 81% normal newborns; Category 2 occurred in 54% with NE vs 19% in normal newborns and Category 3 occurred in 4% with NE versus no normal newborns. Prior to delivery, most tracings were Category 2, regardless of whether NE was diagnosed or not, however Category 3 tracings appear pathologic. This reinforces prior understandings that Category 3 tracings are relatively rare yet may predict poor outcomes, while the more frequent Category 2 tracings cannot reliably predict poor neonatal outcomes.

ACCOMPANIED BY EDITORIAL: Steer PJ. **Continuous electronic fetal heart rate monitoring in labour is a screening test, not a diagnostic test**. *BJOG* 2018, 125(11): 1488

<u>Can the Apgar score predict cerebral palsy and epilepsy?</u>

59.Persson M, Razaz N, Tedroff K, Joseph KS, Cnattingius S. **Five and 10 minute Apgar scores and risks of cerebral palsy and epilepsy: population based cohort study in Sweden**. *BMJ* 2018, 360: k207

Multi-center population study (1999-2012)
This Swedish study hypothesized that Apgar scores at 5 and 10 minutes may be associated with cerebral palsy and epilepsy diagnosed up to 16 years after birth. Among 213, 470 "non-malformed" live infants born, 1221 had cerebral palsy and 975 had epilepsy. The aOR for cerebral palsy increased steadily as the Apgar scored decreased compared with children with a 5-minute Apgar score of 10. This association was stronger for Apgar scores at 10 -minutes for the outcome cerebral palsy. These associations were also noted, albeit less pronounced, for epilepsy. Lower Apgar score at 10 minutes confers higher risks of cerebral palsy and epilepsy than lower 5 minute Apgar scores.



OBSTETRIC HEMORRHAGE

Uterotonics for a non-cooled environment

60.Widmer M, Piaggio G, Nguyen TMH, Osoti A, Owa OO, Misra S *et al.* **Heat-stable Carbetocin versus oxytocin to prevent hemorrhage after vaginal birth**. *N Engl J Med* 2018, 379(8): 743-752

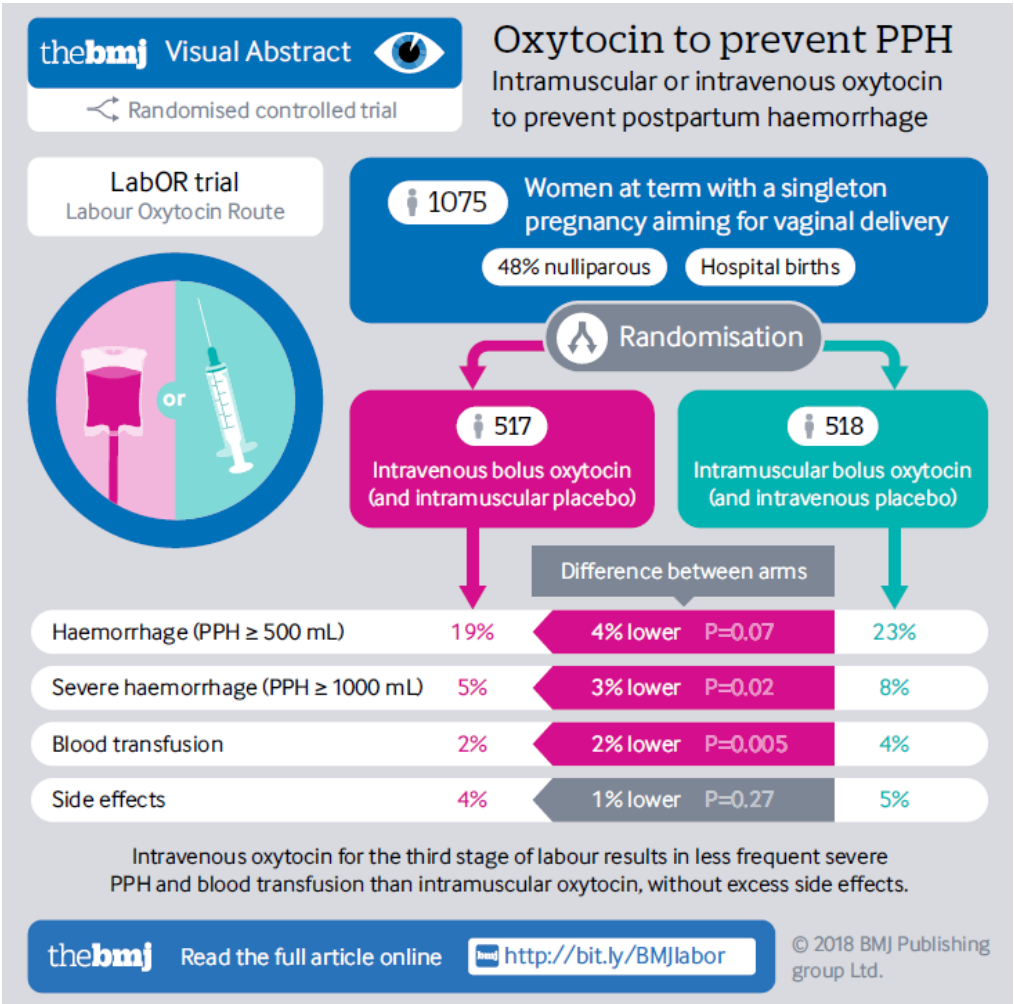
Multi-national non-inferiority randomized controlled trial (2015-18)
Heat-stable carbetocin does not require cold-storage and is currently not included in the WHO PPH prevention guidelines. In 10 countries, women were randomized to receive IM oxytocin 10 units (n=14, 768) vs 100 mcg heat-stable carbetocin (n=14, 771). There were two primary outcomes. The first primary outcome, PPH ≥500 mL measured using a collecting drape and/or additional uterotonic adminstered, occurred in 14.4% with oxytocin versus 14.5% for carbetocin, RR 1.01, 95% CI 0.95 to 1.06. The second primary outcome, EBL ≥1000mL, was nonsignificant yet close to non-inferiority.

ACCOMPANIED BY EDITORIAL: Shakur-Still H, Roberts I. **Finding better ways to prevent postpartum hemorrhage.** *N Engl J Med* 2018, 379(8): 790-792

Uterotonics: Is there an advantage to intramuscular oxytocin?

61.Adnan N, Conlan-Trant R, McCormick C, Boland F, Murphy DJ. **Intramuscular versus intravenous oxytocin to prevent postpartum haemorrhage at vaginal delivery: randomised controlled trial**. *BMJ* 2018, 362: k3546

Single-center randomized controlled trial (2016-17)
After VD, oxytocin can be adminstered IV (recommended by WHO) or IM (recommended by RCOG). Women received 10 units oxytocin immediately after delivery either IV slowly (n=517) over 1 minute or IM in the thigh (n=518). The primary outcome, PPH ≥500 mL measured using a collecting bag, was 18.8% for IV oxytocin vs. 23.2% for IM oxytocin; not statistically significant. Secondary outcomes were significant: severe PPH (≥1000 mL) 4.6% vs. 8.1% and blood transfusion 1.5% vs 4.4% for IV versus IM oxytocin respectively. The side effects were not more frequent with IV administration.



Mythbuster: Third-stage tranexamic acid prophylaxis is not beneficial for all women undergoing vaginal delivery

62.Sentilhes L, Winer N, Azria E, Senat MV, Le Ray C, Vardon D *et al.* **Tranexamic acid for the prevention of blood loss after vaginal delivery**. *N Engl J Med* 2018, 379(8): 731-742

Multi-center randomized controlled trial (2015-16)
TXA may be useful to prevent PPH after VD. Women received 1G IV TXA (n=1461) or placebo (n=1473) 2-minutes after term VD. The primary outcome, PPH≥500 mL measured using a collecting bag, occurred in 8.1% after TXA and 9.8% after placebo, RR 0.83 95% CI 0.68 to 10.1. TXA is not currently recommended for PPH prophlylaxis for VD. However, this study included all women after VD, not just those at high-risk for PPH, and further trials are required for the high risk population.

ACCOMPANIED BY EDITORIAL: Shakur-Still H, Roberts I. **Finding better ways to prevent postpartum hemorrhage.** *N Engl J Med* 2018, 379(8): 790-792

Tranexamic acid for postpartum hemorrhage management is safe and seems effective

63.Gayet-Ageron A, Prieto-Merino D, Ker K, Shakur H, Ageron F-X, Roberts I *et al.* **Effect of treatment delay on the effectiveness and safety of antifibrinolytics in acute severe haemorrhage: a meta-analysis of individual patient-level data from 40, 138 bleeding patients**. *The Lancet* 2018, 391(10116): 125-132

This meta-analysis of 40, 138 bleeding patients evaluated two large RCTs where TXA was administered versus placebo. One study randomized women with PPH, the WOMAN trial (n=20, 011) and the other randomized bleeding trauma patients, the CRASH-2 trial (n= 20, 127). For PPH, TXA administration should not be delayed and should be given as soon as the diagnosis is made; delays were associated with more bleeding, and TXA was not associated with vascular occlusive events in the meta-analysis.

ACCOMPANIED BY EDITORIAL: Dries DJ. **Tranexamic acid: is it about time?** *The Lancet* 2018, 391(10116): 97-98

Increased oxytocin requirements following labor

64.Foley A, Gunter A, Nunes KJ, Shahul S, Scavone BM. **Patients undergoing cesarean delivery after exposure to oxytocin during labor require higher postpartum oxytocin doses**. *Anesth Analg* 2018, 126(3): 920-924

Single-center retrospective study (2015, Jan-Sept)
Among women undergoing CD, women who received oxytocin during labor (n=140) were compared to women without pre-CD oxytocin (n=262). The primary study outcome was maximum infusion rate of oxytocin administered during the third stage and the immediate postpartum period. The maximum infusion dose was selected according to the response to initial oxytocin dose. Women who received oxytocin prior to CD required higher doses of oxytocin more frequently (64%) than women who did not receive pre-CD oxytocin (40%), $p<0.0001$.

Definitions of postpartum hemorrhage

65.Borovac-Pinheiro A, Pacagnella RC, Cecatti JG, Miller S, El Ayadi AM, Souza JP *et al.* **Postpartum hemorrhage: new insights for definition and diagnosis**. *Am J Obstet Gynecol* 2018, 219(2): 162-168

This review highlights that there are several definitions for PPH and vital sign changes associated with PPH, according to 5 major international organizations including FIGO, ACOG, and RCOG. Estimating bleeding volume alone overlooks the clinical condition. Visual estimation delays diagnosis of PPH. The shock index (HR divided by SBP) may improve early identification of women with hypovolemia, and is the focus of some attention in obstetric care.

Intrauterine balloon tamponade should be in the postpartum hemorrhage algorithm

66.Revert M, Rozenberg P, Cottenet J, Quantin C. **Intrauterine balloon tamponade for severe postpartum hemorrhage**. *Obstet Gynecol* 2018, 131(1): 143-149

Retrospective multicenter study (2011-12)
This French study compared two PPH protocols used in two different networks during the same time period. The PPH protocol in one network (n=10 centers) recommended intrauterine balloon tamponade insertion after uterotonic administration, manual removal of placenta and examination/management of delivery trauma, and prior to invasive radiology/other surgical procedures in the management of continuous PPH. The PPH protocol in the other network (n=9) did not mention intrauterine balloon tamponade in the management algorithm. The primary outcome was rate of invasive procedures to manage PPH. The rate of PPH in the balloon using network was 4.5%, and in the other network was 4.1%. The primary outcome was significantly lower in the network recommending intrauterine balloon tamponade. After adjustment, this difference was only significant for women undergoing VD.

High body mass index may not be an important factor in postpartum hemorrhage

67.Butwick AJ, Abreo A, Bateman BT, Lee HC, El-Sayed YY, Stephansson O *et al.* **Effect of maternal body mass index on postpartum hemorrhage**. *Anesthesiology* 2018, 128(4): 774-783

Population database (2008-12)

Previous studies suggested a relationship between BMI and PPH. Pre-pregnancy maternal BMI categories and the relationship with PPH were investigated in a cohort of deliveries in California (n=2,176,673). The rate of PPH was 2.8%, and maternal obesity appeared to have only a modest effect on hemorrhage risk.

Race may be an important factor in postpartum hemorrhage

68.Gyamfi-Bannerman C, Srinivas SK, Wright JD, Goffman D, Siddiq Z, D'Alton ME *et al.* **Postpartum hemorrhage outcomes and race**. *Am J Obstet Gynecol* 2018, 219(2): 185 e181-185 e110

Population database (2012-14)
Race and the association with maternal morbidities associated with PPH were investigated. The primary outcome was maternal morbidity according to 21 CDC maternal morbidity definitions (including shock, stroke, heart failure) and transfusion among women with PPH. The PPH rate was 3.2% among more than 11 million deliveries. Black women were at higher risk for severe morbidity and mortality associated with PPH.

Shock index and lactate can be useful to identify need for massive transfusion

69.Sohn CH, Kim YJ, Seo DW, Won HS, Shim JY, Lim KS *et al.* **Blood lactate concentration and shock index associated with massive transfusion in emergency department patients with primary postpartum haemorrhage**. *Br J Anaesth* 2018, 121(2): 378-383

Single-center retrospective analysis (2004–2015)
Blood lactate >2 mM is a marker of compromised tissue perfusion. Women with PPH who had a blood lactate measurement (n=302) were studied. The primary outcome, massive blood transfusion (dichotomous outcome) >10 units of packed red blood cells within 24 hours of PPH, occurred in 101 women. Median lactate values for all women, regardless of massive blood transfusion were higher than 2 mM, however for women who received massive blood transfusion they were 4.5 mM. Two variables were associated with massive blood transfusion requirement: lactate, OR 1.56, 95% 1.31-1.87) and shock index, OR 10.25 95%CI 3.69 to 28.45. As seen in other populations, high lactate is associated with compromised tissue perfusion. The shock index (HR divided by SBP), used in trauma to identify unstable patients has utility in obstetric hemorrhage and should be investigated further.

Cell saver is safe and cost-effective for high risk cases

70.Lim G, Melnyk V, Facco FL, Waters JH, Smith KJ. **Cost-effectiveness analysis of intraoperative cell salvage for obstetric hemorrhage**. *Anesthesiology* 2018, 128(2): 328-337

This cost-effectiveness model investigated use of cell salvage for three categories: all women undergoing CD, women undergoing CD with high risk of hemorrhage, and no cell saver use. Use of cell salvage is cost effecive for women undergoing CD who are at high risk of hemorrhage.

Basics of blood product compatibility

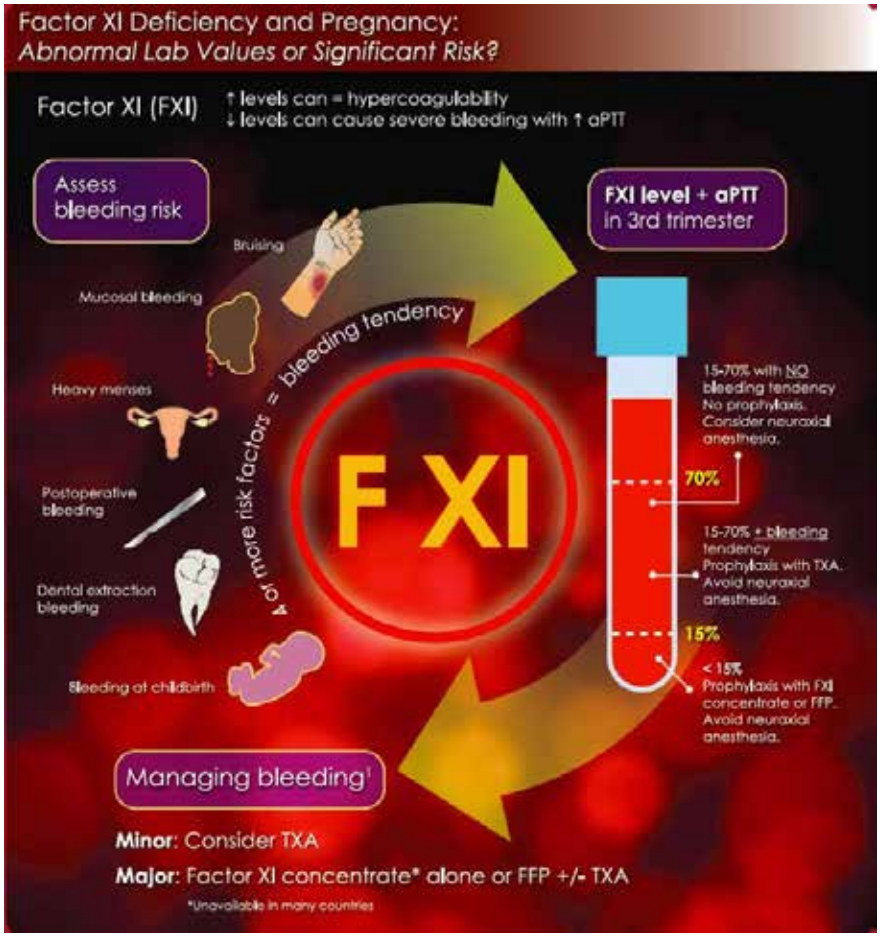
71.Yazer MH, Waters JH, Spinella PC, Cap CA, Fahie CRL, Sr., Gourdine E *et al.* **Use of uncrossmatched erythrocytes in emergency bleeding situations**. *Anesthesiology* 2018, 128(3): 650-656

This clear and relevant review presents updated information about blood bank activities, and tests performed to identify compatible red blood cells. The relatively rare risks of administering uncrossmatched red blood cells are discussed.

Factor XI and labor anesthesia

72.Shander A, Friedman T, Palleschi G, Shore-Lesserson L. **The evolving dilemma of Factor XI in pregnancy: Suggestions for management**. *Anesth Analg* 2018, 126(6): 2032-2037

The authors of this case report and review suggest that women with a known non-bleeding Factor XI deficiency phenotype with Factor XI levels between 15-70% may be considered for neuraxial block. However those with a bleeding or an unknown phenotype and levels below 70% should avoid neuraxial block. Factor XI deficiency is more common than previously thought; homozygotes have levels <15% and heterozygotes have 25-70% or normal values. Importantly, genotype does not predict phenotype thus the bleeding risk may be unknown. Often FXI is discovered after abnormal incidental finding of elevated PTT. Treatment involves TXA, Factor XI concentrate if available and FFP.



CESAREAN DELIVERY

Spinal hypotension

73.Campbell JP, Stocks GM. **Management of hypotension with vasopressors at caesarean section under spinal anaesthesia - have we found the Holy Grail of obstetric anaesthesia?** *Anaesthesia* 2018, 73(1): 3-6

Anesthesiologists have an opportunity to make a direct impact on patient care, as illustrated by this quote from the Editorial accompanying three papers in the January 2018 volume of *Anaesthesia*. "If we were to choose one thing in our obstetric anaesthetic careers which has revolutionized our practice, it would be the introduction of phenylephrine infusions to prevent hypotension during CD under spinal anaesthesia."

74.Kinsella SM, Carvalho B, Dyer RA, Fernando R, McDonnell N, Mercier FJ *et al.* **International consensus statement on the management of hypotension with vasopressors during caesarean section under spinal anaesthesia**. *Anaesthesia* 2018, 73(1): 71-92

This international consensus statement provides a complete update of why and how to prevent hypotension among women undergoing CD with spinal anesthesia. Recommendations for best practice include using phenylephrine rather than ephedrine, administered as prophylaxis rather than therapeutic bolus; with colloid preload or crystalloid co-load and left uterine displacement. The aim is maintenance of SBP≥90% following accurate pre-spinal anesthesia assessment and avoiding <80% baseline measures. No single tactic can predict spinal hypotension; women with pre-eclampsia and women undergoing intrapartum CD experience less spinal hypotension, and women with cardiac disease require individual assessments. The accompanying Editorial asserts that the single-most practice changing element is use of phenylephrine infusions to prevent spinal hypotension.

ACCOMPANIED BY EDITORIAL: Campbell JP, Stocks GM. Management of hypotension with **vasopressors** at caesarean section under spinal **anaesthesia** - have we found the **Holy Grail** of obstetric **anaesthesia**? *Anaesthesia* 2018, 73(1): 3-6

Is spinal hypotension anticipatable?

75.Zieleskiewicz L, Noel A, Duclos G, Haddam M, Delmas A, Bechis C *et al.* **Can point-of-care ultrasound predict spinal hypotension during caesarean section? A prospective observational study**. *Anaesthesia* 2018, 73(1): 15-22

Single-center prospective observational study (2015-6)
Preoperative echocardiography was performed prior to spinal anesthesia for CD (n=40). Using ROC curves, the AUC for the primary outcome, change in velocity time interval (VTI) for supine followed by legs-elevated position, was 0.8 (0.6-0.9) with a PPV 70% and NPV 85%. The authors suggest that assessing the VTI in the two positions can predict spinal hypotension. Future use may be limited as it is not an easily replicable measurement.

ACCOMPANIED BY EDITORIAL: Campbell JP, Stocks GM. **Management of hypotension with vasopressors at caesarean section under spinal anaesthesia - have we found the Holy Grail of obstetric anaesthesia?** *Anaesthesia* 2018, 73(1): 3-6

76.Dyer RA, Emmanuel A, Adams SC, Lombard CJ, Arcache MJ, Vorster A *et al.* **A randomised comparison of bolus phenylephrine and ephedrine for the management of spinal hypotension in patients with severe preeclampsia and fetal compromise**. *Int J Obstet Anesth* 2018, 33: 23-31

Single-center randomized controlled trial (2011-13)
Typically preeclampsia is associated with less spinal hypotension. Phenylephrine is associated with higher umbilical artery pH than ephedrine in healthy women undergoing spinal for CD. Women with severe preeclampsia undergoing CD for non-reassuring heart rate who experienced hypotension after a small fluid bolus were randomized to receive therapeutic boluses of phenylephrine (n=31) versus ephedrine (n=29). The primary outcome, between group comparison of UA base excess, showed mean(SD) UA base excess of -4.9 (3.7) with phenylephrine versus -6.0 (4.6) with ephedrine, a non-significant difference. In women with preeclampsia undergoing CD with a compromised fetus, both phenylephrine and ephedrine can be used to treat spinal hypotension. In the discussion, the authors expounded the particulars of obtaining informed consent in this emergency situation.

77.Higgins N, Fitzgerald PC, van Dyk D, Dyer RA, Rodriguez N, McCarthy RJ *et al.* **The effect of prophylactic phenylephrine and ephedrine infusions on umbilical artery blood pH in women with preeclampsia undergoing cesarean delivery with spinal anesthesia: A randomized, double-blind trial**. *Anesth Analg* 2018, 126(6): 1999-2006

Single-center randomized controlled trial (2006-14)
Prophylactic vasopressor infusions are recommended to avoid spinal hypotension, however these studies were performed in non-preeclamptic women. Women with preeclampsia (mild/severe features) undergoing CD were randomized to receive prophylactic phenylephrine 100 mcg/mL (n=54) versus ephedrine 8mg/mL (n=54); a relative potency 80:1, initiated immediately after spinal anesthesia injection. The primary outcome, UA pH ratio for phenylephrine:ephedrine, was 1.002 (95% CI 0.997 to 1.007). In contrast to studies in non-preeclamptic women, phenylephrine prophylaxis did not confer advantages for fetal acid-base status compared to ephedrine.

Prophylactic vasopressors in preeclampsia

78.Dyer RA, Daniels A, Vorster A, Emmanuel A, Arcache MJ, Schulein S *et al.* **Maternal cardiac output response to colloid preload and vasopressor therapy during spinal anaesthesia for caesarean section in patients with severe pre-eclampsia: a randomised, controlled trial**. *Anaesthesia* 2018, 73(1): 23-31

Single-center randomized controlled trial (2011-13)
Women with preeclampsia or imminent eclampsia symptoms undergoing CD under spinal anesthesia were monitored using non-invasive CO monitor to measure changes in cardiac parameters in response to spinal anesthesia hypotension and the effects of vasopressors. For all 42 enrolled women, increases were noted for CO and HR. Only 20 women experienced hypotension despite the colloid preload and they were randomized to receive phenylephrine bolus (n=10) versus ephedrine (n=10). The primary outcome, mean difference % in cardiac output change following pre-delivery vasopressor administration, was greater in women receiving phenylephrine, corresponding to more effective reversal of maternal hemodynamic changes.

ACCOMPANIED BY EDITORIAL: Campbell JP, Stocks GM. **Management of hypotension with vasopressors at caesarean section under spinal anaesthesia - have we found the Holy Grail of obstetric anaesthesia?** ***Anaesthesia* 2018, 73(1): 3-6**

Automated prophylactic administration

79.Sng BL, Du W, Lee MX, Ithnin F, Mathur D, Leong WL *et al.* **Comparison of double intravenous vasopressor automated system using nexfin versus manual vasopressor bolus administration for maintenance of haemodynamic stability during spinal anaesthesia for caesarean delivery: A randomised double-blind controlled trial**. *Eur J Anaesthesiol* 2018, 35(5): 390-397

Single-center randomized controlled trial (2013-16)
Women were randomized to receive vasopressor boluses administered by an automated device (DIVA) according to maternal hemodynamics (n=117) versus physician administered vasopressor boluses (n=113). The primary outcome, incidence of maternal hypotension, was measured by continuous non-invasive arterial pressure monitor, and occurred in 39% in the DIVA group versus 58% in the physician administered bolus group, p=0.008.

Prophylactic vasopressors in obesity

80.George RB, McKeen DM, Dominguez JE, Allen TK, Doyle PA, Habib AS. **A randomized trial of phenylephrine infusion versus bolus dosing for nausea and vomiting during Cesarean delivery in obese women**. *Can J Anaesth* 2018, 65(3): 254-262

Multi-center randomized controlled trial (2011-14)
Spinal hypotension studies usually exclude obese woman and do not consider nausea and vomiting as the primary outcome. The primary outcome, incidence of IONV, was investigated in obese women (>35 kg/m^2) randomized to receive therapeutic phenylephrine bolus (n=79) versus prophylactic infusion (n=81). Significantly more women receiving bolus (75%) had IONV than women receiving infusion (46%), RR 0.61 95%CI 0.47-0.08. As expected, there was less hypotension in the infusion group, although in both groups rate of spinal hypotension were unexpectedly higher than in previous similar studies.

ACCOMPANIED BY AN EDITORIAL: Ngan Kee WD. **Preventing hypotension-induced nausea and vomiting during spinal anesthesia for Cesarean delivery in obese parturients: a small solution for a big problem**? *Can J Anaesth* 2018, 65(3): 235-238

Noradrenaline prophylaxis

81.Ngan Kee WD, Lee SWY, Ng FF, Khaw KS. **Prophylactic norepinephrine infusion for preventing hypotension during spinal anesthesia for cesarean delivery**. *Anesth Analg* 2018, 126(6): 1989-1994

Single-center randomized controlled trial (2014-16)
Healthy women undergoing elective CD were randomized to receive either prophylactic norepinephrine 5mcg/mL infusion started at 30mL/hour (n=43) versus 5mcg/mL bolus of therapeutic norepinephrine (n=37) according to a BP protocol. The primary outcome, incidence of BP<80% baseline, occurred in 17% receiving prophylaxis and 66% receiving therapeutic norepinephrine, p<0.001. Prophylactic norepinephrine infusion was associated with less hypotension than treatment. An accompanying Editorial discussed the advantage of norepinephrine due to reduced incidence of bradycardia, and suggests that further investigations of this diluted solution (relative to ICU doses) be undertaken, while acknowledging the reticence currently to use noradrenaline in routine clinical practice.

ACCOMPANIED BY EDITORIAL: Vallejo MC, Zakowski MI. **Old ways do not open new doors: Norepinephrine for first-line treatment of spinal hypotension**. *Anesth Analg* 2018, 126(6): 1809-1811

Believe the patient when she complains of pain during cesarean delivery

82.McCombe K, Bogod DG. **Learning from the Law. A review of 21 years of litigation for pain during caesarean section**. *Anaesthesia* 2018, 73(2): 223-230

This narrative review summarizes obstetric anesthesia negligence cases (n=367) where the author (DB) acted as either defense or plaintiff. Major themes are consent, communication with the patient, testing the block before allowing the surgeon to proceed, and most importantly believing the patient when she says she is in pain. The case vignettes are must-reads.

Does anesthesia mode impact outcomes for Category-1 cesarean delivery?

83.Palmer E, Ciechanowicz S, Reeve A, Harris S, Wong DJN, Sultan P. **Operating room-to-incision interval and neonatal outcome in emergency caesarean section: a retrospective 5-year cohort study**. *Anaesthesia* 2018, 73(7): 825-831

Single-center retrospective study (2010-14)
As opposed to decision-to-delivery time (DTI), operating-room-to-decision intervals (ORII) focus on pure anesthesia time (without decision and transfer times to the OR). This study aimed to determine the effect of the category of CD urgency on the ORII (n=9634 women). ORII median was shortest for Category 1 CD (median=11 mins) and longer for Category 2 (median=21 mins), Category 3 (median=28 mins) and Category 4 (median=33 mins). The effect of anesthesia mode on neonatal outcomes was assessed for Category 1 (most urgent) CD (n=667 women). ORII according to anesthesia mode was: GA=6 mins; epidural top-up=11 mins; spinal=13 mins; CSE=24 mins. Despite shortest ORII, GA was associated with the lowest 5 minute Apgar scores in Category 1 CD. This study collaborates previous findings that faster DTI does not improve neonatal outcome.

Cesarean delivery speed does not improve neonatal outcomes

84.Grobman WA, Bailit J, Sandoval G, Reddy UM, Wapner RJ, Varner MW *et al.* **The association of decision-to-incision time for cesarean delivery with maternal and neonatal outcomes**. *Am J Perinatol* 2018, 35(3): 247-253

Secondary analysis of prospectively collected data (2008-2011)
Women with term singleton non-anomalous cephalic presentation without prior CD who intended to labor in MFMU network hospitals were assessed (n=3482). Maternal composite was PPH, EBL>1000mL, blood transfusion, endometritis, wound infection/separation, operative injury, hysterectomy. Neonatal composite was pH<7. 5-min Apgar<5, HIE, seizures, death. CDs were grouped according to DTI ≤15, 16-30, >30 mins. Among women who had CD for arrest of labor, the neonatal composite morbidity was less frequent after *longer* DTI. For women with fetal indication CD, neonatal composite morbidity was more frequent after *shorter* DTI. There was no demonstrable association between DTI and maternal and neonatal outcomes. Given that desire to shorten the DTI may create pressure to perform GA, it would be interesting to investigate anesthesia mode for these cases.

Anesthesia impacts neonatal outcomes

85.Royal College of Obstetricians and Gynaecologists. **Each Baby Counts: Themed report on anaesthetic care, including lessons identified from Each Baby Counts babies born 2015 to 2017**.

The Neonatal Mortality and Severe Morbidity Review, Each Baby Counts (EBC) was launched in the United Kingdom in 2014 by the Royal College of Obstetricians and Gynaecologists. This 2018 EBC report focused on anesthesia care aspects of 49 newborns who either died or had severe intrapartum brain injury during 2015-2017. The report highlights the need to convey to the anesthesiologist the urgency of CD; that decisions about transfer to the operating room should be made with the anesthesiologist and re-assessed on entering the operating room; that handovers between anesthesiologists will maintain situational awareness. Labor epidurals should be reviewed periodically for efficacy; women's safety should be prioritized over haste to deliver the baby; difficult intubation guidelines should be available; and training levels assured. Anesthesiologists were involved in only 41% of the hospital review boards and the report highlights that all review boards should include an anesthesiologist.

Cesarean delivery rate: too high for some yet too low for others

86.Wiklund I, Malalat AM, Cheung NF, Cadee F. **Lancet. Appropriate use of caesarean section globally requires a different approach**. *Lancet* 2018, 392(10155): 1288-1289
87.**Lancet. Stemming the global caesarean section epidemic**. *Lancet* 2018, 392(10155): 1279
88.Occhi GM, de Lamare Franco Netto T, Neri MA, Rodrigues EAB, de Lourdes Vierira Fernandes A. **Lancet. Strategic measures to reduce the caesarean section rate in Brazil**. *Lancet* 2018, 392(10155): 1290-1291

Series introduction: Optimization of the CD rate is key. Women who require this life saving surgery may be unable to receive it, while unneccsary CDs are being performed in other centers or countries, with detrimental maternal and neonatal consequences. This 3-part series plus Editorials intends to generate debate and research, and presents limitations of current knowledge about optimizing the CD rate.

89.Visser GH, Ayres-de-Campos D, Barnea ER, de Bernis L, Di Renzo GC, Vidarte MFE *et al.* **FIGO position paper: how to stop the caesarean section epidemic**. *Lancet* 2018, 392(10155): 1286-1287

The FIGO position paper is a call to action for governments to unify fees for VD and CD, oblige publication of instituitional CD rates, use the Robson TGCS system to categorize the reasons for CD, and to invest financially in care, logistics and staff and their training. The paper calls for low income countries to address limited access to timely CD and train skilled birth assistants for VD.

90.Boerma T, Ronsmans C, Melesse DY, Barros AJD, Barros FC, Juan L *et al.* **Global epidemiology of use of and disparities in caesarean sections**. *The Lancet* 2018, 392(10155): 1341-1348

Series Part 1: This manuscript discusses disparities of CD availability and optimization of the CD rate among different countries. Although many countries have a CD rate above the WHO recommended 15%, particularly among wealthier women and those with private insurance, in low and middle income countries women and their newborns may suffer morbidity and mortality as CD is not readily available.

91.Sandall J, Tribe RM, Avery L, Mola G, Visser GHA, Homer CSE *et al.* **Short-term and long-term effects of caesarean section on the health of women and children**. *The Lancet* 2018, 392(10155): 1349-1357

Series Part 2: This manuscript discusses the increased maternal mortality and morbidity consequences of CD, and higher risks in subsequent pregnancies. The short and long term effects on newborn health are reviewed.

92.Betrán AP, Temmerman M, Kingdon C, Mohiddin A, Opiyo N, Torloni MR *et al.* **Interventions to reduce unnecessary caesarean sections in healthy women and babies**. *The Lancet* 2018, 392(10155): 1358-1368

Series Part 3: This manuscript discusses interventions such as TOLAC guidelines, active labor management, and ECV, that may decrease CD rates. Educational strategies that may decrease CD rates are discussed. Litigation concerns may increase CD rates and no single strategy may decrease the CD rate. The solutions will be complex, and further research is required. The Robson TGCS is presented as one strategy to compare use of CD within and between countries.

Reducing the cesarean delivery rate in China

93.Liang J, Mu Y, Li X, Tang W, Wang Y, Liu Z *et al.* **Relaxation of the one child policy and trends in caesarean section rates and birth outcomes in China between 2012 and 2016: observational study of nearly seven million health facility births**. *BMJ* 2018, 360: k817

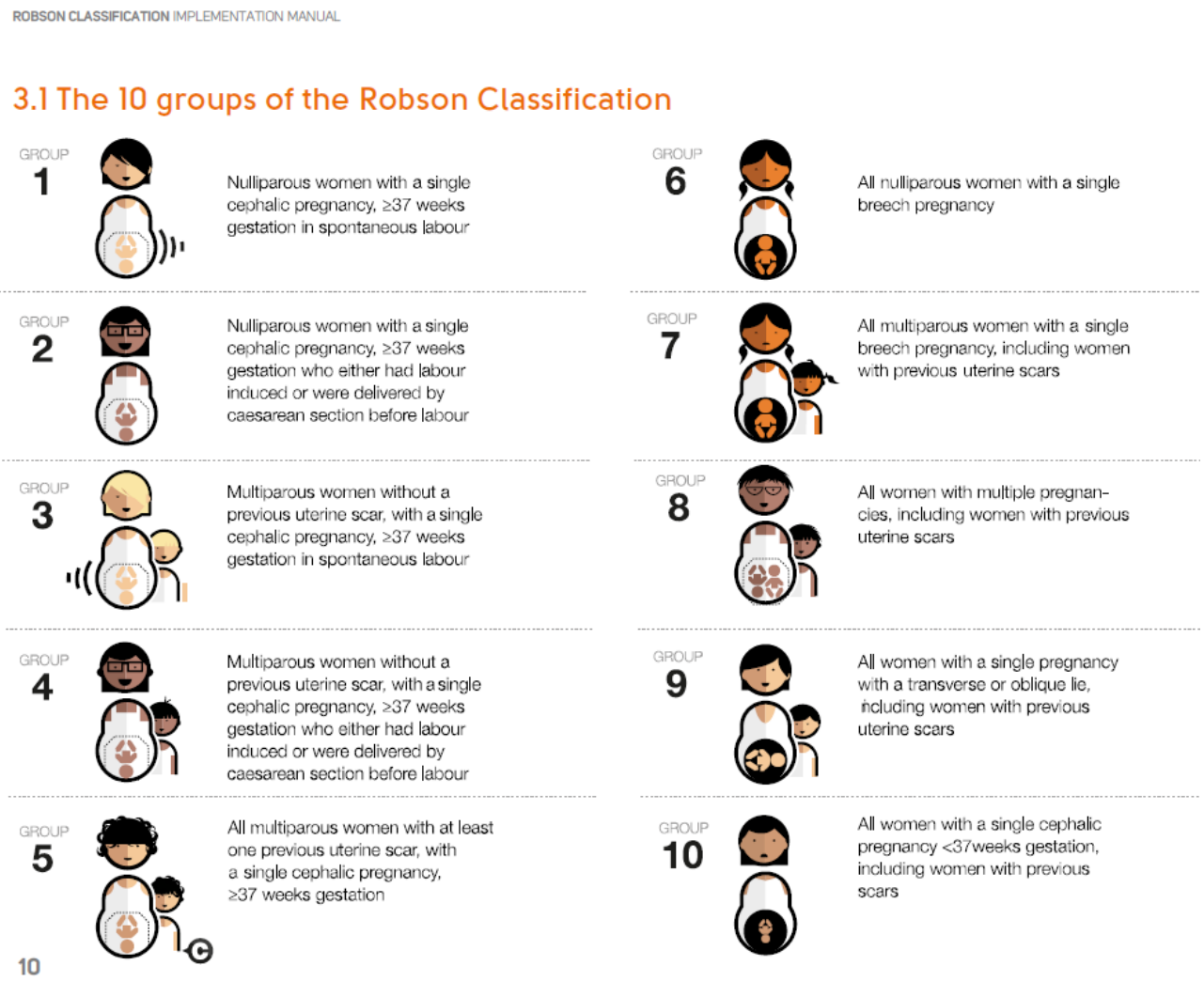
National Maternal Near Miss Surveillance System (2012-16)
Among almost 7 million deliveries in 441 Chinese hospitals, the Robson classification was used to identify trends in CD over time. CD rates declined between 2012 and 2016, from 45% to 41%. Relaxation of the one child policy increased the number of multiparas (34% to 47%). The decrease in CD rates was greatest in hospitals with a high CD rate. The biggest decline was seen among nulliparas with cephalic singleton pregnancy (>37 weeks) and multiparas without a uterine scar. The highest CD rates were seen among women with a prior uterine scar (91%). The authors suggest that increasing multiparous deliveries amplified the decline noted in the CD rate. Government intervention including updated guidelines, training, together with a focus on the high CD rate hospitals, may have impacted the decline in CD rates.

Classifying labor using the Robson Ten Group Classification System

94.Hehir MP, Ananth CV, Siddiq Z, Flood K, Friedman AM, D'Alton ME. **Cesarean delivery in the United States 2005 through 2014: a population-based analysis using the Robson 10-Group Classification System**. *Am J Obstet Gynecol* 2018, 219(1): 105 e101-105 e111

Population database (2005-14)
All 27, 044, 217 deliveries meeting inclusion criteria in the US were categorized according to the Robson TGCS. There are ten possible classification groups for women who undergo CD (see infographic) Robson 10-Group Classification Implementation Manual. In the US during this study period the CD rate was 32%. Most CDs were performed for Group 5 women (singleton term multiparas); 90% of women with previous CD had repeat CD; and 90% of women with breech presentation had CD. Obstetric units can use the TGCS to analyze their contributing categories to the CD rate. For example centers performing more CD for women with prior CD and ECV can focus on these areas where the CD rate may be reduced. Limitations of this TGCS include lack of CD indications.

ACCOMPANIED BY EDITORIAL: Robson MS. The 10-Group Classification System-a new way of thinking. *Am J Obstet Gynecol* 2018, 219(1): 1-4



External cephalic version is not widely performed

95.Son M, Roy A, Grobman WA, Miller ES. **Association between attempted external cephalic version and perinatal morbidity and mortality**. *Obstet Gynecol* 2018, 132(2): 365-370
96.**ACOG Committee Opinion No. 745: Mode of term singleton breech delivery**. *Obstet Gynecol* 2018, 132(2): e60-e63

Single-center retrospective study (2006-16)
Women with breech presentation who underwent an ECV attempt (n=1263, 31%) were compared to women without ECV attempt (n=2854, 69%). The primary outcome, neonatal outcome composite, occurred among 3% of all women, regardless of ECV performance. However the CD rate was significantly lower among women who had ECV. The revised 2018 ACOG bulletin affirms that all eligible women should undergo ECV, in facilities able to perform CD.

Impact of too many cesarean deliveries: Placenta accreta spectrum

97.**Placenta Accreta Spectrum. Obstetric Care Consensus No. 7. American College of Obstetricians and Gynecologists**. *Obstet Gynecol* 2018, 132: e259-275

This PAS SMFM document is accompanied by an Obstetric Consensus Statement from the ACOG. It presents diagnosis, and management strategies for PAS. Anesthesia and other multidisciplinary team members need to be alerted early before the 34-36 week planned delivery.

Conservative management of placenta accreta spectrum

98.Sentilhes L, Kayem G, Chandraharan E, Palacios-Jaraquemada J, Jauniaux E, Diagnosis FPA *et al.* **FIGO consensus guidelines on placenta accreta spectrum disorders: Conservative management**. *Int J Gynaecol Obstet* 2018, 140(3): 291-298

Conservative management for PAS is discussed in the new FIGO international guidelines. Cesarean hysterectomy is one strategy to manage PAS, however conservative management may be selected to avoid cesarean hysterectomy. In contrast to cases of CD without PAS, where removal of the placenta is recommended, the placenta should not be pulled out with force when PAS is suspected as this may result in major hemorrhage. However gentle efforts may be used if during surgery PAS is not seen despite pre-surgery suspicion.

Endovascular balloon prophylaxis for placenta accreta spectrum

99.Shahin Y, Pang CL. **Endovascular interventional modalities for haemorrhage control in abnormal placental implantation deliveries: a systematic review and meta-analysis**. *Eur Radiol* 2018, 28(7): 2713-2726

Systemic review and meta-analysis (69 studies) of endovascular management for hemorrhage in women with PAS. Most were case reports/reviews or retrospective studies, and only 1 was an RCT. Endovascular prophylactic balloon occlusion was placed for (n=1395) 77% of the women in the studies: internal or common iliac arteries, infra-renal abdominal aorta, or uterine artery. In the 14 studies comparing endovascular procedure versus no endovascular procedure for blood loss, endovascular procedures significantly reduced blood loss (MD—893 mL, 95% CI -1389 to -397 ml, p<0.001). In the 11 studies that compared the two methods for number of units of packed red blood cells, endovascular procedures were associated with fewer transfused units, (MD -1.54 units, 95% CI -2.27 to 0.81 units, p<0.001). Although this is thought-provoking and lends support to an argument for IR to manage PAS cases, the meta-analysis did not address confounders such as depth of placental invasion and urgency of surgery, and most of the studies to date are of low quality with small numbers.

Anesthesia for placenta accreta spectrum

100.Markley JC, Farber MK, Perlman NC, Carusi DA. **Neuraxial anesthesia during cesarean delivery for placenta previa with suspected morbidly adherent placenta: A retrospective analysis**. *Anesth Analg* 2018, 127(4): 930-938

Single-center retrospective study (1997-2015)
Neuraxial anesthesia was the primary anesthesia choice for 122/129 women undergoing non-emergency CD for suspected PAS; 16% of these had Mallampati score ≥3. Twenty (16%) women required conversion to GA, 15 during surgery and 7 of these during active resuscitation; 3 conversions to neuraxial anesthesia were difficult to intubate. This group reported good experience selecting neuraxial anesthesia for their population, however emphasize their advanced resources and that use of neuraxial anesthesia may not be suitable for other environments.

ACCOMPANIED BY EDITORIAL: Beilin Y. **Maternal hemorrhage- regional versus general anesthesia: Does it really matter?** *Anesth Analg* 2018, 127(4): 805-807

POSTOPERATIVE ANALGESIA

Respiratory depression with neuraxial morphine is rare

101.Sharawi N, Carvalho B, Habib AS, Blake L, Mhyre JM, Sultan P. **A systematic review evaluating neuraxial morphine and diamorphine-associated respiratory depression after cesarean delivery**. *Anesth Analg* 2018, 127(6): 1385-1395

Systematic review (no date restrictions)

Clinically significant respiratory depression (CSRD) was defined as RD that the authors considered to be clinically relevant. CSRD was sought among studies that reported administration of neuraxial morphine or diamorphine for postpartum CD pain. Among 75 manuscripts, 16 cases of CSRD were identified, a rate of 8.67 per 10, 000 95%CI 4.20-15.16) cases. The doses of opioids varied, and only 2 women with CSRD received contemporaneous low dose (150 mcg) neuraxial morphine.

Quadratus lumborum block for post-cesarean delivery analgesia

102.Krohg A, Ullensvang K, Rosseland LA, Langesaeter E, Sauter AR. **The analgesic effect of ultrasound-guided quadratus lumborum block after cesarean delivery: A randomized clinical trial**. *Anesth Analg* 2018, 126(2): 559-565

Single-center randomized controlled trial (2014-15)
After CD performed under intrathecal isobaric bupivacaine 10mg without neuraxial morphine, women received either US guided bilateral QL block with ropivacaine (n=20) 30 mL 0.2% versus bilateral placebo saline injection (n=20). The primary outcome, cumulative ketobemidone (an opioid) consumption, was significantly reduced after ropivacaine QL block: ratio of means 0.60, 95% CI 0.3 to 0.97, p=0.04 when administered as part of a multimodal analgesia strategy.

Keep it low: local anesthesia doses for transabdominus plane block

103.Ng SC, Habib AS, Sodha S, Carvalho B, Sultan P. **High-dose versus low-dose local anaesthetic for transversus abdominis plane block post-Caesarean delivery analgesia: a meta-analysis**. *Br J Anaesth* 2018, 120(2): 252-263

This meta-analysis (n=14 studies) examined women who received TAP block (n=389) with high or low dose local anesthetics versus controls who did not receive TAP block (n=381) for post CD pain. The primary outcome, 24 hour post CD morphine equivalent consumption, was reported in 8 studies. Consumption was significantly lower both the high and low dose TAP groups versus control. Thus a benefit of high TAP block was not shown, and likely should be avoided as it was associated with LAST.

LABOR and DELIVERY OUTCOMES

Elective term induction versus expectant management

104.Grobman WA, Rice MM, Reddy UM, Tita ATN, Silver RM, Mallett G *et al.* **Labor induction versus expectant management in low-risk nulliparous women**. *N Engl J Med* 2018, 379(6): 513-523

Multi-center randomized controlled trial (2014-17)
Nulliparas in 41 MFMU network centers were randomized to term induction at 39^{+0} to 39^{+4} (n=3059) vs. expectant management (n=3037). Primary outcome, neonatal outcome composite (respiratory support, Apgar ≤3 at 5mins, HIE, seizure, infection, meconium aspiration syndrome, birth trauma) or perinatal death, occurred in 4.3% of neonates in the induction group vs 5.4% in the expectant group (p=0.049) – a priori significance required was 0.046. Other neonatal outcomes were also similar. CD rates was an a priori chief secondary outcome, and was significantly decreased in the term induction group 18.6% vs 22.2%, RR 0.84; 95% CI 0.76 to 0.93, p<0.0001. Term induction was also associated with lower frequency of hypertensive disorders of pregnancy. The accompanying Editorial highlighted the high refusal rate for study enrollment, lower maternal age and unrepresentative racial and ethnic characteristics of the study groups compared to other studies. ACOG responded that elective term induction is a reasonable option for healthy normal nulliparous pregnancies after confirmed 39^{+0} weeks' gestation. This may require logistical overhauls in labor and delivery to enable more elective term inductions.

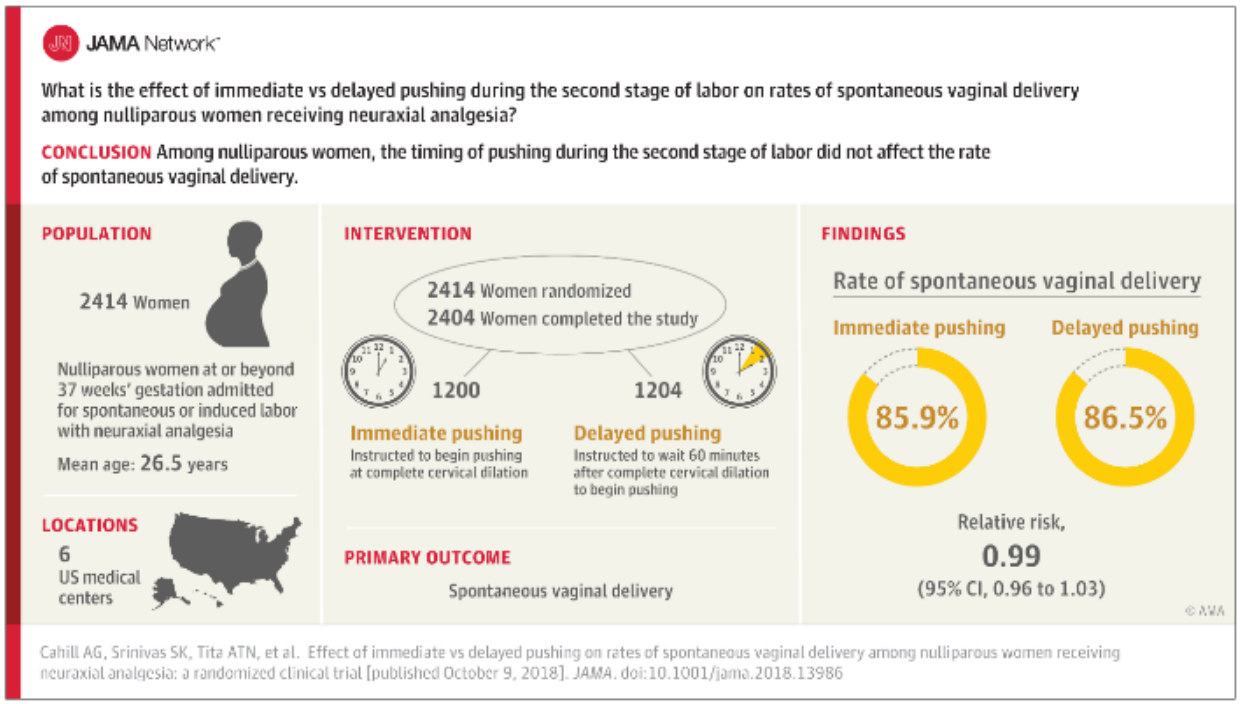
ACCOMPANIED BY EDITORIAL: Greene MF. **Choices in managing full-term pregnancy**. *N Engl J Med* 2018, 379(6): 580-581
ACCOMPANIED BY SMFM STATEMENT **on elective induction of labor in low-risk nulliparous women at term: the ARRIVE trial.** Am J Obstet Gynecol Published August 8, 2018 and endorsed by ACOG
ACCOMPANIED BY Practice Advisory: **Clinical guidance for integration of the findings of The ARRIVE Trial: Labor induction versus expectant management in low-risk nulliparous women**
ACCOMPANIED BY Media Statement: **Leaders in Obstetric Care respond to the published results of the ARRIVE trial published by ACOG and SMFM**. August 8, 2018

Can nulliparas with an epidural push immediately in second stage?

105.Cahill AG, Srinivas SK, Tita ATN, Caughey AB, Richter HE, Gregory WT *et al.* **Effect of immediate vs delayed pushing on rates of spontaneous vaginal delivery among nulliparous women receiving neuraxial analgesia: A randomized clinical trial**. *JAMA* 2018, 320(14): 1444-1454

Multi-center randomized controlled trial (2014-17)
The primary study aim was spontaneous vaginal delivery rate for women randomized at the diagnosis of second stage to immediate (n=1200) versus delayed pushing (n=1204). The study was terminated at 75% of planned enrollment due to futility (similar rates of vaginal delivery in both groups: 86% immediate and 87% delayed pushing). Delayed pushing was associated with an increased rate of PPH, (a pre-specified secondary outcome) 27% for immediate versus 48% for delayed pushing.

ACCOMPANIED BY EDITORIAL: Sperling JD, Gossett DR. **Immediate vs delayed pushing during the second stage of labor**. *JAMA* 2018, 320(14): 1439-1440
WITHDRAWN: ACOG Practice Advisory- Immediate vs. delayed pushing in nulliparous women receiving neuraxial analgesia



106.Korb D, Deneux-Tharaux C, Seco A, Goffinet F, Schmitz T, for the JUmeaux MODe d'Accouchement (JUMODA) study group and the Groupe de Recherche en Obstétrique et Gynécologie. **Risk of severe acute maternal morbidity according to planned mode of delivery in twin pregnancies**. *Obstet Gynecol* 2018, 132(3): 647-655

Multi-center prospective observational study (2015-15)
This was a planned secondary analysis comparing planned CD (n=3062) versus planned VD (n=5062) for twin pregnancies with the presenting twin in cephalic presentation. The primary outcome was a *maternal composite* of intrapartum morbidity (death, PPH, transfusion, artery embolization, vascular ligation, uterine compression suture, hysterectomy, PE, stroke/TIA, severe organ dysfunction, thrombocytopenia, other emergency surgery, and ICU admission). Perineal lacerations were not included in the composite. The primary outcome occurred in 6.1% undergoing CD and 5.4 undergoing VD (RR 1.13%, 95% CI 0.94 to 1.35). The authors conclude that given the similar delivery outcomes for CD versus VD for twin pregnancies, both for neonatal (previous study) and maternal morbidities (current study), VD is preferred due to lower long term maternal morbidities.

Pelvic floor disorders after vaginal delivery

107.Blomquist JL, Munoz A, Carroll M, Handa VL. **Association of delivery mode with pelvic floor disorders after childbirth**. *JAMA* 2018, 320(23): 2438-2447

Prospective longitudinal cohort study (2008-13)
Postpartum women, CD (n=778) and VD (n= 565) were followed up for nine years annually, 5-10 years after the first delivery. The primary outcome, incidence of pelvic floor disorders, was highest among women after operative VD and lowest after CD. Stress urinary incontinence had a peak hazard rate within 5 years of delivery and pelvic organ prolapse peak hazard was >20 years after delivery. As efforts are undertaken to decrease the CD rate, women will also need to know the potential downsides of VD, and it is unclear the impact this information will have on their decisions.

A call for fixed set of outcomes for perineal research

108.Pergialiotis V, Durnea C, Elfituri A, Duffy J, Doumouchtsis SK, International Collaboration for Harmonising Outcomes R *et al.* **Do we need a core outcome set for childbirth perineal trauma research? A systematic review of outcome reporting in randomised trials evaluating the management of childbirth trauma**. *BJOG* 2018, 125(12): 1522-1531

This systematic review identified reported outcomes for studies of perineal lacerations. Among 48 RCTs (n=20, 308 women), there were 77 different reported outcomes. Pain, wound healing, and anorectal dysfunction were the most frequently reported. This study adds to the Core Outcomes in Women's and Newborn Health (CROWN) initiative initiated by *BJOG* to standardize outcomes in women's health research. The notion of a fixed set of outcomes for specific research questions such as "maternal outcomes" and "neonatal outcomes" is being pursued and could advance research clinical investigations and improve the quality of meta-analyses.

ACCOMPANIED BY VIDEO ABSTRACT: https://vimeo.com/279818668

109.Peralta F, Bavaro JB. **Severe perineal lacerations after vaginal delivery: are they an anesthesiologist's problem?** *Curr Opin Anaesthesiol* 2018, 31(3): 258-261

This fresh review discusses perineal injury and its impact on depression and function after labor. Effective labor analgesia may decrease the incidence of perineal injury. Neuraxial analgesia for labor does not appear to predispose to perineal injuries and may possibly be protective. Pain is a significant concern and is insufficiently addressed.

LABOR ANALGESIA

Epidurals may not be uniformly available in the United States

110.Butwick AJ, Bentley J, Wong CA, Snowden JM, Sun E, Guo N. **United States state-level variation in the use of neuraxial analgesia during labor for pregnant women**. *JAMA Netw Open* 2018, 1(8): e186567

Population database (2015)
Date were taken from birth certificates (contain labor and delivery details) for all United States except Connecticut. The final analysis included n=2, 262, 950 women. The study aimed to investigate if there were statewide variations in neuraxial analgesia. Statewide variations in epidural use were wide; however were not related to patient factors or anesthesia workforce levels. Overall, 73% received neuraxial analgesia; highest rates in Nevada 80% and lowest in Maine, 37%. Unmeasured effects, for example service availability and patient preferences may explain these differences.

Proactive management for epidurals that need re-siting

111.Sng BL, Tan M, Yeoh CJ, Han NR, Sultana R, Assam PN *et al.* **Incidence and risk factors for epidural re-siting in parturients with breakthrough pain during labour epidural analgesia: a cohort study**. *Int J Obstet Anesth* 2018, 34: 28-36

Single-center retrospective study (2012-3)
Details for 10, 170 women receiving neuraxial analgesia for labor were retrieved. The primary outcome, epidural catheter re-siting, occurred in 86 (0.85%). The most significant factor associated with likelihood for epidural re-siting was breakthrough pain, aOR 21.31, 95%CI 12.56 to 36.15. The authors state that optimum strategies for identification and management of inadequate labor epidural catheters require further investigation.

Low rate of spinal epidural hematoma at low platelet counts

112.Levy N, Goren O, Cattan A, Weiniger CF, Matot I. **Neuraxial block for delivery among women with low platelet counts: a retrospective analysis**. *Int J Obstet Anesth* 2018, 35: 4-9

Single-center retrospective study (2011-14)
The primary outcome of this study was the rate of neuraxial block in women (n=471) according to platelet range. 23/59 women with platelets ≤49, 000 received neuraxial block. No women had SEH or other complications. Adding these data to previous publications, the authors calculated the 95% CI for risk of SEH at platelet levels 50-69, 000/mcg/L is 0 to 0.26 and at platelet levels 0 to 49, 000/mcg/L is 0 to 9.

Programmed intermittent boluses for labor analgesia

113.Sng BL, Zeng Y, de Souza NNA, Leong WL, Oh TT, Siddiqui FJ *et al.* **Automated mandatory bolus versus basal infusion for maintenance of epidural analgesia in labour**. *Cochrane Database Syst Rev* 2018, 5: CD011344

Original Cochrane review of 12 RCTs (n=1121) that compared AMB versus BI for maintenance of labor epidural analgesia. Breakthrough pain likelihood was significantly reduced using AMB, RR (0.60; 95% CI 0.39 to 0.92). There was no difference in CD rates.

114.Zakus P, Arzola C, Bittencourt R, Downey K, Ye XY, Carvalho JC. **Determination of the optimal programmed intermittent epidural bolus volume of bupivacaine 0.0625% with fentanyl 2 mug.ml(-1) at a fixed interval of forty minutes: a biased coin up-and-down sequential allocation trial**. *Anaesthesia* 2018, 73(4): 459-465

Prospective double blind dose finding study (2016-17)
The optimum PIEB volume with retained efficacy (EV_{90}) was sought in a center where 40 min was found to be the optimum lock out time for PIEB boluses. After epidural catheter placement, two boluses (6mL) of bupivacaine 0.125% + fentanyl 3.3 mcg/mL were administered. Maintenance was bupivacaine 0.0625% + fentanyl 2 mcg/mL, 250 mL/hour. First PIEB dose was given at 60min after initiation of epidural, and subsequent boluses were given every 40 mins. Primary outcome was use of PCEA/additional boluses during the 6 hours after epidural placement or until full dilatation. Using Dixon Mood up-down method, the first enrolled woman had PIEB bolus 7mL, and if unsuccessful the next patient received 8mL; the maximum bolus volume was 12 mL. For women (n = 63) receiving this mixture at 40 min timed boluses, the estimated EV_{90} (95%CI) was 11.0 (10.0 to 11.7 mL) and a volume below 10 mL was ineffective.

115.Lange EMS, Wong CA, Fitzgerald PC, Davila WF, Rao S, McCarthy RJ *et al.* **Effect of epidural infusion bolus delivery rate on the duration of labor analgesia: A randomized clinical trial**. *Anesthesiology* 2018, 128(4): 745-753

Single-center randomized controlled trial (2015-17)

Following a CSE bolus, labor epidural analgesia was maintained using PIEB (10mL bolus every 60 mins in addition to self-administered boluses of 5mL every 10 mins, maximum 3 per hour). Women were randomized to receive slow rate PIEB bolus, 100mL/hr (n=108) versus high rate PIEB bolus, 300mL/hr (n=102). The primary study outcome, proportion of women requiring physician boluses for breakthrough pain, was similar in both groups; 41% receiving slow rate versus 36% receiving high rate. In this study setting, using CSE followed by PIEB 10mL boluses, either PIEB bolus delivery rate can be used.

116.Bullingham A, Liang S, Edmonds E, Mathur S, Sharma S. **Continuous epidural infusion vs programmed intermittent epidural bolus for labour analgesia: a prospective, controlled, before-and-after cohort study of labour outcomes**. *Br J Anaesth* 2018, 121(2): 432-437

Single-center impact of practice change study (2015-15).
This center transitioned from CEI (n=188) to PIEB+PCEA (n=236) for labor analgesia. The primary outcome, any motor weakness, occurred in 21.8% with CEI vs 1% with PIEB+PCEA; this significant difference remained when nulliparas and multiparas where examined separately. As opposed to an RCT with inclusion/exclusion criteria, limited bias and blinding, data from all women who received at least 10mL of study solution were assessed in this study, presenting evidence of the general clinical application of PIEB+PCEA.

Remifentanil labor analgesia

117.Wilson MJA, MacArthur C, Hewitt CA, Handley K, Gao F, Beeson L *et al.* **Intravenous remifentanil patient-controlled analgesia versus intramuscular pethidine for pain relief in labour (RESPITE): an open-label, multicentre, randomised controlled trial**. *Lancet* 2018, 392(10148): 662-672

Multi-center non-blinded randomized controlled trial (2014-16)
Pethidine (meperidine) is widely used in the UK. Healthy women in established labor (regular painful contractions regardless of cervical dilatation) in 14 UK units received IM 100 mg pethidine (n=199) versus IV remifentanil 40 mcg 1 to 2 mins PCA (n=201). The primary outcome, receiving an epidural, occurred for 19% of women with remifentanil PCA vs 41% with pethidine. Once randomized and prior to drug administration, 14/201 (7%) women did not receive remifentanil (none requested epidural) and 45/199 (33%) did not receive pethidine (22 requested epidural). Cervical dilatation at treatment initiation, duration and doses of study drugs were not reported. The study was non-blinded and 22 women refused pethidine, suggesting women a priori considered this an inferior treatment. Remifentanil was associated with more frequent occurrence of low oxygen saturation, and need for supplementary oxygen, corroborating previous studies showing hypoxemia and need for 1:1 nurse: patient ratios that many units may be unable to provide.

Postdural puncture headache

118.Rana K, Jenkins S, Rana M. **Insertion of an intrathecal catheter following a recognised accidental dural puncture reduces the need for an epidural blood patch in parturients: an Australian retrospective study**. *Int J Obstet Anesth* 2018, 36: 11-16

Single-center retrospective study (2009-15)
Among women with ADP and or PDPH, 94 had recognized ADP after epidural and 70% had intrathecal catheter placed. Although the incidence of PDPH was not different between women with versus without intrathecal catheter, 33% with intrathecal catheter required EBP versus 68% without intrathecal catheter, RR 2.04, 95%CI 1.33 to 3.12.

Is sphenopalatine ganglion block a replacement for epidural blood patch?

119.Cohen S, Levin D, Mellender S, Zhao R, Patel P, Grubb W *et al.* **Topical sphenopalatine ganglion block compared with epidural blood patch for postdural puncture headache management in postpartum patients: A retrospective review**. *Reg Anesth Pain Med* 2018, 43(8): 880-884

Single-center retrospective study (1997-2014)
All patients had history and symptoms consistent with PDPH. SPG (n=42) was compared with EBP (n=39). The rationale for treatment selection was not reported although headache intensity was similar in both groups. Fewer patients returned to the ER after SBP (zero) than after EBP (23.1%), OR 0.04, 95%CI 0.002 to 0.67). SPG was associated with greater frequency of headache relief 30 and 60 minutes after treatment; headache relief was similarly good after 24 hours beyond treatment. The number of women who required EBP after SPG was not reported. Lack of randomization introduces the possibility for biased patient selection. Further investigations are required to elucidate the efficacy of SPG: a less-invasive therapeutic strategy for women with PDPH.

Labor epidurals can be performed in the presence of a tattoo

120.Zipori Y, Jakobi P, Solt I, Abecassis P. **The need for an epidural "window of opportunity" in pregnant women with a lumbar tattoo**. *Int J Obstet Anesth* 2018, 33: 53-56

This review discussed recommendations for performing neuraxial block in women with a tattoo. Epidural analgesia should be avoided in the unlikely situation that the tattoo is fresh (<2 weeks old). If possible injection through the tattoo should be avoided. Importantly this review supports not withholding neuraxial block when a tattoo is present.

Neuraxial anesthesia for women with Chiari malformation

121.Waters JFR, O'Neal MA, Pilato M, Waters S, Larkin JC, Waters JH. **Management of anesthesia and delivery in women with Chiari I malformations**. *Obstet Gynecol* 2018, 132(5): 1180-1184

Retrospective case series (2010-15)
Among 63 women (95 deliveries) with Chiari I malformation, 44 had CD and 51 VD. Neuraxial block was performed for 62 deliveries with no untoward effects. Chiari I malformations are not uncommon, and the authors suggest that women with asymptomatic Chiari I or headaches alone, may deliver according to obstetric indications whereas those with hydrocephalus/ papilledema are high risk. As this was a retrospective study on selected data, it is unclear if practice will change in other centers.

POSTPARTUM PAIN

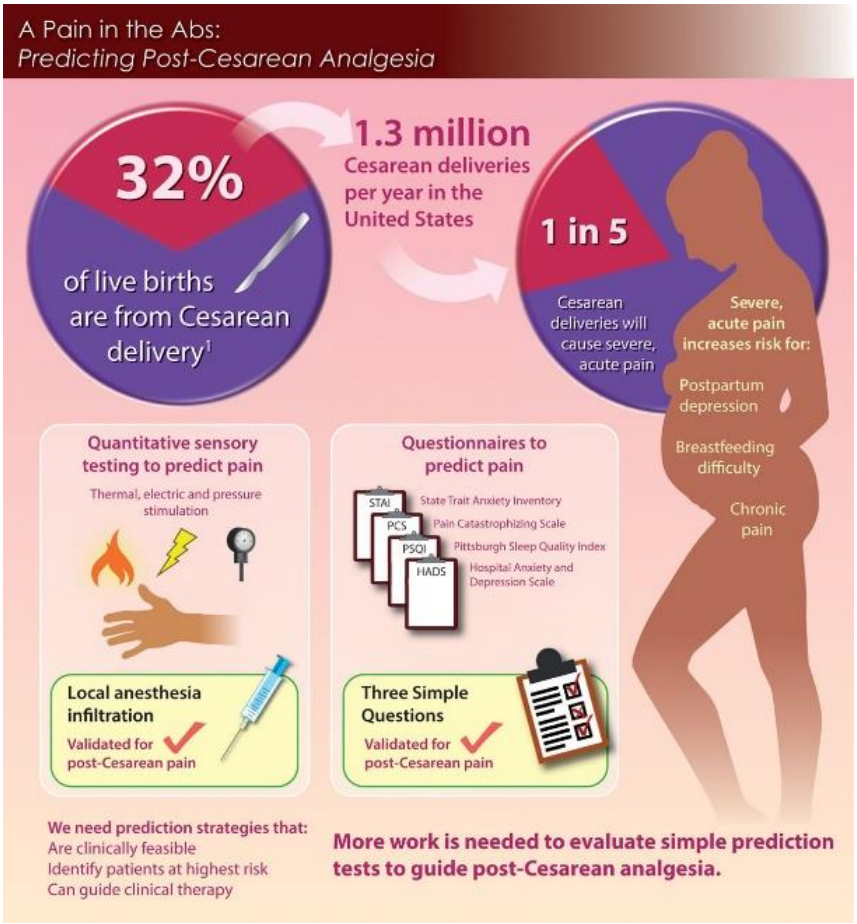
122.**ACOG Committee Opinion No. 742: Postpartum pain management**. *Obstet Gynecol* 2018, 132(1): e35-e43

ACOG published a postpartum pain management committee opinion. Wide variations in pain intensity and experience are recognized, after both VD and CD. Multi-modal analgesia is recommended, and opioids should be reserved for severe pain. Codeine containing agents are not recommended.

Predicting postpartum pain

123.Gamez BH, Habib AS. **Predicting severity of acute pain after cesarean delivery: A narrative review**. *Anesth Analg* 2018, 126(5): 1606-1614

This narrative review identified 13 studies that described methods to predict acute post CD pain. Five studies used QST, 1 used hyperalgesia, 4 used questionnaires and 2 used combined QST and questionnaires including state-trait anxiety inventory and pain catastrophizing scale. The authors concluded that clinically applicable tools are lacking and the best predictive tools currently for postpartum pain are either pain levels following local anesthesia injection prior to the spinal for CD, or 3-simple questions about anxiety and pain.



Induced labor and higher pain on postpartum day 1 predicts prolonged postpartum pain and opioid use

124.Komatsu R, Carvalho B, Flood P. **Prediction of outliers in pain, analgesia requirement, and recovery of function after childbirth: a prospective observational cohort study**. *Br J Anaesth* 2018, 121(2): 417-426

Prospective observational cohort study (secondary analysis) (2014-16)
Nulliparas were enrolled before labor onset or after epidural, and contacted daily starting postpartum day 1 until there were five pain- and opioid-free recovery days (n=134). From 3 months, for women still in pain, calls were made weekly. Women were asked about site-specific pain (depending on VD or CD). A total of 3343 daily phone-calls were made. The primary outcome, number of days until the composite outcome of opioid and pain free recovery, was median (range) 21 (3 to 85) days. Induced labor and higher postpartum day 1 pain scores predicted longer pain duration and need for opioids. After CD, the standard discharge prescription was 30 opioid pills and some women were discharged with opioids after VD. An accompanying Editorial surveyed anesthesiologists in 13 non-US countries: discharge opioids are not prescribed after VD except in the US, and discharge opioids are prescribed regularly only in Canada the US and South Africa after CD.

ACCOMPANIED BY AN EDITORIAL: Wong CA, Girard T. U**ndertreated or overtreated? Opioids for postdelivery analgesia.** *Br J Anaesth* 2018, 121(2): 339-342

125.**Morbidity and Mortality Weekly Report: Opioid Use Disorder Documented at Delivery Hospitalization — United States, 1999–2014**. https://www.cdc.gov/mmwr/volumes/67/wr/mm6731a1.htm. Opioid Use Disorder Documented at Delivery Hospitalization — United States, 1999–2014. Morbidity and Mortality Weekly Report
This report presents opioid use disorder per state per 1, 000 delivery hospitalizations annually from 1999 to 2014. Across the US, rates of opioid use disorder more than quadrupled among delivery hospitalizations, in some states more than others; Vermont, West Virginia, New Mexico and Maine have seen the greatest rise.

Opioids use among women undergoing vaginal delivery

126.Badreldin N, Grobman WA, Yee LM. **Inpatient opioid use after vaginal delivery**. *Am J Obstet Gynecol* 2018, 219(6): 608 e601-608 e607

Single-center case-control study (2015-16)
Women rarely need opioid analgesia after VD and in this center, a specific postpartum order is required to administer opioids after VD. In-hospital postpartum prescriptions for opioid naive women after VD (n=9038) were investigated. NSAIDS were prescribed for 97% of women, acetaminophen for 26% and opioids for 25%. Factors associated with opioid use included high BMI, and delivery complications (such as perineal tear, PPH). 20% of women with normal non-complicated VD received an opioid postpartum. Higher number of acetaminophen (aOR 0.81, 95% CI 0.77 to 0.85) and NSAIDS (aOR 0.92, 95% CI 0.87 to 0.96) doses and more senior practitioner prescribing (OR 0.46, 95% CI 0.29-0.73) were associated with lower likelihood of in-hospital opioid prescription after VD.

127.Prabhu M, Garry EM, Hernandez-Diaz S, MacDonald SC, Huybrechts KF, Bateman BT. **Frequency of opioid dispensing after vaginal delivery**. *Obstet Gynecol* 2018, 132(2): 459-465

Population database (2003-15)
Using an insurance claims database across the US and Puerto Rico, all women with VD (n=1,345,244) were identified. Within 1 week of discharge, 28.5% (95%CI 28.4 to 28.6) filled an opioid prescription; and geographic location accounted for the strongest risk difference. Women on benzodiazepines or antidepressants also had higher likelihood to fill opioid prescriptions, as did women after tubal ligations, operative VD and with perineal tears. Less than 1/5 women who filled opioid prescriptions had tubal ligations, perineal tears, operative VD. Codeine was the prescribed opioid in 15% of cases despite the FDA warning about potential neonatal RD. The reasons for opioid prescriptions were not reported.

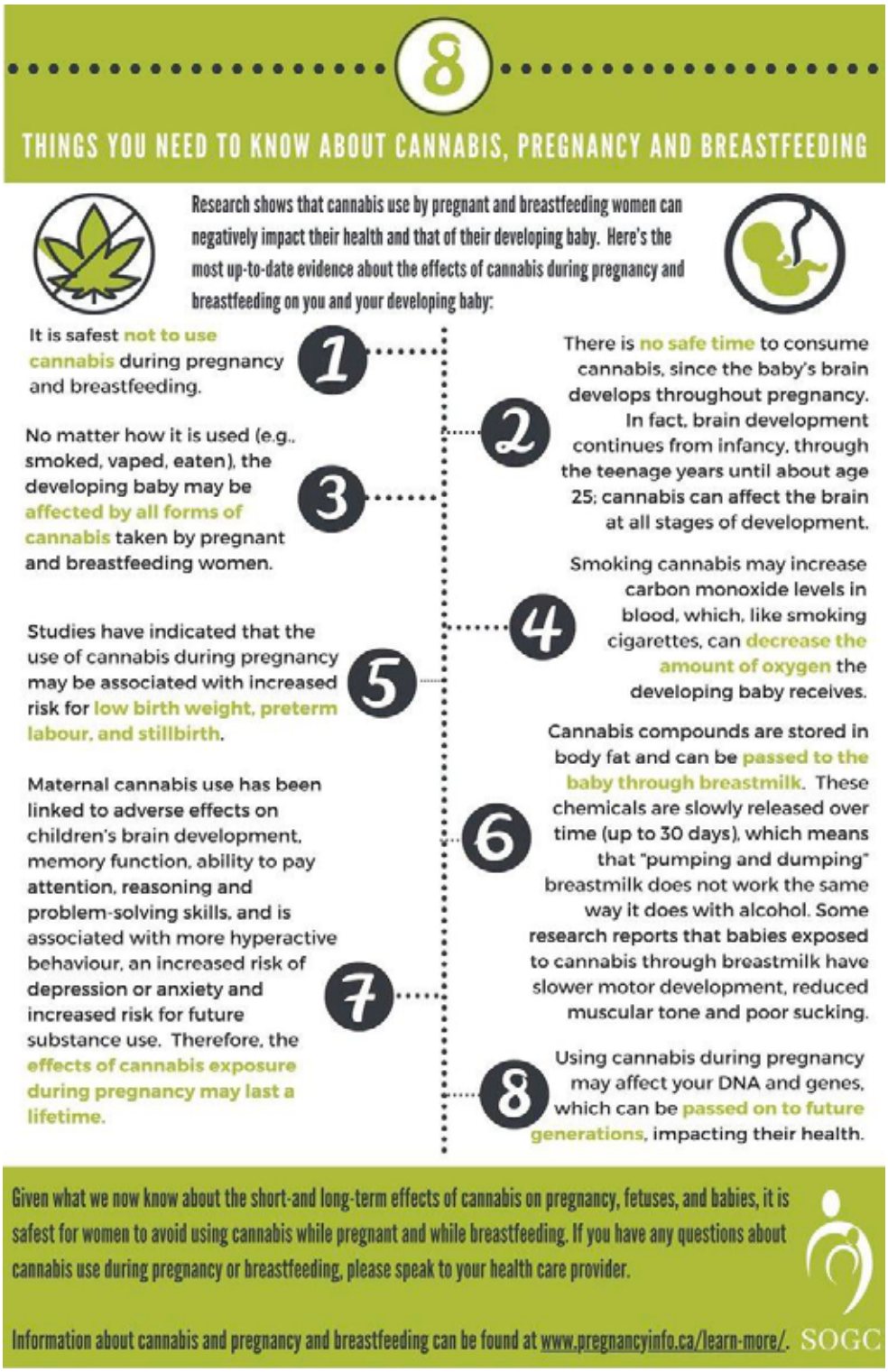
Marijuana use in pregnancy and breastfeeding

128.Dickson B, Mansfield C, Guiahi M, Allshouse AA, Borgelt LM, Sheeder J *et al.* **Recommendations from cannabis dispensaries about first-trimester cannabis use**. *Obstet Gynecol* 2018, 131(6): 1031-1038

Statewide Cross-sectional study (2017 Jun-Jul)
400 Colorado cannabis dispensaries were asked whether they recommended cannabis products to a mystery caller "first trimester pregnant woman" to treat her nausea and vomiting. Most (69%) of the dispensaries recommended cannabis products to the caller. This is concerning given the insufficient safety data about use of marijuana for pregnant and breastfeeding women, and the increased state legalization in the US.

129. Ryan SA, Ammerman SD, O'Connor ME; Committee on substance use and prevention: Section on breastfeeding. **Marijuana use during pregnancy and breastfeeding: Implications for neonatal and childhood outcomes.** *Pediatrics* 2018, 142(3): e20181889.
ERRATUM published Aug 28.

This clinical guidance report published by the American Academy of Pediatrics presents epidemiological data regarding increased marijuana use among pregnant and breastfeeding women, and current knowledge of the effects of marijuana on fetal development.



130.Raymond BL, Kook BT, Richardson MG. **The opioid epidemic and pregnancy: implications for anesthetic care**. *Curr Opin Anaesthesiol* 2018, 31(3): 243-250

The huge burden of opioid use among pregnant women is presented in this review. Maternal and fetal effects of exposure are discussed. Replacement strategies (methadone, buprenorphine) and management of opioid tolerant mothers for postpartum pain are presented.

POSTPARTUM CARE

131.**ACOG Committee Opinion No. 736: Optimizing postpartum care**. *Obstet Gynecol* 2018, 131(5): e140-e150
132.Murray Horwitz ME, Molina RL, Snowden JM. **Postpartum care in the United States - new policies for a new paradigm**. *N Engl J Med* 2018, 379(18): 1691-1693

In the postpartum period, women should be in contact with *their* provider within 3 weeks. ACOG recognizes that many women do not attend the 6 week postpartum visit and that PPD occurs in approximately 10% of postpartum women. Postpartum complications are discussed, including bowel and bladder incontinence, along with educational tools and strategies. Care of the newborn, substance use/abuse, intimate-partner violence are other presented topics. All topics have counselling tools for questions, care, and resources the provider may use in consultation with postpartum women. A NEJM editorial discussed the importance of these care recommendations in the US where maternity leave is relatively short, and social inequalities impact optimum postpartum care.

ACCOMPANIED BY:
ACOG Postpartum ToolKit

Postpartum depression

133.**ACOG Committee Opinion No. 757: Screening for perinatal depression**. *Obstet Gynecol* 2018, 132(5): e208-e212

ACOG recommend that all postpartum women be screened using a validated tool at least once during the postpartum period, and that women with risk factors be closely monitored, given that 10% of postpartum women meet criteria for major depressive disorders.

Postpartum depression and labor analgesia

134.Orbach-Zinger S, Landau R, Harousch AB, Ovad O, Caspi L, Kornilov E *et al.* **The relationship between women's intention to request a labor epidural analgesia, actually delivering with labor epidural analgesia, and postpartum depression at 6 Weeks: A prospective observational study**. *Anesth Analg* 2018, 126(5): 1590-1597

Single-center prospective longitudinal study (2015-6)
PPD may be associated with painful labor. Among 1326 laboring women, 1058 women received epidural and 439 did not; 328 women wanted/did not receive epidural analgesia. The primary study outcome, PPD at 6 weeks for women who wanted/did not receive epidural analgesia versus the other women, was similar for both groups, relative risk difference 1.8%, 95%CI -3% to 7%. However unmet expectations was a risk factor PPD (whether women delivered with epidural/did not want or wanted/did not receive).

ACCOMPANIED BY EDITORIAL: Toledo P, Miller ES, Wisner KL. **Looking beyond the pain: Can effective labor analgesia prevent the development of postpartum depression**? *Anesth Analg* 2018, 126(5): 1448-1450

135.Lim G, Farrell LM, Facco FL, Gold MS, Wasan AD. **Labor analgesia as a predictor for reduced postpartum depression scores: A retrospective observational study**. *Anesth Analg* 2018, 126(5): 1598-1605

Single-center retrospective and observational study (2015)
Women who received epidural analgesia and had pain scores assessed before and after epidural placement were investigated (n=201). The percent change in pain (PIP) was calculated (difference between baseline and subsequent pain scores over time). A positive score reflects good analgesia and a negative score the opposite. The primary outcome, PIP relationship with Edinburgh PPD scores (EPDS) measured at 6 weeks postpartum, was positive in simple linear regression, r=0.025, p=0.002. In a stepwise model including PIP, anxiety/depression history, perineal tears, antepartum anemia, pain scores accounted for 6.6% of the EPDS scores. According to these data, good labor analgesia is associated with reduced frequency of PPD.

ACCOMPANIED BY EDITORIAL: Toledo P, Miller ES, Wisner KL. **Looking beyond the pain: Can effective labor analgesia prevent the development of postpartum depression**? *Anesth Analg* 2018, 126(5): 1448-1450

ULTRASOUND IN OBSTETRIC ANESTHESIA

Ultrasound and the airway in preeclampsia

136.Ahuja P, Jain D, Bhardwaj N, Jain K, Gainder S, Kang M. **Airway changes following labor and delivery in preeclamptic parturients: a prospective case control study**. *Int J Obstet Anesth* 2018, 33: 17-22

Case control study (2014-15)
Physical and ultrasound assessments of the airway of preeclamptic women (n=25) and normal women (n=25) were performed before active labor, at 1 hour and 24-48 hours postpartum. The primary outcome, Mallampati score, worsened in both groups over time. Furthermore, ultrasound airway measurements worsened during labor in both groups. Development of airway edema during labor has been previously reported, however application of ultrasound is novel. Ultrasound skills to assess the airway can be useful to identify changes, and also to identify landmarks if surgical airway is needed.

Models for gastric ultrasound

137.Roukhomovsky M, Zieleskiewicz L, Diaz A, Guibaud L, Chaumoitre K, Desgranges FP *et al.* **Ultrasound examination of the antrum to predict gastric content volume in the third trimester of pregnancy as assessed by MRI: A prospective cohort study**. *Eur J Anaesthesiol* 2018, 35(5): 379-389

Single-center prospective observational study (2015-16)
Gastric antral ultrasound was compared to MRI measurements, to build a mathematical model for predicting gastric volumes in third trimester among non-fasted pregnant women (n=34). It was assumed the correlation between ultrasound and MRI would be high >0.75. The median antral CSA and MRI measure were strongly correlated, 0.76. Ultrasound to measure antral CSA appears reliable in non-fasted non-laboring women in the third trimester.

138.Arzola C, Perlas A, Siddiqui NT, Downey K, Ye XY, Carvalho JCA. **Gastric ultrasound in the third trimester of pregnancy: a randomised controlled trial to develop a predictive model of volume assessment**. *Anaesthesia* 2018, 73(3): 295-303

Single-center randomized controlled trial (2014-16)
Gastric antral ultrasound was performed to build a predictive model in non-laboring third trimester fasted women (n=60). Gastric ultrasound was performed before and after ingestion of clear fluids (fluid volumes were assigned randomly). The primary outcome, correlation between ingested fluid volume and ultrasound measures, was significant in the semi-recumbent position, Spearman rank correlation 0.7, $p<0.0001$. The authors report that ultrasound measures correlated well with ingested volumes and that measurements are best performed in the semi-recumbent position.

ACCOMPANIED BY EDITORIAL: Kinsella SM. **The 'full stomach': full time for sloppy terminology?** *Anaesthesia* 2018, 73(10): 1189-1190

139.Perlas A, Arzola C,Van de Putte P. **Point-of-care gastric ultrasound and aspiration risk assessment: a narrative review**. *Can J Anaesth* 2018, 65(4): 437-448

This is a complete update and review of gastric ultrasound in general and explains the measurement techniques and interpretations of the volumes measured.

Finding the window for ultrasound diagnosis during cardio-pulmonary resuscitation

140.Clattenburg EJ, Wroe P, Brown S, Gardner K, Losonczy L, Singh A *et al.* **Point-of-care ultrasound use in patients with cardiac arrest is associated prolonged cardiopulmonary resuscitation pauses: A prospective cohort study**. *Resuscitation* 2018, 122: 65-68

Single-center prospective study (2016-17)
Video recordings were collected of cardiac arrests managed in the ER and they were reviewed for the primary outcome, CPR pauses when POCUS was performed versus pauses when POCUS was not performed. Among 24 cardiac arrests evaluated, POCUS caused 17 second CPR pauses versus 11 second CPR pauses when POCUS was not performed. POCUS can uncover reversible causes of arrest such as pulmonary embolus, and hypovolemia, thus potentially directing therapies in maternal cardiac arrest, yet optimal resuscitation is achieved with minimal CPR interruptions. The authors suggest implementing a timer strategy to minimize CPR pauses when POCUS is performed during management of cardiac arrest.

141.Zieleskiewicz L, Bouvet L, Einav S, Duclos G, Leone M. **Diagnostic point-of-care ultrasound: applications in obstetric anaesthetic management**. *Anaesthesia* 2018, 73(10): 1265-1279

This is a lovely review of point of care ultrasound in obstetric practice. Important uses of ultrasound include airway assessments, diagnosis of shortness of breath in a pregnant patient, and intravenous fluid management and shock.

ACCOMPANIED BY EDITORIAL: Kinsella SM. **The 'full stomach': full time for sloppy terminology?** *Anaesthesia* 2018, 73(10): 1189-1190

DISPARITIES IN CARE

Racial disparities and adverse maternal outcomes

142.Grobman WA, Parker CB, Willinger M, Wing DA, Silver RM, Wapner RJ *et al.* **Racial disparities in adverse pregnancy outcomes and psychosocial stress**. *Obstet Gynecol* 2018, 131(2): 328-335

Multi-center prospective registry (2010-14)
This secondary analysis of a nulliparous registry investigated frequencies of preterm birth, hypertensive disease of pregnancy and SGA births in a population of 9, 470 women recruited in 8 US centers: 60% non-Hispanic white, 14% non-Hispanic black, 17% Hispanic, 4% Asian and 5% other. Non-Hispanic black women were most likely to experience these adverse pregnancy outcomes, and there was no relationship to psychosocial factors such as stress, racism and social support.

Impact of hospital closures or understaffing

143.Kozhimannil KB, Hung P, Henning-Smith C, Casey MM, Prasad S. **Association between loss of hospital-based obstetric services and birth outcomes in rural counties in the United States**. *JAMA* 2018, 319(12): 1239-1247

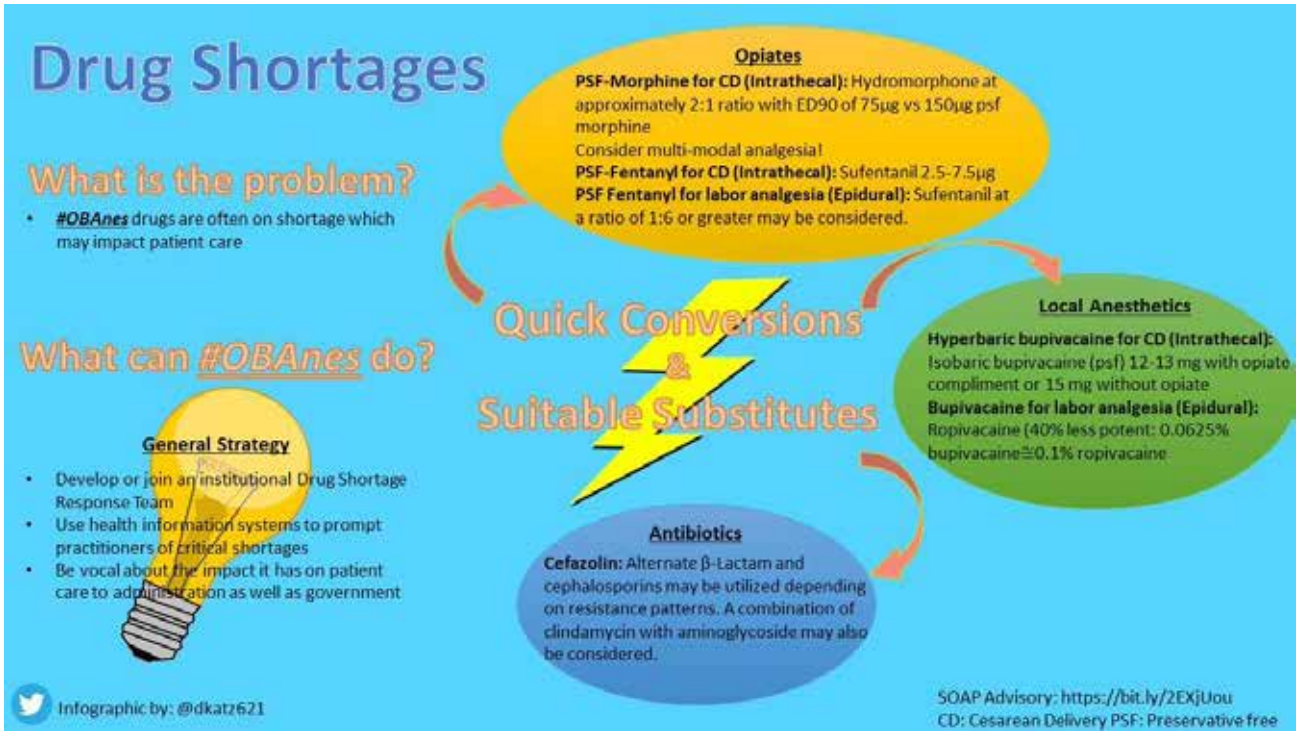
Population database (2004-14)
This study investigated availability of hospital obstetric services for almost 5 million deliveries births among women living in rural US rural counties with hospital obstetric services in 2004. Closure of hospital obstetric services was a concern. The primary study outcome measures were non-hospital delivery, delivery in hospitals without obstetric services, and preterm delivery. Loss of hospital obstetric services since 2004 resulted in increased risk of delivery in hospitals without obstetric services and of preterm delivery. The authors politely suggested some updates in hospital planning strategies.

144.Lonnee HA, Madzimbamuto F, Erlandsen ORM, Vassenden A, Chikumba E, Dimba R *et al.* **Anesthesia for cesarean delivery: A cross-sectional survey of provincial, district, and Mission hospitals in Zimbabwe**. *Anesth Analg* 2018, 126(6): 2056-2064

Cross-sectional survey (2015, Sept to Oct)
Using a structured WFSA/WHO survey, non-urban anesthesia providers in Zimbabwe were interviewed about logistics and practices. Most anesthesia providers were not physicians, 19% had no formal training and only one was a physician anesthesiologist. Most CDs were performed under spinal anesthesia.

DRUG SHORTAGES

145.**https://soap.org/2018-bupivacaine-shortage-statement.pdf**. SOAP statement on drug shortages



SIMULATION IN OBSTETRICS

146.Satin AJ. **Simulation in Obstetrics**. *Obstet Gynecol* 2018, 132(1): 199-209

The various simulation based programs reported in the field of obstetrics are reviewed along with a basic summary and update.

LOCAL ANESTHETIC SYSTEMIC TOXICITY

147.Neal JM, Barrington MJ, Fettiplace MR, Gitman M, Memtsoudis SG, Morwald EE *et al.* **The Third American Society of Regional Anesthesia and Pain Medicine Practice Advisory on Local Anesthetic Systemic Toxicity: Executive Summary 2017**. *Reg Anesth Pain Med* 2018, 43(2): 113-123

This practice advisory reports that LAST may be less frequent than previously reported. One third of patients present with CNS and CVS symptoms; presentation may be atypical and delayed up to an hour. If in doubt of the diagnosis, intralipid should be given.

EXERCISE DURING PREGNANCY

It's safe to exercise in pregnancy

148.Bo K, Artal R, Barakat R, Brown WJ, Davies GAL, Dooley M *et al.* **Exercise and pregnancy in recreational and elite athletes: 2016/2017 evidence summary from the IOC expert group meeting, Lausanne. Part 5. Recommendations for health professionals and active women**. *Br J Sports Med* 2018, 52(17): 1080-1085

This 5 part series reviews the impact of sport participation for recreational and elite pregnant athletes. Exercise is permitted unless there are extreme health concerns e.g. CHD, placenta previa, anemia among others. Hyperthermia in the first trimester, and aortocaval compression later on in pregnancy should be avoided. High altitude exercise should be avoided if not acclimatized. Guidelines suggest that during training the VO_{2max} (maximum rate of oxygen consumption) should not exceed >90% although this is not a proven recommendation. Exercise may reduce the risk of diabetes and PPD, but elite athletes appear to have similar risks of low back pain, girdle pain, pelvic floor pain and perineal tears as the non-athlete population.

POINT of VIEW

Reporting research: lessons for authors and reviewers

149.Adams AD, Benner RS, Riggs TW, Chescheir NC. **Use of the STROBE checklist to evaluate the reporting quality of observational research in obstetrics**. *Obstet Gynecol* 2018, 132(2): 507-512

Cross-sectional study (2008-2016)
This study assessed observational studies submitted to *Obstetrics and Gynecology* for adherence to the STROBE (Strengthening the Reporting of Observational Studies in Epidemiology) items. Published observational studies complied with items 82% of the time, and 78% for critical items (e.g. objectives, study size, data analysis, and number of participants). Authors are required to complete the STROBE statement yet neglect to include some items in the manuscript. Editors and reviewers need to verify inclusion of these items.

Pregnant women often excluded from studies

150.Heyrana K, Byers HM, Stratton P. **Increasing the participation of pregnant women in clinical trials**. *JAMA* 2018, 320(20): 2077-2078

Due to exclusion of pregnant women in many studies, 80% of pregnant women are prescribed drugs that were not tested in this population. The barriers to enrollment of pregnant women such as the ethical committee designation of pregnant women as "vulnerable"; need to show direct benefit to the study population; and legal aspects, are discussed in this Commentary.

WHAT'S NEW in OBSTETRIC ANESTHESIA

The 2017 Gerard W Ostheimer Lecture summarized publications from the year 2016 and was presented by Dr B.T. Bateman in two publications (Epub) in 2018.

151.Bateman BT. **What's new in Obstetric Anesthesia: a focus on maternal morbidity and mortality**. *Int J Obstet Anesth* 2019, 37: 68-72

152.Bateman BT. **What is new in Obstetric Anesthesia: The 2017 Gerard W. Ostheimer Lecture**. *Anesth Analg* 2019, 128(1): 123-127

Phoenix Arizona | 1-5th May 2019

What's New in Obstetric Anesthesia in 2018

Her Heart in Our Hands

Carolyn Weiniger MB ChB
Director of Women's Anesthesia
Division of Anesthesia & Pain & Intensive Care
Tel-Aviv Sourasky Medical Center
Tel-Aviv Israel
@CarolynWeiniger

The Gerard W Ostheimer Lecture | SOAP 2019

#SOAPAM2019

Division of Anesthesia & Pain & Intensive Care

Disclosure

Honorarium: Editor of International Journal of Obstetric Anesthesia

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~ 1200 manuscripts reviewed

152 summarized in Syllabus

Maternal Morbidity & Mortality

Cesarean Delivery

Labor Outcomes & Analgesia

Postpartum Care

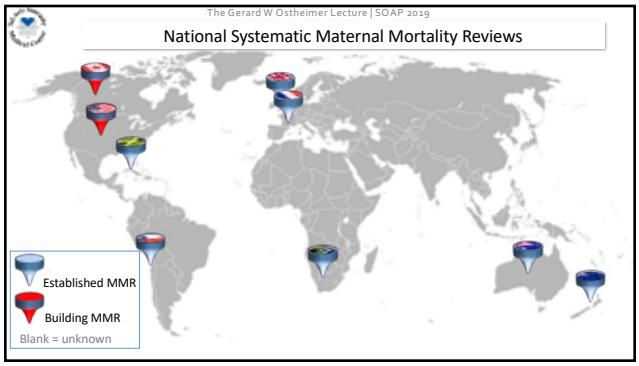
First author |Journal name | Year

Maternal Mortality

Cesarean Delivery

Labor Outcomes & Analgesia

Postpartum Care


The Gerard W Ostheimer Lecture | SOAP 2019
National Systematic Maternal Mortality Reviews
Established MMR
Building MMR
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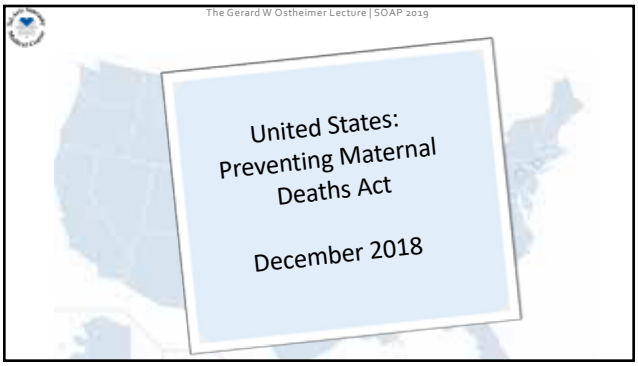
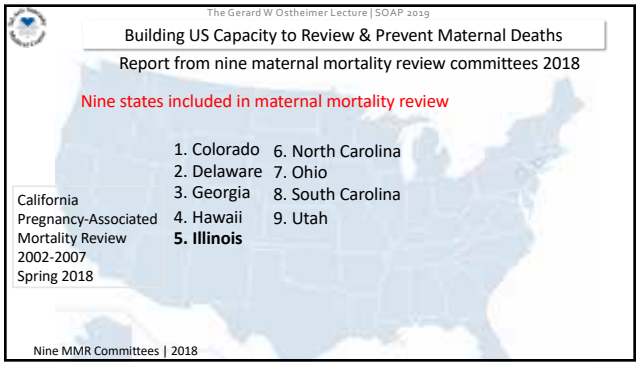
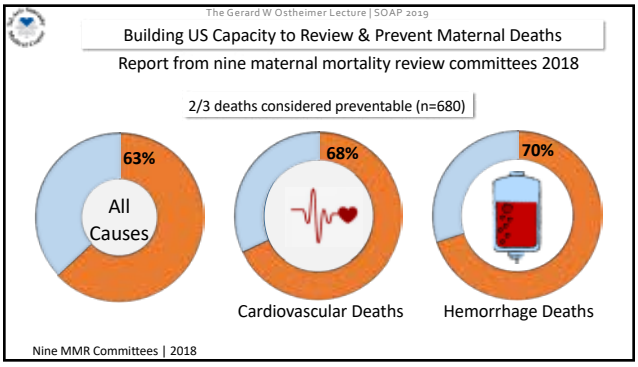
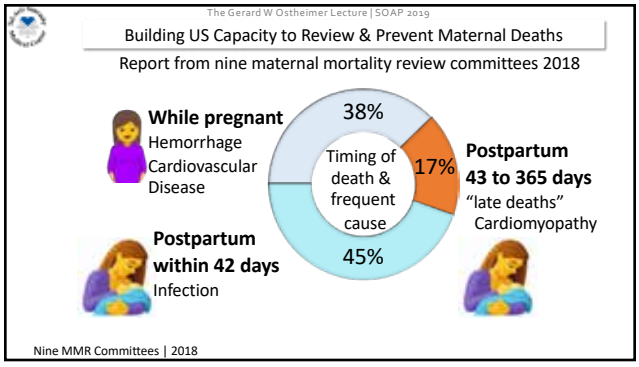
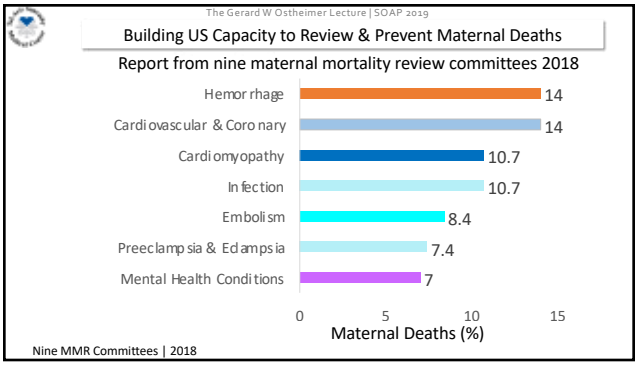

The Gerard W Ostheimer Lecture | SOAP 2019
United States:
Preventing Maternal
Deaths Act
December 2018


The Gerard W Ostheimer Lecture | SOAP 2019
Building US Capacity to Review & Prevent Maternal Deaths
Report from nine maternal mortality review committees 2018
Nine states included in maternal mortality review
1. Colorado
2. Delaware
3. Georgia
4. Hawaii
5. Illinois
6. North Carolina
7. Ohio
8. South Carolina
9. Utah
California
Pregnancy-Associated
Mortality Review
2002-2007
Spring 2018
Nine MMR Committees | 2018

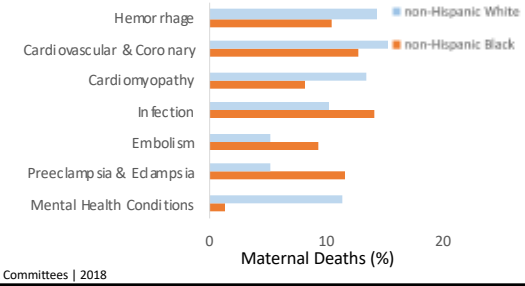

The Gerard W Ostheimer Lecture | SOAP 2019
Building US Capacity to Review & Prevent Maternal Deaths
Report from nine maternal mortality review committees 2018
2/3 deaths considered preventable (n=680)
63%
All Causes
68%
Cardiovascular Deaths
70%
Hemorrhage Deaths
Nine MMR Committees | 2018


The Gerard W Ostheimer Lecture | SOAP 2019
Building US Capacity to Review & Prevent Maternal Deaths
Report from nine maternal mortality review committees 2018
While pregnant
Hemorrhage
Cardiovascular
Disease
Postpartum
within 42 days
Infection
38%
17%
45%
Timing of death & frequent cause
Postpartum
43 to 365 days
"late deaths"
Cardiomyopathy
Nine MMR Committees | 2018


The Gerard W Ostheimer Lecture | SOAP 2019
Building US Capacity to Review & Prevent Maternal Deaths
Report from nine maternal mortality review committees 2018
Hemorrhage 14
Cardiovascular & Coronary 14
Cardiomyopathy 10.7
Infection 10.7
Embolism 8.4
Preeclampsia & Eclampsia 7.4
Mental Health Conditions 7
0
5
10
15
Maternal Deaths (%)
Nine MMR Committees | 2018

Building US Capacity to Review & Prevent Maternal Deaths

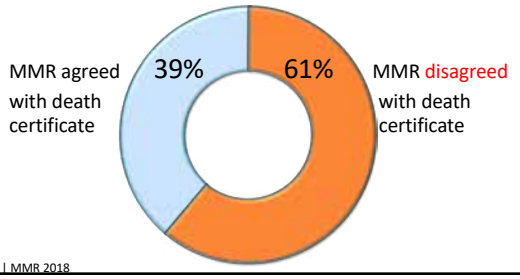
Report from nine maternal mortality review committees 2018



Nine MMR Committees | 2018

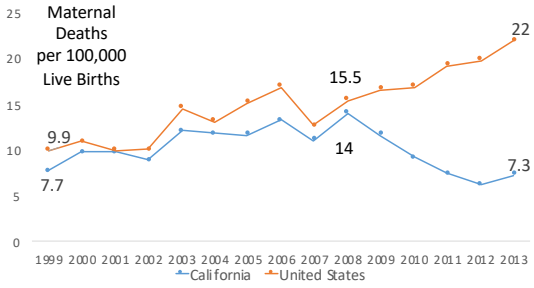
Illinois Maternal Morbidity & Mortality Report (2016-17)

Maternal Mortality Review (MMR) Death Certificate Review



Illinois | MMR 2018

California Pregnancy-Associated Mortality Review (2002-7)



California | MMR 2018

California Pregnancy-Associated Mortality Review (2002-7)

TOOLKITS

CMQCC California Maternal Quality Care Collaborative

- Cardiovascular Disease
- OB Hemorrhage V2.0
- Preeclampsia
- Venous Thromboembolism
- Early Elective Deliveries
- Supporting Vaginal Birth & Reducing Primary Cesarean Deliveries

California | MMR 2018

MBBRACE-UK Saving Lives Improving Mother's Care

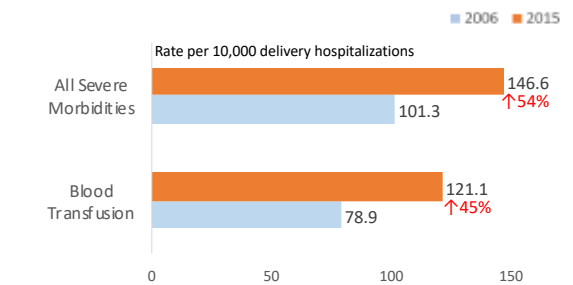
Deaths & Morbidity 2014-16

Risk of maternal mortality according to race

Black & Asian women have higher pregnancy mortality risk

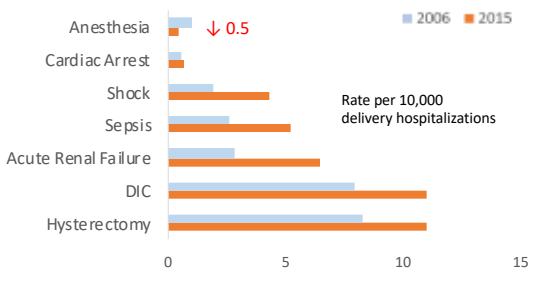
Knight | MBBRACE 2018

Severe Maternal Morbidity in Delivery Hospitalizations (2006-15)



Fingar | Healthcare Cost and Utilization Project Statistical Brief No 243

Severe Maternal Morbidity in Delivery Hospitalizations (2006-15)



Fingar | Healthcare Cost and Utilization Project Statistical Brief No 243

Maternal Morbidity

- Hemorrhage
- Cardiovascular Disease
- Venous Thromboembolism
- Infection
- Preeclampsia

Maternal Morbidity

- Hemorrhage
- Cardiovascular Disease
- Venous Thromboembolism
- Infection
- Preeclampsia

RCT: Postpartum Hemorrhage Prophylaxis after Vaginal Delivery

Frequency of PPH — Borovac-Pinheiro | AJOG 2018

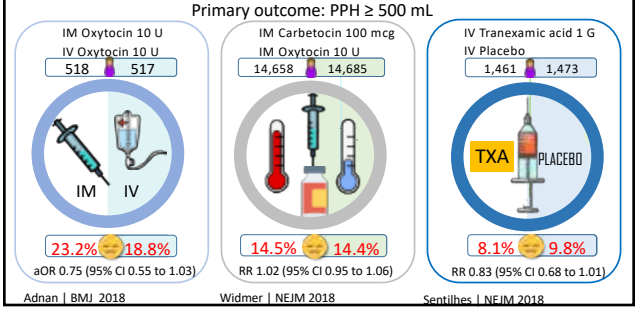
Better pharmacologic strategies needed for PPH prophylaxis after vaginal delivery

Study Design	Blinded randomized controlled trial
Primary Outcome	Frequency of PPH ≥ 500 mL

Adnan | BMJ 2018 Widmer | NEJM 2018 Sentilhes | NEJM 2018

RCT: Postpartum Hemorrhage Prophylaxis after Vaginal Delivery

Primary outcome: PPH ≥ 500 mL



Adnan | BMJ 2018 Widmer | NEJM 2018 Sentilhes | NEJM 2018

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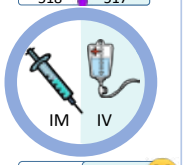
RCT: Postpartum Hemorrhage Prophylaxis after Vaginal Delivery

IM Oxytocin 10 U
IV Oxytocin 10 U
518 517



8.1% 4.6%
OR 0.54 (95% CI 0.32 to 0.91)

Single center

Secondary outcome: Severe PPH ≥ 1000 mL

IV Oxytocin superior to IM for severe PPH

COMMENT

Relatively high PPH rates
Collecting bags measured blood loss

Adnan | BMJ 2018

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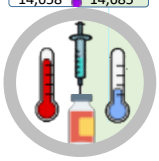
RCT: Postpartum Hemorrhage Prophylaxis after Vaginal Delivery

IM Carbetocin 100 mcg
IM Oxytocin 10 U
14,658 14,685



1.51% 1.45%
RR 1.04 (95% CI 0.87 to 1.25)

10 countries, 23 centers

Primary outcome: Severe PPH ≥ 1000 mL
Non-inferiority margin was 1.23

The Confidence Interval crossed margin

COMMENT

Drug company sponsored study
Both study drugs were cooled

Widmer | NEJM 2018

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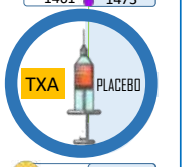
RCT: Postpartum Hemorrhage Prophylaxis after Vaginal Delivery

IV Tranexamic acid 1 G
IV Placebo
1461 1473



7.8% 10.4%
RR 0.74 (95% CI 0.61 to 0.91)

Multicenter

Secondary outcome: Clinically significant PPH

COMMENT

One-third of cohort had previous PPH
Prophylactic TXA in high-risk not investigated

Sentilhes | NEJM 2018

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Maternal Morbidity

Hemorrhage

Cardiovascular Disease

Venous Thromboembolism

Infection

Preeclampsia

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Cardiovascular Disease in Pregnancy (1994-2014)

Pregnancy Heart Team:
Anesthesiologist, cardiologist, obstetrician

European Society of Cardiology Guidelines | 2018

Study Design: Prospective observational study
CARPREG team

Primary Outcome: Incidence of maternal severe cardiac events

Silversides | J Am Coll Cardiol 2018

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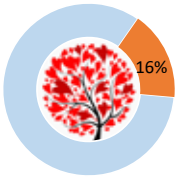
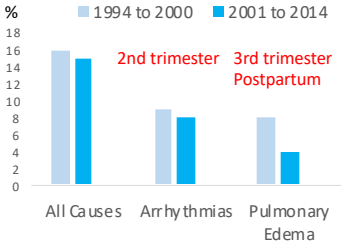
Cardiovascular Disease in Pregnancy (1994-2014)

1,938 women with cardiac disease & pregnancies > 20 weeks

Maternal severe cardiac events





Silversides | J Am Coll Cardiol 2018

Maternal Morbidity

- Hemorrhage
- Cardiovascular Disease
- Venous Thromboembolism
- Infection
- Preeclampsia

Illinois Maternal Morbidity & Mortality Report (2016-17)

Jasmine was a pregnant Black woman in her 20s

ER & LW

During pregnancy she presented 8 times to ER
Complained of calf pain & numbness
Severe leg pain during delivery hospitalization

Preventable death

Re-admitted after discharge - given analgesics & ice

Jasmine died of PE 18 days after delivery

Illinois | MMR 2018

Diagnosing Pulmonary Embolism in Pregnant Women

Clinical suspicion is vital to diagnose venous thromboembolism

D-dimer
not used to diagnose VTE

Study Design: Prospective diagnostic outcome management study (2 European countries, 11 centers)

Primary Outcome: VTE risk after PE excluded thus women not anticoagulated during 3 month follow-up

Righini | Ann Intern Med 2018

Diagnosing Pulmonary Embolism in Pregnant Women

Pretest probability
Geneva score (non validated in pregnancy)

395

Low/ Intermediate risk

-ve < 500 mcg/L

No PE
No anticoagulation

Clinical Signs of PE: New onset or worsening symptoms
Shortness of breath or chest pain
without obvious etiology

Righini | Ann Intern Med 2018

Diagnosing Pulmonary Embolism in Pregnant Women

Pretest probability
Geneva score (non validated in pregnancy)

Low/ Intermediate risk

-ve < 500 mcg/L

No PE
No anticoagulation

Pretest probability high risk and/or

+ve ≥ 500 mcg/L

No PE
No anticoagulation

V/Q Scan

Positive = PE

Righini | Ann Intern Med 2018

Diagnosing Pulmonary Embolism in Pregnant Women

PE Incidence: 93% of 395 women had PE excluded
7% women had PE diagnosed

VTE Risk: VTE risk in women who had PE excluded
0% (95% CI 0.0 to 1.0)
None had subsequent DVT, PE or died

COMMENT: Novel use of D-dimer to diagnose PE in pregnancy
Small population of negative D-dimer (n = 46)

Righini | Ann Intern Med 2018

SOAP Consensus Statement: Anesthesia for Pregnant & Postpartum Women on Thromboprophylaxis or Higher Dose Anticoagulants

Low Dose LMWH	Intermediate Dose LMWH	High Dose LMWH
e.g. Enoxaparin ≤ 40 mg od or < 30 mg bd	e.g. Enoxaparin > 40 mg od, 1.5 mg/kg od < 1 mg/kg bd	e.g. Enoxaparin 1 mg/kg bd or 1.5 mg/kg od
≥ 12 hours since last dose	Insufficient data ? 12 ? 24 hours	≥ 24 hours since last dose

No — Yes — Yes — No

Low risk to proceed with neuraxial block

Consider risks for hematoma versus GA risks

Leffert | Anesth & Analg 2018

SOAP Consensus Statement: Anesthesia for Pregnant & Postpartum Women on Thromboprophylaxis or Higher Dose Anticoagulants

Intermediate Dose LMWH
e.g. Enoxaparin
> 40 mg od, 1.5 mg/kg od
< 1 mg/kg bd

Insufficient data
? 12 ? 24 hours

Case vignettes discuss risks for spinal epidural hematoma versus general anesthesia

Early referrals for early decision making

Leffert | Anesth & Analg 2018

Maternal Morbidity

- Hemorrhage
- Cardiovascular Disease
- Venous Thromboembolism
- Infection
- Preeclampsia

ACOG Practice Bulletin: Antibiotics for Cesarean Delivery

INFECTION

- Cephalosporin (1st generation) 60 min prior to skin incision for cesarean delivery
- Azithromycin for urgent cesarean delivery (since 2016)
- Clindamycin + Gentamycin alternative e.g. significant penicillin allergy
- Vaginal cleansing not yet recommended

Haas | Cochrane 2018

ACOG | Obstet Gynecol 2018

Infection Associated with Cesarean Delivery Antibiotic Administered

INFECTION

Study Design	Retrospective single center study
Primary Outcome	Cesarean delivery infection rate after cefazolin vs. any alternative

Kawakita | Obstet Gynecol 2018

Infection Associated with Cesarean Delivery Antibiotic Administered

	Cefazolin 6,163 (93.9%)	Alternative 421 (6.4%)	Crude OR (95% CI)
Primary outcome (SSI composite)	4.5%	10.2%	2.43 (1.73 to 3.40)
Endometritis before discharge	1.8%	5.0%	2.94 (1.82 to 4.75)
Endometritis after discharge	0.4%	1.9%	4.40 (1.99 to 9.75)
Deep wound infection	0.4%	1.2%	3.36 (1.27 to 8.91)
Cellulitis	2.4%	5.7%	2.51 (1.61 to 3.91)

Kawakita | Obstet Gynecol 2018

The Gerard W Ostheimer Lecture | SOAP 2019

Infection Associated with Cesarean Delivery Antibiotic Administered

First generation cephalosporin versus inappropriate alternative

Cefazolin	n = 6,163
Inappropriate alternative	n = 147

aOR 4.13 (95% CI 2.59 to 6.36) for primary outcome

Kawakita | Obstet Gynecol 2018

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Algorithm to Select Antibiotic for Penicillin Allergy

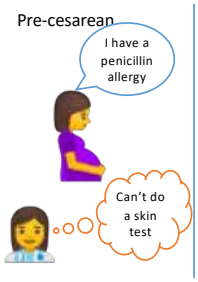
What we know	~ 10% report penicillin allergy Only 5% test positive
Cross Reaction	Cephalosporin crossreactivity 2 to 5%

Hermanides | Anesthesiology 2018

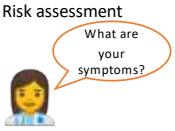
The Gerard W Ostheimer Lecture | SOAP 2019

Algorithm to Select Antibiotic for Penicillin Allergy

Pre-cesarean



Risk assessment



MILD: Skin rash > 2 hours after exposure to suspected allergen

SIGNIFICANT: Anaphylaxis, angioedema, respiratory distress, urticaria

Decision algorithm

MILD symptoms
GIVE CEFAZOLIN

SIGNIFICANT symptoms
AVOID B-lactams

Hermanides | Anesthesiology 2018

The Gerard W Ostheimer Lecture | SOAP 2019

Anaphylaxis in Pregnant Women

Life Threatening Anaphylaxis:

Airway
Breathing
Circulatory problem

Study Design	UK Obstetric Surveillance Survey (2012 to 15)
Primary Outcome	Anaphylaxis incidence in pregnancy

McCall | BJOG 2018

The Gerard W Ostheimer Lecture | SOAP 2019

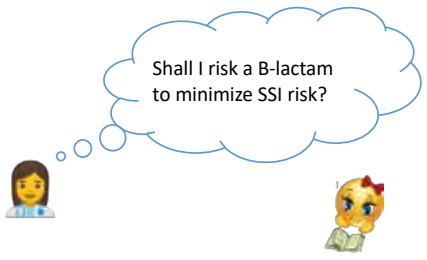
Anaphylaxis in Pregnant Women

Incidence	2,324,552 pregnancies, 37 cases of anaphylaxis Anaphylaxis incidence: 1.6 (95% CI 1.1 to 2.2) per 100,000 maternities
Cesarean Antibiotic	Anaphylaxis incidence to cesarean antibiotic: 2.1 (95% CI 1.1 to 3.6) per 100,000 maternities
Known Allergy	4 women with known penicillin allergy received B-lactams and had anaphylaxis

McCall | BJOG 2018

The Gerard W Ostheimer Lecture | SOAP 2019

Anaphylaxis in Pregnant Women



McCall | BJOG 2018 Kawakita | Obstet Gynecol 2018

Maternal Morbidity

Hemorrhage

Cardiovascular Disease

Venous Thromboembolism

Infection

Preeclampsia

Antihypertensive Drug Use in Preeclampsia (2006-14)

Antihypertensive drugs should be administered:
Systolic BP ≥ 160 mm Hg
Diastolic BP ≥ 105 mm Hg

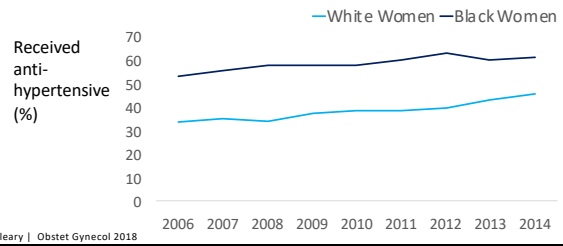
Study Design: Single center retrospective study

Primary Outcome: Antihypertensives during delivery hospitalizations in preeclampsia

Cleary | Obstet Gynecol 2018

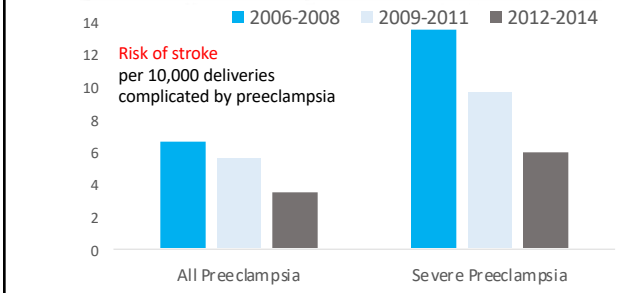
Antihypertensive Drug Use in Preeclampsia (2006-14)

239,454 women with preeclampsia
44% received an antihypertensive



Cleary | Obstet Gynecol 2018

Antihypertensive Drug Use in Preeclampsia (2006-14)



Cleary | Obstet Gynecol 2018

First Trimester B-Blocker Use & Risk of Congenital Anomalies

Study Design: Population databases
US & Nordic countries

Primary Outcome: Any major congenital abnormality after 1st trimester B-blocker use

Bateman | Ann Intern Med 2018

First Trimester B-Blocker Use & Risk of Congenital Anomalies

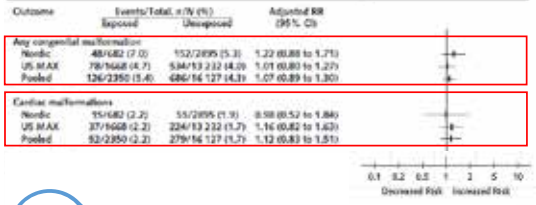
US Cohort:
Hypertensive women N = 14,900
Exposed to B-Blockers = 1,668 (11.2%)

Nordic Cohort:
Hypertensive women N = 3,577
Exposed to B-Blockers = 682 (19.1%)

Primary Analysis: Exposed versus unexposed women

Bateman | Ann Intern Med 2018

First Trimester B-Blocker Use & Risk of Congenital Anomalies



Summary

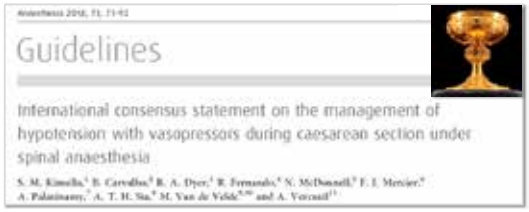
Maternal B-blocker 1st trimester use not associated with large increased risk of congenital abnormalities

Cleft lip risk imprecise (small numbers)

Bateman | Ann Intern Med 2018

Cesarean Delivery

Consensus Statement: Management of Hypotension during Cesarean Delivery under Spinal Anesthesia



Kinsella | Anaesthesia 2018

Consensus Statement: Management of Hypotension during Cesarean Delivery under Spinal Anesthesia

What we Know

Hypotension following spinal harmful to 🤰 & 👶

Hypotension is frequent (7 to 74%)

Klohr | Acta Anaesth Scand 2010

How to Avoid

Use vasopressor infusions as prophylaxis

Phenylephrine most recommended – most data

Left lateral uterine displacement

Colloid pre-load or crystalloid co-load

Kinsella | Anaesthesia 2018

Consensus Statement: Management of Hypotension during Cesarean Delivery under Spinal Anesthesia

Other Tips

Start infusion immediately after spinal injection

Top up vasopressor boluses if needed

Ephedrine in small doses if low heart rate

Future may be smart pumps/double infusions

Sng |EJA 2018

Special Cases

Women with preeclampsia have less hypotension

Kinsella | Anaesthesia 2018

RCT: Phenylephrine Versus Ephedrine in Preeclampsia

Is phenylephrine the best vasopressor for women with preeclampsia?

Study Design

Blinded randomized controlled trial

Two single center studies

Primary Outcome

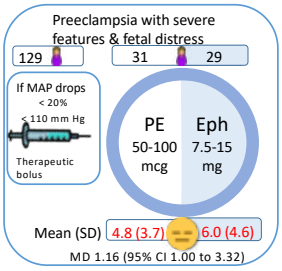
Fetal acid-base status

Dyer | IJOA 2018

Higgins | Anesth Analg 2018

The Gerard W Ostheimer Lecture | SOAP 2019

RCT: Phenylephrine Versus Ephedrine in Preeclampsia



Primary outcome:
Uterine artery base excess

Dyer | IJOA 2018

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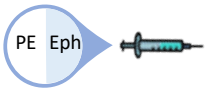
RCT: Phenylephrine Versus Ephedrine in Preeclampsia



Therapeutic bolus

COMMENT 47% had hypotension → randomized

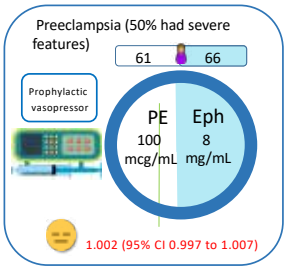
Women had severe disease & fetal distress
89% received magnesium; 94% had SBP > 160 mm Hg
Gestational age < 34 weeks; 19% were in labor

Prophylactic infusion?

Dyer | IJOA 2018

The Gerard W Ostheimer Lecture | SOAP 2019

RCT: Phenylephrine Versus Ephedrine in Preeclampsia

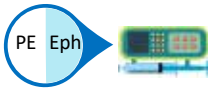


Primary outcome:
Uterine artery pH ratio PE:Eph

Higgins | Anesth Analg 2018

The Gerard W Ostheimer Lecture | SOAP 2019

RCT: Phenylephrine Versus Ephedrine in Preeclampsia



Prophylactic infusion

COMMENT Non-emergencies, 36 weeks gestational age

Infusion given for 2 min if SBP < 160 mm Hg
→ 32% infusion stopped & not restarted after 2 min

~ 50% had hypotension (SBP < 80% baseline)
Vasopressor boluses administered

Higgins | Anesth Analg 2018

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RCT: Spinal Hypotension Despite Colloid Preload in Preeclampsia

↑Cardiac output, ↓TPR after spinal anesthesia in healthy women
Dyer | Anesthesiology 2008

and also women with preeclampsia
Dyer | Anesthesiology 2009

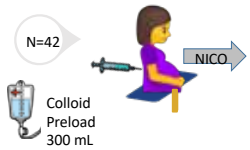
Study Design	Blinded randomized controlled trial
Primary Outcome	Cardiac output change after phenylephrine versus ephedrine to treat hypotension

Dyer | Anaesthesia 2018

The Gerard W Ostheimer Lecture | SOAP 2019

RCT: Spinal Hypotension Despite Colloid Preload in Preeclampsia

Stroke volume changes: non-invasive cardiac output monitor



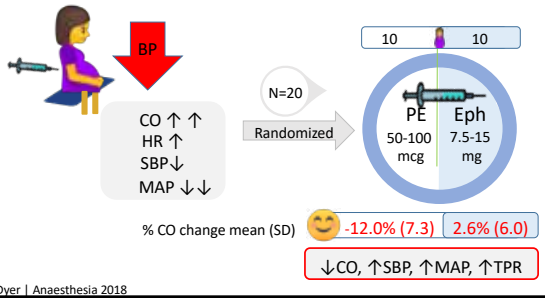
Post-spinal changes
CO ↑ (HR ↑ & SV ↑), TPR ↓

20/42 women had drop in BP MAP ≤ 80% baseline or < 110 mm Hg

Dyer | Anaesthesia 2018

The Gerard W Ostheimer Lecture | SOAP 2019

RCT: Spinal Hypotension Despite Colloid Preload in Preeclampsia



Dyer | Anaesthesia 2018

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RCT: Spinal Hypotension Despite Colloid Preload in Preeclampsia

Unpredictable response to colloid preload
Restrict fluids if not using cardiac monitoring

↓ BP

Treatment of hypotension despite colloid preload
Phenylephrine reversed hemodynamic changes more effectively than ephedrine

COMMENT

Cohort had maternal indication cesarean

Dyer | Anaesthesia 2018

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Stemming the Global Cesarean Delivery Epidemic

Part 1. Disparities of cesarean delivery availability & cesarean delivery rate optimization

Part 2. Consequences of cesarean delivery: Maternal mortality & morbidity

Part 3. Interventions to decrease cesarean delivery rates

Boerma | Lancet 2018 Sandall | Lancet 2018 Betran | Lancet 2018

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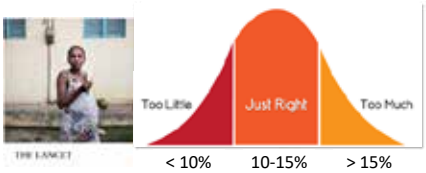
Stemming the Global Cesarean Delivery Epidemic



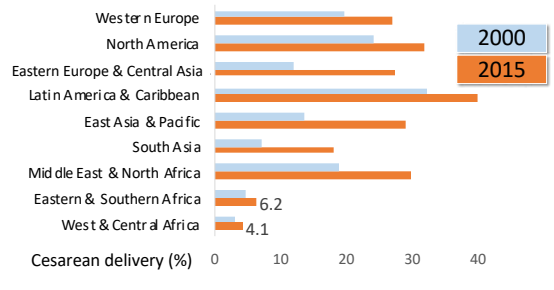
21% of 140·6 million livebirths were cesarean deliveries in 2015

Rate increased globally 3.7% per annum since 2000

Boerma | Lancet 2018 Sandall | Lancet 2018 Betran | Lancet 2018

The Gerard W Ostheimer Lecture | SOAP 2019

Stemming the Global Cesarean Delivery Epidemic



Boerma | Lancet 2018 Sandall | Lancet 2018 Betran | Lancet 2018

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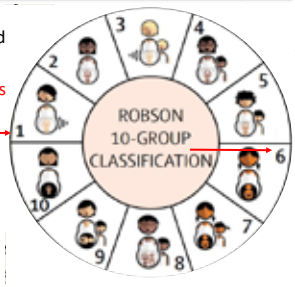
Robson 10-Group Classification System

Delivery rates can be compared using a classification system

10 delivery classification groups

Parity
Prior cesarean
Plurality
Fetal presentation
Gestational age
Labor onset mode



Hehir | Obstet Gynecol 2018

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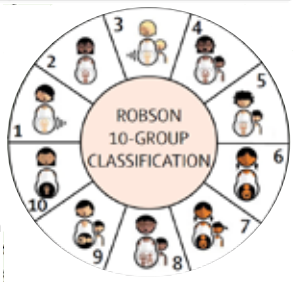
Robson 10-Group Classification System

USA population database
27,044,217 deliveries

All deliveries categorized according to the Robson 10-Group Classification System



Hehir | Obstet Gynecol 2018

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Robson 10-Group Classification System

Most common category
Expected vaginal delivery
Group 3
Multiparous
No scar
Singleton
Cephalic
> 37 weeks
Spontaneous labor

96 % vaginal delivery

Instead of cesarean delivery
Increase TOLAC
Group 5:
Multiparous
At least 1 scar
Singleton
Cephalic
> 37 weeks

88 % cesarean delivery

Hehir | Obstet Gynecol 2018

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Robson 10-Group Classification System

Instead of cesarean delivery
Perform ECV
Group 6:
Nulliparous
Breech

96 % cesarean delivery

COMMENT 10- Group Classification System highlights areas for improved care

Hehir | Obstet Gynecol 2018

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Placenta Accreta Spectrum Disorders

FIGO consensus guidelines on placenta accreta spectrum disorders: Conservative management

Sentilhes | Int J Gynaecol Obstet 2018 Placenta Accreta Spectrum | Obstet Gynecol 2018

The Gerard W Ostheimer Lecture | SOAP 2019

Placenta Accreta Spectrum Disorders: Conservative Management

FIGO consensus guidelines on placenta accreta spectrum disorders: Conservative management

Hysterectomy accepted approach for placenta accreta spectrum

Conservative management may avoid hysterectomy - select cases

Expectant management: leaving the placenta and uterus in situ

Extirpative technique: tugging the placenta manually

Sentilhes | Int J Gynaecol Obstet 2018

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Placenta Accreta Spectrum Disorders: Conservative Management

FIGO consensus guidelines on placenta accreta spectrum disorders: Conservative management

Tugging the placenta (extirpative):

Avoid if planning cesarean hysterectomy

Avoid in women with clinical signs of placenta accreta spectrum

Avoid if difficulties delivering the placenta

Sentilhes | Int J Gynaecol Obstet 2018

The Gerard W Ostheimer Lecture | SOAP 2019

Anesthesia for Placenta Accreta Spectrum Disorders

Study Design: Single center retrospective study

Cohort: 129 women with non-emergency cesarean, placenta accreta spectrum

Markley | Anesth Analg 2018

The Gerard W Ostheimer Lecture | SOAP 2019

Anesthesia for Placenta Accreta Spectrum Disorders

7/129 had planned GA

100% confirmed invasion of pathology
100% hysterectomy

3/7 (43%) placental tug

Markley | Anesth Analg 2018

The Gerard W Ostheimer Lecture | SOAP 2019

Anesthesia for Placenta Accreta Spectrum Disorders

122 had neuraxial anesthesia; 20 converted to GA

		GA 7	NA 122
BMI kg/m²	median (range)	32 (29 to 41)	28 (21 to 54)
Mallampati 3 or 4	n (%)	2 (29%)	18 (15%)
Bleeding as indication for cesarean	n (%)	2 (29%)	17 (14%)

5/20 women converted to GA had a difficult airway

Markley | Anesth Analg 2018

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Anesthesia for Placenta Accreta Spectrum Disorders

		GA 7	NA 122
BMI kg/m²	median (range)	32 (29 to 41)	28 (21 to 54)
Mallampati 3 or 4	n (%)	2 (29%)	18 (15%)
Bleeding as indication for cesarean	n (%)	2 (29%)	17 (14%)
Pre-cesarean invasive radiology	n (%)	4 (57%)	23 (19%)

Markley | Anesth Analg 2018

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Endovascular Balloon Catheters for Placenta Accreta Spectrum Disorders

No difference in bleeding
Less bleeding & transfusion

Shrivastava | Am J Obstet Gynecol 2007
Ballas | Am J Obstet Gynecol 2012

Study Design: Systematic review & meta-analysis

Primary Outcome: Prophylactic endovascular balloon interventions effect on blood loss

Shahin | Eur Radiol 2018

The Gerard W Ostheimer Lecture | SOAP 2019

Endovascular Balloon Catheters for Placenta Accreta Spectrum Disorders

Studies:
69 studies, n = 1, 811
16 controlled; 53 cohort/case series
1 Randomized controlled trial

Balloon Placement:
n = 1,395 (77%) had endovascular procedures:

Internal iliac arteries
Common iliac arteries
Uterine arteries
Infra-renal abdominal aorta

Shahin | Eur Radiol 2018

Endovascular Balloon Catheters for Placenta Accreta Spectrum Disorders

Result

14 studies: outcome = blood loss

Significantly ↓ blood loss

MD -0.9 L (95% CI -1.4 to -0.4) p<0.001

Result

11 studies: outcome = blood transfusion

Significantly ↓ blood transfusion

MD -1.5 units (95% CI -2.3 to -0.8) p<0.001

Shahin | Eur Radiol 2018

Endovascular Balloon Catheters for Placenta Accreta Spectrum Disorders

Summary

Low level evidence: Prophylactic endovascular balloons reduce blood loss & transfusion

COMMENT

No difference in hysterectomy rates

Complications in 87/1,395 women e.g.

Pseudo-aneurysm (2); Arterial thrombosis (16)

Intermittent claudication (10); Groin hematoma (10)

Uterine necrosis (2)

Maybe I should look into this further

Shahin | Eur Radiol 2018

Cesarean Delivery & Adequate Anesthesia

Study Design

Lessons learned from litigation cases over 21 years in UK

367 Cases

76 (21%) cesarean delivery

56/76 (74%) pain during cesarean

McCombe | Anaesthesia 2018

Cesarean Delivery & Adequate Anesthesia

Test the Block

1. Test the block level – 2 modalities

42% of cesareans started before the block level was verified

One woman said that she could feel the cold

The anesthesiologist said "I doubt you can"

McCombe | Anaesthesia 2018

Cesarean Delivery & Adequate Anesthesia

Believe the patient

2. Believe the patient when she says she is in pain

Blocks may fail even after testing

1.7% failure rate D'Angelo | Anesthesiology 2014

Unwillingness to believe the patient after a suitable block test

McCombe | Anaesthesia 2018

Each Baby Counts Report

Royal College of Obstetricians & Gynaecologists

49 Cases

Neonatal deaths or severe intrapartum brain injury

Critical anesthesia contributory factors

Only 20 (41%) review committees included an anesthesiologist

Each Baby Counts | RCOG 2018

Each Baby Counts Report

Royal College of Obstetricians & Gynaecologists

49 Cases

38 women had cesarean delivery

30/38 had GA

11/30 had failed labor epidural → delayed conversion to surgical anesthesia → delayed start of cesarean

Review labor epidural analgesia for efficacy:
"proactive management"

Mhyre | Anesth Analg 2016

Each Baby Counts | RCOG 2018

Each Baby Counts Report

Royal College of Obstetricians & Gynaecologists

Other reasons for delayed cesarean:

1. Lack of Communication
Degree of cesarean urgency & change in status

2. Difficult Intubation
5/30 had unanticipated difficult intubation

Need for difficult intubation strategy

Mushambi | Anaesthesia 2015

Each Baby Counts | RCOG 2018

Each Baby Counts Report

Royal College of Obstetricians & Gynaecologists

Maternal safety first

Maternal safety is the primary concern at all times

Haste to deliver should not compromise maternal safety

Each Baby Counts | RCOG 2018

Maternal Morbidity & Mortality

Cesarean Delivery

Labor Outcomes & Analgesia

Postpartum Care

RCT: Elective Term Induction Versus Expectant Management

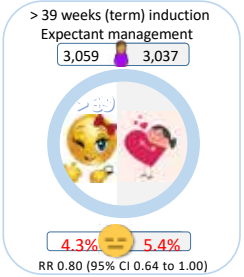
≥ 39 weeks

Study Design: Randomized controlled trial
USA, 41 centers (ARRIVE trial)
Non-blinded nulliparous cohort

Primary Outcome: Severe neonatal composite: Severe perinatal variables or neonatal death

Grobman | NEJM 2018

RCT: Elective Term Induction Versus Expectant Management



Primary outcome:
Severe neonatal composite

Week of delivery, median (IQR):

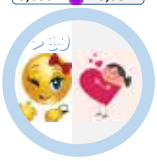
Induction: 39.3 (39.1 to 39.6)
Expectant: 40.0 (39.3 to 40.7) p < 0.001

Grobman | NEJM 2018

RCT: Elective Term Induction Versus Expectant Management

> 39 weeks (term) induction | Expectant management

3,059 | 3,037



18.6% | 22.0%

OR 0.84 (95% CI 0.76 to 0.93)

Secondary outcome:
Rate of cesarean delivery

Grobman | NEJM 2018

RCT: Elective Term Induction Versus Expectant Management

No difference for severe neonatal composite

Lower CD rate with elective term induction

Lower rate of hypertensive disorders of pregnancy

COMMENT

ACOG Practice Advisory:
Elective Term Induction may be offered

Generalizability concerns
- > 50,000 women evaluated
- > 44,000 excluded
- 16,427 declined to participate

Grobman | NEJM 2018

Statewide Variations for Neuraxial Analgesia in Labor

Statewide variations exist for obstetric practices

Study Design: Population database
Detailed USA birth certificates

Primary Outcome: Statewide variations for neuraxial analgesia

Butwick | JAMA Netw Open 2018

Statewide Variations for Neuraxial Analgesia in Labor

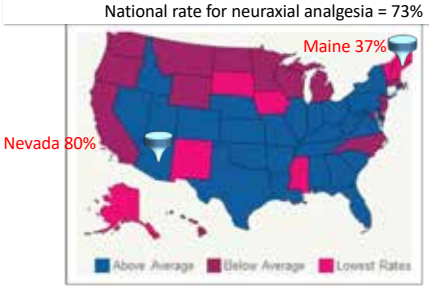
Study Population: 2,625,950 women
Vaginal or intrapartum cesarean deliveries in 2015

3 Models:
1. Statewide variation (null model)
2. Patient factors e.g. Prior CD, presentation, labor induction, gestational age
3. Anesthesia workforce per state

Butwick | JAMA Netw Open 2018

Statewide Variations for Neuraxial Analgesia in Labor

National rate for neuraxial analgesia = 73%



Butwick | JAMA Netw Open 2018

Statewide Variations for Neuraxial Analgesia in Labor

Result: Statewide variations not explained by state factors, patient factors or anesthesia workforce levels

Summary: Unmeasured factors accounted for differences:
? No available labor analgesia service
? Women preferred to deliver without epidural

COMMENT: Disparities have been described for labor analgesia
Toledo | Anesth Analg 2012

Butwick | JAMA Netw Open 2018

Postpartum Care

Pain Management in the "Fourth Trimester"

ACOG COMMITTEE OPINION

Postpartum Pain Management

Neuraxial Opioids & Postpartum Respiratory Depression After Cesarean Delivery

Neuraxial opioids offer the best postoperative analgesia

Study Design	Systematic review
Primary Outcome	Clinically significant respiratory depression (need for intervention) after neuraxial opioids

Sharawi | Anesth Analg 2018

Neuraxial Opioids & Postpartum Respiratory Depression After Cesarean Delivery

Result	75 studies; 54 Randomized controlled trials 18,452 women - neuraxial morphine/diamorphine
Result	16 clinically significant respiratory depression events 8.7 episodes (95% CI 4.2 to 15.2) per 10,000 cases
COMMENT	2 women received intrathecal low dose morphine (≤ 150 mcg)

Sharawi | Anesth Analg 2018

Inpatient & Discharge Opioid Use After Vaginal Delivery

Wide variation for postpartum recovery patterns

Komatsu | Anesthesiology 2017

Time to pain/opioid-free functional recovery:

median 21 days (range 3 to 85) Komatsu | BJA 2018

Inpatient opioid use — Discharge opioid use

Badreldin | Am J Obstet Gynecol 2018 Prabhu | Obstet Gynecol 2018

Inpatient Opioid Use After Vaginal Delivery

Study Design	Single center retrospective study
Primary Outcome	Inpatient opioid use after vaginal delivery

Badreldin | Am J Obstet Gynecol 2018

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Inpatient Opioid Use After Vaginal Delivery

Cohort 9,038 opioid naïve women after vaginal delivery

Result
97% received NSAIDs
26% received acetaminophen
25% received opioids
(median equivalence 4 tabs hydrocodone 5 mg)

Result 20% used opioid after uncomplicated vaginal delivery

Badreldin | Am J Obstet Gynecol 2018

The Gerard W Ostheimer Lecture | SOAP 2019

Discharge Opioid Use 1 Week After Vaginal Delivery

Study Design Nationwide population database

Cohort 1,345,344 women (opioid-free during pregnancy)

Result 29% filled opioid prescription within 1 week of discharge after vaginal delivery

Prabhu | Obstet Gynecol 2018

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Risk Factors for Opioid Use After Vaginal Delivery

Perineal laceration, neuraxial block, vaginal birth after cesarean delivery, postpartum hemorrhage and infectious complication

Perineal laceration, operative vaginal delivery, antidepressant use, tubal ligation

Badreldin | Am J Obstet Gynecol 2018 Prabhu | Obstet Gynecol 2018

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Opioid Use After Vaginal Delivery

Higher acetaminophen doses & senior prescriber: decreased risk of opioid prescribing

Geographic location accounted for risk difference

To Do Address opioid prescribing after vaginal delivery

Badreldin | Am J Obstet Gynecol 2018 Prabhu | Obstet Gynecol 2018

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Labor Analgesia & Postpartum Depression (PPD)

1 in 7 suffer PPD

Suicide is a leading cause of maternal death

Only 20% of women with PPD report symptoms

Edinburgh Postnatal Depression Scale
Quick test to assess for PPD

ACOG | Perinatal Depression 2018

The Gerard W Ostheimer Lecture | SOAP 2019

Labor Analgesia & Postpartum Depression (PPD)

Unclear association between labor epidurals & PPD

Study Design Prospective single center study

Primary Outcome Wanted/ Didn't get epidural & relationship to PPD

Orbach-Zinger | Anesth Analg 2018

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Labor Analgesia & Postpartum Depression (PPD)

Cohort: 1326 laboring women
Postpartum day 1 ? Labor epidural expectations

Unmet expectations	Expectations met
172 (13%) Wanted / Didn't get	811 (61%) Wanted / Got
121 (9%) Didn't want / Got	222 (17%) Didn't want / Didn't get

Edinburgh postnatal depression scale
6 weeks postpartum

Orbach-Zinger | Anesth Analg 2018

The Gerard W Ostheimer Lecture | SOAP 2019

Labor Analgesia & Postpartum Depression (PPD)

PPD Rate: 87/1326 (6.6%) women had PPD at 6 weeks

Who had PPD: No difference in PPD rates for women who wanted/didn't get epidural & other women

COMMENT: More PPD among women with unmet expectations

Orbach-Zinger | Anesth Analg 2018

The Gerard W Ostheimer Lecture | SOAP 2019

Labor Analgesia & Postpartum Depression (PPD)

Labor pain & PPD?

N=201

Retrospective observational single center study
Relationship between good epidural analgesia & PPD

Pain assessment before epidural: 0 — 10
Pain assessments after epidural: 0 — 10

Percent Change in Pain (PIP)
Baseline minus average intrapartum/Baseline
High score = good epidural analgesia

Edinburgh postnatal depression scale
6 weeks postpartum

Lim | Anesth Analg 2018

The Gerard W Ostheimer Lecture | SOAP 2019

Labor Analgesia & Postpartum Depression (PPD)

Result: Good epidural analgesia was associated with lower Edinburgh postnatal depression scale

COMMENT: Connection between labor epidural analgesia & PPD still unclear but may be significant

Orbach-Zinger | Anesth Analg 2018 Lim | Anesth Analg 2018

The Gerard W Ostheimer Lecture | SOAP 2019

Maternal Morbidity & Mortality

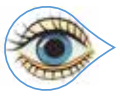
Cesarean Delivery

Labor Outcomes & Analgesia

Postpartum Care

The Gerard W Ostheimer Lecture | SOAP 2019

Use prophylactic infusions of phenylephrine
Use antihypertensives
Check the neuraxial block; Believe the patient in pain
Infection risk versus B-lactam anaphylaxis risk
Targeted opioid prescribing after labor
Endovascular balloons for placenta accreta spectrum
Postpartum depression & labor analgesia
D-dimers to investigate pulmonary embolus
Impact of elective term inductions



THANK YOU

Division of Anesthesia & Pain & Intensive Care

What's New In Neonatology?

Alan D. Bedrick MD

Division of Neonatology and Developmental Biology
Department of Pediatrics
University of Arizona College of Medicine
Tucson, Arizona

THE UNIVERSITY OF ARIZONA. College of Medicine

DISCLOSURE

I have no vested interest or intention to discuss off-label and/or investigational use of pharmaceuticals or devices

I have no financial or other relationship with any manufacturer or commercial product or services discussed in this presentation

(other than the U of A which I love dearly)

Eat, Sleep and Console:

Non-Pharmacologic Management of Neonatal Abstinence Syndrome

Why this approach?

Traditional

- Routine Morphine every 3 hours
- Length of stay 3 – 4 weeks
- Judgmental Environment

FC NAS

- Little or no morphine
- Length of stay 5-10 days
- Nurses, medical team, and families partner together!

Tucson's Success…
30 Infants (as of December 2019)
Average Length of Stay 6 days
<10 doses of Morphine total

Checklist

- Mother hears about program – Flyers!
  - Early identification of moms (ie..Antepartum – MAT, OB Office; Maternal Substance Ab use Clinics)
- Mother contacts NICU to schedule an appointment
- Neonatal Consult (ideally) to outline expectations
  - Caregiver (Mom, Dad, Grandparent, Adoptive Parents)
  - Available at bedside for a reasonable amount of time
  - Calendar, Handout (consoling), Recommendation for family to watch Video – Dr. Karp's "Happiest Baby on the Block"
  - **Notification: At birth, mom and baby are drug tested**
  - **Methadone or Subutex are okay**
  - **Drug screen must be negative for anything that is not prescribed.**
- Notify Labor/Delivery upon arrival of plan to be in program

Labor/Delivery & Post Partum

- L/D notify NICU Medical Team
- Routine care on Post-Partum with Finnegan Scoring
- If Scores exceed threshold (ie…three consecutive scores over 8), infant is transferred to NICU
- Mom is discharged ASAP in order to stay in unit with baby
- Baby managed with Eat, Sleep, and Console in private room in NICU

Eat, Sleep, Console

Eat –Able to eat at least 1 ounce/feed or breast feed well. If unable to eat (too sleepy or uncoordinated), consider placing a NG tube for feeding.

Sleep –Able to sleep for at least 1 hour undisturbed. May have to be held to sleep.

Console –Able to be consoled within 10 minutes. Baby should be fed with clean diaper. If unable to console in 10 minutes another person should try for 10 minutes (Set a timer)

If still not able to console after 20 minutes, a one-time dose of morphine (0.05mg/kg) can be given.

Infant placed on pulse oximetry for 4 hours after morphine dose.

Reassessed 3 hours after first dose to ensure infant remains consoled

In the NICU…

- Rooming in one of the private rooms off monitor
  - (Pulse oximeter x 4 hours if morphine dose given)
- Encourage breastfeeding or sensitive formula (on demand)
- Prophylactic Skin Barrier to Diaper Area
- Sucrose only for painful procedures
  - Not appropriate for treatment of fussiness with NAS
- Family provides **24 hour** care for infant (including nighttime).
- Staff can relieve for breaks (clinic, eat, shower, nap, etc.)
- Parents can sleep through 1 set of cares (3 hour) period at night
- Give parents or ourselves a break when becoming overwhelmed with crying infant

Family Supportive Care

- Our job…teach parents how to care and console.
- Every situation is different so use your best judgment. We want to support them, but not set them up for failure when they go home
  - Example: if staff take the baby for long lengths of time to allow family to sleep – this may not paint an accurate picture of the baby for the family. Once they go home, they won't have us ☺
- Initially more staff assistance as the parents learn to console, then towards discharge, parents should be the ones with the ability to calm the infant.
- It is **always appropriate** to give parents or ourselves a break when becoming overwhelmed with crying infant!
- DCS to determine final discharge outcome
- MOM IS THE TREATMENT!

What is Different?

- Assessments
  - Routine Assessments with Vital Signs once a shift preferably done in the patient's room. *Do not wake baby to do assessment
  - No routine blood pressure
  - Daily weights and weekly measurements
- NAS scores at least 3x per shift done 30-60 minutes AFTER feeding (Data Collection only - not treating based on scores)
- Hourly rounding
  - Document what is going on in room (mom holding, feeding, sleeping, etc.)
  - Parents caught sleeping while holding infant or if they are asleep with infant in the bed
    - Educated and receive warning infant will be removed from room it is happens again.
    - Happens again? Infant is placed in a bed space in the NICU for 12 hours and parents need to come to bedside to provide care for baby.
    - If it happens a third time, the infant is removed from the room for 24 hours.

Additional Measures

- Keep lighting dim and room quiet
- May use low "White Noise" to keep infant from hearing you enter/leave room
- Side lying while held by care givers, use "back to sleep" when sleeping in crib
- T-shirts with hand covers
- Start prophylactic skin barrier to bottom upon admission and escalate as soon as redness appears
- SWADDLING

What If Nothing Is Working?

Give the baby to another provider who attempts to console the infant.

The second person can be a nurse, NNP, resident, attending… **Anyone** who is well versed in the techniques of consoling infants

Didn't work? Try the next step…

Call the NNP/Resident

- If two caregivers cannot console the infant after trying 10 minutes each – call the NNP/resident
- A one time rescue dose of Morphine (0.05mg/kg) should be given
- Infant will need to be monitored on a pulse oximeter x 4 hrs after Morphine dose

Any member of the team can console

Team Approa

Ethical Dilemmas in the Neonatal Intensive Care Unit:

An Avalanche on the Slippery Slope

Case Presentation

39 y.o. G4 P3 presents at 23 5/7 weeks gestation with vaginal bleeding; passing clots; ROM; ctx. Both parents are physicians.
U/S: placental abruption. FHR ~115 with relatively flat baseline.
Decreased fetal movement x 12 hours. Pregnancy otherwise without complication.

Social: 3 children healthy; all in private school.
Ave. GPA = 3.8

Exam: Clots present. Fetal extremity in cervix. Ctx q. 3 min.

Counseled by neonatologist re: survival/outcomes.

Case Presentation

39 y.o. G4 P3 presents at 23 5/7 weeks gestation with vaginal bleeding; passing clots; ROM; ctx. Both parents are physicians.
U/S: placental abruption. FHR ~115 with relatively flat baseline.
Decreased fetal movement x 12 hours. Pregnancy otherwise without complication. No antenatal steroids.
Counseled by neonatologist re: survival/outcomes.

Social: 3 children healthy; all in private school.
Ave. GPA = 3.8

Exam: Clots present. Fetal extremity in cervix. Ctx q. 3 min.

Parents request no obstetric aggressive intervention / EFM

Parents request no neonatal resuscitative measures

Case Presentation

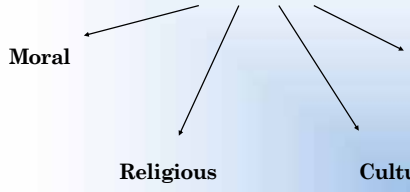
Parents request no obstetric aggressive intervention or EFM
Parents request no neonatal resuscitative measures

Infant born 2 hours later: Male infant
HR ~ 110; RR ~ 50 w/ G, F, R;
Slight cyanosis; BW = 675 grams

NOW WHAT?

Ethical Dilemmas

NO ALGORITHMS!!



The Slippery Slope: The assumption that just because one event occurs, it will automatically lead to a series of undesirable events

Nature of NICU Care Is Changing

2000's: VLBW Infants
Newborns w/ hypoxic insults
Chronic illness

"Technology has allowed severely affected infants to survive, sometimes because of that technology"

The "Dilemma" is Changing

Past: No dilemmas in years passed; No interventions were performed capable of supporting life

Present: Try each / all possible medications and procedures

Push the limits of an infant's physiology

Ethical Assumptions

"We assume that use of technology to preserve life is always a good worth to pursue"

Technologies: exogenous surfactant
ventilation
ECMO

Do we, at times, prolong the dying process?

OR

Allow for survival of a child with severe physical and cognitive handicaps?

Approaches to Care

Wait Until Certainty

Statistical Approach

Individualized Approach

Approaches to Care

Wait Until Certainty

- treatment for all
- wait until all the information is in

- then, ask whether initiating / continuing care is the "right" thing to do

Err on the side of maintaining life

Approaches to Care

Wait Until Certainty

Avoids the death of an infant who might survive with a fairly good outcome

However, it is at the "expense" of infants who live with severe handicaps

Approaches to Care

Statistical Approach

- Determine patient categories in which treatments may be limited or withheld

Sweden: < 25 weeks
< 600 grams

warmth, touch, nutrition
supplemental oxygen
NO VENTILATION

NIH Prematurity Statistical Database

NICHD Neonatal Research Network (NRN): Extremely Preterm Birth Outcome Data

Can I use the data to determine individual outcomes?

These data are not intended to be predictive of individual infant outcomes. Instead, the data provide a range of possible outcomes based on specific characteristics.

If you choose to use these data to determine possible outcomes, please remember that the information provided is not intended to be the sole basis for care decisions, nor is it intended to be a definitive prediction of outcomes if intensive care is provided. Users should keep in mind that every infant is an individual, and that factors beyond those used to formulate these standardized assessments may influence an infant's outcomes.

Enter the characteristics below.

Gestational Age *(Best Obstetric Estimate in Completed Weeks)*: 23 weeks

Birth Weight *(401 Grams to 1,000 Grams)*: 675 grams

Sex: Female / Male

Singleton Birth: Yes / No

Antenatal Corticosteroids *(Within Seven Days Before Delivery)*: Yes / No

View Outcome Estimates | Clear

NICHD Neonatal Research Network (NRN): Extremely Preterm Birth Outcome Data

Based on the following characteristics:

Gestational Age *(Best Obstetric Estimate in Completed Weeks)*: 23 weeks
Birth Weight: 675 grams
Sex: Male
Singleton Birth: Yes
Antenatal Corticosteroids: No

Estimated outcomes* for infants in the NRN sample are as follows:

Outcomes	Outcomes for All Infants	Outcomes for Mechanically Ventilated Infants
Survival	23%	35%
Survival Without Profound Neurodevelopmental Impairment	13%	19%
Survival Without Moderate to Severe Neurodevelopmental Impairment	6%	9%
Death	77%	65%
Death or Profound Neurodevelopmental Impairment	87%	81%
Death or Moderate to Severe Neurodevelopmental Impairment	94%	91%

NICHD Neonatal Research Network (NRN): Extremely Preterm Birth Outcome Data

Based on the following characteristics:

Gestational Age *(Best Obstetric Estimate in Completed Weeks)*: 23 weeks
Birth Weight: 675 grams
Sex: Female
Singleton Birth: Yes
Antenatal Corticosteroids: Yes

Estimated outcomes* for infants in the NRN sample are as follows:

Outcomes	Outcomes for All Infants	Outcomes for Mechanically Ventilated Infants
Survival	50%	60%
Survival Without Profound Neurodevelopmental Impairment	35%	44%
Survival Without Moderate to Severe Neurodevelopmental Impairment	23%	29%
Death	50%	40%
Death or Profound Neurodevelopmental Impairment	65%	56%
Death or Moderate to Severe Neurodevelopmental Impairment	77%	71%

Approaches to Care

Individualized Approach

Initiate care on any infant with a chance of survival, but determine as soon as possible, whether continuing care is in the best interests of the infant

- Decision making before all information is in
- Ongoing re-assessment

Neonatal Intensive Care: Dramatic Success or Misguided Efforts

- Lung immaturity indicates a threshold of 22-23 weeks

<22 weeks; < 500 g.: comfort care
23 / 24 weeks: "flexibility"
observe infant at birth
family values/wishes considered
25 weeks: full resuscitation

Any child with a reasonable chance to survive (23 – 24 wks., 500 g.) is aggressively supported; treatment options discussed after initial response is assessed

HYPOXIC ISCHEMIC ENCEPHALOPATHY:

Management and Patient Identification

Case Scenario

- 32 year old G2P1 woman whose last baby was delivered via C-Section for breech presentation, but who wished to attempt a vaginal birth for this pregnancy. The woman, who is at term and had been in labor for the past 4 hours, suddenly complained of excruciating abdominal pain, became hypotensive, and fetal heart rate was undetectable. An emergency C-Section is performed under general anesthesia.

Case Scenario

- The baby is delivered and is brought to the resuscitation warmer. Initial assessment reveals an unresponsive floppy infant with no respiratory effort and a heart rate of 70 bpm. Resuscitation is undertaken. Following intubatin, subsequent Apgar scores are 1, 3, and 7 at 1, 5 and 10 minutes, respectively. The baby is transferred to the NICU for further care.

Definitions

- Hypoxia or Anoxia: A partial (hypoxia) or complete (anoxia) lack of oxygen in the brain or blood
- Asphyxia: The state in which placental or pulmonary gas exchange is compromised or ceases altogether
- Ischemia: The reduction or cessation of bloodflow to an organ which compromises both oxygen and substrate delivery to the tissue
- Hypoxic-Ischemic Encephalopathy: Abnormal neurologic behavior in the neonatal period arising as a result of a hypoxic-ischemic event.

Etiology of HIE (Acute, Chronic)

- Maternal:
  - Cardiac arrest
  - Asphyxiation
  - Severe anaphylaxis
  - Status epilepticus
  - Hypovolemic shock
- Uteroplacental:
  - Placental abruption
  - Cord prolapse
  - Uterine rupture
  - Hyperstimulation with oxytocic agents (?)
- Fetal:
  - Fetomaternal hemorrhage
  - Twin to twin transfusion
  - Severe isoimmune hemolytic disease
  - Cardiac arrhythmia

Pathophysiology: Timing is everything!

- Gestational age plays an important role in the susceptibility of CNS structures
  - < 20 weeks: Insult leads to neuronal heterotopia or polymicrogyria
  - 26-36 weeks: Insult affects white matter, leading to periventricular leukomalacia
  - Term: Insult affects primarily gray matter

Pathophysiology

- Acute HIE leads to primary and secondary events:
  - Primary neuronal damage: cytotoxic changes due to failure of microcirculation → inhibition of energy-producing molecular processes → ATPase membrane pump failure → cytotoxic edema and free radical formation → compromised cellular integrity
  - Secondary neuronal damage: May extend up to 72 hours or more after the acute insult and results in an inflammatory response and cell necrosis or apoptosis (fueled by reperfusion)

Diagnosis

- There is no clear diagnostic test for HIE
- Abnormal findings on the neurologic exam in the first few days after birth is the single most useful predictor that brain insult has occurred in the perinatal period
- *Essential Criteria for Diagnosis of HIE:*
  - Metabolic acidosis (cord pH <7 or base deficit of >12)
  - Early onset of encephalopathy
  - Multisystem organ dysfunction (+/-)

Assessment Tools in HIE

- Neuroimaging
  - Cranial ultrasound: Not the best in assessing abnormalities in term infants. Echogenicity develops gradually over days
  - CT: Less sensitive than MRI for detecting changes in the central gray nuclei
  - MRI: Most appropriate technique and is able to show different patterns of injury. Presence of signal abnormality in the internal capsule later in the first week has a very high predictive value for neurodevelopmental outcome
  - Amplitude-integrated EEG (aEEG)

CNS complications

- Most widely reported and best known sequelae
- Major findings include: intracranial hemorrhage, cerebral infarction, cerebral edema & gross brain swelling (BG/Watershed)
- Clinical manifestations: abnormal states of consciousness and tone, full or tense anterior fontanel, irritability, tremors, convulsions and poor suck
- Long Term: Static Motor Encephalopathy
  Cognitive Impairment

CNS complications

Pharmacologically management:

Anticonvulsants (phenobarbital, Keppra, phenytoin) [Sz around 6-30 hrs]

Sedation, especially if ventilated and cooled (morphine, midazolam)

Pulmonary Complications

- Provide respiratory support if required (CPAP or ventilation)
- Monitor respiratory status by observation and blood gases
- Treat underlying pathology, ie. sepsis (antibiotics), meconium aspiration/PPHN (ventilation/nitric oxide), poor or no respiratory drive due to CNS complications (ventilation)

Metabolic complications

Monitor and manage sequelae such as:

- **Metabolic acidosis** (ventilate and use sodium bicarbonate corrections)
- **Hypoglycemia** (initial infusion of 10% dextrose, but more concentrated solutions may be required if fluid restriction is required)
- **Hypocalcemia** (calcium corrections)
- **Hyponatremia**: dilutional or actual? (Fluid restrict for dilutional or replace Na if losing it through the kidneys)
- **Monitor blood pressure**, iatrogenic blood loss (from mulitiple tests) and **hematocrit** level (will give you an indication of degree of hemodilution or concentration)

Therapeutic Hypothermia

- Term Infants, cooling is started within 6 hrs of birth to 33.5 degrees Centigrade x 72 h.
- Cooling can be started at the hospital of birth and continued throughout transport, by using simple equipment (passive coolong). The aim is to lower the brain temperature to protect it from damage
- This treatment could prevent as many as **1 in 7** from dying or surviving with a significant disability

Hypothermia - Mechanism of Action

- Reduces cerebral metabolism, prevents edema
- Decreases energy utilization
- Reduces/suppresses cytotoxic amino acid accumulation and nitric oxide
- Inhibits platelet-activating factor, inflammatory cascade
- Suppresses free radical activity
- Attenuates secondary neuronal damage
- Inhibits cell death
- Reduces extent of brain damage
  - + DEATH OR SEVERE DISABILITY AT 18 MONTHS OF AGE SIGNIFICANTLY REDUCED!!

Outcomes

- The location and extent of damage, and the immediate medical management, will determine the short and long term outcomes
- It is possible to have no long term complications as a result of a brain injury at birth
- But complications that can occur are delayed, or failure to reach, milestones (as determined by developmental assessments); cerebral palsy; death

Neonatal Procedural Pain

Neonates are capable of mounting robust physiologic, Behavioral, hormonal and metabolic responses to stimuli (as early as 22 weeks gestation)

Such stimuli can have adverse short and long term effects

Early and repeated exposure to painful stimuli can lead to persistent behavioral changes (heel sticks)

Neonates in an NICU experience greater than 16 painful procedures per day, most of which are still performed without effective pain control (over 100 interruptions/d)

General Principles of Neonatal Procedural Pain Management

- Environmental, behavioral and non-pharmacologic measures recommended for procedures

  pacifier with sucrose + distraction techniques

- For planned procedures (blood sampling, vascular access), an optimal baseline of quiet wakefullness should be obtained
- If possible, do not interrupt sleep; plan for recovery time from other painful procedures.

Neonatal Pain –> Neurodevelopmental Focus

Conduct procedure in a calm, relaxing environment with minimal external noxious stimuli

Monitor pain and stress as a 5th vital sign during painful procedures With validated neonatal pain scales

Post procedure, monitor physiologic parameters until they return to baseline state, and plan no other painful/disruptive procedures for atleast 2 hours after the procedure

Heel Sticks

- Venipuncture preferred as it is less painful
- Distraction techniques

  Massage/tallking to baby while administering oral glucose

  Involve the Mother
  skin to skin, breastfeeding
  (efficacy of breast feeding during multiple painful procedures not documented)

  DO NOT squeeze the heel – squeezing itself is a cause of pain

  WARMING the heel does not alter the pain response

Heel Sticks

Measures to control pain:

Use sucrose or non-nutritive sucking/human milk

administration of multiple doses 2 minutes before a procedure, immediately before and 2 min after heel lancing is more effective than a single dose

EMLA cream not recommended

Tracheal Intubation

Many different approaches with a wide variety of medications For elective intubation

opiates (fentanyl)
muscle relaxants (paral;ytic agent)
sedation (midazolam)

Appropriate analgesia/sedation results in fewer intubation attempts and shorter times

(residents successfully < 50% of the time)

Lumbar Puncture

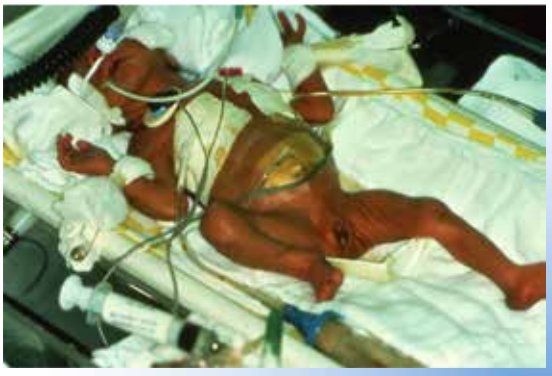
Avoid extreme neck flexion and knees towards the chest ->
significant hypoxemia

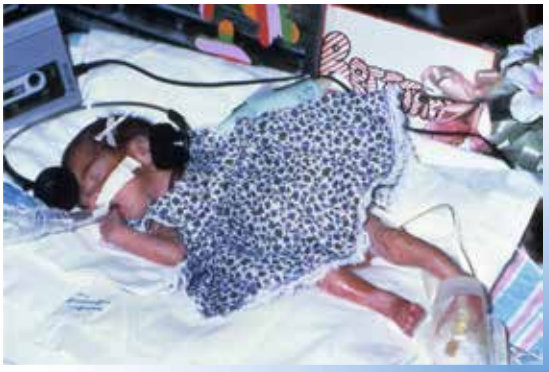
Use needle with stylet
(early stylet removal improves success rate) vs. 23 G butterfly)

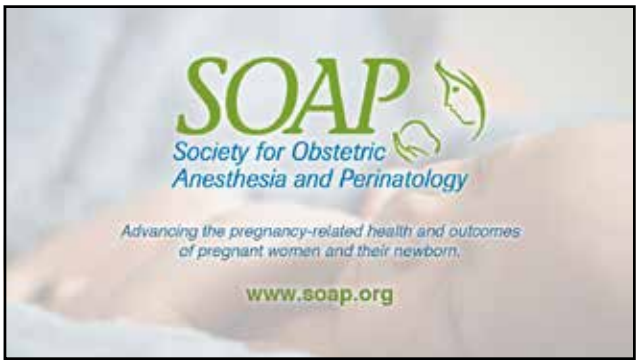
Non-pharmacologic measures:
Sucrose, non-nutritive sucking, human milk

Pharmacologic measures
Apply EMLA cream 60" prior to the procedure

If the patient is intubated:
systemic analgesia/sedation with slow IV opiate bolus







Management of Neuraxial Labor Analgesia

Kenneth E Nelson, M.D.
Wake Forest School of Medicine

Disclosures: none.

SOAP Society for Obstetric Anesthesia and Perinatology

Learning Objectives

- Compare various neuraxial techniques for labor analgesia.
- Utilize PCEA and PIEB for labor analgesia maintenance.
- Determine the most appropriate management after accidental wet tap occurs.

Three "best" references

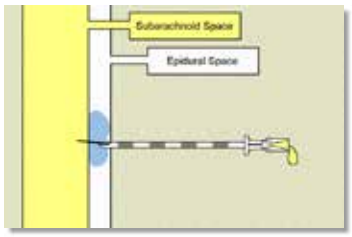
- Techniques:
  - Simmons SW, Taghizadeh N, Dennis AT, Hughes D, Cyna AM. Combined spinal-epidural versus epidural analgesia in labour. Cochrane Database Syst Rev. 2012 Oct 17;10:CD003401.
- Maintenance:
  - Carvalho B, George RB, Cobb B, McKenzie C, Riley ET. Implementation of Programmed Intermittent Epidural Bolus for the Maintenance of Labor Analgesia. Anesth Analg. 2016 Oct;123(4):965-71.
- Wet tap management:
  - Russell IF. A prospective controlled study of continuous spinal analgesia versus repeat epidural analgesia after accidental dural puncture in labour. Int J Obstet Anesth. 2012 Jan;21(1):7-16.

Outline

- Techniques
  - CSE
  - DPE
- Maintenance
  - PCEA
  - PIEB
- Wet Tap Management
  - Spinal catheter
  - Resite epidural

Techniques

CSE



CSE

- Advantages (vs traditional epidural)
  - Faster onset
  - Greater reliability
  - Less motor block
  - Confirmation of epidural needle position

Cochrane Database Syst Rev. 2003;(4)

CSE

- Advantages (vs traditional epidural)
  - Faster onset
  - Less need for rescue analgesia
  - Less urinary retention
  - Less instrumental deliveries

Cochrane Database Syst Rev. 2012

CSE

- Advantages
  - Faster cervical dilation
    - Versus epidural
    - Versus systemic analgesia

Tsen Anesthesiology 1999;91:920-5
Wong N Engl J Med 2005;352:655-65

CSE

- Disadvantages
  - Opioid induced pruritus
  - Untested catheter
  - FHR effects

CSE-associated FHR changes

06:47 CSE injection
06:54 Onset of FB
06:56 Maternal BP unchanged
Fluids, oxygen, positioning, ephedrine
07:05 FHR normal
Uneventful remainder of labor and delivery at **08:44**

CSE-associated FHR changes

- **Meta-analysis**
  - CSE vs Epidural
  - 17 trials (3947 parturients)
  - NRFHRT
  - Fetal bradycardia

Hattler et al. Anesth Analg. 2016;123(4):955-64

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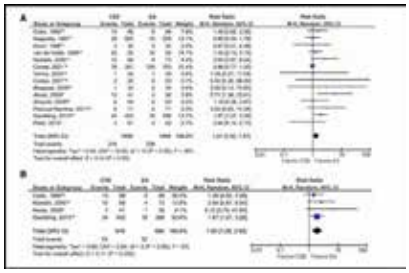
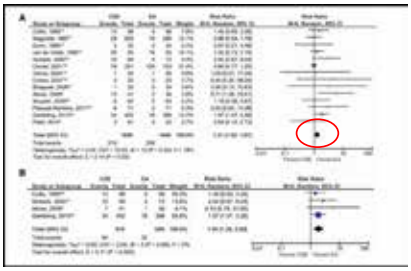
CSE-associated FHR changes



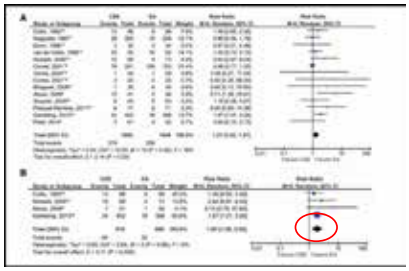
Hattler et al. Anesth Analg. 2016;123(4):955-64

CSE-associated FHR changes



Hattler et al. Anesth Analg. 2016;123(4):955-64

CSE-associated FHR changes



Hattler et al. Anesth Analg. 2016;123(4):955-64

CSE

- Recipe
  - **Bupivacaine**
    - <2.5mg
    - WFU: 1.75mg (0.7ml of 0.25%)
  - **Fentanyl**
    - <50 mcg
    - WFU: 15 mcg (0.3ml)
  - **Sufentanil**
    - <7.5 mcg
    - Potency sufentanil:fentanyl 4.4 : 1

Nelson Anesthesiology. 2002 May;96(5):1070-3

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Dural Puncture Epidural (DPE)

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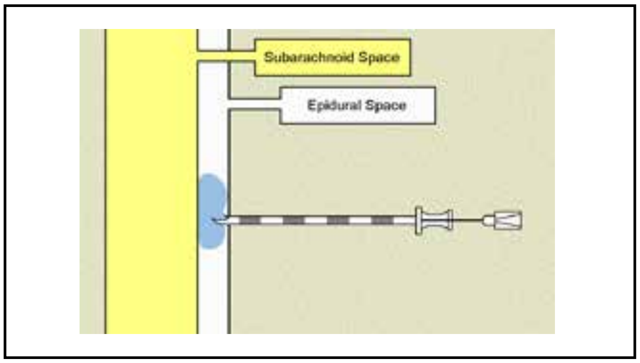
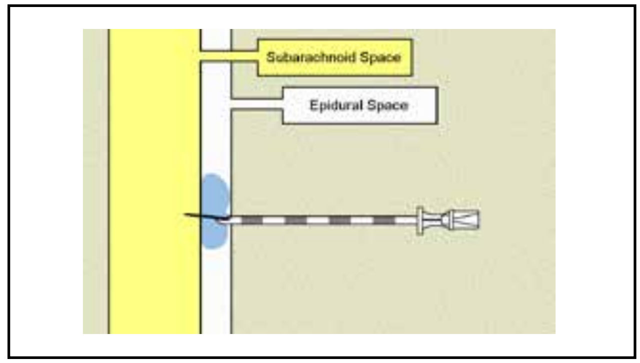
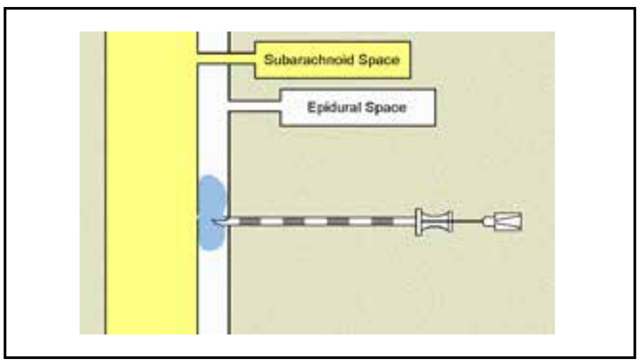
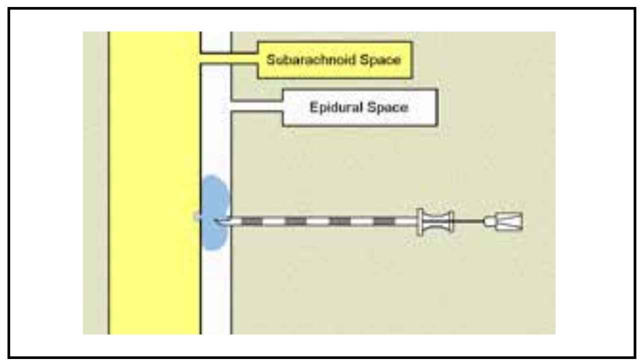
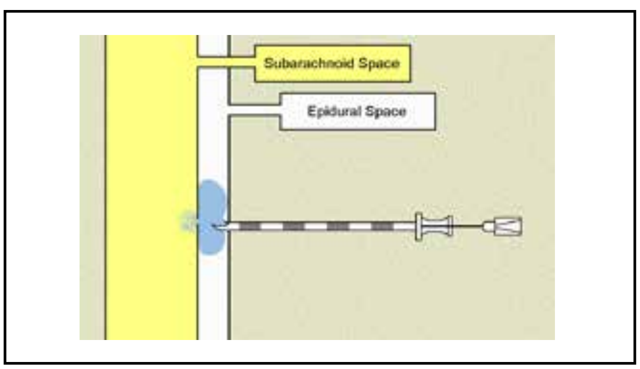
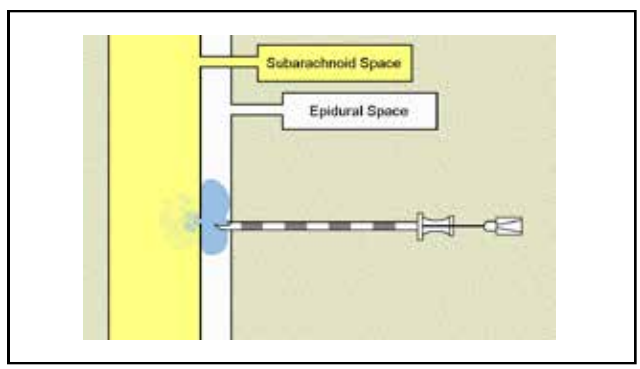

Subarachnoid Space
Epidural Space


Subarachnoid Space
Epidural Space


Subarachnoid Space
Epidural Space


Subarachnoid Space
Epidural Space


Subarachnoid Space
Epidural Space


Subarachnoid Space
Epidural Space

Dural Puncture Epidural

- CSEs work better, faster
- Sometimes you want a "fully tested" catheter
- DPE can provide best of both worlds

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Dural Puncture Epidural

- Prospective, double blind, randomized trial
- DPE vs Epidural
- DPE:
  - Faster onset
  - Improved sacral spread
  - Reduced unilateral block
  - No increase in motor block
  - No increase in PDPH

Capiello Anesth Analg. 2008;107:1646-51

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Dural Puncture Epidural

- Prospective trial **CSE** vs **DPE** vs **EPD**
- 120 total
  - Rate of onset: CSE > (DPE = EPD)

Chau et al. Anesth Analg. 2017;124(2):560-569.

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Dural Puncture Epidural

- Prospective trial **CSE** vs **DPE** vs **EPD**
- 120 total
  - Block quality: (CSE = DPE) > EPD (asymmetry, redoses)

Chau et al. Anesth Analg. 2017;124(2):560-569.

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Dural Puncture Epidural

- Prospective trial **CSE** vs **DPE** vs **EPD**
- 120 total
  - Fetal effects: CSE > (DPE = EPD)

Chau et al. Anesth Analg. 2017;124(2):560-569.

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Maintenance

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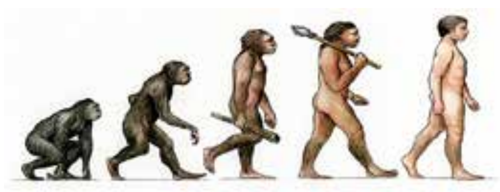
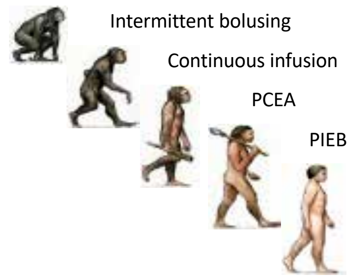
The Evolution of Labor Analgesia



The Evolution of Labor Analgesia



Intermittent bolusing

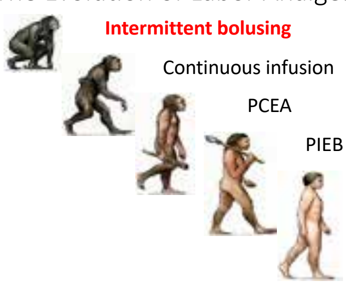
Continuous infusion

PCEA

PIEB

Smart Pumps

The Evolution of Labor Analgesia



Intermittent bolusing

Continuous infusion

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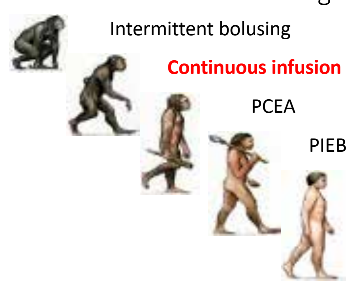
The Evolution of Labor Analgesia



Intermittent bolusing

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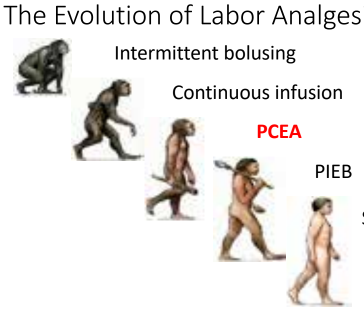

Intermittent bolusing

Continuous infusion

PCEA

PIEB

Smart Pumps

PCEA

- Gambling, 1988
  - First randomized controlled study of PCEA vs Continuous Infusion during labor
  - Analgesia same in both groups
  - PCEA group used less drug
  - PCEA = satisfaction with control

Can J Anaesth. 1988;35:249-54

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PCEA

- Since 1988
  - Huge volume of literature
  - PCEA Consistently:
    - Safe and effective
    - Less local anesthetic used
    - Less provider intervention
    - High patient satisfaction

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PCEA

- Since 1988
  - Huge volume of literature
  - Best parameters unknown:
    - Basal rate
    - Bolus volume
    - Lockout

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PCEA

- 2009 Review: *Patient-Controlled Epidural Analgesia for Labor*
  - Systematic review of RCTs (47 refs)
    - Low concentration (max 0.125% Bup; 0.2% Rop)
      - Fentanyl 1-3 ug/ml
      - Sufentanil 0.5-0.75 ug/ml
    - Basal rate 2-10 ml/hr
    - Bolus dose at least 5 ml

Halpern et al. Anesth Analg 2009;108:921-8

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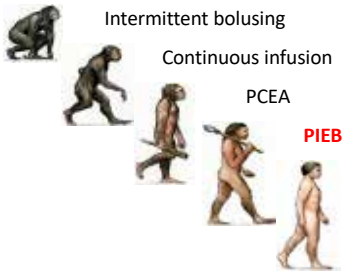
The Evolution of Labor Analgesia



Intermittent bolusing

Continuous infusion

PCEA

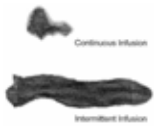
PIEB

Smart Pumps

PIEB

(**P**rogrammed **I**ntermittent **E**pidural **B**olus)

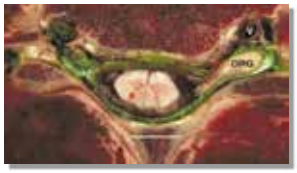
- A Brief History:
  - 1988: differential flow described
  - 1999: *in vitro* dye study



Power et al. Anaesthesia 1988;43:876-8.
Kaynar et al. Anesth Analg 1999;89:531-8.

PIEB

- Higher volumes and pressures result in more uniform distribution of injectate
- Injectate simply spreads better with bolus vs infusion



Hogan. Reg Anesth Pain Med 2002;27:150-6

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PIEB

- Consistent evidence for superiority of PIEB over CEI (both groups with PCEA)
  - Chua, Sia 2004
    - Longer time to first rescue
    - Higher patient satisfaction
  - Wong et at 2006
    - Lower total drug dose
    - Fewer rescue doses required
    - Higher patient satisfaction
  - Capogna et al 2011
    - Less motor block
    - Lower total drug does
    - Fewer rescue doses required

Can J Anaesth 2004;51:581-5
Anesth Analg 2006;102:904-9
Anesth Analg 2011;113:826-31

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Can J Anaesth 2004;51:581-5
Anesth Analg 2006;102:904-9
Anesth Analg 2011;113:826-31

Carvalho B, et al. Anesth Analg. 2016 Oct;123(4):965-71

Wet Tap Management

The Scenario

Intended epidural for labor analgesia
Unintended dural puncture occurs

- Spinal Catheter
- Resite Epidural

No actual CSF was lost during the creation of this photo!

Spinal Catheter

- Infection
- Spinal cord trauma
- Neurotoxicity
- Inappropriate injections
- Accidental lumbar CSF drain

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Resited Epidural

- Inferior analgesia
- Unexpected high block
- Risk of repeat wet tap

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Spinal Catheter vs Resite

Does our choice alter **PDPH** rate?

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PDPH

- First prospective study on PDPH after CSA
  - **117** patients: LE or lower abdominal surgery

PDPH incidence less than **1%** !

Anesth Analg 1987;66:791-4

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PDPH

- Prospective, non-randomized study in parturients
  - First **21** patients in resite group
  - Next **35** patients in spinal catheter group

No difference between groups
in PDPH or EBP rate.

Norris, Leighton. Regional Anesthesia 1990;15:285-7

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PDPH

IJOA 2007;17:329-35

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PDPH

- Prospective, controlled, multicenter (UK) trial
- 34 hospitals
- Two protocols (spinal catheter vs resite)
  - Rotated at 6 month intervals over two years
- Spinal catheters left in for 24-36 hours

	Resited Epid n=47	Spinal Cath n=50	
PDPH	62%	72%	ns
EBP	55%	50%	ns

IJOA 2012;21:7-16.

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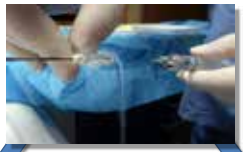
Unintended dural puncture

Infection
Spinal cord trauma
Neurotoxicity
Inappropriate injections
Accidental lumbar CSF drain



Inferior analgesia
Unexpected high block
Risk of repeat wet tap

Spinal Catheter

Resite Epidural

When to use a spinal catheter?

When delivery is eminent

How to use a spinal catheter?

Intermittent dosing: CSE dose = 1.75mg bupivacaine, 15mcg fentanyl

Infusion: 0.11% bupivacaine, 2mcg/ml fentanyl @ 1ml/hr

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thank you!

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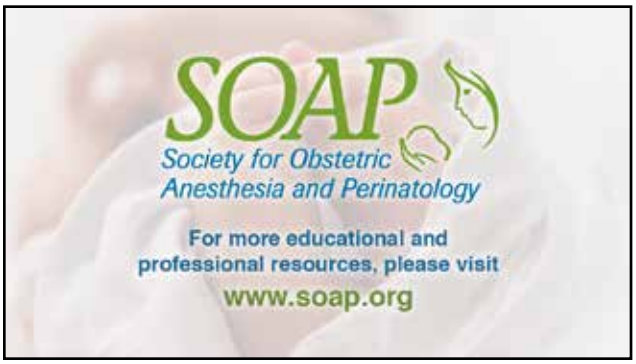
Questions?
SOAP
Society for Obstetric Anesthesia and Perinatology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Society for Obstetric Anesthesia and Perinatology
For more educational and professional resources, please visit
www.soap.org

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Advancing the pregnancy-related health and outcomes of pregnant women and their newborn.

www.soap.org

Opioid Use Disorder and Pregnancy: *Implications for Anesthetic Care*

Britany L. Raymond, MD
Assistant Professor of Anesthesiology, Vanderbilt
(no disclosures to report)

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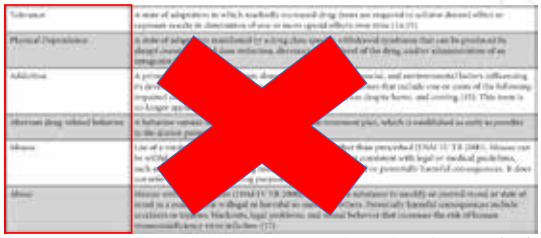
OUTLINE

- Scope of opioid use disorder in pregnancy
- Fetal/maternal effects of opioid exposure
- Opioid substitution medication-assisted therapy (MAT)
- Multi-modal approach to peripartum pain

Photo credit: Shutterstock

Defining the Problem:



Kaye, Alan D. et al. *Pain physician* 20 2S (2017): S93-S109

Spectrum of '*Opioid Use Disorder*'

Mild (2-3) *Moderate (4-5)* *Severe (6+)*

1. Taking larger amounts than intended
2. Unsuccessful efforts to quit or control use
3. Cravings
4. Excessive time spent acquiring/recovering
5. Recurrent use despite consequences
6. Recurrent use despite interpersonal problems
7. Recurrent use despite health problems
8. Interference with obligations
9. Use in hazardous situations (while driving)
10. Tolerance
11. Withdrawal

Am J Psychiatry 2013; 170: 834–851

Scope of the Problem:

1 in 5 parturients fill an opioid prescription **during pregnancy**

Profile: 24 years, Caucasian, Medicaid recipient, southeast region

a. Acute or chronic pain:
- 68% back pain, 41% abdominal pain, 28% joint pain
- most continue (without decreasing dose) while pregnant

b. Non-medical use: 5.1%
- 50% obtain from their doctor (compared to 28% non-preg)

Desai R. Obstet Gynecol 2014; 123:997–1002
Bateman B. Anesthesiology 2014; 120:1216–1224
Kozhimannil K. Womens Health Issues 2017; 27:308–315

OUTLINE

- Scope of opioid use disorder in pregnancy
- Fetal/maternal effects of opioid exposure
- Opioid substitution medication-assisted therapy (MAT)
- Multi-modal approach to peripartum pain

Photo credit: Dreamstime

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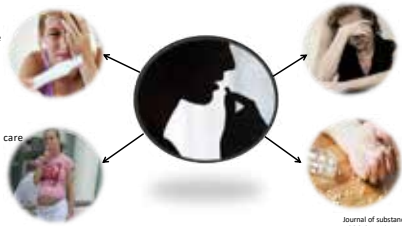
Maternal Effects:

↑ Unintended pregnancy rate (86% vs. 45%)

Health Problems:
- limited prenatal care
- malnutrition
- mental illness
- polysubstances



Micro-cycles of physical intoxication and withdrawal

~30% maternal deaths: accidental overdose or self-harm

Photos:
Wildflower Health
Lifetime Adoption
Wikipedia
MentalHelp.net
Psychiatry Advisor

Journal of substance abuse treatment. 2011;40(2):199-202
ACOG Committee Opinion 711
Obstet Gynecol 2016; 128: 1233–1240

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Fetal Effects:

Pediatrics 2017 Jun; 139(6)
Pediatrics 2015; 135:842–850
J Perinatol 2015;35:650-5

Gestation

All opioids cross the placenta:

a. Congenital Heart Disease
b. Neural tube defects
c. Club foot
(Odds Ratios: 2-4)

Peripartum

↑ Increased Risk for:
- Preterm labor
- IUGR
- IUFD
- Abruption
- Meconium

Postpartum

Neonatal Abstinence Syndrome (NAS): abrupt withdrawal → hyperactive CNS
- Tremors, poor feeding, autonomic instability, GI dysfunction, temp
- LOS - **17** vs. 2 days
  - **$66,700** vs. $3,500 hospital cost
  - **$1.5 billion** (80% financed by Medicaid)

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OUTLINE

- Scope of opioid use disorder in pregnancy
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Photo credit: Dreamstime

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Therapy

Supervised detox?

relapse rates during pregnancy 59-90%

Curr Obstet Gyn Rep 2016;5:257-63
ACOG Committee Opinion 711
J Subst Abuse Treat 2008;35:245-59
J Subst Abuse Treat 2015;48:37-42

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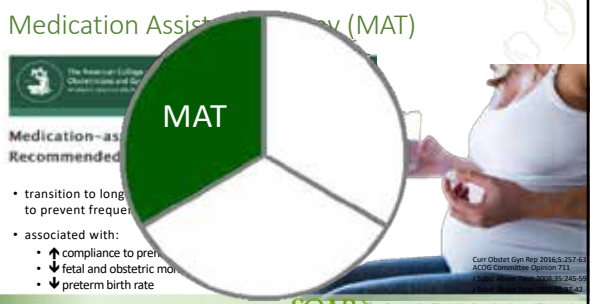
Medication Assis… …y (MAT)



- transition to long… to prevent freque…
- associated with:
  - ↑ compliance to pre…
  - ↓ fetal and obstetric mo…
  - ↓ preterm birth rate

Curr Obstet Gyn Rep 2016;5:257-63
ACOG Committee Opinion 711

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Medication Assisted Therapy

Methadone

- Full μ agonist, NMDA antagonist
- Variable and unpredictable pharmacokinetics
- Requires specialized treatment center

Buprenorphine

- Higher affinity for μ receptor
  - (lower agonist activity)
- Safety profile, ceiling effect:
  - respiratory depression
  - sedation
  - euphoria
  - (not pain!) J Clin Pharm 2014 Dec;39(6):577-83
- Convenient- unsupervised and off-site

ACOG Committee Opinion 711
Curr Opinion Anes 2018;31:243-250

ADDICTION
REVIEW
SSA

Buprenorphine compared with methadone to treat pregnant women with opioid use disorder: a systematic review and meta-analysis of safety in the mother, fetus and child

Buprenorphine *superior* for:

- ↑ birth weight
- ↓ preterm birth
- larger head circumference
- ↓ NAS incidence and severity
- adherence to MAT regimen

Curr Obstet Gyn Rep 2016;5:257-63
ACOG Committee Opinion 711
Addiction 2016; 111:2115–2128

OUTLINE

- Scope of opioid use disorder in pregnancy
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- Multi-modal approach to peripartum pain

Approach to Peripartum Pain

1. Opioid Strategies:

a. CONTINUE methadone/buprenorphine
   - ↑ buprenorphine maintenance dose by 50%
     - divide into TID or QID

b. Additional opioids: 1.5x 'normal' start dose
   - hydromorphone ideal

Obstet Gynecol 2007; 110(2 Pt 1):261–266
Eur J Pain 2010; 14:939–943.
a) ACOG Committee Opinion 711
Am J Obstet Gynecol 2017; 217:459–459.
J Clin Pharm Ther. 2014;39:577-583
b) Anesth Anal. 2017 Nov; 125(5) 1179-1783
Weimer. Project ECHO OHSU. 2017
c) Alford DP, Compton P, Samet JH. Ann Intern Med 2006

Anesth Anal. 2017 Nov; 125(5) 1179-1783

Table 2.

μ-Opioid Receptor Binding Affinities (Ki) for Commonly Used Opioids and Antagonists

Opioid	Ki (nM)
Sufentanil	0.1380[3]
Buprenorphine	**0.2157[3]**
Hydromorphone	0.3654[3]
Morphine	1.168[3]
Fentanyl	1.346[3]
Naloxone	1.518[3]
Methadone	3.378[3]
Remifentanil	21.1[4]
Oxycodone	25.87[3]
Hydrocodone	41.58[3]
Codeine	734.2[3]
Tramadol	12,486[3]

Highest affinity for μ receptor

Lowest affinity for μ receptor

Approach to Peripartum Pain

1. Opioid Strategies:

a. CONTINUE methadone/buprenorphine
   - ↑ buprenorphine maintenance dose by 50%
     - divide into TID or QID

b. Additional opioids: 1.5x 'normal' start dose
   - hydromorphone is ideal!

c. Avoid other mixed agonists/antagonists (nubain, stadol)
   - precipitates withdrawal

a) ACOG Committee Opinion 711
Am J Obstet Gynecol 2017; 217:459–459.
J Clin Pharm Ther. 2014;39:577-583
b) Anesth Anal. 2017 Nov; 125(5) 1179-1783
Weimer. Project ECHO OHSU. 2017
c) Alford DP, Compton P, Samet JH. Ann Intern Med 2006

Approach to Peripartum Pain

2. Multimodal Strategies:

a. Schedule acetaminophen 1000 TID

b. Schedule ketorolac 30 mg IV q6h x 3 days, → ibuprofen

c. Limited evidence in CD: gabapentin (600mg preop, 200mg q8h postop)

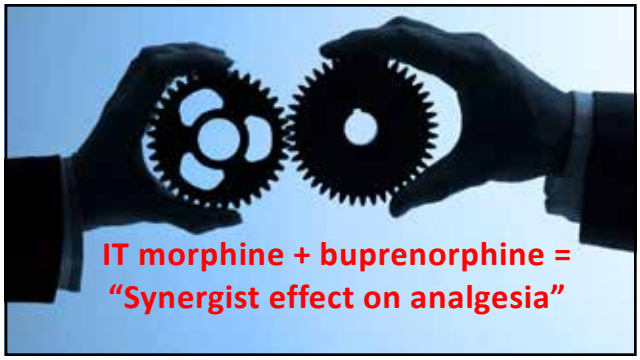
b) Reg Anesth Pain Med 2016; 41:763–772
c) Anesthesiology 2015; 123:320–326

Approach to Peripartum Pain

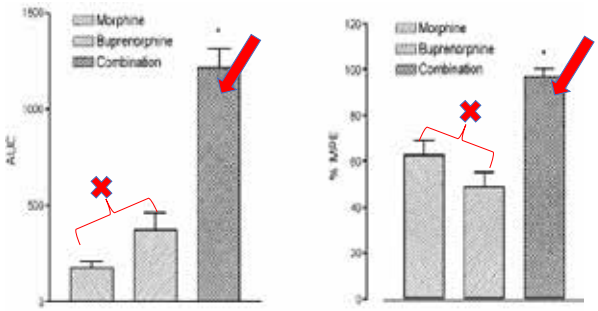
3. Regional Strategies:

1. Labor epidural
   - Consider adjuncts: clonidine, fentanyl, hydromorphone

2. Cesarean Delivery



Anesth Analg. 1998 Sep;87(3):583-6.



Approach to Peripartum Pain

Regional Strategies:

1. Labor epidural
   - Consider adjuncts: clonidine, fentanyl, hydromor

2. Cesarean Delivery
   a. IT morphine is synergistic with buprenorphine- use it!
      - consider IT hydromorphone? – 75 mcg
   b. IT clonidine – 37.5 mcg
   c. Transversus Abdominus Plane blocks

Anes Anal. 2016 Sep;123 (3)690-7
Int J Crit Illn Inj Sci. 2012 May;2(2):63-9
Anesth Essay Res. 2017 Oct-Dec; 11(4)946-951

#SOAPAM2019

Summary Points

1. Opioid Use Disorder (OUD) is new terminology

1. OUD is common among parturients, mostly for acute/chronic pain
   - associated with multiple adverse maternal and fetal effects

2. Medication substitution with buprenorphine is Gold Standard
   - should be continued, if not increased, in peripartum admission

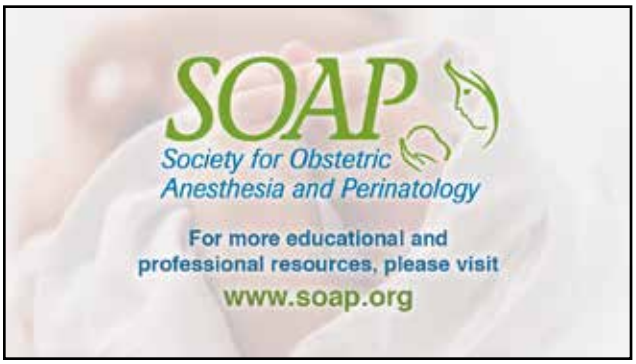
3. Employ multi-modal adjuncts and regional anesthesia strategies
   - Use IT morphine!

#SOAPAM2019

Key References:

- American College of Obstetricians and Gynecologists' Committee on Obstetric Practice. Committee Opinion No. 711: Opioid use and opioid use disorder in pregnancy. Obstet Gynecol 2017; 130:e81–e94.
- Raymond et al. The opioid epidemic and pregnancy: implications for anesthetic care. Current Opinion in Anesthesiology 2018; 31: 243-250.

SOAP Society for Obstetric Anesthesia and Perinatology



A 32 y/o G3P2 patient at 37 weeks gestation presents to labor and delivery for an induction of labor due to intrauterine growth restriction. The patient's obstetric history includes a vaginal birth followed by cesarean delivery for failure to progress. She had post-partum hemorrhage (PPH) with her second delivery but did not require a blood transfusion. Currently her hemoglobin is 9.5 g/dL despite oral iron therapy. The patient is 80kg, HR 93, BP 117/65, saturation 99% on room air.

The patient asks you what her risk is for repeat PPH.

1. What is the leading cause of PPH?
2. What are risk factors for PPH?
3. Which mode of delivery and induction status is most likely going to result in PPH?

The patient is admitted for her trial of labor and oxytocin is started. The patient receives her combined spinal-epidural at 4cm dilation. She has repeat fetal heart rate decelerations over the next few hours and the obstetrician calls you and says the patient needs a cesarean delivery.

In the operating room, you dose the epidural and the fetus has an uneventful delivery. Fifteen minutes later the obstetrician comments that there is persistent bleeding from the placental bed and persistent uterine atony. Estimated blood loss is 1000 cc and the bleeding is continuing.

1. Which initial medications can you give to treat the uterine atony?

At this time in the case, urine output is 15cc/hr, BP is 95/70 on phenylephrine infusion at 100mcg/min, HR 70 beats/min. The patient has received 1.4 liters intravenous fluid during the surgery. The lab reports a hemoglobin level of 8.5g/dL. The blood loss is continuing.

1. What does the OB hemorrhage bundle consist of at your institution? Which labs are included in the OB hemorrhage panel?
2. What are the Acute Trauma Life Support stages of hypovolemic shock?
3. Would you administer tranexamic acid (TXA) at this time?
4. Should TXA be used for all women with PPH? What is the criteria to administer TXA at your institution?
5. Do you have a massive transfusion protocol or major hemorrhage protocol? If yes, do you activate it now?

The rest of the laboratory results are available: International Normalized Ratio (INR) 1.1, Partial Thromboplastin Time 34 sec, fibrinogen 310 mg/dL, platelets 150,000.

1. Is there a laboratory value that independently predicts severe PPH?

You have given 200 mcg of methergine, 1 L of lactated ringers with 30 u oxytocin, and 800 mcg buccal misoprostol. However, the blood loss is ongoing and the obstetrician tells you that the uterus is globally atonic. The current estimated blood loss is 2500 cc. Repeat laboratory values show a hgb value of 6.7g/dL. The fibrinogen value is 190 mg/dl. Urine output remains low, and the patient remains on phenylephrine (100 mcg/min) to maintain her mean arterial pressure > 60 mmHg and HR is 115. 3L crystalloid has been infused so far. You decide to transfuse the patient.

1. Which blood products are you going to give?
2. What is the clinical utility of fibrinogen supplementation with fibrinogen concentrate or fresh frozen plasma, or cryoprecipitate?
3. Should you use a fixed ratio approach to transfusion e.g., 1 unit FFP : 1 unit RBC?
4. What are the endpoints to transfusing the patient?
5. How can thromboelastography (TEG) or thromboelastometry (ROTEM) be utilized in guiding a resuscitation?

Despite your aggressive resuscitation using the massive transfusion protocol, the bleeding continues.

1. Which other surgical or medical interventions can be used for PPH management? Does your institution use Resuscitative Endovascular Balloon Occlusion of the Aorta (REBOA), or interventional radiologic techniques?
2. When would you consider peripartum hysterectomy for hemorrhage control?
3. When would you consider placing additional invasive lines?
4. Would you consider converting to general anesthesia? If so, at what time?
5. How would you secure the airway?

A hysterectomy is performed due to uncontrollable bleeding. At the end of the case the patient is volume resuscitated but the PaO_2 is 85 on 70% FiO2 and PEEP 8. You decide to keep the patient intubated and transfer the patient monitored to the ICU. Postpartum labs show a creatinine of 1.2, baseline was 0.5.

1. How should the patient's pulmonary edema be managed?
2. Should maintenance fluids be started?
3. How can volume status be assessed? (central venous pressure, pulse pressure variation, focused cardiac US, urine output)
4. After PPH, should heparin prophylaxis be started?
5. What is the involvement of the obstetric team in ICU management?

Suggested reading:

1. Callaghan WM, et al. Am J Obstet Gynecol 2010;202:353.e1-6.
2. ACOG Practice Bulletin No. 183: Postpartum Hemorrhage. Obstet Gynecol 2017; 130: e168-186.
3. Bateman BT, et al. Anesth Analg 2010; 110: 1368-73.
4. **Charbit BJ, et al. Thromb Haemost 2007;5:266-273.**
5. **Shields,L, et al. Am J Obstet Gynecol; 2015; 272.**
6. **Butwick, AJ, et al. Curr Opin Anaesthesiol 2015; 28: 275-84.**
7. Collis RE, et al. Anaesthesia 2015; 70 Suppl 1; 78-86.
8. Collins PW, et al. Int J Obstet Anesth 2019; 37: 106-17.
9. Woman Trial Collaborators. Lancet 2017; 389: 2105-16.
10. Main EK, et al. (National Partnership for Maternal Safety) Anesth Analg 2015; 121: 142-8.
11. Shaylor R, et al. Anesth Analg 2016; 124: 216-32.
12. Green L, et al. Br J Haematol 2016; 172: 616-24.

Fred Hehre Lecture 2019

Dogmas in Obstetric Anesthesia: The Balance between Evidence, Common Sense, Habit and Fear

Jose Carvalho, MD PhD FANZCA FRCPC
Director of Obstetric Anesthesia, Mount Sinai Hospital
Professor of Anesthesia and Obstetrics and Gynecology, University of Toronto

No disclosures related to this lecture

Learning Objectives:

1) Identify possible reasons behind dogmas in anesthesia practice
2) Identify dogmatic practices in obstetric anesthesia
   - Mostly resolved (and learn from them)
   - On the path to resolution
   - Far from resolution
3) Identify opportunities for reassessment and change of some of these practices, particularly those that may have a beneficial impact in patient care
4) Identify strategies to validate and promote changes in these practices amongst peers as appropriate

Regional Anesthesia
Section Editor
Terese T. Horlocker
Editorial

Evidence-Based Medicine: Haute Couture or the Emperor's New Clothes?

Terese T. Horlocker, MD, and Daniel R. Brown, MD, PhD
Department of Anesthesiology, Mayo Clinic College of Medicine, Rochester, MN

Performing a systematic review is much like weaving cloth. Although the design may be the same, depending on the age, strength, and quantity of the material, the final product may be either silk brocade or polyester. While both cover the subject, they vary greatly in intrinsic worth. As clinicians, it is our responsibility to achieve the best "fit."

Anesth Analg 2005;100:1807–10

Traditions, Dogma and Myths in Anesthesia Practice

[redacted]

Anesthesiology
April 2008 • Volume 72 • Number 4

In the pursuit of safer perioperative care, anesthesiologists are under increasing pressure to fulfill a series of clinical duties and practice guidelines that often have no proven merit. Indeed, some have been demonstrated to lead to adverse outcomes. In addition, we religiously adhere to a variety of fundamental dogmatic beliefs and perform a series of trusted rituals inherited from our founding fathers that have never been subjected to scientific scrutiny. This article will attempt to illuminate a few of these practices and hopefully raise questions as to whether we should continue their implementation in the absence of supporting evidence-based medicine.

Pre-operative fasting durations
Cricoid pressure during RSI
Demonstrating ability to ventilate before administration of muscle relaxants

THE OPEN MIND

Anesthesia Dogmas and Shibboleths: Barriers to Patient Safety?

Ronald J. Gordon, MD, PhD*

Anesth Analg 2012; 114: 694-699

1. Shibboleth: Venous thromboembolic prevention is strictly a surgical issue.
   Modified version: Venous thromboembolic prevention is a shared responsibility of the surgeon and anesthesiologist.
2. Dogma: Administration of a muscle relaxant should only occur after ability to mask ventilate is verified.
   Modified version: Administration of a muscle relaxant should occur without verifying ability to mask ventilate.
3. Shibboleth: Anesthesia providers should use fentanyl to blunt the sympathetic response to tracheal intubation.
   Modified version: Anesthesia providers should use substitutes for fentanyl such as alfentanil and remifentanil to blunt the sympathetic response to tracheal intubation.
4. Shibboleth: Anesthesia providers should maintain the end-tidal CO_2 level during surgery between 32 to 37 mm Hg.
   Modified version: Anesthesia providers should maintain the end-tidal CO_2 level during surgery between 40 to 45 mm Hg.
5. Dogma: All general anesthetics that result in a stable, comfortable patient in the recovery room are equivalent with respect to long-term outcome.
   Modified version: General anesthetics that result in a stable, comfortable patient in the recovery room vary greatly in their effects on long-term outcome.
6. Dogma: All patients should be awakened from anesthesia while receiving 100% oxygen.
   Modified version: Emergence from anesthesia in most patients should involve administration of 80% oxygen.

NARRATIVE REVIEW ARTICLE

Aortocaval Compression Syndrome: Time to Revisit Certain Dogmas

Allison J. Lee, MD, and Ruth Landau, MD

Anesth Analg 2017;125:1975-85

THE OPEN MIND

Aspiration Prophylaxis and Rapid Sequence Induction for Elective Cesarean Delivery: Time to Reassess Old Dogma?

Duncan G. de Souza, MD, FRCPC, Lauren H. Doar, MD, Sachin H. Mehta, MD, and Mohamed Tiouririne, MD

Anesth Analg 2010; 110:1503-1505

EDITORIAL

Obstetric Neuraxial Anesthesia Contraindicated? Really? Time to Rethink Old Dogma

William Camann, MD

Anesth Analg 2015; 121:846-8

vasopressors

Maintenance of Uteroplacental Blood Flow (1980's)

Acute preload
Uterine displacement
Short induction-delivery time
Normoglycemia
Trendelenburg
Vasopressors (ephedrine only)

Anesthesiology
V 40, No 4, Apr 1974

Effects of Equipotent Ephedrine, Metaraminol, Mephentermine, and Methoxamine on Uterine Blood Flow in the Pregnant Ewe

David H. Ralston, M.D.,* Sol M. Shnider, M.D.,† Alfred A. deLorimier, M.D.‡

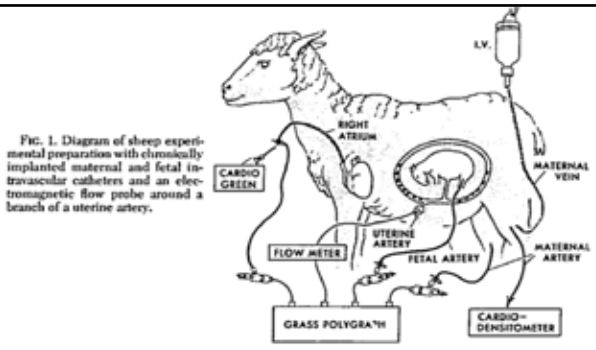


FIG. 1. Diagram of sheep experimental preparation with chronically implanted maternal and fetal intravascular catheters and an electromagnetic flow probe around a branch of a uterine artery.

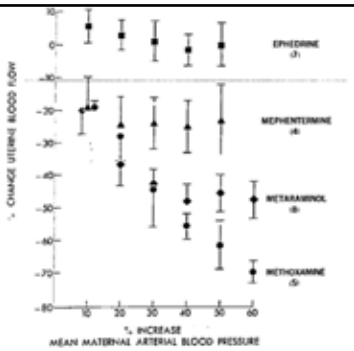


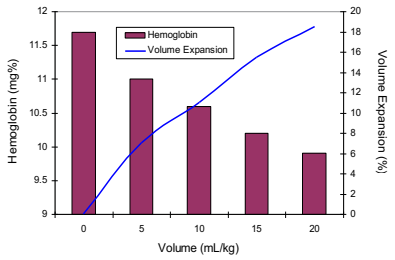
FIG. 8. Mean changes in uterine blood flow at equal elevations of mean arterial blood pressure following vasopressor administration.

Ephedrine during Spinal Anesthesia for Cesarean Delivery: Influence of the Method of Administration

	no hypo-no ephe (n=22)	hypo >30% (n=18)	any hypo (n=20)
umbilical art pH (mean)	7.30	7.23 *	7.30
nausea/vomiting (%)	0	66 *	10
Apgar < 7 min 1 (%)	0	83 *	0

Datta S. Anesthesiology 1982;56:68-70

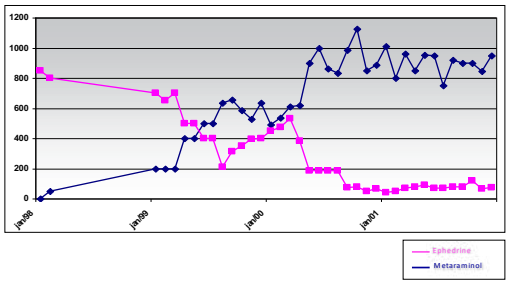
Crystalloid Preload at Cesarean Delivery



Carvalho JCA et al. Int Anesthesiol Clin 1994;32(2):103

Vasopressor Consumption at Santa Joana Maternity Hospital (São Paulo, Brazil)

(montly # of ampoules requested from pharmacy)



Prophylactic Phenylephrine Infusion during Spinal Anesthesia for Cesarean Delivery

75 patients undergoing elective CS
No acute preload – Bupivacaine 0.5% 10 mg plus fentanyl 15 µg
Phenylephrine 100 µg/min titrated to 100%, 90% or 80% baseline SBP. Rescue 100 µg

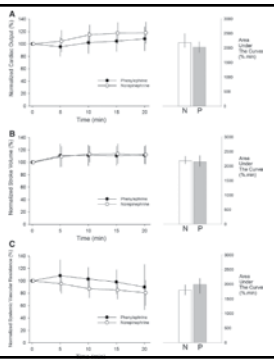
	Group 80	Group 90	Group 100
Hypotension (%)	**96**	**72**	**29 ***
Hypertensive episodes (n)	**5**	**2**	**0 ***
Nausea or vomiting (%)	**40**	**16**	**4 ***
Fetal acidosis (UA pH < 7.20)	**0**	**0**	**0**
Bradycardia < 50 (%)	**20**	**32**	**8**

Ngan Kee WD et al. Br J Anaesth 2004; 92: 469-74

Randomized Double-blinded Comparison of Norepinephrine and Phenylephrine for Maintenance of Blood Pressure during Spinal Anesthesia for Cesarean Delivery

Warwick D. Ngan Kee, M.B.Ch.B., M.D., F.A.N.Z.C.A., F.H.K.A.M.,
Shara W. Y. Lee, B.Sc.(Hons.), M.Sc., Ph.D., Flora F. Ng, R.N., B.A.Sc.,
Perpetua E. Tan, B.Sc., M.Phil., Kim S. Khaw, M.B.B.S., M.D., F.R.C.A., F.H.K.A.M.

Anesthesiology 2015; 122:736-45



Norepinephrine for Spinal Hypotension during Cesarean Delivery

Another Paradigm Shift?

Brendan Carvalho, M.B.B.Ch., F.R.C.A., Robert A. Dyer, F.C.A.(SA), Ph.D.

"[F]uture research needs to address a number of questions before norepinephrine is considered preferable to phenylephrine for maintaining maternal hemodynamics."

Norepinephrine Intermittent Intravenous Boluses to Prevent Hypotension During Spinal Anesthesia for Cesarean Delivery: A Sequential Allocation Dose-Finding Study

Desire N. Onwochei, MBBS BSc (Hons), FRCA,* Warwick D. Ngan Kee, MBChB, MD, FANZCA, FHKCA,† Lillia Fung, MD, FRCPC,* Kristi Downey, MSc,* Xiang Y. Ye, MSc,‡ and Jose C. A. Carvalho, MD, PhD, FANZCA, FRCPC*

ED90: 6 mcg

Anesth Analg 2017; 125:212-218

Comparison of Intermittent Intravenous Boluses of Phenylephrine and Norepinephrine to Prevent and Treat Spinal-Induced Hypotension in Cesarean Deliveries: Randomized Controlled Trial

Aidan M. Sharkey, MD,* Naveed Siddiqui, MD, MSc,* Kristi Downey, MSc,* Xiang Y. Ye, MSc,† Jennifer Guevara, MD,* and Jose C. A. Carvalho, MD, PhD*

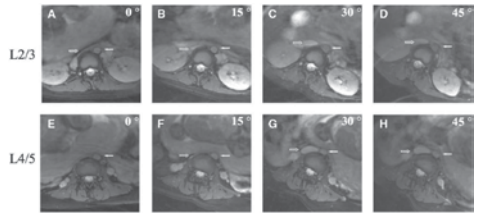
71% relative reduction in the incidence of maternal bradycardia

Anesth Analg 2018; pub ahead print Aug 2018

NARRATIVE REVIEW ARTICLE

Aortocaval Compression Syndrome: Time to Revisit Certain Dogmas

Allison J. Lee, MD, and Ruth Landau, MD



Anesth Analg 2017; 125:1975-85

EDITORIAL

The Aortocaval Compression Conundrum

David H. Chestnut, MD

Anesth Analg 2017; 125:1838-9

Anaesthesia 2018, 73, 71-92 doi:10.1111/anae.14080

Guidelines

International consensus statement on the management of hypotension with vasopressors during caesarean section under spinal anaesthesia

S. M. Kinsella,[1] B. Carvalho,[2] R. A. Dyer,[3] R. Fernando,[4] N. McDonnell,[5] F. J. Mercier,[6] A. Palanisamy,[7] A. T. H. Sia,[8] M. Van de Velde[9,10], A. Vercueil[11] and the Consensus Statement Collaborators

Anaesthesia 2018, 73, 3-14

Editorial

Management of hypotension with vasopressors at caesarean section under spinal anaesthesia – have we found the Holy Grail of obstetric anaesthesia?

J. P. Campbell
G. M. Stocks
Consultant Anaesthetists
Queen Charlotte's and Chelsea Hospital
Imperial College Healthcare NHS Trust
London, UK

THE OPEN MIND

Aspiration Prophylaxis and Rapid Sequence Induction for Elective Cesarean Delivery: Time to Reassess Old Dogma?

Duncan G. de Souza, MD, FRCPC, Lauren H. Doar, MD, Sachin H. Mehta, MD, and Mohamed Tiouririne, MD

Anesth Analg 2010; 110:1503-4

International Journal of Obstetric Anesthesia (2015) 24, 1–4
0959-289X/$ - see front matter
http://dx.doi.org/10.1016/j.ijoa.2014.12.006

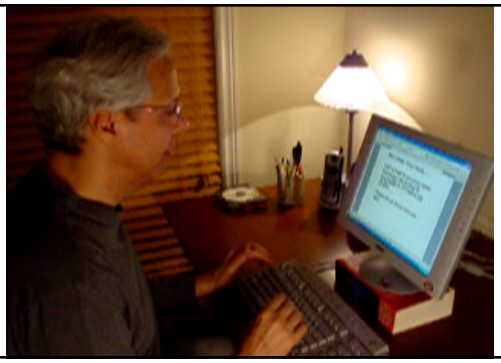
EDITORIAL

Be wary of awareness – lessons from NAP5 for obstetric anaesthetists

David Bogod and Felicity Plaat

ELSEVIER
www.obstetanesthesia.com

X



Acid Aspiration Prophylaxis in the UK: a Survey of OB Units

OAA database, 250 clinicians, 83% response

Use of AA Prophylaxis

32% routinely, 61% occasionally, 7% never

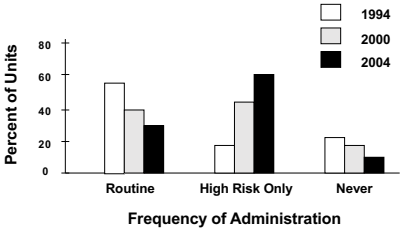
First-line AA prophylaxis drug

ranitidine 97% 150 mg PO q 6h (50 mg IV q 6h

Sodium Citrate: 2.5% of units only!

Calthorpe N, Lewis M. IJOA 2005; 14:300-304

UK Policies for Antacid Prophylaxis



Calthorpe N, Lewis M. IJOA 2005; 14:300-304

Anaesthesia 2016, 71, 999–1012

Editorial

Cricoid pressure: apply – but be ready to release

J. Turnbull
A. Patel
Consultants
The Royal National Throat, Nose and Ear Hospital,
London, UK,
Email: anil.patel@uclh.nhs.uk
V. Athanassoglou
J. I. Pandit
Consultants
Nuffield Department of Anaesthetics,
Oxford, UK

Conclusions

In the light of the uncertainties, it is perhaps surprising that the courts appear to favour the use of CP. Athanassoglou and Pandit [4] cite the judgement in M vs. E Hertfordshire HA 1991, where an anaesthetist failed to apply CP and the patient suffered aspiration pneumonitis. The judge ruled that: "*We cannot assert that CP is not effective until trials have been performed* (i.e. we must assume its efficacy), *especially as it is an integral part of anaesthetic technique. . .that has been associated with a reduced maternal death rate from aspiration since the 1960's.*" United States lawsuits appear more common after aspiration than in other settings, and are settled for higher amounts if CP is not applied [46].

Cricoid Pressure Controversies

Narrative Review

M. Ramez Salem, M.D., Arjang Khorasani, M.D., Ahed Zeidan, M.D., George J. Crystal, Ph.D.

Recent surveys and guidelines indicate the common use of CP.[182–184] However, some anesthesiologists have advocated abandonment of CP.[185] This does not seem justified on several grounds. First, in the last 7 yr, two well-conducted studies, using different methodologies, have provided convincing evidence of the effectiveness of CP in occluding the esophageal inlet.[24,25] Second, the common belief that aspiration is very rare and the consequences are mild has been shattered by the report of the 4th National Audit in the United Kingdom, showing that aspiration is the single most common anesthesia-related cause of death.[76] The report further indicated that not all qualifying events were submitted, and the real incidence could be up to four times greater than that reported.[186,187] Other studies concur that aspiration of gastric contents is still the commonest cause of deaths associated with airway anesthetic management and remains a serious concern of anesthetic-related morbidity.[74,188]

Anesthesiology 2017; 126:738-52

Research

JAMA Surgery | Original Investigation

Effect of Cricoid Pressure Compared With a Sham Procedure in the Rapid Sequence Induction of Anesthesia
The IRIS Randomized Clinical Trial

Aurélie Birenbaum, MD; David Hajage, MD, PhD; Sabine Roche, MD; Alexandre Mebazaa, MD; Mathilde Eurin, MD; Philippe Cuvillon, MD, PhD; Aurélien Rozin, MD; Vincent Compere, MD, PhD; Dan Benhamou, MD; Matthieu Biais, MD, PhD; Remi Mercat, MD; Cédric Bercault, MD; François Lanfrant, MD, PhD; Bruno Riou, MD, PhD; for the IRIS Investigators Group

JAMA Surg 2019; 154(1):9-17

IMPORTANCE The use of cricoid pressure (Sellick maneuver) during rapid sequence induction (RSI) of anesthesia remains controversial in the absence of a large randomized trial.

OBJECTIVE To test the hypothesis that the incidence of pulmonary aspiration is not increased when cricoid pressure is not performed.

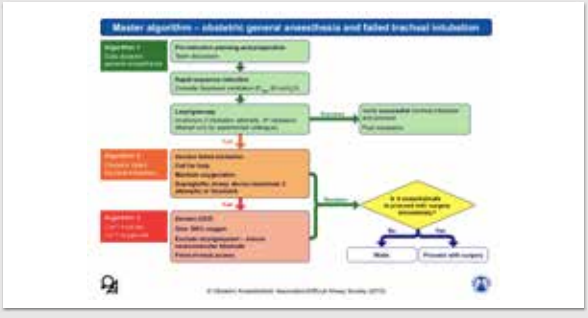
DESIGN, SETTING, AND PARTICIPANTS Randomized, double-blind, noninferiority trial conducted in 10 academic centers. Patients undergoing anesthesia with RSI were enrolled from February 2014 until February 2017 and followed up for 28 days or until hospital discharge (last follow-up, February 8, 2017).

INTERVENTIONS Patients were assigned to a cricoid pressure (Sellick group) or a sham procedure group.

MAIN OUTCOMES AND MEASURES Primary end point was the incidence of pulmonary aspiration (at the glottis level during laryngoscopy or by tracheal aspiration after intubation). It was hypothesized that the sham procedure would not be inferior to the cricoid pressure. The secondary end points were related to pulmonary aspiration, difficult tracheal intubation, and traumatic complications owing to the tracheal intubation or cricoid pressure.

RESULTS Of 3472 patients randomized, mean (SD) age was 51 (19) years and 1777 (51%) were men. The primary end point, pulmonary aspiration, occurred in 10 patients (0.6%) in the Sellick group and in 9 patients (0.5%) in the sham group. The upper limit of the 1-sided 95% CI of relative risk was 2.00, exceeding 1.50, failing to demonstrate noninferiority ($P = .14$). The risk difference was −0.06% (2-sided 95% CI, −0.57 to 0.42) in the intent-to-treat population and −0.06% (2-sided 95% CI, −0.56 to 0.43) in the per protocol population. Secondary end points were not significantly different among the 2 groups (pneumonia, length of stay, and mortality), although the comparison of the Cormack and Lehane grade (Grades 3 and 4, 10% vs 5%; $P < .001$) and the longer intubation time (Intubation time >30 seconds, 47% vs 40%; $P < .001$) suggest an increased difficulty of tracheal intubation in the Sellick group.

CONCLUSIONS AND RELEVANCE This large randomized clinical trial performed in patients undergoing anesthesia with RSI failed to demonstrate the noninferiority of the sham procedure in preventing pulmonary aspiration. Further studies are required in pregnant women and outside the operating room.



Can J Anaesth Can Anesth (2014) 61:489–503
DOI 10.1007/s12630-014-0125-x

CONTINUING PROFESSIONAL DEVELOPMENT

Cesarean delivery under general anesthesia: Continuing Professional Development

Sandra Lesage, MD

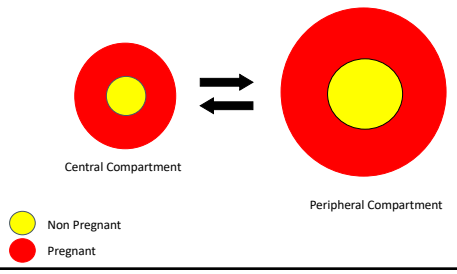
Table 1 Maternal risks associated with general anesthesia for Cesarean delivery

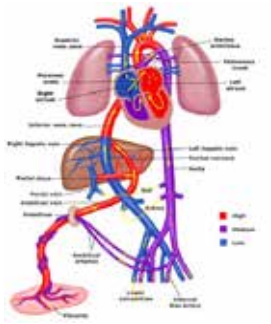
Risks	Physiology of pregnancy	Possible obstetrical setting
Difficult airway management	- Shorter apnea time without desaturation - Increased risk of aspiration - Tissue edema + mucosal hyperemia - Voluminous breasts	- Extremely urgent situation - Rapid sequence induction with cricoid pressure - Difficult positioning - Limited experience of anesthesiologist and staff
Intraoperative awareness	- More rapid distribution of intravenous agents - Slower equilibrium of partial pressure of volatile agents	- Under-dosage to avoid neonatal depression - Under-dosage to avoid hemodynamic instability - Under-dosage to avoid uterine atony
Regurgitation with secondary aspiration	- Alteration of the cardia angle - Less inferior esophageal sphincter tone	- Fasting not observed - Slower gastric emptying **secondary** to labour and opioids

Response to Different Anesthetic Techniques
Pregnant versus Non Pregnant Women

Regional Anesthesia	Pregnant > Non Pregnant
Inhalational Anesthesia	Pregnant > Non Pregnant
Intravenous Anesthesia	Pregnant < Non Pregnant

Body Compartments in Pregnancy





Braz J Anesthesiol Int Issue, 1992;3 : 35-37

General Anesthesia for Cesarean Section with Fentanyl: Maternal and Fetal Plasma Concentrations

Alfredo Augusto Vieira Portella, MD,TSA, Guilherme Frederico Ferreira dos Reis, MD,TSA
Geraldo Augusto de Mello Silva,MD,TSA & Nelbe Uchôa Cyreno, MD

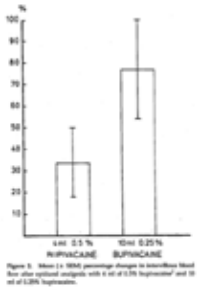
The plasma concentration of fentanyl was determined in the maternal and umbilical cord blood in 16 pregnant women undergoing cesarean section under general anesthesia. The patients were anesthetized with fentanyl 10 $\mu g.kg^{-1}$, pancuronium 100 $\mu g.kg^{-1}$ and enflurane. Maternal and umbilical cord blood samples were drawn 12.47 $\pm$ 2.75 minutes after the administration of fentanyl. The concentration of fentanyl in plasma was determined by radioimmunoassay with the following results: 7.8 $\pm$ 2.4 $ng.ml^{-1}$, in the maternal vein; 5.2 $\pm$ 0.9 $ng.ml^{-1}$ in the maternal artery; 3.6 $\pm$ 1.2 $ng.ml^{-1}$ in the umbilical vein; and 1.4 $\pm$ 0.6 $ng.ml^{-1}$ in the umbilical artery. These results show that there is a plasma concentration gradient of fentanyl between maternal and fetal blood. The Apgar score observed at the 1st minute was 6 for one newborn, while it was between 7 and 9 for the other newborns. At the 5th minute it was 8 for one newborn, 9 for one newborn, and 10 for 14 newborns; at the 10th minute it was 10 for all 16 newborns. These results suggest that no adverse effect attributable to fentanyl was detected in neonates, as evaluated by the Apgar score.

Key Words: ANESTHETIC, Venous: fentanyl; ANESTHETIC TECHNIQUE, General: venous; SURGERY: obstetric.

Thrombocytopenia

Lumbar Epidural Analgesia to Improve Intervillous Blood Flow During Labor in Severe Preeclampsia

PENTTI JOUPPILA, MD, REETTA JOUPPILA, MD, ARNO HOLLMÉN, MD, AND ANTERO KOIVULA, MSc



Obstet Gynecol 1982; 50:158-161

BJA

OBSTETRICS

Antepartum continuous epidural ropivacaine therapy reduces uterine artery vascular resistance in pre-eclampsia: a randomized, dose-ranging, placebo-controlled study

Y. Ginosar[1]*, M. Nadjari[2], A. Hoffman[3], N. Firman[3], E. M. Davidson[3], C. F. Weiniger[1], L. Rosen[4], C. Weissman[3], U. Elchalal[2] and the ACET study group

Fetal Diagnosis Therapy

Fetal Diagn Ther 2005;20:208–213
DOI: 10.1159/000083927

Received: November 27, 2002
Accepted after revision: April 7, 2004

Epidural Local Anesthetics: A Novel Treatment for Fetal Growth Retardation?

D. Strümper[a] F. Louwen[c] M.E. Durieux[d] H.F. Gramke[a] J. Stuessel[b]
D. Marcus-Soekarman[f] H. Van Aken[a] M.A.E. Marcus[a]

Departments of [a]Anesthesiology and Intensive Care Medicine, [b]Obstetrics and Gynecology, University of Münster, and [c]Obstetrics and Gynecology, University of Frankfurt, Germany; [d]Anesthesiology, University of Virginia, Va., USA; [e]Anesthesiology, Pain Therapy and Home Ventilation, and [f]Genetics, University Hospital Maastricht, The Netherlands

Journal of Human Hypertension (1999) 13, 167–171

http://www.stockton-press.co.uk/jhh

ORIGINAL ARTICLE

A new treatment of severe pre-eclampsia by long-term epidural anaesthesia

N Kanayama, HM Belayet, S Khatun, N Tokunaga, M Sugimura, T Kobayashi and T Terao

Department of Obstetrics and Gynecology, Hamamatsu University School of Medicine, 3600 Handa-Cho, Hamamatsu shi 431-3192 Japan

Thrombelastography changes in pre-eclampsia and eclampsia

C. E. P. Orlikowski, D. A. Rocke, W. B. Murray, E. Gouws, J. Moodley, D. G. Kenoyer and S. Byrne

There was no correlation between bleeding time and any measured TEG variable. Of the 10 (20 %) patients with an adequate platelet count (> 100×10^9 litre^{-1}) but prolonged bleeding time, the TEG was normal, suggesting adequate haemostasis. An MA of 53 mm, which is the lower limit for normal pregnancy, correlated with a platelet count of 54×10^9 litre^{-1} (95 % confidence limits 40–75 $\times 10^9$ litre^{-1}). Although the number of patients with severe thrombocytopenia was small, a platelet count of 75×10^9 litre^{-1} should be associated with adequate haemostasis. (*Br. J. Anaesth.* 1996; **77**: 157–161)

Br J Anaesth 1996; 77:157-161

International Journal of Obstetric Anesthesia (2006) 15, 7–12

doi:10.1016/j.ijoa.2005.04.011

ORIGINAL ARTICLE

Evaluation of the platelet function analyzer (PFA-100®) vs. the thromboelastogram (TEG) in the parturient

Y. Beilin, I. Arnold, S. Hossain

Departments of Anesthesiology, Obstetrics, Gynecology & Reproductive Sciences, and Biomathematical Sciences, Mount Sinai School of Medicine of New York University, New York, NY, USA

The American College of Obstetricians and Gynecologists

ACOG PRACTICE BULLETIN

Clinical Management Guidelines for Obstetrician-Gynecologists

Number 207 (Replaces Practice Bulletin Number 166, September 2016)

Committee on Practice Bulletins—Obstetrics. This Practice Bulletin was developed by the American College of Obstetricians and Gynecologists' Committee on Practice Bulletins—Obstetrics in collaboration with Mark Tarantino, MD.

Thrombocytopenia in Pregnancy

VOL. 133, NO. 3, MARCH 2019

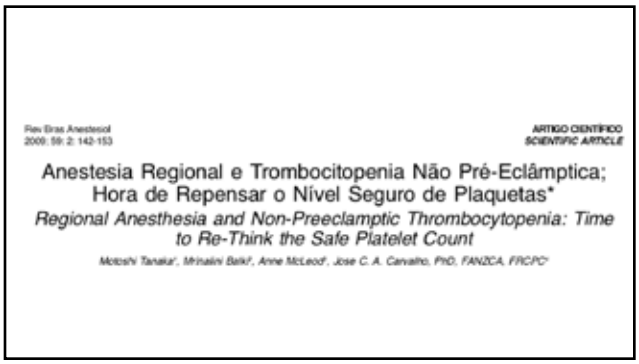
Summary of Recommendations and Conclusions

The following recommendation and conclusion are based on limited or inconsistent scientific evidence (Level B):

- Maternal thrombocytopenia between 100×10^9/L and 149×10^9/L in asymptomatic pregnant women with no history of bleeding problems is usually due to gestational thrombocytopenia.
- Given the very low risk of serious neonatal hemorrhage, the mode of delivery in pregnancies complicated with immune thrombocytopenia should be determined based on obstetric considerations alone.

The following recommendations and conclusions are based primarily on consensus and expert opinion (Level C):

- Consensus guidelines recommend platelet transfusion to increase the maternal platelet count to more than 50×10^9/L before major surgery.
- Epidural or spinal anesthesia is considered acceptable, and the risk of epidural hematoma is exceptionally low in patients with platelet counts of 70×10^9/L or more provided that the platelet level is stable, there is no other acquired or congenital coagulopathy, the platelet function is normal, and the patients are not on any antiplatelet or anticoagulant therapy.
- Fetal–neonatal alloimmune thrombocytopenia should be suspected in cases of otherwise unexplained fetal or neonatal thrombocytopenia, hemorrhage, or ultrasonographic findings consistent with intracranial bleeding.



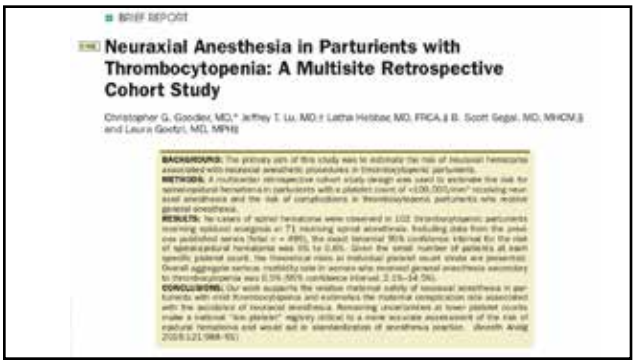
Rev Bras Anestesiol
2009; 59: 2: 142-153

ARTIGO CIENTÍFICO
SCIENTIFIC ARTICLE

Anestesia Regional e Trombocitopenia Não Pré-Eclâmptica; Hora de Repensar o Nível Seguro de Plaquetas*

Regional Anesthesia and Non-Preeclamptic Thrombocytopenia: Time to Re-Think the Safe Platelet Count

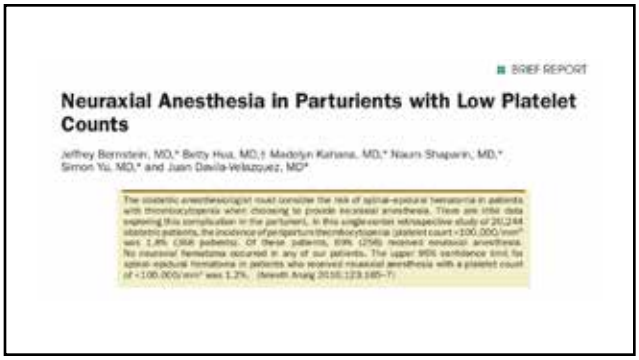
Motoshi Tanaka', Mrinalini Balki', Anne McLeod', Jose C. A. Carvalho, PhD, FANZCA, FRCPC'



BRIEF REPORT

Neuraxial Anesthesia in Parturients with Thrombocytopenia: A Multisite Retrospective Cohort Study

Christopher G. Goodier, MD,* Jeffrey T. Lu, MD,† Latha Heisbe, MD, FRCA,‡ B. Scott Segal, MD, MHCM,§ and Laura Goetzl, MD, MPH‖



BRIEF REPORT

Neuraxial Anesthesia in Parturients with Low Platelet Counts

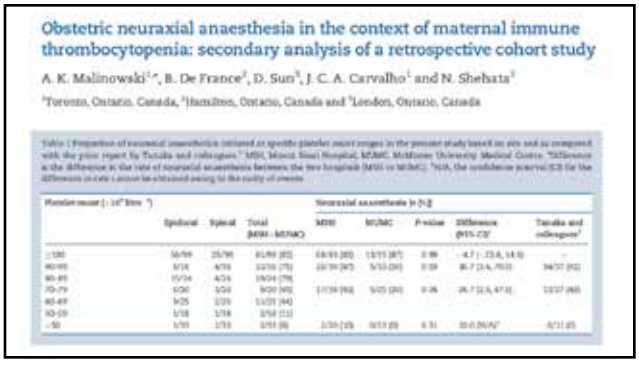
Jeffrey Bernstein, MD,* Betty Hua, MD,† Madelyn Kahana, MD,* Nauni Shaparin, MD,* Simon Yu, MD,* and Juan Davila-Velazquez, MD*

Risk of Epidural Hematoma after Neuraxial Techniques in Thrombocytopenic Parturients

A Report from the Multicenter Perioperative Outcomes Group

Linden G. Lee, M.D., Brian T. Bateman, M.D., M.Sc., Sachin Kheterpal, M.D., M.B.A., Thomas T. Klumpner, M.D., Michelle Housey, M.P.H., Michael F. Aziz, M.D., Karen W. Hand, M.D., Mark MacEachern, M.L.I.S., Christopher G. Goodier, M.D., Jeffrey Bernstein, M.D., Melissa E. Baase, D.O., on behalf of the Multicenter Perioperative Outcomes Group Investigators*

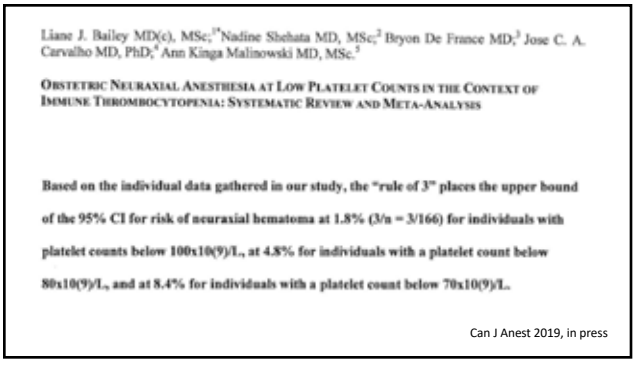
ABSTRACT



Obstetric neuraxial anaesthesia in the context of maternal immune thrombocytopenia: secondary analysis of a retrospective cohort study

A. K. Malinowski[1,*], B. De France[2], D. Sun[3], J. C. A. Carvalho[1] and N. Shehata[1]

[1]Toronto, Ontario, Canada, [2]Hamilton, Ontario, Canada and [3]London, Ontario, Canada



Liane J. Bailey MD(c), MSc;[1*]Nadine Shehata MD, MSc;[2] Bryon De France MD,[3] Jose C. A. Carvalho MD, PhD,[4] Ann Kinga Malinowski MD, MSc.[5]

OBSTETRIC NEURAXIAL ANESTHESIA AT LOW PLATELET COUNTS IN THE CONTEXT OF IMMUNE THROMBOCYTOPENIA: SYSTEMATIC REVIEW AND META-ANALYSIS

Based on the individual data gathered in our study, the "rule of 3" places the upper bound of the 95% CI for risk of neuraxial hematoma at 1.8% (3/n = 3/166) for individuals with platelet counts below 100x10(9)/L, at 4.8% for individuals with a platelet count below 80x10(9)/L, and at 8.4% for individuals with a platelet count below 70x10(9)/L.

Can J Anest 2019, in press

Investigation of an increase in postpartum haemorrhage in Canada

KS Joseph,[a] J Rouleau,[b] MS Kramer,[c] DC Young,[a] RM Liston,[a] TF Baskett[a]; for the Maternal Health Study Group of the Canadian Perinatal Surveillance System

Results Rates of postpartum haemorrhage increased from 4.1% in 1991 to 5.1% in 2004 (23% increase, 95% CI 20–26%), while rates of postpartum haemorrhage with hysterectomy increased from 24.0 in 1991 to 41.7 per 100 000 deliveries in 2004 (73% increase, 95% CI 27–137%). These increases were because of an increase in atonic postpartum haemorrhage, from 29.4 per 1000 deliveries in 1991 to 39.3 per 1000 deliveries in 2004 (34% increase, 95% CI 31–38%). Adjustment for temporal changes in risk factors did not explain the increase in atonic postpartum haemorrhage but attenuated the increase in atonic postpartum haemorrhage with hysterectomy.

Conclusions There has been a recent, unexplained increase in the frequency, and possibly the severity, of atonic postpartum haemorrhage in Canada.

Br J Obstet Gynecol 2007; 114:751-59

OBSTETRICS

Trends in postpartum hemorrhage: United States, 1994–2006

William M. Callaghan, MD, MPH; Elena V. Kuklina, MD, PhD; Cynthia J. Berg, MD, MPH

OBJECTIVE: The purpose of this study was to estimate the incidence of postpartum hemorrhage (PPH) in the United States and to assess trends.

STUDY DESIGN: Population-based data from the 1994–2006 National Inpatient Sample were used to identify women who were hospitalized with postpartum hemorrhage. Data for each year were plotted, and trends were assessed. Multivariable logistic regression was used in an attempt to explain the difference in PPH incidence between 1994 and 2006.

RESULTS: PPH increased 26% between 1994 and 2006 from 2.3% (n = 85,954) to 2.9% (n = 124,706; P < .001). The increase primarily was due to an increase in uterine atony, from 1.8% (n = 66,567) to 2.4% (n = 99,904; P < .001). The increase in PPH could not be explained by changes in rates of cesarean delivery, vaginal birth after cesarean delivery, maternal age, multiple birth, hypertension, or diabetes mellitus.

CONCLUSION: Population-based surveillance data signal an apparent increase in PPH caused by uterine atony. More nuanced clinical data are needed to understand the factors that are associated with this trend.

Key words: postpartum hemorrhage, pregnancy, uterine atony

Am J Obstet Gynecol 2010; 202:353e1-6

Society for Obstetric Anesthesia and Perinatology

National Partnership for Maternal Safety: Consensus Bundle on Obstetric Hemorrhage

Elliott K. Main, MD, Dena Goffman, MD, Barbara M. Scavone, MD, Lisa Kane Low, PhD, CNM, Debra Bingham, DrPH, RN, Patricia L. Fontaine, MD, MS, Jodi B. Gerlin, MD, David C. Lagrew, MD, and Barbara S. Levy, MD

Safety Bundle Concept

Straight forward, evidence-based recommendations for practice and care processes known to improve outcomes

4 domains

readiness
recognition and prevention
response
reporting and system learning

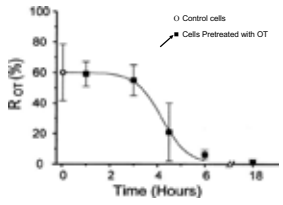
Anesth Analg 2015; 121:142-8

Myometrial oxytocin receptor concentration

	Median (fmol/mg DNA)	Intercentile range
Non pregnant	19	11-40
Pregnant (13-17 wk)	128	65-417
Pregnant (37-41wk)	1140	1081-2490
Early labor	3550	3090-4240
Advanced labor	246	133-1830

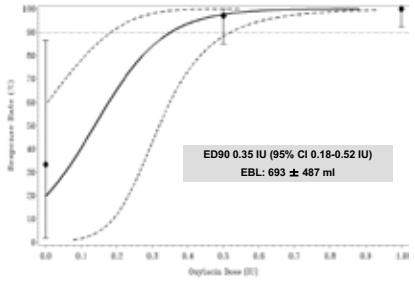
Fuch AR. Am J Obstet Gynecol 1984;150:734-41

Desensitization of Oxytocin Receptors
(human myometrium culture)



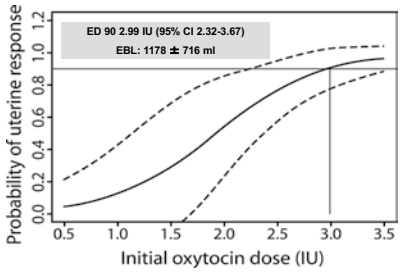
Robinson C et al. Am J Obstet Gynecol 2003, 188: 497-502

ED90 of Oxytocin at Elective Cesarean Deliveries



Carvalho JCA et al. Obstet Gynecol 2004; 104: 1005-10

ED90 of Oxytocin at Cesarean Deliveries for Labor Arrest



Balki M et al. Obstet Gynecol 2006, 107:45-50

Oxytocin exposure during labor and PPH

	PPH atony n=54	Control n=54	P value
Total oxytocin dose (mU)	10,054 ± 11,340	3,782 ± 7,093	< 0.001
Duration of oxytocin infusion (min)	628 ± 574	294 ± 467	< 0.001
Oxytocin maximal dose (mU/min)	16.8 ±14.7	7.0 ± 10.9	< 0.001

Grotegut et al. Am J Obstet Gynecol 2011;204(1):56.e1-6.

PERIOPERATIVE MEDICINE

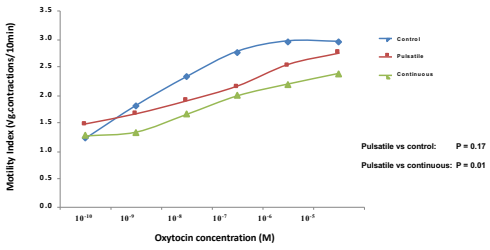
Oxytocin Pretreatment Attenuates Oxytocin-induced Contractions in Human Myometrium *In Vitro*

Mrinalini Balki, M.D.,* Magda Erik-Soussi, M.Sc.,† John Kingdom, M.D.,‡ Jose C. A. Carvalho, M.D., Ph.D.§

Anesthesiology 2013; 119:552-61

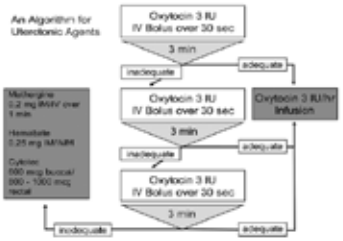
The Effect of Intermittent Oxytocin Pretreatment on Oxytocin-Induced Contractility of Human Myometrium In Vitro

Chiraag Talati, MBBS, BSc (Hons), FRCA,* Jose C. A. Carvalho, MD, PhD,*† Alice Luca, MSc,* and Mrinalini Balki, MBBS, MD*†‖



Anesth Analg 2019;128:671-678

The Rule of Threes



Balki & Tsen. Int Anesthesiol Clin 2014; 52 (2):48-66

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GUIDELINES

International consensus statement on the use of uterotonic agents during caesarean section

M. Heesen, B. Carvalho, J.C.A. Carvalho, J. J. Duvekot, R.A. Dyer, D. N. Lucas, N. McDonnell, S. Orbach-Zinger and S. M. Kinsella

Anaesthesia, 2019, in press

First-line drug

Oxytocin

Elective caesarean section	*Intrapartum caesarean section*
Bolus 1 IU oxytocin; start oxytocin infusion at 2.5 – 7.5 IU.hr^{-1} (0.04 - 0.125 IU.min^{-1}).	3 IU oxytocin over ≥ 30 s; start oxytocin infusion at 7.5 - 15 IU.hr^{-1} (0.125 – 0.25 IU.min^{-1}).
If required after 2 min, give a further dose of 3 IU over ≥ 30 s.	
Consider second-line agent early in the event of failure of this regimen to produce sustained uterine tone.	
Review the patient's clinical condition before discontinuing the infusion; this will usually be between 2 - 4 h after commencement.	

Alternative - carbetocin

Elective caesarean section

- 100 µg over ≥ 30 s.
- Smaller doses (as low as 20 µg) may be sufficient; in this case, doses can be repeated if required, up to 100 µg.
- Do not exceed 100 µg – if required move to second-line drug.

Intrapartum caesarean section

- 100 µg over ≥ 30 s.
- Do not exceed 100 µg – if required move to second-line drug.

Second-line drugs

These drugs should be considered for both prophylaxis and treatment of postpartum haemorrhage. Consider early use in the event of failure of first-line drug to produce sustained uterine tone.
Depending on local availability, the following drugs can be used:

- Ergometrine (ergonovine) 200 - 500 µg / methylergometrine (methylergonovine) 200 µg; intramuscular, or slow i.v. in exceptional circumstances; may be repeated after 2 h.
- Misoprostol 400 - 600 µg; sublingual, rectal, vaginal, oral; repeat after 15 min if required, maximum dose 800 µg.
- Carboprost 250 µg; intramuscular or intramyometrial (contraindicated i.v.); up to every 15 minutes if required, maximum 8 doses.
- Sulprostone 500 µg; i.v. at 100 µg.h^{-1}; maximum dose 1500 µg.

Consider early use of adjunctive medication to counter adverse effects, e.g. antiemetics.
Further uterotonic administration (third drug) should be considered within a multimodal postpartum haemorrhage regimen (pharmacology/ haematology and antifibrinolysis / surgery/ interventional radiology).

Fig. 1. Suggested dose regimens for uterotonic administration at low-risk elective caesarean section, and caesarean section in labouring women. N.B. take account of national drug license restrictions. See text for supporting information.

Abstract # O2-01

Unable to Assess Due to Body Habitus: High Frequency of Inappropriately High Neuraxial Block Placement in Super-Obese (BMI ≥ 50) Parturients

Type: Original Research
Primary Author: David E Arnolds MD, PhD - University of Chicago
Additional Authors: Jennifer E Hofer MD - University of Chicago
Barbara M Scavone MD - University of Chicago

Background: Morbid obesity increases the difficulty of palpating anatomic landmarks and may increase the risk for inappropriately high dural puncture during neuraxial procedures. Dural puncture above the tip of the conus medullaris, which lies at or above the L2 vertebral body in >98% of adults (1), carries the risk of damage to the spinal cord. The accuracy of anesthesiologists' estimates of interspinous level has been examined and is imperfect (2,3), but there are no data on accuracy in super-morbidly obese (body mass index (BMI) ≥ 50) parturients. Our goal was to evaluate the frequency of inadvertently high epidural/intrathecal catheters (at or above the L1/L2 interspace) in parturients with a BMI ≥ 50.

Methods: The anesthetic records and x-rays taken to rule out retained foreign objects of 150 women with a BMI ≥ 50 who underwent cesarean delivery with an epidural or intrathecal catheter were retrospectively reviewed. The pre-specified primary outcome was the percentage of catheters placed at or above the L1/L2 interspace. Secondary outcomes were agreement between the estimated and actual catheter location, as well as subgroup analysis of those catheters placed with ultrasound guidance.

Results: 125 cases were included after excluding 15 cases where it was not possible to determine catheter location and 10 cases where the estimated level was not recorded. 26/125 (21%) catheters were unintentionally placed at or above L1/L2. There was poor agreement between the estimated and actual catheter level (Figure, kappa statistic 0.02). 88/125 (70%) of catheters were placed more cranially than estimated. High catheter placement occurred despite the use of ultrasound: 11/39 (28%) catheters placed with ultrasound were at or above L1/L2. No patients experienced neurologic complications.

Conclusions: Super-morbidly obese parturients are at high risk for inappropriately high neuraxial block placement. Prior studies in non-obese parturients demonstrate a 1-6% incidence of catheter placement at or above L1/L2 (2,3) compared to the 21% incidence in our super-obese population. The use of ultrasound did not prevent high catheter placement. Retrospectively, we are unable to determine whether ultrasound was used to explicitly identify intervertebral level. We suggest close attention to intervertebral level in this high risk population and rigorous use of ultrasound.

References:

1. Saifuddin et al Spine 1998 2:Schlotterbeck et al BJA 2008 3:Tanaka et al Braz J Anes 2013

Abstract # O2-01

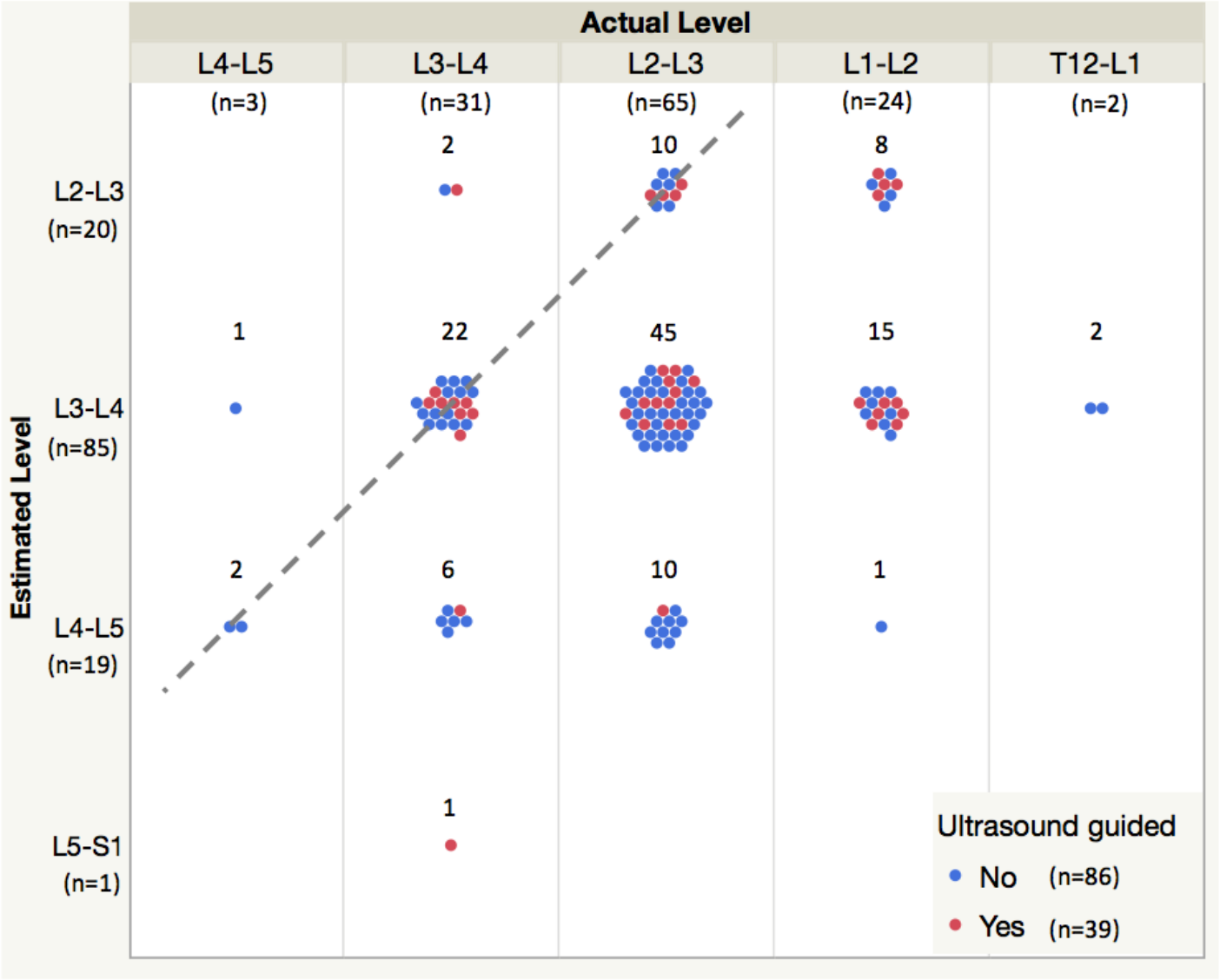


Figure: Correlation between anesthesiologist's estimate of interspinous level (x-axis) and actual level as determined by retained foreign body x-ray (y-axis). Blue dots indicate procedures in which ultrasound guidance was not used. Red dots indicate procedures in which ultrasound guidance was used. The dashed line indicates agreement between estimated and actual levels. Catheters placed at a level lower than estimated are to the left of the dashed line, whereas catheters placed at a higher level are to the right of the dashed line. n=125 catheters were analyzed

Abstract # O2-02

Liposomal Bupivacaine Transversus Abdominis Plane Block for Pain After Cesarean Delivery: Results From a Multicenter, Randomized, Double-Blind, Controlled Trial

Type: Original Research
Primary Author: Ashraf S Habib MB, BCh - Duke University Medical Center
Additional Authors: Srdjan S Nedeljkovic MD - Brigham and Women's Hospital, Harvard Medical School
Attila Kett MD - Saint Peter's University Hospital
Manuel C. Vallejo MD, DMD - West Virginia University
Jean-Louis Horn MD - Stanford University School of Medicine Brendan Carvalho MBBCh - Stanford University School of Medicine

Background: In women receiving intrathecal morphine, transversus abdominis plane (TAP) blocks with standard bupivacaine may not improve analgesia after cesarean delivery.1 However, in a retrospective analysis, use of a TAP block with long-acting liposomal bupivacaine (LB) after cesarean delivery reduced opioid consumption and improved analgesia.2 We present results of a multicenter, randomized, double-blind study (NCT03176459) comparing opioid consumption after TAP blocks with LB plus bupivacaine HCl vs bupivacaine HCl alone as part of a multimodal analgesia protocol including intrathecal morphine postsurgery. Methods: Adults (N=186) with term pregnancies of 37-42 weeks scheduled to undergo elective cesarean delivery using spinal anesthesia, including intrathecal morphine 150 mcg, were randomized (1:1) to receive TAP with LB 266 mg plus bupivacaine HCl 50 mg or bupivacaine HCl 50 mg alone after surgery. All patients received IV ketorolac 15 mg and IV acetaminophen 1000 mg at the end of surgery, followed by oral acetaminophen 650 mg and ibuprofen 600 mg every 6 h for ≤72 h or until discharge. Efficacy was evaluated in a prespecified modified intent-to-treat (mITT) population who met study protocol criteria. Primary efficacy endpoint was total postsurgical opioid consumption (morphine equivalent dosing [MED]) through 72 h after cesarean delivery. Pain intensity was measured with a 10-cm visual analog scale. Opioid sparing was prespecified as taking ≤10 mg of oxycodone (or equivalent) with no opioid-related side effects through 72 h. Treatment-emergent adverse events (TEAEs) were recorded through day 14.

Results: In the mITT efficacy set (LB, n=71; bupivacaine, n=65), demographics were similar across groups. Total opioid consumption (MED) through 72 h was significantly lower in the LB vs bupivacaine group (least squares mean [LSM] standard error [SE], 15.5 [6.67] vs 32.0 [6.25] mg; P=0.01). Reductions were also observed at 1 week (LSM [SE], 23.3 [9.75] vs 45.8 [9.13] mg; P=0.02) and 2 weeks (LSM [SE], 28.2 [11.20] vs 47.8 [10.49] mg; P=0.05). Area under the curve of imputed pain intensity scores through 72 h was lower in the LB vs bupivacaine group (LSM [SE], 147.9 [21.13] vs 178.5 [19.78]; P=0.002). Percentage of opioid- spared patients was 2.2 times higher in the LB vs bupivacaine group (54 vs 25%; P=0.001). Safety was similar between groups; 64% of patients in the LB group experienced a TEAE vs 56% in the bupivacaine group. The most common TEAEs were pruritus and nausea. Serious TEAEs were rare (~3% in both groups), with no fatal TEAEs.

Conclusions: TAP block using LB plus bupivacaine HCl as part of a multimodal analgesia protocol after cesarean delivery resulted in reduced opioid consumption and pain during and after hospitalization vs bupivacaine HCl alone. Results suggest an opioid-sparing benefit of adding LB to bupivacaine TAP blocks in a cesarean delivery setting.

References:

1. Can J Anaesth. 2012;59:766-78. 2. J Pain Res. 2018;11:3109-16.

Abstract # O2-03

Survey of Drug Shortages on Academic Obstetric Anesthesiology Units

Type: Original Research
Primary Author: Erin Haggerty MD - University of Illinois Chicago
Additional Authors: Heather C Nixon MD - University of Illinois Chicago

Introduction: Drug shortages may result in patient harm1. No current evidence exists whether suggested strategies to deal with drug shortage actually reduce the number of shortages or improve patient safety2. In light of the recent increase in drug shortages, the goal of our study was to determine how drug shortages are being managed on academic obstetric anesthesiology units.

Methods: A previously created and administered survey examining the impact and management of drug shortages was electronically administered (SurveyMonkey Jan 2019) to a list of academic obstetric anesthesiology directors (93 total). Descriptive statistics were used to categorize survey responses and was compare to results from its 2014 administration.

Results: Forty-one participants responded (response rate 44%). Fifty-one percent of respondents indicated their unit was experiencing a shortage at the time of the survey and 82% had experienced a shortage in the last year. In order to conserve drug supply, 42.5% of participants indicated that single dose medications were being divided for use on multiple patients and 17.6% reported this was being done by the anesthesiologists on the floor and not under sterile conditions. Medication errors/ near misses linked to drug shortages were reported by 30.8%. Anesthesiology consultation prior to drug changes by pharmacy was identified as occurring by 23.1% of respondents. Seventy-two percent reported there was a mechanism in place to alert anesthesiologists of any changes in drugs manufacturers or concentration, with e-mail notification being the most common mode of communication. Comparisons to 2014 data is in Table 1.

Conclusion: Drug shortages remain a concern for most obstetric units, with over 75% of respondents indicating that their unit experienced a drug shortage in the last year. The presence of a designated anesthesiology drug managers has reportedly increased, while medication errors (including near-misses) and the division of single dose vials via non-sterile technique has reportedly increased. This may indicate a need for drug managers to work closely with pharmacy to provide sterile single dose medications to the unit. More units have alert systems in place to provide more information to obstetric anesthesiology providers, however there is no data available to assess the efficacy of these systems.

References:

1. ISMP Canada Safety Bulletin. March 20 2012;12(3).
2. Fox ER,. Am J H Syst Phar, Aug 1 2009;66(15):1399-1406.

Abstract # O2-04

Learning Outcomes of a Serious Video Game-Based Experiment: a Battle of the Sexes

Type: Original Research
Primary Author: Allison J Lee M.D., M.B.B.S. - Columbia University
Additional Authors:
Stephanie Goodman M.D. - Columbia University Beatriz Corradini M.Sc. - Columbia University Chen-Miao Chen Ph.D. - Columbia University Madhabi Chatterji Ph.D. - Columbia University Ruth Landau M.D. - Columbia University

Background: Teaching the skills to perform general anesthesia (GA) for cesarean delivery (CD) requires innovative strategies, as trainee exposure to managing such cases has declined.1 High-fidelity simulation (HFS) training in GA for CD improves performance in subsequent simulations.2,3 We developed a serious game (SG), EmergenCSim, with an embedded debriefing and scoring tool, that reproduces a virtual obstetric OR. In the game, the trainee, represented by an avatar, must perform GA for CD for umbilical cord prolapse. We hypothesized that exposure to EmergenCSim improves novice CA1 knowledge and observed behaviors on performing GA for CD and is equivalent to HFS to evaluate competency.

Methods: The efficacy of EmergenCSim (a) as an adjunct to a lecture for teaching GA for CD and (b) for use vs HFS to assess CA1 knowledge and skills were evaluated over time. In this RCT, CA1s (N=52) received a lecture on GA for CD; 4 weeks later (Time 1, T1) they all took a 29-item MCQ test.4 They were then randomized to play EmergenCSim (GAME gp) or a SG on anaphylaxis (SHAM gp). Outcomes were measured via the MCQ test in week 8 (Time 2, T2), and again between week 8-28 (Time 3, T3), via a SG score (SGS) produced with both groups playing EmergenCsim (T3), and behavior checklist scores (BCS)5 from participation in a HFS of GA for CD – the average for 2 raters (T3).

Results: At T3, BCS were significantly higher in GAME gp (Mean 226.5, SD 37.2) vs. SHAM gp (Mean 211.8, SD 76.9) ($p<0.05$), with high inter-rater BCS correlation ($r = 0.95$). There was a significant correlation between BCS and SGS ($r = 0.34$; $p=0.01$, 1-tailed). Mean MCQ scores (Cronbach's alpha reliability = 0.71; Fig A) were higher at T3 vs T1, and T2 vs T1 in the GAME gp compared with SHAM gp, and the difference was statistically significant in post-hoc comparisons. There was a significant increase in MCQ scores over time among male residents but not females ($p=0.035$; Fig B).

Discussion: Exposure to EmergenCsim improved performance on an identical HFS scenario but MCQ scores significantly improved only in males, possibly unveiling gender differences for SG-based learning platforms. SG scores strongly correlated with HFS BCS, suggesting SGs have value as performance assessment tools. Next steps are to refine the MCQ test, define optimal debriefing methods and explore outcome differences by gender.

References:

1. IJOA 2011;20:10-6
2. SiH 2010;5:320-4
3. IJOA 2014;23:341-7
4. JEPM 2018;20:E621
5. Anesthesiol 2006;105:260-6

Abstract # O2-04

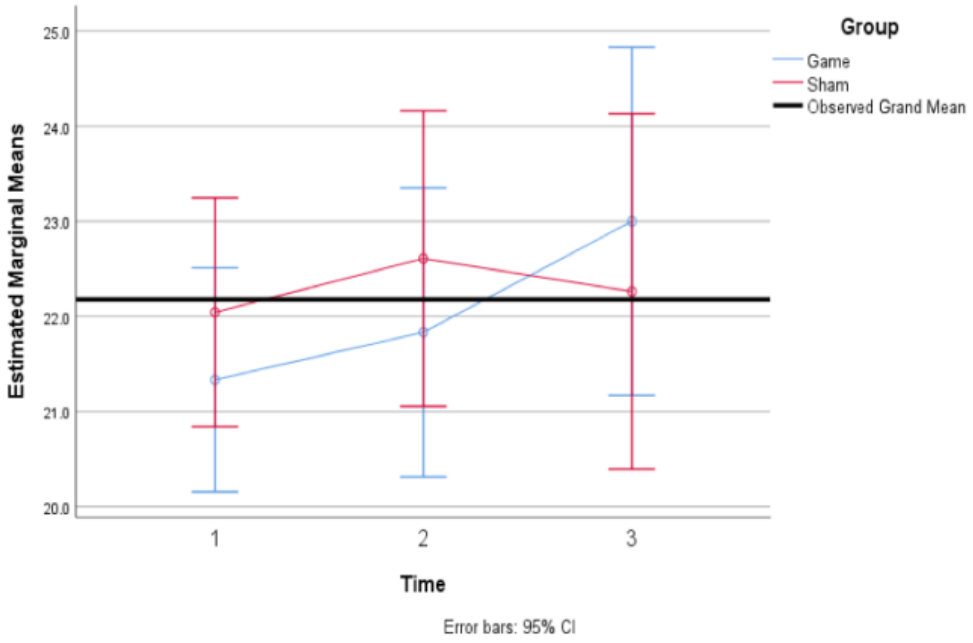


Figure A: Mean MCQ test scores by group

Key: Time 1= week 4, Time 2 = week 8
Time 3 = week 8 – 28 of training (CA1 year)

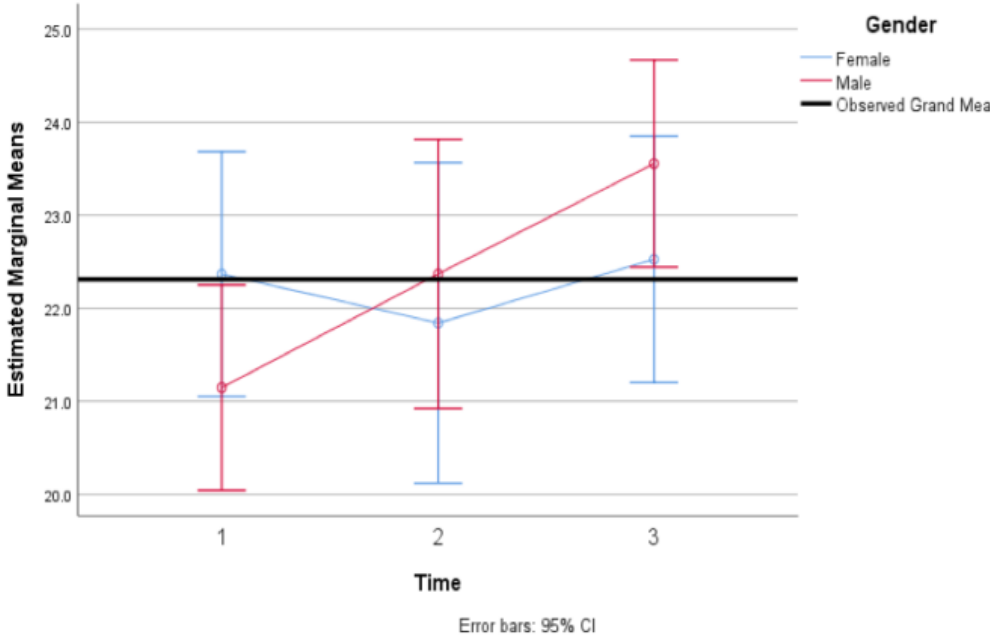


Figure B: Mean MCQ test scores by gender.
Significant difference in MCQ score increase over time between male (N=27) and female (N=19) residents (p=0.035)

Abstract # O2-05

Improved Programmed Intermittent Epidural Bolus Volume Regimen in the Setting of Labor Analgesia

Type: Original Research
Primary Author: Jie Zhou M.D., M.S., M.B.A. - Brigham and Women's Hospital, Harvard Medical School
Additional Authors: Mingping Hu PHD - The second Affiliated Hospital and Yuying Children's Hospital of Wenzhou Medical University
Weiwei Kong Master - The second Affiliated Hospital and Yuying Children's Hospital of Wenzhou Medical University
Qixing Wu Master - The second Affiliated Hospital and Yuying Children's Hospital of Wenzhou Medical University
Shengxing Zheng PHD - The second Affiliated Hospital and Yuying Children's Hospital of Wenzhou Medical University
Yufei Ni Master - The second Affiliated Hospital and Yuying Children's Hospital of Wenzhou Medical University
Bing Zhang Master - The second Affiliated Hospital and Yuying Children's Hospital of Wenzhou Medical University

Background: Evidence suggests that programmed intermittent epidural bolus (PIEB) administration improves analgesia efficacy as compared continuous epidural infusion (CEI); however, the value of optimal PIEB volume remains unclear. We aimed to determine the optimal PIEB volume with the use of patient-controlled epidural analgesia (PCEA) to provide effective analgesia during labor.

Methods: In a prospective, randomized, double-blinded study, 428 laboring parturients requesting epidural analgesia were administered PCEA in 0.1% ropivacaine/0.33 ug/ml sufentanil and randomly assigned to four groups: CEI 8 (control group) received 8 ml/h continuous epidural infusion and PIEB groups received a 5-, 8-, and 10 ml/h programmed intermittent epidural bolus, respectively. The primary endpoint was the difference observed in VAS pain score seen among the four treated groups.

Results: Pain score was significantly lower in the PIEB 8 and PIEB 10 programmed intermittent epidural bolus groups versus the CEI 8 and PIEB 5 groups ($P < 0.05$). Hourly ropivacaine consumption was significantly lower in parturients receiving 5, and 8 ml/h PIEB than the other groups ($P < 0.05$). However, a higher PCEA rate were found in the CEI 8 and PIEB5 groups. Maternal satisfaction was significantly higher for PIEB 8 and 10 ($P < 0.05$). No differences in motor block, adverse events, instrumental delivery rate and neonatal outcomes were observed.

Conclusion: Observations suggest that PIEB 8 and 10 ml/h improves analgesia and patient satisfaction during labor with a reduced need for rescue by PCEA bolus without any adverse outcomes.

References:

1. Jung H, Kwak KH. Neuraxial analgesia: a review of its effects on the outcome and duration of labor. Korean journal of anesthesiology 2013; 65: 379-84.
2. Practice guidelines for obstetric anesthesia: an updated report by the American Society of Anesthesiologists Task Force on Obstetric Anesthesia. Anesthesiology 2007; 106: 843-63.
3. Feldheiser A, Aziz O, Baldini G, et al. Enhanced Recovery After Surgery (ERAS) for gastrointestinal surgery, part 2: consensus statement for anaesthesia practice. Acta anaesthesiologica Scandinavica 2016; 60: 289-334.
4. Guay J, Nishimori M, Kopp SL. Epidural Local Anesthetics Versus Opioid-Based Analgesic Regimens for Postoperative Gastrointestinal Paralysis, Vomiting, and Pain After Abdominal Surgery: A Cochrane Review. Anesthesia and analgesia 2016; 123: 1591-602.

Post Dural Puncture Headache

Barbara M. Scavone, MD

Professor
Department of Anesthesia and Critical Care
Department of Obstetrics and Gynecology
University of Chicago Medical Center

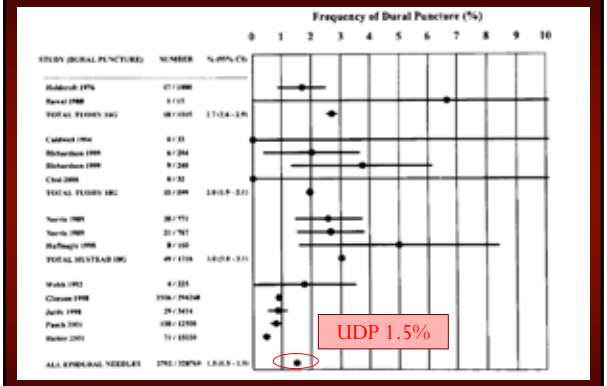
I have no financial relationships or other conflicts of interest to disclose.

Learning Objectives

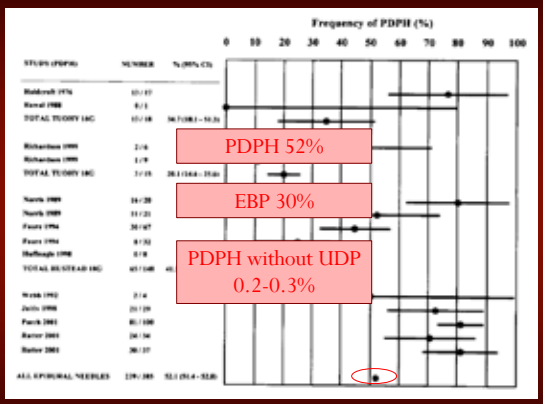
Upon completion of this activity the participant will be able to:

- List the incidence, clinical features, and risk factors for post dural puncture headache.
- Assess the risks and benefits of different treatment modalities for post dural puncture headache.
- Describe possible long-term effects from post dural puncture syndromes.

Incidence and Clinical Features



Choi: Can J Anesth 2003; 50:460-69



Choi: Can J Anesth 2003; 50:460-69

- Traction on pain-sensitive meninges
- Intracranial venous dilation

Iqbal: Headache 1995;35:420-22
Grant: J Neurol Neurosurg Psych 1991;54:440-42

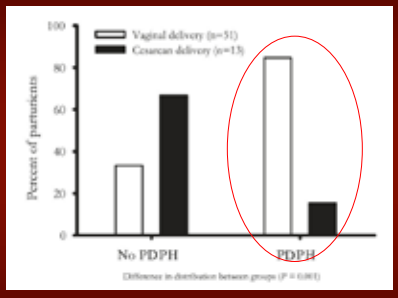
- Positional HA, frontal, occipital or global
- Sometimes accompanied by
  - Neck/back pain
  - Visual disturbances
  - Auditory disturbances
  - Nausea/vomiting
  - Cranial/upper cervical nerve dysfunction
- Onset 1-7 days
- Duration 1-7 days

Choi: Can J Anesth 2003;50:460-69

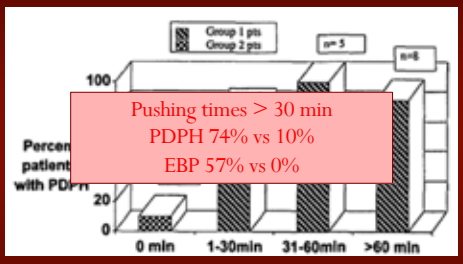
Risk Factors

- Age
- Gender
- Pregnancy?
- Body habitus
  - More likely UIDP
  - Less likely PDPH

Vandam: JAMA 1956;161:586-91
Hollister: IJOA 2012;21:236-41
Faure: Reg Anesth 1994;19:361-63
Peralta: Anesth Analg 2015;121:451-56



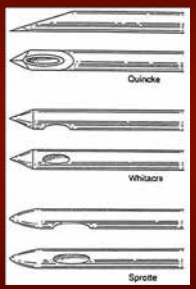
Scavone: Anesthesiology 2004;101:1422-27



Pushing times > 30 min
PDPH 74% vs 10%
EBP 57% vs 0%

Angle: Can J Anesth 1999;46:861-66

Needle Size and Type



Vandam: JAMA 1956;161:586-91
Vallejo: Anesth Analg 2000;91:916-20

Loss of Resistance Medium

- Quasi-randomized, n = 2730 (pain patients)

	Air	Saline
PDPH	87%	10%

No difference UDP
↑ Pneumocephalus
Effect on classic PDPH unknown

*$P < 0.05$

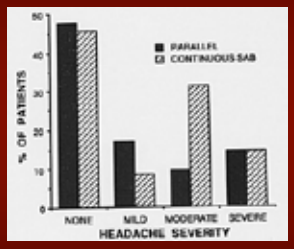
- Air-related HA's fast onset, short duration
- Pneumocephalus

Aida: Anesthesiology 1998;88:76-81

Epidural vs. Intrathecal Catheters

- Theory
- Retrospective studies:
  - Conflicting
  - Confounded
  - Small n

- Sequential allocation, n = 56 OB patients



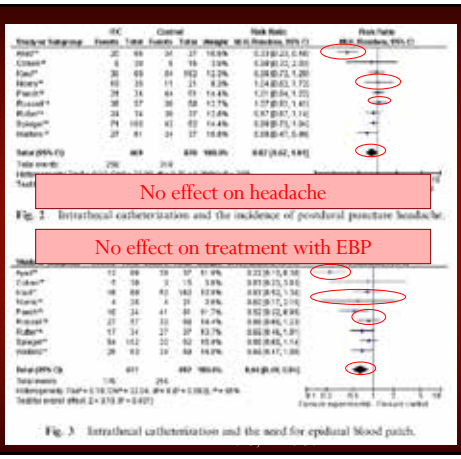
- No difference EBP

Norris: Reg Anesth 1990;15:285-87

- RCT, n = 97 OB patients

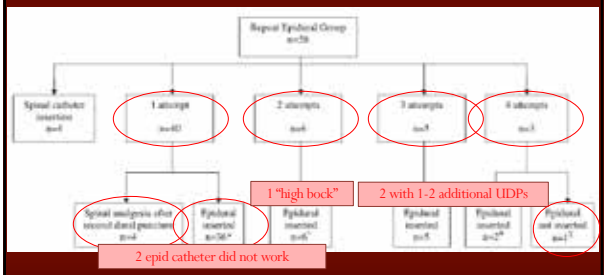
	Epidural n = 47	Intrathecal x 24 hr n = 50
PDPH	62%	72%
EBP	55%	50%

Russell: IJOA 2012;21:7-16



No effect on headache

No effect on treatment with EBP



Russell: IJOA 2012;21:7-16

Epidural vs. Intrathecal Catheters
Other Issues

- Intrathecal
  - Accidental dosing errors/high spinal
  - Dangerous to leave it in on postpartum floor!
- Epidural
  - Translocation through large dural puncture/high spinal

Prophylaxis and Treatment

Non-invasive Measures

- Bedrest – No
- Hydration – No
- Abdominal binders – Possibly but not popularly used
- Analgesics
  - Acetaminophen
  - Non-steroidal anti-inflammatory drugs
  - Opioids
  - Combinations (with butalbital and/or caffeine)

Caffeine

- Modest, transient effect
- Prolonged $t_{1/2}$ in postpartum patients
- Accumulation with repeated doses or infusion
- Reports of seizure, arrhythmia with IV dosing

Camann: Anesth Analg 1990;70:181-84

Other Proposed Treatments

- ACTH analogs
- Sumatriptan
- Intrathecal morphine
- Epidural/intrathecal saline

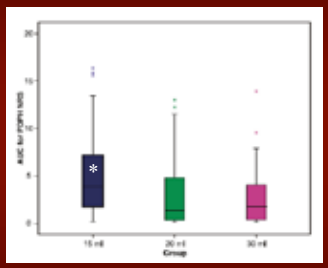
Katz: Anesth Analg 2017;124:1219-28

Sphenopalatine Ganglion Block

Katz: Anesth Analg 2017;124:1219-28
Cohen: Reg Anesth Pain Med 2018;880-84

Epidural Blood Patch

- Tamponade effect intrathecal sac
- Increases epidural/intrathecal pressures
- Clot adheres to tears in dura over next several hours



Paech: Anesth Analg 2011;113:126-33

Efficacy

	Paech	Williams	Banks
A			
N			
>			
Complete permanent	22%	33%	44%

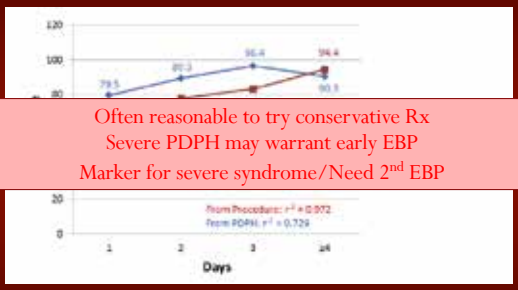
No relief at all unusual

2nd EBP: Up to 31%

Paech: Anesth Analg 2011;113:126-33
Williams: IJOA 1999;8:105-9
Banks: IJOA 2001;10:172-76

Timing

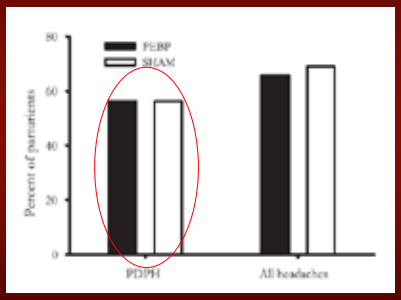
- Uncontrolled
- Retrospective
- Male, female
- OB, non-OB
- Mix of needle types, sizes
- Varying definitions of "failure"



Often reasonable to try conservative Rx
Severe PDPH may warrant early EBP
Marker for severe syndrome/Need 2nd EBP

Booth: IJOA 2017;29:10-17

Prophylactic EBP

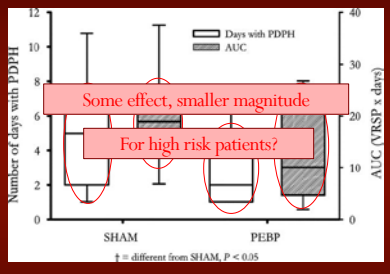


Scavone: Anesthesiology 2004; 101:1422-27

Prophylactic EBP

	Prophylactic (n = 60)	Therapeutic (n = 49)	p value
Headache	11 (18.3%)	39 (79.6%)	< 0.0001
Severity score			
Mild	2 (3.3%)	3 (6.1%)	0.49
Moderate	4 (6.7%)	13 (26.5%)	0.004
Severe	5 (8.3%)	23 (46.9%)	< 0.0002
Accompanying symptoms			
Nuchal rigidity	7 (11.7%)	27 (55.1%)	< 0.0001
Tinnitus	1 (1.7%)	11 (22.4%)	0.001
Photophobia	1 (1.7%)	4 (8.1%)	0.23
Diplopia	0	3 (6.1%)	0.053
Nausea	0	1 (2.0%)	0.45
Vomiting	0	0	–

Stein: Anaesthesia 2014; 69:320-26



Some effect, smaller magnitude
For high risk patients?

Scavone: Anesthesiology 2004; 101:1422-27

Complications

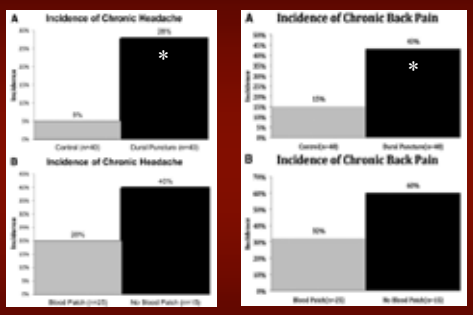
- Backache (85%)
- Arachnoiditis
- Deterioration of mental status and seizures
- Lumbovertebral syndrome
- Transient bradycardia
- Transient 7th cranial nerve palsy

Scope of the Problem

PDPH:

- Interferes with ADLs
- Increased hospital/ER visits
- Increases length of stay
- Severe complications
  - Cranial Nerve VI palsy
  - Subdural hematoma

Angle: Can J Anesth 2005; 52:397-40
Zeidan: IJOA 2006; 50-58
Hofer: Anesth Analg 2015;644-46



Webb: Anesth Analg 2012;115:124-32:

THE UNIVERSITY OF Chicago

Maternal Levels of Care: 2019 Update

Sarah J. Kilpatrick MD, PhD
Helping Hand Endowed Chair
Chair, Obstetrics & Gynecology
Associate Dean for Faculty Development and Diversity
Cedars-Sinai Medical Center

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Learning Objectives

- Describe need for levels of maternal care and role in health system to respond to high-risk maternal conditions
- Be able to conceptualize each level of maternal care

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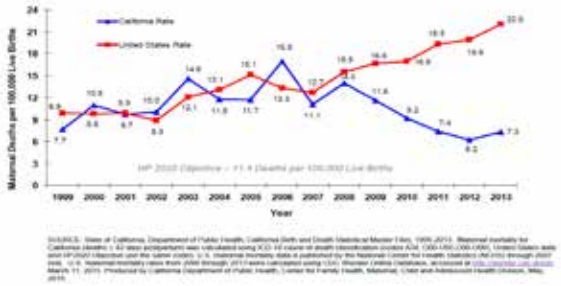
Maternal Mortality Rate, California and United States; 1999-2013



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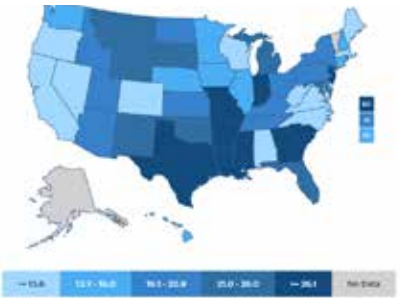
Deaths From Any Cause Related to or Aggravated by Pregnancy or its Management (Excluding Accidental/ Incidental Causes) During Pregnancy & Childbirth or Within 42 Days of Termination of Pregnancy, Irrespective of the Duration & Site of the Pregnancy, Per 100,000 Births

Maternal Mortality, 2016 Health of Women and Children Report Source: CDC, National Vital Statistics System from 2010-2014



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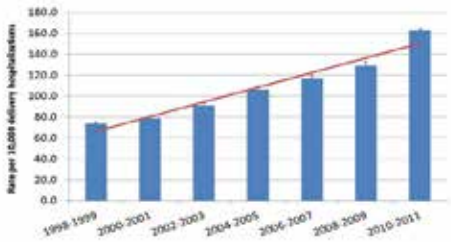
Severe Maternal Morbidity During Delivery Hospitalizations: United States, 1998-2011



http://www.cdc.gov/reproductivehealth/MaternalInfantHealth/SevereMaternalMorbidity.html

CDC.go

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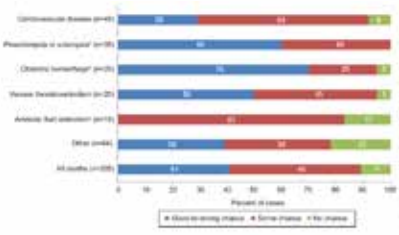
Pregnancy Related Mortality CA 2002-2005
Chance to Alter Outcome



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Contributing Provider Factors to Maternal Deaths CA

Main. Pregnancy-related mortality in California: Obstet Gynecol 2015;125:938–47

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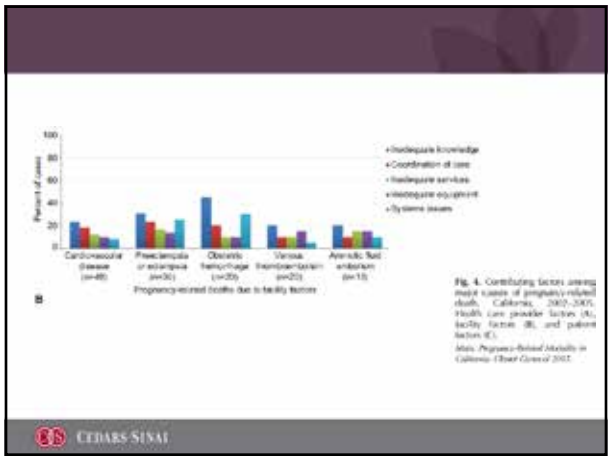

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Severe Maternal Morbidity

- Severe maternal morbidity cases
  - ➢ 0.5% deliveries 1991-2003
    - ▪291,000 cases, 464 hospitals, national hospital discharge survey
  - ➢ Based on ICD-9 codes most common: transfusion, eclampsia, hysterectomy (75%)
  - ➢ 50X more common than death
- Transfused 4 or more units
- Admitted to ICU

Callaghan ajog 2008;199:133

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Near Miss Preventable Factors

- 40% deaths preventable factors
- 45% near misses preventable factors
- 17% severe morbidities preventable factors (p = .01)
- Clearly opportunity for slowing progression through the continuum at least from severe morbidity to worse

Geller AJOG 2004;191:939-44

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Results: Ozimek, 2016

Table 1: Type of Severe Maternal Morbidity and Opportunity for Improvement in Care

Type of SMM	n (%)	Overall Opportunity for Improvement n (%)[a,b]	Contributing Factors: System n (%)	Provider n (%)	Patient n (%)
Hemorrhage	107 (71.3%)	41 (38.3%)	5 (12.2%)	37 (90.2%)	7 (17.1%)
Preeclampsia/Eclampsia	16 (10.7%)	8 (50.0%)	2 (25.0%)	2 (25%)	4 (50.0%)
Cardiovascular	6 (4.0%)	2 (33.3%)	0	2 (100%)	1 (50.0%)
Sepsis/Infection	6 (4.0%)	4 (66.7%)	0	2 (50.0%)	3 (75.0%)
Pulmonary Edema	5 (3.3%)	4 (80.0%)	0	4 (100%)	1 (25.0%)
Other [c]	10 (6.7%)	7 (70.0%)	2 (28.6%)	5 (71.4%)	3 (42.9%)
Total	150 (100%)	66 (44.0%)	9 (13.6%)	52 (78.8%)	19 (28.8%)

[a] Includes "possible" or "strong" opportunity for improvement
[b] Sum of System+Provider+Patient factors will not necessarily equal Overall Opportunity number as some patients had >1 type of opportunity
[c] Other severe maternal morbidities included one each of the following: iatrogenic intra-abdominal hemorrhage secondary to heparin use, postpartum exploratory laparotomy for suspected uterine rupture, uterine rupture that did not meet criteria for hemorrhage, rectal bleeding requiring blood transfusion, respiratory distress requiring ICU care, trauma, cerebrovascular accident, amniotic fluid embolism, cardiomyopathy and maternal death secondary to cardiopulmonary arrest in the setting of severe tumor lysis syndrome.

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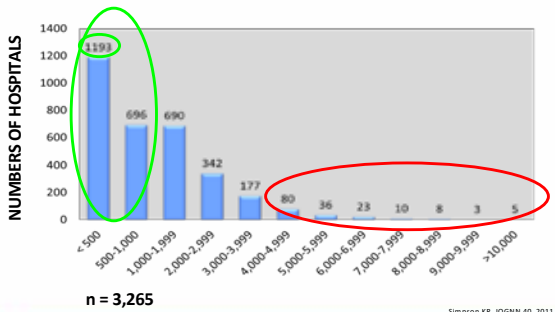
Annual Birth Volume in U.S. Hospitals, 2008



n = 3,265

Simpson KR, JOGNN 40, 2011

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What Would You Do With These Women at 3 AM?

- 25 YO G1 at 35 wks with HELLP and DIC
- 42 YO G2P1 at 38 wks with acute fatty liver of pregnancy
- 20 YO G1 at 36 wks with flu that progresses to ARDS and she is ventilated
- 34 YO at 36 wks with known severe pulmonary hypertension presents in labor
- 40 YO at 33 wks with 2 prior cesareans, suspected accreta presents with rom

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Levels of Maternal Care

- 1976 Toward Improving Outcome of Pregnancy
  - MOD, rec 3 levels of maternal and neonatal care
  - Regionalized perinatal care
- Neonatal levels nearly universally established
  - Data support less mortality with higher level hospital
- **Maternal levels virtually ignored**

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OB care consensus #2 Feb 2015

Maternal Levels Should Matter But…

- Direct data difficult to find
- OB complications more common in hosp with low del vol (kyser obstet gynecol 2012:207:42)
- Low volume providers sig more ob complications (janakiraman obstet gynecol 2011;118:521)
- Maternal mortality inversely correlated to population density of MFM (sullivan ajog 2005;193:1083)

OB care concensus #2 Feb 2015

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Does Hospital Acuity Level Matter?

- Compared smm rates for high comorbidity index women between low and high acuity hospitals
  - **Comorbidity index** based on diagnosis and procedure codes
    - Low/intermediate/high
  - **Hospital acuity**: low if bottom quartile; high if top quartile for % women with high comorbidity index

Clapp doi: 10.1016/j.ajog.2018.04.015

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TABLE 1
Patient and hospital characteristics at low- and high-acuity hospitals

Characteristics	Hospitals, % Low acuity (n=185,414)	High acuity (n=702,920)	*P* value
Patient comorbidity risk			<.001
Low risk	68.2	53.0	
Intermediate risk	31.0	43.7	
High risk	0.8	5.5	
Primary insurance type			<.001
Private	47.5	55.1	
Public	46.8	40.6	
Uninsured/self-pay	5.5	4.1	
Missing	0.2	0.3	
Median income of zip code			<.001
Quartile 1	26.3	26.2	
Quartile 2	33.3	21.5	
Quartile 3	27.2	23.7	
Quartile 4	11.7	27.7	
Missing	1.5	0.9	

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Clapp AJOG 2018;219:111.e1-7

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 MA et al. AJOG 2018;219:111.e1-7

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Hospital Acuity May Matter

- > 1.6 million births, 1200 hospitals
- Total SMM rate 1.2%
- Compared to low risk women:

- **Highest rate SMM in high risk women in low acuity hospitals**

- **Intermediate risk women same rates SMM**

Clapp doi: 10.1016/j.ajog.2018.04.015

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Levels of Maternal Care (LoMC)

- Levels of Maternal Care provide nationally applicable uniform definitions based on capability of facilities to provide increasing complexity of care to pregnant women to promote best outcomes
- Guidelines for Perinatal Care, 8th Edition will include both maternal and newborn levels of care

Jointly published by ACOG and SMFM 2015

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Maternal Levels of Care: Key Premises

- Focus on best maternal outcomes
  - **Matching care she needs with obstetric site**
- Build **relationships** between hospitals across levels
- Align multidisciplinary women's health orgs
  - ACOG, SMFM, AABC, ACNM, AWHONN, AAP, SOAP, Commission for the Accreditation of Birth Centers
- Complementary but distinct from neonatal levels
- Incorporate ante, intra, and postpartum care
- Gather data, quality focus

OB care consensus #2 Feb 2015; reaffirmed 2016

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The American College of Obstetricians and Gynecologists

Society for Maternal-Fetal Medicine

WHAT ARE THE ESSENTIAL COMPONENTS OF LMC?

Levels of Maternal Care is about:

- ✓ Supporting high quality care in rural/smaller settings
- ✓ Regional centers (Level III & IV) supporting education, data capture, QI among referring facilities
- ✓ Building culture of collaboration and efficient communication
- ✓ Facilitating training and resource identification/distribution
- ✓ Considering unique needs, resources of community, state, region
- ✓ Matching needs of mother with appropriate care
- ✓ Improving outcomes for mothers, newborns

Levels of Maternal Care is not about:

- ✗ Closing or singling out small or rural maternity care centers.

LoMC Levels of Maternal Care — Verification Program

A partnership of the
American College of Obstetricians and Gynecologists
Society for Maternal-Fetal Medicine
Centers for Disease Control and Prevention
Arizona Perinatal Trust
National Perinatal Information Center

Goal: LMC Verification Program

Application
- Hospital completes an efficient, online application for a specific level

Site Visit
- Verify application
- Review protocols
- Not a peer review

Report
- Verification level
- Recommendations for improvement
- Verification valid for 3 years

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Levels of Care Assessment Tool (LOCATe)

- **CDC** developed **LOCATe** using ACOG/SMFM Levels of Maternal Care guidance and AAP's national guidelines, to help states assess levels of maternal and neonatal care in obstetric facilities
- Utilizes self-reported information on staffing availability, equipment, and procedures
- Designed to be conversation starter among stakeholders regarding risk appropriate care
- Implemented in 12 states and Puerto Rico

CDC LOCATe: Example

MATERNAL CARE *The next 12 questions relate to services and staff available at your facility that involve the care of obstetric (maternal) patients.*	
W3. Does your facility have a **plan** for **transport of complicated obstetric/maternal patients**?	○ Yes ○ No *(If "No" skip to W4.)*
W3.1 Does this **plan** include… *(Mark all that apply)*	❑ Transport out to a higher level of care facility ❑ Receipt from a lower level of care facility
W4. Does your facility have an **intensive care unit onsite** that is available to accept **obstetric/maternal care patients**?	○ Yes ○ No

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LoMC Partners: Developed Assessment Tool & Site Visit Process

Assessment Tool:

- Based on 2015 ACOG/SMFM OB Care Consensus created to verify facility's level of maternal care

Site Visit Process:

- **Pre-site visit:** Facility completes LoMC forms, provides Policies and Procedures documents
- **On site:** Site visit team meets with facility personnel
  - discuss items on assessment tool
  - obtain feedback from facility personnel on process/assessment tool, address questions
  - provide highlights from LoMC team on the facility.

Post-site visit

- LoMC Team prepares Verification Report includes:
  - Verification of level according to Levels of Maternal Care OB Care Consensus
  - Comments, highlights, suggestions
- Optional call with LoMC team to discuss report
- Facility submits Feedback Survey

Pilot Program

- Launched pilot project in March 2017 to:
  - Evaluate LoMC verification tool.
  - Assess site visit process
  - Better understand challenges of hospitals in (1) adoption of LoMC guidelines; (2) involvement in regionalized maternal care system
- CDC's Division of Reproductive Health collaborated with health departments in states implemented LOCATe to identify and invite hospitals in diverse geographic locations with different staffing capacities/capabilities to participate

Pilot Program

•Site visit team includes reps from:*

- American College of Obstetricians and Gynecologists
- Society for Maternal-Fetal Medicine
- American College of Nurse-Midwives
- American Academy of Family Physicians
- Centers for Disease Control and Prevention, Division of Reproductive Health
- National Perinatal Information Center
- Arizona Perinatal Trust

•Hospital team includes:

- Women's and Infant's Service/Perinatal Unit Director
- OB Nurse Manager
- Obstetric Department Chair or Chief of Staff
- Maternal-Fetal Medicine Director (as applicable)
- Administrative leadership: CEO or CNO
- Obstetric anesthesiologist representative
- Nursery or NICU representative

Invited observers:*

- State health department representative(s)
- ACOG district and/or section chair and co-chair
- Association of Women's Health, Obstetric and Neonatal Nurses

*Please note: Levels of Maternal Care site visitors and invited observers are required to complete non-disclosure and conflict of interest forms.

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Pilot Sites

Between March and September 2017, LoMC verification tool and site visit process piloted at 14 hospitals in Georgia, Illinois, and Wyoming.

Level	# of Hospitals Visited*
Level 1	2
Level 2	8
Level 3	4
Level 4	0

LoMC
Levels of Maternal Care

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Texas Levels of Maternal Care Verification Program

- All Texas hospitals that provide OB care will need maternity state designation by **August 31, 2020** to receive Medicaid funding.
- TX rules align closely with Levels of Maternal Care OCC criteria, but provide more specificity in some areas.

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Texas Program

- Houston-based office
- Medical Director: Eugene Toy, MD, University of Texas Houston
  - –Consulted on the TX legislation for this designation process
- Program Director: Stacy Andries, DNP, MSN, BSN, RNC-OB, CNML
- Provide survey services for Levels II, III, and IV hospitals that provide maternity care.

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ACOG's Approach

- Opened a Houston-based office with Texas staff
- Engaged key Texas organizations
- Recruited, trained team of Texas-based surveyors to verify compliance with Texas rules
- ACOG's goal extends beyond its survey services: focused on quality, outcomes

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Surveys: Started July, 2018

- Pre-visit questionnaire and Policies and Procedures documents
  - –Customized questions from CDC's Levels of Care Assessment Tool (LOCATe) to Texas rules for pre-visit survey. Used as information only; no level assessed.

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Texas Program Site Visit Includes

- Medical record review
- Dinner with hospital staff
- Interviews
- Hospital tour
- Optional confidential consultation that highlights strengths in the hospital's maternal services and recommendations based on ACOG's clinical guidance.

Comments from Hospitals

"…thanking you and your team for a very professional and collegial survey. We are really proud to be carrying the flag with ACOG and the state of Texas for high quality maternity care."

"I enjoyed preparation process and site visit. It is an opportunity to critically reflect and demonstrate work performed daily. This will be meaningful process for all facilities and allows the mission to reduce maternal mortality and morbidity truly remain the daily focus of ones practice."

2019 LoMC OCC Update Long Process

- Over 2 years of group writing
- Innumerable conference calls
- Several meetings
- Goal: better clarity and consistency
  - Clearer availability definitions
  - 3, 4 distinction
  - Not closing 1, 2

LoMC OCC Update Multidisciplinary Feedback

- Feedback from:
- AAFP
- AAP
- AABC
- ACNM
- AHA
- AWHONN
- CWISH
- SMFM
- **SOAP**
- National rural health

Examples of Comments Addressed

- Clarification: what's expected for each level regarding providers (e.g., board-certified anesthesiologist with special training or experience in obstetric anesthesia)

- Clarification: timing/availability (in-house vs. available to come in)

Examples of Comments Addressed

- Clarification of Level III vs. Level IV: MFM/critical care relationship
  - "On-site ICU care for obstetric patients with whom **MFM team co-manages** the patients. Co-management includes at least daily rounds of MFM with interaction with the ICU team and other subspecialists with daily documentation. In some settings, the ICU is in an adjoining building which is acceptable as long MFM co-manages as noted above."

LoMC Implementation Guide Meeting

- December 2018 at ACOG
- Areas in which the Obstetric Care Consensus may need clarification
- Maternal transport
- Telehealth
- Samples of resources, such as policies and procedures and nursing competency checklists, that could be advantageous to share with other hospitals

LoMC Implementation Guide Meeting

- ACOG developed on-site assessment tool
- Will be developing implementation guide
- Training materials
- All will be available soon on website

Maternal Levels

- Birth Center
- Level I (Basic care)
- Level II (Specialty care)
- Level III (Subspecialty care)
- Level IV (Regional perinatal health care center)

OB care consensus #2 Feb 2015

Levels of Maternal Care Definitions

Level	Definition
Level I - Basic Care	Uncomplicated pregnancies with the ability to detect, stabilize, and initiate management of unanticipated problems that occur during the antepartum, intrapartum, or postpartum period until patient can be transferred.
Level II - Specialty Care	Level I facility plus care of appropriate high-risk conditions, both directly admitted and transferred from another facility.
Level III - Subspecialty Care	Level II facility plus care of more complex maternal medical conditions, obstetric complications, and fetal conditions.
*Level IV - Regional Perinatal Center	Level III facility plus on-site medical and surgical care of the most complex maternal conditions and critically ill women and fetuses. *ACOG/SMFM Obstetric Care Consensus guidelines recommend these four designations for levels of maternal care. We will carefully review the categories again, following pilot assessment studies, and use the findings to further improve the guidelines and level designations.

Birth Center

- Definition from AA Birth Centers
- Low risk uncomplicated singleton term vertex
- **Able to initiate** emergency procedures and transport (cannot do CD)
- **Established agreement** with receiving hosp
- Every birth attended by **2 professionals** –Cnm, cm, cpm, legally recognized
- Medical consultation "at all times"

OB care concensus #2 Feb 2015

Birthcenters.com

Level I Basic Care

- Care uncomplicated preg but able to **stabilize, initiate management** until transport
- Ability to **begin CD** within "time interval best incorporates maternal/fetal risks and benefits"
- Protocols hemorrhage, support services, etc
- **OB with privileges for CD avail** for all del
- Anesthesia "available"
- Term twins, tolac, term preeclampsia without severe

OB care consensus #2 Feb 2015

Level II Specialty Care

- More services: CT, MRI, OB ultrasound, obese specific care
- **OB GYN available at all times**
- Director OB board certified
- **MFM available for consult**
- **Anesthesia available at all times**
- BC anesthesiologist in OB for consult
- Med/surg consultants available
- Previa no prior surgery, severe preeclampsia

OB care consensus #2 Feb 2015

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Level III Subspecialty Care

- Advanced imaging
- Assist level I, II with QA etc
- **ICU accept pregnant patients critical care attendings on site actively collaborate with MFM**
- OBGYN **onsite at all time**
- **MFM with inpatient privileges** available at all times
- Director MFM board certified
- **Full complement subspecialists available**
- Suspected accreta, prior cd, ARDS, expectant management severe preeclampsia

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Level IV Regional Perinatal Health Care Center

- Onsite care most complex and critically ill
- Onsite ICU for OB patients
- **Perinatal system leadership**
  - **Outreach, education, data, quality, analysis etc**
- **MFM care team able to care for critically ill patient include co-management of pts in ICU**
- MFM available at all times for onsite care
- **Severe cardiac, neurosurgery, coma, organ transplant**

OB care consensus #2 Feb 2015

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Patient Examples

BC	I	II	III	IV
Term singleton vertex	Term twins TOLAC Preecl w/o severe Uncomp CD	Severe preeclamp Previa no prior ut surgery	Accreta, previa with prior surg, ARDS, exp manage < 34 wk severe preeclamp	Severe mat cardiac Pulm hypertension Liver failure Requiring neurosx, cardiac sx Unstable needing organ transplant

OB care concensus #2 Feb 2015

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A Day in the Life at Cedars-Sinai

On average, every day we serve:

- 800 Inpatients
- 88 Hospital Admissions
- 265 Emergency Room Patients
- 4 Level I Trauma Patients
- **18 OB Deliveries**
- **10 High Risk OB Patients**
- 82 Operative Procedures
- 5 Multi Organ Adult Transplants
- 1,790 Outpatient Visits & Procedures
- 900 Imaging Tests & Procedures

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Is California Prepared for Maternal Levels?

- Cross sectional survey all CA hospitals
  - Phone call to L+D RN managers
- Asked about characteristics for basic, intermediate, regional care (CA perinatal summit)
- 96% response rate (239/248 hospitals)

Korst ajog 2015;213:527.e1-12.

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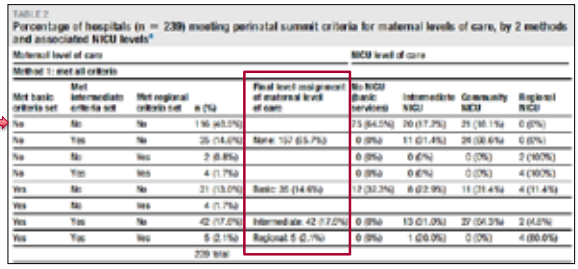
Putative Maternal Levels Care California Hospitals 2014



Korst. AJOG 2015.

Korst Results Maternal

- **Only 34% (82) hospitals met any criteria**
  - –35 basic, 42 intermediate, 5 regional
- **Only 15% met Basic criteria**
  - –Lack ability to perform cd within 30 min 100% of time
  - –Lack availability pediatrician day and night
  - –Lack ultrasound capability within 12 hrs

Korst Results: Neonatal

- **Only 64% had licensed NICU**
  - **–74% these CCS designation**
- Only 35% (29/82) of classifiable hospitals NICU level matched maternal level
- NICU level higher most remaining hospitals (52/53)

States with Levels of Perinatal Care Including Maternal

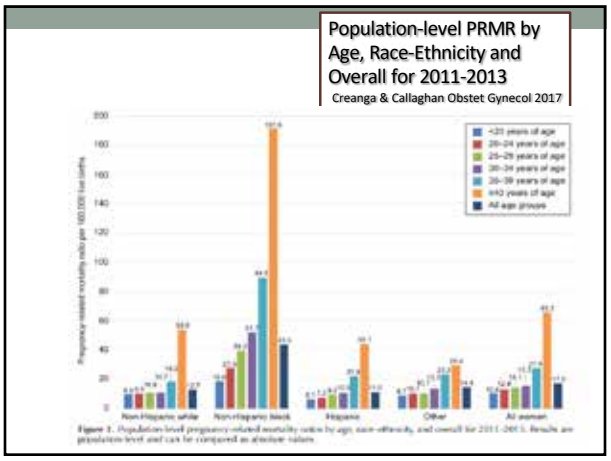
- –Arizona (Arizona Perinatal Trust 2012)
  - •Since 1980
- –Indiana (Indiana Perinatal Network 2012)
  - •Since 1998
- –Maryland (Perinatal Clinical Advisory Committee 2014)
  - •Since mid 1990's

Some states have integrated levels of maternal care into their state-run levels of perinatal care programs. As data come in can inform national LMC efforts.

We Must Do This

- We did it for babies
- Mothers deserve the same
- There are barriers
  - –Geography
  - –Cost: real and perceived

Disparities in Maternal Mortality by Race/Ethnicity, California Residents; 1999-2013


Population-level PRMR by Age, Race-Ethnicity and Overall for 2011-2013
Creanga & Callaghan Obstet Gynecol 2017

Maternal Levels of Care: The Anesthesiologist Role

Jamie Murphy, MD
Chief, Division of Obstetric, Gynecologic and Fetal Anesthesia
Assistant Professor
The Johns Hopkins University
Baltimore, MD

#SOAPAM2019

Disclosures

No financial disclosures

Objective

Describe the expectations for anesthesia services associated with the different levels of maternal care

Overview of the Maternal Levels of Care

"The goal of regionalized maternal care is for pregnant women at high risk to receive care in facilities that are prepared to provide the required level of specialized care, thereby reducing maternal morbidity and mortality in the United States"

-ACOG Obstetric Care Consensus Number 2, February 2015

Birthing Centers

e.g. term, singleton, vertex presentation

SYSTEM CAPABILITIES

- Ability to care for low risk patients
- Ability to initiate emergency procedures and to facilitate transport to an acute care setting
- Establish agreement with a receiving

ANESTHESIA REQUIREMENTS

- NO ANESTHESIA SERVICES or Consultation present

Level 1—Basic Care

e.g. term twin gestation, TOLAC, uncomplicated c-section, PEC without severe features

SYSTEM CAPABILITIES

- Ability to do an emergency c-section in a timely manner
- 24hr Support services including:
  - OB ultrasound, lab testing, blood bank supplies
  - Emergency release blood
  - Massive transfusion protocol
  - Management of multi component therapy

ANESTHESIA REQUIREMENTS

- Anesthesia services should be available to provide labor analgesia and surgical anesthesia.

Level 2 Specialty Care

e.g. severe PEC, placenta previa w/o uterine surgery

SYSTEM CAPABILITIES

- CT scan and MRI with interpretation available
- Basic ultrasound for maternal and fetal evaluation
- Equipment necessary to care for and accommodate obese parturient

ANESTHESIA REQUIREMENTS

- Anesthesia services available at all times to provide labor analgesia and surgical anesthesia
- Board certified anesthesiologist with special training or experience in obstetrics available for consultation

April 16, 2019 7

LEVEL 3 (Subspecialty Care)

e.g. suspected placenta accreta/percreta, previa with prior uterine surgery, severe PEC <34wks, adult respiratory syndrome

SYSTEM CAPABILITIES

- Advanced imagining
- Perinatal leadership
- Medical and Surgical ICU's with onsite CC providers
- Ability to ventilate and monitor women in labor till they can be transferred to the ICU

ANESTHESIA REQUIREMENTS

- ANESTHESIA SERVICES AVAILABLE ONSITE AT ALL TIMES
- BOARD CERTIFIED ANESTHESIOLOGIST WITH SPECIAL TRAINING OR EXPERIENCE IN OB ANESTHESIA IN CHARGE OF OB ANESTHESIA SERVICES

April 16, 2019 8

Level 4: Regional Perinatal Health Care Centers

Any pt appropriate for Level 3 care plus high risk conditions including: severe maternal cardiac conditions, pulmonary hypertension, liver failure, those requiring neuro or cardiac surgery, unstable medical conditions or need of organ transplant

SYSTEM CAPABILITIES

- ALL LEVEL 3 PLUS:
- Onsite ICU care
- Onsite medical and surgical management and consultation
- Facilitation of maternal referral and transport
- Evaluation of regional data and outcomes analysis

ANESTHESIA REQUIREMENTS

- Onsite anesthesia services available at all times
- Board certified anesthesiologists with special training or experience in obstetric anesthesia in charge of obstetric services

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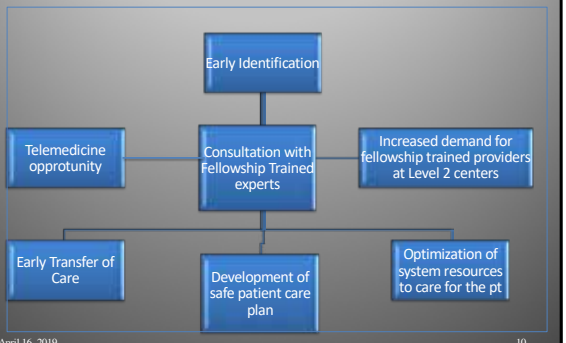
Opportunities



April 16, 2019 10

Program Material

Sunday, May 5, 2019

- **Best Case Reports - You Did What?**
  Moderator: Klaus Kjaer, M.D., M.B.A.
  Panelists: Jeanette R. Bauchat, M.D., M.S.; Laurent A. Bollag, M.D.; Jean M. Miles, M.D.
- **It's All in Her Head: Approaches to the Anesthetic Management of Pregnant Women with Intracranial Disease**
  Moderator: Heather C. Nixon, M.D.
  Speakers: Mateja De Leonni Stanonik, M.D., M.A., Ph.D.; Guy Edelman, M.D.; Lisa R. Leffert, M.D.
- **Faculty Case Report Posters**
  Moderator Leader: Roulhac D. Toledano, M.D., Ph.D.

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Society for Obstetric Anesthesia and Perinatology

Advancing the pregnancy-related health and outcomes of pregnant women and their newborn.

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@hnixon147

It's All In Her Head: Intracranial Disease in the Parturient

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Disclosure Statement:

None of the presenters today have significant disclosures

Panelists:

Dr. Guy Edelman MD - Neuroanesthesiologist

Dr. Lisa Leffert - Obstetric Anesthesiologist

Dr. Mateja de Leonni Stanonik - Neurologist

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Learning Objectives:

Understand how intracranial diseases in the parturient may influence obstetric care including the timing of delivery and use of neuraxial techniques

Create obstetric anesthetic plans with considerations for hemodynamic and intracranial pressure management in the parturient with intracranial disease

Format

CASE — Case Based Question - Audience Polling

Basics of Intracranial Pathology in Parturient

Panelists Will Discuss the Case

???? — Opportunity for Audience Questions and Commentary

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CASE #1

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CASE

25 yo G_3P_2 at 38 weeks in Spontaneous Labor at 6cm

Known Cerebral Aneurysm:

Asymptomatic – No history of bleeding

Stable – found during headache workup 2 years ago

Two Previous Spontaneous Vaginal Deliveries

No other past medical history, reassuring airway, NPO

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CASE

Audience Poll……

Plan for Vaginal Delivery and Requesting Labor Analgesia

Based on this information…… your anesthetic plan would be?

a. Combined Spinal Analgesia
b. Dural Puncture Epidural Analgesia
c. Epidural Analgesia
d. This patient is not a candidate for neuraxial techniques

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Intracranial Hemorrhage

Intracerebral, Subarachnoid or Subdural hemorrhage
12.2 per 100,000 parturients

Causes:
Structural - Trauma, Tumors, Vascular Anomalies
Spontaneous - Preeclampsia and Coagulopathy

Presentation most common in third trimester

Mortality rates are lower in pregnant population compared to non-pregnant population

Ascanio et al., Neurocritical Care, 2019 Feb:30(1):5-15

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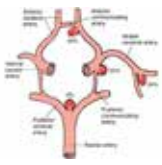
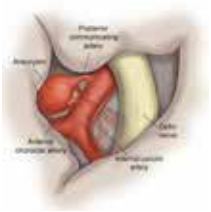
Aneurysmal Rupture





Subarachnoid Hemorrhage

Incidence – Increasing based on National Inpatient Sample data
8.5 per 100,000 in 2014

Higher Incidence in African-American women (16.3 per 100,000)

Overall 8% Mortality Rate

Treatment = Limit Rebleeding and Ischemic Complications of Vasospasm

Risk of Rupture of Aneurysm with Pregnancy and Delivery – 1.4 %

Kim et al., Neurosurgery, 2013 Feb;72(2):143-9
Limaye et al., J Stroke Cerebrovasc Dis 2019 Apr 28(4) 1141-1148

Questions for the Panelist:

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Is there a certain size of aneurysm or location that is more likely to bleed?

What kind of questions would you ask this patient to clinically assess their risk of rupture?

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Is there anything you can do to reduce the risk of intrapartum rupture?

Would a cesarean delivery be warranted?

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What Did We Actually DO?

Impromptu Multi-disciplinary Meeting

Decision for Vaginal Delivery

Neuraxial Analgesia with Combined Spinal Epidural Catheter

Hemodynamic Control
- Arterial Line Place
- Vasopressors to Tightly Management Blood Pressure

Assisted Second Stage of Labor

Avoidance of Methylergonovine

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CASE #2

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CASE

37 yo Spanish speaking G_4P_3 at 39 weeks

Admitted for mild altered mental status, word finding difficulty

Two SVDs, unknown Cesarean Delivery Scar

No other past medical history, reassuring airway, NPO

Left inferior posterior temporal lobe hemorrhage - no midline shift

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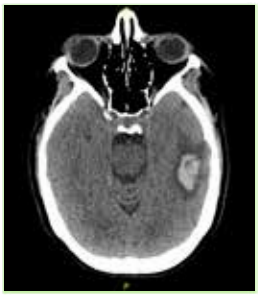
CASE



Stable with no further cognitive decline since admission

Blood pressures within normal limits

CASE

Audience Poll……

Based on this information……which would be the most reasonable course of action?

a. Deliver via Cesarean Delivery and then Cerebral Angiogram
b. Perform Cerebral Angiogram and then Delivery via Cesarean Delivery

CASE

Audience Poll……

On Fetal Monitors - Intermittent Late Decelerations

Based on this information…… your anesthetic plan would be?

a. Spinal anesthesia
b. Combined spinal anesthesia
c. Epidural anesthesia
d. General Anesthesia

Intracerebral or Intraparenchymal Hemorrhage

Arteriovenous Malformations are most common etiologies

May be management medically rather than surgical
- Reducing Intracranial Pressure
- Blood Pressure Management

Ascanio et al., Neurocritical Care, 2019

Spontaneous Intracranial Hemorrhage

Not secondary to trauma or structural defects
(tumor or vascular malformation)
Indeterminant cause following imaging

24% of intracranial hemorrhage - mostly intracerebral

Roughly 50% Maternal Mortality

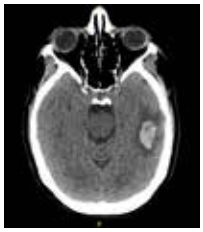
Ascanio et al., Neurocritical Care, 2019

Questions for the Panelist:

37 yo Spanish speaking female - NOT Pregnant

Admitted for mild altered mental status, word finding difficulty

Left inferior posterior temporal lobe hemorrhage with no midline shift



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What kind of work up is warranted in this patient?

What is the Normal Physiology of Intracerebral Hemorrhage?

What are typical treatments?

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So, now let's talk about the Pregnancy.....

How would the management be different if this was secondary to AVM vs Pre-eclampsia?

How does gestational age affect management?

What are some of the fetal considerations for neurosurgical management?

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What factors affect the timing of neurosurgical vs. obstetric intervention?

What are our hemodynamic goals?

When is it appropriate to perform neuraxial interventions?

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What Did We Actually DO?

During Decision Making -
Spontaneous Labor on Unknown Scar

Decision for Cesarean Delivery prior to Neurosurgical
Dural Puncture Epidural
A-line with tight blood pressure control with vasopressors

Postpartum Day #1 = Cerebral Angiogram with AVM
Taken to OR for Craniectomy with AVM resection

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CASE

37 yo Spanish speaking G_4P_3 at 39 weeks Admitted for Headache

Known AVM - s/p coiling

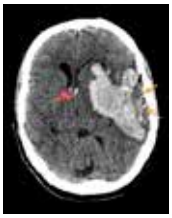
Two SVDs, unknown CD scar

No other past medical history, reassuring airway, NPO

CT Scan is demonstrates hemorrhage with midline shift

MRI - Chiari Malformation

OB – Stable, Category I



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Neurologically, how is this scenario different from the last?

What should be the timing of neurosurgical to obstetric intervention?

Is it appropriate to perform neuraxial interventions?

What is the normal physiology of intracranial hemorrhage?

What kind of work up is warranted in this patient?

Is epidural anesthesia safer than spinal anesthesia?

CASE #3

CASE

G2 P0 at 32 weeks – Presents with Seizure

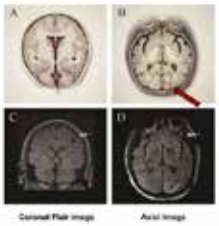
Post-Ictal and Mildly Confused but Resolving

Ruled out for Preeclampsia

CT Scan demonstrates posterior tumor

NO MIDLINE SHIFT

OB – Stable, Category I



CASE

Audience Poll……

10 Hours Later, Patient Neurologically Intact
On Fetal Monitors - Intermittent Late Decelerations

Based on this information…… your anesthetic plan would be?

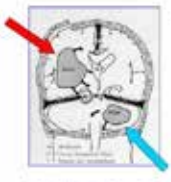
a. Spinal anesthesia
b. Combined spinal anesthesia
c. Epidural anesthesia
d. General Anesthesia

Brain Tumors

Incidence of primary brain tumor = 2.6 per 100,000 in women

Meningiomas and Vestibular Schwannomas–
Estrogen and progesterone receptors
Accelerated growth during pregnancy

Most common are gliomas



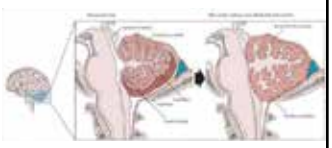
Hopkins et al., Semin Perinatol. 2014 Oct;38(6):359-69.

Elevated Intracranial Pressure

Intracranial Pressure greater than 20mmHg

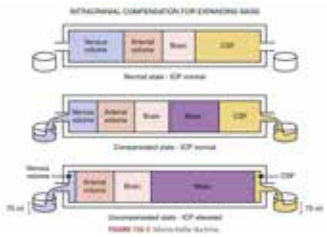
Multiple Etiologies:

- Hemorrhagic or Ischemic Stroke
- Cerebral Edema
- Mass
- Hydrocephalus



May compromise cerebral perfusion or compress brain tissue

Elevated Intracranial Pressure



Questions for the Panelist:



How would this patient initially be treated?

What factors affect the timing of neurosurgical vs. obstetric intervention?

Are there predictive factors for tumor growth?

How does the management of intracranial tumor differ from intracranial hemorrhage?

Given this patient is 32 weeks, how would that alter her delivery plan and tumor therapy?

What Did We Actually DO?

Patient admitted and started on steroid therapy

Induced at 34 weeks:

- **Neurologically intact and asymptomatic - Scan without midline shift**
- **Labor Analgesic Combined Spinal Epidural Catheter**
- **Vaginal Delivery with assisted second stage**

Two Weeks Following Delivery – Craniectomy and Tumor Resection

CASE

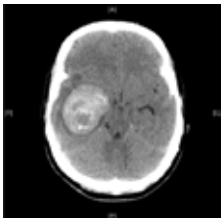
G2 P0 at 32 weeks – Presents with Seizure

Post-Ictal and Mildly Confused

Ruled out for Preeclampsia

CT Scan demonstrates large temporal tumor
MIDLINE SHIFT

OB – Stable, Category I



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Questions for the Panelist:

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How does the size of the tumor and symptoms affect management?

Given this patient is 32 weeks, how would that alter her delivery plan and tumor therapy?

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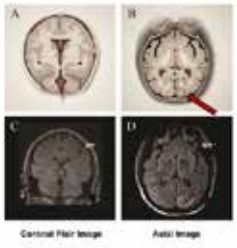

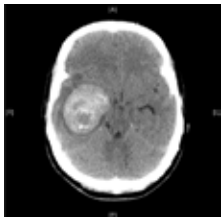

What Did We Actually DO?

Cesarean Delivery - General anesthesia
No regional due to some herniation

Hemodynamic monitoring and tight blood pressure monitoring

Following Delivery – Craniectomy and Tumor Resection

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????

Audience Questions and Comments

Abstract #: FCA-38

Fatal Hyperhemolysis Syndrome in a Postpartum Patient with Sickle Cell Disease

Presenting Author: Lacey E Straube MD
Presenting Author's Institution: University of North Carolina - Chapel Hill, North Carolina
Co-Author: Kathleen Smith MD - University of North Carolina

Case Report: A 31-year-old G3P1 with sickle cell disease (SCD) underwent urgent repeat cesarean delivery (CD) at 32w5d for preeclampsia with severe features. Previous transfusions resulting in multiple alloantibodies significantly limited availability of compatible blood. Despite a hemoglobin of 6.3 g/DL, Hematology and Transfusion Medicine recommended against transfusion unless frank hemorrhage occurred. CD under spinal anesthesia was completed with 600 mL of blood loss. Albumin and limited crystalloid were given to avoid hemodilution. Cell salvage returned inadequate volume to transfuse. Baseline nasal cannula oxygen was continued. The patient was stable throughout surgery. Postoperative blood pressure (124/84mmHg), heart rate (92bpm), respiratory rate (8) and temperature (36.5°C) were stable.

Several hours later, the patient became somnolent. Vitals were stable with the exception of low temperature. Magnesium was discontinued, and the patient was actively warmed. Given her medical complexity, she was transferred to stepdown care. Five hours later, she became acutely unresponsive and hypotensive. Labs revealed severe metabolic acidosis, hypoxemia and anemia (PH 6.9/PCO2 25/PO2 75/BD -25/HCO3 5/O2sat 57%/Hgb 2.5). She was intubated, started on multiple vasopressors, and underwent emergent exploratory laparotomy for a positive FAST exam. Hemoperitoneum (350ml) originating from the rectus abdominus muscle was evacuated. She received 7 units of RBCs (5 unmatched). Postoperative labs were consistent with hyperhemolysis syndrome. Per hematology, she was treated with Eculizumab, Rituximab, high-dose steroids, and Erythropoietin. Despite improving hemolysis, the patient developed multisystem organ failure with diffuse myocarditis, renal failure, and DIC. She was transfused two more matched RBCs for diffuse ST segment elevations, hypotension, and a Hgb of 3.3 g/DL. She was ultimately transitioned to comfort care and passed away shortly after terminal extubation.

Discussion: Hyperhemolysis syndrome (HHS) is a transfusion complication characterized by hemolysis of both native and transfused RBCs and is well-described in SCD. It is characterized by posttransfusion Hgb levels that are lower than pretransfusion. Post-cesarean anemia was multi-factorial in the setting of potential hemorrhage, DIC, sickle cell hemolytic crisis and sequestration, and was further complicated by the development of HHS after transfusion. Administering uncrossmatched blood also put her at risk for a hemolytic transfusion reaction. Treatment of HHS includes avoiding further transfusions and administering IVIG, steroids, the C5 convertase inhibitor Eculizumab to inhibit complement activation, erythropoietin to overcome erythropoiesis suppression, folic acid to stimulate hemoglobin synthesis, and Rituximab for rapid recovery of reticulocytes and reduction of alloantibody production.

References:
Banks M, Shikle J. Arch Pathol Lab Med. 2018.

Abstract #: FCA-125

Peri-partum course of a 67-year-old elderly gravida

Presenting Author: Sonal N Zambare MD
Presenting Author's Institution: Baylor College of Medicine Houston, Texas - Houston, TX
Co-Author: Leila Magistrado MD - Baylor College of Medicine, Houston, TX
Mary C Tolcher MD - Baylor College of Medicine, Houston, TX
Anju Suhag MD - Baylor College of Medicine, Houston, TX
Kjersti M Aagaard MD, PHD - Baylor College of Medicine, Houston, TX

Background: There is limited data on the anticipated prenatal, intrapartum, and postpartum course among gravida over 45 years old, particularly among post-menopausal women in their sixth and seventh decades. Here, we present a relatively uncomplicated case of pregnancy in a 67-year-old woman conceived by donor oocyte in vitro fertilization (IVF) and was able to successfully breastfeed postpartum.

Case: A 67-year-old essential primigravidae (G5P0040) conceived a singleton pregnancy via IVF with donor oocytes in West Africa, then immigrated shortly thereafter to the US and presented at 11 1/7 weeks gestation to initiate prenatal care. Her obstetric history was significant for four second trimester losses. Her medical history was significant for chronic hypertension, hyperlipidemia, and Class I Obesity. Given marked advanced maternal age, her cardiac function was monitored throughout pregnancy with echo-cardiograms and serum markers. She otherwise received generally accepted "standard care" for elderly gravidae. She was delivered at 36 1/7 weeks of gestation by primary cesarean delivery when increased shortness of breath and physical exam findings precipitated a follow up echocardiogram which demonstrated a 6% decline in left ventricular ejection fraction with new-onset mitral regurgitation. An uneventful single shot subarachnoid block was performed to provide anesthesia along with neuraxial preservative free Morphine for post-operative analgesia. Her post -anesthetic course was uncomplicated.

Her intra-partum and post-partum course were uncomplicated, and she was able to successfully breastfeed and resume pre-pregnancy activity level within 2 weeks of delivery.

Discussion: The data for per-partum course of such elderly parturients is lacking, but this case highlights several anesthetic and obstetric concerns. A multidisciplinary approach with close follow up was essential for successful management of this patient. This case also makes one consider the ethical issues of assisted reproductive technology use in the postmenopausal women.

This case represents the eldest gravidae identified in the literature to date, and illustrates the potential for a relatively uncomplicated perinatal course including capacity for breastfeeding. This case may enable providers to counsel elderly patients on mode of delivery, anesthetic considerations, and anticipated outcomes.

References:

1. Bayrampour et al. Advanced maternal age and the risk of cesarean birth: a systematic review. Birth 2010;37(3):219-26.
2. Carvalho B. Respiratory depression after neuraxial opioids in the obstetric setting. Anesth Analg 2008;107:956-61.
3. Cavazos-Rehg PA, Krauss MJ, Spitznagel EL, Bommarito K, Madden T, Olsen MA, et al. Maternal age and risk of labor and delivery complications. J Maternal Child Health 2015; 19(6): 1202-1211

Abstract #: FCA-193

Anesthetic Considerations in an Obstetric Patient with Klippel-Feil Syndrome

Presenting Author: Megan E Gauthier DO, MBA
Presenting Author's Institution: University of Cincinnati Medical Center - Cincinnati, OH
Co-Author: Lesley Gilbertson MD - University of Cincinnati

Introduction: Klippel-Feil Syndrome (KFS) is a disorder characterized by the congenital fusion of cervical vertebrae. The most common signs are short neck, low posterior hairline and restricted mobility of the upper spine. Patients may also have CV, pulmonary and renal abnormalities with scoliosis and rib anomalies (1,2).

Case: A 27 year old G2P0010 presented at 25 weeks for anesthetic planning prior to delivery. She had a known history of KFS diagnosed at birth, cleft palate with subsequent repair, jaw surgery and low back pain. On physical exam her height was 147 cm and weight 56 kg (BMI of 25 kg/m2). Her airway exam was significant for a Mallampati Class IV airway with short thyromental distance and limited mouth opening. She reported a history of a failed oral intubation attempt that was successfully converted to a nasal intubation. Ultrasound examination of her lumbar spine did not predict difficulty with neuraxial placement. A plan of care was formulated at this visit to include labor epidural for vaginal delivery versus combined spinal epidural with reduced spinal local anesthetic for a cesarean delivery (CD). Awake fiberoptic intubation was discussed during this visit as patient history included a known difficult airway.

She presented to L&D at 37 weeks for induction of labor for gestational hypertension. A labor epidural placed in 2 attempts provided satisfactory analgesia. She progressed to complete dilation at zero station and pushed for 3 hours before arrest of descent necessitated CD. Her epidural was dosed with 2% Lidocaine and adequate surgical anesthesia was achieved. The CD was uncomplicated and patient tolerated delivery well. APGARS were 1 and 7 and neonatal weight was 3140 grams.

Discussion: Previous KFS case reports are limited and describe frequent inadequacy of neuraxial anesthesia requiring IV narcotic supplementation or GA (1,2). In this case neuraxial anesthesia was adequate for both labor analgesia and surgical anesthesia; likely due to the mild severity of scoliosis in our patient (2). Case reports have discussed airway topicalization prior to neuraxial placement when intubation may be required. When planning for delivery each potential strategy poses risks that must be balanced for individual patients. Ultrasound guidance can aid in assessing likelihood of successful neuraxial placement.

References:

Klippel-Feil Syndrome Information Page. National Institute of Neurological Disorders and Stroke. https://www.ninds.nih.gov/Disorders/All-Disorders/Klippel-Feil-Syndrome-Information-Page. Published June 13, 2018. Accessed January 7, 2019.

Kavanagh T, Jee R, Kilpatrick N, Douglas J. Elective cesarean delivery in a parturient with Klippel–Feil syndrome. International Journal of Obstetric Anesthesia. 2013;22(4):343-348. doi:10.1016/j.ijoa.2013.06.005.

Abstract #: FCA-224

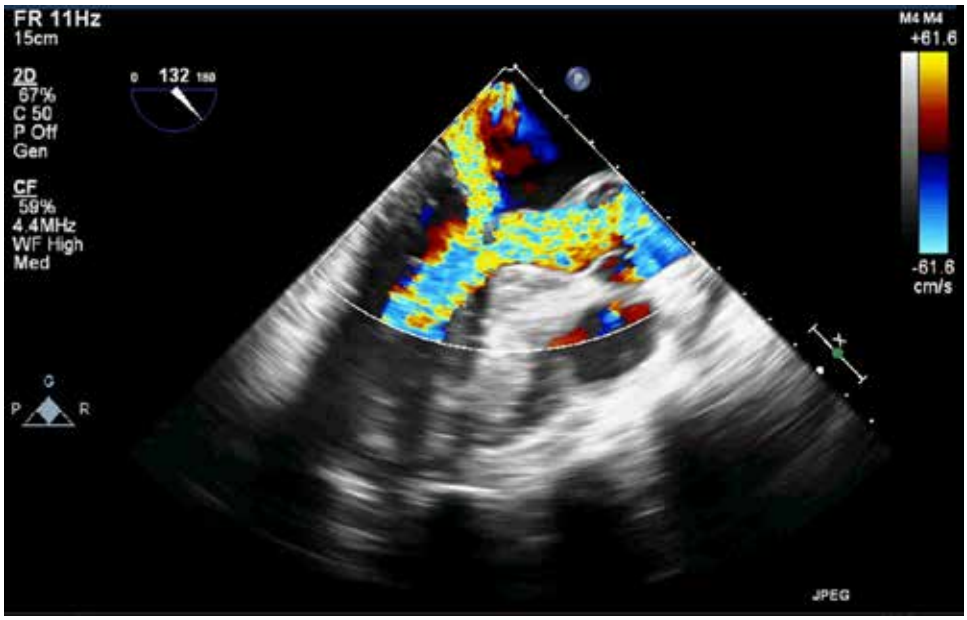
Cesarean Section in a Parturient with Hypertrophic Obstructive Cardiomyopathy, Severe Pulmonary Hypertension, and Suspected Accreta

Presenting Author: Laura L Roberts M.D.
Presenting Author's Institution: Medical University of South Carolina - Charleston, SC
Co-Author: Loren R Francis M.D. - Medical University of South Carolina
David A. Gutman M.D. - Medical University of South Carolina

Introduction: Hypertrophic obstructive cardiomyopathy (HOCM) is characterized by left ventricular outflow tract obstruction with a high gradient. Management includes maintaining preload, afterload, and normal sinus rhythm. Conversely, treatment of pulmonary hypertension (PHTN) involves minimizing pulmonary vascular resistance and hypervolemia while promoting right heart function. Pregnancy significantly complicates these conditions as intravascular volume and cardiac output rises during gestation and peaks immediately after delivery. We present a case of a parturient with concurrent HOCM and severe PHTN.

Case: A 31yo G4P3 parturient was admitted at 35 weeks gestation with symptoms of heart failure, IUGR, preeclampsia, and suspected placenta accreta. Past history included obesity, HTN, asthma, HOCM s/p ICD, NSTEMI, heart failure, and severe PHTN, as well as, two prior C-sections under general anesthesia. She did admit to frequent episodes of chest pain, dyspnea and syncope, and required diuresis on admission. A TTE revealed an EF 75%, severe LVH, an LVOT gradient 40mmHg, and a RVSP 81mmHg. Due to the severity of her condition, a multidisciplinary team of OB/GYN, OB/CT anesthesia, cardiology, neonatology, trauma surgery, and ICU staff was assembled to devise a plan for her delivery at 36 weeks gestation. To promote the most optimal conditions, a TIVA technique was used following RSI and intubation with etomidate, remifentanil, esmolol, and succinylcholine. Standard and invasive devices were used for monitoring and resuscitation, including an arterial line, PA catheter, and TEE. To avoid the side effects of uterotonic medications, a REBOA device was placed to manage hemorrhage. A combination of vasopressors was used to augment cardiac function with vasopressin being the most efficacious. Intra-op the pulmonary artery pressure increases to 95 mmHg, near systemic levels, and was treated with inhaled nitric oxide (iNO). Following delivery, the patient's condition improved greatly. Vasopressors and iNO were discontinued within 24 hours and the patient was extubated. The rest of her stay was uneventful.

Conclusion: Perioperative management of this patient was especially challenging due to the comorbidities that required opposing therapeutic strategies. In all likelihood, the number of parturients with complicated heart disease will continue to grow, and therefore, the need for a comprehensive team approach for these challenging cases will remain.



Abstract #: FCA-265

Anesthetic management of a parturient with a mitral mechanical valve

Presenting Author: Rachel Rachler CRNA, DNAP, APRN
Presenting Author's Institution: Yale School of Medicine - New Haven , CT
Co-Author: Paula Trigo-Blanco MD - Yale School of Medicine
Aymen Alian MD - Yale School of Medicine
Antonio Gonzalez MD - Yale School of Medicine

Mechanical prosthetic heart valve (MPHV) is associated with complications such as thromboembolism and bleeding.1 Physiologic changes of pregnancy, therapeutic anticoagulation, and the presence of a MPHV places the parturient at risk for maternal cardiovascular events such as an embolic event, hemorrhage, miscarriage, preterm birth, and fetal complications.2,3

A 39 year-old G3P1 at 37 weeks with a past medical history of mitral valve replacement with a St. Jude valve due to a congenital cleft of the mitral valve, nonsustained ventricular tachycardia (NSVT), and gestational diabetes presented for induction of labor. Medications prior to admission consisted of a beta blocker, and enoxaparin 80 mg subcutaneously. The plan for labor analgesia included placing an epidural 24 hours post lovenox and 2 hours post cessation of heparin drip Upon admission, enoxaparin was discontinued, and a heparin infusion was initiated. The patients most relevant coagulation profile is summarized in Table 1. In regard to her NSVT, cardiac monitoring along with the placement of a code cart outside the labor room was established in the event of cardiac decompensation.

Given that the enoxaparin was discontinued 24 h prior, and a normal coagulation profile was obtained 2 h after discontinuation of heparin, an early epidural placement was deemed safe. An atraumatic early labor epidural was placed at the L3-4 level. The heparin drip was restarted one hour after placement of the epidural; adjustments were made to keep the PTT within protocol range. Heparin was stopped when the patient was in active labor. Epidural catheter was removed given normal PTT. The postpartum course consisted of close neurologic and cardiac monitoring, and anticoagulation was progressively transitioned from enoxaparin to a warfarin regimen. The patient was discharged stable on post partum day 3.

When caring for a parturient with an MPHV it is imperative to monitor the patient coagulation profiles to prevent maternal and fetal morbidity and mortality. A multidisciplinary approach is crucial for improving patient and fetal outcomes. In our case an early labor epidural was considered important given her history of NSVT. Anticoagulation places the patient at high risk for spinal epidural hematoma and hemorrhage, strict adherence to ASRA guidelines for neuraxial blocks is imperative.

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	Pre-labor (2/4/2018)	Prior to Epidural (2/5/2018)	Prior to Removal of Epidural (2/5/2018)
PT	9.5		9.6
PTT (sec)	26.2	33.9	29.4
INR	0.84		0.85

Table 1. PT-Prothrombin Time; PTT-Partial Thromboplastin Time; INR- International normalized ratio

Abstract #: FCA-295

Anesthetic management for cesarean delivery in a parturient with repaired pulmonary atresia, ventricular septal defect and major aortopulmonary collateral arteries

Presenting Author: Sun-Kyung Park MD.
Presenting Author's Institution: Seoul National University Hospital - Seoul, Seoul
Co-Author: Seokha Yoo MD. - Seoul National University Hospital
Young-Jin Lim MD.,PhD. - Seoul National University Hospital
Jae-Hyon Bahk MD.,PhD. - Seoul National University Hospital
Jin-Tae Kim MD.,PhD. - Seoul National University Hospital

Introduction: Pulmonary atresia with a ventricular septal defect and major aortopulmonary collateral arteries (PA/VSD/MAPCAs) is an extremely rare congenital malformation characterized by lack of a pulmonary valve and a pulmonary vascular bed supplied by aortopulmonary collateral arteries. Anesthetic management for cesarean delivery in these patients poses unique challenge to anesthesiologist, due to physiologic changes during pregnancy. We present a case of a parturient with corrected PA/VSD/MAPCAs who had undergone cesarean delivery under epidural anesthesia.

Case report: A 33-year-old primigravida admitted for cesarean delivery due to fetal breech presentation and maternal heart anomaly. She was diagnosed with PA/VSD/MAPCAs and underwent surgical corrections during childhood. In 1989, she underwent staged operation including left modified Blalock-Taussig shunt and left unifocalization, right ventricle (RV) to pulmonary artery (PA) conduit interposition, and palliative right ventricular outflow tract reconstruction at 4 years of age. Upon referral to our clinic, her SpO2 was measured as 80-85% on room air status. Her echocardiography revealed a large VSD with bidirectional shunt, moderate RV-PA conduit stenosis with peak velocity of 2.7 m/sec, mild to moderate pulmonary regurgitation. Her estimated left ventricular ejection fraction was 69%. Her cardiologist recommended to use diuretics and to avoid volume overload. Oxygen was supplied in order to maintain SpO2 more than 85%. A radial arterial line was placed. Then, an epidural catheter was inserted at the L3-4 intervertebral space and 3 mL of lidocaine 2% was given as a test dose. After 10 minutes, 2% lidocaine 140 mg and 0.75% ropivacaine 75mg was administered in gradual manner. A sensory block to the T6 was achieved bilaterally. Hemodynamic parameters were stable throughout the surgery and a female baby was delivered with Apgar scores 9 at 1 minute and 9 at 5 minutes. The mother was transferred to the intensive care unit for close monitoring after delivery. She remained stable and was transferred to the general ward 24 hours after delivery. She was discharged without any complications on the postoperative day 5. One month after delivery, she was examined in the cardiologic outpatient clinic, and she was doing well.

Discussion: The physiologic changes associated with pregnancy can compromise parturients with PA/VSD/MAPCAs. The stress and pain during labor and delivery can increase PVR, thereby worsening right-to-left shunt. SVR is reduced throughout pregnancy and may lead to worsening of a right-to-left shunt. Surgically corrected patients may have various types of residual abnormality. Careful review of the history and consultation with the primary care physician will help understand the residual pathophysiology and plan the perioperative management. Careful titration of epidural anesthesia with the invasive arterial monitoring can be safely used in these patients.

Abstract #: FCA-379

Successful Perinatal Management of a Woman with McArdle's Disease: A Case Report

Presenting Author: Chad T Dean MD
Presenting Author's Institution: University of Pittsburgh Medical Center Magee Womens Hospital - Pittsburgh, PA
Co-Author: Lauri Adler MD - University of Pittsburgh Medical Center Magee Womens Hospital
Susan McElroy DO - University of Pittsburgh Medical Center Magee Womens Hospital
Grace Lim MD MS - University of Pittsburgh Medical Center Magee Womens Hospital

McArdle's disease (type V glycogen storage disease) is a rare (incidence 1:100,000), autosomal recessive, metabolic disease resulting in myophosphorylase enzyme deficiency. This enzyme is present in skeletal muscle and is involved in glycogen breakdown into glucose for use in muscle. Exacerbations present as muscle pain/cramping, early fatigue, and myoglobinuria. With muscle inability to use glucose for energy, alternative energy sources (proteins and fatty acids) are used. Protein catabolism leads to rhabdomyolysis which can progress to renal failure. There are few reported cases of anesthetic management in pregnant patients with McArdle's disease. We report perinatal management of a woman with this rare disease.

A 24-year-old G1P0 with McArdle's disease and anxiety presented at 37 weeks for elective cesarean delivery. Pre-operative optimization included clear fluids until two hours before surgery followed by initiation of D10 ½ NS intravenous infusion at 1.5 times maintenance rate, to prevent hypoglycemia and protein catabolism. She received midazolam for anxiolysis and uneventful spinal anesthesia with bupivacaine 12mg and duramorph 150mcg. Intraoperative course was uncomplicated. The dextrose infusion was continued throughout the case, with lactated ringers for fluid boluses to maintain intravascular volume. Adequate urine output and appearance was closely monitored. Normothermia was maintained with an upper body forced air warmer. To prevent physiologic stresses from nausea and vomiting, she was prophylactically treated with phenylephrine infusion, ondansetron and dexamethasone prior to delivery. Postoperatively, the dextrose solution continued for 24 hours until a full diet was tolerated.

Inborn errors of metabolism can pose significant problems during the peri-operative period if physiologic stressors, temperature, euglycemia, and protein catabolism are not addressed. Perioperative risks include fatigue, respiratory compromise, hypoglycemia, rhabdomyolysis, myoglobinuria, renal failure, and potentially malignant hyperthermia (MH). Although no known link between MH and McArdle's exists, there have been two case reports suggesting a possible connection. Patients often have chronically elevated creatine phosphokinase (CPK), which is released from muscle catabolism. Careful monitoring of CPK levels can provide early evidence of stressors and inadequate homeostasis maintenance. Spontaneous compartment syndrome can potentially arise as well [1]. For obstetric patients, special concerns include anxiolysis, pain management, and candidacy for the physiologic stresses of labor and delivery; successful vaginal delivery has been described [2]. In conclusion, with careful attention to maintaining adequate blood glucose levels and fluid management, normothermia maintenance, blood pressure monitoring, and maintaining MH precautions, safe anesthesia can be provided to these patients.

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Abstract #: FCA-414

Anesthetic Management of a Parturient with Limb Girdle Muscular Dystrophy Type 2D For Cesarean Delivery

Presenting Author: Tristyn V. St. Thomas-Achoja MD
Presenting Author's Institution: University of Texas Southwestern Medical Center - Dallas, TX
Co-Author: Nwamaka Nnamami MD - University of Texas Southwestern Medical Center
Kara Bennett MD - University of Texas Southwestern Medical Center
Nathaniel Loo MD - University of Texas Southwestern Medical Center
Rhonda Arnette MD - University of Texas Southwestern Medical Center
Miakka Smith MD - University of Texas Southwestern Medical Center

Muscular dystrophies are genetic neuromuscular disorders associated with abnormalities of the muscle membrane and are characterized by progressive loss of skeletal muscle function(1). Limb girdle muscular dystrophy (LGMD) is characterized by severe weakness that primarily involves the shoulder and hip girdles(2). LGMD can be autosomal recessive or dominant(3). The literature is limited in regards to pregnancy and delivery in patients with the disease(4). The following case report describes the successful anesthetic management of a parturient with LGMD at our institution.

A 33 year-old G1 presented with Class III obesity (BMI of 42) and LGMD Type 2D. She was diagnosed at age 22 via muscle biopsy and the only one in her family with LGMD. Although she could perform some activities of daily living, her mobility was limited and required the assistance of a wheelchair. Her cardiac history was significant for cardiomyopathy. A third trimester echocardiogram showed normal LV and RV function with an ejection fraction of 60%. Her pulmonary history was found to be unremarkable. She was scheduled for induction at 39 weeks and 6 days, but presented to labor and delivery at 40 weeks and 4 days after experiencing spontaneous rupture of membranes. She requested an epidural for analgesia. Given her medical history, body habitus and desire to avoid general anesthesia, the plan was to place an epidural. Her epidural was successfully placed while sitting with one attempt at the L3-L4 interspace. Labor analgesia was initiated with a continuous infusion of bupivacaine and fentanyl. After laboring for more than 24 hours, a decision was made by the obstetricians to perform a cesarean section for failure to progress. She received a total of 20mL of 2% lidocaine with epinephrine through her epidural catheter which provided bilateral T4 surgical block. She delivered a healthy boy 20 minutes after incision. Intraoperatively, she suffered hemorrhage secondary to uterine atony which resolved with a dose of carboprost 250mcg IM. She remained hemodynamically stable. After meeting postpartum goals, she was discharged home on POD# 5 with daily enoxaparin 40mg SQ to prevent deep vein thrombosis.

This case illustrates the successful use of epidural anesthesia in providing a safe and uneventful cesarean delivery in a parturient with LGMD. Women with LGMD have been reported to have an increase in progression and exacerbation of their disease during pregnancy(3). Given the risks due to the increased physiological demands of pregnancy, the possibility of worsening respiratory function and potentially developing rhabdomyolysis and malignant hyperthermia, neuraxial anesthesia is preferred over general anesthesia(4).

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Abstract #:FCA-439

Cesarean Delivery in a Patient with Myotonic Dystrophy, Severe Cardiopulmonary Decompensation and Pulmonary Hypertension

Presenting Author: Anjum Anwar MD
Presenting Author's Institution: UF Health - Ponte Vedra, FL
Co-Author: Cai Yi MD - Mayo Clinic, Jacksonville
Kristen Vanderhoef MD - UF Health, Jacksonville
Adrienne Warrick MD - UF Health, Jacksonville

BACKGROUND AND AIMS: Myotonic dystrophy (MD) is a rare disorder characterized by progressive myopathy and myotonia but systemic complications may include cardiomyopathy and difficulty weaning from mechanical ventilation (MV) [1]. Discussion of obstetrical cases in the context of these comorbidities are sparse, and to our knowledge, this is the first case of regional anesthesia for full-term delivery in a parturient with MD and concomitant cardiopulmonary compromise.

CASE: A 27 year-old G3P0020 at 35w2d with a history of MD and prolonged tracheostomy in her childhood was admitted to the hospital for delivery planning and progressive hypoxia requiring supplemental oxygen since 25 weeks gestation. Hospital monitoring revealed periodic episodes of non-sustained ventricular tachycardiac, and echocardiogram showed severe right ventricular enlargement with septal wall flattening during both systole and diastole. Cesarean section after betamethasone and optimization was scheduled. Prior to surgery, arterial line and defibrillation pads were placed. A combined spinal-epidural (CSE) was placed at L3-4 (loss of resistance 4 cm; catheter 8 cm at skin) without intrathecal drug administration. Epidural testing was negative for intrathecal or vascular placement. Intravenous epinephrine and vasopressin infusions were initiated to maintain hemodynamic stability. Due to incomplete sensory deficit, local infiltration using lidocaine was used on skin and uterine incision points. Uterine incision was made 33 minutes after skin incision, and a viable male with APGAR scores of 3 at 1 minute and 7 at 5 minutes was delivered at 36w2d. The patient continued BiPAP in the intensive care unit.

CONCLUSIONS: The choice of vasoactive agents in parturients with MD and cardiopulmonary compromise should reflect pulmonary vascular selectivity [2] and fluid balance after auto-transfusion. Given the risk of prolonged MV, neuraxial anesthesia was critical to maintaining spontaneous respiration. Epidural or intrathecal opioid was avoided due to risk of apnea [3], and intrathecal anesthetic avoided due to sympathectomy. A CSE without an intrathecal dosing may provide adequate anesthesia with aid of local infiltration of lidocaine.

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Abstract #: FCA-540

Complex Delivery of a Parturient with Von Hipple Lindau Disease and Pheochromocytoma

Presenting Author: Erica M. Johnson MD
Presenting Author's Institution: Emory University - Atlanta, Georgia
Co-Author: Erica Johnson MD - Emory University
Hee Won Lee MD - Emory University
Christina Faya MD - Emory University
Dawn Manning-Williams MD - Emory University

A 27yo G3P0020 with PMH of Von-Hipple Lindau (VHL) and Chiari malformation had prenatal care transferred to Grady Hospital at 34wks gestation for delivery planning of this complex patient. The patient has a strong family history of VHL disease and was officially diagnosed in 2016 with both VHL and Chiari malformation. On presentation to our maternal fetal medicine (MFM) clinic she expressed symptoms of palpitations with heart rate range of 100-170 bpm, hypertension, and occasional dizziness. Due to the nature of VHL disease, a MRI Brain-Abdomen-Thorax-Lumbar Spine was performed to evaluate the extent of her Chiari malformation and to rule out potential vascular hemangiomas in her lumbar region. Imaging revealed mild cerebellar tonsillar ectopia with normal CSF flow, multiple pancreatic and renal cysts which are hallmarks of VHL presentation, and no vascular malformations. Although imaging was reassuring with no visible adrenal mass, her symptomatology was concerning for a pheochromocytoma. Further workup revealed elevated plasma and urine metanephrines with a suspected microscopic pheochromocytoma. A multidisciplinary team including MFM, obstetric anesthesiology, neurology, and endocrinology is used to manage this patient. In this case report, we will discuss the dilemma of when to administer appropriate alpha blockade and the potential maternal and fetal complications associated; the pros and cons of both vaginal and cesarean delivery methods in a parturient with VHL and pheochromocytoma; and the choice of anesthesia for both delivery methods and potential neurological complications. This patient's delivery is scheduled on February 12, 2019. Our current plans include a primary elective cesarean section at 38weeks under epidural anesthesia. There are limited case reports and evidence to help guide the management of a pregnant patient with VHL complicated by microscopic pheochromocytoma, so we hope to discuss our experience with this complex patient and outline the key factors to mitigate maternal and fetal morbidity.

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Abstract #: FCB-74

Hydatidiform Mole with Co-Existing Live Fetus: A Case of Suspected Peripartum Emboli During Cesarean Section

Presenting Author: Sarah Rose Hall M.D.
Presenting Author's Institution: Medical College of Wisconsin - Milwaukee, WI
Co-Author: Jessica N Rock M.D. - Medical College of Wisconsin
Elizabeth Ellinas M.D. - Medical College of Wisconsin

Case: A 27-year-old G4P2103 with a history of three prior cesarean sections (CS) had two early pregnancy ultrasounds (US) showing a singleton pregnancy. At 16 weeks gestation, vaginal bleeding (VB) prompted an addition US, showing a cystic molar mass sharing the same sac with a normally growing fetus, suspicious for a complete molar pregnancy with a coexisting viable fetus (CHMCF). Except for abnormally high hCG, chest X-ray and labs were normal. She declined an offer of pregnancy termination. Her antepartum course was notable for multiple episodes of VB occurring between 23-27 weeks gestation.

A repeat CS at 34 weeks and 1 day was performed with a single-shot spinal anesthetic technique. A 2150 g neonate with Apgars 9 and 9 was delivered 11 minutes after incision. During delivery of the placenta, copious amounts of hydropic villi were evacuated from the uterus. At 2-3 minutes and at 25 minutes after delivery, the patient complained of shortness of breath and difficulty speaking, followed by mild hypoxemia, hypotension, and tachycardia. Supportive management (not requiring intubation) ensued and her symptoms and vitals improved. Postoperatively, the patient stated her symptoms occurred abruptly and felt as though she could not speak, her "teeth hurt, and [her] whole body felt pressurized."

Discussion: CHMCF is extremely rare, with an estimated incidence of one in 22,000-100,000. In addition to an increased risk for maternal complications (preeclampsia, hyperthyroidism, hemorrhage), only 40-60% result in live births. Increased hCG levels are associated with poorer fetal outcomes and gestational trophoblastic neoplasia. It is unknown whether higher hCG is associated with maternal intrapartum embolic events. Self-limited, acute maternal respiratory distress arises in 3%-10% of molar pregnancies at the time of uterine evacuation. In a multicenter cohort of 72 cases of CHMCF, the only maternal death was caused by acute respiratory insufficiency during medical termination of pregnancy due to severe preeclampsia. There was a high suspicion for peripartum emboli—either amniotic fluid embolism (AFE) or trophoblastic embolism (TPE)—in our case. Most TPE happens in gestational trophoblastic disease, during CS or curettage. Like AFE, TPE is characterized by hypoxia, hypotension, and coagulopathy; treatment is supportive.

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Abstract #: FCB-131

Pericardial effusion and morbidly adherent placenta: a delicate balance

Presenting Author: Shubhangi Singh MBBS, MD
Presenting Author's Institution: Brigham and Women›s Hospital - Boston, MA
Co-Author: Michaela K Farber MD, MS - Brigham and Women›s Hospital
Jean M Carabuena MD - Brigham and Women's Hospital

Perioperative management of patients with pericardial effusion presents many anesthetic challenges (1). While increased blood volume in pregnancy may offset tamponade physiology, administration of anesthesia may favor it. Further, hemorrhage may provoke cardiovascular collapse.

A 40 y.o. G2P1 at 38 wks with chronic pericardial effusion (PE) was scheduled to have repeat cesarean delivery (CD) for twins (one viable, one fetal demise with accreta). Her PE was incidentally diagnosed 6 y. prior during workup of ovarian mass and she had percutaneous drainage (PD) of 660mL of pericardial fluid for concern of early tamponade physiology seen on transthoracic echo (TTE). Partial re-accumulation (RA) was followed conservatively.

In her first pregnancy, RA of a large PE was followed with TTE with no PD. She underwent primary CD for previa with epidural anesthesia without event. An interim TTE showed a marked decrease in PE.

This 2nd pregnancy was complicated by suspected accreta of the demised twin and evidence of RA of a large PE on serial TTE during pregnancy. Delivery was planned in the hybrid OR. On admission she was tachycardic to 130s. She received 5% albumin. Pre-procedure TTE showed a moderate effusion with right atrial inversion but no evidence of tamponade (Figure). With an arterial line in place, a co-load of 5% albumin was given and a dural puncture epidural technique was used to achieve a level of T4 with epidural 2% lidocaine with epinephrine. Surgical prep was extended to the xiphoid. After CD, the placenta was morbidly adherent requiring hysterectomy. Blood loss was substantial (6L) and she had massive transfusion (Figure) with intermittent phenylephrine infusion to maintain blood pressure. Epidural anesthesia was maintained for the procedure with minimal sedation at time of closure. Recovery was stable and she continues to be monitored for chronic PE.

While PD of large PE is controversial, detecting and treating early tamponade is paramount. Both cardiovascular instability from anesthesia and hemorrhage can contribute to tamponade physiology in patients with large PE. A controlled neuraxial technique with colloid loading allowed for stable onset of surgical anesthesia. Preparations for massive blood loss were in place. Multidisciplinary planning is essential and discussions should include location of delivery, availability of cardiac personnel and preparation for potential adverse events.

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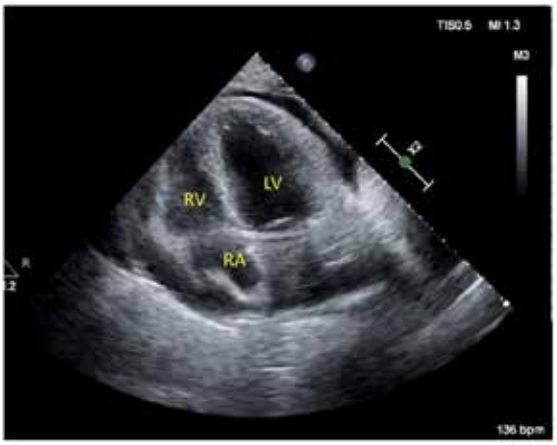

Fig 1. Preprocedure TTE showing circumferential pericardial effusion and right atrial inversion.

EBL: 6L URINE OUTPUT: 875mL
PRBC: 10 units
FFP: 10 units
PLATELETS: 2 units
FIBRINOGEN: 3300 mg
CRYOPPT: 2 units
5% ALBUMIN: 1750 mL
CRYSTALLOID: 3500 mL
TRANEXAMIC ACID: 1000 mg

Table 1. Input and output of blood products and fluids

Abstract #: FCB-154

Early diagnosis and treatment of Anaphylactoid Reaction of Pregnancy (formerly known as Amniotic Fluid Embolism) using Rotational Thromboelastometry (ROTEM)

Presenting Author: Courtney McGuigan MSN, CRNA
Presenting Author's Institution: Yale School of Medicine - New Haven, CT
Co-Author: Antonio Gonzalez-Fiol MD - Yale School of Medicine
Aymen Alian MD - Yale School of Medicine
Michael Simoni MD - Yale School of Medicine
Michelle Silasi MD - Yale School of Medicine

Anaphylactoid reaction of pregnancy (ARP) is an extremely rare, often fatal complication of pregnancy occurring only in 20-40,000 parturients. This reaction can lead to severe and sudden respiratory and cardiovascular collapse and is often associated with early and profound disseminated intravascular coagulation (DIC). (1) We present a case which was diagnosed and successfully treated with the early use of rotational thromboelastometry (ROTEM).

A 32 y.o G1P0 presented for a scheduled cesarean delivery for known complete placenta previa. Spinal anesthesia was performed. Shortly after uterine incision, the patient became unresponsive and cyanotic. EKG revealed severe bradycardia with profound hypotension (Figure 1A). She was intubated as baby was delivered. Volume resuscitation and pressor support were initiated. Intra-op Trans Esophageal Echocardiogram revealed dilated right ventricle and atrium, moderate tricuspid regurgitation and pulmonary artery dilation, all consistent with pulmonary emboli (PE). With fundal pressure, 1L BRB was expelled. Coagulation profile and a blood sample for ROTEM analysis were sent given increased intra-operative bleeding. Blood products given can be seen in Figure 1B. ROTEM results confirmed DIC with hyperfibrinolysis and a consumption of coagulation factors (Figure 1C). Fibrinogen concentrate was used as a bridge to treat hypofibrinogenemia while awaiting cryoprecipitate. A follow up ROTEM revealed improvement of coagulation (Figure 1D,E). A head CT was negative for stroke, and the patient was extubated hours later in SICU. On POD 1 patient, had full neurological recovery and was discharged after 3 days.

ARP is a rare obstetric emergency with diagnosis made only after exclusion of other causes. In this case, factors supportive of ARP included complete previa, sudden and reversible hypoxemia and an early coagulopathy observed on ROTEM. ROTEM is a viscoelastomeric method of testing whole blood which can be visualized in real time. (2) Its unique ability to visualize hyperfibrinolysis enabled us to appropriately diagnose ARP over PE or cardiomyopathy, and guided blood factor replacement and use of tranexamic acid. Hyperfibrinolysis may be a contributor to coagulopathy associated with ARP, but infrequently reported due to traditional coagulation tests. Fibrinogen concentrate should be considered while awaiting cryoprecipitate in these cases.

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Abstract #: FCB-154

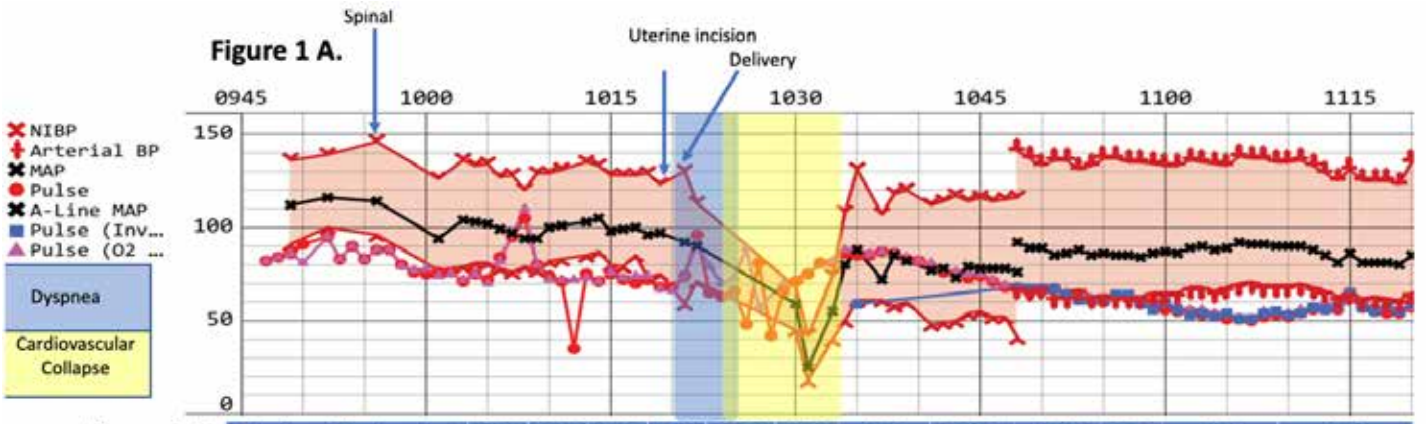
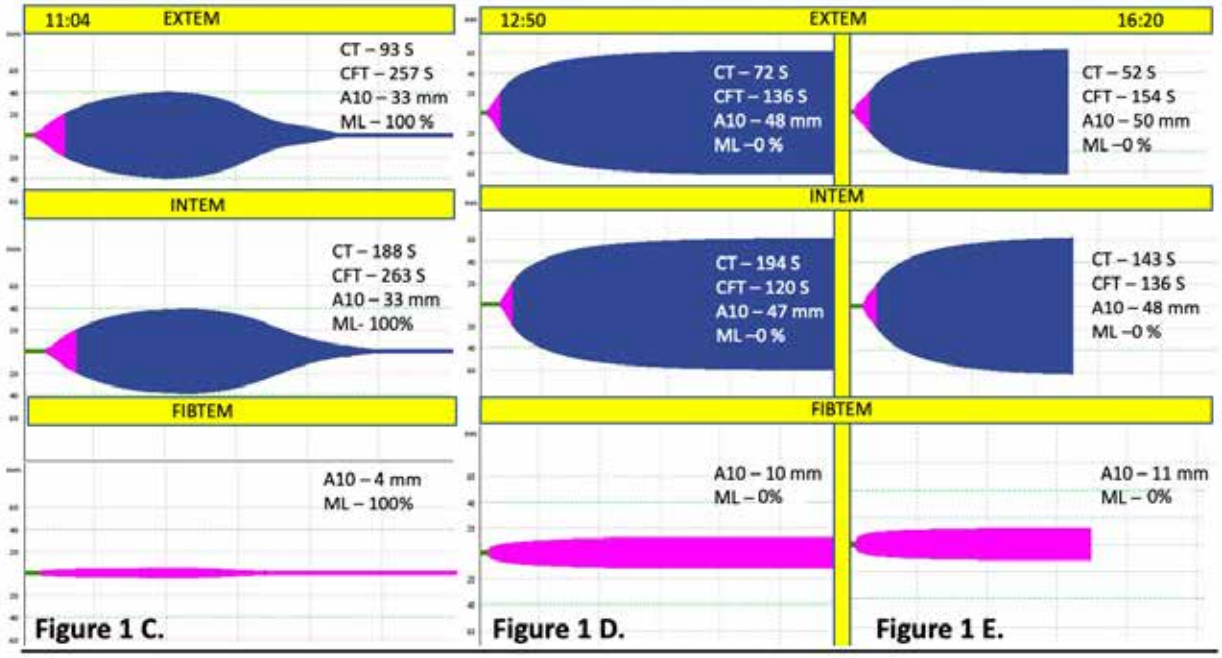


Figure 1 B.

Timeline of Blood product administration	12:36	12:40	12:42	12:50	13:01	13:03	13:08	13:12	13:15	13:16	13:20	13:25
Tranexamic Acid	1g			1g								
Packed Red blood Cells		1 unit	1 unit								1 unit	1unit
Fibrinogen Concentrate									4.356 g			
Cryoprecipitate					1 unit	1 unit	1 unit					
Platelets								1 pool		1 pool		



Abstract #:FCB-211

Fresh frozen plasma for reversal of succinylcholine-induced neuromuscular blockade following cesarean delivery under general anesthesia

Presenting Author: Borislava Pujic MD PhD
Presenting Author's Institution: Clinical Center Novi Sad - Novi Sad, Vojvodina
Co-Author: Bedrana Ilic-Ostojic MD - Clinical Center Novi Sad
Craig Palmer MD - University of Arizona

General anesthesia (GA) is used frequently for cesarean delivery (CS) in low-resource countries. We present a case of succinylcholine (sux) induced respiratory depression in undiagnosed psuedocholinesterase (PchE) deficiency.

The parturient was 34-years-old, G6P1, 34 weeks EGA with a triplet pregnancy who presented with preterm labor. Weight was 87 kg, with normal VS and class II airway. PMH was significant for prior vaginal delivery, and 3 laparoscopic procedures for ectopic pregnancy. After a prior procedure, she had a prolonged wake-up, and was advised to have \"some laboratory test" which she \"forgot to do".

On presentation, cervix was 3 cm and all 3 infants were breech. An urgent CS was called. Spinal anesthesia was attempted unsuccessfully before GA was induced, with propofol 2 mg/kg and sux 75mg. Anesthesia was maintained with sevoflurane, rocuronium, and fentanyl. All 3 infants were delivered in good condition.

At the end of surgery, despite lack of sevoflurane, she remained unresponsive and hypotensive with no respiratory effort. No peripheral nerve stimulator (PNS) was available in the facility. Over several minutes, the patient became tachycardic and hypertensive. A diagnosis of PchE deficiency was entertained, and 2 units of fresh frozen plasma (FFP) were administered. Two hours later she recovered sufficiently to be extubated, but respiratory efforts were weak, and 2 more units of FFP were given. Effort improved significantly, and the remainder of her recovery was uneventful. The day after delivery a PchE level returned a value of 2709 u/L (normal, 2879-12,669 u/L).

Discussion: Atypical or decreased PchE is present in about 1:2800 people (1). Pregnancy can further decrease PchE level (2). Deficiency is often undiagnosed prior to surgery. Prevention of complications is with careful monitoring of NM block, both before and after subsequent administration of a non-depolarizing relaxant.

When diagnosed post-op, conservative management includes mechanical ventilation and sedation until spontaneous recovery occurs. FFP has been reported as an effective active treatment (1). FFP retains its PchE level without decrease for at least 7 weeks (1), and can result in recovery of NM function within minutes. The PchE level assayed on the first post-op day likely represents the level of the enzyme present after transfusion of the FFP.

Unfortunately, in some low-resource settings, conservative treatment can be problematic. In this case, a PNS was not available, and the facility lacked the ability to provide prolonged ventilation outside the OR, necessitating ambulance transfer to another facility.

In summary, a case of successful treatment of PchE deficiency with FFP in a post-cesarean patient is presented. Such occurrences provide further impetus to continue to advocate for wider training and utilization of regional anesthetics in the obstetric population.

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Abstract #: FCB-214

Amniotic Fluid Embolism: A Management Conundrum

Presenting Author: Brandon M. Lopez MD
Presenting Author's Institution: University of Florida Shands - Gainesville, Florida
Co-Author: Carolyn Witman MD - University of Florida Shands
Tammy Euliano MD - University of Florida Shands

Amniotic fluid embolism (AFE) is a rare but serious complication of pregnancy, presenting as sudden onset hypotension or cardiac arrest during labor, CS or within 30 minutes of delivery, with associated severe hypoxia and coagulopathy. Mortality rates as high as 80% have been reported (1,2). The pathophysiology is likely an anaphylactoid reaction to fetal antigens leading to intense pulmonary vasospasm and acute right heart failure, as well as activation of the coagulation cascade and DIC.

We present a 35yo P1001 healthy female at 37w gestation with complete placenta previa for scheduled primary CS. A spinal anesthetic (12mg hyperbaric bupivacaine + 20 mcg fentanyl + 0.1 mg morphine) was placed with stable hemodynamics. During delivery, she developed profound bradycardia and became unresponsive with no palpable pulse and PEA. We initiated ACLS: CPR, intubation, epinephrine; and obtained arterial and central venous access. SpO2 <80% on 100% O2; TEE showed a massively dilated right heart with significantly depressed RV function. ROSC was obtained after 10 minutes. We suspected AFE, initiated inhaled nitric oxide and consulted CT surgery for emergent ECMO. MTP was ordered. About 30 minutes after the event, the hypoxia acutely worsened. TEE revealed a large RA thrombus. tPA 50 mg IV caused immediate improvement. ECMO initiated. Massive hemorrhage noted from upper abdomen with apparent uterine hemostasis and normalized TEG. Trauma surgery attempted to occlude the aorta by endovascular balloon but eventually cross clamped open. Multiple lacerations of the liver and spleen required splenectomy and left hepatectomy.

The patient was transferred to interventional radiology with an open abdomen for embolization, but active bleeding from the remaining liver could not be controlled. Upon transfer to CV ICU, ECMO circuit flow fell rapidly with multiple clots noted in the circuit; CPR was reinitiated and circuit thrombectomy attempted unsuccessfully. After 20 minutes, CPR was discontinued and the patient expired.

Untreatable liver lacerations contributed to this poor outcome. Significantly more common in pregnant women than the nonpregnant population (43% vs 2%)(3), hand placement and angle of compression should be carefully considered.

This case highlights several unique challenges for the anesthesiologist. There is no perfect method for management of these complex and contradictory patient issues, with very little data to support any particular strategy given the extreme rarity of AFE. This helps to explain why outcomes are still poor even with incredible resources at our disposal.

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Abstract #:FCB-218

Anesthetic Management of Primiparous Sexagenarian undergoing Cesarean Delivery complicated by Uterine Atony

Presenting Author: Lesley M. Bautista MD FRCPC
Presenting Author's Institution: Dalhousie University - Halifax, Nova Scotia
Co-Author: Ronald B. George MD FRCPC - Dalhousie University
Prasad Bolleddula MD FRCA - Dalhousie University
Renda Bouzayen MD FRCSC - Dalhousie University

Though rare, pregnancy at very advanced maternal age (AMA) is becoming more frequent in high-income countries.(1) Assisted reproductive technology (ART) now allows post-menopausal women to conceive, but has been associated with increased risk of adverse maternal and neonatal outcomes.(2) Anesthetic literature addressing pregnant women of extreme AMA is sparse.

A 64 year-old G1P0 healthy female presented for elective cesarean delivery (CD) at 36+1 weeks. She had undergone in-vitro fertilization with embryo donation and returned to Canada for prenatal care. Though her pregnancy was uncomplicated, it was felt by obstetrics that CD was preferred due to concern regarding vaginal elasticity, uterine tone, and risk of spontaneous intrauterine fetal death.

Anesthetic management consisted of two 18g peripheral intravenous catheters and a spinal anesthetic with hyperbaric bupivacaine, fentanyl, and morphine. The patient was co-loaded with lactated Ringers and phenylephrine infusion was started. The patient developed second degree heart block and bradycardia shortly after introduction of the spinal anesthetic that responded to glycopyrolate.

Following delivery (APGARS 9,9), poor uterine tone was noted despite oxytocin infusion. A bolus of oxytocin was given; then with no improvement, it was followed by carboprost and ergonovine. Given the failure of uterotonics and possible postpartum hemorrhage, tranexamic acid was administered. Uterotonics and tranexamic acid were given without adverse effect. On closure of the hysterotomy, the myometrium was noted to be unusually rigid and tore easily. Estimated blood loss was 1000 ml. The patient remained hemodynamically stable, holding her infant. She had an uneventful postoperative course and breastfed. The neonate was later admitted to the NICU due to possible transient pulmonary hypertension of the newborn which resolved without intervention.

CD in a healthy parturient over 60 years of age may safely be performed with standard spinal anesthetic technique. Though hyperbaric bupivacaine may result in a higher level of block and increased latency to maximal level of spread with increasing age(4), a high block was not observed in this patient. Baroreceptor reflex sensitivity decreases, risk of conduction defects increases with age; therefore an elderly parturient's response to phenylephrine infusion may be unpredictable. It is not known how a uterus of this age would respond to these uterotonic agents. The risk of postpartum hemorrhage has been found to be increased with advanced maternal age(5), however it is unclear whether this patient's advanced age contributed to the uterine atony.

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Abstract #:FCB-278

Multidisciplinary Management of Cesarean Delivery, Serial Embolizations, and Delayed Hysterectomy for a Parturient with Placenta Percreta into the Cervix

Presenting Author: Nathalia Torres Buendia MD
Presenting Author's Institution: University of Miami/Jackson Memorial Hospital - Miami, FL
Co-Author: Daria Moaveni MD - University of Miami/Jackson Memorial Hospital
Reine Zbeidy MD - University of Miami/Jackson Memorial Hospital

A 27 year old G5P3 woman at 23 weeks gestation with suspected placenta percreta was transferred to our institution for delivery planning. She had a history of three previous cesarean deliveries. Ultrasound and MRI showed complete placenta previa with signs of extensive placental invasion of the cervix and focal bladder invasion. The patient was admitted for antenatal observation and monitoring, weekly multidisciplinary meetings and serial MRIs. Due to the extent of the disease and subsequent impossibility to perform a hysterectomy without massive hemorrhage, the surgical plan was cesarean delivery in the Main OR, transfer of the patient to the interventional radiology (IR) suite for embolization, postpartum methotrexate therapy, and then later hysterectomy.

The cesarean delivery was performed at 28 weeks gestation under general anesthesia. Preparations for massive hemorrhage were done in case the placenta began to separate intraoperatively or during embolization. A central line, large bore peripheral IV access and an arterial line were placed. A rapid infuser, cell saver, cardiac anesthesia and trauma surgery were available. Cesarean delivery was performed uneventfully and the placenta remained in situ. The patient was transferred to the IR suite for uterine artery embolization. She was extubated following embolization, transverse abdominis plane blocks were done and she was monitored in ICU. Estimated blood loss was 800 mL. She remained hospitalized for 6 weeks with methotrexate therapy and 2 additional embolizations due to development of collaterals seen on pelvic CTA and MRI. She subsequently had an emergent total hysterectomy, bilateral salpingectomy with complete placental resection due to hemorrhage. Her fibrinogen was 89 mg/dL and INR 1.6. She received 4 units PRBC, 6 units FFP and 1 unit cryoprecipitate to correct coagulopathy. She was extubated at the end of surgery. Postoperative course was uneventful.

Discussion: Cesarean with planned delayed hysterectomy has shown to reduce total blood loss in patients with severe morbidly adherent placenta (MAP). The optimal timing of delayed hysterectomy has not been established. Several complications such as disseminated intravascular coagulation and sepsis have been reported with retained placenta. This case illustrates a staged cesarean hysterectomy complicated by hemorrhage and coagulopathy. Interval cesarean hysterectomy for severe MAP can be the only feasible approach for complex cases such as this one. Obstetric anesthesiologists should be prepared to manage possible complications at any stage of the course of treatment. Further research is needed to reduce the risks associated with this staged approach.

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Abstract #:FCB-285

Use of Intraoperative TTE for a Patient with Hypertrophic Cardiomyopathy Undergoing a Cesarean Delivery with a Neuraxial Technique

Presenting Author: Nathalia Torres Buendia MD
Presenting Author's Institution: University of Miami/Jackson Memorial Hospital - Miami, FL
Co-Author: Selina Patel MD - University of Miami/Jackson Memorial Hospital
Reine Zbeidy MD - University of Miami/Jackson Memorial Hospital
Daria Moaveni MD - University of Miami/Jackson Memorial Hospital

Hypertrophic cardiomyopathy (HCM) prevalence is estimated to be around 2% in the general population. It is defined as any left ventricle myocardial segment thickness ≥ 15 mm not explained by abnormal loading conditions. An instantaneous peak Doppler left ventricular (LV) outflow tract pressure gradient ≥ 30 mmHg at rest or with activity is considered obstructive. Patients with HCM are at risk of heart failure, arrhythmias and sudden cardiac death. Pregnant patients with HCM usually reach term and are at greater risk of cardiovascular complications.

We present the case of a 22 year old G1P0 patient at 37 weeks with history of HCM and an AICD admitted for cesarean delivery. She was taking 200 mg of metoprolol BID. Echocardiogram showed severe diffuse concentric LV hypertrophy, systolic anterior motion of the mitral valve leaflet with LV obstruction (maximum instantaneous gradient 125 mmHg, mean gradient 56 mmHg).

Combined spinal epidural (CSE) anesthesia was planned for cesarean delivery. Hemodynamic goals included avoiding tachycardia, maintaining preload, and maintaining afterload. Large bore peripheral intravenous access and an arterial line where placed under remifentanil infusion for anxiolysis. Transthoracic echocardiogram (TTE) monitoring was done intraoperatively in conjunction with a cardiac anesthesiologist. Prior to CSE, TTE showed adequate volume status and LV function. Fentanyl 15 mcg and morphine 100 mcg where given intrathecal followed by slow titration of epidural lidocaine 2% to obtain a T4 level. TTE was repeated to evaluate LV function and volume throughout the procedure. Intraoperative course was uneventful, 3.2 L of crystalloids were administered, and vasopressors were not required. She was monitored for 24 hours postoperatively in the ICU. She was discharged home on postoperative day 4.

In this patient with obstructive HCM, the decision for modified CSE was made to give the benefit of intrathecal opioid for postoperative analgesia and intraoperative block density, while titration of epidural local anesthetic avoided sudden sympathectomy and decreased preload and afterload. In addition, TTE was a noninvasive monitor to guide fluid administration to maintain adequate preload and prevent dynamic left ventricle obstruction.

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Abstract #: FCB-342

I want to keep my uterus!

Presenting Author: Angelique M. Garay DNAP, CRNA II, ACNP-BC
Presenting Author's Institution: Yale New Haven Hospital - New Haven, CT
Co-Author: Kristen Fardelmann MD - Yale School of Medicine
Victoria Greenberg MD - Yale School of Medicine
Antonio Gonzalez MD - Yale School of Medicine
Aymen Alian MD - Yale School of Medicine

Morbidly adherent placenta is a rare but serious condition defined as a placenta that is abnormally adherent to the uterus. It has a prevalence of about 10/10,000 deliveries but is becoming more common as cesarean delivery rates rise.1 When counseling patients with abnormal placentation, the potential need for hysterectomy must be discussed. We describe a case in which a patient dictated the anesthetic and obstetric course of her cesarean delivery.

A 35-year-old G10P8 at 28 weeks and 4 day was referred to our Maternal-Fetal Medicine (MFM) and high-risk obstetric anesthesiology consult service for supervision and counseling given a diagnosis of placenta accreta. The patient refused standard of care, consisting of scheduled cesarean delivery at 37 weeks and possible cesarean hysterectomy. The patient wanted to be delivered at 39 weeks and refused the possibility of a hysterectomy. She agreed to have in-situ management of the placenta. Use of methotrexate and prophylactic uterine artery embolization was discouraged as the literature did not show improvement in outcomes with their use in this context.

In terms of anesthesia, combined spinal anesthesia was offered as the anesthetic plan with general anesthesia as a back up plan in case of hemodynamic instability. She refused the use of an epidural or general anesthesia (GA), and stated that if she was to become unstable, her husband would decide if GA was a possibility. The patient only agreed to receive a single-shot spinal. The ethics committee was consulted, and it was determined that the patients request be granted as such.

At 37 weeks, the patient asked for her surgery to to be re-scheduled at 39 weeks. At 39 weeks, a cesarean delivery with in-situ management of the placenta was performed under spinal anesthesia. The intraoperative course of the patient was uneventful, and she was discharged on post-operative day 4 in stable condition.

The management of placenta accreta is complicated and it often involves the need to perform a hysterectomy. Even when the plan is to perform an in-situ placenta approach, sepsis and or hemorrhage could lead to the possibility of needing to perform a hysterectomy. In any case, once a patient has been sufficiently informed about the treatment options offered by a physician, the patient has the freedom to decide what a physician or other healthcare professional can or can not do. It is unethical to physically force or coerce a patient into a treatment against her will if she is is mentally capable of making an informed decision. After all, the most important right the patient possess is the right of self-determination; the right to make the final decision of what will or will not be done to their bodies.2

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Abstract #: FCB-436

Long QT syndrome during cesarean section under general anesthesia

Presenting Author: Kum Hee Chung M.D.
Presenting Author's Institution: CHA University Bundang CHA Medical Cnter - Seongnam-si, Gyeonggi-do
Co-Author: KumHee Chung M.D. - CHA University Bundang CHA Medical Cnter

Long QT syndrome (LQTS) is a congenital disorder characterized by prolongation of QT interval in the electrocardiogram (ECG) and a propensity to develop ventricular arrhythmias, which may lead to syncope, cardiac arrest or sudden death. Congenital LQTS has been categorized by many genetic studies. The diagnostic rate has also improved by a diagnostic scoring system. A prolonged QT interval on the EKG is the essential condition of the LQTS but around 10~15% of LQTS patients shows normal QT interval. We present here a case of LQTS experienced during general anesthesia for cesarean section in a pregnant woman who had normal EKG findings before surgery and taking levothyroxine as hypothyroidism

Case report: A 38-year-old woman (body weight: 56 kg, height: 158 cm) at 34 weeks of pregnancy with history of dizziness and 2-3 episodes of syncope but no underlying disease diagnosed was admitted for emergency cesarean section due to oligohydroamnios, premature rupture of membranes and fetal distress. Chest X-ray, EKG, CBC, electrolytes, general chemistry, blood coagulation test, urinalysis at the time of admission were all within normal range. Initial vital sign were BP 100/50 mmHg and pulse rate (PR) 60 beat/min. Right after propofol 120 mg IV and succinylcholine 60mg IV were given, airway pressure increased, PR fastened to 135 beat/min and EKG showed large tall T wave and ST elevation. Patient was immediately intubated and given O2 2L/min, N2O 2L/min with sevoflurane at 1.0 vol.%. At the same time, the surgery started and immediately took out the baby and APGAR score was 7 at 1 min., 9 at 5 min. Amiodarone 150 mg mixed with 100 cc N/S was infused and isosorbide dinitrate (0.1 mg/ml) was infused. Patient's EKG was normalized and BP was 70/40. Arterial cannulation was performed with a 20G catheter in the left radial artery, and central venous cannulation was done in the right internal jugular vein. After 1 to 2 minutes, torsade de pointes (TdP) ventricular tachycardia (VT) occurred and one defibrillation was performed. The EKG returned to normal sinus rhythm and blood pressure returned to 90/40. At this time, MgSO4 (2g + N / S 100 CC mixture) was infused. After the patient woke up after the surgery, she was transferred to intensive care unit after self-ventilation was confirmed. At the ICU, patient was alert with stable vital signs after 1 day and transferred to the general ward. There was no change in EKG afterward and no other neurologic abnormalities were found. Coronary angiography showed normal coronary arteries and ergonovine provocation test was negaive. After patient\'s recovery, family history of sudden death of patient\'s mother during vaginal delivery was found out. This required further evaluation, including genetic studies for the diagnosis of congenital long QT syndrome, but the patient refused. After the discharge, patient followed up with a cardiologist and showed healthy condition without any abnormal sequelae.

Abstract #: FCC-93

Myoclonus after Spinal Anesthesia for Cesarean Delivery: A Case Report.

Presenting Author: Dung T Pham M.D.
Presenting Author's Institution: Mount Sinai West - New York, NY
Co-Author: Deborah Stein M.D. - Mount Sinai West
Bryan Mahoney M.D. - Mount Sinai West
Barbara Orlando M.D. - Mount Sinai West

Introduction: Myoclonus following a neuraxial placement is a rare occurrence. Myoclonus is described as sudden, brief, shock-like involuntary movements that may occur at rest, during voluntary movement, or secondary to provoked stimuli [1]. We present a case of myoclonic jerks following spinal anesthesia for a repeat cesarean delivery.

Case Presentation: The patient is a 35-year-old female, G3P1011 at 39-week gestation, who presented for scheduled repeat cesarean. Her past medical history is significant for pregnancy-induced gastric reflux for which she is taking omeprazole. Family history is notable for seizures.

On arrival to the operating room standard ASA monitors were placed. With the patient in the sitting position, a single shot spinal was performed at L3-L4 interspace, with a 25-gauge pencil-point needle and hyperbaric bupivacaine 0.75%-1.5cc, preservative free morphine 150 mcg and fentanyl 15 mcg injected. The patient was then positioned supine with left uterine displacement, and the cesarean delivery proceeded uneventfully.

Following completion of the surgery the patient was brought to the PACU, stable vital signs noted and full report given. Soon after, the patient reports mild involuntary, painless left leg twitching, and then involvement of her right leg in the recovery room (approximately 60 minutes from spinal placement). Symptoms progressively got worse within 30 minutes (left > right) of arrival to the PACU. The patient was alert and oriented without hemodynamic changes. On physical exam there was presence of irregular, bilateral myoclonic jerks of both legs, muscle strength and sensation intact, and 2+ bilateral dorsal pedis pulses.

Following a literature search the patient received 2 mg midazolam IV with complete resolution of twitching within 5 minutes. The patient was discharged to the postpartum floor without recurrence of myoclonic jerks for the remaining hospitalization. She was discharged home on postoperative day 3.

Discussion: Myoclonus after neuraxial placement is an uncommon event. Myoclonus does not necessarily represent a pathological phenomenon; metabolic derangements and many types of medication can transiently cause myoclonus [1]. There have been several cases describing myoclonic-like involuntary movements following spinal; fewer cases after an epidural placement [2]. Medications such as sodium valproate, clonazepam, barbiturates and benzodiazepines may be utilized to stop the movements [3]. In conclusion, it is important for anesthesiologists to be aware of the potential for myoclonus after neuraxial placement and the subsequent available treatments.

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Abstract #: FCC-153

Unilateral Horner's Syndrome and Brachial Plexus Palsy with a Labor Epidural

Presenting Author: Michelle S Burnette M.D.
Presenting Author's Institution: The Johns Hopkins University School of Medicine - Baltimore, Maryland
Co-Author: Amanda N Hopkins M.D. - The Johns Hopkins University School of Medicine - ,
Neil Lee M.D. - TeamHealth

A 31-year-old G1P0 at 39w6d with preeclampsia undergoing augmentation of labor requested an epidural. Past medical history included anxiety and migraines with aura. Her CBC and CMP were unremarkable.

The epidural was easily placed using loss of resistance to air and a nylon 20G closed tip catheter was threaded 4.5cm in the epidural space. After negative test dose,10cc of 0.125% bupivacaine was given and a 0.125% bupivacaine with 2mcg/ml fentanyl infusion was started at 6cc/hr. Over the next 30mins, the patient reported right hand paresthesias that progressed to right upper extremity numbness and then, marked weakness. Her sensory level was found to be T10 bilaterally to temperature, without chest wall or left arm numbness, respiratory depression, or hemodynamic compromise. The patient denied headache or vision changes. Neurologic exam was notable for mild right ptosis and injected sclera, right pupil smaller than left, partial paralysis of the right upper extremity (0/5 strength in triceps, finger flexion/extension, interossei, thumb abduction, wrist flexion), decreased sensation to light touch and pinprick on the right upper extremity, and 1+ reflex in the right triceps. The differential included preeclampsia with focal neurologic deficit, migraine with transient weakness, TIA, carotid dissection, and epidural side effect. The epidural infusion was paused for an MRI/MRA of the brain/c-spine, which was unrevealing. Shortly after, the patient experienced resolution of symptoms except for persistent Horner\'s syndrome. Epidural replacement was discussed with her, and she elected to continue with the original catheter. The catheter was bolused with 7cc of 0.125% bupivacaine and the infusion restarted. Within 30mins, her pain was well controlled with a T11 bilateral sensory level, but the paresis returned to her right fingers and arm. The patient was closely observed during her 8hrs of labor, and the catheter was discontinued after delivery. Within a few hours of removal, her neurologic exam returned to her normal baseline.

Horner's syndrome is a recognized complication of lumbar epidural anesthesia (1). Multiple possible etiologies have been described, but cephalic spread of the local anesthetic to interrupt the sympathetic chain, in the region of C8 to as low as T4, is surmised. Unilateral Horner's syndrome accompanied by ipsilateral brachial plexus palsy has been reported exceedingly rare, and the mechanism not well understood. While the symptomatology in this case suggests unilateral cephalic spread of local anesthetic, our assessment of symmetric T10 level is inconsistent with prior case reports, which were associated with truncal levels of T6 or higher (2). Upon our review, this is the first reported instance of Horner's syndrome and ipsilateral brachial plexus palsy after labor epidural placement with an assessed low (T10) truncal level.

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Abstract #: FCC-186

Drug error resulting from look-alike pharmacy compounding during bupivacaine shortage

Presenting Author: Kyra R Bernstein BA, MD
Presenting Author's Institution: Columbia University Irving Medical Center - New York, New York
Co-Author: Richard Smiley MD - Columbia University Irving Medical Center
Laurence Ring MD - Columbia University Irving Medical Center
Ruth Landau MD - Columbia University Irving Medical Center

Introduction: Drug shortages increase the risk of medication error due to increased "look-alike" preparations, both from pharmacy compounding and alternative vial purchasing.1 The 2018 bupivacaine (BUP) shortage called for changes in obstetric anesthetic care as proposed by the 2018 SOAP Advisory.2 We requested pharmacy-compounded BUP syringes for epidural 'top-up' in labor (BUP 0.125% 10ml) as one of many conservation measures. This resulted in BUP syringes appearing similar to the nitroglycerin (NTG) syringes (1000mcg/10ml) that pharmacy had been preparing for years (Photos).

Sentinel event: A wrong drug administration occurred with the epidural administration of NTG 100 mcg/ml instead of BUP 0.125%; the anesthesiologist injecting the drug noticed the drug error and stopped after 5ml. Based on the package insert, the material injected into the epidural space contained 500mcg NTG, 5.25mg citrate, and 0.042ml ethanol in D5W (Photo). Monitoring of maternal and fetal hemodynamic parameters over the next hour revealed no changes. After delivery (>10 hours later), neonatal Apgar scores were 8/9, and maternal sensory-motor function recovery followed a usual course. No ill effects to mother or baby were noted through the 6-week postpartum visit.

Actions taken: After immediate QI review, actions taken were 3-fold: (1) NTG syringes were changed from 10 to 5ml and each syringe placed in opaque brown plastic bag to reduce the likelihood of look-alike errors, (2) larger epidural carts were purchased to allow better display of the numerous pharmacy-prepared syringes due to ongoing drug shortages, (3) this case was reported to the national Institute for Safe Medication Practices (ISMP)3 to raise awareness about this error occurring to other patients in the context of the bupivacaine shortage. No medication substitution errors have occurred since then.

Discussion: Obstetric units are fast-paced environments with provision of neuraxial labor analgesia and of anesthesia for cesarean delivery demanding rapid response from the anesthesia team. Changes in medication formulations (vials or syringes) may cause serious drug errors, which can be prevented by color-coding syringes or providing additional distinct coverings, alerting providers to institutional vial and manufacturer substitutions, and through national bulletins.

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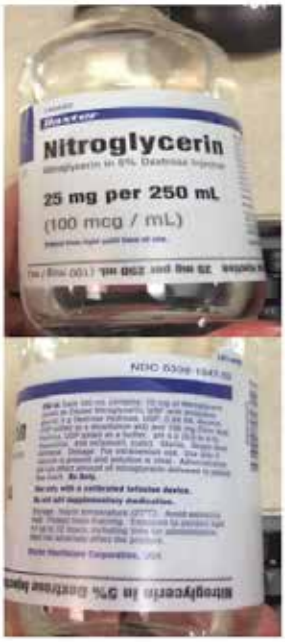
Abstract #: FCC-186

Before sentinel event:
- Small epidural cart
- Epidural drug tray is full (overflowing)
- Various 10ml syringes stacked with no dividers



Nitroglycerine 5% (Baxter)
100mcg/ml diluted in 0.84% alcohol, buffered by citric acid

After QI review:
- New larger epidural cart with larger drug tray
- Spacious display of drugs with dividers

5ml NTG syringe in individual amber plastic bag

NTG syringe (5ml) in amber plastic bag is no longer 'look-alike' with bupivacaine 0.125% syringe (10ml)

Abstract #: FCC-314

Tonic-clonic seizure after unrecognized unintentional dural puncture: A case report

Presenting Author: Cameron R Taylor MD
Presenting Author's Institution: Duke University Hospital - Durham, North Carolina
Co-Author: Jennifer Dominguez MD - Duke University Hospital
Jennifer Mehdiratta MD - Duke University Hospital
Mary Yurashevich MD - Duke University Hospital
Ashraf Habib MBBCh - Duke University Hospital

Introduction: Unintentional dural puncture is associated with a high risk of headache, but neurological complications have also been reported. We present a case of tonic-clonic seizure in a parturient who suffered an unrecognized unintentional dural puncture during placement of an epidural catheter for labor analgesia.

Case Report: A 21 yo primigravid woman presented for induction of labor at 39w5d gestation. Her pregnancy was complicated by Crohn's disease, obesity, anemia, and depression. She requested labor epidural analgesia approximately 24 hours after her induction began. Two unsuccessful attempts were made by a resident, the first resulting in an intravascular catheter. The attending physician subsequently made two attempts using ultrasound guidance, and an epidural catheter was placed successfully on the second attempt with negative aspiration. The patient first reported neck pain during epidural placement that continued throughout her peripartum course. Her remaining labor was uneventful and she had a vaginal delivery of a vigorous neonate on induction day two. On post-partum day (PPD) 1, the patient endorsed neck pain and a non-positional headache. Postdural puncture headache was not diagnosed and she was not offered an epidural blood patch (EBP). She was discharged on PPD 2.

She was re-admitted on PPD 5 with post-partum headache. Her headache remained non-positional, but tinnitus was noted to be worse when sitting up. She also endorsed blurry vision. She was evaluated by both anesthesiology and neurology teams. An MRI showed marked intracranial hypotension including bilateral subdural effusions and a 6 mm cerebellar tonsillar herniation. There was no evidence of venous thrombosis. The neuroradiology team was consulted for the placement of an urgent EBP. While awaiting this intervention, the patient developed a tonic-clonic seizure and her trachea was intubated for airway protection. An emergent CT demonstrated findings consistent with earlier MRI findings. An EBP was placed that evening using 20mL of autologous blood. An EEG overnight uncovered temporal seizure activity spreading to both hemispheres. The patient was extubated the following morning, and a follow-up EEG demonstrated no seizure activity though she continued to report headache that improved when the head of her bed was lowered. On PPD 7, persistent SVT in conjunction with hypoxia prompted a CT chest that demonstrated pulmonary embolism and therapeutic enoxaparin was started. She was transitioned to unfractionated heparin and a second EBP using 20mL of autologous blood was performed by neuroradiology on PPD 10 for continued headache. She was discharged home on PPD 11 without headache, and has had no long-term sequelae.

Discussion: We report a case of seizure following intracranial hypotension caused by an unrecognized unintentional dural puncture. Prompt recognition and treatment with an EBP may prevent further seizure activity and neurological decompensation.

Abstract #: FCC-327

Retained....and ineffective....epidural catheter during labor

Presenting Author: Cathy Drexler M.D.
Presenting Author's Institution: Medical College of Wisconsin - Milwaukee, WI
Co-Author: Charles Penn M.D. - Medical College of Wisconsin

A 17 y/o healthy laboring primiparous patient was brought urgently to the operating room for unscheduled Cesarean delivery due to recurrent fetal heart rate decelerations. With continuous fetal monitoring and the patient in lateral decubitus position, a combined spinal-epidural was attempted. Upon loss of resistance, no CSF was obtained with the spinal needle, and the epidural catheter was advanced 5 cm into the epidural space. After negative test dose, the catheter was incrementally dosed with a total of 15 mL 2% lidocaine with epinephrine 1:200,000. At this point the fetal heart rate pattern returned to Category 1 and the obstetrician made the decision to allow labor to continue.

Thirty minutes after placement of the epidural, the patient reported profound numbness and weakness in the right leg, and continued to experience painful contractions. Testing with ice showed a dense sensory and motor block from T12 through sacral levels on the right and no appreciable block on the left. The catheter was withdrawn 2 cm and additional dosing with lidocaine failed to result in a bilateral block, so the decision was made to replace the epidural catheter.

However, the epidural catheter was not able to be withdrawn, despite repositioning the patient several times and having her flex and extend her back. Attempts at removal were abandoned when the catheter began to stretch and exhibit thinning of its diameter.

The anesthesia team rejected the idea of placing a second epidural catheter, even at another vertebral level, due to concerns about shearing with the Tuohy needle, or entanglement involving the retained catheter. As the labor had progressed to 8 cm cervical dilation, consideration was given to offering a single shot spinal. This option was discussed with the patient and her mother, who declined. A fentanyl PCA was initiated for control of labor pain, and the patient had an uneventful vaginal delivery.

The epidural catheter was able to be removed easily one hour after delivery, and a kink was noted 7-8 cm from the tip of the catheter. Given the failure to obtain CSF and the unilateral block, the catheter may have exited a foramen with a nerve root despite the lack of reported paresthesia. In this case, the kink may have been created by impingement near the facet joint.

Review of the literature reveals some suggestions for avoiding or managing retained catheter, but this case is unique in that it occurred prior to delivery.

Abstract #: FCC-353

Cerebrospinal Fluid Leak After Disconnection of an Intrathecal Catheter Adapter Placed After Inadvertent Dural Puncture

Presenting Author: John C. Markley MD, PhD
Presenting Author's Institution: Zuckerberg San Francisco General Hospital and Trauma Center / University of California San Francisco - San Francisco, CA
Co-Author: Erica M. Langnas MD, MPH - Zuckerberg San Francisco General Hospital and Trauma Center / University of California San Francisco
Julin F. Tang MD, MS - Zuckerberg San Francisco General Hospital and Trauma Center / University of California San Francisco
Maytinee Lilaonitkul MBBS - Zuckerberg San Francisco General Hospital and Trauma Center / University of California San Francisco

Introduction: There remains controversy regarding the efficacy of post-delivery intrathecal (IT) catheter retainment to reduce post-dural puncture headache (PDPH) risk. Furthermore, there are inherent risks of sustaining an IT catheter. We present a case of a complication of cerebrospinal fluid (CSF) leak resulting from a disconnection of the adapter from an IT catheter that was used for continuous spinal labor analgesia and maintained post-delivery to reduce PDPH risk.

Case: A 25 year-old gravida 1 para 0 at 38 weeks 3 days was admitted for induction of labor due to intrauterine growth restriction and non-reassuring fetal heart tracing. Pertinent medical history included a history of viral meningitis complicated by seizure three years prior. She was 149 cm tall, 52 kg in weight, and a physical exam and laboratory analyses were within normal limits.

Upon labor epidural request, an L3/L4 epidural was attempted (Arrow 17G Tuohy/Arrow 19G FlexTip Plus catheter) that resulted in an inadvertent dural puncture (IDP). An IT catheter was placed for labor analgesia, which was successfully accomplished through the bolus and continuous infusion of bupivacaine 0.25% isobaric without patient-controlled functionality. The neonate was delivered by normal spontaneous vaginal delivery 11 hours later. After delivery, the anesthesia service discontinued the infusion and left the IT catheter in place, capped off, to reduce PDPH risk. No knot was tied in the catheter.

Two hours post-partum, the patient complained of mild headache. Five hours post-partum, the patient complained of wet bed sheets. The nursing staff found the IT catheter leaking liquid from it. On inspection by the anesthesia service, the catheter tip was open to air and the Arrow SnapLock catheter syringe adapter could not be found. The catheter was removed. It could not be determined when the adapter had separated from the catheter. No attempt to quantify or analyze the liquid was made, but it was assumed to be CSF. The patient complained of postural headache, but exhibited no other concerning neurologic signs. No head imaging or neurology consultation was obtained. A diagnosis of PDPH was made and, after initially declining, she underwent uncomplicated epidural blood patch 24 h later with resolution of her headache.

Discussion: A recent meta-analysis of 13 studies (2 prospective, 11 retrospective) by Deng et al. showed an association of IT catheters with a reduced rate of PDPH compared to epidural catheters. Importantly, however, the two prospective studies included in the analysis did not show a significant difference. This case highlights the risks of leaving an IT catheter in place to prevent PDPH. Providers should maintain high level of caution and vigilance if using this controversial technique to reduce PDPH risk.

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Abstract #: FCC-410

Epidural anesthesia for postpartum tubal ligation and subsequent blood patch for a patient with postdural puncture headache

Presenting Author: Hsi Chiao MD PhD
Presenting Author's Institution: University of Texas Southwestern Medical Center at Dallas - Dallas, Texas
Co-Author: Robert S Ackerman MD - UTSW Medical Center at Dallas
Brenda K Anyaehie MD - UTSWMedical Center at Dallas
Hsi Chiao MD PhD - UTSW Medical Center at Dallas

Introduction: Postdural puncture headache (PDPH) is a major complication of neuraxial anesthesia that can occur with inadvertent dural puncture during epidural anesthesia. In addition to severe headache, patient may experience nausea, neck stiffness, and vision changes. A epidural blood patch (EBP) is considered the definitive treatment for severe PDPH with a success rate of 61-98% (1). A scheduled case, such as postpartum bilateral tubal ligation (BTL) would be cancelled if the patient has severe PDPH without the treatment. Our patients desire postpartum tubal ligations, however, an EBP prior to a BTL may delay the case or prolong their hospital stays. We discuss the successful treatment of PDPH with a post-operative EBP via an epidural catheter that was used for her postpartum BTL.

Case: A 31 years old female (G5P4A1) with severe positional headache and photophobia presented on postpartum day one from vaginal delivery for postpartum BTL. Patient had an inadvertent dural puncture during her epidural placement by a 17 gauge epidural needle two days ago. Her headache and photophobia occurred one day after the incident and did not have any improvement with hydration, caffeine beverages, and oral pain medications. Despite the suggestion to postpone her surgery by obstetric team, patient insisted to have the BTL at that time. Therefore plan was made to do an epidural anesthesia for her BTL and leave the epidural catheter in situ to perform EBP post operatively. An epidural catheter was placed one level below the site of dural puncture and was dosed with 20 ml 2% lidocaine to achieve surgical level for BTL. After surgery, the epidural catheter was left in situ and taped in aseptic fashion. After her epidural level was regressed, patient was assessed for PDPH again prior to EBP. Twenty milliliters autologous blood was drawn using strict aseptic fashion and slowly injected into epidural space through the epidural catheter. Patient had complete relief of her headache and photophobia and the end of EBP and discharged home as scheduled.

Conclusion: Accidental dural puncture can occur during labor epidural placement and cause PDPH. Although there are conservative treatments, EBP is proved to be the definitive treatment for PDPH. Studies have shown that prophylactic EBP did not decrease the need for therapeutic EBP (2) and several studies suggested increased successful rate if give EBP after 24 hours of dural puncture (3). Our anesthesia management for this patient has suggested that there is no need to cancel the postpartum BTL for patients with PDPH. The epidural anesthesia may serve not only for surgery, but also for EBP post-operatively. This will shorten patients' hospital stay and increase the satisfactions by patients and the obstetric team.

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Abstract #: FCC-488

Cluster of intravascular epidural catheters resulting in numerous near-misses including a patient with achondroplasia and atlantoaxial instability

Presenting Author: Ben S Shatil D.O., MPH
Presenting Author's Institution: Columbia University Medical Center - New York, NY
Co-Author: Elena Reitman MD - Columbia University Medical Center
Ruth Landau MD - Columbia University Medical Center

Background: Intravascular (IV) siting of epidural catheters is an insidious and potentially fatal complication during neuraxial labor analgesia.1 Catheter design has improved over time, with various options that impact analgesic spread, paresthesias, kinking, migration and intravascular cannulation.2 Catheter material plays a significant role with wire-reinforced nylon or polyurethane being the most commonly used, both with high melting points that withstand sterilization and body temperature;2 further features are blunt-tip multiport (closed end 3 eyes) or open-tip uniport. In a randomized control trial, the incidence of IV catheterization was 0% with the Arrow FlexTip Plus® Teleflex (open-tip, polyurethane) catheter vs 10.5% with the Duraflex® Portex (blunt-tip, multiport) catheter.2 Polyurethane catheters reduce IV epidural rate compared to nylon catheters from 4.5% to 0.5% (Table).1 Delayed recognition of IV cannulation is another patient safety issue that may occur with multiport catheters; the lateral holes may be sited in different compartments and the epidural injectate my provide analgesia while the distal hole(s) may be intravascular.2

We have experienced an unpreceded and unacceptable high number of IV epidural catheters in a clustered pattern over the last 9 months. We currently use the Portex/Smiths Medical Duraflex® (blunt-tip multiport) in a customized CSE kit. It has been suggested that fluctuating temperatures during shipment may change catheter stiffness, causing these accidental IV effractions, although other explanations have not been excluded. We present here one of the cases where a late recognition of an IV catheter resulted in a near-miss.

Case: 41 yo G6P1 54kg 122cm woman with achondroplasia, atlantoaxial instability, Mallampati 4 airway and large tongue presented for repeat cesarean delivery (CD); previous CD had been with low dose spinal bupivacaine 3.75mg, followed by immediate epidural lidocaine 2%.3 For this CD, a CSE with spinal hyperbaric bupivacaine 7.5mg and neuraxial opioids was provided. The epidural catheter was threaded with initial negative aspiration, however at skin closure, prior to injecting an epidural dose for breakthrough pain, aspiration of frank blood was noted. The possibility of a faulty catheter in such complex patient with challenging airway and short stature triggered a thorough investigation of these catheters.

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Table. Incidence of intravascular cannulation of epidural catheters

Catheter Type	IV Cannulation rate
Portex/Smiths Medical Duraflex® (nylon open-end uniport)	4.0 - 5.7%
Portex/Smiths Medical Duraflex® (nylon blunt-tip multiport)	5.7% - 10.5%
B. Braun® Perifix (nylon open-end uniport)	7.0%
B. Braun® Perifix (nylon blunt-tip multiport)	6.5%
Arrow® Flex Tip Teleflex (polyurethane open-tip uniport)*	0.0 - 0.67%

In bold, the catheter currently used in our institution
*also available in a blunt-tip multiport, but no study reporting on IV cannulation incidence
Data reported in Anesthesiology 2014;121:9-17.

Abstract #: FCC-503

Arachnoiditis after Inadvertent Dural Puncture and Epidural Blood Patch in a Parturient

Presenting Author: Courtney G Masear M.D.
Presenting Author's Institution: Johns Hopkins University School of Medicine - Baltimore, Maryland
Co-Author: Asif Padiyath M.D. - Johns Hopkins University School of Medicine
Steven D Beaudry D.O. - Johns Hopkins University School of Medicine

Arachnoiditis is a rare complication of epidural blood patch following accidental dural puncture with few case reports in the obstetric anesthesia literature(1,2).

A 36-year-old G7 P3123 at 39 weeks gestation presented for induction of labor in the setting of anticoagulation for a DVT diagnosed at 12 weeks. She was maintained on therapeutic enoxaparin until 36 weeks and then transitioned to unfractionated heparin. Coagulation studies were within normal limits at presentation. She initially declined labor epidural analgesia but then requested it at 7cm cervical dilation.

Skin was prepped with iodine povacrylex and isopropyl alcohol (Duraprep, 3M) and a 17 gauge Tuohy needle was advanced at the L3-4 interspace. Loss of resistance to air technique was used and inadvertent dural puncture was noted with freely flowing CSF. The needle was removed and reinserted with successful placement of the catheter. A test dose of preservative-free lidocaine with epinephrine was negative. Before an epidural loading dose could be given however, the patient was found to be fully dilated and had an immediate vaginal delivery. She was offered a prophylactic epidural blood patch (EBP) through the epidural catheter but she declined. On postpartum day 1, her symptoms were consistent with postdural puncture headache and EBP was performed using 20mL of sterile blood prior to resuming anticoagulation. No CSF was noted in the epidural needle nor did the patient endorse back pain during the procedure. Her headache symptoms resolved immediately and she was discharged the next day on enoxaparin.

The patient returned on postpartum day 6 complaining of severe low back pain that radiated to her posterior thighs and subjective leg weakness. Our differential diagnosis included lumbar strain, transient neurological symptoms, epidural hematoma, and abscess. Despite a grossly normal exam, lumbar MRI was performed showing focal crowding of the cauda equina nerve roots at the level of L3. A neurosurgical consult was obtained and a methylprednisolone taper was started, in addition to continuing ibuprofen and acetaminophen. Her symptoms primarily resolved within 14 days although 2 months later she endorses low back pain with bending and prolonged activity.

Arachnoiditis is a rare but serious complication of neuraxial anesthesia that may present similarly to neuraxial hematoma or abscess. In this case, it was likely secondary to intrathecal blood administration during EBP. Other causes include use of non-preservative free local anesthetic, nerve trauma, and chlorhexidine prep solution. While EBP is considered the gold standard for treatment of postdural puncture headache, alternative therapies such as intravenous cosyntropin or sphenopalatine ganglion block may be considered first due to their favorable safety profile in addition to standard oral analgesics.

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Abstract #: FCD-56

Using TEG to perform neuraxial anesthesia for cesarean delivery in the setting of pre eclampsia with severe features and thrombocytopenia

Presenting Author: Leslie Renfro MD
Presenting Author's Institution: University of Minnesota - Minneapolis, MN
Co-Author: Leslie Renfro MD - University of Minnesota
Ryan Childs DO - University of Minnesota
Lucas Deschenes MD - University of Minnesota

Our patient is a 41 year old Malaysian female who presented to the labor and delivery suite at 39 weeks gestation with premature rupture of membranes and on admission was diagnosed with preeclampsia with severe features. She has a medical history of refractory aplastic anemia with resultant severe thrombocytopenia. Her complete blood count on admission was significant for pancytopenia with a white blood cell count of 2.2 x10^9/L, hemoglobin of 9.7 g/dL, and platelets of 16 x10^9/L. Her admission chemistry profile was grossly within normal limits and her liver function tests were normal (ALT 10 U/L, AST 30 U/L). She was started on a magnesium infusion and labor was induced with oxytocin and misoprostol. She was given two units of platelets with goal of >20 x10^9/L for vaginal delivery, however due to failed induction of labor and uptrending liver function tests (ALT 16 U/L, AST 81 U/L) concerning for HELLP syndrome, the decision was made to proceed with a cesarean delivery. Her platelet count two hours prior to this decision was 18 and we utilized thromboelastography (TEG) to get a more complete picture of her coagulation profile. Her TEG result was completely within normal limits (figure 1) suggesting preserved hemostatic function despite her severe thrombocytopenia and preeclampsia with severe features. At this time, the patient was grossly edemetous with a MPIII airway. After discussion with the obstetric team and informed consent from the patient, we proceeded with spinal anesthesia. In the operating room, routine noninvasive monitoring was established. Her baseline blood pressure was 145/92 mmHg, heart rate was 92 beats per minute, and SpO2 was 99% on room air. EKG showed normal sinus rhythm. The patient was placed in a sitting position and 2mL lidocaine was used for local anesthesia at the L3-4 interspace. A 24-gauge pencan needle was inserted through the introducer. After clear cerebrospinal fluid was detected, and after aspiration was negative for heme, 1.6 mL 0.75% hyperbaric bupivacaine, 15 micrograms of fentanyl and 150 micrograms of morphine was injected into the intrathecal space with a bilateral T4 level. Her cesarean section was uneventful. Postoperatively she was given a transversus abdominal plane block. Over the following days, her magnesium infusion was titrated down and by postoperative day one her aplastic anemia began to improve. She was discharged to home with close follow up on postoperative day five.

Abstract #: FCD-183

Neuraxial Anesthesia for Cesarean Delivery in a Parturient With a Cerebral Cavernous Malformation

Presenting Author: Kelly L Au MD FRCPC
Presenting Author's Institution: BC Women›s Hospital, University of British Columbia - Vancouver, British Columbia
Co-Author: Simon Massey MBBCh MRCP FRCA FRCPC - BC Women›s Hospital, University of British Columbia
Roanne Preston MD FRCPC - BC Women's Hospital, University of British Columbia
Vit Gunka MD FRCPC - BC Women's Hospital, University of British Columbia
Anthony Chau MD FRCPC MMSc - BC Women's Hospital, University of British Columbia

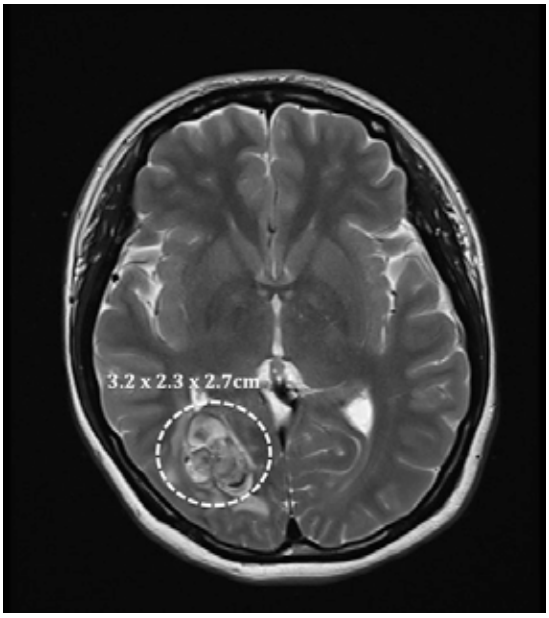
Introduction: Cerebral cavernous malformations (CCMs) are slow-flow, low-pressure vascular lesions devoid of smooth muscle and elastin that rupture at a rate of 1%/lesion/yr.[1] The paucity of literature on the anesthetic management of CCMs in pregnancy presents a dilemma for neuraxial anesthesia (NA) due to concerns for potential for spinal CMs and the poorly understood mechanism for hemorrhage.[2] We report the management of a parturient with CCM who underwent successful cesarean delivery (CD) under NA.

Case: A 31 yo G1P0 presented at 5 weeks gestation with sudden onset L-sided photopsia and hemianopsia. Imaging showed a R-occipital lobe intracranial bleed from a large CCM with additional small (<1cm) CCMs.(Fig) She was managed conservatively and was left with small residual visual deficits.

Given the low-pressure nature of CCMs, Neurosurgery felt route of delivery was the patient's choice; she opted for elective CD. We recommended a single-shot spinal (SSS) over general anesthesia (GA) in consultation with Neurosurgery given the benefits of NA and likely greater changes in ICP during laryngoscopy and extubation. Neuroradiology did not feel further neuraxial imaging would be useful as without contrast, small extramedullary CCMs would not be located, and the woman was clinically asymptomatic. Furthermore, Neurosurgery indicated that direct needle entry into an extradural CM would be expected to behave like an epidural venous bleed.

At 38 weeks gestation, ultrasound-guided SSS was performed with a 25G Whitacre needle at L3-4 level. Bilateral T5 block was achieved and BP was maintained with a phenylephrine infusion. She had an uneventful operation and healthy neonate. She had good post-operative analgesia with PO acetaminophen and hydromorphone. While not contraindicated, NSAIDs were avoided. Her thrombosis risk was low so prophylactic LMWH was not required.

Discussion: This case highlights the challenge in devising an anesthetic plan for a parturient with familial CCM. The risks of ICP changes and spinal involvement have led some reports to recommend neuraxial MRI and GA for patients with CCMs undergoing CD[2, 3]. We illustrate the importance to collaborate with Neurosurgery for risk stratification and that a small-gauge, SSS can be successfully performed and may better balance the risk-benefit profile over GA in a parturient with CCMs.



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Abstract #: FCD-208

Oh no, no fibrinogen: use of ROTEM to guide management of postpartum hemorrhage after vaginal delivery

Presenting Author: Billy Miguez Master of Science: Nurse Anesthesia
Presenting Author's Institution: New York Presbyterian Hospital: Weill Cornell - New York, NY
Co-Author: Jaime Aaronson MD - New York Presbyterian: Weill Cornell

Introduction: Postpartum hemorrhage (PPH) is the leading cause of maternal mortality worldwide. Strategies to prevent PPH are well studied. But, the use of systematic processes to manage PPH when it occurs is also needed to decrease maternal morbidity and mortality. We present a case of PPH where ROTEM – as part of an institutional PPH algorithm – was used to successfully guide transfusion management in a patient with disseminated intravascular coagulopathy (DIC) after vaginal delivery.

Case Report: The patient is a 40 year-old G5P4 who presented to Labor and Delivery with painful contractions. Approximately 9 hours after admission, the patient delivered a male neonate with APGARS 8,9. Immediately after delivery, lower uterine segment atony and heavy vaginal bleeding were noted. In addition to the usual oxytocin infusion, the patient received methylergonovine 200 mcg IM, while placement of an intrauterine balloon was attempted. Given ongoing bleeding, additional uterotonics were given, as well as tranexamic acid 1 gram. Early on, ROTEM revealed DIC (Figure 1). Based on the results of the ROTEM, transfusion of cryoprecipitate, in addition to red blood cells, was initiated. Despite seemingly adequate uterine tone, however, bleeding continued. The patient was brought to the interventional radiology suite, where she underwent successful embolization of her bilateral uterine arteries and continued resuscitation with the use of consecutive ROTEM evaluations to guide transfusion management. Laboratory values – resulted significantly after the initial ROTEM specimen – revealed an undetectable fibrinogen level. The rest of her hospital course was uneventful, and she was transferred to home on post-partum day #5.

Discussion: To best manage PPH, it is important to understand the mechanism whereby coagulopathy develops. Low fibrinogen levels, in particular, are associated with severe PPH. Algorithms to manage PPH and use of ROTEM can lead to early identification of hypofibrinogenemia. Importantly, ROTEM also allows for targeted correction of coagulopathy, as opposed to an empiric transfusion strategy, which may result in the need for fewer blood products during PPH.

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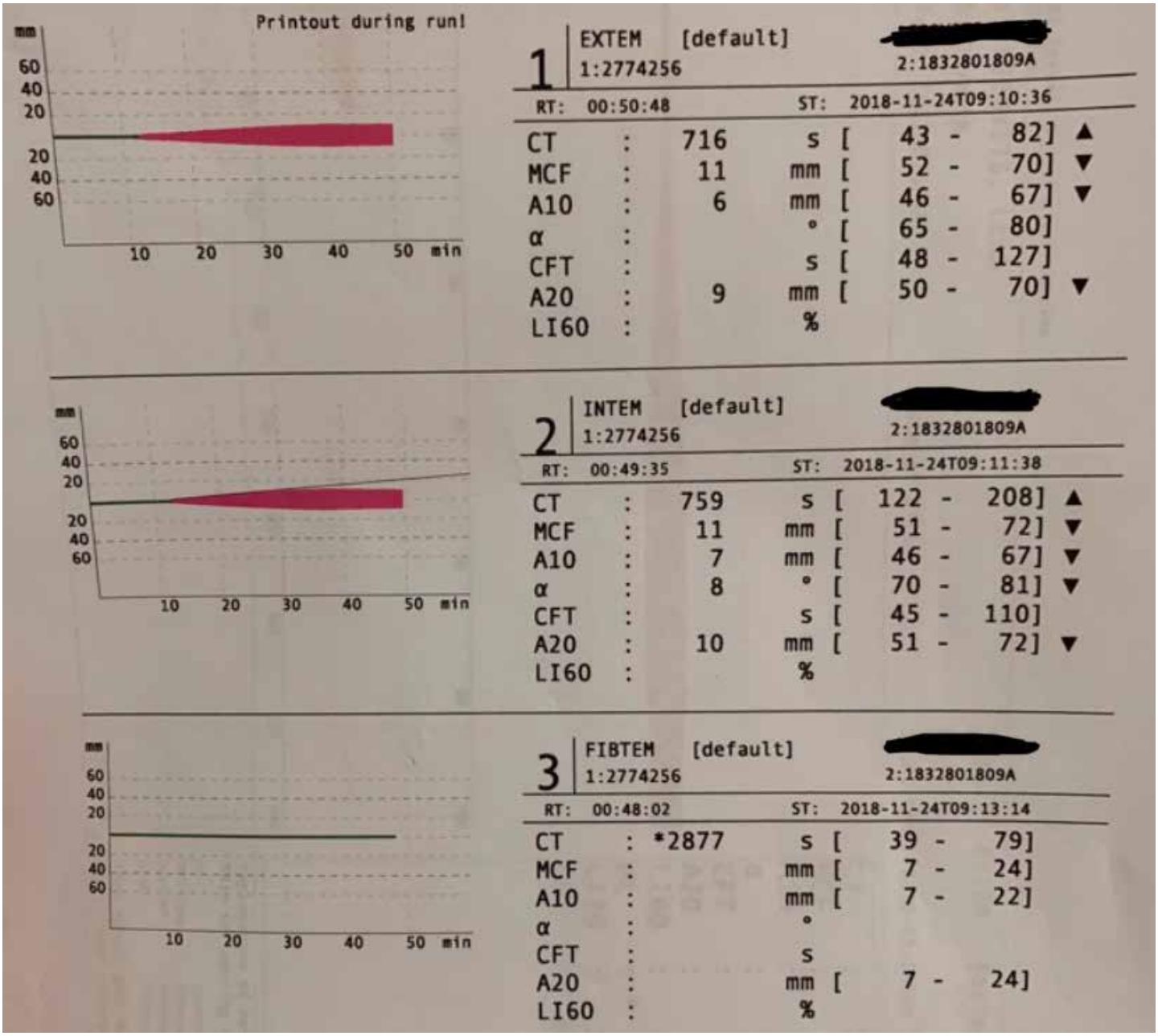
Abstract #: FCD-208



Abstract #:FCD-232

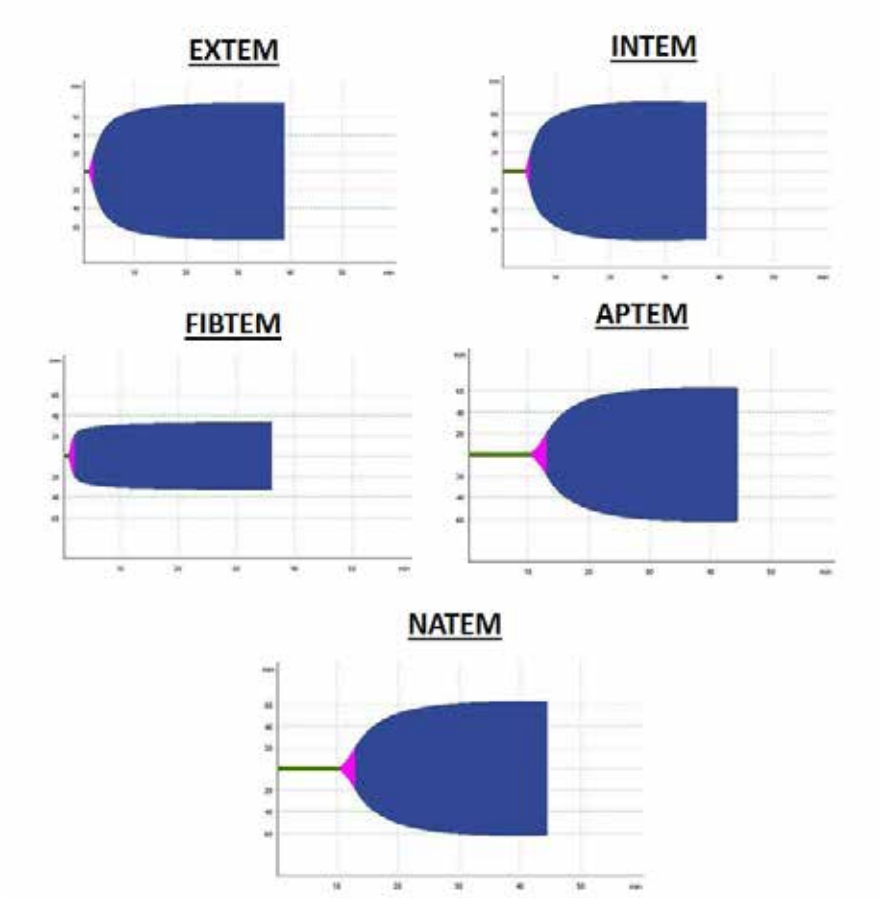
Epidural Anesthesia in a Parturient with Homozygous Factor XI Deficiency

Presenting Author: Ashley J Whisnant MD
Presenting Author's Institution: Icahn School of Medicine at Mount Sinai - New York City, NY
Co-Author: Yaakov Beilin MD - Icahn School of Medicine at Mount Sinai
Daniel Katz MD - Icahn School of Medicine at Mount Sinai

BACKGROUND: Factor XI Deficiency is a rare autosomal inherited bleeding disorder that is common in the Ashkenazi Jewish population with a prevalence of approximately 1 in 8 for heterozygosity and 1 in 190 for a homozygous gene mutation. With increases in antenatal genetic testing, more women are presenting to the labor floor with this diagnosis. Currently there is no clear consensus on the anesthetic management of these phenotypically diverse patients.

CASE: A 34 year old G3P1 with newly diagnosed homozygous Factor XI Deficiency presented to our labor floor at 39 weeks gestation for induction of labor. The patient was diagnosed after routine antenatal screening for IVF. She saw a hematologist and presented for an anesthesiology consult at 36 weeks gestation. The patient had a negative bleeding history despite 7 surgical challenges, including 3 prior NSVD with epidural analgesia, during which she never had increased bleeding or required a blood transfusion. Her Factor XI Levels were 6% and her aPTT was 42.2. Her ROTEM tracings were reassuring (see figure) and after discussion with the hematologist she was deemed a candidate for neuraxial anesthesia. She began oral tranexamic acid (TXA) the night prior to induction. A dural puncture epidural was performed at L4-L5 without complication. Approximately 5 hours later, the patient delivered via NSVD with a QBL of 156 and no complication from the epidural catheter. She was discharged home on postpartum day 2 and continued oral TXA for 5 days postpartum.

DISCUSSION: Unlike other coagulation disorders, the factor level in factor XI deficiency does not correlate with the risk of bleeding. Our patient had 3 prior NSVDs and 4 prior surgeries without increased bleeding demonstrating that phenotypically her disorder is not associated with bleeding. We therefore believed it was safe to administer epidural analgesia. This case highlights the need for a collaborative approach from hematology, anesthesiology and obstetrics to safely manage these complex, phenotypically diverse patients. By taking a thorough bleeding history and performing additional coagulation profiling, e.g., ROTEM, many of these patients can be safely managed with neuraxial anesthesia.



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Abstract #:FCD-247

Spinal anesthesia for cesarean delivery in a morbidly obese women with recent subarachnoid hemorrhage in the setting of early onset preeclampsia

Presenting Author: Danica Han MD
Presenting Author's Institution: Columbia University Medical Center - New York , NY
Co-Author: Harry Wanar MD - Columbia University Medical Center
Ruth Landau MD - Columbia University Medical Center

Background: Intracranial hemorrhage (ICH) in pregnancy is a rare but devastating event (7:100,000 deliveries) causing up to 12% of maternal deaths. Spontaneous subarachnoid hemorrhage (SAH) is more commonly associated with pre-existing aneurysms and neurovascular malformations,1 while spontaneous intracerebral hemorrhage (ICH) in obstetric patients is most often associated with hypertensive disorders.2 We present here the management of a women with SHA complicating early onset preeclampsia (EOP).

Case: A morbidly obese (BMI 48) 33-yo G2P0 at 28 weeks with persistent right temporal headache, generalized neck pain and rigidity, new onset high BP (160/80mmHg) was diagnosed with EOP with severe features; MgSO4, nifedipine/labetalol, and betamethasone were started. Cerebral MRI was requested which confirmed suspicion of SHA (Figure). Decision was to proceed with cesarean delivery with spinal anesthesia (increased ICP was deemed unlikely by neurologists based on presentation and imaging). With an arterial line for BP monitoring, spinal anesthesia (27G Whitacre) was provided with bupivacaine 0.75% 12mg, fentanyl 15 mcg, morphine 150 mcg. Other than heme-stained CSF (photo), spinal was unremarkable, with patient alert and oriented before and throughout delivery of a 1310g baby. Patient remained in the hospital until POD7 for neurological monitoring given high risk for recurrent intracranial bleed and/or vasospasm. BP was managed (goal SBP<140mmHg) on labetalol/nimodipine/verapamil. Daily transcranial doppler monitoring and repeat MRA were stable overall, and patient remained neurologically intact at time of discharge.

Discussion: There is little data to guide treatment of EOP complicated by ICH, but management remains control of hypertension, seizure prophylaxis, and expedited delivery. The deleterious effects of blood in the cranial vault only accentuates these issues. In the case of our patient, prompt treatment with labetalol, nifedipine, and MgSO4 appeared effective. The absence of mass effect and obstructive hydrocephalus has been shown to correlate with absent-to-minimal risk of herniation from dural puncture, in which case it is reasonable to proceed with neuraxial technique.3 In summary, we performed a spinal anesthetic in women with acute SAH in the setting of EOP in a morbidly obese women, with a spontaneous recovery and resolution of all predelivery symptoms.

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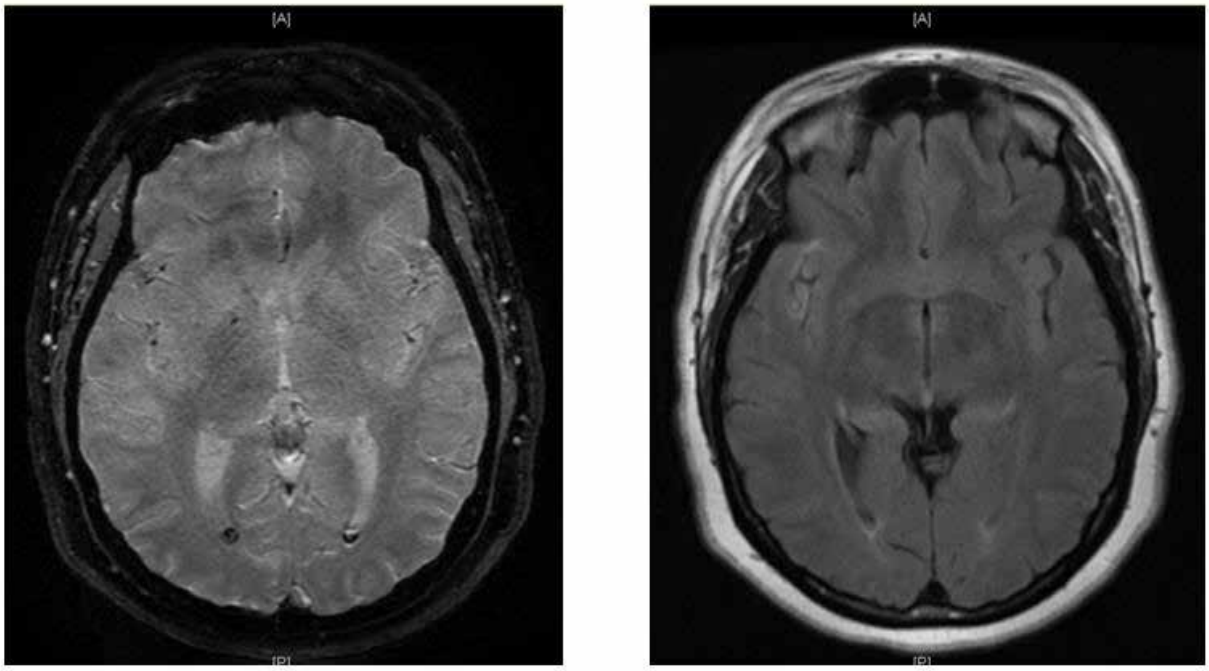
1. Neurology. 2006;67:424–9.
2. Obstet Med. 2009;2:142-8.
3. Anesthesiology 2013;119:703-18

Abstract #:FCD-247



Cerebral MRI: Blood in occipital horns of lateral ventricles bilaterally (left panel) and in right anterior insula (right panel)

Heme-stained CSF (during single shot spinal with 27G Whitacre needle)

Abstract #: FCD-288

Neuraxial Anesthesia for Cesarean Delivery in a Patient with Acquired Hypofibrinogenemia

Presenting Author: John C. Markley MD, PhD
Presenting Author's Institution: Zuckerberg San Francisco General Hospital and Trauma Center / University of California San Francisco - San Francisco, CA
Co-Author: Jared Brown MD - Zuckerberg San Francisco General Hospital and Trauma Center / University of California San Francisco
Sara Newmann MD - Zuckerberg San Francisco General Hospital and Trauma Center / University of California San Francisco
Stefan G. Simon MD - Zuckerberg San Francisco General Hospital and Trauma Center / University of California San Francisco

Introduction: Rotational thromboelastometry (ROTEM) can help diagnose, and guide resuscitation of, obstetric coagulopathy. Unlike for Prothrombin time (PT), Partial thromboplastin time (PTT), and platelets, there are few guidelines regarding fibrinogen level and safety of neuraxial anesthesia. We present a case in which ROTEM and fibrinogen concentrate helped guide anesthetic management of cesarean delivery (CD) in a patient with acquired hypofibrinogenemia due to placental abruption.

Case: A 28 year-old woman, gravida 4, para 3, at 30 weeks gestation with dichorioinic-diamniotic twins presented clinically with placental abruption: painful contractions and vaginal bleeding. She had a history of three prior uncomplicated CDs. Her contractions and bleeding stopped soon after admission. Laboratory analyses over the course of her admission were significant only for a decreasing serum fibrinogen level from 306 to 168 mg/dL. She had a consistently normal PT of ~14 s, PTT of ~26 s, and Platelet count of ~150 x 10^9/mL (Figure 1). She was diagnosed with an atypical coagulopathy characterized by hypofibrinogenemia that was thought to be on the spectrum of disseminated intravascular coagulation due to placental abruption.

On hospital day two the patient again started having painful contractions and cervical dilation. She was taken to the operating room for urgent CD. Due to her decreasing fibrinogen level, concern for epidural hematoma from neuraxial anesthesia was acknowledged; general anesthesia was considered. However, ROTEM analysis demonstrated a coagulation profile within normal limits, with a FIBTEM maximal clot firmness of 12 mm (normal 7-24 mm, Figure 2). With these data, combined with the availability of fibrinogen concentrate, the benefits of spinal anesthesia were thought to outweigh the risk of epidural hematoma.

After central access and radial artery access were obtained, the patient received a single shot spinal anesthetic as fibrinogen concentrate was administered. The surgery was complicated by post-partum hemorrhage due to atony that was treated with oxytocin, methylergonovine, misoprostol, tranexamic acid, fibrinogen concentrate, and red blood cell and fresh frozen plasma transfusion. The patient's recovery was uneventful and she demonstrated no signs and symptoms of epidural hematoma.

Conclusion: The availability of ROTEM and fibrinogen concentrate may help guide anesthetic planning in patients with acquire hypofibrinogenemia.

Abstract #: FCD-288

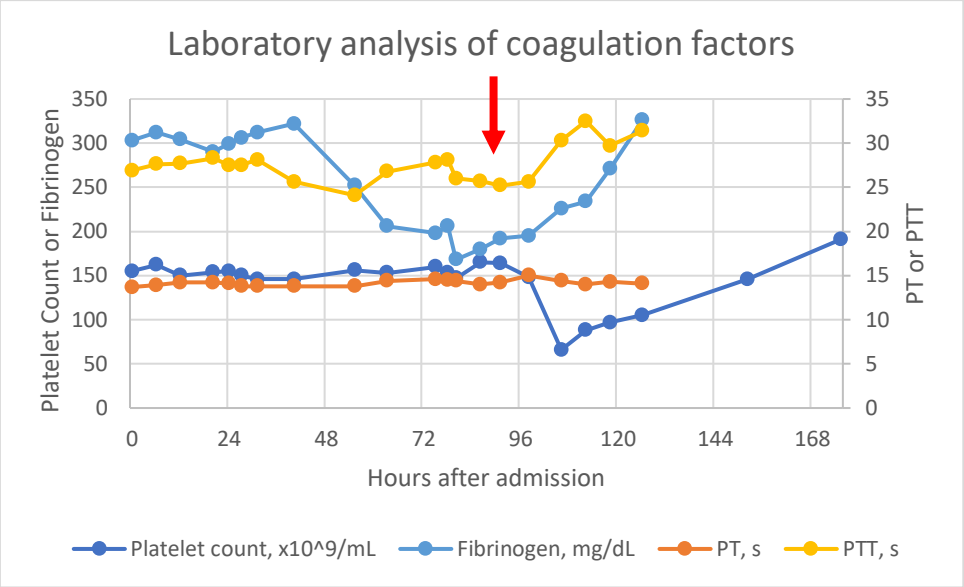


Figure 1: Laboratory analysis of coagulation factors. Red arrow denotes time of delivery.

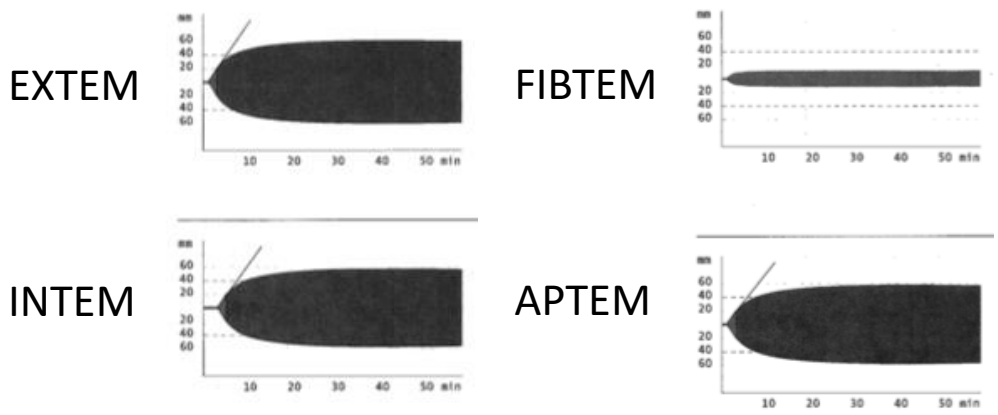


Figure 2: Preoperative ROTEM analysis demonstrating FIBTEM maximal clot firmness of 12 mm.

Abstract #: FCD-312

High Dose Unfractionated Heparin In an Antepartum Patient with a History of Thromboembolism

Presenting Author: John Kim, MD
Presenting Author's Institution: North Shore University Hospital - Manhasset, NY.
Co-Author: Gregory T Palleschi MD - North Shore University Hospital

Pregnancy is a hypercoaguable state. Frequently, antepartum patients receive thromboprophylaxis, particularly if presenting with a thrombophilia. We present a case of a multigravida who received high-dose subcutaneous heparin in the antepartum period and subsequently presented for urgent cesarean section.

This is a 32 year old gravida 3 para 1 with a twin gestation at 24 weeks. She is admitted to the hospital with a cervical dilation of 1-2 cm, but not in labor. Her past medical history is significant for the presence of a pulmonary embolus and a deep venous thrombosis approximately eleven years prior to admission. Treatment consisted of unfractionated heparin, followed by 6 months of warfarin therapy. One year later, she presented with lower extremity deep venous thrombosis complicated by pulmonary embolism. Six months of warfarin therapy was repeated. Testing for thrombophilia yieled negative results. Almost four years later the patient delivered a full term baby girl. During this pregnancy the patient was maintained on lovenox and transitioned to subcutaneous heparin in the last weeks of gestation.

On admission, the patient was transitioned from LMWH to unfractionated subcutaneous heparin. A heparin infusion at a rate of 1600 units/hour, yielded a therapeutic aPTT. Conversion to twice daily subcutaneous dosing was based on this daily intravenous dose, and 19000 units SQ q12 hours was commenced upon termination of the infusion. Follow-up aPTT values were obtained. The q12 hour dose was adjusted to achieve a consistent aPTT value >50 seconds. The final dose of heparin needed to achieve this value was 23,000 units administered subcutaneously every twelve hours.

Approximately eight weeks after initiation of this therapy, the patient was transferred to the labor floor with non-painful contractions and a cervical dilation of 4-5 cm. She presented at 1800 hours and had received subcutaneous heparin, 23000 units at 10 am that morning. The aPTT was 71 seconds. Twin "B" was transverse and the cervix rapidly dilated to 8 cm. An uneventful general anesthetic was performed and cesarean section commenced. Protamine, 50 mg intravenously, was administered prior to incision. The blood loss was estimated at 600 cc and repeat aPTT the next morning was 32 seconds.

Patients are not infrequently anticoagulated on the antepartum floor. The guidelines governing the administration of LMWH and unfractionated heparin vis-a-vis neuraxial analgesia have recently been updated. This case involves the administration of high dose unfractionated heparin subcutaneously over a prolonged period. This differs from IV administration given that the prolongation of effect due to the reservoir of subcutaneous heparin is unknown. Acute reversal with protamine may lead to reheparinization later with the possibility of post-partum bleeding. Management of such patients presents challenges should intraoperative or postoperative bleeding occur.

Abstract #: FCD-378

Neuraxial anesthesia in a parturient with Idiopathic Intracranial Hypertension and a Lumboperitoneal shunt

Presenting Author: Heather D Craig MD
Presenting Author's Institution: Icahn School of Medicine at Mount Sinai - New York, NY
Co-Author: Yaakov Beilin MD - Icahn School of Medicine at Mount Sinai
Jeffrey Zahn MD - Icahn School of Medicine at Mount Sinai

Introduction: Idiopathic Intracranial Hypertension (IIH), or Pseudotumor Cerebri, is characterized by increased intracranial pressure of unknown etiology with no evidence of hydrocephalus or mass lesion. Symptoms include headache, papilledema, and transient vision loss. Lumboperitoneal (LP) shunts may be used to treat IIH in patients who are unresponsive to conservative management or those with rapidly progressive symptoms. There is controversy regarding the safety of neuraxial anesthesia in these patients. We present a case of neuraxial anesthesia for labor analgesia in a patient with IIH and an LP shunt.

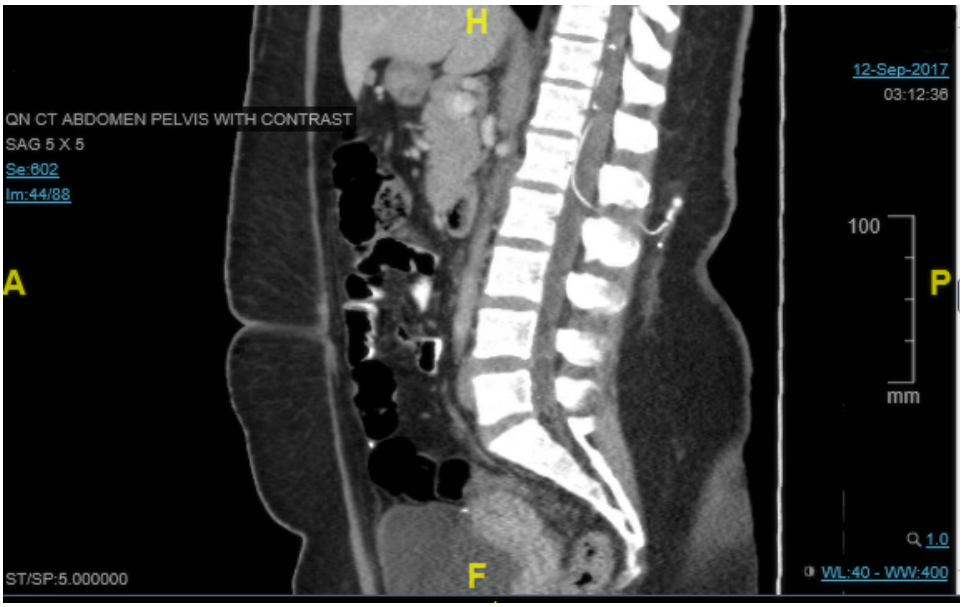
Case Report: A 30-yr-old G1P0 was admitted at 39 weeks and 2 days gestation in labor. Her history included IIH successfully treated 6 years before with placement of a LP shunt at the T11-T12 interspace. She was currently asymptomatic and denied any recent headaches or visual changes. On exam she had a vertical midline scar over her lumbar spine at approximately L1-L3 with a tunneled shunt palpated in the soft tissue to the right of her spine. A pre-pregnancy CT revealed the shunt exiting the epidural space at L1-L2 and tunneled to the right into the peritoneal cavity (Figure). A combined spinal-epidural was placed at the L3-L4 level which was well below the LP shunt. Her labor progressed uneventfully, and she delivered a healthy neonate nine hours later. Two hours after her delivery the epidural catheter was removed without complication.

Discussion: There are conflicting recommendations regarding the safety of neuraxial anesthesia in someone with an LP shunt. Concerns include potential damage to the LP shunt by the epidural or spinal needle, entanglement of the epidural catheter with the shunt, infection, and unpredictable block spread and duration due to local anesthetic wash-out into the peritoneal cavity through the shunt. After review of the CT, we were comfortable placing the epidural catheter below L1-L2, which was the exact location of the shunt. This case highlights that with proper imaging one can identify the location of the shunt and assure that the epidural catheter will not interfere with the shunt.

References:

Karmaniolou I, Petropoulos G, Theodoraki K. Management of idiopathic intracranial hypertension in parturients: anesthetic considerations. Can J Anesth 2011;58:650-7.

Bedard JM, Richardson MG, Wissler RN. Epidural anesthesia in a parturient with a lumboperitoneal shunt. Anesthesiology 1999; 90: 621-3.



Abstract #: FCD-532

Epidural Placement in the Super Morbidly Obese Parturient

Presenting Author: Elizabeth Devlin MD
Presenting Author's Institution: Brigham and Women›s Hospital - Boston , MA
Co-Author: Jie Zhou MD, MBA, MS, FASA - Brigham and Women›s Hospital

Introduction: More than half of parturients are overweight or obese (BMI >30), and 8% have morbid obesity (BMI>40). MO imparts higher risk for maternal, fetal, and neonatal complications. Anesthesia concerns include increased risk for difficult intubation, aspiration, failed neuraxial techniques, cesarean delivery, hemorrhage, and difficult IV access. Furthermore, MO comorbidities are frequently exacerbated in pregnancy, including diabetes mellitus (DM), obstructive sleep apnea (OSA), hypertension, heart disease, and venous thrombosis. The 2013 ACOG Committee Opinion on MO in pregnancy recommends anesthesia consultation in the third trimester for women with a BMI > 40 kg/m2. We present a novel maneuver for epidural placement in a patient with MO.

Case: A 27 yo G2P0 with a BMI of 83 was admitted with intrauterine fetal demise for anticipated vaginal delivery at 33w6d. The pregnancy was complicated by illicit drug use, OSA, and gestational DM. The patient requested epidural analgesia. She was placed in the sitting position with lumbar flexion and silk tape used to retract excess tissue toward the shoulders. Despite this, complete obscuration of the low lumbar skin entry point by redundant adipose tissue was noted. To improve access to the spine, two sterile silk tape rolls were placed paramedian to the spine (Figure). The epidural space was reached at 13 cm with a 17g, 17cm Gertie Marx needle, a 25g Gertie Marx spinal needle confirmed CSF, and an epidural catheter was threaded. The patient was positioned lateral before taping to avoid anchoring at the skin and catheter dislodgement. The procedure took 40 minutes. Delivery was complicated by dystocia requiring vacuum and forceps delivery then transfer to the OR for D&E of retained tissue. All required procedures were performed under effective epidural anesthesia.

Discussion: Neuraxial use can provide safety for conditions including shoulder dystocia, macrosomia, and cesarean delivery, all of which are more common with MO. However, epidural placement can be time consuming and technically challenging. Parturients with MO benefit from early counseling on the benefits of an early epidural in labor to enable adequate time and planning for personnel with the highest technical expertise.

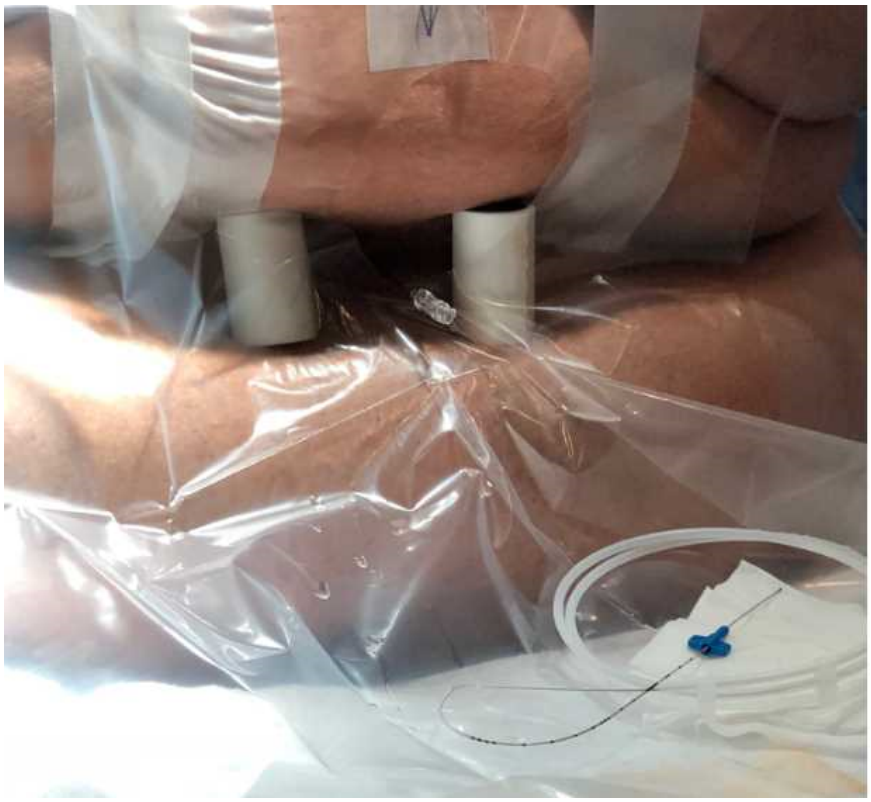


Figure: sterile tape rolls used as support pillars for adipose tissue in lumbar area

References:

Chestnut, 2015

Lamon, 2016

Soens, 2008

Abstract #: FCH-255

Autoimmune Hepatitis in Pregnancy

Presenting Author: Roneisha McLendon MD, MS
Presenting Author's Institution: Ochsner Health System - New Orleans, LA
Co-Author: Kirbie Broughton MD - Ochsner Health System
Adrienne P Ray MD - Ochsner Health System

Introduction: Autoimmune hepatitis (AIH) is a rare, inflammatory disease of the liver with unclear etiology, and more prevalent in women than in men. Disease control and immunosuppression allows for pregnancy to occur, but the exact course of disease progression during pregnancy is not well understood1. We present a case of AIH during pregnancy.

Case Presentation: A 20 yo G1P0 presented to consult clinic at 21 weeks EGA with a history of AIH complicated by cirrhosis, portal hypertension, thrombocytopenia (42 x 103/µl), grade 1 gastric varices (Fig. 1) and grade 2 esophageal varices. The patient was diagnosed via biopsy a year prior to pregnancy and was stable on azathioprine 100mg daily and prednisone 15mg daily with epistaxis and gingival bleeding being the primary complaints.

During the second trimester, an EGD showed stable gastric varices without bleeding, liver function tests mostly within normal limits (total bilirubin slightly elevated at 2.2mg/dL) and MELD score stable at 10 (range of 6-40, 40 being most severe). A multidisciplinary discussion was held and plans to deliver at the tertiary care center were made due to the risks of major liver decompensation, variceal bleeding, encephalopathy and worsening thrombocytopenia.

At 37 weeks EGA the patient had spontaneous rupture of membranes and was admitted for cesarean delivery. General anesthesia was induced followed by placement of arterial and central lines. There was 500ml estimated blood loss and she received one six-pack of platelets and a unit of FFP. A viable female infant was delivered and the patient was transferred to surgical ICU for post-operative care. Obstetrics and hepatology managed the patient and she remained stable throughout the five-day hospital course without any worsening of the thrombocytopenia and no signs of liver function decompensation.

Discussion: AIH has an incidence of 10-20 per 100 000 people. It was once thought women with AIH were unable to have successful pregnancies, but that has been disputed by recent reports of excellent control and continued therapy leading to lower risks of complications2. As in our patient, cirrhosis is usually the first presentation in almost half of AIH patients, which in parturients increases the risk of preeclampsia, preterm delivery, low birth weight and fetal demise. These patients have the best outcomes when a multidisciplinary approach is taken and good control of AIH is established prior to conception.

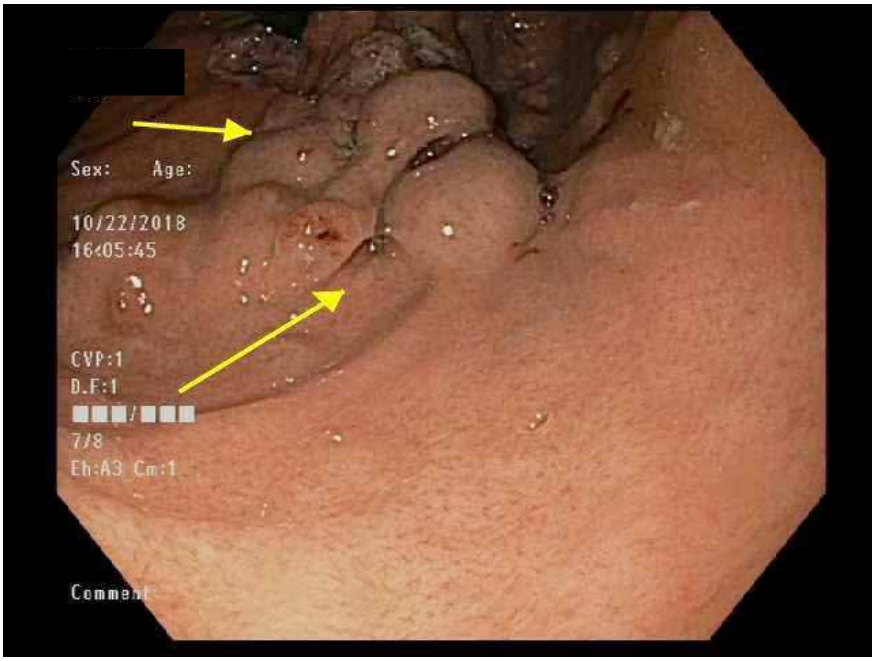


Figure 1 - Type 1 isolated gastric varices (IGV1, varices located in the fundus) with no bleeding were found in the gastric fundus. There were no stigmata of recent bleeding. They were medium in largest diameter.

References:

1. Orgul
2. Peters

Abstract #: FCH-304

Acute Liver Failure of Unclear Etiology in Pregnancy

Presenting Author: Vibha Mahendra MD
Presenting Author's Institution: Baylor College of Medicine - Houston, TX
Co-Author: Kelly West MD - BCM
Jose Rivers MD - BCM

Liver disease occurs in approximately 3% of pregnancies and while rare, acute liver failure during pregnancy is associated with a high mortality rate for both mother and fetus . This case report describes a twenty-seven year old parturient who developed acute and fulminant liver failure of unclear etiology at 27 weeks gestation.

Our patient was a 27 year old female, G4P0121 at gestational age 27 weeks, 2 days, with history of cervical insufficiency requiring cerclage placement at 20 weeks. She presented with five days of generalized malaise and chills, and was found to have a mild fever, tachycardia and transaminitis. Two days after beginning treatment for pyelonephritis, she developed high fevers and uterine fundal tenderness with cervical discharge. An uncomplicated urgent Cesarean delivery was performed under general anesthesia, for suspected chorioamnionitis. Despite delivery, her condition declined and she underwent a hysterectomy for source control, but pathology reports later indicated no evidence of infection in the uterus. Perioperatively, she developed hypotension requiring vasopressors and ICU admission, and evolved clinically from transaminitis and mild synthetic dysfunction to eventual DIC and encephalopathy. After a prolonged and complex ICU course, the patient was deemed to have irreversible and multifactorial acute liver failure, but due to immigration status was not a candidate for orthotopic liver transplantation. After 6 weeks, the patient expired due to multisystem organ failure.

The differential diagnosis for the patient's liver failure included AFLP, HELLP, toxin/medication induced injury and Hemophagocytic Lymphohistiocytosis (HLH) . AFLP occurs primarily during the third trimester, causing elevations in transaminases <5 times the upper limit of normal, and is distinguished from HELLP by the presence of hypoglycemia . The treatment for AFLP is immediate delivery, and the characteristic liver biopsy finding is fatty infiltration of hepatocytes. Our patient's liver biopsy showed large areas of necrosis with minimal inflammation (consistent with drug induced, ischemia, HELLP, and viral etiology). The patient's prolonged exposure to hepatotoxic medications including meropenem and inhalational anesthetic agents likely intensified the underlying liver dysfunction and explain the biopsy findings.

While our patient had some characteristics of AFLP, HELLP and HLH, she did not perfectly meet any diagnosis or respond to treatment with IVIG or steroids. Exposure to hepatotoxins and periods of hypotension likely worsened her hepatic dysfunction and complicated the clinical and diagnostic picture. The complex nature of this case demonstrates the importance of early identification of liver dysfunction in pregnancy, avoidance of hepatotoxic medication exposure in at risk patients, and early initiation of supportive care.

Abstract #: FCH-338

Anesthetic management of a parturient with congenital hepatic fibrosis

Presenting Author: Antonio Gonzalez MD
Presenting Author's Institution: Yale School of Medicine - New Haven, CT
Co-Author: Victoria Chase MD - Yale School of Medicine
Aymen Alian MD - Yale School of Medicine

Congenital hepatic fibrosis (CHFib) is a rare disease of autosomal dominant inheritance with variable penetrance and expression, hence, diverse clinical presentations. The course of this disease leads to portal hypertension which is associated with increased risks of gastrointestinal hemorrhage, and impaired liver function.1

A 37-year-old G0 woman was incidentally diagnosed with congenital hepatic fibrosis, chronic portal vein stenosis/ hypertension, portal vein thrombosis, thrombocytopenia and esophageal varices. In addition, her known past medical history included Factor V Leiden heterozygosity and protein S deficiency. In pre-pregnancy consultation, she was recommended to have a splenectomy and to consider achieving parentage with a gestational carrier or adoption. She declined splenectomy and conceived spontaneously. Antenatally, she received multidisciplinary care with maternal-fetal medicine, gastroenterology, hematology and anesthesiology. Portal hypertension was treated with carvedilol, and portal vein thrombosis, Factor V Leiden heterozygosity and protein S deficiency with enoxaparin. At 36 weeks, she was transitioned to unfractionated heparin 15,000 units twice daily. At 38 weeks, she was admitted for fetal growth restriction with abnormal umbilical artery Doppler. The obstetric plan was to commence induction and to perform an assisted second stage of delivery to minimize the impact of Valsalva on portal pressure.

The patient coagulation profile is summarized in table 1. Heparin was discontinued for 24 h, and given a normal coagulation profile and ROTEM, an epidural was deemed safe. An epidural was performed at the L3-L4 level. The patient tolerated the procedure well. During the second stage, a forceps-assisted vaginal delivery of a 2185 g female infant was performed. Postpartum, enoxaparin 40 mg daily was resumed. Her post-partum period was uneventful and was discharged home on postpartum day 3.

When caring for a parturient with CHFib, it is important to consider that esophageal varices bleeding is more common during pregnancy given increased blood volume and inferior vena cava compression. Up to 50% of parturients with known portal hypertension may experience esophageal bleeding.2 Liver function should be closely monitored as it may impact the anesthetic plan. A multidisciplinary approach is imperative when caring for patients with CHfib.

References:

1. Int J Gynaecol Obstet 2005;88:142–3.
2. Liver Transpl 2008;14:1081–91.

Abstract #: FCH-338

Coagulation profile before admission				Coagulation profile during admission	
PT	13.0	12.4	10.4	10.9	11.3
PTT	26.3	25.9	27.7	26.3	26.3
INR	1.23	1.16	1.02	1.00	1.05

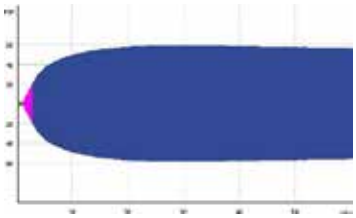
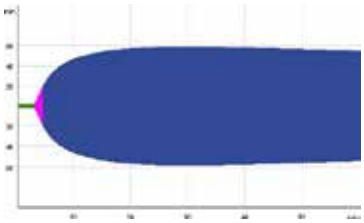
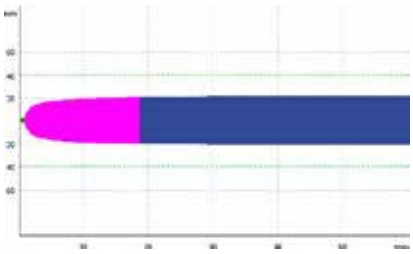
ROTEM during admission		
EXTEM		CT- 67 [43-82] CFT- 98 [48-127] A10 – 51[46-67
INTEM		CT- 181 [122-208] CFT – 90 [45-110] A10- 51 [46-67]
FIBTEM		CT- 50 [39-79] A10- 19 [7-22]

Table 1. PT-Prothrombin Time; PTT-Partial Thromboplastin Time; INR- International normalized ratio. Extem- Extrinsic pathway activation; Intem- intrinsic pathway activation; Fibtem- Fibrin activity

Abstract #: FCH-345

Anesthetic management of a parturient with Emery-Dreifuss Muscular Dystrophy

Presenting Author: Antonio Gonzalez MD
Presenting Author's Institution: Yale School of Medicine - New Haven , CT
Co-Author: Roberto Calix MD - Yale School of Medicine
Aymen Alian MD - Yale School of medicine

Emery-Dreifuss muscular dystrophy (EDMD) is characterized by contractures of elbows and posterior cervical muscles limiting their range of motion, progressive muscle wasting and weakness. In addition, these patients are very susceptible to cardiac conduction defects and cardiomyopathy.1,2 Modes of inheritance can be either X-linked autosomal recessive or dominant. The prevalence of this muscular dystrophy is unknown, but it is thought to be less than 1-2/100,000.1,2

A 31-year-old female, gravida 1 para 0, at 40 weeks gestation, with a past medical history of Emery-Dreifuss muscular dystrophy (EDMD) and paroxysmal atrial fibrillation, was admitted in labor to our hospital. Her past surgical history revealed an Achilles tendon lengthening without any anesthetic complication. Her family history was significant for arrhythmia and cardiomyopathy in her father, brother and sister. All her aforementioned relatives had automatic implantable cardioverter-defibrillator (AICD) in place secondary to this. The patient's echocardiogram performed during this pregnancy revealed normal left and right ventricular size and function, with an estimated ejection fraction of 64%. Her paroxysmal atrial fibrillation was asymptomatic and managed only with aspirin as rate control medication was not deemed necessary. Otherwise, this patient's prenatal course had been relatively uncomplicated.

An early labor epidural at the L3-L4 level was performed in order to minimize catecholamine surge associated with labor pain. After confirming negative intrathecal or intravascular placement, 8 ml of bupivacaine 0.25% was administered over a 10-minute period and a bupivacaine 0.125%- 8ml/h infusion started. The patient tolerated procedure well. As per cardiology recommendation, the patient was on continuous telemetry throughout the peripartum period, and a transcutaneous pacemaker/defibrillator was immediately available given her risk of peripartum arrhythmias. Her intrapartum and postpartum course were uncomplicated, and she was discharged home 3 days after delivery.

There seems to be paucity of literature regarding the anesthetic management of patients with EDMD, despite the challenges this disease poses to anesthesiologists. AICD's are frequently placed for patients with this dystrophy. Hence, the physiologic changes of pregnancy, the risk of cardiomyopathy and AICD precautions should be kept in mind when caring for patients with EDMD. Neuraxial analgesia/anesthesia, when possible, avoids the potential challenges of difficult intubation secondary to limited neck range of motion and an unknown, yet rare, susceptibility to malignant hyperthermia.1,2 A multidisciplinary approach is recommended when caring for a pregnant patient with EDMD.

References:

1. Rev Esp Anestesiol Reanim 1996;43:288–90.
2. Anaesth Intensive Care 2010;38:744–7.

Abstract #: FCH-408

Acute Liver Failure in Pregnancy

Presenting Author: Katherine M Seligman MD
Presenting Author's Institution: University of New Mexico - Albuquerque, New Mexico
Co-Author: Boyd Goodwin MD - University of New Mexico
Kirill Gelfenbeyn DO - University of New Mexico

Background: Acute liver failure (ALF) is defined as acute liver injury, elevated PT/INR, and encephalopathy in previously healthy individuals. It affects 2000 adults yearly in the US. We present the case of fulminant liver failure and multisystem organ failure in an obstetric patient during 2nd trimester.

Case: A 24 G2P1 with IUP at 22 weeks was transferred to a tertiary care facility with transaminitis, pancytopenia, and renal failure. Patient had 1 week history of nausea, vomiting and was seen by her PCP and diagnosed with a viral illness. 2 days prior to transport, she was treated for presumed severe urosepsis at an outside hospital. At the time of transfer, she was in acute renal and liver failure of unknown etiology. DDX of liver failure included sepsis, HELLP, Acute fatty liver of pregnancy, toxic ingestions (mushroom vs. acetaminophen) or other. Admission labs showed AST 7317, ALT 1752, INR 3.25. The patient was started on IV piperacillin/tazobactam, norepinephrine, and fluid replacement. Invasive lines included a PICC and a-line. Fetal demise was diagnosed and the decision was made to proceed to OR for D&E for fetal evacuation to possibly improve liver function if secondary to acute fatty liver of pregnancy.

Once in the OR, general anesthesia was induced, a central line was placed, and transfusion of platelets, FFP, and Cryoprecipitate was undertaken. Following the D&E, significant blood loss was reported, and massive transfusion was initiated. Patient required increasing vasopressor support including norepinephrine, epinephrine, vasopressin, and dobutamine. Systolic pressure could not be maintained above 60mmHg. The patient experienced flash pulmonary edema and > 1L of fluid was suctioned from lungs. Upon opening the distended abdomen, 3L of bloody ascitic fluid was suctioned out and the patient experienced cardiac arrest. After 2 rounds of CPR, there was a brief return of circulation and then PEA for > 20 rounds of CPR before the end of resuscitation and time of death. On autopsy, cause of death was determined to be sequela from acute liver failure secondary to herpes simplex virus (HSV).

Discussion: Fulminant HSV hepatitis is fatal in up to 80% of cases. Prompt diagnosis and treatment is required as well as early referral for liver transplantation. Pregnant and immune compromised individuals are at higher risk of acquiring this disease. HSV hepatitis should be suspected in patients with severely elevated serum transaminases and coagulopathy in the absence of jaundice. Mucocutaneous lesions or rash are only visible in 50% of the patients. Empiric Acyclovir should be initiated in patients with acute liver failure and no other source identified. HSV induced ALF is often unrecognized until autopsy. We recommend early consideration of HSV and treatment with Acyclovir in patients with ALF in pregnancy.

References:

1. Reuben et al. Ann Intern Med 2016;164:724-32.
2. Little et al. Hepatology 2019;69: 917-919

Abstract #: FCH-510

Spontaneous Adrenal Hemorrhage (SAH) and Preeclampsia: A Case Report

Presenting Author: Ibrahim Abushoshah MD
Presenting Author's Institution: Brigham and Women›s Hospital, Harvard Medical School - Boston, MA
Co-Author: Jie Zhou MD, MS, MBA, FASA - Brigham and Women›s Hospital, Harvard Medical School

Case: A 22-year old female G2P0010 at 36 weeks of gestation presented with a 24-hour history of left flank pain and nausea. The pain was sharp, stabbing, constant, and radiated to the left mid abdomen. She denied fever, chills, dysuria, hematuria, urinary frequency, or urgency. She underwent a CT scan at an outside hospital that was concerning for adrenal hemorrhage. She then developed severe range blood pressure and was found to have normal preeclampsia labs and negative urine spot. She underwent an MRI that confirmed left adrenal hemorrhage. No history of trauma or anticoagulation to explain hemorrhage. Subsequently, she was transferred to our hospital. Past medical history is noticeable for migraines, anxiety, and depression (not on medications). Past surgical history was significant for right laparoscopic oophorectomy for a large simple cyst. On admission, her heart rate was 92 and her blood pressure was 168/110 mmHg, despite 3 doses of IV anti-hypertensives. Her abdominal exam: soft, non-tender gravid abdomen. Labs were notable for WBC of 19 K/uL, Hematocrit (Hct) of 30.8 % and Spot Protein/Creatinine Ratio of 0.3 g/day. The rest of the lab work was not significant. The plan was made for conservative management and control her blood pressure. Serial Hct checks had been stable. She was diagnosed with preeclampsia with severe features due to severe range blood pressure despite receiving IV anti-hypertensives. The patient was offered an external cephalic version for fetal breech presentation, but she declined. The decision was made to proceed with cesarean delivery. A combined spinal-epidural was placed successfully. The patient tolerated the procedure well and was discharged 5 days later.

Discussion: Spontaneous adrenal hemorrhage is a rare condition in the general population. The incidence of SAH ranges from 0.14 to 1.1% in autopsy studies1 but its incidence during pregnancy is unknown2. The differential diagnosis for adrenal hemorrhage includes: infectious causes (Waterhouse-Friderichsen syndrome), bleeding secondary to a mass (such as pheochromocytoma), trauma and coagulopathy. The anesthetic considerations for this patient were: preeclampsia with sever features, hemodynamic instability after delivery (due to the loss of the tamponading effect of the gravid uterus), the inability to rule out adrenal tumor with vasoactive mediators and the risk for adrenal insufficiency.

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Abstract #: FCH-510

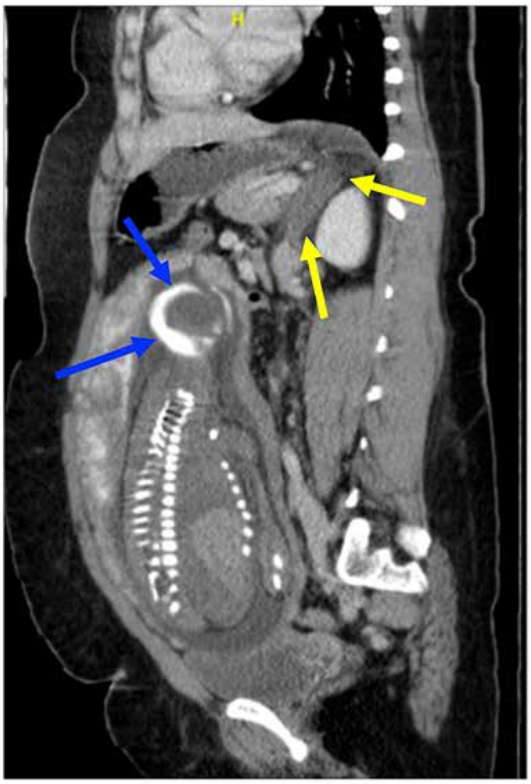

FIGURE 1: Sagittal abdominal CT scan with thickening and stranding (yellow arrows) surrounding the left adrenal gland consistent with adrenal hemorrhage. Fetal skull (blue arrows) showing the breech presentation.

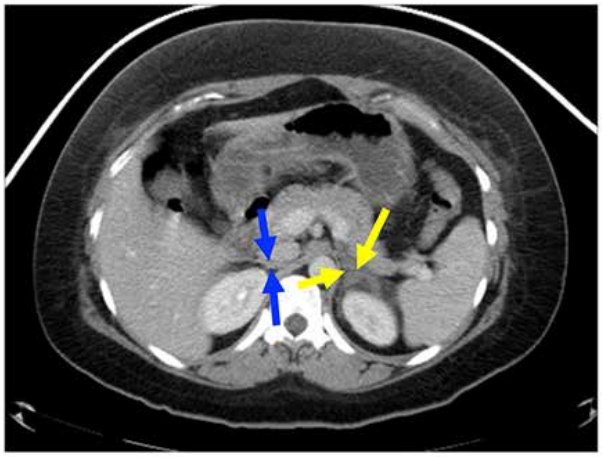

FIGURE 2: Cross-sectional abdominal CT scan with thickening and stranding (yellow arrows) surrounding the left adrenal gland consistent with adrenal hemorrhage. Normal right adrenal gland (blue arrows)

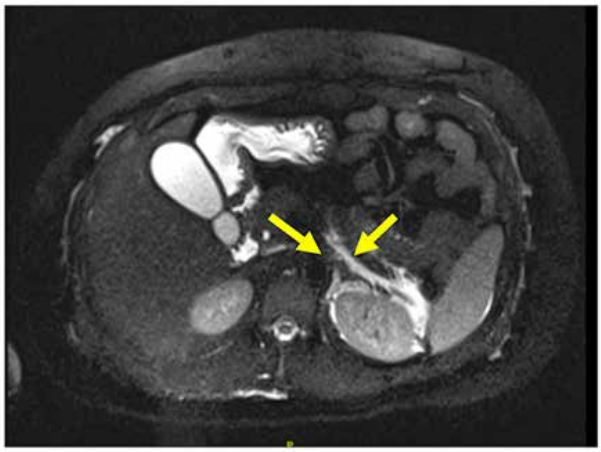

FIGURE 3: Cross-sectional abdominal T2 Fat suppressed MRI scan with stranding around the mildly enlarged left adrenal gland consistent with adrenal hemorrhage (yellow arrows)

Abstract #: FCH-544

Anesthetic Considerations for a Parturient with Enlarging Left Frontoparietal Mass Causing Worsening Midline Shift

Presenting Author: Amy W Willett M.D.
Presenting Author's Institution: Stanford University School of Medicine - Palo Alto, Caifornia
Co-Author: Jeremy Collins M.D. - Stanford University School of Medicine

Background: No randomized controlled trials exist to compare the safety of neuraxial versus general anesthesia in pregnant patients with intracranial lesions. Tumors such as meningiomas can be hormone responsive, thereby enlarging during pregnancy and further presenting challenges with regards to timing of intervention. We present a case report of suspected meningioma in a parturient with worsening clinical and radiologic evidence of tumor burden.

Case description: 38-year old woman presented at 19 weeks gestation with progressive vertigo and right hand clumsiness. A 5 x 5 x 4 cm left frontoparietal extra-axial mass was identified in the parasagittal region on non-enhanced MRI, most consistent with meningioma. After multidisciplinary collaboration, the initial plan was to proceed with term cesarean section and delay mass resection until 4 weeks postpartum. As pregnancy progressed, deteriorating neurological symptoms and associated new onset focal seizures required escalation of corticosteroid and antiepileptic therapy. Repeat MRI demonstrated increased effacement of the left lateral ventricle with progression of a left-to-right midline shift of 3mm.

At 37+4 weeks, a healthy boy was delivered by scheduled cesarean section under general anesthesia. Hemodynamic parameters were carefully controlled using invasive blood pressure measurement, while surrogate intraoperative ICP monitoring was done via ultrasound guided optic nerve sheath measurements. Bilateral Transversus Abdominis Plane blocks were performed in an effort to reduce postoperative opioid usage. Contrast MRI performed on postpartum day 3 showed significant enlargement of the mass, increased cerebral edema and worsening midline shift. She underwent expedited craniotomy and tumor resection on postpartum day 10 with a plan for continued adjuvant radiation therapy.

Conclusion: Enlarging intracranial pathology presents unique risks in the pregnant patient. We review the literature with regards to preferred timing of surgical resection and evaluate the risk of herniation when selecting an appropriate anesthetic technique.

Abstract #: FCH-547

Challenges in the Management of a Parturient with Takayasu Arteritis: a Case Report and Review of the Literature

Presenting Author: M. Waseem Athar MBBS, DESA, MCAI
Presenting Author's Institution: Stanford University School of Medicine - Stanford, CA
Co-Author: Amy W Willett MD - Stanford University School of Medicine
Neil S Kalariya MD - Stanford University School of Medicine
Pamela Dru Flood MD - Stanford University School of Medicine

Introduction: Takayasu arteritis (TA) is a vasculitis which primarily affects the aorta and its primary branches. Women are affected in 80 to 90 percent of cases, with an age of onset between 10 and 40 years. These patients are at high risk for preeclampsia, refractory hypertension, and miscarriages. Cesarean section is usually performed for obstetric reasons or uncontrolled blood pressures. Analgesic and anesthetic management of such parturient is a challenging task. We present a case report of a parturient with TA who posed unique clinical challenges due to refractory hypertension and pre-eclampsia in the setting of significant pathology affecting the carotid and subclavian arterial vasculature.

Case presentation: 35-year old female, G1P1001 with longstanding history of TA complicated by subclavian steal syndrome requiring left subclavian and carotid artery stent placement and two subsequent revascularization procedures. She was admitted at 36 weeks for refractory hypertension and blood pressure lability. Due to the presence of variable pulses, right carotid vascular narrowing and left carotid and subclavian artery neovascularization, blood pressures were monitored with a non-invasive blood pressure cuff on the right calf. Mean BP was same in both right sided extremities, but pulse pressure was wider on the lower extremity. She received labor epidural when she was in L&D and her BP was closely monitored. She stayed on that epidural for 12 hours and then due to constant pain despite multiple top-ups, it was re-sited with CSE technique. After 18 hours of labor, she was taken for Cesarean section which was done under epidural anesthesia top-ups with 2% lidocaine. An arterial line was placed in right radial artery for closed BP monitoring. Her postpartum course was complicated by uterine atony causing significant hemorrhage, as well as pre-eclampsia induced pulmonary edema requiring admission to the intensive care unit.

Discussion: Understanding the pathophysiology of TA and its extent is very important in the optimal anesthetic management of these patients. Closed communication between different teams and a proper plan of care should be in place both for elective and emergency scenarios. Goals should be set for optimal blood pressures.

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Abstract #: FCH-552

Levels of maternal care: timely transport and management for a parturient with severe heart failure

Presenting Author: Elizabeth Devlin MD
Presenting Author's Institution: Brigham and Women›s Hospital - Boston, MA
Co-Author: Elizabeth Devlin MD - Brigham and Women›s Hospital
Sharon Reale MD - Brigham and Women's Hospital
Jean Marie Carabuena MD - Brigham and Women's Hospital

Cardiovascular disease is a leading cause of maternal mortality. A system to classify and access centers that are prepared to provide specialized care is necessary to minimize maternal morbidity and mortality. Moreover, a system that defines how the care can be delivered is essential.

38-year-old G5P3 at 37wks was transferred to our institution with severe heart failure (HF). She had a history of HF after her 2nd child and was intermittently on vasodilator and diuretic before and after delivery of her third, all born at the high-risk (HR) maternal hospital near her home.

This current pregnancy was significant for a 2 wk history of worsening symptomatic HF. She was admitted to the cardiac care unit (CCU) in the same regional medical center for medical management. The HR maternity/neonatal area is near but not on the main campus. With an untested system for providing immediate obstetric coverage and delivery at one site (or escalation of cardiac services at the OB site), she was transferred to our regional center.

With worsening HF, she was admitted to our CCU, critically ill with an EF of 10%. With ongoing medical therapy a multidisciplinary delivery plan was made. Cesarean delivery (CD) took place in a cardiac hybrid operating room. Femoral cannulation was performed with access that would allow ECMO or Impella insertion if necessary. General anesthesia was induced. A transesophageal echo probe was placed. The CD proceeded uneventfully. Post-delivery diuresis and inotropic support were adequate to maintain perfusion, and femoral access was left in place on transfer to the ICU. She was extubated POD1, maintained on diuretic and vasodilator, and discharged POD8 with her baseline EF of 23%. All care took place in our regional center with all services on site.

This case highlights the importance of prenatal planning and counselling for women with high risk cardiac disease, and the pathway to escalation of care when necessary. Patients may have hesitance in transferring care distant from their base, but proper expectations must be set early for women with severe disease. Transfer of care to a facility with Level IV maternal care is essential (Table); however, consideration on how to deliver that care effectively is an important factor. Coordination with multiple specialists, nurses and operating room leaders is vital. Prompt multidisciplinary planning with in-house specialty teams was contributory to a good outcome.

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AmJOBGYN 2015;212(3):259-71

Abstract #: FCH-552

	Levels of Maternal Care Am J Obstet Gynecol. 2015 Mar;212(3):259-71
Birth Center	Peripartum care of low-risk women with uncomplicated singleton term pregnancies with a vertex presentation who are expected to have an uncomplicated birth
Level I (Basic Care)	Care of uncomplicated pregnancies with the ability to detect, stabilize, and initiate management of unanticipated maternal–fetal or neonatal problems that occur during the antepartum, intrapartum, or postpartum period until patient can be transferred to a facility at which specialty maternal care is available
Level II (Specialty Care)	Level I facility plus care of appropriate high-risk antepartum, intrapartum, or postpartum conditions, both directly admitted and transferred from another facility
Level III (Subspecialty Care)	Level II facility plus care of more complex maternal medical conditions, obstetric complications, and fetal conditions
Level IV (Regional Perinatal Health Care Centers)	Level III facility plus on-site medical and surgical care of the most complex maternal conditions and critically ill pregnant women and fetuses throughout antepartum, intrapartum, and postpartum care

Abstract #: FCI-97

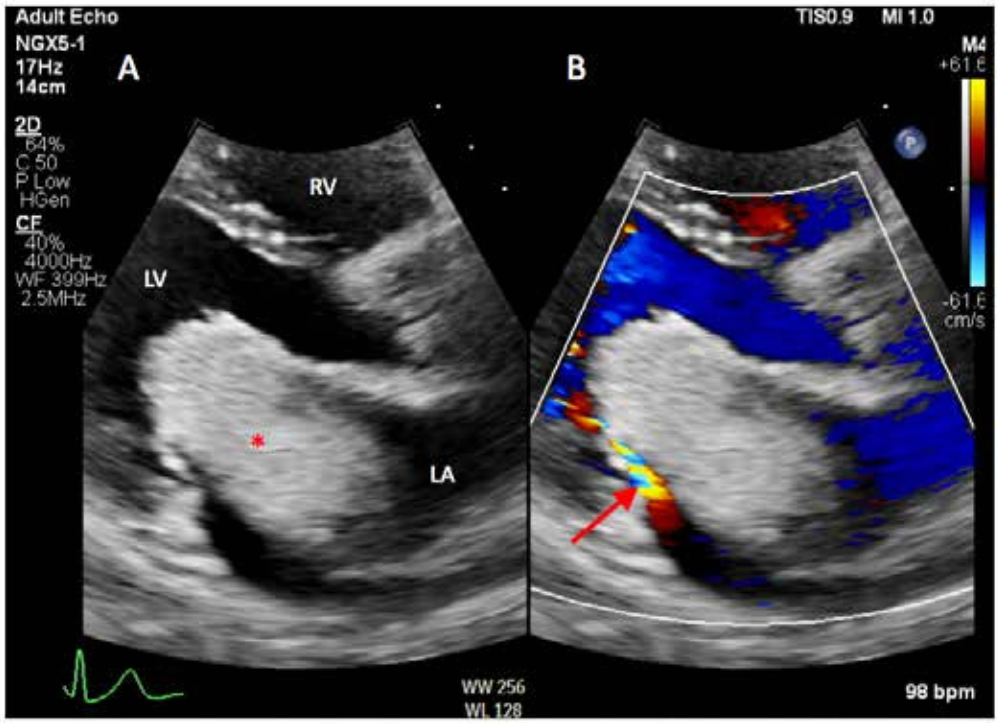
Anesthetic Management of Atrial Myxoma Resection in the Second Trimester

Presenting Author: David E Arnolds MD, PhD
Presenting Author's Institution: University of Chicago - Chicago, IL
Co-Author: Jennifer Banayan MD - University of Chicago

A healthy 23 year old G2P0 at 14 weeks of gestation presented with complaints of shortness of breath and dyspnea on exertion for 2 months. Transthoracic echocardiography demonstrated a 3 x 5 cm mass in the left atrium consistent with an atrial myxoma that prolapsed through the mitral valve resulting in functional mitral stenosis (Figure). Following a multidisciplinary meeting with cardiology, cardiothoracic surgery, maternal-fetal medicine, and anesthesia, surgical resection was recommended given that the increasing cardiac output associated with progression of pregnancy was likely to exacerbate the functional mitral stenosis associated with the patient's already symptomatic lesion.

The patient underwent surgical removal of the mass at 14w3d of gestation. Anesthesia was induced with propofol and sufentanil and maintained with isoflurane and a low dose propofol infusion. High pump flows were used with a cardiac index of 2.4 L/min/m2. Phenylephrine was used to maintain a mean arterial pressure ≥70 mm Hg and the patient's temperature was maintained ≥35 C. Given the gestational age, fetal heart tones were not monitored intraoperatively, but were monitored immediately postoperatively and daily during her admission. The patient was discharged on post-operative day 4 and was doing well at her most recent follow up appointment.

Cardiac surgery during pregnancy is rare and is thought to carry a significant risk to the fetus, with a fetal loss rate estimated at 33% and a 28% risk of preterm delivery (1). While data to guide anesthetic management of cardiac bypass is sparse, normothermia, high pump flow, and increased perfusion pressure (≥ 70 mm Hg) are recommended (2). Pulsatile flow may improve placental perfusion, and we considered utilization of an intraaortic balloon pump while on bypass to provide an element of pulsatility (3), but ultimately decided that the unproven benefits of pulsatile flow were outweighed by the potential maternal risks. Cardiac myxomas during pregnancy are rare with 51 cases reported (4), the majority of whom underwent surgical resection with favorable maternal and neonatal outcomes. While we do not yet have fetal outcomes for this case, it adds to the literature of favorable maternal outcomes following surgical resection of atrial myxoma during pregnancy.



Parasternal long axis transthoracic echocardiogram demonstrating an atrial intracardiac mass (*) prolapsing through the mitral valve (A). Color Doppler demonstrates flow acceleration (arrow) through the mitral valve consistent with functional mitral stenosis due to the mass (B). LA: left atrium, LV: left ventricle, RV: right ventricle.

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Abstract #:FCI-180

Dexmedetomidine for sedation during fetoscopic procedures under spinal anesthesia.

Presenting Author: Jennifer Guevara MD
Presenting Author's Institution: Clinica Universitaria Colombia - Bogotá D.C., Cundinamarca
Co-Author: Juan Carlos Bocanegra MD - Clínica Universitaria Colombia

BACKGROUND: Fetoscopy is a minimally invasive intervention that allows prenatal procedures with significant impact in fetal morbidity and mortality. Delivering anesthesia for these procedures is challenging and their requirements can be met by general, neuraxial, or monitored anesthesia care. So far, there is no consensus regarding the safest anesthesia management. There has been growing awareness of possible anesthesia-induced neurotoxicity from animal studies, but it is unknown whether these concerns are justified since evidence has failed to translate to human studies. Nevertheless, avoiding medications that might trigger deleterious neurological effects during the antenatal period is desirable. Dexmedetomidine is an α2-adrenoceptor agonist with sedative, analgesic, sympatholytic, anxiolytic and neuroprotective properties. It has been previously used in obstetric anesthesia with a degree of placental transfer of 0.68 and so far, no adverse effects on the neonate.

We present 2 cases where IV dexmedetomidine was used as an adjuvant for sedation during fetoscopic procedures under spinal anesthesia.

CASE DESCRIPTION: Two patients with monochorionic twin pregnancies who were diagnosed with Quintero stage III twin–twin transfusion syndrome (TTTS) underwent fetoscopic laser photocoagulation at 17(A) and 19(B) weeks of gestation. Written informed consent was obtained. Patients received a single shot spinal with 10mg hyperbaric bupivacaine+25mcg fentanyl. A co-load bolus of 500mL of ringer's and norepinephrine 0.05µg/k/m (titrated to 90% initial PAS) were given. Concomitantly, dexmedetomidine (0.05µg/k/h) and remifentanil (TCI 1ng/mL) were started. Supplemental oxygen was administered. Remifentanil was titrated to ≥2 score in the Observer Assessment of Alertness/Sedation Scale. Procedures were completed in 30(B) and 45(A) min with adequate fetal immobility and 100% surgeon satisfaction. Patient B had 3 episodes of respiratory rate <8 with no episodes of apnea >30sec or SpO2<90%. Same patient also had 2 episodes of HR <50 requiring atropine 0.4mg. No significant changes were detected at the end of the procedure in fetal heart rate compared to baseline. Patient satisfaction, pain, sedation and nausea were assessed upon arrival to PACU, 30min and 1h later. Patient A required to keep norepinephrine infusion at PACU for 40 minutes. No other complications were recorded until discharge. Patient A underwent emergency cesarean section for persistent TTTS and placental insufficiency at 29w, patient B is close to term with adequate fetal growth.

CONCLUSION: Intravenous dexmedetomidine has many desirable properties valuable for the obstetric anesthesiologist. Research is warranted to enlarge evidence on its use.

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3. 10.1177/0300060517698330

Abstract #: FCI-189

Anesthetic Management of Abdominal Hysterectomy for second trimester Cornual Ectopic Pregnancy in a Super Obese Woman

Presenting Author: Lesley M. Bautista MD FRCPC
Presenting Author's Institution: Dalhousie University - Halifax, Nova Scotia
Co-Author: Ronald B. George MD FRCPC - Dalhousie University
Christopher Nash MD FRCSC - Dalhousie University
David Rittenberg MD FRCSC - Dalhousie University

Ectopic pregnancies have been estimated to occur at a rate of 6-20 / 1000 pregnancies.(1,2) Cornual pregnancies are rare and comprise 2-3% of all ectopics.(3) Cornual pregnancies are rarely compatible with a viable fetus and are often diagnosed at the time of rupture. Therefore, these pregnancies are treated promptly in the first trimester with either methotrexate or surgery.

A 34 year-old G11P2 female with BMI of 53 kg/m2 was transferred to our tertiary care centre at 20 wks gestational age after having failed multiple doses of methotrexate for termination of a suspected cornual pregnancy. Repeat MRI and US imaging confirmed a viable 19 week cornual pregnancy encased in a thin layer (less than 3 mm) of myometrium/serosa. Past medical history was significant for asthma, smoking, type I diabetes, hypertension, hypothyroidism, and GERD. Due to the risk of rupture, decision was made to terminate the pregnancy via abdominal hysterectomy with vertical midline incision extending above the umbilicus. It was delayed until 21 + 6 weeks gestation as the patient had wanted to proceed with the pregnancy despite counselling regarding the risks of rupture, hemorrhage, fetal risks of methotrexate exposure, and maternal mortality.

After placement of an 18g peripheral catheter, rapid sequence induction was performed with midazolam, remifentanil, lidocaine, propofol, and succinylcholine in a semi-sitting position. An arterial line, 16g peripheral intravenous catheter, and 8.5 fr cordis sheath were placed. Cell salvage was available in the theatre. The patient had declined epidural analgesia. Within the peritoneal cavity, a small amount of free blood was noted and an omental adhesion to the uterus was present sealing off a small area of uterine dehiscence. The uterus appeared intact with a large bulging gestation sac covered by a thin layer of serosa/myometrium from the right cornual region. The pregnancy and uterus were removed en bloc without complication. Intraoperatively analgesia consisted of ketamine, hydromorphone, and bilateral transversus abdominis plane (TAP) block at the end of the procedure. Estimated blood loss was 700 ml. The patient was extubated and transferred to PACU. On the ward she required SpO2 monitoring for suspected obstructive sleep apnea. She had an uneventful post-operative course.

Though this case proceeded smoothly, this patient was at high risk for rupture and life-threatening hemorrhage with the added challenge of her body habitus. In future cases, we would still prepare for massive hemorrhage. The case was also emotionally distressing for the patient as her fetus was still living prior to her hysterectomy.

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Abstract #: FCI-290

Opioid overdose and cardiorespiratory arrest in the postpartum period: a case report

Presenting Author: Natasha Clunies-Ross MBBS BSc FRCA
Presenting Author's Institution: BC Women›s Hospital, University of British Columbia - Vancouver, British Columbia
Co-Author: Jonathan Collins BA BM BCh MA (Oxon) FRCA - BC Women›s Hospital, University of British Columbia
Anthony Chau MD FRCPC MMSc - BC Women's Hospital, University of British Columbia

Introduction: The incidence of opioid use disorder (OUD) in pregnancy has quadrupled over the last two decades, matching that of the opioid epidemic in the general population.[1] In addition, maternal mortality reviews in the United States identify substance use as a major risk factor for pregnancy-associated death.[2] We describe a parturient with OUD during pregnancy who successfully detoxified but relapsed and overdosed leading to a cardiorespiratory arrest in the postpartum period.

Case: A 31-yo G7P5 parturient at 36+1 weeks presented to the obstetric unit for stabilization of OUD prior to delivery. Her polysubstance abuse history included heroin, crystal methamphetamine and alcohol. She required treatment for substance-induced psychosis with suicidal ideation and reported having abstained from substance use for the preceding 4 weeks. Stabilization medications included regular extended-release morphine sulphate, citalopram, quetiapine, and PRN loxapine and lorazepam.

At 38+5 weeks, she had a successful vacuum assisted delivery under epidural analgesia and standard programmed intermittent epidural bolus regimen for maintenance. She remained as an in-patient postpartum for further stabilization, weaning off opioids entirely. About 8 weeks later, she was found in a neighbouring patient's room apneic, pulseless, and with vomitus at the bedside. Chest compressions (CPR) and intramuscular naloxone 0.4mg from a 'naloxone kit' were immediately administered by the responding nurse. On arrival of the anesthesiology team, supraventricular tachycardia at a rate of 140 was noted on the monitor. A pulse was obtained at 6 minutes accompanied by gradual return of consciousness. No further medications were given. She was transferred to the high acuity unit where normal electrocardiogram and chest x-ray were attained. The toxicology screen was positive for fentanyl.

At this point, her parental custody was suspended, and the baby was apprehended by the Ministry of Children and Family Development, permitting supervised visits. She was discharged 16 days post-cardiorespiratory arrest to an addiction's recovery centre for ongoing treatment of OUD with the goals of abstinence and regaining custody of her child.

Discussion: Mothers with OUD are particularly vulnerable in the postpartum period and are at high risk of relapse, overdose and adverse outcomes.[3] The swift recognition of overdose, immediate institution of CPR and the readily available 'naloxone kits' were important factors in this successful resuscitation. Despite effective multidisciplinary stabilization of OUD, this case demonstrates that it may not be protective against relapse, highlighting the ongoing responsibility anesthesiologists have in managing mothers with OUD throughout the peripartum period.

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3. Schiff DM, Obstet Gynecol. 2018

Abstract #: FCI-299

Perioperative Management of Surgical Thrombectomy for Right Heart Thrombus and Pulmonary Emboli during 1st Trimester of Pregnancy

Presenting Author: Jon M Christensen MD
Presenting Author's Institution: Mayo Clinic - Rochester , Minnesota
Co-Author: Marissa L Kauss MD - Mayo Clinic

Introduction: Pulmonary embolism is the leading cause of maternal death in the developed world1. In cases of hemodynamic compromise treatment consists of systemic thrombolytic therapy, catheter-directed therapies, or surgical thrombectomy2. Surgical thrombectomy requires cardiopulmonary bypass (CPB) which poses significant risks to both the mother and fetus3. We present a patient within the first trimester requiring surgical thrombectomy for significant right heart thrombus burden including pulmonary emboli and atrial thrombus in transit.

Case Presentation: 30 year old G3P2 presented with chest pain and dyspnea. Lower extremity ultrasound (US) revealed deep vein thrombosis. Transthoracic echocardiogram revealed a thrombus extending from inferior vena cava across the tricuspid valve into the right ventricular outflow tract and also a thrombus in transit across the fossa ovalis. Right ventricular (RV) function was severely reduced. Pregnancy screening was positive and US estimated gestational age (GA) at 5 weeks. Due to the large thrombus in transit and significant thrombus burden, the patient was offered emergent surgical thrombectomy and PFO closure.

General anesthesia was induced with stable hemodynamics. Transesophageal echocardiography (TEE) confirmed a large right atrial thrombus and thrombus in transit. During CPB cannulation RV function worsened and required escalating doses of epinephrine. CPB was maintained with non-pulsatile flows of 2.4 L/min/m2and mean arterial pressures over 70 mmHg. Surgically, thrombus was removed from the right atrium, foramen ovalis, pulmonary bifurcation, and the PFO was closed. The patient separated from bypass and hemodynamics remained stable with improved RV function. She had an uneventful recovery. Her B-hCG trended up only minimally however US revealed reassuring fetal heart tones. She was discharged on enoxaparin anticoagulation. Most recently she had reassuring fetal heart tones at 26 4/7 weeks gestation.

Discussion: Cardiac surgery and CPB during pregnancy pose significant risks to both the mother and fetus. Recent data reported maternal mortality of 11% which is greater than previously published. In addition, fetal mortality is estimated at 33% with higher risks in the first trimester3. CPB strategies to minimize fetal risks include using normothermic CPB, minimizing CPB times, maintaining high flow rates (2.4 L/min/m2), and mean arterial pressures greater than 70 mmHg4. This presentation will further describe this patient's perioperative management, TEE findings, and recommendations for the parturient undergoing cardiac surgery requiring cardiopulmonary bypass.

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Abstract #: FCI-461

The parturient with severe sickle cell disease and red blood cell alloimmunization

Presenting Author: Yahui Tammy Symons MD FRCPC
Presenting Author's Institution: Schulich Medicine & Dentistry, Western University - London, Ontario
Co-Author: Magdalena Terlecki MD - Western University
Ian McConachie MB, ChB, FRCA, FRCPC - Western University
Indu Singh MD, FRCPC - Western University

Despite progress in treatment of sickle cell disease (SCD), pregnancy remains a high risk situation for both mother and fetus. There have been no published reports of the parturient with SCD with alloimmunization to red blood cell antigens, despite rates of red blood cell alloantibodies being 18-38% amongst SCD patients.1 We present a case of a parturient with a complicated history of SCD presenting with severe anemia and red blood cell alloimmunization requiring cesarean delivery (CD).

A 25 year old G2P0010 presented with homozygous SCD complicated by a history of multiple recurrent occlusive events including bone crises, acute chest syndrome, multi-organ infarcts, frontal lobe stroke, and bilateral internal carotid artery occlusions. Her pathology was further complicated by multiple alloantibodies from previous transfusions. A recent severe hemolytic reaction demonstrated presence of an additional unspecified antibody. She was admitted to hospital at 29 weeks 3 days gestation with hemoglobin (Hb) 53. She was difficult to crossmatch due to the alloimmunization. Given the scarcity of compatible blood and high risk of transfusion reaction, the decision was made to transfuse only if absolutely necessary. With supportive measures and darbepoietin, she had gradual return of Hb to baseline levels in the mid-80's.

An induction of labour was planned in hopes of avoiding an operative delivery. Given her SCD, intraoperative cell salvage was not an option. Crossmatched blood remained severely limited. At 36 weeks gestation her Hb dropped to 41 and her platelet count to 64. The decision was made to proceed to CD at this time due to severe fetal IUGR. She was given IVIG, methylprednisolone, and rituximab prior to preoperative transfusion of 1 unit packed red blood cells. In the operating room, standard CAS monitors were applied. General anesthesia was administered with rapid sequence induction. Arterial line and second large bore IV were obtained post induction. Hb on initial baseline gas was 60. Care was taken to avoid hypoxia, hypotension, hypothermia, and acidosis. A female infant was delivered uneventfully with Apgars 1 at 1 minute and 8 at 5 minutes. The uterus was initially noted to be atonic with uterine inversion during placenta removal. Carbetocin 100 mcg, tranexamic acid 1g and carboprost 250 mcg were administered with improvement of uterine tone. Total blood loss was 700 mL. She did not receive further transfusion intraoperatively. She had a planned admission to the intensive care unit, intubated and ventilated. Hb was 42 on postoperative day (POD) 1. Her postpartum course was complicated by an acute chest crisis, an episode of demand ischemia, and ongoing anemia requiring a second unit of PRBC transfusion. She was discharged home POD 15. This case highlights the complexities in managing the complex parturient with SCD and alloimmunization to red blood cell antibodies undergoing CD.

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Abstract #: FCI-465

Obstetric Anesthetic Considerations for a Pre-eclamptic Patient with Cardiomyopathy and Limb Girdle Muscular Dystrophy

Presenting Author: Jessica L Galey M.D.
Presenting Author's Institution: University of Maryland, School of Medicine - baltimore, MD
Co-Author: Bhavani Kodali MD - University of Maryland, School of Medicine
Shobana Bharadwaj MBBS - University of Maryland, School of Medicine

Case Presentation: A morbidly obese 23year old G1P0 at 38 weeks gestation was transferred from an outside facility for induction of labor for pre-eclampsia and with a newly diagnosed cardiomyopathy, and a known history of Limb Girdle Muscular Dystrophy (LGMD). The patient had not previously been diagnosed with cardiomyopathy. However prior to induction an echocardiogram was obtained due to the patient's history of LGMD because of high association with cardiomyopathy that revealed an ejection fraction of 20%. The patient had significant lower limb swelling that had been progressively increasing over a 2 week period causing increasing difficulty with ambulation. Given her elevated blood pressures and an elevated Urine protein/creatinine ratio of 0.34, the patient fulfilled the criteria of pre-eclampsia. A multidisciplinary approach involving maternal fetal medicine, anesthesiology, nursing and cardiology was convened.

Hospital Course: Because of higher propensity for sudden cardiac death in patients with cardiomyopathy related to LGMD, and associated elevated blood pressures due to pre-eclampsia, a pre-labor induction arterial line and right jugular central venous catheter were placed. Induction of labor was started with misoprostol and followed by Pitocin infusion. Early neuraxial labor analgesia was initiated and continued with infusion of 8ml per hour of 0.08% bupivacaine with 2mcg/ml fentanyl. When her cervix was fully dilated, attempted vacuum for passive delivery failed and patent underwent cesarean delivery. The epidural was used to gradually bring surgical anesthesia level with 2% lidocaine with epinephrine. Healthy neonate was delivered and subsequent postpartum period was uneventful under careful monitoring and supervision. Postoperative analgesia was achieved with epidural morphine.

Discussion: There are several important considerations for a patient with cardiomyopathy at term complicated by pre-eclampsia and LGMD. LGMD is an inherited progressive weakness and wasting of limb, shoulder and hip girdle muscles with accompanying scoliosis and lordosis, arrhythmias, heart block and cardiomyopathy. These patients are at high risk for ongoing congestive heart failure, arrhythmias, and sudden death in the postpartum period. Postpartum patients are further susceptible to congestive heart failure as the intravascular volume remains elevated necessitating careful hemodynamic monitoring. Regional anesthesia is preferred approach. General anesthesia is avoided for several reasons. Succinylcholine and inhalational agents are avoided due to susceptibility to Malignant Hyperpyrexia. Laryngeal reflexes are decreased and gastric emptying time is prolonged. Patients are sensitive to respiratory depressant effects of sedatives. Magnesium therapy for preeclampsia and the use of non-depolarizing muscle relaxants may further complicate the recovery profile from general anesthesia.

Abstract #: FCI-466

Mother's Day Gift is a Heart Transplant…Obstetric and Anesthetic Considerations for a Patient with Severe Peripartum Cardiomyopathy

Presenting Author: Jessica Galey M.D.
Presenting Author's Institution: University of Maryland, School of Medicine - baltimore, MD
Co-Author: Bhavani Kodali MD - University of Maryland, School of Medicine
Shobana Bharadwaj MBBS - University of Maryland, School of Medicine

Case Presentation: A 31yr previously healthy nulliparous patient who presented at 38weeks gestation with shortness of breath was diagnosed with new onset of severe cardiomyopathy. The patient presented to an outside facility with 2 weeks of progressive shortness of breath and orthopnea requiring sleeping upright. She was found to have an ejection fraction of 10% and pulmonary edema and transferred to this facility. After multidisciplinary discussions regarding the patient's severity of symptoms and an unfavorable cervix for possible induction of labor, the patient was taken for cesarean delivery. An arterial line was placed and a low dose epinephrine infusion was started prior to induction for inotropic support. A rapid sequence induction and intubation was performed with etomidate and succinylcholine. Central venous access was obtained via the right internal jugular vein. A live male child was delivered. Following delivery the volatile anesthetic discontinued, and intravenous morphine and diazepam were administered and the patient was maintained on a low dose propofol infusion and 100% oxygen. Small intermittent boluses of Pitocin 3units IV at a time were given for management of uterine tone following delivery. The patient remained intubated and was taken directly to the Cardiac Care Unit for further management of her cardiomyopathy.

Hospital Course: The patient was extubated on the following day. However, she continued to require inotropic support and ultimately an intra-aortic balloon pump was placed. There was no improvement in ejection fraction and her course was complicated by a pulmonary embolism. LVAD as a bridge to heart transplant was not possible due to heparin inducted thrombocytopenia, therefore the patient was emergently listed for a heart transplant. The patient's hemodynamics continued to worsen requiring cannulation for VA ECMO on which she remained for many weeks while waiting for a heart transplant. She continued to have worsening pulmonary edema and underwent atrial septostomy for management of volume overload and apulsility. Two months after delivery, and the day after Mother's Day, the patient underwent orthotopic heart transplantation. Following the transplant the patient was weaned off inotropic support and her cardiac function showed a consistent ejection fraction of 55%. She was discharged 2 weeks following her transplant.

Discussion: This case highlights the complexities in the management of peripartum cardiomyopathy. Early referral to a level 4 center is recommended. A multidisciplinary approach should determine timing and mode of delivery, and strategizing management of expected postpartum complications that include heart failure and pulmonary embolism. This case also demonstrated the value of ECMO as a bridge to heart transplant. Although recovery of cardiomyopathy is expected after delivery, this case demonstrates that cardiac function can deteriorate and ECMO and heart transplant may be required.

Abstract #: FCI-507

Perioperative management of cauda equina syndrome in pregnancy.

Presenting Author: Neil Kalariya MD
Presenting Author's Institution: Stanford University School of Medicine - Stanford, CA
Co-Author: Giillian Abir MBChB, FRCA - Stanford University School of Medicine

Cauda equina syndrome is a rare condition associated with lower extremity weakness and sensory deficits. It is caused by external compression of the cauda equina, which is a bundle of spinal nerves extending from the conus medullaris at L1. Here we describe a case of CES in late pregnancy requiring urgent intervention

A 37 year old female G5P2112 at 32w3d transferred higher acuity care for chronic hypertension with superimposed preeclampsia, undifferentiated breast mass, and L3 compression fracture resulting in cauda equina syndrome.

The patient has a history of 2 cm x 2 cm left breast mass found approximately 5 months prior to presentation that was initially being followed by serial ultrasounds. Due to the pregnancy and difficulty keeping appointments, she did not follow up as directed.

Then approximately 3 weeks prior to presentation the patient had a fall down two stairs and since then has had worsening back pain and bilateral lower extremity weakness. She eventually went to the emergency room and was found to have severe range blood pressures with elevated AST and ALT on labs.

On initial imaging of her lumbar spine she was found to have likely metastatic disease at T12 and L3. She was found to have an L3 pathological burst fracture with retropulsion causing complete effacement of the canal. On exam she had fecal incontinence, LLE global weakness, and absent bilateral plantar and Achilles reflexes.

After multidisciplinary planning, she underwent cesarean for delivery under general anesthesia followed by emergent spinal cord decompression.

Cauda Equina Syndrome

Two clinical categories:
1. Cauda equina with retention: presents with urinary retention
2. Incomplete cauda equina syndrome: reduced urinary sensation, loss of desire to void, but no overflow incontinence or urinary retention

Presentation and diagnosis:
- Can have acute onset, progression from chronic back pain or insidious onset
- Clinical diagnosis and must include bladder, bowel, or sexual dysfunction and "saddle" anesthesia
- Can also include lower extremity weakness or sensory changes, reduction in lower extremity reflexes, and have a unilateral or bilateral distribution.
- Typically CT or MRI are used to confirm cauda equina compression
- Treatment
- Surgical decompression is indicated when a reversible cause is identified
- Patient with incomplete CES may have better improved outcomes after surgery
- Considerations in pregnancy
- Diagnosis: Can be difficult as some clinical symptoms are normal in pregnancy
- Positioning: surgical decompression often is urgently necessary in the prone position. Abdominal compression is poorly tolerated in the fetus in later part of pregnancy and delivery may be necessary before neurosurgical intervention

References:
Cauda Equina Syndrome. BMJ. 2009; 338(7699):881-4.

Cauda equina syndrome during pregnancy: a condition to consider. Int J of Surg. 2018; 48:14-16.

Presentation of cauda equina syndrome during labour. BMJ Case Rep. 2015; 1-3

Abstract #: FCI-537

Anesthetic Considerations for Osteogenesis Imperfecta in Pregnancy

Presenting Author: Neil Kalariya MD
Presenting Author's Institution: Stanford University School of Medicine - Stanford, CA
Co-Author: Jessica Ansari MD - Stanford University School of Medicine

Osteogenesis imperfecta (OI) or "brittle bone disease" encompasses a wide spectrum of features related to genetic malformation of type 1 collagen. This collagen plays a pivotal role in the formation of bones, dentin, sclera, ligaments, and tendons. Here we describe a case of maternal and fetal OI and considerations when assessing and treating these patients.

A 29 year old G1P000 at 33w1d with history of mild intermittent asthma and osteogenesis imperfecta that presented for primary cesarean section for preeclampsia with severe features and non-reassuring fetal heart rate tracing. Her pregnancy has additionally been complicated by high suspicion for fetal osteogenesis imperfecta, IUGR, and preeclampsia.

Complications of her OI include poor dentition and severe scoliosis requiring C7 to S1 complete spinal fusion with Harrington rods with subsequent severe kyphosis and lordosis. She has been primarily wheelchair bound since childhood, but is able to transfer independently. She is 3'9" and on day of delivery had a BMI of 59. Although she had not undergone genetic testing, from her clinical exam, she had been previously been diagnosed with type 3/4.

Preoperatively, large bore intravenous access was established as well as arterial line. Intraoperatively there was an unsuccessful attempt at neuraxial block, followed by uncomplicated general anesthetic for delivery. Special attention was made to padding and positioning. The fetus was delivered en caul and amniotic sac was ruptured with NICU on the surgical field. Postoperative pain was managed with bilateral TAP blocks and PCA.

Osteogenesiis imperfecta

Incidence

- 1 ini 20,000 live births
- Concerns with Pregnancy
- Gravid uterus can cause further reduction on FRC from expected as there is often a "bell shaped" chest and restrictive lung physiology
- Higher risk of postpartum hemorrhage from platelet adhesion abnormalities
- Often associated with preterm delivery, preeclampsia, and gestational diabetes.

Anesthetic Management

A primary concern includes preventing additional fractures. This can be accomplished by:

- Avoiding succinylcholine as these patients often have prolonged states of immobility and fasciculations could result in fractures:
- Meticulous attention to padding and positioning
- Utilizing invasive arterial blood pressure monitoring to avoid regular blood pressure cuff cycling.
- Planned cesarean delivery

Additional Considerations include:

- No link between OI and malignant hyperthermia, but can have a hypermetabolic state under general anesthesia causing hyperthermia
- Short stature makes appropriate dosing for neuraxial blocks challenging, recommend a catheter technique
- Often have a history of scoliosis and multiple vertebral body compressions making neuraxial block difficult

References:

Osteogenesis Imperfecta. In: Mankowitz S. (eds) Consults in Obstetric Anesthesiology. Springer, Cham

Osteogenesis imperfecta. Lancet. 2016; 387:1657-71.

Abstract #: FC10-105

Management of Labor and Delivery of a Patient With a Single Ventricle Status Post Fontan Procedure

Presenting Author: Michael T Bangert M.D.
Presenting Author's Institution: University of Florida Jacksonville - Jacksonville, FL
Co-Author: Kristen Vanderhoef M.D. - University of Florida Jacksonville
Adrienne Warrick M.D. - University of Florida Jacksonville

Single ventricle disease is a rare disorder occurring approximately 4-8 per 10,000 births and in 7.7% of congenital heart disease diagnosed at childhood (1). This case involves a 28 year-old G2P0010 who presented for induction of labor at 36 weeks and zero days. She has a past medical history of single ventricle of right ventricular morphology, transposition of great vessels with severe valvular and subvalvular pulmonic stenosis, recurrent reentrant atrial tachycardia status post direct current cardioversion and antiarrhythmic therapy currently on amiodarone. Her past surgical history includes modified Blalock, Glenn, modified Fontan with subsequent revision of the atrial septal defect, and ligation of superior vena cava to left atrium vessels. She is status post ablation of two intraatrial reentrant tachycardia circuits and placement of a single chamber intraatrial pacer for antitachycardia pacing due to refractory intraatrial tachycardia. She was also on enoxaparin that was transitioned to heparin, and heparin was held prior to induction in order to follow ASRA guidelines for neuraxial anesthesia. A cardiology consult was obtained, and as recommended, she received a lumbar epidural for labor and delivered uneventfully with a vacuum assisted vaginal delivery in the obstetric operating room. Monitoring included standard ASA monitors with a portable vitals monitor including a continuous EKG and a right radial arterial blood pressure. Via her epidural catheter, she received 5 ml of lidocaine 1.5% with epinephrine 1:200,000 in divided doses immediately after catheter placement. An epidural infusion of bupivacaine 0.1% was started at 8 ml/hr. She later received boluses of 5 ml of lidocaine 2% once approximately one hour before and once immediately before transport to the OR for vaginal delivery. Management of patients with Fontan physiology includes balancing preload, afterload, pulmonary vascular resistance, and cardiac output. The physiological changes of pregnancy include an increase in preload, decrease in afterload, increase in heart rate, and an increase in blood volume (2). Whether a patient with Fontan physiology can handle these changes depends on whether the pulmonary vasculature and the single ventricle can handle the increased preload. For this patient, monitoring for dysrhythmias was also important, and management included continuation of antiarrythmic medications, continuous EKG and arterial blood pressure monitoring, and having emergency drugs immediately available.

Abstract #: FC10-110

Anesthetic Management of a Parturient With Primary Spinal Malignant Melanoma: A Case Report and Review of the Literature

Presenting Author: Shahenaz Elsamragy MBBCh
Presenting Author's Institution: University of Texas Medical Branch - Galveston, Texas
Co-Author: Rovnat Babazade MD - University of Texas Medical Branch
Mohamed Ibrahim MD - University of Texas Medical Branch
Rakesh Vadhera MD - University of Texas Medical Branch
Michelle Simon MD - University of Texas Medical Branch
Niyant Jain MD - University of Texas Medical Branch

A 30-year old patient scheduled for an elective repeat cesarean section at 37 weeks was referred to anesthesia for preoperative assessment. During her previous pregnancy, she was diagnosed with an primary spinal malignant melanoma, levels C1-C3. An emergency cesarean section (CS) under general anesthesia (GA) was required at 31 weeks gestational age due to acute development of refractory pain and lower limb weakness. Acute onset quadriplegia and dyspnea following extubation necessitated emergency surgical tumor removal & irradiation of the surgical bed.

The patient had regular follow-up cervical MRIs since then. At 6 weeks of her following pregnancy , her MRI showed T1 hyperintense/ T2 isointense foci at C3-C4. These findings suggested possible leptomeningeal malignancy. A follow-up MRI was planned in a few months, followed by contrast enhanced imaging after delivery. The follow-up MRI findings five months later were the same.

Our main concern was airway manipulation/difficulty due to her history. We therefore recommended a spinal anesthetic. However, we requested a lumbar MRI to exclude recurrence of malignancy. Her lumbar MRI unfortunately showed the presence of numerous nodular foci along the cauda equina roots, suggestive of leptomeningeal malignancy.

Her delivery was therefore rescheduled to an earlier date to start investigations & treatment as needed. Our initial decision was reconsidered in favor of GA to avoid causing any complications by interfering in an area of the dura with a possible malignancy, such as failure to achieve an adequate block and development of postoperative neurological deficits, as well as possible 'seeding' malignant cells further into the neuroaxis.

Imaging studies done after delivery supported the initial impression of malignant recurrence, in addition to metastatic findings in her brain MRI.

Primary CNS malignant melanomas are quite rare, accounting for 1% of all CNS tumors. Their diagnosis is done by using Hayward's criteria(1), which are: absence of melanoma outside the CNS, absence of this lesion elsewhere in the CNS & histopathological confirmation. Little data on recurrence rate and prognosis is available due to its rarity. We found 58 cases while reviewing literature, only two of which were also pregnant.

References:

1. Hayward RD. Malignant melanoma and the central nervous system. A guide for classification based on the clinical findings. J Neurol Neurosurg Psychiatry. 1976;39(6):526-30.

Table 1: Case Reports and Review of the Literature (1900-1998).[b,d]

	Year & Publication[c]	Author	Age/Sex	Site
1	1906 - Virchows Archiv	Hirschberg	67/F	T
2	1907 - Frankf Z Pathol	Boit	51/M	T
3	1907	Esser	32/M	T
4	1910 - Virchows Archiv	Kawashima	26/F	T
5	1912 - Hygeia	Lindbom	45/F	C
6	1916 - Z Gesamte Neurol Psychiatr	Koelichen	25/M	C
7	1926 - Rev Neurol	Ringertz	61/F	T
8	1926 - Frankf Z Pathol.	Schmid	71/M	T
9	1929 - Rev Neurol	Bau-Prussak & Mackiewicz	29/M	T-L
10	1930 - JACS	Bell	48/F	C-T
11	1930 - Pathalogica	De Blasi	71/F	T
12	1933 - J Belge Neurol Psychiatr	Van Bogaert & Verbrugge	38/M	T
13	1938 - J Nerv Ment Dis	Schnitker & Ayer	49/F	T
14	1939 - Mayo Clin Proc	Da Costa & Love	55/F	T
15	1941 - Rev Neurol	Garcin *et al.*	52/M	L-S
16	1942 - J Nerv Ment Dis	Mackay & Hurteau	32/F	C
17	1950 - Eur Neurol	Castaner Vendrell *et al.*.	52/F	L
18	1950 - J Pathol Bacteriol	Forbes & Maloney	57/M	T
19	1950 - Rev Neurol	Kissel *et al.*.	25/F	C

20	1951 - Rev psiquiatr clin	Hirschberg	26/M	L
21	1951 - J Neurol Psychiatry	Boit	47/M	L
22	1952 - Guthrie Clin Bull	Esser	53/M	L
23	1953 - Neurocirugia	Kawashima	40/M	T
24	1954 - Clin Investig Med	Lindbom	50/F	T-L
25	1957 - J Pathol Bacteriol	Koelichen	51/F	T
26	1960 - J Neurosurg	Ringertz	42/M	T
27	1961 - J Neurosurg	Schmid	33/F	C4-C6
28	**1975 - Neurological Surgery**	**BauPrussak & Mackiewicz[a]**	**27/F**	**C2**
29	1984 - Neurosurgery	Bell	15/F	C
30	1986 - J Neuroradiology	De Blasi	64/M	T
31-35	1987 - J Neurosurg	Van Bogaert & Verbrugge	63/M	T
			67/F	T
			57/F	C
			69/F	T
36	1989 - Neurosurgery	Yamasaki T *et al.*.	31/M	T6
37	1994 - Neurosurgery	Skarli SO *et al.*.	20/F	C5-C6
38	1998 - Br J Neurosurg	François P *et al.*.	62/M	T7-T9
39	1998 - J Neurosurg	Salpietro FM *et al.*.	62/M	C3

[a] Pregnant cases are in bold.[b] Abbreviations: C; Cervical, C-T; Cervicothoracic, T; thoracic, T-L; Thoracolumbar, L; Lumbar, L-S; Lumbosacral.[c] Unattainable Data was left blank. [d] Table adapted from Salpietro FM et al.

Table 2: Case Reports and Review of the Literature (1999-Present)[b]

	Year & Publication	Author	Age/Sex	Site
1	2000 - Acta Neurochir	BidzinÂski J et al.	36/M	C6-C7
2	2001 - AJNR	Farrokh D et al.	80/F	T12-L1
3	2004 - Neuroradiology	Blanchard N et al.	27/F	L5
4	2005 - Clin Neurol Neurosurg	Gueorgui K.Kounin et al.	41/F	C2-C4
5	2007 - Br J Neurosurg	Kanatas AN et al.	76/F	C6-C7
6	2010 - Spine	Lee CH et al.	39/M	C1-C6
7	2010 - Eur Spine J	Lee NK et al.	71/F	C6-C7
8	2010 - Neurol India	Vij M et al.	40/M	C1-C2
9	2010 - Neurol India	Vij M et al.	40/M	C1-C2
10	2011 - J Clin Oncol.	Fuld AD et al.	62/M	C2-C3
11	2012 - Clin Neurol Neurosurg	Ganiüsmen et al.	49/F	L3
12	2012 - Chin Med J	Yan L et al.	44/F	L
13	2013 - Can J Neurol Sci	Grahovac et al.	76/M	T12
14	2013 - J Neurosurg Spine.	Chance A et al.	46/M	T12
15	2015 - J Cancer	Sharma A et al.	30/M	C2-C3
16	2016 - Spine J	Wang YB et al.	60/F	T1,T3-T4
17	**2016 - Oncology**	**Westergaard et al.[a]**	**27/F**	**C2-C3**
18	2017 - Int J Clin Exp Med.	Yang Y et al.	42/F	L5
19	2018 - World Neurosurg	Zhang M et al.	52/F	T10-T11

[a]Pregnant cases are in bold. [b] Abbreviations: C; Cervical, T; thoracic, L; Lumbar

Abstract #:FC10-113

Brain Tumor, Pheochromocytoma, and Cesarean Section: A Case Report of a Parturient with von Hippel-Lindau Disease

Presenting Author: Michelle S Burnette M.D.
Presenting Author's Institution: The Johns Hopkins University School of Medicine - Baltimore, MD
Co-Author: Taylor S Mann M.D. - The Johns Hopkins University School of Medicine
David J Berman M.D. - The Johns Hopkins University School of Medicine
Truc-Anh T Nguyen M.D. - The Johns Hopkins University School of Medicine

Case: A 28 year-old G3P0020 female at 32w3d was urgently scheduled for cesarean section in the setting of a large cerebellopontine brain mass and symptomatic pheochromocytoma. She had been diagnosed recently with VHL at another institution after presenting with vomiting and imbalance. Work-up revealed multiple tumors including a 4.2cm right cerebellopontine angle mass with mass effect on adjacent brain stem with hydrocephalus, thoracic hemangioblastomas, and a left adrenal pheochromocytoma. Given her pheochromocytoma and preeclampsia with severe features, magnesium and alpha blockade with prazosin were continued. Due to concern for increased intracranial pressure (ICP), recommendations were against neuraxial anesthesia and pushing with vaginal delivery by a multidisciplinary team. General anesthesia was induced using a modified rapid-sequence induction with fentanyl, lidocaine, propofol, and rocuronium. Sevoflurane was used for maintenance and transitioned to propofol and remifentanil infusions after delivery. EtCO2 was controlled at 30mmHg and blood pressure maintained with a phenylephrine infusion. With fascial dissection, the patient became acutely hypertensive requiring a bolus of nitroprusside. Fetal delivery was uneventful and adequate uterine tone was achieved by oxytocin infusion and intramuscular carboprost. The patient was extubated and transferred to the ICU in stable condition, and had an uncomplicated postpartum hospitalization. Approximately one month after discharge, she underwent an urgent embolization and cerebellopontine mass excision.

Discussion: Von Hippel-Lindau disease (VHL) is a rare autosomal dominant genetic disorder associated with the development of malignant and benign tumors in the central nervous symptom and viscera (1). There have been successful resections of symptomatic hemangioblastomas and pheochromocytomas during pregnancy, and even combined with cesarean section (2,3). To avoid the potential for hypertensive crisis and eclampsia associated with labor and pheochromocytoma, most patients undergo cesarean section. There are reports of successful neuraxial anesthesia with VHL: risks include possible rupture of hemangioblastomas or cerebellar herniation with dural puncture in the presence of increased ICP (4). Imaging of the brain and spine along with neurosurgical consultation should be arranged before placement. With general anesthesia, hyperventilation can decrease ICP and total intravenous anesthesia has more advantageous effects on cerebral circulation, ICP, and uterine tone over volatiles. These patients should undergo delivery at tertiary care centers as the key to this patient's outcome was the coordination of a skilled multidisciplinary team.

References:

1. Adekola et al. Obstet Gynecol Surv. 2013;68(9):655-662.
2. Boker et al. Can J Anaesth. 2001;48(4):387-390.
3. Joffe et al. Can J Anaesth. 1993;40(9):870-874.
4. Plon et al. Clinical features, diagnosis, and management of von Hippel-Lindau disease. UpToDate. 2017.

Abstract #: FC10-161

Anesthetic management of a patient with progressive familial intrahepatic cholestasis type III

Presenting Author: Antonio Gonzalez MD
Presenting Author's Institution: Yale School of Medicine - New Haven , CT
Co-Author: Aymen Alian MD - Yale School of Medicine
Olga Grechukhina MD - Yale School of Medicine

Progressive familial intrahepatic cholestasis (PFIC) type III is caused by a mutation in the ABCB4 gene, which encodes multidrug resistance protein 3 (MDR3). Dysfunctional MDR3 activity results in an imbalance in bile composition which ultimately causes solubilization of biliary epithelial membranes, cell death and inflammation.1

A 32-year-old G2P1, known heterozygous carrier of a missense variant of ABCB4 gene, presented to an outside facility at 20 weeks and 2 days with hematemesis. Initial workup revealed grade III esophageal varices with active bleeding and hepatic portal hypertension. Blood work revealed elevated liver enzymes, INR of 1.6 and negative hepatitis serologies. Cardiac workup was unremarkable. The varices were banded to achieve hemostasis and hemodynamic stability. She was then transferred to our institution for further evaluation.

PFIC type III was confirmed given elevated bile acids, liver cirrhosis on biopsy, and genetic test. A transjugular intrahepatic portosystemic shunt (TIPS) was performed at 21 weeks. The patient was admitted for delivery at 36 weeks due to risk of fetal demise in the setting of elevated bile acids. Given the possibility of fetal cholestatic phenotype (potentially transient), the final delivery method was to be determined pending fetal coagulation profile after percutaneous umbilical blood sampling (PUBS). Given the normalized coagulation profile in the patient (Table 1) an epidural was deemed safe and was performed at the L3-L4 level. The PUBS was performed after confirming surgical level. Despite normal fetal coagulation profile, the patient elected for a cesarean delivery. The epidural was extended with a total of 15 ml of Lidocaine 2% with epinephrine and 100 μg of fentanyl to provide a T4 surgical level. The surgery and post-operative course were unremarkable. The patient was discharged home on post-operative day 4. Currently, she is undergoing testing for liver transplant candidacy.

Increased maternal blood volume, compression of the inferior vena cava favors esophageal varices bleeding. The use of TIPS during pregnancy is controversial, but may favor some patients.2 When caring for parturient with PFIC, the anesthetic plan should be individualized based on liver function and comorbidities. A multidisciplinary approach including gastroenterology, maternal fetal medicine and anesthesiology is imperative.

References:

1. Best Pract Res Clin Gastroenterol 2010;24:541–53.
2. Liver Transpl 2008;14:1081–91.

Abstract #: FC10-161

Coagulation Profile	3/20/18	3/27/18	4/1/18	Day of surgery 4/2/18	4/3/18	4/4/18
PT	13.9	13.9	12	11.4	11.6	11.6
PTT	26.4	25.8	23.1	22.6	24.7	24.6
INR	1.32	1.32	1.12	1.06	1.07	1.07
4/2/18						
Rotem ®	EXTEM		INTEM		FIBTEM	
CT	60 [43-82]		118 [122-208]		53 [39-79]	
CFT	75 [48-127]		57 [45-110]			
A10	56 [46-67]		59 [46-67]		23 [7-22]	

Table 1. PT- Prothrombin time; PTT- Partial Thromboplastin time; INR- international normalized ratio; CT- Clotting time; CFT- Clot formation time; A10- Clot firmness 10 min after clotting time.

Abstract #: FC10-162

Anesthetic management of a patient with Loeys-Dietz syndrome

Presenting Author: Antonio Gonzalez MD
Presenting Author's Institution: Yale School of Medicine - New Haven, CT
Co-Author: Aymen Alian MD - Yale School of Medicine

Aortic dissection peripartum is uncommon but conveys high morbidity and mortality.1 Loeys-Dietz syndrome (LDS) is a rare autosomal dominant aortopathy that is associated with aortic aneurysm or dissection. There is limited data to guide the management of patients with LDS. Peripartum imaging including transthoracic echocardiogram are needed to make case by case decisions.2

A 38-year-old G3P1 at 34 weeks with a past medical history of LDS was evaluated at our high-risk obstetric anesthesiology clinic. Her obstetrical history was significant for a previous low transverse cesarean delivery (CD). She was diagnosed with LDS given her family history. Her father developed an aortic dissection at the age of 40, and later succumbed to a cerebral aneurysm. The patient was routinely followed by cardiology ever since her diagnosis. Her echocardiogram revealed a normal biventricular size and functions, and a 33-34 mm aortic root (normal 22-36 mm). This was reported to be stable when compared to a prior echocardiogram. Magnetic Resonance Angiography of the chest and brain demonstrated no aortic aneurysm, mild stable focal dilation of the distal aorta, and no cerebral aneurysm. Previous cervical spine images were unremarkable; no cervical instability.

Given her obstetrical history, the plan was to proceed with a scheduled repeat CD. A spinal anesthetic was performed using intrathecal injection of hyperbaric bupivacaine 0.75% 12mg, 15 µg of fentanyl and preservative morphine 0.1 mg. After a T4 level was achieved, surgery was commenced. Her intraoperative course was uneventful, and she delivered a vigorous 2.28 kg baby boy. On post-operative day 1, the patient showed symptoms of post-dural puncture headache. An epidural blood patch (EBP) was performed on post-operative day 2. A total of 25ml of autologous blood was injected into the epidural space. The EBP was successful and patient was discharged home on post-operative day 4.

When caring for a patient with LDS, it is important to obtain brain and chest imaging to decide the mode of delivery of the patient and morbidity and mortality risk. Cesarean delivery is recommended for parturients with an aortic diameter of more than 4.5 cm. Extrapolating from data of patients with Marfan syndrome, there is a 10% risk of aortic dissection peripartum in patients with a maximal aortic diameter > 40 mm.1 Early neuraxial analgesia for labor is preferred to avoid catecholamine surge during labor. Dural ectasia and cervical spine instability should be taken into account to tailor the anesthetic plan.2 The use of oxytocin is controversial, as it has been related to aortic dissection. A high level of suspicion for aortic dissection should be maintained when caring for patients with LDS, and a multidisciplinary approach is recommended.

References:

1. Int J Obstet Anesth 2018. [Epub ahead of print]
2. Int J Cardiol 2017;226:21–5.

Abstract #: FC10-166

Management of a parturient with symptomatic severe aortic stenosis and unstable mood disorder

Presenting Author: Kelechi Brenda Anyaehie MD, MPH
Presenting Author's Institution: UT Southwestern Medical Center - Dallas, Texas
Co-Author: Alexa Kaminski MD - UT Southwestern Medical Center

Physiologic changes of pregnancy can increase cardiac complications in patients with history of valve repair or replacement. The mean pressure gradient across a prosthetic valve increases throughout gestation leading to worsening symptoms as pregnancy progresses1. This can be challenging to manage in the setting of unstable mood disorder. We present a parturient with symptomatic severe stenosis of her bioprosthetic aortic valve and the challenges associated with her mental health.

Case: A 38 yo G4P2 with history of thoracic aortic aneurysm s/p aortic root replacement with bioprosthesis in 2004, presented at 32 weeks gestation to the labor and delivery unit after a witnessed syncopal episode in a lobby of the hospital. She reported worsening chest pain and intermittent shortness of breath since her third trimester. She also had a history of bipolar/schizoaffective disorder, and had self-discontinued her monthly Haldol injections early this pregnancy. Transthoracic echo revealed severe stenosis of her bioprosthetic aortic valve with peak velocity of 6.1m/s and aortic valve area of 0.6cm2. Given the severity of her symptoms and stenosis, cardiology recommended urgent aortic balloon valvuloplasty. Initially, she was very tearful, with intermittent screaming outbursts and expressed hopelessness for her and baby's life. She refused all forms of care including IV access and any cardiac intervention. She left the labor unit several times, and her capacity was assessed by psychiatry as she expressed no concern about the mortality of her condition without emergent intervention. After much counseling, she eventually agreed to plan of care.

Given the concern of maternal mortality and unpredictable nature of delivery, our multidisciplinary team planned for C-section and bilateral tubal ligation with cardiopulmonary bypass and surgeons on standby. In the event of acute decompensation, an emergent aortic valve replacement would take place. In the OR, an awake arterial line and right IJ central line were placed with a low dose dexmedetomidine infusion in the background. Dural puncture epidural was placed, slowly dosed with 2% lidocaine until a T6 level was obtained. CVTS placed sheaths in the right common femoral artery and vein. Once, baby was delivered, a remifentanil infusion was initiated and she received morphine through her epidural. Hemodynamics remained stable throughout and she was transported to CVICU for monitoring. Two days later, she returned to the OR for an aortic valve replacement and was discharged home 5 days later.

Discussion: During pregnancy, in 10% of maternal severe aortic stenosis, cardiac complications are reported1. Evidence shows this risk can significantly increase in the setting of untreated mood disorders, potentially exposing the patient and fetus to harm2. Thus, treatment and delivery planning should include integration of mental health services in the perinatal management of these patients.

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Abstract #: FC10-172

New-Onset Atrial Fibrillation after cesarean delivery; The unusual cardiac event in the postpartum setting

Presenting Author: Mary J Im M.D.
Presenting Author's Institution: Drexel University College of Medicine, Hahnemann University Hospital - Philadelphia, PA
Co-Author: Jovannah Linnen MD - Drexel University College of Medicine, Hahnemann Hospital
Kirsten Fill MD - Drexel University College of Medicine, Hahnemann Hospital

Case: A 38 y/o at 37.2 weeks of pregnancy presented with elevated blood pressure. She had previous C-sections but denied any medical problem. Cesarean delivery was indicated for preeclampsia with uncontrolled hypertension. She was treated with 5 mg of IV hydralazine and 4 g of Mg Sulfate before surgery. CSE anesthesia was induced without any difficulty. Immediately after delivery, she started complaining of chest discomfort and occasional PVCs were observed with sinus tachycardia. After she was given 2 mg of IV midazolam, tachycardia was resolved. In PACU, she developed tachycardia with irregular heartbeat up to 150/min on a cardiac monitor. On 12 lead EKG, new onset of atrial fibrillation (AF) with rapid ventricular response was revealed. Metoprolol 5 mg IV was given initially, and then IV Esmolol infusion was started to control the rate on continuous cardiac monitoring. Her initial evaluation including electrolytes, urine drug screen, thyroid studies, an echocardiogram, and CT chest was all normal. She continued showing atrial fibrillation 12 hours postoperatively. Concerning persistent AF, the decision was made to start anticoagulation for possible electrical cardioversion. While preparing electrical cardioversion, her arrhythmia was converted to sinus rhythm spontaneously. She was discharged home on metoprolol 12.5 mg without anticoagulation.

Discussion: During pregnancy, there are many physiologic changes which place pregnant women at the risk of developing cardiac arrhythmia. AF without preexisting heart disease during pregnancy is a very rare occasion. In addition to physiologic changes, our patient had comorbidities with preeclampsia. This patient developed AF with a rapid ventricular response after spinal anesthesia with additional vasodilators. According to the recent article, it showed the high rate of spontaneous cardioversion up to 81% of AF episodes with a structurally normal heart in pregnancy (1). The treatment of choice is the rate control with beta blockers. If AF is persistent, cardioversion can be considered with anticoagulation. The protection against thromboembolic complications by continuing anticoagulation can be determined based on the assessment of thromboembolic risk in the postpartum setting.

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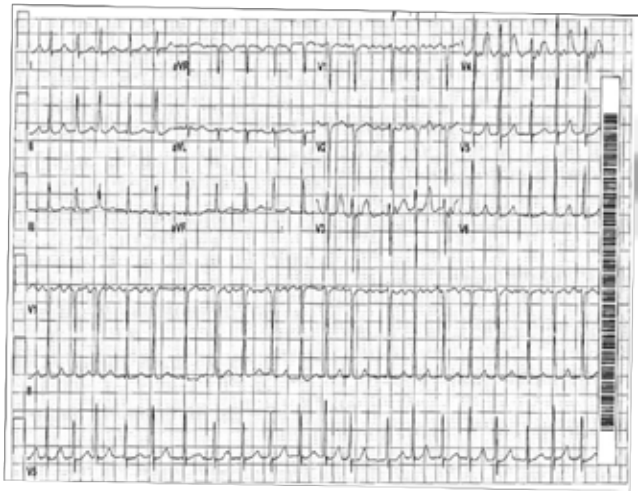

Fig1. Immediate postop

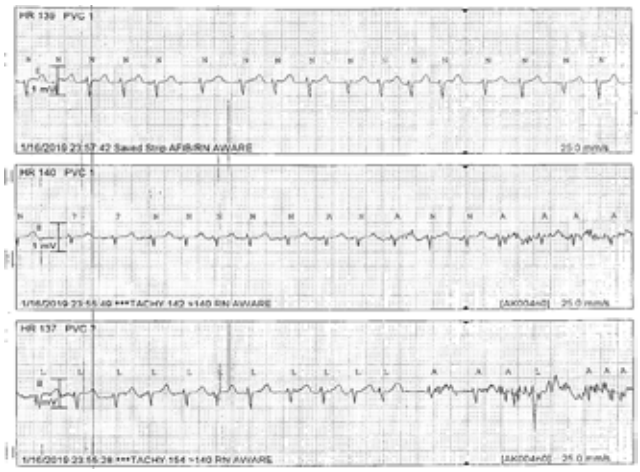

Fig2. 3 hours postop

Abstract #: FC10-474

Management of Emergency Cesarean Delivery in a Parturient with Acute Transverse Myelitis

Presenting Author: Michelle S Burnette M.D.
Presenting Author's Institution: The Johns Hopkins University School of Medicine - Baltimore, MD
Co-Author: Courtney G Masear M.D. - The Johns Hopkins University School of Medicine
Gillian Isaac M.D. - The Johns Hopkins University School of Medicine

A 41-year-old female G1P0 at 15 weeks gestation presented to an outside hospital with loss of sensation in her lower extremities 11 days after a flu-like illness. The hypoesthesia progressed from numbness to paralysis. Lumbar puncture revealed marked pleocytosis, elevated protein, and was negative for common neurotropic viruses. MRI showed extensive T2 hyper-intensity extending from the cervical spine to the conus. Neurological examination revealed paraplegia with 0/5 strength in the bilateral lower extremities and impaired sensation of all modalities below T8. The patient was diagnosed with acute transverse myelitis (TM) and treated with plasmapheresis, cyclophosphamide, and steroids.

The patient presented to our labor & delivery suite at 33 weeks with vaginal bleeding and a neurologic exam that was stable since her diagnosis. A non-reassuring fetal heart tracing with recurrent prolonged variable decelerations resulted in a decision for urgent cesarean delivery. A discussion was held with the patient and her family regarding the risks and benefits of neuraxial versus general anesthesia (GA) in the setting of acute TM. Although the patient desired neuraxial to be awake for delivery, she had a reassuring airway exam, had been NPO for greater than 8hrs and there was concern for worsening neurologic disease with neuraxial. While preparing for the operating room, the fetus experienced a terminal bradycardia requiring emergent delivery under GA. After rapid sequence induction, the airway was secured and a viable infant was delivered. In the 4 months since delivery, the patient has shown a gradient of improvement in her neurologic exam with perception of pinprick intermittently down to T12 and improved tone in the lower extremities.

TM is an acute inflammatory lesion of the spinal cord which results in motor, sensory, and autonomic dysfunction. Reports of acute TM during pregnancy are extremely rare (1,2). Concerns for the TM parturient requiring anesthesia include possible autonomic dysreflexia, progressive neurologic disease, prolonged neuromuscular blockade and hyperkalemia in response to depolarizing neuromuscular blockade. Evidence suggests that neuraxial anesthesia can reduce symptoms of autonomic dysreflexia in susceptible laboring women. Epidural anesthesia has been reported with both chronic and acute TM patients without apparent complication (1) but there is ongoing controversy over the safety of neuraxial techniques in patients with preexisting neurologic disease, especially in the setting of an acute process. While GA is commonly avoided in obstetrics for concern of difficult airway and aspiration risk, our patient's exam and NPO status were reassuring. For every surgical delivery, the risks and benefits of neuraxial anesthesia vs. GA are weighed. In this case, urgency ultimately dictated the need to proceed with GA.

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Abstract #: FC10-492

Management of a Parturient with Hermansky-Pudlak Syndrome

Presenting Author: Kristen L. Fardelmann M.D.
Presenting Author's Institution: Yale School of Medicine - New Haven , Connecticut
Co-Author: Antonio Gonzalez-Fiol M.D. - Yale School of Medicine
Aymen Alian MBChB - Yale School of Medicine

Introduction: Hermansky-Pudlak Syndrome (HPS) is an autosomal recessive disorder characterized by oculocutaneous albinism (OCA), bleeding diathesis, and in some patients pulmonary fibrosis. Parturients with HPS warrant a multi-disciplinary approach to prevent maternal morbidity and mortality.

Case: The patient was a 28 year old G3P2 admitted at 36 weeks gestation in the setting of acute respiratory insufficiency. The patient's medical history was significant for HPS, asthma, morbid obesity, pre-eclampsia, peripartum cardiomyopathy, and postpartum hemorrhage (PPH). On admission, she reported dyspnea on exertion and peripheral edema. Over the next ten days, the patient decompensated requiring intubation for acute respiratory distress syndrome with the differential including pneumonia (rhinovirus and mycoplasma positive), pulmonary fibrosis, asthma exacerbation, cardiomyopathy, and pulmonary arterial hypertension. Cardiothoracic surgery was consulted for possible extracorporeal membrane oxygenation. On day eleven, the patient was transferred for cesarean section in the cardiac operating room. Vaginal bleeding was noted. On exam, patient was found to be 10cm dilated with a liveborn male delivered via vacuum-assisted vaginal delivery with APGARS 2/4/7 and estimated blood loss of 150cc. Tranexamic acid and platelet transfusion were prophylactically administered. Several hours later, the patient developed PPH requiring red blood cell and platelet transfusion. Following delivery, the patient had persistent respiratory and right heart failure. She was discharged to rehabilitation 51 days after admission. Three months postpartum, the patient is awaiting lung transplantation for interstitial lung disease.

Discussion: Ten subtypes of HPS have been identified. All are characterized by OCA and platelet dysfunction associated with mild to severe bleeding. Identified by platelet transmission electron microscopy, the absence of delta granules whose content initiates the platelet aggregation cascade is diagnostic. Pulmonary fibrosis is associated with HPS-1, 2, and 4 and develops most commonly in the third decade of life. High-resolution CT is the diagnostic modality of choice showing increased reticular opacities, thickened interlobular septa, ground-glass infiltrations, and fibrotic changes. The severity of HRCT findings correlates with decrease in pulmonary function and mortality which most commonly occurs in the fourth and fifth decade of life. There are no recommendations for management in the parturient, however, diagnosis of specific subtype, analysis of platelet dysfunction, and evaluation for pulmonary disease are critical. Avoidance of neuraxial anesthesia and NSAID use with recognition of increased risk for PPH have been described. Treatment of bleeding by single donor, HLA-matched platelet transfusion and desmopressin is recommended.

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