

# SOAP 2021

## Annual Meeting

Building & Moving  
Bridges & Forward

*A Virtual Event*

May 13-16

# Syllabus

**SOAP**   
Society for Obstetric  
Anesthesia and Perinatology

#SOAPAM2021



# SOAP 53<sup>rd</sup> Virtual Annual Meeting

## Building Bridges & Moving Forward

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Welcome .....	2
Planning Committees.....	5
Program Faculty .....	6
Program Information & Policies .....	15
Session Descriptions .....	18
Program Agenda .....	21
Speaker Disclosures .....	44
Program Materials .....	45



# Welcome!

On behalf of the SOAP Board of Directors and the 2020-2021 Annual Meeting and Live Events Committee, we are delighted to welcome you to the 2021 SOAP 53<sup>rd</sup> Virtual Annual Meeting.

The meeting theme of “**Building Bridges and Moving Forward**” could not be more appropriate for the times and our profession. As we look towards the future, we strive to find use cutting edge research, guidelines and the collective expertise of our specialty to provide our patients the highest level of care.

The virtual format has provided an opportunity for learner flexibility by bringing you education on your timeline. All the lectures presented during the 2021 meeting will be available on the virtual platform for 30 days to attendees.

We start our Thursday session with the much beloved “Best Case Report Session” lead by Dr. Klaus Kjaer. Join us to discuss some of this year’s most challenging clinical cases and hear discussion by our panelists on how to approach such patients. Next we move to the “**What’s New in Obstetrics?**” lecture given by invited lecturer Dr. Luis Pacheco, MD, from the Society of Maternal Fetal Medicine to hear about some of new concepts in the care of high risk parturients. Following these sessions, we will begin our **Clinical Track** which will be featured both Thursday and Friday night during the meeting. These sessions are 45 min clinical updates on a variety of topics that are important to the anesthesiologist providing care for OB patients. Some of the important topics covered include reviews of ERAC protocols, COVID and Sepsis in the Parturient, Non-obstetric surgery and a Patient Safety MOCA session on Airway Management in Pregnancy.

Friday Night our fellows will kick off the activities presenting some of their most challenging patient scenarios in the Fellow Case report session. Wondering where you will find the research posters? Don’t worry, a breadth of scientific research will be presented in moderated breakout rooms. We are also thrilled to present

a session entitled “Patient with Placenta Accreta Spectrum Disorder: Where do you Deliver and How do you Do It?” by Dr. Michaela Farber and Dr. Carolyn Weiniger. Finally, we will conclude the Friday session with the remainder of our clinical track lectures featuring important topics like obesity in the parturient, a lively panel on obstetric emergencies where we will look at real world considerations with time is of the essence, and state of the art labor analgesia practices.

Saturday and Sunday feature some of our most anticipated lectures where Dr. Grace Lim will present the annual **Gerard W. Ostheimer Lecture – a review of the most important literature for the obstetric anesthesiologist in 2020**. Saturday will also feature the trainee **Gertie Marx Research Competition** and the **Best Paper Competitions**, where the most highly rated scientific abstracts are presented and the researchers vie for the title of Gertie Marx champion or Best Paper of the annual meeting. We are thrilled that Dr. May Pian-Smith was selected to present the **Fred Hehre Lecture** which recognizes outstanding members of the obstetric anesthesiology field and their reflections on practice and life.

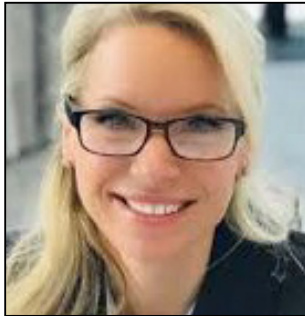
Knowing that schedules are ever-changing, over 100 case reports will also be available in a pre-recorded on-demand format.

Just because we are virtual does not mean that we have to miss out on socializing! Be sure to join us on Saturday, May 15 for the Charcuterie Class and Reception, where you can learn how to prepare a charcuterie board for your next get-together. Link up with friends across the country and watch the event or compete with each other at home to see who can design the best plate.

If you are a Fellow, the Fellows Reception on Saturday, May 15 is where you can meet and get to know your fellow colleagues from around the world along with program directors and SOAP board of directors. Join us in this Zoom breakout room format with a favorite screen shot behind you (pets, travel pictures, hobbies, favorite entertainment). We will also close out the 2021 Annual Meeting with a Sunday, May 16 Closing Reception where we will announce the winners of the Gertie Marx Research Competition, Best Paper Competition and other awards.

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





On behalf of the SOAP Board of Directors and the 2021 Annual Meeting & Live Events Committee, we are delighted to welcome you to the Society for Obstetric Anesthesia and Perinatology (SOAP) virtual 53rd Annual Meeting, May 13-16, 2021.



### **Educational Program**

This meeting is dedicated to Building Bridges and Moving Forward, acknowledging the challenges we have faced as a medical profession and as a global community, while continuing to provide the highest level of care for our patients.

**Heather C. Nixon, M.D.**

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# Program Information and Policies

## **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 from around the world who share an interest in the care of the pregnant patient and the newborn.

The mission of our society is to advance and advocate for the health of pregnant women and their babies through research, education, and best practices in obstetric anesthesia care. Our vision is safe and equitable care for women and newborns everywhere. Our mission, vision and core values are at the forefront of everything we do as a society.

Membership in SOAP is an opportunity to meet people who share your interests and to stimulate improvements in health care for pregnant patients. If you are a member, thank you! We are pleased to have you engaged in the society. If you are not currently a member, please join SOAP to become part of our growing community.

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

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This activity contributes to the patient safety CME requirement for the CME component of the American Board of Anesthesiology's (ABA) redesigned Maintenance of Certification in Anesthesiology™ (MOCA®) program, known as MOCA 2.0®. Please consult the ABA website, [www.theABA.org](http://www.theABA.org), for a list of all MOCA 2.0 requirements.



## **About This Meeting**

Despite continued advances in medical technology, maternal morbidity and mortality continues to increase in the United States. The continued opioid crisis in the United States, its impact on postpartum analgesic and surgical modalities and the ongoing global pandemic provides a level of exigency to the current maternal morbidity and mortality rates.

Lack of knowledge of these emergent risk factors and improved anesthetic techniques can contribute to lower quality of care. The goal of this year's meeting is to congregate experts to teach evidence-based methods and techniques to actionably improve maternal outcomes.

## **Target Audience**

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

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

The mission of the AM/LE 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 53rd Annual Meeting**

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

## **Educational Format**

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

## **Annual Meeting Objectives**

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

1. Improve the care of the parturient through better understanding of the physiology of pregnancy and the impact of maternal disease, improved knowledge of anesthetic techniques, and implementation of safe practices.
2. Utilize an evidence-based approach when caring for the pregnant patient with COVID and to plan for the anesthetic management of pregnant patients in future pandemics.
3. Implement practices in the anesthetic management of the parturient undergoing cesarean section that will enhance recovery and provide postpartum analgesia using minimal opioids.
4. Develop specific measures that increase safety in care of the obese pregnant patient, the patient with placenta accreta, and the patient requiring surgery in the postpartum period.
5. Incorporate recommendations in the management of the pregnant patient who requires analgesia/anesthesia and who has either a difficult airway or thrombocytopenia.

## **Special Needs Statement**

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



**Disclosure Policy**

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

**Instructions on How to Receive Credit**

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

**Disclaimer Statement**

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

**Anti-Harassment Policy**

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.

**Photo and Video Disclosure**

Photos and video footage are periodically taken of people participating in a SOAP meeting. Please be aware that by registering for a SOAP meeting or participating in an activity or attending an event at a SOAP meeting, you authorize SOAP and its management company to use these photos and video footage for promotional purposes in SOAP publications, advertising, marketing materials, brochures, social media (including Facebook, YouTube, Instagram, Twitter, and other social media sites used by SOAP), and the SOAP website without additional prior notice or permission and without any compensation. All photos and videos are property of SOAP.



# SESSION DESCRIPTIONS

## **Best Case Reports – Top 10**

This live presentation highlights some of the most highly graded and interesting case reports submitted to the Annual Meeting. Cases were selected to represent a wide range of topics from various institutions and are sure to foster lively discussions among the panelists. There will be author and audience participation, via virtual chat function, to encourage interactive discussion. This session will be moderated by Dr. Klaus Kjaer, featuring panelists Dr. Jaime Daly, Dr. Bob Gaiser, and Dr. Emily Sharpe.

## **Best Paper Session**

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

## **Fellow Case Reports**

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

## **Research Poster Sessions**

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

## **Oral Presentation Sessions**

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

## **Case Reports – Live**

These concurrent moderated sessions, presented on Saturday and Sunday morning, are designed to showcase interesting cases in various topic areas such as COVID, Practice Improvement, and Post Delivery Outcomes, among others. The sessions will feature engaging question-and-answer opportunities regarding these challenging clinical scenarios.

## **Case Reports – Pre-Recorded On-Demand**

The amount of high-quality case reports was extraordinary this year, and the on-demand option allows attendees at your convenience access to pre-recorded case reports presented by the authors.

## **Fred Hehre Lecture**

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

## **Gerard W. Osteheimer Lecture**

Always a highlight and one of the most highly anticipated sessions of the meeting, the Gerard W. Osteheimer lecture is a review of important, relevant, and/or practice-changing literature related to obstetric anesthesia, obstetrics, perinatology, and allied medical disciplines that was published in the preceding calendar year (2020). This digestible synthesis of the literature analyzes the clinical impact of published works and latest evidence-based advances in the field of obstetric anesthesia. This year's Osteheimer lecturer will be Dr. Grace Lim.



## **Gertie Marx Research Paper Competition**

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

### **Panel – Why do you Need an OB Anesthesia Fellowship?**

This session—moderated by Dr. Bryan Mahoney and featuring panelists Dr. Agnes Lamon, Dr. Jackie Galvan and Dr. Greg Palleschi—will discuss the importance of an obstetric anesthesia fellowship as a critical element for institutions, advancing your professional skills, and obstetric anesthesia as a specialty.

### **Thrombocytopenia in the Laboring Patient**

Dr. Melissa Bauer and Dr. Roulhac D. Toledano will review the common types of thrombocytopenia during pregnancy and how to perform a bleeding history assessment. They will also discuss how to apply the new SOAP consensus statement to a variety of clinical scenarios.

### **Panel – Disparities in Maternal Care: Providers, Patients and Outcomes**

Dr. Allison Lee, Dr. Cesar Padilla, and Dr. Paloma Toledo will discuss the racial and ethnic disparities in maternal morbidity and mortality as well as inequities related to obstetric anesthesia care in the United States. They will share evidence for structural racism/provider bias in healthcare outcomes and the benefits of diversification of the anesthesia workforce, as well as how to develop a strategic framework for improving equity in maternal health outcomes.

### **Lessons Learned in Obstetric Anesthesia**

In this innovative session, Dr. Joy Hawkins and Dr. Caitlin Sutton will share their reflections on learning the art and science of obstetric anesthesia from their unique perspectives and career paths.

## **CLINICAL TRACK**

### **What's New in Obstetrics Lecture**

Dr. Luis Pacheco will present Tranexamic Acid and Obstetrical Hemorrhage, from the Maternal Fetal Medicine and Surgical Critical Care perspectives.

### **ERAC Update**

Dr. Laurent Bollag and Dr. Carlos Delgado will outline the care elements that compose an enhanced recovery after cesarean (ERAC) delivery pathway and discuss the variances between different societal ERAC guidelines. Opportunities to improve elements of existing enhanced-recovery pathways and formulate strategies to address them will also be identified.

### **COVID/Sepsis Update**

Dr. Emily Naoum and Dr. Arvind Palanisamy will review updates for treating sepsis in the peripartum period and share insights gained from research on COVID in pregnancy. They will share strategies for how, when, and for whom to escalate care, regardless of practice setting.

### **Non-Obstetric Surgery in Pregnancy and the Early Post-partum Period**

Dr. Hans Sviggum and Dr. Valerie Zaphiratos will discuss how the pregnant state influences perioperative care as well as the impact of anesthesia and surgery on teratogenicity and fetal neurodevelopment. Techniques to evaluate both maternal and fetal outcomes following non-obstetric surgery will be reviewed along with how to formulate an anesthetic plan for the pregnant or post-partum woman undergoing non-obstetric surgery.

### **Patient with Placenta Accreta Spectrum Disorder: Where do You Deliver and How do You Do It?**

Dr. Carolyn Weiniger and Dr. Michaela Farber will review managing patients with morbidly adherent placentation, including what types of resources and settings are safest for these patients.



### **The Obese Patient for Obstetric Anesthesia: Identifying Risk Factors in the Preoperative Clinic**

Dr. C. LaToya Mason-Bolden and Dr. Jennifer Dominguez will share strategies to improve care of the obese parturient through a better understanding of associated comorbidities and complications. They will also review how to develop specific measures to increase patient safety and utilize effective communication practices.

### **When Time is of the Essence: Common Emergencies on the Labor & Delivery Floor**

Dr. Alexander Butwick, Dr. Heather Nixon and Dr. Feyce Peralta take a case-based discussion approach to tackle some of the most common obstetric emergencies and the intricacies of system preparation and goal setting. The panelists will share guidelines and personal tips and strategies for system-based improvements for clinical situations involving eclamptic seizures, cord prolapse and postpartum hemorrhage. Be prepared for a lively debate.

### **Labor Analgesia: State of the Art**

Dr. Jeanette Bauchat and Dr. Elizabeth Lange will describe the advantages and disadvantages of non-neuraxial labor analgesia techniques as well as how to delineate evidence-based practices and SOAP Center of Excellence best practices for neuraxial labor analgesia. There will be discussion of which recent articles have been most influential and most controversial in labor analgesia management.

## **PATIENT SAFETY MOCA LECTURES**

### **Airway Management During Pregnancy**

In this session, Dr. Jeremy Collins and Dr. Mary Mushambi will provide an update on airway-related morbidity and mortality during rapid sequence induction (RSI) in the pregnant woman. There will also be discussions on how to improve patient safety by addressing non-technical as well as technical skills.

### **A Unit in Crisis – How Do I Fix It? Patient Safety on Labor and Delivery**

Dr. Rachel Kacmar and Dr. Grant Lynde will present sources of patient safety related metrics and initiatives related to obstetric anesthesia, discuss how to implement quality improvement activity and how attendees can critique their medical practice as it relates to national patient safety initiatives.



# SOAP 2021 Annual Meeting Agenda

\*all time are listed in CST

## THURSDAY, MAY 13

**3:30pm Access to the AccelEvents platform begins**

**4:00-4:15pm Welcome Remarks**

Ruth Landau, MD – SOAP President

Heather C. Nixon, MD - Annual Meeting/Live Events Chair

**4:15-5:15pm Best Case Reports – Top 10**

Moderator: Klaus Kjaer, MD

Panelists: Jaime Daly, MD; Emily Sharpe, MD, Robert Gaiser, MD

Speakers:

1. Post-partum Veno-Venous Extracorporeal Membrane Oxygenation in a COVID-19 patient as a bridge to lung transplantation – *Ioannis Angelidis, MD*
2. Chloroprocaine Labor Epidural for Parturient with Local Anesthetic Resistance - *Michael Brule, MD*
3. Combined Craniotomy and Cesarean Section in an Acutely Neurologically Compromised Parturient - *Jose Andrew Iglesias, MD*
4. Anesthetic Management of a Parturient with Recurrent Pulmonary Artery Sarcoma and Severe Pulmonary Hypertension for Cesarean Section: A Case Report - *Benjamin Houseman, MD*
5. Management of a pregnant patient on dual anti-platelet therapy - *Jiaxin Huang, MD*
6. Urgent Cesarean Delivery of a COVID-19 Parturient in the Intensive Care Unit - *Daniel Kim, MD*
7. Diagnosis of Peripartum Cardiomyopathy Prompted by "Smart" Watch - *Chawla Mason, MD*
8. Acute Fatty Liver of Pregnancy Leading to a Delayed Hepatic Failure Necessitating Liver Transplantation: A Case Report - *Patty Yang, MD*
9. Management of the difficult airway in obstetric patients for cesarean delivery - *Olivia Valencia, MD*
10. Intraoperative POCUS in the management of dilated cardiomyopathy and pericardial effusion for cesarean delivery - *Danielle White, MD*

**5:15-6:15pm What's New in Obstetrics Lecture**

Luis Pacheco, MD

Society of Maternal-Fetal Medicine

Director, Maternal Critical Care Services

Professor, Obstetrics & Gynecology

Professor, Anesthesiology

University of Texas Medical Branch

Galveston, TX

**6:15-6:30pm BREAK and view pre-recorded case reports**

**6:30-7:15pm ERAC Update**

Laurent A. Bollag, MD

Chief, Obstetric Anesthesia

Associate Professor, Anesthesiology and Pain Medicine

University of Washington

Seattle, WA

Carlos Delgado, MD

Assistant Professor, Associate Director Obstetric Anesthesia Division

University of Washington

Seattle, WA



**7:15-8:00pm COVID/Sepsis Update**

Emily Naoum, MD  
Massachusetts General Hospital  
Boston, MD

Arvind Palanisamy, MD  
Associate Professor, Anesthesiology  
Washington University Physicians  
St. Louis, MO

**8:00-8:45pm Non-Obstetric Surgery in Pregnancy and the Early Post-partum Period**

Hans Sviggum, MD  
Medical Director of Obstetric Anesthesiology  
Mayo Clinic  
Rochester, MN

Valerie Zaphiratos, MD  
Hôpital Maisonneuve-Rosemont, Université de Montréal  
Montreal, Quebec  
Canada

**8:45-9:30pm Airway Management During Pregnancy – PATIENT SAFETY**

Jeremy Collins, MD  
Emory University Hospital  
Atlanta, GA

Mary Mushambi, MD  
DAS Professor of Anaesthesia and Airway management  
Leicester, Leicestershire  
United Kingdom



## FRIDAY, MAY 14

3:00 – 4:20pm

### Fellows Case Reports – Concurrent Breakout Rooms

**Moderators:** Corrine Weinstein, MD; Mark Rollins, MD, PhD; Trish Dalby, MD;  
Laura Sorabella, MD; Joy Schabel, MD

#### Room 1: Corrine Weinstein, MD

1. Hazards Associated with Epidural Placement During Labor in Uncontrolled Seizure – *Mohannad Abushora, MD*
2. A Stress Test on the Eye: How Labour and Delivery Can Reveal Hidden Intracranial Pathology - *Yousif Ali, MD*
3. Intraoperative Medication Error and Mishap Mitigation: a Tale of Two Syringes - *Yousif Ali, MD*
4. Sonographic resolution of B-lines after diuresis in a pregnant patient with preeclampsia associated pulmonary edema – *Mohamad Ayoub, MD*
5. Cesarean Hysterectomy in a Patient with Squamous Cell Carcinoma of the Cervix – *Morganne Beard, MD*
6. Epidural Anesthesia for a Parturient with Associated Spina Bifida Occulta, Tethered Cord and Lipomyelomeningocele – *Maria Borrelli, MD*
7. Streptococcus intermedius Ventriculitis in Pregnancy - *Kaitlyn Brennan, MD*
8. Pregnancy Complications in Severe Ehlers Danlos Syndrome: The Issue is the Tissue – *Kaitlyn Brennan, MD*
9. Methamphetamine-associated cardiomyopathy with acute heart failure in the setting of pregnancy – *Sabrina Burn, MD*
10. Anesthetic Management of a patient with Goldenhar syndrome undergoing cesarean delivery and subsequent debridement of mandibular abscess – *Meghan Cook, MD*
11. Labor epidural analgesia in a patient with multifocal acquired demyelinating sensory and motor (MADSAM) neuropathy – *Christopher Cosden, MD*

#### Room 2: Mark Rollins, MD, PhD

12. Laser Division of Subglottic Stenosis in a 28-Year-Old Parturient – *Paul Davis, MD*
13. From Novice to Expert: Beside Echocardiography Using Artificial Intelligence Ultrasound Software for Perioperative Management of a Patient with Hypertrophic Cardiomyopathy – *Angelica Delgado, MD*
14. Volume Overload in a Pregnant Heart Transplant Patient – *Monica DiLorenzo, MD*
15. Neuraxial anesthesia for C-section in a patient with brain Arteriovenous malformation with history of rupture during pregnancy – *Sherif Elsayed Ali Ali, MD*
16. Peripartum Management of a Parturient with Ornithine Transcarbamylase Deficiency – *Robert Ffrench-O'Carroll, MD*
17. An Epidural Knot – *Anna Gabrielian, MD*
18. Puerperium Stroke and Subsequent Tissue Plasminogen Activator-Induced Hemorrhage: A Case Report – *Ryan Hanson, MD*
19. When Real Life Mimics Oral Boards: Massive Venous Air Embolism Detected by End-Tidal CO2 Decrease and Transthoracic Echocardiography During Cesarean Delivery in a Profoundly Thrombocytopenic Patient – *Dan Hoang, MD*
20. Management of Severe Maternal Cardiac Disease for Cesarean Section - *Hanna Hussey, MD*
21. Anesthetic management of a grand multiparous parturient with placenta percreta and severe asthma – *Hebah Ismail, MD*
22. Early Third Trimester Cesarean Delivery in COVID-19 Positive Patient on V-V Extracorporeal Membrane Oxygenation: Clinical and Ethical Considerations – *Paige Keasler, MD*

#### Room 3: Trish Dalby, MD

23. Electroconvulsive Therapy at Term Gestation: Successful Multidisciplinary Management with Unique Challenges – *Paige Keasler, MD*



24. New Diagnosis of Caval Leiomyosarcoma in the Third Trimester of Pregnancy – *Samantha Lu, MD*
25. Anesthetic Management of a Complex Parturient with Holt-Oram Syndrome, Covid-19 pneumonia and Endocarditis – *Jessica Meister Berger, MD*
26. Obstetric Management of a Patient with Osteogenesis Imperfecta Type III – *Jessica Meister Berger, MD*
27. Recurrent Dysautonomia and Pre-Eclampsia in a Grand Multipara – *Vasilije Mijovic, MD*
28. Headache and Facial Palsy in the Early Postpartum Period - *Vasilije Mijovic, MD*
29. Viridans streptococci Bacterial Meningitis Following Neuraxial Anesthesia, Labor and Cesarean Delivery – *Ryan Militana, MD*
30. Post Dural Puncture Headache: Four years review of a Tertiary Maternity Hospital in Qatar – *Umar Mushtaq, MD*
31. Anesthetic Considerations for Conjoined Twins – Separation as a Pediatric Anesthesia Fellow and Delivery as an Obstetric Anesthesia Fellow – *Claire Naus, MD*
32. Peripartum Diagnosis of Currarino Syndrome with Anterior Sacral Meningocele: A Case Report – *Kaitlyn Neumann, MD*
33. Management of pericardial effusion in a pregnant woman-A multi-disciplinary approach - *Shri Vidya Niranjana Kumar, MD*

#### **Room 4: Laura Sorabella, MD**

34. Spontaneous intracranial hypotension in pregnancy treated with a single epidural blood patch: A case report – *Helen Parker, MD*
35. Peripartum hysterectomy for placenta accreta in a patient with situs inversus and scoliosis under combined spinal-epidural anesthesia – *Iakshmi Ram, MD*
36. Stat Breech Delivery in a Patient with Undiagnosed Cardiac Pathology – *Jonathan Rogerson, MD*
37. Born from a Horn: Anesthetic Management of a Primary Cesarean Delivery for Unicornuate Uterine Pregnancy – *Erik Romanelli, MD*
38. Paralysis after a failed spinal: epidural hematoma or conversion syndrome? – *Nayema Salimi, MD*
39. Multimodal pain management for cesarean delivery in a patient with metastatic breast cancer – *Nayema Salimi, MD*
40. Using Shared Decision-Making to Navigate a Complex Obstetric Scenario in a Patient with Contraindications to Intubation and Neuraxial Anesthesia – *Francis Seiler, MD*
41. Mechanical Valve Thrombosis, Acute Myocardial Infarction, and Acute Heart Failure in Late Pregnancy: Pearls and Pitfalls – *Marwa Sidani, MD*
42. Multidisciplinary Management of a Parturient with a Hemorrhagic Renal Mass: A Rare Case of Wunderlich Syndrome in Pregnancy – *Christopher Smith, MD*
43. Management of a Parturient Patient for Urgent Cesarean Section with Acute Posterior Encephalopathy Syndrome – *Derek Sundermann, MD*
44. Cardiac sarcoid and acute worsening of heart block in the parturient, a case report – *Justin Swengel, MD*

#### **Room 5: Joy Schabel, MD**

45. Pharmacologic management of hemorrhage in a COVID positive parturient with HELLP syndrome and a breech twin vaginal delivery, a case report – *Justin Swengel, MD*
46. Grand Multiparous Mother with Phenylketonuria – *Anne Wanaselja, MD*
47. Chiari Conundrum: A Case Report and Literature Review – *Anne Wanaselja, MD*
48. Point of care ultrasound used in management on pulmonary edema in the setting of undiagnosed preeclampsia – *Danielle White, MD*
49. Anesthetic management of a parturient with Marfan Syndrome and scoliosis for cesarean delivery - *Danielle White, MD*
50. A Critical Role for Critical Care Obstetric Anesthesiologists – *Michael Williams, MD*



51. Emergent Cesarean Delivery Secondary to Non-conventional Presentation of Uterine Rupture in a Parturient with Systemic Lupus Erythematosus– *Mike Wong, MD*
52. Elective cesarean delivery in a patient with VACTERL - *Mike Wong, MD*
53. Labor Analgesia Management for a Patient with Gluteal Implant Migration – *Stephanie Woodward, MD*
54. A Case of Atrial Fibrillation Requiring Synchronized Cardioversion on Labor and Delivery - *Lakshmi Nemani, MD*
55. Management of Acute Type-B Aortic Dissection in a Pregnant Woman with Marfan Syndrome and Worsening Pre-eclampsia—A Case Report – *Taylor Ziga, MD*

#### **4:20-4:30pm Distinguished Service Award Presentation**

Introduction: Paloma Toledo, MD, MPH  
 Assistant Professor  
 Feinberg School of Medicine  
 Chicago, IL

Recipient: Cynthia Wong, MD  
 Chair and Department Executive Officer  
 Professor of Anesthesia - Obstetrical Anesthesia  
 Iowa City, IA

#### **4:30 – 5:30pm Research Poster Session #1 – concurrent breakouts**

Moderators: Gillian Abir, MD; Meredith Albrecht, MD; Katherine Arendt, MD; Emily McQuaid-Hanson, MD; Anton Chau, MD; Sharon Reale, MD; John Kowalczyk, MD; Emily Dinges, MD

##### **Room 1 – COVID (Moderator: Meredith Albrecht, MD)**

1. The unrecognized burden of "Persons under Investigation" on obstetric anesthesia services during the COVID-19 pandemic - *Aidan Spring, MD*
2. Obstetric Outcomes of SARS-Cov-2 Positive Parturients with Labor Analgesia - *Alexandria Lehrmann, MD*
3. Anaesthetic considerations and outcomes in 90 pregnant women with coronavirus disease 2019: a prospective observational study - *Olivia Sherwood, MD*
4. SARS-CoV-2 Infection Does not Affect the Incidence and Severity of Preeclampsia with Severe Features: A prospective observational study of 106 pregnant patients - *Yunping Li, MD*
5. Excess maternal deaths associated with coronavirus disease 19 (COVID-19) in Mexico during 2020 - *Mario Lumbreras-Marquez, MD*
6. Differences Between Neonatal Outcomes in Symptomatic and Asymptomatic COVID19 Positive Patients – *Kristine Spicer Lane*
7. Virtual compared to in-person obstetric anesthesiology trainee education during the COVID-19 pandemic - *Kelly Fedoruk, MD*

##### **Room 2 – International (Moderator: Katherine Arendt, MD)**

1. Anesthesia for cesarean delivery in Africa: a review of publications (2010-2021) – *Anjan Saha, MD*
2. Can epidural labor analgesia reduce the cesarean section rate? – *Karunakaran Ramaswamy, MD*
3. The Influence of a Kybele Teaching Program on the Use of Regional Anesthesia for Labor and Cesarean Delivery, During COVID-19 Pandemic, in Tuzla, Bosnia and Herzegovina – *Ivan Velickovic, MD*
4. Obstetric anesthesia practice and outcomes in low and middle-income countries: a review of publications – *Anjan Saha, MD*
5. A systematic review of patient-reported outcome measures used to assess global outpatient postpartum recovery using COSMIN guidelines – *Perman Pandai, MD*
6. A systematic review of patient-reported outcome measures used to assess sleep in postpartum women using COSMIN guidelines - *Perman Pandai, MD*



### **Room 3 – Hemoglobin, Hemorrhage and Transfusion (Moderator: Sharon Reale, MD)**

1. Effect of Oral Iron Therapy on Hemoglobin Levels prior to Delivery in Pregnant Inpatients with Anemia – *Claire Spradling, MD*
2. Retrospective Review of Peripartum Blood Transfusion Practices – *Maria Borrelli, MD*
3. TOP MOM: Treatment and Optimisation of Iron Deficiency Anemia in Peripartum Women – *Anne Lavoie, MD*
4. Use of labor neuraxial analgesia and reduced risk of blood transfusion among women who delivered vaginally in the United States, 2017-2018 – *Jean Guglielminotti, MD*
5. Development of a Clinical Risk Prediction Model for Uterine Atony – *Katilyn Brennan, MD*
6. Uterine atony during intrapartum cesarean delivery: a retrospective cohort study – *Jessica Ansari, MD*

### **Room 4 – Post Delivery Outcomes (Moderator: Emily McQuaid-Hanson, MD)**

1. Proposed domains for postpartum recovery: A concept elicitation study – *Perman Pandal, MD*
2. Long-Term Symptoms Following inadvertent dural puncture: A Systematic Review and Meta-analysis – *Sierra Mims, MD*
3. A High Incidence of Inadequate Anesthesia for Postpartum Tubal Ligation – *Maria Sheikh, MD*
4. Prospective study to assess relationship of a postpartum recovery survey (ObsQoR-10) within 24 hours and mode of delivery – *Din Ben Hayoun, MD*
5. Association of 24 hour postpartum recovery with depression and quality of life measures at 6 and 12 weeks: A prospective observational study – *Din Ben Hayoun, MD*
6. Acute Pain and Ambulation after Vaginal Delivery With or Without Neuraxial Analgesia: A Prospective Cohort Study – *Ayumi Maeda, MD*
7. Racial and ethnic disparities in epidural blood patch utilization for postdural puncture headache among obstetric patients – *Anne-Sophie Janvier, MD*

### **Room 5 – Hypertensive Disorders of Pregnancy (Moderator: Gillian Abir, MD)**

1. Weight-related Disparities in Acute Treatment of Severe Hypertension in the Postpartum Period – *Amal Javaid, MD*
2. Understanding the Effect of Different Short Acting Anti-hypertensives on the Time to Resolution of Severe Sustained Postpartum Hypertension Stratified by BMI - *Amal Javaid, MD*
3. Trends in Eclampsia in the United States, 2009 to 2017: A population-based study – *Zixuan Xiao, MD*
4. Association between Intrapartum Magnesium Administration and Incidence of Maternal Fever in Preeclamptic Parturients: A Retrospective Study – *Samantha Lu, MD*
5. Racial Differences in Cardiovascular Complications Following Cesarean Delivery in Women with Preeclampsia in the United States – *Marie Louise Meng, MD*
6. Extracellular Vesicles from Women with Severe Pre-eclampsia Impair Vascular Endothelial Function – *Hanna Hussey, MD*
7. Extracellular vesicle Vasoconstrictor is a Vascular Protectant: Downregulation as a Mechanism for Preeclampsia Induced Vascular Dysfunction - *Hanna Hussey, MD*

### **Room 6 – Practice Improvement (Moderator: John Kowalczyk, MD)**

1. Cesarean Section Under General Anesthesia: Why our Incidence Greater Than 5%? - *Mark Wise, MD*
2. Implementation of the oxytocin 'rule of threes' algorithm for cesarean section in a Japanese tertiary hospital: a retrospective cohort study using propensity score matching – *Serabi Tanabe, MD*
3. Neuraxial Ultrasound Educational Card for Preprocedural Ultrasound Use on Labor and Delivery – *Ryan Militana, MD*
4. Cost of Care of COVID-19 Positive Parturients Delivered with Labor Epidural Analgesia – *Iakshmi Ram, MD*
5. Candidate Gene Association Study of Severe Acute Pain Following Cesarean Section – *Johanna Cobb, MD*



6. Association of acute kidney injury and adverse maternal outcomes: a multistate analysis, 2007-2018 – *Angelica Delgado, MD*
7. *Time of greatest decisional conflict about labor analgesia in pregnancy: a survey study* – *Arthur Chyan, MD*

#### **Room 7 – Placenta Accreta Spectrum (Moderator: Emily Dinges, MD)**

1. Neuraxial to general anesthesia conversion has equitable intraoperative and improved postoperative outcomes compared to general anesthesia in cesarean hysterectomy for Placenta Accreta Spectrum (PAS) – *Jessian Munoz, MD*
2. Application of the Surgical APGAR Score (SAS) to predict intensive care unit admission and post-operative outcomes in cesarean hysterectomy for Placenta Accreta Spectrum (PAS) - *Jessian Munoz, MD*
3. Selection of general anesthesia negatively impacts neonatal outcomes in cesarean hysterectomies for placenta accreta spectrum - *Jessian Munoz, MD*
4. Carbetocin versus oxytocin following vaginal and cesarean delivery: a before-after study – *Ahmad Ben Tareef, MD*
5. Impact of oxytocin administration prior to cesarean hysterectomy for placenta accreta spectrum – *Sarah Watson, MD*
6. Comparison of Carbetocin administration as a Bolus or as an Infusion on maternal heart rate using a phenylephrine infusion for cesarean delivery under spinal anesthesia - *Christian Loubert, MD*
7. Cesarean Hysterectomy for Placenta Accreta Spectrum: Comparison of Two Management Strategies – *Laurence Ring, MD*

#### **Room 8 – Epidural Analgesia (Moderator: Anton Chao, MD)**

1. The Effects of Bolusing Fentanyl Through the Labor Epidural Upon Initiation of Labor Epidural Analgesia – *Joshua Younger, MD*
2. Evaluation of the Safety of Labor Analgesia Initiated with Low-Dose Local Anesthetic Injection Through Epidural Needle Prior to Epidural Catheter Placement – *Justin Newman, MD*
3. Labour Epidural Information cards in multiple languages – A survey for the necessity and ensuring availability – *Harikumar Sivakumar, MD*
4. To PIE (B) or not to PIE (B)? - A prospective audit of patient controlled epidural analgesia (PCEA) efficacy for labour at a large tertiary centre – *Catherine Lloyd, MD*
5. Gravity Flow Technique to Validate Proper Location of Epidural Needle Tip in High BMI Parturients – *Jeffery Bernstein, MD*
6. Timing of epidural catheter insertion and removal in laboring patients with thrombocytopenia – *David He, MD*

#### **5:30-6:15pm Patient with Placenta Accreta Spectrum Disorder: Where do You Deliver and How do You Do It?**

Michaela Farber, MD

Assistant Professor, Harvard Medical School  
Fellowship Program Director and Associate Chief, Division of Obstetric Anesthesiology  
Brigham & Women's Hospital  
Boston, MA

Carolyn Weiniger, MD

Director, Obstetric Anesthesia Unit  
Division of Anesthesia, Critical Care and Pain  
Tel Aviv Sourasky Medical Center  
Safed Area, Israel



**6:15-6:30pm BREAK and view pre-recorded case reports**

**6:30-7:15pm The Obese Patient for OB Anesthesia: Identifying Risk Factors in the Preoperative Clinic**

C. LaToya Mason-Bolden, MD, FASA  
University of Mississippi Medical Center  
Jackson, MS

Jennifer E. Dominguez, MD  
Associate Professor of Anesthesiology  
Program Director Obstetric Anesthesiology Fellowship Program  
Duke University Medical Center  
Durham, NC

**7:15-8:00pm When Time is of the Essence: Common Emergencies on the Labor & Delivery Floor**

Moderator: Feyce Peralta, MD

Speakers:

Alexander Butwick, MD  
Professor of Anesthesiology, Perioperative and Pain Medicine (OB)  
Stanford University Medical Center  
Stanford, CA

Heather Nixon, MD  
Associate Head of Education  
University of Illinois College of Medicine  
Chicago, IL

**8:00-8:45pm Labor Analgesia: State of the Art**

Jeanette Bauchat, MD  
Chief , Obstetric Anesthesiology  
Associate Professor , Obstetric Anesthesiology  
Vanderbilt University Medical Center  
Nashville, TN

Elizabeth Lange, MD  
Assistant Professor  
Northwestern University  
Chicago, IL



## SATURDAY, MAY 15

8:15 – 9:00am

### Case Reports Session #1 – Concurrent Breakouts

**Moderators:** David Stahl, MD; Manny Vallejo, MD; Naida Cole, MD

#### Room 1: David Stahl, MD

1. Type A Aortic Intramural Hematoma in a Parturient with Marfan Syndrome – *Willie Agee, MD*
2. Holistic care of transgender patients on the Labor and Delivery Floor: a case report – *Miriam Alghothani, MD*
3. Neuraxial Anesthesia for Cesarean Section with Unrepaired Tetralogy of Fallot - *Karishma Batra, MD*
4. Anesthetic Management of Granulomatosis with Polyangiitis in Pregnancy – *Sara Boldt, MD*
5. Allergic to the cold? Cold urticaria in a parturient and implications for anesthetic management – *Anjali Doshi, MD*
6. Maternal Death due to Multi-organ Failure secondary to COVID infection in the second trimester - *Mohit Garg, MD*
7. Multiple Epidural Attempts and Placements in a Morbidly Obese Parturient with Normal Thrombocytes Levels Resulting in Emergent Spinal Epidural Hematoma Decompression – *Liliana Goelkel Garcia, MD*

#### Room 2: Manny Vallejo, MD

8. Unexpected Thrombocytopenia in a Parturient with Evans Syndrome Complicated by COVID-19 Infection -*Shuchi Jain, MD*
9. Management of Urgent Pre-Term Cesarean Delivery in a Parturient with Prior Lung Resection, Severe Progressive Peripartum Cardiomyopathy and Pulmonary Hypertension – *Taimoor Khan, MD*
10. Inhaled Tranexamic Acid for Management of Hemoptysis in a Parturient with Severe Cystic Fibrosis - *Sung Kim, MD*
11. Two Zebras in One: Management of a Parturient with Full-Term Submassive Pulmonary Embolism and Undiagnosed Placenta Accreta Spectrum – *Joseph Klaus, MD*
12. Obstructive, Non-Toxic Goiter in Morbidly Obese Parturient with an “Impossible-to-Intubate” Airway - *Eva Martinez, MD*
13. Bilateral Paraparesis After Cesarean Section Under Combined Spinal Epidural and Transversus Abdominus Plane Block – *Logan Fairchild, MD*
14. Anticoagulation During Labor Epidural in Patient with History of Transposition of the Great Arteries Status Post Mustard Procedure – *Daniel O'Reilly, MD*

#### Room 3: Naida Cole, MD

15. Pregnancy-related Spontaneous Coronary Artery Dissection: A Tale of Two Outcomes – *Max Schubert, MD*
16. Shared decision-making in the management of a medically complex parturient with CML and high thrombotic risk – *Margaret Smith, MD*
17. Suspected Case of Amniotic Fluid Embolism Complicated by Undiagnosed Patent Foramen Ovale – *Yasmin Sritapan, MD*
18. Failed Uterine Artery Embolization x2 Resulting in Hysterectomy - *Arjun Varadarajan, MD*
19. Common Immunologic Underpinnings for Amniotic Fluid Embolism and Reversible Cerebral Vasoconstriction Syndrome after Cell Salvage: A Case Report and Pathophysiology Review – *Anne Wanaselja, MD*
20. Unusual leg pain in pregnancy - a case report of acute compartment syndrome – *Simon Wydall, MD*
21. Anterior Mediastinal Mass and Cardiac Tamponade in Pregnancy – *Alix Zuleta Alarcon, MD*



**9:00-9:15am**

**Opening Remarks**

Ted Yaghmour, MD – SOAP Vice President

**9:15-10:15am**

**Oral Presentations #1**

Moderator: Thomas Klumpner, MD

Speakers:

1. Post-cesarean analgesia with epidural morphine following epidural 2-chloroprocaine - *Linden Lee, MD*
2. Effect of Dexmedetomidine as an adjuvant in Quadratus Lumborum block in patients undergoing caesarean section- A randomized controlled study. – *Neha Singh, MD*
3. High flow humidified nasal oxygen versus face mask oxygen for preoxygenation of pregnant women – a prospective randomized controlled crossover study – *Patrick Tan, MD*
4. Heart rate variability (HRV) can identify parturients at risk for maternal hypotension and fetal bradycardia following combined spinal epidural analgesia (CSEA) – *Shunsuke Hygwa, MD*
5. Treatment of Hypertension in Pregnancy: A Network Meta-Analysis of Randomized Control Trials – *Paige Keasler, MD*
6. Bupivacaine Pharmacokinetics After Labor Epidural Analgesia, Intrapartum Cesarean Delivery Anesthesia, and Transversus Abdominis Plane Block With Liposomal Bupivacaine – *Daniel Katz, MD*

**10:15-11:45am**

**Gertie Marx Research Competition**

Moderator: Richard Smiley, MD

Judges: Joanna Kountanis, MD; Ruth Landau, MD; Brendan Carvalho, MD;

Phil Hess, MD; Allison Lee, MD

Speakers:

1. The Effect of High Dose versus Low Dose Epidural Fentanyl on Gastric Emptying in Non-Fasted Parturients: A Double-Blinded Randomized Controlled Trial - *Elisheva Fiszer, MD*
2. Maternal Tranexamic Acid Plasma Concentration and Coagulation Status During Cesarean Delivery – *Sara Seifert, MD*
3. Carbetocin vs Oxytocin at elective cesarean deliveries: a double-blind, randomized controlled non-inferiority trial of high and low dose regimens – *Fergal McDonagh, MD*
4. The ED90 of intrathecal chloroprocaine for cervical cerclage placement: an up-down sequential allocation dose-response study – *Riley Landreth, MD*
5. Review of post C-Section Analgesia during Covid Crisis: Bilateral TAP (Tranversus Abdominis Plane) blocks with liposomal bupivacaine and neuraxial morphine reduces use of narcotics and length of stay – *Jason Kim, MD*
6. Use of WhatsApp to improve high risk obstetric referrals in Accra, Ghana – *Hebah Ismail, MD*

**11:45am-12:30pm**

**Why Do You Need an OB Anesthesia Fellowship?**

Moderator: Bryan Mahoney, MD

Speakers: Agnes Lamon, MD

Director of Obstetric Anesthesia  
Penn Medicine Princeton Health  
Princeton, NJ

Greg T. Palleschi, MD

North Shore University Hospital  
Dix Hills, NY



Jackie Galvan, MD

Associate Professor of Clinical Anesthesia  
The University of Illinois College of Medicine

**12:30-1:00pm**

**LUNCH and view pre-recorded case reports**

**1:00-2:00pm**

**Gerard W. Ostheimer Lecture**

Introduction: Ron George, MD

Speaker: Grace Lim, MD, MD

Associate Professor  
Chief, Division of Obstetric & Womens Anesthesiology  
Magee-Womens Research Institute BIRCWH Scholar  
Faculty, Magee-Womens Research Institute  
University of Pittsburgh  
Pittsburgh, PA

**2:00-2:15pm**

**BREAK and view pre-recorded case reports**

**2:15 - 3:45pm**

**SOAP/ASRA Panel**

Moderator: Ruth Landau, MD

Panelists: Lisa Leffert, MD

Samer Narouze, MD, PhD

Britany Raymond, MD

Stuart Grant, MD

**3:45-4:30pm**

**Thrombocytopenia in the Laboring Patient**

Melissa E. Bauer, DO

Associate Professor of Anesthesiology  
Duke University School of Medicine

Roulhac D. Toledano, MD. PhD

Clinical Associate Professor, Department of Anesthesiology  
Perioperative Care, and Pain Medicine at NYU Grossman School of Medicine  
Brooklyn, NY

**4:30-5:15pm**

**Disparities in Maternal Care: Providers, Patients and Outcomes**

Allison Lee, MD

Columbia University  
New York, NY

Cesar Padilla, MD

Clinical Assistant Professor  
Stanford University School of Medicine  
Stanford, CA

Paloma Toledo, MD

Northwestern Medicine  
Chicago, Illinois

**5:15-5:30pm**

**BREAK**

**5:30 -6:30pm**

**Social Event – Charcuterie Class & Reception**

**5:30 -6:30pm**

**Fellows Reception**



## SUNDAY, MAY 16

8:15 – 9:00am

### Case Reports Session #2 – Concurrent Breakouts

Moderators: **Erin Haggerty, MD, Amy Lee, MD, Kristen Vanderhoef, MD**

#### Room 1: Erin Haggerty, MD

1. Case report: Hypofibrinogenemia and neuraxial for elective cesarean section – *Kevin Barkley, MD*
2. Anesthetic Management Of A Parturient With Charcot-Marie-Tooth Disease – *Yveline Blot, MD*
3. Failed intrathecal catheter in a parturient with primary pulmonary hypertension and history of spinal fusion for scoliosis – *Paulina Cardenas, MD*
4. Case report of a parturient with coronary artery fistula: a multidisciplinary approach – *Meghan Cook, MD*
5. Undiagnosed Thrombotic Thrombocytopenic Purpura In The Setting Of An Urgent Primary Cesarean Section – *Paula Escobar, MD*
6. To Delay or Not to Delay: Cesarean Delivery in an Extremely Dyspneic Parturient with a Massive Anterior Mediastinal Mass – *David Gutman, MD*
7. Venous Air Embolism Mediated Near-Cardiac Arrest During Cesarean Delivery for Placenta Accreta – *David Gutman, MD*

#### Room 2: Amy Lee, MD

8. Challenges in the management of the parturient with hyperosmolar hyperglycemic state complicated by intrauterine fetal demise, septic shock and stress-induced cardiomyopathy – *Christian Hurst, MD*
9. Anesthetic Management of a Parturient with Nemaline Myopathy – *Allison Lee, MD*
10. Successful Cesarean Delivery of a Coronavirus Positive Patient with Hypoplastic Right Ventricle and Pulmonary Atresia at 27 Weeks' Gestation – *William Trudo, MD*
11. Eclamptic Seizure Prophylaxis in patients with renal failure – *Rudo Makonza Goto, MD*
12. Maternal exhaustion or hyponatremia: delay in diagnosis – *Christine McKenzie, MD*
13. Urgent Cesarean Birth for Worsening Pulmonary Hypertension Performed in Intensive Care Unit under Combined Spinal-Epidural case report – *Teshi Kaushik, MD*
14. Parturient with Jarcho-Levin Syndrome Managed Successfully for a Full-term Delivery with Labor Neuraxial Analgesia – *Erik Romanelli, MD*

#### Room 3: Kristen Vanderhoef, MD

15. Pre-eclampsia associated bilateral serous retinal detachments diagnosed on bedside ultrasound – *Jessica Sheeran, MD*
16. Persistent Vegetative State and 24 Weeks Pregnant: A Clinical and Ethical Dilemma - *Kathleen Smith, MD*
17. Patient-Centered Management of a COVID+ Pregnant Pediatric Patient with Fetal Congenital High Airway Obstruction Syndrome – *Caitlin Sutton, MD*
18. Massive Transfusion Protocol for Uterine Rupture in a Preterm Obstetric Patient with Suspected Cornual Pregnancy - *Amy Walker, MD*
19. Takotsubo's Cardiomyopathy and Spontaneous Coronary Artery Dissection in a 40-year-old Postpartum Patient with Cardiogenic Shock - *Gabriel Washington, MD*
20. Labor Epidural Analgesia for a Patient with Brugada Syndrome – *Lawrence Weinstein, MD*



<b>9:00-9:15am</b>	<b>Opening Remarks</b> Klaus Kjaer, MD, MBA - Legacy Director
<b>9:15-10:15am</b>	<b>Oral Presentations #2</b> Moderator: Philip Hess, MD Speakers: <ol style="list-style-type: none"> <li>1. Which continuous monitor should we use for accurate detection of postoperative apnea events? – <i>Mohamed Elgamal, MD</i></li> <li>2. Comparing the use of Quantra vs. Rotational Thromboelastometry for Point of Care Viscoelastic Testing – <i>Nayema Salimi, MD</i></li> <li>3. Peripartum magnesium sulfate in preeclampsia: effect on postpartum endothelial function and blood pressure in early versus late onset preeclampsia – <i>Samantha Parsons, MD</i></li> <li>4. Association of obstructive sleep apnea with body fluid distribution in pregnant women with obesity – A prospective observational pilot study – <i>James Wicker, MD</i></li> <li>5. Anesthesia work force capacity and maternal mortality in low and middle-income countries – <i>Anjan Saha, MD</i></li> <li>6. The clinical tolerability and pharmacokinetics of intraperitoneal chloroprocaine administered to peripartum women – <i>Brandon Togioka, MD</i></li> </ol>
<b>10:15-11:00am</b>	<b>Fred Hehre Lecture</b> Introduction: Rebecca Minehart, MD, MSHPEd Speaker: May Pian-Smith, MD, MS Massachusetts General Hospital Boston, MA
<b>11:00-11:15am</b>	<b>BREAK and view pre-recorded case reports</b>
<b>11:15-11:30am</b>	<b>American Society of Anesthesiologists (ASA) President-Elect Address</b> Randall M. Clark, M.D., FASA President Elect, American Society of Anesthesiologists Professor of Anesthesiology, University of Colorado School of Medicine Pediatric Cardiac Anesthesiologist, Children's Hospital Colorado Aurora, Colorado
<b>11:30am-12:15pm</b>	<b>A unit in crisis --how do I fix it? Patient Safety on Labor and Delivery – PATIENT SAFETY</b> Rachel Kacmar, MD Associate Professor, Anesthesiology University of Colorado Anschutz Medical Campus Denver, CO Grant Lynde, MD Emory University Atlanta, GA
<b>12:15-1:00pm</b>	<b>LUNCH</b>



**1:00-1:45pm**

**Lessons Learned in OB Anesthesia**

Joy Hawkins, MD

Professor and Director of Obstetric Anesthesiology  
University of Colorado  
Denver, CO

Caitlin Sutton, MD

Chief, Division of Maternal-Fetal Anesthesiology  
Texas Children's Hospital, Baylor College of Medicine  
Houston, TX

**1:45-3:15pm**

**Best Paper Competition**

Moderator: Cynthia Wong, MD

Judges: Arvind Palanisamy, MD; Jill Mhyre, MD; Daniel Katz, MD; Jose Carvalho, MD;

Speakers:

1. A Randomized, Double-Blind, Placebo-Controlled Trial of Outpatient Gabapentin to Reduce Persistent Pain and Opioid Use in Women Suffering from Severe Pain after Cesarean Delivery - *Cedar Fowler, MD*
2. Treatment of Shivering After Cesarean Delivery Under Epidural Anesthesia During Labor : Dexmedetomidine vs Meperidine – *Gabriel Paquin-Lanthier, MD*
3. A Randomized Controlled Trial of Dural Puncture Epidural versus Standard Labor Epidural Technique in Parturients with Obesity - *Olga Diomedee, MD*
4. Magnesium sulfate bioavailability and clearance after intramuscular dosing in women with preeclampsia - *Kathleen Brookfield, MD*
5. Appetite regulation in pregnancy: peripheral and central leptin and melanocortin neuropeptides - *Richard Smiley, MD*
6. Association between labor neuraxial analgesia and reduced odds of severe maternal morbidity among women who delivered vaginally in New York State hospitals, 2010-2016. - *Jean Guglielminotti, MD*

**3:15-4:15pm**

**Research Poster Session #2 – Concurrent Breakouts**

Moderators: Ron George, MD; Barbara Scavone, MD;

Moderators: Pamela Flood, MD; Yaakov Beilin, MD; Ashraf Habib, MD; Pervez Sultan, MD; Christine Warrick, MD; David Gambling, MD; Mark Zakowski, MD

**Room 1 – Practice Improvement and Pain Control (Moderator: Christine Warrick, MD)**

1. The association between patient satisfaction and inadequate regional anesthesia for cesarean delivery: a prospective observational study – *Michael Hofkamp, MD*
2. Effect of implementation of perineal tear pain management program on pain scores – *Karunakaran Ramaswamy, MD*
3. Acute pain intensity and opioid dose requirement after cesarean delivery in parturients with pre-existing chronic pain – *Ryu Komatsu, MD*
4. Informed Consent in Obstetric Anesthesiology: Resident Practices and Education to Improve Quality of Consent – *Jessica Meister Berger, MD*
5. Evaluating racial/ethnic inequities in the utilization of liposomal bupivacaine truncal blocks following cesarean delivery – *Christine McKenzie, MD*
6. Comparative Effectiveness of First-Dose Oral Versus Intravenous Acetaminophen for Cesarean Delivery Analgesia: A Prospective Interrupted Time Series Trial – *Francesca Jung, MD*



### **Room 2 – Cesarean Delivery: Maternal & Fetal Outcome (Moderator: Mark Zakowski, MD)**

1. A Retrospective study to evaluate the effect of anaesthesia technique on foeto maternal safety among women with cord prolapse undergoing category one cesarean section – *Varsha Tipparaju, MD*
2. Impact of Post Anesthesia Position on Post Spinal Hemodynamic Variables in Elective Cesarean Sections – *Iakshmi Ram, MD*
3. Validation of a Portuguese version of the Obstetric Quality of Recovery-10 (ObsQoR-10) instrument – *Ricardo Vieira Carlos, MD*
4. Effect of Prophylactic Phenylephrine versus Noradrenaline Infusions on Funic Gases in Healthy Women for Elective Low Risk Caesarean Delivery: A Randomized, Double-Blind Trial – *Apoorva Singh, MD*
5. Reducing Cesarean Section Surgical Site Infections: Multidisciplinary Implementation of a Novel Bundle within an Integrated Health Care System – *Eric Hunt, MD*
6. Association Between Unscheduled Procedure and Poor Postpartum Recovery in Cesarean Delivery Patients: A prospective observational cohort study – *Cyrus Bhiladvala, MD*
7. Quality Improvement Survey Study of Obstetric Anesthesia Personnel with STAT C-Section Kit and Its Use in Preventing Inappropriate Practices When Preparing Medications – *Edward Kalaidjian, MD*

### **Room 3 – Miscellaneous (Moderator: Ashraf Habib, MD)**

1. Obstetric Anesthesia Workload and Facility Utilization of SOAP Centers of Excellence Designated Institutions - *Mary Im, MD*
2. Obstetric and anesthetic management of deliveries in women with a Fontan circulation: single centre experience and trends in practice over the past 21 years – *Aidan Spring, MD*
3. Association between Diastolic Function Parameters and Obstructive Sleep Apnea in Morbidly Obese Pregnant Women – *Olga Diomedes, MD*
4. Association of Medicaid Expansion with the Provision of Neuraxial Labor Analgesia: A Retrospective Cross-sectional Analysis – *Dylan Whitney, MD*
5. Anesthetic Management of Parturients with Vascular Malformations – *Stephen Ellwood, MD*
6. Uterine Exteriorization Versus In Situ Repair of Hysterotomy During Cesarean Delivery: A Systematic Review, Equivalence Meta-Analysis, and Trial Sequential Analysis – *Adithya Bhat, MD*
7. Preventing Postpartum Hemorrhage After Cesarean Delivery: A Network Meta-Analysis of Available Pharmacologic Agents – *Danish Jaffer, MD*

### **Room 4 – Neuraxial Labor Analgesia (Moderator: Barbara Scavone, MD)**

1. The rate of maternal fever does not differ between women receiving continuous spinal versus continuous epidural labor analgesia – *Francis Seiler, MD*
2. Racial and ethnic disparities in obstetric anesthesia: a review of the literature (2004-2021) – *Chloe Kern, MD*
3. Labor Epidural with Dural Puncture Reduces Catheter Replacement Rates when Compared to Epidural without Dural Puncture – *Amnon Berger, MD*
4. The Interaction of Programmed Intermittent Epidural Bolus Flow Rate and Time Interval on Labor Analgesia Quality: A Prospective, Randomized, Double-Blind Study of Three Pump Settings – *Charlie Prior, MD*
5. Anesthetic Outcomes of the Dural Puncture Epidural Technique: A Retrospective Cohort Study – *Ayumi Maeda, MD*
6. Labour epidural made safe – *Tam Al-Ani, MD*
7. Association Between Documentation Accuracy and Number of Neuraxial Placement Attempts and Redirections: A Prospective Observational Study – *Yousif Ali, MD*



### **Room 5 – Practice Improvement/Physiology (Moderator: Ron George, MD)**

1. Implementation of an electronic alert notification platform for a maternal early warning system – *Gillian Abir, MD*
2. A cost-savings comparison between disposable and reusable pulse oximetry sensors in labor and delivery operating rooms – *Emily Stockert, MD*
3. Which tracks MV better, TV or RR for assessment of ventilatory function in postoperative patients? - *Mohamed Elgamal, MD*
4. Central cortisol regulation in pregnancy – *Richard Smiley, MD*
5. A Peripheral Immune Signature of Acute Labor – *Kazuo Ando, MD*
6. Intrathecal Bupivacaine Dosing for Transvaginal Cervical Cerclage: A Retrospective Analysis – *Sierra Mims, MD*
7. Intrathecal Bupivacaine versus Chloroprocaine for Transvaginal Cervical Cerclage: A Retrospective Analysis - *Sierra Mims, MD*

### **Room 6 – Practice Improvement/a-Adrenergic Agonists (Moderator: Yaakov Beilin, MD)**

1. Introduction of a pre-procedural checklist to enhance compliance with anesthesia medication safety in the labor and delivery room – *Johanna Cobb, MD*
2. Use of Intrathecal Dexmedetomidine in Caring for Pregnant Women who have Opioid Use Disorder Undergoing for Cesarean Delivery – *Yunping Li, MD*
3. Effect of Neuraxial Clonidine on Post-Cesarean Opioid Consumption and Pain Scores in Parturients on Chronic Buprenorphine Therapy: a Retrospective Cohort Study – *Michael Taylor, MD*
4. Cognitive Aid for Maternal Cardiovascular Life Support in Corona Virus Disease-19 Infection: A Simulation-Based Development of New Clinical Pathway – *Vandana Vaishnav, MD*
5. Dexmedetomidine as an Adjunct to Neuraxial Anesthesia in Cesarean Delivery: A Retrospective Chart Review – *Paul Davis, MD*
6. Predictive performance of 3 risk-assessment tools for postpartum hemorrhage after vaginal delivery: A nested case-control study using quantitative blood loss – *Arthur Chyan, MD*
7. Labor & Delivery Operating Room Staffing and Operating Efficiency Using Queueing Theory – *Grace Lim, MD*

### **Room 7 – Practice Improvement and Teamwork (Moderator: David Gambling, MD)**

1. Standardizing the Approach to Epidural Placement to Reduce Time to Epidural Completion: A Quality Improvement Project – *Kaitlyn Brennan, MD*
2. Questionnaire on Management of Unwitnessed Disconnected Labor Epidurals – *Rustin Roberts, MD*
3. Nutritional preferences of women during labor: a survey study – *Geoffrey Liang, MD*
4. High Dependency Unit on the Labor and Delivery Floor - *Rustin Roberts, MD*
5. Using verbal and physical cues to identify temporary co-leaders during an obstetrical critical event in the operating room – *Grace Shih, MD*
6. Anesthesia and Nursing Leadership During an Obstetrical Critical Event Enhances Communication, Performance, and Teamwork - *Grace Shih, MD*



### **Room 8 – Maternal-Fetal Health (Moderator: Pamela Flood, MD)**

1. Mitochondrial dysfunction accompanies placental aging and promotes labor onset – *Erin Ciampa, MD*
2. A Cellular Model of Placental Aging – *Padraich Flahardy, MD*
3. Combined Spinal-Epidural and Fetal Heart Rate Monitoring: Time to Reevaluate the Use of Intrathecal Fentanyl – *Javier Pílania Guetierrez, MD*
4. Effect of enhanced recovery after surgery for elective cesarean deliveries on neonatal outcomes – *Khadija Razzaq, MD*
5. Correlating Prenatal and Delivery Platelet Count Values in Obstetric Patients: Clinical Utility of Reflexive Admission Laboratory Assessments – *Michelle Yanik, MD*
6. The association between umbilical cord, maternal and neonatal sodium concentration: using cord gas analysis to expedite a diagnosis of peripartum hyponatraemia – *Louis Carlson-Hedges, MD*

### **Room 9 – POCUS/Fetal Interventions (Moderator: Pervez Sultan, MD)**

1. Maternal Pain Management for Fetal Myelomeningocele Repairs: From Fetal Surgery to Delivery – *Claire Naus, MD*
2. Review of anesthetic management of minimally invasive fetal interventions for complex monochorionic pregnancies – *Meryl William, MD*
3. Ultrasound-assisted versus landmark-based spinal block performance in emergency caesarean delivery in obese patients at a central hospital – a randomised controlled trial – *Bojan Korda, MD*
4. Importance of Forward Leaning in Optimizing Sitting Position for Administration of Labor Neuraxial Analgesia in Term Parturients: An Ultrasonographical Study – *Jie Zhou, MD*
5. A multicenter interdisciplinary national survey of practices and perceptions regarding oral intake during labor – *Elisheva Fiszer, MD*
6. Ultrasound Image Quality Comparison between an Inexpensive Handheld Ultrasound Machine and a Large Mobile Ultrasound – *Nayema Salimi, MD*
7. Echocardiography During Active Labor - Initial Observations and Protocol Implementation – *Piranthini Suntharalingam, MD*

**4:15-5:15pm**

**Closing Reception & Award Ceremony**



# Pre-Recorded Presentations

1. Neuroaxial Block in pregnant women with Pseudotumor Cerberi- *Mohannad Abushora, MD*
2. LSCS after 5 weeks & 4 days of Percutaneous transluminal coronary angioplasty/ Drug eluting stent Anesthesiologist's Dilemma - *Megha Agrawal, MD*
3. Anesthetic Management of a Parturient with Glanzmann's Thrombasthenia - *Saamia Alam, MD*
4. Lumbar Neuraxial Ultrasound Made Easy - *Tam Al-Ani, MD*
5. Use of epidural catheter for emergent hysterectomy immediately after prophylactic epidural blood patch: not our usual practice! - *Mariam Ashraf, MD*
6. Successful External Cephalic Version and Anesthesia Management in a Patient with Repaired Tetralogy of Fallot - *Mohamad Ayoub, MD*
7. Anesthetic Management of a Parturient with Fontan Circulation - *Mariam Batakji, MD*
8. Anesthetic considerations for cesarean section in a parturient with multiple uncommon co-morbidities - *Ali Bazzi, MD*
9. Reduction in massive postpartum haemorrhage and red blood cell transfusion during a national quality improvement project, Obstetric Bleeding Strategy for Wales, OBS Cymru: an observational study - *Sarah Bell, MD*
10. Induction of Labor for a Primigravid Patient with Propionic Acidemia - *David Bennett, MD*
11. Severe Right Ventricular dilatation and Pulmonary Hypertension caused by a large ASD: Obstetric Anesthesia Management - *Michael Beshara, MD*
12. Life Threatening Labial Hematoma - *Callan Bialorucki, MD*
13. Epidural Analgesia for Labor: Comparing the Effects of Continuous Epidural Infusion (CEI) and Programmed Intermittent Epidural Bolus (PIEB) on Obstetric Outcomes – *Yair Binyamin, MD*
14. Subdural Hematoma after Unintentional Dural Puncture- *Lauren Blake, MD*
15. Refractory Hypotension Secondary to Labetalol Administration in Preeclampsia and the Utility of Glucagon - *Taylor Blalack, MD*
16. Management of Postpartum Hemorrhage in a Parturient with Type 2M von Willebrand Disease - *Kaitlyn Brennan, MD*
17. Managing Critical Mitral Stenosis in Pregnancy in Kenya - *Kaitlyn Brennan, MD*
18. Emergent cesarean delivery in a parturient with previously undiagnosed severe mitral stenosis - *Derek He, MD*
19. Greater Occipital Nerve Block as an Adjunct in Postdural Puncture Headache - *Seung Choi, MD*
20. Abdominal Pain despite functioning epidural anesthesia: Uterine rupture - *Lu Chou, MD*
21. Multiple Failed Neuraxials - *Dhruv Choudhry, MD*
22. Obstetric Anesthesia Management Of Cesarean Delivery For A Patient With Repaired Aortic Coarctation, Total Anomalous Pulmonary Venous Return, And Thoracolumbar Scoliosis - *Annie Chow, MD*



23. XSupraglottic Airway for General Anesthesia in Obstetric Emergency - *Praeophayom Clarke, MD*
24. Remifentanyl for Labor Analgesia in a Morbidly Obese Parturient. Is it Worth the Pain? - *Collin Conrad, MD*
25. Development of a competency-based curriculum for obstetric anesthesia residency training using a Delphi Model - *Christopher Cosden, MD*
26. Cesarean in a Parturient with a Complicated Tetralogy of Fallot Repair - *Candace Curtis, MD*
27. Complex Regional Pain Syndrome in the Parturient Patient - *Veronica D'Ambra, MD*
28. Video-assisted Thoracoscopic Surgery under General Anesthesia for Directed Biopsy of a Mediastinal Mass in Pregnancy - *James Damron, MD*
29. Low-Dose Combined Spinal-Epidural for Cesarean Delivery in a Woman with Severe Aortic Stenosis - *Camille Davis, MD*
30. A case report for the management of refractory sustained, unstable supraventricular tachycardia in the peripartum period - *Kathryn Davis, MD*
31. Awake Dual-Lumen Endotracheal Tube Placement for Primary Mediastinal B-Cell lymphoma in a parturient - *Gustavo Diaz-Mercado, MD*
32. Migraine with aura presenting as a transient ischemic attack in a parturient - *Gustavo Diaz-Mercado, MD*
33. The Perfect Storm: Thyrotoxicosis, Full Anticoagulation, and Difficult Airway in a Parturient - *Timothy Edmonds, MD*
34. Subarachnoid Hemorrhage Complicating Severe Pre-eclamptic Neuropathology: A Case Report - *Lindsey Efird, MD*
35. Successful Neuraxial anesthesia in the parturient with history of spinal cord AVM - *Kevin Elaahi, MD*
36. Anesthetic Management of a Parturient with Arthrogryposis Multiplex Congenita for Cesarean Delivery - *Ilhan Eli, MD*
37. Anesthesia for C-section in a Patient with Brain Meningioma with mass effect and increased ICP - *Sherif Elsayed Ali Ali, MD*
38. Anesthetic management of a woman with mast cell activation syndrome and allergy to lidocaine undergoing cesarean delivery - *Marie Eve Fiset, MD*
39. Management of a Patient with Severe Mitral Regurgitation and Non-ischemic Cardiomyopathy for Cesarean Delivery in a Cardiac Operating Room - *Taylor Foster, MD*
40. Anesthetic Management for Cesarean Delivery in a Patient with a Difficult Airway and Risks for Postpartum Hemorrhage - *Rofayda Gad, MD*
41. Anesthetic Management for a Grand Multipara Patient With HELLP Syndrome and Acute Renal Failure undergoing CD - *Rofayda Gad, MD*
42. Detection of apical hypertrophy (Yamaguchi syndrome) and subsequent anesthetic management of cesarean delivery - *Rofayda Gad, MD*
43. Multimodal anesthesia for EXIT procedure - *Rofayda Gad, MD*
44. Prolonged sedation in a parturient with COVID-19 and fetal outcome - *Rofayda Gad, MD*
45. Case Report: Vaginal Delivery and A Tale of Two Ventricles (Transposition of the Great Arteries), Simply Baffling! - *Ishan Garg, MD*



46. Acute respiratory failure in a patient with severe preeclampsia and morbid obesity during cesarean section - *Aryeh Ginsburg, MD*
47. Management of Undiagnosed Pseudocholinesterase Deficiency in a Parturient Undergoing Urgent Cesarean Section Under General Anesthesia - *Lana Glantz, MD*
48. Emergent Cesarean Delivery Secondary to Non-conventional Presentation of Uterine Rupture in a Parturient with Systemic Lupus Erythematosus - *Ashlee Gourdine, MD*
49. Sphenopalatine Ganglion Block to Treat Perioperative Migraine Headache - *Gilbert Grant, MD*
50. Paramyotonia Congenita - *Carter Guice, MD*
51. The non-Subarachnoid "Worst Headache of My Life" in a T4 Paraplegic Parturient with Autonomic Dysreflexia - *Katherine Herbert, MD*
52. Procedure on Placental Support Under Neuraxial Anesthesia for Fetal Oropharyngeal Mass - *Kathryn Hackett, MD*
53. Anesthesia Management Of Emergency Cesarean Section With A Platelet Count Of 3000/ $\mu$ l and Idiopathic Thrombocytopenic Purpura - *Achmad Hariyanto, MD*
54. Factor XIII deficiency: Is it or isn't it? - *Jakayla Harrell, MD*
55. Delayed Interval Delivery in a Parturient with Essential Thrombocythemia and a Triamniotic-Trichorionic Triplet Pregnancy - *Jakayla Harrell, MD*
56. General Anesthesia for Balloon Valvuloplasty in A Pregnant Patient with Severe Mitral Stenosis and Pulmonary Hypertension: A Case Report - *Pamela Huang, MD*
57. Case Report: Management of a case of severe Abruptio with IUFD and severe PET: Importance of ROTEM in management of such high risk cases - *Sanjeev Jain, MD*
58. Subdural hematoma as a complication of accidental dural puncture - *Deborah Jeon, MD*
59. Anesthetic Management of a Parturient with Pulmonary Hypertension On Treprostinil Treatment - *Samuel Joseph, MD*
60. Anesthetic management of a parturient with vascular Ehlers-Danlos Syndrome undergoing repeat cesarean delivery - *Lana Joudeh, MD*
61. Anesthesia for an Unscheduled Cesarean Delivery in a Woman with Stage IV Alcoholic Cirrhosis - *Gus Kefalopoulos, MD*
62. Supraglottic Airway for General Anesthesia in Obstetric Emergency - *Kyle Kang, MD*
63. Successful neuraxial anesthesia administration in a patient with hydromyelia - *Alexandra Kiers, MD*
64. Atypical Presentation of Iatrogenic Bladder Injury during Elective Cesarean Delivery - *Jinsoo Kim, MD*
65. Multiple Etiologies of Postpartum Headache Presenting in a Single Parturient - *Christopher Kim, MD*
66. It's Time to Wake Up: An International Quality Improvement Project that Dramatically Decreased the Rates of Cesarean under General Anesthesia - *Joseph Klaus, MD*
67. Demystifying the Epidural: Increasing the Use of Neuraxial for Labor Pain in Ukraine - *Anna Gabrielian, MD*
68. Novel Approach to Analgesia for an Intellectually Disabled Labor Patient - *Anna Gabrielian, MD*
69. Management of Labor With Heliox in a Patient with Subglottic Stenosis - *Seth Landa, MD*



70. Cerebral Venous Sinus Thrombosis Discovered After Post-dural Puncture Headache Treated with Sphenopalatine Ganglion Block and Epidural Blood Patch - *Danielle Levin, MD*
71. The Peripartum Management of COVID-19 in a Patient with Brugada Syndrome - *Sherry Liou, MD*
72. Amniotic Fluid Embolism and the Recrudescence of COVID-19 Symptoms - *Nathaniel Liu, MD*
73. Preterm Cesarean Delivery in a Patient with Methamphetamine-Associated Cardiomyopathy - *Mingchun Liu, MD*
74. Management of the Parturient with Factor VII Deficiency - *Whitney Loggins, MD*
75. Placement of a Labor Epidural in a Patient with a Spinal Cord Stimulator - *Kody Massner, MD*
76. Spinal anesthesia for caesarian in a parturient with Arnold-Chiari Type 1 Malformation and significant lumbar disc prolapse - case report. *Gisha Mathew, MD*
77. Neuraxial anesthesia in a parturient with cerebral palsy and prior selective dorsal rhizotomy - *Christine McKenzie, MD*
78. Anesthetic Management of a Morbidly Obese Parturient with Charcot Marie Tooth and HELLP with Cord Prolapse - *Jessica Meister Berger, MD*
79. Spontaneous Postpartum Uterine Rupture in a Primigravida Following Vaginal Delivery - *Jessica Meister Berger, MD*
80. Life Threatening Hemorrhage Secondary to Hidden Uterine Inversion - *Vasilije Mijovic, MD*
81. Management of Post-Partum Hemorrhage in a 31-year-old Patient with Severe Osteomyelitis and Placenta Accreta Spectrum Disorder - *Aaron Montani, MD*
82. Case Study: Management Of Peripartum Cardiomyopathy At Delivery - *Suzanne Mundhenke, MD*
83. Convulsion immediately after vaginal delivery - *Hyo-Seok Na, MD*
84. Two Surgeries in the Second Trimester: Fetal Myelomeningocele Repair Followed by Laparoscopic Cholecystectomy - *Claire Naus, MD*
85. Multidisciplinary management of pulmonary arterial hypertension in pregnancy: a case report - *Nemade Preeti, MD*
86. Resistance to local anesthetics: a case report in pregnant woman who failed to achieve skin analgesia – *Thong Nguyen, MD*
87. Perioperative Management of Parturient with Cystic Lung Disease - *Leziga Obiyo, MD*
88. Labor Analgesia Options for Parturient with an Implanted Intrathecal Baclofen Pump - *Taylor O'Neal, MD*
89. Central Anticholinergic Syndrome: An Unusual Awakening from General Anesthesia after Cesarean Delivery - *Sophia Dunworth, MD*
90. Neuraxial anesthesia for a laboring patient with hereditary spastic paraplegia: a case report - *Joshua Falescky, MD*
91. Cesarean delivery in Spinal Muscular Atrophy type 3 (Kugelberg- Welanders Syndrome) - Case report - *Borislava Pujic, MD*
92. Initiation of First ERAS Protocol for Cesarean Delivery in Serbia-preliminary results – *Borislava Pujic, MD*
93. Lidocaine allergy? 2-Chloroprocaine, An Ester Alternative, May Be The Solution For Epidural Anesthesia When Amide Local Anesthetics Are Not An Option - *Sidhant Pamnani, MD*



94. Compartment Syndrome Following C-section Complicated By Persistent Postpartum Hemorrhage - *Sidhant Pamnani, MD*
95. Complicated analgesic management for a laboring patient on buprenorphine - *Sue Panayiotou, CRNA*
96. 30 Minutes Decision to Incision: A Quality Improvement Project - *Javier Polania Gutierrez, MD*
97. Avoiding Perioperative Sudden Cardiac Death In Williams Syndrome - *Bethany Potere, MD*
100. Labor epidural placement in a patient with tinea versicolor of thoraco lumbar region - *lakshmi Ram, MD*
100. Platelets are Overrated! Hemostatic Strategies for Cesarean Delivery with < 5k Platelets – *Krishnan Ramanujan, MD*
101. AFE or PE: A Case of Acute CV Collapse - *Julian Rios, MD*
102. A Case Report of Anesthetic Planning for a Parturient with Severe Mitral Valve Stenosis – *Mary Roberts, MD*
103. Prone Positioning for the Treatment of ARDS in the Post-Partum Patient - *Spencer Robichaux, MD*
104. Intracranial Mass in a Pregnant Patient, the management, of the patient, and course of pregnancy – *Jonathan Rogerson, MD*
105. Uterine Rupture and Emergent Cesarean Hysterectomy in an Unscarred Uterus - *Susanne Rupert, MD*
106. Use of ROTEM as an adjunct to assess coagulopathy in thrombocytopenic parturient prior to neuraxial anesthesia - *Emmarie Myers, MD*
107. Cesarean Delivery in a patient with COVID-19 and Holt-Oram Syndrome - *Maria Sheikh, MD*
108. Can You Place Neuraxial Anesthesia in a Patient With a History of Intravenous Drug Abuse and Presumed Bacteremia? - *Jennifer Song-Andrews, MD*
109. Avoiding Amide Anaphylaxis – Unconventional Neuraxial Options for Cesarean Delivery – *Claire Spradling, CRNA*
110. What To Do When You Can't Transfuse – Blood Transfusion Alternatives for Jehovah's Witnesses - *Mellany Stanislaus, MD*
111. Evans Syndrome: A Qualitative or Quantitative Defect in Platelets? - *Nathan Steiner, MD*
112. Placental Abruption and Disseminated Intravascular Coagulation Unveiled by Epidural Catheter Site Bleeding - *Nathan Steiner, MD*
113. Elective cesarian hysterectomy in parturient complicated by placenta previa and placenta accreta spectrum and history thoracolumbar spinal fusion with Harrington rods - *Shruti Sudhakar, MD*
114. Urgent Cesarean Delivery of Dichorionic/Diamnionic Twins in a Parturient with Prior C5 Spinal Cord Injury and Resultant Incomplete Quadriplegia with a History of Autonomic Dysreflexia - *Cameron Sumner, MD*
115. Parturient with rare bleeding disorder requiring all facets of obstetric anesthesia care – *Justin Swengel, MD*
116. Pneumocephalus after Labor Epidural - *Erica Tafuro, MD*



117. Unilateral Lung Hypoplasia in the Morbidly Obese Obstetric Patient: A Case Report - *Angeli Thawani, MD*
118. Obstetric anesthesia for a patient with HELLP syndrome versus SLE flare: a diagnostic challenge - *Caroline Thomas, MD*
119. Ballantyne Syndrome- *Julie-Ann Thompson, MD*
120. Spinal cord hemangioblastoma resection and cesarean delivery in a 31-week gravid patient: a case report – *Reade Tillman, MD*
121. Perioperative Management of a Parturient with a Spontaneous Cerebrospinal Fluid Leak. - *Joseph Tipton, MD*
122. Identification of Factors that Lower the Accuracy of Quantitative Blood Loss During Cesarean Delivery: Pre- Delivery Fluid and Omission of Gravimetry – *Natalie Tukan, MD*
123. Management of extra cardiac Fontan patient on labor and delivery for three obstetric procedures – *Nicholas Unkrich, MD*
124. Neuraxial Analgesia in a Parturient with NF-1 - *Yuri Volnov, MD*
125. Anesthetic Management for Diabetic Autonomic Dysregulation in Pregnancy - *Allen Wang, MD*
126. Anesthetic Management of a Patient with Intracranial Aneurysm for Cesarean Delivery – *Lawrence Weinstein, MD*
127. Postpartum hemorrhage in a patient with prior uterine artery embolization - *Kelly West, MD*
128. Clinical improvement and tumor regression in parturient with brain tumor and intracranial bleeding after c-section with general anesthesia : a case report - *Andreas Willianto, MD*
129. Elective cesarean delivery in a parturient with transverse myelitis - *Mike Wong, MD*
130. Symptomatic Vasovagal Episodes in Synchrony with Uterine Contractions in an Expectant Multipara – *Ivana Wroblewski, MD*



# Speaker Disclosures

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

Name	Type of Relationship	Ineligible Company
Brian Bateman	Grant / Contract	Eli Lilly and Company
Brian Bateman	Grant / Contract	Takeda California, Inc.
Brian Bateman	Grant / Contract	GlaxoSmithKline
Brian Bateman	Grant / Contract	Pacira Pharmaceuticals Inc.
Brendan Carvalho	Independent Contractor - Consultant	Gauss Surgical Inc.
Pamela Flood	Stock Options	Concentric
Ashraf Habib	Heron Therapeutics, Inc.	Grant / Contract
Ashraf Habib	Pacira Pharmaceuticals Incorporated	Grant / Contract
Ashraf Habib	Trevena	Consultant
Ashraf Habib	Vertex Pharmaceuticals	Consultant
Christian Loubert	Grant / Contract	Ferring
Grant Lynde	Independent Contractor - Consultant	Merck
Rebecca Minehart	Independent Contractor - Consultant	Rivanna Medical, LLC
Yasuko Nagasaka	Independent Contractor - Consultant	Masimo Corporation
Anjan Saha	Independent Contractor - Consultant	Lean Medical Technologies, Inc.
Richard Smiley	Grant / Contract	Ionis Pharmaceuticals
Richard Smiley	Grant / Contract	Pacira Pharmaceuticals Inc.
Richard Smiley	Grant / Contract	Biogen
Claire Spradling	Stock	Medtronic
Claire Spradling	Stock	Dermtech
Patrick Tan	Grant / Contract	Fisher & Paykel Healthcare LTD
Brandon Togioka	Grant / Contract	Merck
Brandon Togioka	Grant / Contract	B. Braun Medical
Valerie Zaphiraatos	Grant / Contract	Ferring
Valerie Zaphiraatos	Independent Contractor - Consultant	Ferring
Valerie Zaphiraatos	Intellectual Property - Patent	Menodys

All relevant financial relationships for this activity have been mitigated.

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



# Program Material

## Thursday, May 13, 2021

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### Best Case Reports – Top 10

Moderator: Klaus Kjaer, MD

Panelists: Jaime Daly, MD; Robert Gaiser, MD; Emily Sharpe, MD

### SFMF Lecture - What's New in Obstetrics Lecture? Tranexamic Acid and Obstetrical Hemorrhage

Speaker: Luis Pacheco, MD

### COVID-19 and Sepsis Update

Speaker: Emily Naoum, MD, Arvind Palanisamy, MD

### Non-Obstetric Surgery in Pregnancy and the Early Post-partum Period

Speakers: Hans Sviggum, MD; Valerie Zaphiratos, MD

### Airway Management During Pregnancy

Speakers: Mary Mushambi, MD



**SOAP**  
Society for Obstetric  
Anesthesia and Perinatology  
5354@qgpcid@ hhwkj

## Best Case Reports

Klaus Kjaer, MD, MBA  
NewYork-Presbyterian Weill Cornell, New York, NY

Robert Gaiser, MD  
Yale University, New Haven, CT

Jaime Daly, MD  
University of Colorado, Denver, CO

Emily Sharpe, MD  
Mayo Clinic, Rochester, MN

May 13, 2021

1

**Learning Objectives**

SOAP  
Society for Obstetric  
Anesthesia and Perinatology

- Appreciate the highly skilled management of challenging obstetric anesthesia cases by talented anesthesia teams.
- Describe appropriate anesthetic plans for various challenging and unusual obstetric scenarios.
- Recognize the patterns recurring in the management of these cases.

5354@qgpcid@ hhwkj

2

**Session Format**

SOAP  
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Anesthesia and Perinatology


- This will be a presentation of 10 of the most highly ranked abstracts as determined by the SOAP scoring process.
- It will be representative of a wide range of topics from various institutions.
- The panel will engage the authors in participating.

5354@qgpcid@ hhwkj

3

**Types of Cases**

SOAP  
Society for Obstetric  
Anesthesia and Perinatology



COVID-19    Pulmonary    Cardiac    Neuro    Hepatic    Heme

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4

**1** Urgent Cesarean Delivery of a COVID-19 Parturient in the Intensive Care Unit

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**What Happened:**

- 23 yo G1P0 admitted to ICU at 30 weeks' gestation for worsening hypoxemia from COVID pneumonia
- Despite high flow nasal cannula and 100% FIO2, patient required intubation
- Post intubation, FIO2 100% and PEEP 20, oxygen saturation in high 80's
- Cesarean Delivery in ICU to help with respiratory status of patient
- Anesthesia consisted of propofol, cisatracurium, and fentanyl
- Able to prone patient after delivery, discharged on post-op day 20

Authors: D Kim et al  
University of California, Irvine

1010956

5

**1** Urgent Cesarean Delivery of a COVID-19 Parturient in the Intensive Care Unit

SOAP  
Society for Obstetric  
Anesthesia and Perinatology

**Questions:**

- Were antibiotics adjusted because delivery took place outside the operating room?
- What is the proposed mechanism for improvement in respiratory disease after delivery? Is prone positioning possible in a women with a 30 weeks' gestation fetus?
- Was the patient anticoagulated after delivery? Was the patient asked about recall?
- What is the main learning point from this case?

Authors: D Kim et al  
University of California, Irvine

1010956

6





### 2 Post-partum Veno-Venous Extracorporeal Membrane Oxygenation in a COVID-19 Patient as a Bridge to Lung Transplantation



#### What Happened:

- 28 yo at 35 weeks' gestation with no significant medical history was diagnosed with COVID-19 pneumonia
- At 37 weeks developed respiratory failure leading to hospital admission
- Upon admission she had an emergent cesarean section under general anesthesia
- The patient remained intubated due to poor arterial oxygen levels
- Hospital course was complicated severe ARDS and possible aspiration
- She was put on Veno-Venous ECMO until bilateral lung transplantation

Authors: I Angelidis et al  
Northwestern University, Chicago

1012277

7



### 2 Post-partum Veno-Venous Extracorporeal Membrane Oxygenation in a COVID-19 Patient as a Bridge to Lung Transplantation



#### Questions:

- Did the patient receive any treatment for her COVID-19 prior to her decline such as dexamethasone or remdesivir?
- Did the patient have any evidence of coagulopathy upon admission?
- How long was the patient on V-V ECMO prior to transplantation?
- Did the delivered fetus have any complications?

Authors: I Angelidis et al  
Northwestern University, Chicago

1012277

8



### 3 Anesthetic Management of a Parturient with Recurrent Pulmonary Artery Sarcoma and Severe Pulmonary Hypertension for Cesarean Section: A Case Report



#### What Happened:

- 38 y/o G2P1 with recurrent pulmonary artery sarcoma (s/p excision, L PA dilation and stent placement, chemo/radiation)
- Presented at 23 weeks' gestation with dyspnea, NYHA Class II, and severe pulmonary hypertension (RVSP 66 mm Hg, severe TR)
- At 32 weeks status declined to NYHA Class III and planned cesarean delivery at 34 weeks
- Had general anesthesia, inhaled nitric oxide, dobutamine, and TEE
- Postop transfer to ICU for extubation and weaned from nitric oxide

Authors: B Houseman et al  
Envision, Florida

1008155

9



### 3 Anesthetic Management of a Parturient with Recurrent Pulmonary Artery Sarcoma and Severe Pulmonary Hypertension for Cesarean Section: A Case Report



#### Questions:

- Was the previous resection of her sarcoma via sternotomy or thoracotomy?
- What lines were placed (CVC or arterial)? Were they placed prior to induction?
- Why was dobutamine your first line choice?
- With ECMO on standby, was the plan for VV or VA ECMO? With her challenging anatomy, would ECMO cannulation be central or peripheral? How would your anesthetic change if the patient required ECMO?
- How was TEE used to guide anesthetic management in this patient? If ECMO was warranted, how could TEE assist proper placement?
- Why does inhaled nitric oxide have to be weaned over time?

Authors: B Houseman et al  
Envision, Florida

1008155

10



### 4 Management of the Difficult Airway in Obstetric Patients for Cesarean Delivery



#### What Happened:

- 24 yo G7P2042 presented at 36 2/7 weeks' gestation with stridor, difficulty breathing and inability to lie flat
- Past history includes MVA requiring tracheostomy and subsequent tracheal stenosis requiring tracheal resection
- Indirect laryngoscopy: supraglottic edema with partial laryngeal intubation obstruction
- Unable to do neuraxial anesthesia due to accessory muscle dependence
- Airway Preparation: glycopyrrolate, dexmedetomidine, remifentanyl, inhaled 4% lidocaine, superior and recurrent laryngeal blocks
- 5.0 MLT passed with oral fiberoptic; dislodged when patient coughed
- Failed jet ventilation, tracheostomy, mask ventilation; able to ventilate with LMA

Authors: O Valencia et al  
Vanderbilt University, Nashville

1011241

11



### 4 Management of the Difficult Airway in Obstetric Patients for Cesarean Delivery



#### Questions:


- What concerns did you have with performing superior and recurrent laryngeal blocks in a patient who had a tracheal resection?
- Was thoracic surgery consulted given the tracheal resection?
- After placement of the LMA, was the patient intubated? If yes, how did you insure proper tube placement?
- What was the fetal heart rate during the airway management?
- Given the indirect laryngoscopy findings, did you get the opportunity to look at the laryngeal inlet with the LMA in place?
- Why was cesarean delivery performed prior to tracheostomy?

Authors: O Valencia et al  
Vanderbilt University, Nashville

1011241


12





**Diagnosis of Peripartum Cardiomyopathy Prompted by "Smart" Watch**

5




**What Happened:**

- A healthy 43 y/o G2P1 had an uncomplicated elective cesarean delivery under spinal anesthesia at term
- 2 weeks postpartum the patient developed fatigue and a dry cough
- Her smart watch alerted her to a resting heart rate >120 bpm
- Cardiology work up showed BP 172/120 mm Hg and 137 bpm, EF ~20%, CXR with dilated cardiac silhouette
- Diagnosed with postpartum cardiomyopathy with superimposed preeclampsia
- Admitted for diuresis and started on low-dose aspirin, bromocriptine, carvedilol, sacubitril/valsartan, and atorvastatin
- 3 months later her EF was 40%, 1 year later her EF was 62% with normal parameters

Authors: L Mason et al  
University of Mississippi, Jackson


1007411

13



**Diagnosis of Peripartum Cardiomyopathy Prompted by "Smart" Watch**

5




**Questions:**

- Is it common for PPCM to present with tachycardia?
- What were the patient's risk factors for PPCM and preeclampsia?
- How would a delayed diagnosis have impacted this patient's course and/or prognosis?
- What barriers do you think exist that result in this diagnosis often being delayed?

Authors: L Mason et al  
University of Mississippi, Jackson


1007411

14



**Intraoperative POCUS in the Management of Dilated Cardiomyopathy and Pericardial Effusion for Cesarean Delivery**

6




**What Happened:**

- 28 y/o G3P2002 at 35 w 6 d gestation with history of dilated cardiomyopathy (NYHA Class I; EF ~25%) came for scheduled cesarean
- On admission, pt was asymptomatic and TTE showed severely dilated LV and reduced EF <20%, grade II LV diastolic dysfunction, no pericardial effusion
- Epidural anesthesia established with 10 mL of 2% lidocaine with epinephrine
- Awake, pre-epidural arterial line placed and transduced through a Vigileo cardiac output monitor, Butterfly iQ ultrasound monitored patient's cardiac function
- A pericardial effusion was noted intraoperatively without tamponade effect and cardiac indices were stable
- Furosemide 5 mg was given and postop echo revealed reduction in pericardial effusion

Authors: D White et al  
University of Texas, Houston


1011643

15



**Intraoperative POCUS in the Management of Dilated Cardiomyopathy and Pericardial Effusion for Cesarean Delivery**

6




**Questions:**

- Why was cesarean delivery scheduled prior to 37 weeks' gestation?
- What was your rationale for choosing epidural anesthesia? Can spinal or combined spinal-epidural anesthesia be safely used in women with dilated cardiomyopathy?
- Briefly describe the Vigileo monitor. Is it validated for use in pregnant women?
- How was the baseline echo performed? How frequently was echo performed in the OR? When did the pericardial effusion appear? What are possible causes for the development of pericardial effusion? Could different imaging modalities explain the changing size of the effusion?
- Should anesthesiologists demonstrate proficiency with echocardiography and specifically with Butterfly iQ prior to clinical use?

Authors: D White et al  
University of Texas, Houston


1011643

16



**Combined Craniotomy and Cesarean Section in an Acutely Neurologically Compromised Parturient**

7




**What Happened:**

- 24 yo G1P0 at 34 weeks' gestation with tonic-clonic seizure and left-sided weakness and ataxia
- MRI: Right 5.4x4.8x4.5 cm frontoparietal mass
- Reassuring EEG and FHR so delayed intervention until 39 weeks
- Readmitted at 37 weeks' gestation with worse symptoms and increase in mass size
- MRI revealed increased mass and 6 mm leftward shift
- General anesthesia with remifentanyl/propofol with cesarean delivery first
- Diagnosis: anaplastic ependymoma

Authors: J Iglesias et al  
Medical University of South Carolina, Charleston


1009634

17



**Combined Craniotomy and Cesarean Section in an Acutely Neurologically Compromised Parturient**

7



**Questions:**


- Why was a cesarean section not performed when initially diagnosed?
- How did you differentiate increased ICP from preeclampsia?
- Any consideration to delaying delivery after the craniotomy?
- Was the patient followed in the hospital or at home from 34 to 37 weeks' gestation?
- What neuromonitoring was used for the case?
- What plan was in place for managing uterine tone in a patient with increased intracranial pressure?

Authors: J Iglesias et al  
Medical University of South Carolina, Charleston

1009634

18





8

Chloroprocaine Labor Epidural for Parturient with Local Anesthetic Resistance


**What Happened:**

- 34 yo G4P2012 with obesity at 34 weeks' gestation for induction of labor for IUFD
- Hx of inadequate dental local anesthesia and ineffective ropivacaine labor epidurals
- Started initially on a ketamine infusion but poor analgesia and unpleased side effects
- 3% chloroprocaine tested via skin patch and provided localized anesthesia
- 75 mcg of fentanyl and 40 mg of 3% chloroprocaine was used as the test dose
- A continuous epidural infusion of 0.3% chloroprocaine at 12 cc/hour with intermittent epidural boluses of 5 cc of 3% chloroprocaine plus 50 mcg of fentanyl was given for breakthrough pain
- The patient reported adequate pain relief for her uneventful vaginal delivery

Authors: N Ayele et al  
Loyola University, Chicago

1011768

19



8

Chloroprocaine Labor Epidural for Parturient with Local Anesthetic Resistance


**Questions:**

- How common is true local anesthetic resistance?
- What other alternatives could you have offered this patient for labor analgesia?
- Is there an optimal chloroprocaine concentration and infusion rate for labor analgesia?
- Are there any specific risks with administering a chloroprocaine infusion for labor analgesia?

Authors: N Ayele et al  
Loyola University, Chicago

1011768

20



9

Acute Fatty Liver of Pregnancy Leading to a Delayed Hepatic Failure Necessitating Liver Transplantation: A Case Report


**What Happened:**

- 41 y/o G1P0 at 31 weeks' gestation w/ PMH Factor V Leiden and GDM presents with nausea, vomiting, pruritus, and jaundice
- Lab values: AST 2595 u/L, ALT 1999 u/L, Hgb 13.8 g/dL, alkaline phosphatase 227 u/L, total bilirubin 20.0 mg/dL, INR 2.5, and PT 30.1
- Diagnosed with acute fatty liver of pregnancy and proceeded with urgent CD via GA
- She received 2 units FFP, DDAVP infusion, and tranexamic acid. EBL was 800 mL
- Postpartum transjugular liver biopsy revealed persistent acute fatty liver of pregnancy
- With worsening clinical deterioration and INR 5.5, lactate 4.2, and MELD-Na score of 37, she was listed as UNOS status 1A on POD 19
- Subsequently underwent a successful deceased donor orthotopic liver transplantation

Authors: G Palleschi et al  
Northwell Health, New York

1011094

21



9

Acute Fatty Liver of Pregnancy Leading to a Delayed Hepatic Failure Necessitating Liver Transplantation: A Case Report


**Questions:**

- With the patient's history of Factor V Leiden, was she anticoagulated? Were there concerns correcting coagulopathy? What else might help assess clot dynamics?
- What lines were placed for hemodynamic monitoring? Was echocardiography utilized?
- Which lab value most reflects acute liver failure/prognosis?
- At what point should this patient be transferred to a hospital with a transplant program?
- What options are there for extracorporeal liver support? Is this an indication?

Authors: G Palleschi et al  
Northwell Health, New York

1011094

22



10

Management of a Pregnant Patient on Dual Anti-Platelet Therapy


**What Happened:**

- 40 yo G7P4 induction of labor with PMH CAD and previous MI
- NSTEMI and DES in LM/LAD and LCx requiring dual anti-platelet therapy
- Repeat NSTEMI at 21 weeks' gestation from 95% LM restenosis – another DES placed
- Admitted at 35 weeks' gestation for cangrelor bridge, a direct-acting P2Y12 platelet receptor inhibitor that blocks adenosine diphosphate induced platelet activation and aggregation, that has rapid metabolism
- Started on day 4 and continued to day 12 and stopped 3 hours prior CSE for failed version and cesarean delivery/BTL
- Prasugrel started 6 hours after removal of epidural catheter (off DAPT for 11.5 hrs)

Authors: J Huang et al  
Washington University, St Louis

1011093

23



10

Management of a Pregnant Patient on Dual Anti-Platelet Therapy

**Questions:**

- Was the patient on the cangrelor infusion for 8 days? What was the cost? Were any hematologic variables followed during this time period?
- What cardiac testing was performed prior to anesthesia?
- What was the blood loss for the cesarean delivery?
- If the patient had been successfully turned, would the patient have been induced? Does this medication cross the placenta? Would a fetal scalp electrode be contraindicated in a patient who is receiving cangrelor?
- What measures were taken to help the patient with proper use of her medication?

Authors: J Huang et al  
Washington University, St Louis

1011093

24



## Tranexamic Acid and Obstetrical Hemorrhage

Luis D Pacheco MD  
Maternal Fetal Medicine/Surgical Critical Care  
The University of Texas Medical Branch



1

## Introduction

- Post partum hemorrhage is a major cause of maternal morbidity and mortality
- Leading cause of **preventable** maternal mortality worldwide
- Among top causes of maternal mortality in US
- Consequences include transfusion, infection, renal/pulmonary injury, prolonged hospital stay



2

## Introduction

- Cesarean section rate in USA is 32%
- Blood transfusion is required in 2-4% of cesarean sections

MFM CD Registry and Apex Trial



3

## Introduction

- Excessive fibrinolysis has been described in the setting of trauma associated hemorrhage
- Similar scenario in cardiothoracic, orthopedic, and transplant surgery

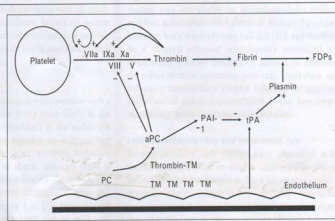
Lancet 2010;376:23-32



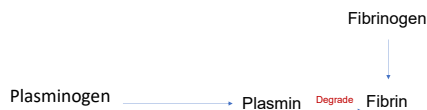
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Figure 2 Hyperfibrinolysis

Tissue plasminogen activator (tPA) is released from the endothelium by injury and hypoperfusion and cleaves plasminogen to initiate fibrinolysis. Activated protein C (aPC) consumes plasminogen activator inhibitor-1 (PAI-1) when present in excess, and reduced PAI-1 leads to increased tPA activity and hyperfibrinolysis.



5



TXA blocks lysine binding sites blocking plasminogen conversion to plasmin



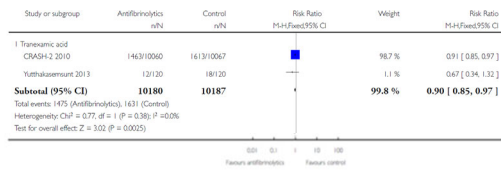
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## TXA for Acute Traumatic Injury

Ker K, et al. *Cochrane Reviews* 2015

## All Cause Mortality

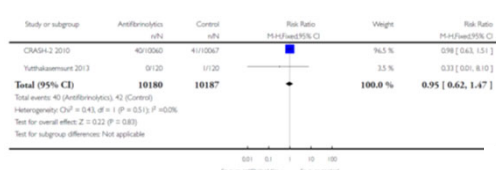
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## TXA for Acute Traumatic Injury

Ker K, et al. *Cochrane Reviews* 2015

## Deep Vein Thrombosis

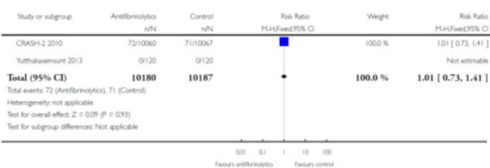
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## TXA for Acute Traumatic Injury

Ker K, et al. *Cochrane Reviews* 2015

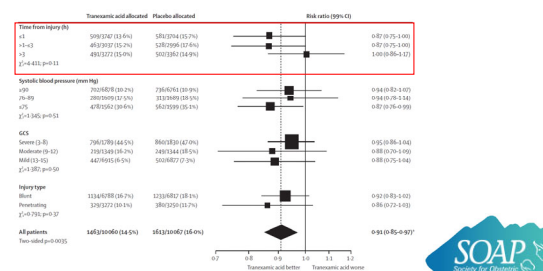
## Pulmonary Embolism

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## TXA in Trauma RCT (CRASH-2)

Lancet 2010;376:23-32

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## Effects of tranexamic acid on death, disability, vascular occlusive events and other morbidities in patients with acute traumatic brain injury (CRASH-3): a randomised, placebo-controlled trial

The CRASH-3 trial collaborators\*

**Interpretation** Our results show that tranexamic acid is safe in patients with TBI and that treatment within 3 h of injury reduces head injury-related death. Patients should be treated as soon as possible after injury.

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## Tranexamic Acid in Patients Undergoing Coronary-Artery Surgery

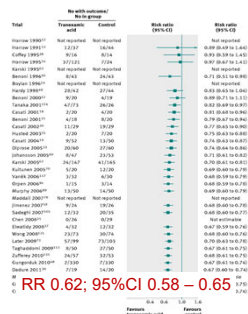
Paul S. Myles, M.P.H., M.D., Julian A. Smith, F.R.A.C.S., Andrew Forbes, Ph.D.,  
Brendan Silbert, M.B., B.S., Mohandas Jayarajah, M.B., B.S.,  
Thomas Painter, M.B., Ch.B., D. James Cooper, M.D., Silvana Marasco, Ph.D.,  
John McNeil, Ph.D., Jean S. Bussi res, M.D., Shay McGuinness, M.B., Ch.B.,  
Kelly Byrne, M.B., Ch.B., Matthew T.V. Chan, M.B., B.S., Ph.D.,  
Giovanni Landoni, M.D., and Sophie Wallace, M.P.H.,  
for the ATACAS Investigators of the ANZCA Clinical Trials Ne

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## Prophylactic TXA in Elective Surgery Effect on Blood Transfusion



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## Original Research

ajog.org

### GYNECOLOGY

## Anti-hemorrhagic effect of prophylactic tranexamic acid in benign hysterectomy—a double-blinded randomized placebo-controlled trial

Marta Fink Topsoe, MD, Thomas Bergholt, PhD, Pernille Ravn, DMSc, Lars Schouenborg, MD, Charlotte Moeller, PhD, Bent Otlesen, DMSc, Annette Settnes, PhD

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14

### JAMA Surgery | Original Investigation

## Association of Intravenous Tranexamic Acid With Thromboembolic Events and Mortality: A Systematic Review, Meta-analysis, and Meta-regression

Isabel Tansler, Stephanie Weibel, PhD, Eva Herrmann, PhD, Vanessa Neef, MD, Tobias Schlegler, MD, Peter Kranke, MD, Lella Meszrogh, MD, Kai Zacharowski, MD, PhD, Sumit Choorngkajay, PhD, Patrick Mayrhofer, MD

No evidence of increased risk of clotting, even in subgroup with previous history of thrombosis and no correlation with doses used

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15

## Fibrinolytic Pathway During Pregnancy

- Following delivery of the placenta the fibrinolytic pathway is activated for up to 6-10 hours post partum

Br J Obstet Gynaecol 1996;103:1250-1

Br J Anaesth 2016;116:641-648

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16

## TXA for Prevention of Obstetrical Hemorrhage: Systematic Review

- 11 RCT of prophylactic use of TXA during cesarean delivery
- Overall findings:  
Decreased blood loss  
No adverse effects

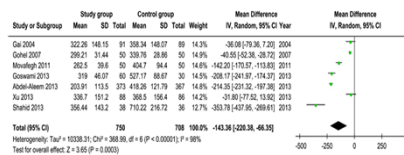
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17

## TXA for Prevention of Obstetrical Hemorrhage: Meta-analysis

### Intraoperative blood loss



Am J Perinatol 2015;35:818-25

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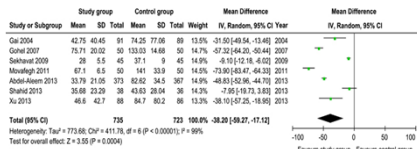


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## TXA for Prevention of Obstetrical Hemorrhage: Meta-analysis

### Postpartum blood loss



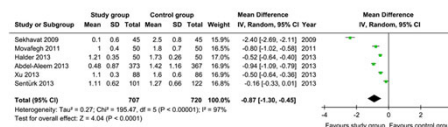
Am J Perinatol 2015;35:818-25

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## TXA for Prevention of Obstetrical Hemorrhage: Meta-analysis

### Hemoglobin drop



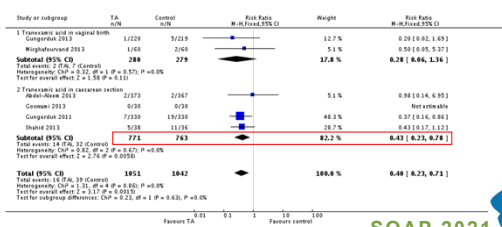
Am J Perinatol 2015;35:818-25

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## TXA for Prevention of Obstetrical Hemorrhage

### Blood loss > 1000 mL

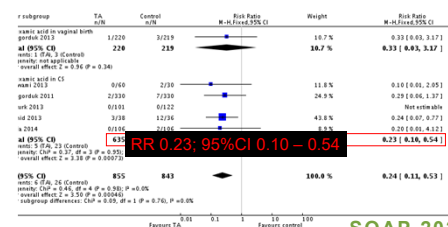


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## TXA for Prevention of Obstetrical Hemorrhage

### Blood transfusion

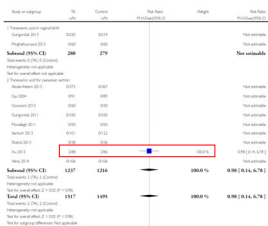


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## TXA for Prevention of Obstetrical Hemorrhage

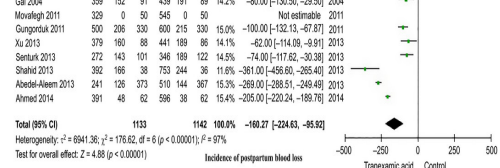
### Thromboembolism



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## TXA for Prevention of Obstetrical Hemorrhage

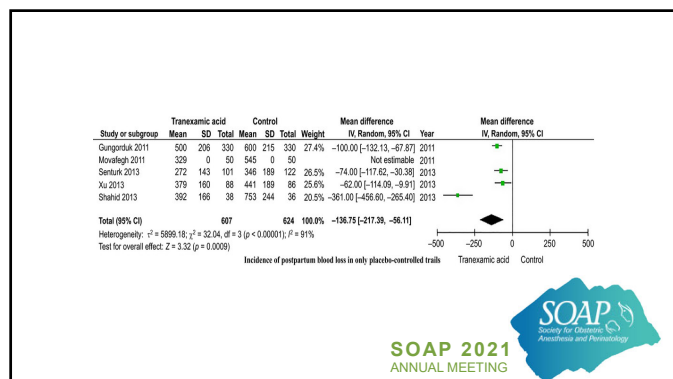


Acta Obstet Gynecol Scand 2016;95(1):28-37

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25

## TXA for Prevention of Obstetrical Hemorrhage

**Limitations of available evidence**

- Low or middle income countries
- Small sample size
- Subjective assessment of blood loss

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### Authors' conclusions

TA (in addition to uterotonic medications) decreases postpartum blood loss and prevents PPH and blood transfusions following vaginal birth and CS in women at low risk of PPH based on studies of mixed quality. There is insufficient evidence to draw conclusions about serious side effects, but there is an increase in the incidence of minor side effects with the use of TA. Effects of TA on thromboembolic events and mortality as well as its use in high-risk women should be investigated further.

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27

THE NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

### Tranexamic Acid for the Prevention of Blood Loss after Vaginal Delivery

Loïc Sentilhes, M.D., Ph.D., Norbert Winer, M.D., Ph.D., Elie Azria, M.D., Ph.D., Marie-Victoire Sénat, M.D., Ph.D., Camille Le Ray, M.D., Ph.D., Delphine Vardon, M.D., Franck Perrotin, M.D., Ph.D., Raoul Desbrière, M.D., Florent Fuchs, M.D., Ph.D., Gilles Kayem, M.D., Ph.D., Guillaume Ducarme, M.D., Ph.D., Muriel Doret-Dion, M.D., Ph.D., Cyril Huisoud, M.D., Ph.D., Caroline Bohec, M.D., Philippe Deruelle, M.D., Ph.D., Astrid Darsonval, Pharm.D., Jean-Marie Chretien, M.Sc., Aurélien Seco, M.Sc., Valérie Daniel, Pharm.D., and Catherine Deneux-Tharaux, M.D., Ph.D. for the Groupe de Recherche en Obstétrique et Gynécologie<sup>a</sup>

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28

**Table 2. Primary and Secondary Outcomes (Modified Intent-to-Treat Population).**

Outcome or Event	Tranexamic Acid Group (N=1945)	Placebo Group (N=1946)	Risk Ratio (95% CI)	Difference (95% CI)*	P Value
Primary outcome — no blood loss (mL)	156 (161 (8.1))	182 (181 (9.3))	0.83 (0.68 to 1.02)	-1.7 (-3.5 to 0.1)	0.07
Clinically significant postpartum hemorrhage, according to guideline — no, (%)	151 (7.8)	203 (10.4)	0.74 (0.61 to 0.90)	-2.7 (-4.5 to -0.7)	0.004
Additional uterotonic agent for excessive bleeding — no, (%)	141 (7.2)	189 (9.7)	0.75 (0.61 to 0.92)	-2.5 (-4.2 to -0.7)	0.006
Severe postpartum hemorrhage — no, (%)	47 (2.4)	57 (2.9)	0.82 (0.56 to 1.22)	-0.5 (-1.6 to 0.5)	0.32
Blood loss — mL					
At 15 min	130.5 (44.3)	131.3 (48.8)	—	-0.7 (-2.4 to 1.0)	0.32
At 10 min	195 (232.2)	210.4 (256.1)	—	-11.3 (-27.7 to 5.0)	0.17
Estimated total	220.3 (280.4)	236.9 (291.6)	—	-16.7 (-34.7 to 1.4)	0.07
Blood transfusion — no, (%)	37 (19.5)	58 (29.8)	0.59 (0.49 to 0.70)	-0.1 (-0.6 to 0.3)	0.007
Arterial embolization or surgery for postpartum hemorrhage — no, (%)	3 (0.2)	3 (0.2)	0.80 (0.14 to 2.32)	-0.1 (-0.4 to 0.2)	0.73
Hemoglobin					
Postpartum change — g/dL	-0.77 (1.23)	-0.79 (1.28)	—	0.02 (-0.06 to 0.10)	0.64
Decrease > 2 g/dL	369 (14.8)	374 (15.2)	0.98 (0.82 to 1.12)	-0.6 (-2.9 to 1.8)	0.61
Hemoglobin*					
Postpartum change — percentage points	-2.05 (3.89)	-2.04 (4.11)	—	-0.02 (-0.29 to 0.25)	0.88
Decrease > 10 percentage points — no, (%)	47 (7.7)	51 (11.1)	0.68 (0.39 to 1.20)	-0.4 (-1.3 to 0.7)	0.10

**CONCLUSIONS**

Among women with vaginal delivery who received prophylactic oxytocin, the use of tranexamic acid did not result in a rate of postpartum hemorrhage of at least 500 mL that was significantly lower than the rate with placebo. (Funded by the French Ministry of Health; TRAAP ClinicalTrials.gov number, NCT02302456.)

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29

ORIGINAL ARTICLE

### Tranexamic Acid for the Prevention of Blood Loss after Cesarean Delivery

L. Sentilhes, M.V. Sénat, M. Le Lou, N. Winer, P. Rozenberg, G. Kayem, E. Verspyck, F. Fuchs, E. Azria, D. Gallot, D. Korb, R. Desbrière, C. Le Ray, C. Chaleur, F. de Marillac, F. Perrotin, O. Parant, L.J. Salomon, E. Gauchotte, F. Bretelle, N. Sananes, C. Bohec, N. Mottet, G. Legendre, V. Letouzey, B. Haddad, D. Vardon, H. Madar, A. Mattuizi, Y. Daniel, S. Regueme, C. Roussillon, A. Benard, A. Georget, A. Darsonval, and C. Deneux-Tharaux, for the Groupe de Recherche en Obstétrique et Gynécologie<sup>a</sup>

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30



**Table 2. Primary and Secondary Outcomes in the Modified Intention to Treat Population.\***

Outcome	Transcendental Acid Group (n=2222)	Placebo Group (n=2200)	Unadjusted Difference (95% CI)†	Adjusted Risk Ratio or Mean Difference (95% CI)‡	P Value§
Postpartum hemorrhage — no, total no. (%)	156/2084 (7.5)	83/2087 (4.0)	-4.9 (-7.7 to -2.2)	0.84 (0.73 to 0.94)	0.001
Calculated estimated blood loss >1000 mL	150/2084 (7.2)	65/2086 (3.1)	-1.1 (-2.7 to -0.5)	0.84 (0.73 to 0.94)	—
Red cell transfusion by day 2	35/2221 (1.6)	30/2209 (1.4)	0.2 (-0.5 to 0.9)	1.16 (0.71 to 1.85)	—
Gravimetrically estimated blood loss — mL	689±887	719±920	-30.6 (-90.2 to 29.0)	-33.06 (-77.48 to 11.37)	NS
Gravimetrically estimated blood loss category — no, total no. (%)					
<500 mL	1233/1774 (69.6)	1110/1754 (63.3)	0.6 (-2.6 to 3.8)	1.02 (0.90 to 1.09)	—
>1000 mL	541/1774 (30.7)	521/1754 (29.7)	1 (-2 to 4)	1.03 (0.92 to 1.16)	—
Clinically significant postpartum hemorrhage according to health care providers — no, total no. (%)	893/2228 (40.1)	327/2208 (14.8)	-1.2 (-3.2 to 0.8)	0.82 (0.79 to 1.08)	NS
Additional obstetric agents for excessive bleeding — no, total no. (%)	130/2217 (5.9)	159/2206 (7.2)	-1.3 (-2.8 to 0.1)	0.81 (0.64 to 1.01)	NS
Blood transfusion — no, total no. (%)	43/2221 (1.9)	19/2208 (0.9)	0.1 (-0.7 to 0.9)	1.07 (0.89 to 1.26)	NS
No. of red cell units transfused	53±1.9	53±1.2	-0.1 (-1.0 to 0.98)	-0.08 (-1.18 to 1.01)	—
Postoperative non-surgical drainage — no, total no. (%)	80/2209 (3.6)	84/2218 (3.8)	0.1 (-0.6 to 0.8)	1.10 (0.91 to 1.39)	—
Antenatal ambulation, emergency surgery for postpartum hemorrhage, or hysterectomy — no, total no. (%)¶	13/2221 (0.6)	7/2209 (0.3)	0.1 (-0.1 to 0.3)	1.84 (0.73 to 4.62)	NS
Transfer to intensive care unit — no, total no. (%)	32/2221 (1.4)	22/2209 (1.0)	0.4 (-0.2 to 1.1)	1.44 (0.83 to 2.47)	—
Calculated estimated blood loss — mL	686±748	787±750	-107 (-152 to -62)	-107 (-152 to -65)	<0.001
Calculated estimated blood loss category — no, total no. (%)					
<500 mL	1233/2084 (59.2)	1136/2086 (54.5)	-6.0 (-8.9 to -3.0)	0.91 (0.84 to 0.98)	—
>1000 mL	215/2084 (10.3)	265/2086 (12.7)	-2.4 (-4.4 to -0.5)	0.81 (0.68 to 0.97)	—
Hemoglobin					
Peripartum change — g/dL	-1.2±1.2	-1.4±1.2	0.2 (0.1 to 0.3)	0.18 (0.11 to 0.25)	<0.001
Peripartum decrease >2 g/dL — no, total no. (%)	397/2088 (19.0)	497/2071 (24.0)	-5.0 (-7.2 to -2.9)	0.79 (0.69 to 0.90)	—
Hematocrit					
Peripartum change — percentage points	-3.2±3.7	-4.0±3.7	0.5 (0.3 to 0.8)	0.53 (0.31 to 0.75)	<0.001
Peripartum decrease >10 percentage points — no, total no. (%)	46/2084 (2.2)	91/2071 (4.3)	-1.1 (-1.9 to -0.3)	0.70 (0.51 to 0.97)	—

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31

## Primary Research Question

To determine if prophylactic TXA at the time of cord clamping during cesarean delivery reduces the need for packed red blood cell transfusion

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32

## Secondary Research Questions

- Decrease estimated blood loss?
- Decrease use of uterotonics?
- Decrease post operative drop in hemoglobin?
- Decrease need for surgical/radiological procedures to control bleeding?
- Decrease need for transfusion of other blood products (FFP, platelets, cryoprecipitate)
- Increase risk of thrombotic events?

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33

## Study Design

- Randomized placebo controlled trial of women undergoing either a scheduled or non-scheduled cesarean delivery
- Randomization to either TXA 1 gram IV or identically appearing placebo immediately after cord clamping

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34

## Inclusion Criteria

All women undergoing a scheduled or non-scheduled cesarean section

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35

## Exclusion Criteria

- Seizure disorder
- Acute or chronic renal failure
- Thrombophilias, history of thrombotic disease
- Active cancer
- Autoimmune diseases
- Sickle cell disease
- Pre operative transfusion or anticoagulation
- Patient refusal of blood products

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36



## Randomization

- Urn method
- Prepared and maintained by the Biostatistical Coordinating Center (BCC)
- Stratified by clinical site
- Center's pharmacy will determine next treatment assignment by using a secure internet BBC site

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37

## Primary Outcome

- Maternal death or transfusion of packed red blood cells by discharge from the hospital or 7 days post partum, whichever comes first

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38

## Secondary Outcomes

- Estimated blood loss > 1 L
- Transfusion related reactions
- Transfusion of other blood products
- Hemoglobin decrease
- Acute kidney injury
- Post partum infectious complications
- Use of uterotonics
- Need for surgical/radiological interventions to control bleeding
- Maternal mortality
- ICU admissions for more than 24 hours
- Adverse events:
  - New onset seizures
  - Thromboembolic events (up to 6 weeks)

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39

## Sample Size Calculation

### Transfusion of PRBC in MFMU

- The MFMU CD registry:
  - 2.6% overall
  - 2.2% with repeat cesarean
  - 3.2% with primary cesarean
- **APEX study-Primary outcome met :**
  - 1.8% with scheduled cesarean
  - 3.5% with non-scheduled cesarean

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40

## Sample Size Calculation

- Based of the latter 2 cohorts, we estimate the primary outcome to occur in:
- **2% of those with a scheduled cesarean**
- **3.5% of those with non scheduled cesarean**

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41

## Sample Size Calculation

- Cochrane review 95% range for TXA effect size in preventing blood transfusion was between 46-90%
- We will estimate a more conservative reduction effect of 33-40%

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42



Risk reduction (%)	Power (%)	Primary Outcome Rate in Placebo group			
		1.8%	2.3%	2.8%	3.5%
30	80	16,500	12,900	10,600	8,500
	85	18,900	14,800	12,200	9,700
	90	22,100	17,300	14,200	11,400
33.3	80	13,100	10,300	8,400	6,800
	85	15,000	11,800	9,700	7,700
	90	17,600	13,700	11,300	9,000
35	80	11,800	9,200	7,600	6,100
	85	13,500	10,600	8,700	7,000
	90	15,800	12,300	10,100	8,100
40	80	8,800	6,900	5,600	4,500
	85	10,000	7,800	6,500	5,200
	90	11,700	9,200	7,500	6,000

Sample size calculations to achieve 80-90% power to detect a 30-40% difference in the primary outcome

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43

## Sample size

- We will ensure approximately equal enrollment (5500 scheduled and 5500 non scheduled) of **11,000** women providing 85% power to detect a 33% reduction in the primary outcome

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44

## Reasons to Conduct the Study

- Post partum hemorrhage **significant cause of maternal morbidity and mortality worldwide**
- Preventive** measures are preferable to therapeutic measures
- TXA appears to be an **effective** and **safe** alternative
- None of the trials in the US
- Easy and cheap** to apply in various settings

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45

## WOMAN Trial

- Large international multicenter trial
- Low, middle, and high income countries
- TXA decreased mortality due to bleeding and need for reoperation for uncontrolled hemorrhage

Lancet 2017 ;389:2105-16

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46

## WOMAN Trial

- No difference in transfusion of blood products
- Benefit seen only within 3 hours of birth
- Maximum dose was 2 grams in 24 hours

Lancet 2017 ;389:2105-16

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47

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

Angeli-Cayre Agnès, David Prieto-Morin, Katherine Kee, Nadema Shaker, François-Xavier Agnès, Ian Roberts, for the Antifibrinolytic Trials Collaboration\*



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48



**Findings** We obtained data for 40138 patients from two randomised trials of tranexamic acid in acute severe bleeding (traumatic and post-partum haemorrhage). Overall, there were 3558 deaths, of which 1408 (40%) were from bleeding. Most (884 [63%] of 1408) bleeding deaths occurred within 12 h of onset. Deaths from post-partum haemorrhage peaked 2-3 h after childbirth. Tranexamic acid significantly increased overall survival from bleeding (odds ratio [OR] 1.20, 95% CI 1.08-1.33,  $p=0.001$ ), with no heterogeneity by site of bleeding (interaction  $p=0.7243$ ). Treatment delay reduced the treatment benefit ( $p<0.0001$ ). Immediate treatment improved survival by more than 70% (OR 1.72, 95% CI 1.42-2.10,  $p<0.0001$ ). Thereafter, the survival benefit decreased by 18% for every 15 min of treatment delay until 3 h, after which there was no benefit. There was no increase in vascular occlusive events with tranexamic acid, with no heterogeneity by site of bleeding ( $p=0.5956$ ). Treatment delay did not modify the effect of tranexamic acid on vascular occlusive events.

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49

## WOMAN Trial

**WHO recommendation  
on tranexamic acid  
for the treatment of  
postpartum haemorrhage**

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50

### Key Messages

- The World Health Organization (WHO) recommends early use of intravenous tranexamic acid (TXA) within 3 hours of birth in addition to standard care for women with clinically diagnosed postpartum haemorrhage (PPH) following vaginal birth or caesarean section.
- Administration of TXA should be considered as part of the standard PPH treatment package and be administered as soon as possible after onset of bleeding and within 3 hours of birth. TXA for PPH treatment should not be initiated more than 3 hours after birth.
- TXA should be used in all cases of PPH, regardless of whether the bleeding is due to genital tract trauma or other causes.
- TXA should be administered at a fixed dose of 1 g in 10 mL (100 mg/mL) IV at 1 mL per minute (i.e. administered over 10 minutes), with a second dose of 1 g IV if bleeding continues after 30 minutes.
- TXA should be administered via an IV route only for treatment of PPH. Research on other routes of TXA administration is a priority.

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51

### Original Research

## Plasma Concentrations of Tranexamic Acid in Postpartum Women After Oral Administration

Kopelasantharam Muhunthan, MS, FRCOG, Sandrasagarampillai Balakumar, PhD, Thiyahini S. Navaratnaraja, MD, Sundaralingum Premakrishna, MD, and Sabaratnam Arulkumaran, PhD, FRCOG

**TXA therapeutic concentrations: 5-15 micrograms/mL  
Achieved within 1 hour after a 2-gram dose**

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52

## TXA for treatment of obstetrical hemorrhage

*The following recommendations and conclusions are based on limited or inconsistent scientific evidence (Level B):*

- ▶ When uterotonics fail to adequately control post-partum hemorrhage, prompt escalation to other interventions (such as tamponade or surgical techniques) and escalation of intensity of care and support personnel are indicated.
- ▶ Given the mortality reduction findings, tranexamic acid should be considered in the setting of obstetric hemorrhage when initial medical therapy fails.

Obstet Gynecol 2017;130(4):e168-86

Still unknown if benefits of this trial will apply in US

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53

## TXA and Breastfeeding

- TXA has been used extensively in neonates undergoing congenital heart disease surgery with no increase in thrombosis or seizures
- No adverse effects reported in WOMAN trial
- No adverse effects reported in breastfeeding women taking oral TXA

Breastfeed Med 2014;9:407-10

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54



## TXA and Breastfeeding

- TXA levels in breast milk are 1/100 of serum levels
- FDA required PK study on exposed neonates
- Discard milk for 24 hours in < 34 weeks

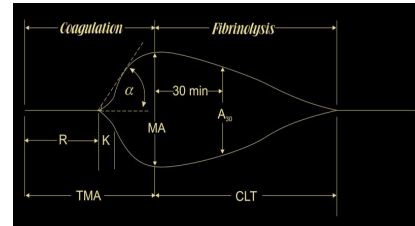
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55

## What about mechanism of action?

- We will perform an ancillary study of TEG to analyze TXA effect on LY30



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56

Thank You

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57



# COVID-19 and Sepsis Update

Emily Naoom, M.D.  
Massachusetts General Hospital, Boston, MA

1

## Anesthetic considerations in COVID-19

- Neuraxial anesthesia preferred
- Earlier placement encouraged
- Prevention of nausea/vomiting
- Pre vs during pandemic decrease in emergency general anesthesia rate

Basur ME, et al. Anesth Analg. 2020.  
Patkar-Kattimani C et al. Int J Obstet Anesth. 2021.

2

## Anesthetic considerations in COVID-19

- Platelet count on admission – recommended
- Nitrous oxide – controversial
- PCA – not recommended
- NSAIDs – likely safe
- Epidural blood patch – likely safe, better than alternatives

Basur ME, et al. Anesth Analg. 2020.  
Ashoka B, et al. Am J Obstet Gynecol. 2020.  
Scemama P, et al. Pain Physician. 2020.

3

## Escalation of care for COVID-19 patients

- Admission to hospital
  - $SpO_2 \leq 95\%$
  - Co-morbid conditions
  - Fevers  $\geq 39^\circ C$  despite APAP  $\rightarrow$  possible cytokine storm
- Admission to ICU
  - $SpO_2 \leq 95\%$  with rapidly escalating oxygen requirement
  - Hypotension despite IVF resuscitation
  - Evidence of end-organ dysfunction

Schoettler WT et al. Am J Obstet Gynecol. 2020.

4

## ICU management of pregnant patients with COVID-19

- Prone positioning – OK
- Neuromuscular blockade – OK
- Epoprostenol/INO – OK
- ECMO – consider if  $< 32$  weeks
- Delivery – consider if  $> 32$  weeks

Schoettler WT et al. Am J Obstet Gynecol. 2020.  
Safaei Fakhr B, et al. Obstet Gynecol. 2020.  
Tolcher MC, et al. Obstet Gynecol. 2020.

5

## Advanced therapies in brief

- Prone positioning
- ECLS

Successful Treatment of Pregnant and Postpartum Women With Severe COVID-19 Associated Acute Respiratory Distress Syndrome With Extracorporeal Membrane Oxygenation

Tolcher MC, et al. Obstet Gynecol. 2020.  
Barron JH, et al. ASAIO. 2021.  
Naoom EE, et al. J Am Heart Assoc. 2020.

6



COVID-19 therapies in pregnant patients

- Steroids
- Remdesivir
- Convalescent plasma
- Antibody therapy

Society for Maternal-Fetal Medicine

Society for Maternal-Fetal Medicine  
Management Considerations for Pregnant Patients With COVID-19  
Developed with guidance from Tami Fakhour, MD, MSc, Jason Vaughn, MD, and the SMFM COVID-19 Task Force  
3.2.21 (this is an update of the draft originally posted on 1.7.21)

RECOVERY  
Randomized Controlled Trial of Hydroxychloroquine in COVID-19

Conservative (COVID-19) Infection in Pregnancy

Burwick RM, et al. Clin Infect Dis. 2020.

Grisolia G, et al. Am J Obstet Gynecol. 2020.

7

Maternal sepsis

- Epidemiology
  - Frequency 1/2000 – 1/10,000
  - Trends
  - ICU admission
- Mortality

Wandersman JP, et al. Crit Care Med. 2013.

Bauer ME, et al. Anesth Analg. 2013.

Bauer ME, et al. Obstet Gynecol. 2015.

Accosta CD, et al. BMC. 2012.

Accosta CD, et al. PLoS One. 2013.

Accosta CD, et al. PLoS Med. 2014.

Accosta CD, et al. BMC Open. 2015.

Knight M, et al. MBRRACE. 2019.

Hewings ME, et al. JAMA. 2019.

Creanga AA, et al. Obstet Gynecol. 2017.

8

Maternal sepsis

- Etiology
  - Diagnoses
  - Specific bugs

Bauer ME, et al. Anesth Analg. 2013.

Accosta CD, et al. BMC Open. 2015.

Bauer ME, et al. Anesth Analg. 2013.

Table 3. Proportion of Specific Types of Severe Delivery Hospitalization Cases, N = 82

Clinical Characteristic	n(%)
Organism identified	
Escherichia coli	12 (14.6)
Group A Streptococcus	6 (7.3)
Other Streptococcus	2 (2.4)
Staphylococcus	5 (6.1)
Other Gram-negative rods	8 (9.8)
Multiple organisms	6 (7.3)
Other	6 (7.3)
Unknown	37 (45.1)
Serratia septicemia	NR

NR = not reported due to number  $\leq 10$ .

9

Risk factors for maternal sepsis

Obstetric	Maternal	Social
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Bauer ME, et al. Anesth Analg. 2013.

Bauer ME, et al. Anesth Analg. 2015.

Amelsson D, et al. Infect Dis. 2017.

Accosta CD, et al. BMC. 2012.

Accosta CD, et al. PLoS One. 2013.

Accosta CD, et al. PLoS Med. 2014.

10

Recognition of maternal sepsis

- Fever?
- Scoring systems
  - SIRS
  - qSOFA
  - MEW
  - MEOWS

Table 1. Definitions of SIRS, qSOFA, and MEW Criteria

Term	Definition
SIRS*	$\geq 2$ of the following: Temperature: $>38^{\circ}\text{C}$ or $<36^{\circ}\text{C}$ Heart rate: $>90$ beats/min

Table 1. MEOWS variables: normal ranges and trigger criteria (CEMACH 2007)

Variable	Normal range for pregnancy	"Amber" (caution) trigger	"Red" (urgent) trigger
MEOWS vital signs components			
Respiratory rate (breaths/min)	10–20	21–30	$<10$ or $>30$
Temperature ( $^{\circ}\text{C}$ )	37–38	35–36	$<35$ or $>38$
Heart rate (beats/min)	51–99	40–50 or 100–120	$<40$ or $>120$
Systolic blood pressure (mmHg)	101–149	90–100 or 150–160	$<90$ or $>160$
Diastolic blood pressure (mmHg)	60	60–90	$>90$
Other components			
Oxygen saturation (%)	$>90$	No trigger	$<90$
Looks unwell	No	Yes	No trigger
Neurologic response	Fully responsive	Responsive to voice	Responsive only to pain or unresponsive
Pain score*	0–1	2–3	No trigger
Amniotic fluid	Clear	No trigger	Green
Lochia	Light to moderate with no odour	No trigger	Heavy or foul
Passed urine (yes/no)	Yes	No trigger	No trigger
Diastolic proteinuria	Negative or $\leq 20\text{g}$	No trigger	$>2$

\*could be scored by an obstetric clinician and must not replace clinical judgment. As a core safety principle, bedside nurses should always feel comfortable to escalate their concerns at any point.

11

SOS Score

- Prediction for ICU admission for pregnant patients with sepsis
- SOS score  $\geq 6$

Table 1. The Sepsis in Obstetrics Score

Variable	High Abnormal Range				Normal				Low Abnormal Range			
	+4	+3	+2	+1	0	+1	+2	+3	+4			
Temperature ( $^{\circ}\text{C}$ )	Higher than 40.9	39–40.9	38.5–38.9	38.5–38.9	36–38.4	34–35.9	32–33.9	30–31.9	Less than 30			
SPO <sub>2</sub>	Higher than 99	150–179	130–149	120–129	119 or less	90	70–90	Less than 70	Less than 70			
HR	Higher than 179	159	139–149	129–139	119 or less	90	70–90	Less than 70	Less than 70			
RR	Higher than 49	35–49	25–34	12–24	10–11	6–9	5 or less	5 or less	5 or less			
SyC <sub>2</sub>	Higher than 99	150–179	130–149	120–129	119 or less	90	70–90	Less than 70	Less than 70			
WBC	Higher than 29.9	25–39.9	17–24.9	5.7–16.9	3–5.6	1–2.9	85–89%	Less than 85%	Less than 85%			
% immature neutrophils	Higher than 10	10 or higher	10 or higher	10 or higher	10 or higher	10 or higher	10 or higher	10 or higher	10 or higher			
Lactic acid	Higher than 4	4 or higher	4 or higher	4 or higher	4 or higher	4 or higher	4 or higher	4 or higher	4 or higher			

SIRS: systolic blood pressure; HR, heart rate; RR, respiratory rate; SyC<sub>2</sub>, peripheral oxygen saturation; WBC, white blood cell count.

Table 5. Scoring System Characteristics

Scoring System	Sensitivity (%) (95% CI)	Specificity (%) (95% CI)	PPV (%) (95% CI)	NPV (%) (95% CI)	Overall AUC (95% CI)
SOFA* threshold=4	64.3 (51.1–67.2)	87.6 (84–90.6)	15 (7.1–26.6)	98.6 (96.8–99.6)	0.85 (0.76–0.93)
qSOFA* threshold=2	35.7 (12.8–64.9)	89.3 (85.9–92.1)	18.2 (14.4–22.2)	97.6 (95.5–98.9)	0.74 (0.64–0.83)
MEWS* threshold=5	100 (76.8–100)	32.6 (15.7–53.3)	6.5 (3.6–10.6)	100 (98.2–100)	0.81 (0.73–0.90)
REMS* threshold=6	30 (23–37)	63.6 (51.9–68.9)	15.6 (14.4–20.6)	98.1 (96.9–99.2)	0.82 (0.73–0.91)

PPV, positive predictive value; NPV, negative predictive value; AUC, area under the receiver operating characteristic curve; SOFA, Sepsis in Obstetrics Score; qSOFA, Sequential Organ Failure Assessment; MEWS, Modified Early Warning Score; REMS, Rapid Emergency Medicine Score. The scoring system characteristics are all based on data from this prospective study.

12



## Sepsis management

### Surviving Sepsis Campaign: International Guidelines for Management of Sepsis and Septic Shock: 2016

#### Surviving sepsis

- Fluid resuscitation
- Antibiotic therapy
- Vasopressors
- Corticosteroids

#### Antibiotic therapy

- Regimen
- Timing

Rhodes A, et al. Crit Care Med. 2017.  
Baier ME, et al. Am J Perinatol. 2019.

13

## Prevention of complications

- Avoidable deaths
- Avoidable ICU admission
- Delays in care
- Clinical care pathways
- Bundles

Beig C, et al. Obstet Gynecol. 2005.  
Fanghui C, et al. Am J Obstet Gynecol. 2011.  
Sodler LC, et al. Am J Obstet Gynecol. 2013.  
Baier ME, et al. Obstet Gynecol. 2015.

Albright CM, et al. Obstet Gynecol. 2017.  
Baier ME, et al. Anesth Analg. 2019.  
Knight M, et al. MMRACE. 2019.

Classification and cause of maternal death	Total	Contributory factors present	Potentially avoidable deaths
Direct maternal death	20	11	6
Amniotic fluid embolism	8	4	—
Postpartum hemorrhage	3	2	2
Pulmonary embolism	2	1	1
Peripartum cardiomyopathy	1	—	—
Preeclampsia	4	3	3
Sepsis	2	1	—
Indirect maternal death	26	16	11
Preexisting medical condition	9	7	4
Nonobstetric sepsis	6	2	2
Intracranial hemorrhage	1	—	—
Suicide	10	7	5
Unclassifiable	3	—	—
Total	46	27	17
Maternal mortality ratio	19.2/100,000		

Fanghui C. Perinatal mortality in maternal deaths in New Zealand 2006 through 2009. Am J Obstet Gynecol 2011.

14

## CMQCC sepsis bundle

- Two-step approach
  - Initial screen
  - Confirmation
- Action-oriented

Gilks R, et al. Improving Diagnosis and Treatment of Maternal Sepsis: A Quality Improvement Toolkit. 2020. CMQCC.

15

## Escalation of care

- Monitoring
- Medication administration
- Invasive procedures

BOX 4. Criteria for Consideration of Transfer to a Higher Level of Care

Criteria Considerations

- Hypotension (MAP < 65mm Hg) despite fluid resuscitation or need for administration of vasopressors
- Persistent hypoxia (SpO<sub>2</sub> < 92% on room air)
- Altered mental status (combative, confusion, disorientation)

Gilks R, et al. Improving Diagnosis and Treatment of Maternal Sepsis: A Quality Improvement Toolkit. 2020. CMQCC.

Location	ICU for Antepartum Patient	Labor and Delivery	ICU for Postpartum Patient
Team	<ul style="list-style-type: none"> <li>Critical care physician (with MFM/OB consult)</li> <li>Anesthesiologist</li> <li>L&amp;D/antepartum RN to assess for labor signs and perform fetal monitoring</li> <li>ICU staff on standby</li> </ul>	<ul style="list-style-type: none"> <li>MFM/OB with critical care consult</li> <li>Anesthesiologist</li> <li>ICU RN to perform postpartum assessments</li> <li>Postpartum RN to perform postpartum assessments</li> <li>ICU staff on standby</li> </ul>	<ul style="list-style-type: none"> <li>Critical care physician (with MFM/OB consult)</li> <li>Postpartum RN to perform postpartum assessments</li> <li>ICU staff on standby</li> </ul>
Preparation	<ul style="list-style-type: none"> <li>Vaginal delivery and emergent cesarean section equipment in the ICU</li> <li>Neonatal resuscitation equipment in the ICU</li> </ul>	<ul style="list-style-type: none"> <li>Vaginal delivery and emergent cesarean section equipment in the ICU</li> <li>Neonatal resuscitation equipment in the ICU</li> </ul>	<ul style="list-style-type: none"> <li>Cesarean section set up</li> <li>Neonatal bonding, pictures, visits to ICU/skin-to-skin</li> <li>Psycho-social support for the woman and her family</li> </ul>

16

## Conclusions

- COVID-19
  - Neuraxial anesthesia safe
  - Standard medical therapies apply
  - Severe ARDS – OK to prone, ECMO/NO if ≤ 32 weeks, consider delivery if ≥ 32 weeks, multidisciplinary discussions critical
- Sepsis
  - Preventable morbidity
  - Modified early warning systems
  - Early antibiotic therapy
  - Escalation of care – systems, interdisciplinary management, delivery planning

17

## Questions?

• [enaoum@mgm.harvard.edu](mailto:enaoum@mgm.harvard.edu)

18



## Non-obstetric Surgery in Pregnancy and the Early Postpartum Period

Hans Sviggum, MD  
Medical Director of Obstetric Anesthesia  
Mayo Clinic  
Rochester, MN - USA

Valerie Zaphiratos, MSc MD FRCPC  
Lead Obstetric Anesthesia  
CEMIL Maisonneuve-Rosemont hospital  
University of Montreal, Canada

1

### Disclosures

- UpToDate author on non-obstetric surgery (HS)
- Breastfeeding support person for Nourri-Source (VZ)

2

### Objectives

- Understand the perioperative goals for patients undergoing non-obstetric surgery during and after pregnancy
- Discuss the potential implications of anesthesia on fetal neurodevelopment
- Formulate an anesthetic plan for the woman undergoing non-obstetric surgery during pregnancy
- Acquire basic knowledge of human lactation
- Describe the latest evidence regarding breastfeeding and anesthesia
- Discuss the anesthetic considerations of the lactating patient

3

## Non-obstetric Surgery in Pregnancy



4

**Case:** 26 year old G1 at 24 weeks' gestation seen in ED for abdominal pain

- Healthy
- BMI 29

**Diagnosed with appendicitis**



5

### Coming to an operating room near you . . . .

Nearly 100,000 non-obstetric surgeries annually

Most common procedures:

- Appendectomy
- Cholecystectomy
- Gynecologic Surgery
- Trauma Surgery



Ni Mhuireaschaigh R, et al. J Clin Anesth 2006;18:60-6

6



Will you alter your anesthetic plan based on teratogenic effects of anesthetic drugs?

**Audience Vote:**

Yes, I would withhold certain drugs to limit potential teratogenicity

No, I would not be concerned with potential for teratogenicity



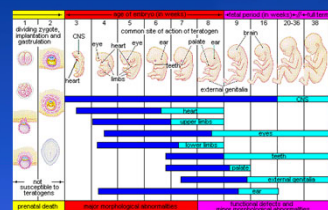
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## Teratogenicity

A developmental change producing congenital malformation

Dependent on:

- Dose
- Duration of exposure
- Stage of development



8

## Teratogenicity – Animal Studies

Multiple studies showing teratogenic effects of anesthetics

Skeletal, visceral, and CNS anomalies

Inhaled > systemic agents

Difficult (or impossible) to extrapolate to humans

Doses

Duration

Interspecies variation



Finnell RH, et al. Teratology 1987;35:177-85  
Basford AB. Anesthesiology 1968;29:1167-73  
Mazze RI, et al. Anesthesiology 1986;64:339-44

9

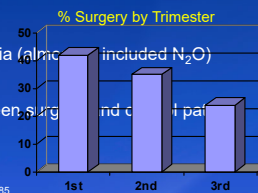
## Teratogenicity – Human Studies

Swedish study of 720,000 pregnant women

5405 had non-obstetric surgery

54% received general anesthesia (all included N<sub>2</sub>O)

No increase in birth defects between surgical and control pairs



Mazze RI, Kallen B. Am J Obstet Gynecol 1989;161:1178-85

10

## Teratogenicity – Human Studies

2005 systemic review of 54 studies – 12,452 patients

No increase in birth defects compared to general population

Cohen-Kerem R, et al. Am J Surg 2005;190:467-73

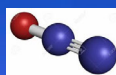
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## Teratogenicity – Pearls

1) Anesthesia and surgery during pregnancy **do not** increase the risk for congenital anomalies

2) No anesthetic agent\* is a proven teratogenic in humans

\*When used at clinical doses in perioperative setting



12



Are you going to suggest an open or laparoscopic approach?

**Audience Vote:**

I would ask the surgeon to perform an open procedure

I would suggest that the surgeon perform a laparoscopic procedure



13

## Laparoscopy

Clinical Science

The American  
Journal of Surgery

### The use of laparoscopic surgery in pregnancy: evaluation of safety and efficacy

Clinical studies suggest effects of pneumoperitoneum are minor  
No difference in perinatal complication rate

Reedy MB, et al. J Reprod Med 1997;42:33-8  
Buser KB. JSLS 2009;13:32-5  
Cornelle MG, et al. Am J Surg 2010;200:363-7

14

## Laparoscopy/Robotic Surgery - Pearls

Can be performed safely during any trimester

Similar benefit compared to laparotomy as non-pregnant patients

CO<sub>2</sub> insufflation should ideally be 10-15 mmHg



15

What important fetal considerations should I have?

**Pearl:** What's good for mom is good for the baby



16

## Fetal Considerations

Limit drug exposure

Prevent preterm labor and delivery

Maintain fetal well-being

- Oxygenation
- Acid-Base status
- Uteroplacental perfusion



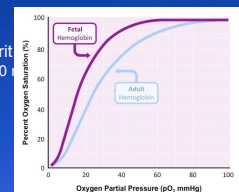
17

## Oxygenation

Fetal hemoglobin has a high affinity for oxygen

Fears of hyperoxia are likely without merit

- Fetal PaO<sub>2</sub> doesn't get higher than 60



18



## Acid-Base status

Fetal PaCO<sub>2</sub> correlates directly with maternal PaCO<sub>2</sub>



**Pearl:** Keep PaCO<sub>2</sub> in normal range for pregnancy (30-32 mm Hg)

19

## Uteroplacental Perfusion

Multiple factors influence uteroplacental blood flow

Hormones

**Pearl:** Maternal diastolic BP in normal range, slightly higher is better than hypotension

Pharmacologic agents

Ephedrine vs. phenylephrine

Regional anesthesia

Positioning

No differences in uterine blood flow

Higher uterine blood flow

Higher uterine blood flow with phenylephrine (no difference in <7.20)

Metabolic effects of ephedrine on fetal Beta receptors

20

## Positioning

Left uterine displacement after 18-20 weeks widely accepted and practiced

- ≥ 15°, by wedge or table tilt
- Most surgeries can be accomplished



However . . .

- Recent data questions need for LUD at cesarean delivery
- Successful outcomes with patients lying flat

**Pearl:** Prudent to employ left uterine displacement (15-30°) if possible

Lee AJ, Landau R. *Anesth Analg* 2017;126:1975-85  
 Chisham CH. *Anesthesiology* 2017;127:183-9  
 Lee AJ, et al. *Anesthesiology* 2017;127:241-9

21

## How are you going to reverse muscle paralysis?

**Audience Vote:**

- I would use Sugammadex
- I would use neostigmine and glycopyrrolate
- I would use neostigmine and atropine
- I would let the non-depolarizer wear off without reversal



22

## Sugammadex

Animal

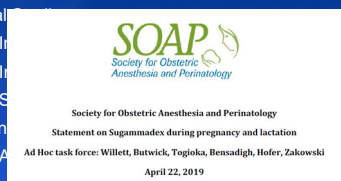
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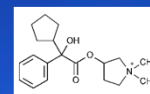
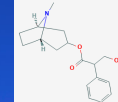
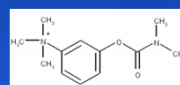
## Neuromuscular reversal

Neostigmine and glycopyrrolate

- *Rare* (and moderate) case reports of fetal bradycardia

Neostigmine and atropine

- Anecdotal reports of fetal tachycardia



Clark RB, et al. *Anesthesiology* 1996;84:450-2  
 McClure JH, et al. *Br J Anaesth* 2011;107:127-32

24



### Outcomes - Maternal

Original Investigation  
Effect of Pregnancy on Adverse Outcomes After General Surgery

Matched cohorts of 2539 undergoing general surgery

	Pregnant	Non-pregnant	
30-day mortality	0.4%	0.3%	P=0.82
Overall morbidity	6.6%	7.4%	P=0.30

Moore HB, et al. JAMA 2015;150:637-43

25

### Outcomes - Pregnancy

The Risk of Adverse Pregnancy Outcomes Following Nonobstetric Surgery During Pregnancy

Estimates From a Retrospective Cohort Study of 6.5 Million Pregnancies

	No Surgery 6,438,652	Surgery 47,628	Attributable Risk
Miscarriage	5.8%	6.6%	0.7%
Stillbirth	0.6%	0.9%	0.4%
Low birth weight	5.6%	8.6%	2.6%
Preterm delivery	7.5%	11.1%	3.2%
Cesarean	23.9%	28.8%	4.0%

Balinskaite V, et al. Ann Surg 2017;266:260-6

26

### Outcomes – Maternal and Pregnancy

Maternal outcomes are good (Pearl: Don't delay needed surgery!)

Small, but definite risks to the fetus

- Preterm delivery
- Low birth weight
- Fetal demise

Cause of risks is difficult to determine

- Disease process vs. Surgery vs. Anesthesia

27

### What about fetal neurodevelopment?

FDA U.S. Food and Drug Administration  
Protecting and Promoting Your Health

#### Drug Safety Communications

FDA review results in new warnings about using general anesthetics and sedation drugs in young children and pregnant women

Safety Announcement

"Repeated or lengthy (>3 hours) use of general anesthesia or sedation drugs during procedures in children <3 years or in pregnant women during their 3<sup>rd</sup> trimester may affect development of children's brains"

28

### Fetal Neurodevelopment

Tymofiyeva O et al. Br J Radiol 2014;87:20140086

29

### Neurodevelopment - Human Studies (Children)

PANDA study

MASK study

GAS study

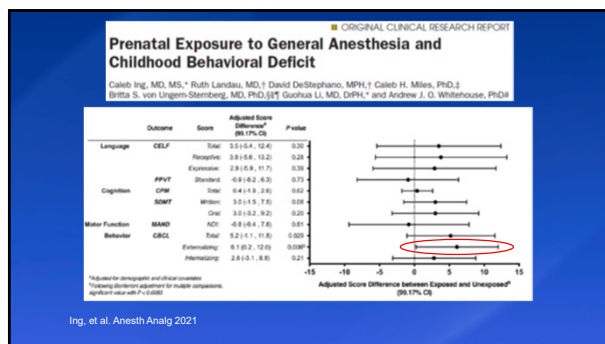
#### Summary of findings

- Single, brief exposure unlikely to cause harm
- May be an issue with multiple exposures
- Behavioral impact > Intelligence impact

Sun LS, et al. JAMA 2016;315:2312-20  
Warner DO, et al. Anesthesiology 2016;129:89-105  
McCann ME, et al. JAMA 2019;393:664-77

30





31

### Fetal Neurodevelopment - Pearls

Nearly all anesthetics have potential to alter neurodevelopment

It is a reason to minimize fetal exposure . . .  
... But remember "what is best for mom is best for baby"

Andropoulos DB. Fetal Diagn Ther 2018;43:1-11  
Palanisamy A. Anesthesiology 2011;114:521-8  
Fel-Juan K. Biochem Pharm 2012;84:558  
Vutskits L, Culey DJ. Anesthesiology 2019;131:762-4

32

**Case:** 34 year-old IVF patient has a positive pregnancy test

- Hallmark moment in front yard
- She jumps and lands awkwardly on the curb

Fracture  
Dislocation and fixation

33

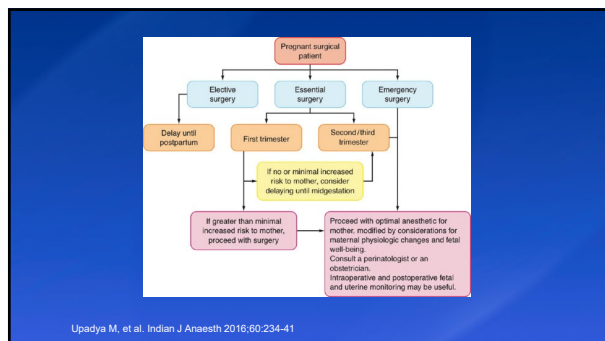
**Would you suggest delaying surgery until 2<sup>nd</sup> trimester?**

**Audience Vote:**

Yes, I would suggest delaying surgery until 2<sup>nd</sup> trimester

No, I would suggest proceeding with surgery

34



35

### Monitoring – Maternal

Patient monitors dictated by comorbidities and surgical procedure

36



### Are you going to recommend continuous fetal monitoring intraoperatively?

#### Audience Vote:

Yes, I would recommend continuous fetal monitoring

No, I would not recommend continuous fetal monitoring

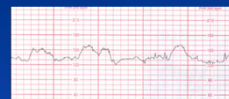


37

### Fetal Heart Rate (FHR) Monitoring

#### Previable fetus

FHR before and after



#### Viable fetus

Simultaneous FHR and contraction monitoring before and after

#### Intraoperative monitoring

Physically possible to perform

Someone qualified to interpret

Fetus is viable

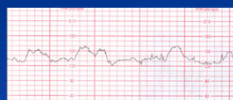
Surgeon willing to intervene

Nature of surgery allows for interruption and urgent delivery

AACOG Committee Opinion No. 775. Obstet Gynecol 2019;133:285-6

38

### Fetal Heart Rate (FHR) Monitoring



Less than half of U.S. institutions routinely use

Has not been shown to improve fetal outcomes

Decision made primarily by OB/MFM in case-by-case basis

**Pearl:** Always obtain OB consult prior to surgery when possible

AACOG Committee Opinion No. 775. Obstet Gynecol 2019;133:285-6  
Kilpatrick CC, et al. South Med J 2010;103:212-5

39

### What is your anesthetic plan?

#### Audience Vote:

General anesthesia with popliteal nerve block

General anesthesia

Spinal anesthesia with popliteal nerve block

Spinal anesthesia



40

### Anesthetic Type

Regional, general, and sedation have all been administered safely!

No association between fetal outcome and anesthesia type\*

Surgical procedure

**Pearl:** Always being equal . . . . . Regional preferred

Reduces need for intubation and airway manipulation

Limits drug exposure to fetus

Provides degree of postoperative analgesia

**Pearl:** Be careful about deviating from your typical practice



41

42



**Case:** 28 year old G1 at 20 weeks gestation

- History of inflammatory bowel disease
- Worsening epigastric pain
- 15 lb weight loss (BMI 27)
- Past Med Hx – allergy induced asthma

**Needs EGD and colonoscopy**



43

**Are you going to intubate her for the procedure?**

**Audience Vote:**

Yes, I would intubate her

No, I would administer deep sedation with natural airway



44

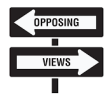
### Aspiration Risk

#### **Clinical Significance of Pulmonary Aspiration during the Perioperative Period**

A review of patients with pulmonary aspiration of gastric contents during anesthesia reported to the Departmental Quality Assurance Committee<sup>27</sup>

Several large studies have failed to identify pregnancy as a risk factor

Warner MA, et al. Anesthesiology 1993;78:76-82  
Neelakanta G, Chikyarappa A. J Clin Anesth 2006;18:102-7



45

### Aspiration Risk

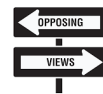
Must consider all risk factors for aspiration

Intubation after 18-20 weeks is *generally accepted*

**Other factors likely more important than pregnancy**

No specific prophylaxis regimen has shown to be superior

Murphy JD. J Clin Anesth 2011;23:435-6



46

### Induction and Intubation

Propofol generally preferred

Others can be used based on patient status

Succinylcholine widely used to facilitate intubation

Limiting time from induction to intubation

"Rapid sequence intubation" controversial

Failed intubation 5-10 times higher than general population

Difficult airway algorithm similar to non-pregnant patients

Video laryngoscopy has revolutionized pregnant airway management

Cantwell R, et al. BJOG 2011;118:1-203

47

### Maintenance

Anesthetics

- Volatile agents *may* reduce uterine irritability
- NO<sub>2</sub> can be used, but limit to 50%
- Opioids are safe and effective
- Low dose ketamine likely safe, but consider risk/benefit ratio

- Inspired oxygen of at least 50%
- Fluid management like non-pregnant patients
- Hypotension should be treated aggressively
- Prophylactic treatment for preterm labor is *not* indicated

48



## Postop Care

### Analgesia

Local anesthetics

Acetaminophen

Opioids

- Oxycodone has robust safety profile

NSAIDs

- Increased risk of miscarriage early in pregnancy
- >30 weeks - premature PDA closure, oligohydramnios, anti-platelet effects
- A single dose in mid-pregnancy highly likely to be safe and effective



Babb M, et al. Can Fam Physician 2010;56:25-7  
Yazdy MM, et al. J Pediatr Genet 2015;4:56-70

Antonucci R, et al. Curr Drug Metab 2012;13:474-90  
Bloor M, et al. Anesth Analg 2013;116:1063-75

49

## Postop Care – (Typically dictated by OB)

### Monitoring

Pre-viable – Fetal heart rate

Viable – Simultaneous electronic FHR and contraction monitoring

### DVT Prophylaxis

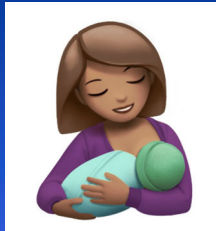
+/- Pharmacologic  
Early ambulation



Criteria for hospital admission same as non-pregnant patient

50

## Surgery in the Early Postpartum Period



51



52

## Case

- 28 yo G1P1, 3 weeks post-partum
- Exclusively breastfeeding her newborn
- Hospitalized x 5 days waiting for a cholecystectomy
- Baby formula fed at home

53

## Is it necessary for her to pump her milk at regular intervals?

### Audience Vote:

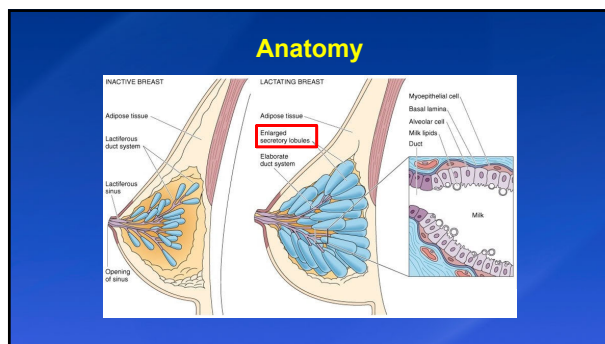
Yes, it maintains milk production and prevents harm to mom

No, there is no impact at this stage of lactation and baby is fed

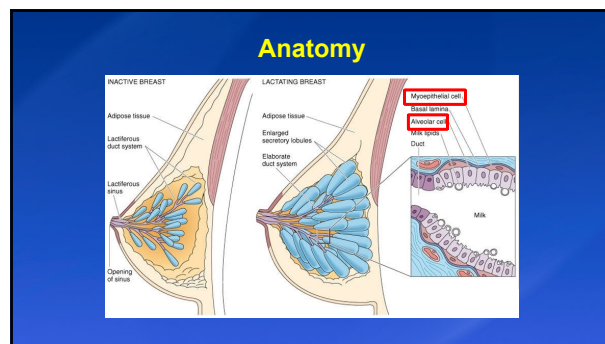


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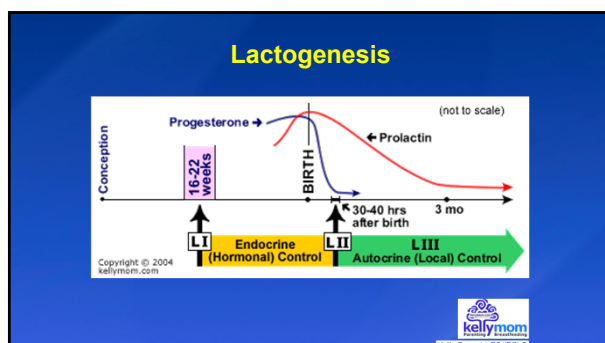




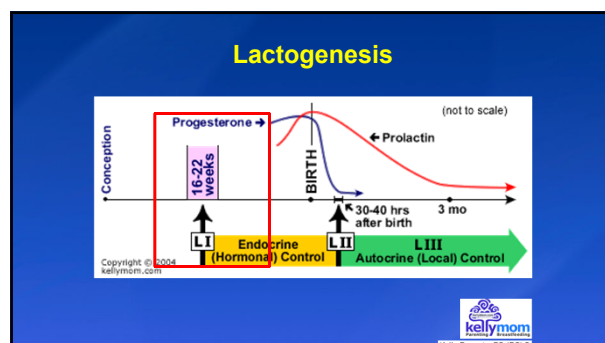
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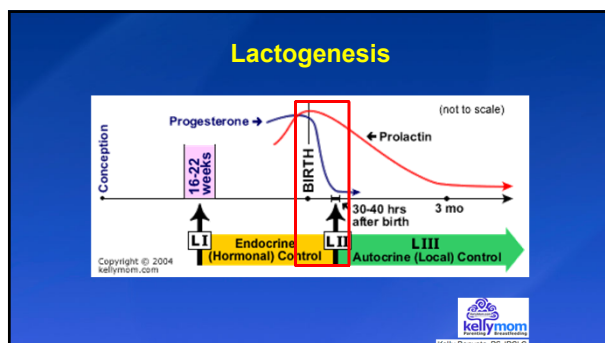
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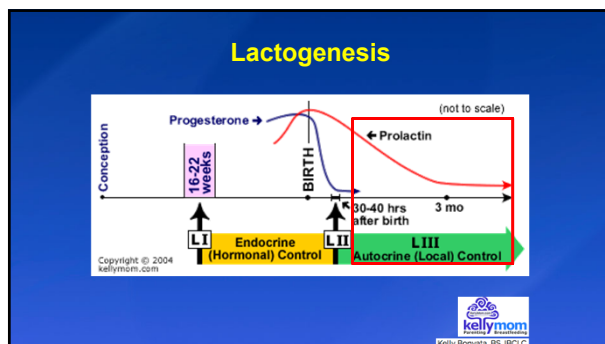


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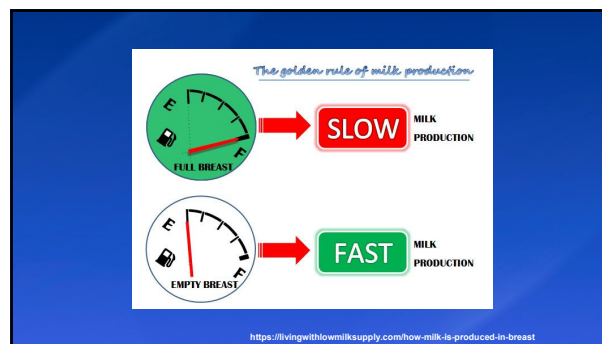


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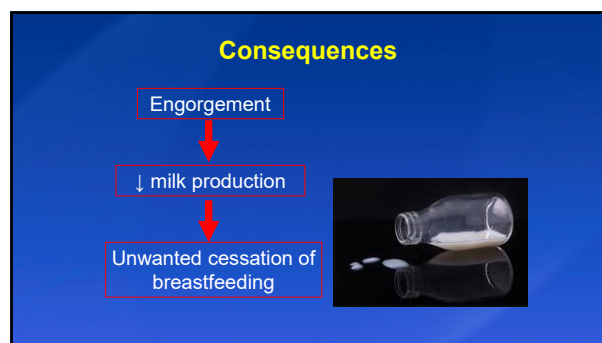
62

### Tenets of breastfeeding

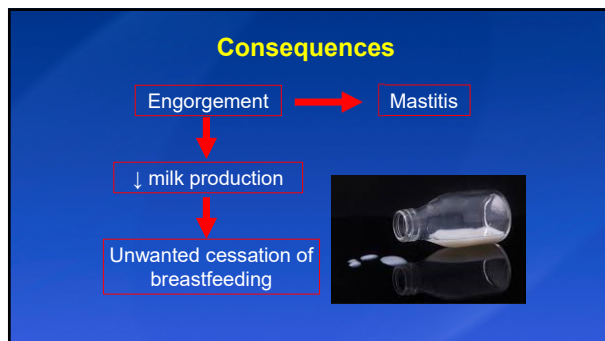
- 1) Feed the baby
- 2) Protect supply
- 3) Keep baby familiar with the breast

<http://www.dr milk.org/>

63



64



65

### MASTITIS

#### Risk factors

- Change in feeding schedule
- Decreased feeds
- Stress
- Fatigue
- Illness

www.shutterstock.com - 792378513

66



### Pearls

- First 3 months post-partum = critical period of establishing milk supply. Need to empty breasts q 2-3h

67

### Pearls

- First 3 months post-partum = critical period of establishing milk supply. Need to empty breasts q 2-3h
- Otherwise:
  - Unwanted cessation of breastfeeding
  - Engorgement and Mastitis

68

### Case

- 28 yo G1P1, 3 weeks post-partum
- Exclusively breastfeeding her newborn
- Hospitalized x 5 days waiting for a cholecystectomy
- Baby formula fed at home

69

### Case

- 28 yo G1P1, 3 weeks post-partum
- Exclusively breastfeeding her newborn
- Hospitalized x 5 days waiting for a cholecystectomy
- Baby formula fed at home



70

### After a general anesthetic, can she breastfeed her baby?

#### Audience Vote:

- a) Yes, as long as she pumps and dumps her milk before breastfeeding
- b) Yes, once she is awake, stable, and alert and she can hold baby
- c) Yes, as long as opioids are avoided completely
- d) No, she needs to wait 24 hours

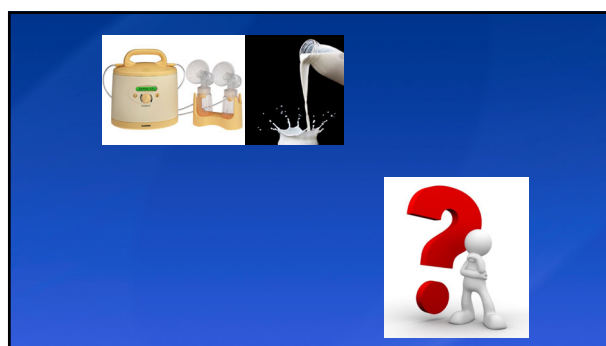


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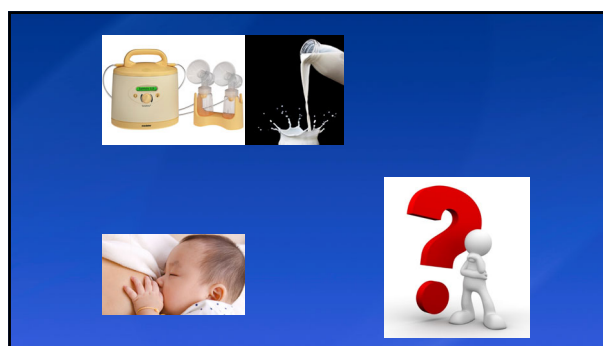


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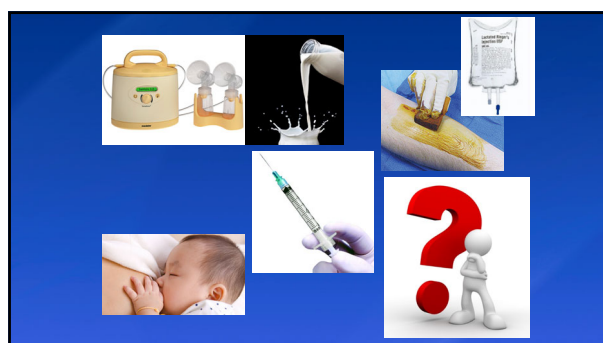
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75



76

## Anesthesia and Breastfeeding: More Often Than Not, They Are Compatible

In this issue, Lee et al<sup>1</sup> endorsed laboring patients to different concentrations of epidural for fetal. There was no difference in successful breastfeeding outcomes at 6 weeks.

## Breastfeeding is Important to Infant Health. Recovering anesthesia should not affect mom's ability to breastfeed, or the safety of her breastmilk.<sup>1,4</sup>

Medication	PROCESS
<b>Fentanyl</b> <small>(opioid analgesic)</small>	<b>PROCEED</b>
<b>Hydroxyzine</b> <small>(anxiolytic)</small>	<b>Monitor closely</b>
<b>Propofol</b> <small>(anesthetic agent)</small>	<b>Monitor closely</b>
<b>Neuraxial opioids</b>	<b>PROCEED</b>
<b>Chlorbutol</b>	<b>PROCEED</b>
<b>Sevoflurane</b>	<b>PROCEED</b>
<b>Halothane</b>	<b>PROCEED</b>

Medication	PROCESS
<b>Propofol</b>	<b>PROCEED</b>
<b>Etomidate</b>	<b>PROCEED</b>
<b>Etomidate</b>	<b>No data</b>
<b>Neuraxial opioids</b>	<b>PROCEED</b>
<b>Neuraxial opioids</b>	<b>PROCEED</b>
<b>Neuraxial opioids</b>	<b>PROCEED</b>
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<b>Etomidate</b>	<b>PROCEED</b>
<b>Etomidate</b>	<b>PROCEED</b>

<sup>1</sup>A general principle is that a mother can resume breastfeeding once she is awake, stable, and alert after anesthesia has been given.<sup>2,3</sup>

Anesthesiology, V 127 • No 4

77

## Anesthesia & Breastfeeding:

### More Often Than Not, They Are Compatible

In this issue, Lee et al<sup>1</sup> examined laboring patients to different combinations of epidural bolus. There was no difference in successful breastfeeding outcomes at 6 weeks.

Breastfeeding is important to infant health. Receiving anesthesia should not affect a mother's ability to breastfeed, or the safety of her breastmilk.<sup>1,4</sup>

Anesthetic		PROCESS
Fentanyl	Mother takes it	PROCEED
Morphine	Mother takes it	PROCEED
Sufentanil	Mother takes it	PROCEED
Propofol	Mother takes it	PROCEED
Epidural	Mother takes it	PROCEED
General	Mother takes it	PROCEED
Nitrous oxide	Mother takes it	PROCEED
Ketamine	Mother takes it	PROCEED
Barbiturates	Mother takes it	PROCEED
Benzodiazepines	Mother takes it	PROCEED
Local anesthetics	Mother takes it	PROCEED

**Periparturient Administration of Anesthetics**

- Propofol PROCEED
- General PROCEED
- Sevoflurane PROCEED
- Nitrous PROCEED
- Barbiturates PROCEED
- Benzodiazepines PROCEED
- Ketamine PROCEED
- Epidural PROCEED
- Local anesthetics PROCEED

**Other Anesthetics**

- Propofol PROCEED
- General PROCEED
- Sevoflurane PROCEED
- Nitrous PROCEED
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- Nitrous PROCEED
- Barbiturates PROCEED
- Benzodiazepines

78



**Breastfeeding after Anesthesia: A Review for Anesthesia Providers Regarding the Transfer of Medications into Breast Milk**  
 Benjamin Cobb, MD, Remy Liu, MD PhD, Elizabeth Valentine, MD, and Onyi Onuoha, MD  
*Transl Perioper Pain Med* 2015 ; 1(2): 1-7

**Breastfeeding after anaesthesia: a review of the pharmacological impact on children**  
 T. C. CHU<sup>1</sup>\*, J. McCALLUM<sup>2</sup>, M. F. YI<sup>2</sup>  
*Anaesth Intensive Care* 2013; 41: 35-40

**Safety of the breast-feeding infant after maternal anesthesia**  
 Priti G. Dalal<sup>1</sup>, Jodi Bosak<sup>2</sup> & Cheston Berlin<sup>3</sup>  
*Paediatr Anaesth* 2014; 24:359-71

79

**ABM Clinical Protocol #15: Analgesia and Anesthesia for the Breastfeeding Mother, Revised 2017**  
 Sarah Reece-Stremtan<sup>1</sup>, Matilde Campos<sup>2</sup>, Lauren Kokajko<sup>3</sup>, and The Academy of Breastfeeding Medicine  
 BREASTFEEDING MEDICINE  
 Volume 12, Number 9, 2017

Breastfeed Med. 2017 Nov;12(9):500-506.

80

**ABM Clinical Protocol #15: Analgesia and Anesthesia for the Breastfeeding Mother, Revised 2017**  
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 BREASTFEEDING MEDICINE  
 Volume 12, Number 9, 2017

*A central goal of The Academy of Breastfeeding Medicine is the development of clinical protocols, free from commercial interest or influence, for managing common medical problems that may impact breastfeeding success. These protocols serve only as guidelines for the care of breastfeeding mothers and infants and do not delineate an exclusive course of treatment or serve as standards of medical care. Variations in treatment may be appropriate according to the needs of an individual patient.*

Breastfeed Med. 2017 Nov;12(9):500-506.

81

**ABM Clinical Protocol #15: Analgesia and Anesthesia for the Breastfeeding Mother, Revised 2017**  
 Sarah Reece-Stremtan<sup>1</sup>, Matilde Campos<sup>2</sup>, Lauren Kokajko<sup>3</sup>, and The Academy of Breastfeeding Medicine  
 BREASTFEEDING MEDICINE  
 Volume 12, Number 9, 2017

**Recommendations**  
 General principles

Breastfeed Med. 2017 Nov;12(9):500-506.

82

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 BREASTFEEDING MEDICINE  
 Volume 12, Number 9, 2017

**Recommendations**  
 General principles

Mothers with healthy term or older infants can generally resume breastfeeding as soon as they are awake, stable, and alert<sup>1-3</sup> (IV) Resumption of normal mentation is a hallmark that medications have redistributed from the plasma compartment (and thus generally the milk compartment) and entered adipose and muscle tissue where they are slowly released.

Breastfeed Med. 2017 Nov;12(9):500-506.

83

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 BREASTFEEDING MEDICINE  
 Volume 12, Number 9, 2017

**Recommendations**  
 General principles

Infants at risk for apnea, hypotension, or hypotonia may benefit from a brief interruption of breastfeeding (6-12 hours) after maternal anesthesia. In this situation, mothers can express and store her milk in small amounts to be used when the infant is older, or it can be mixed with fresh milk containing no medications to dilute the milk with medications present.

Breastfeed Med. 2017 Nov;12(9):500-506.

84



## Pearls

- **Pump and dump** is no longer recommended
- Mom **awake, stable, alert** can breastfeed



85



86

## Ressources

Resource	Sponsor	Website and contact information
LactMed E-Lactancia	U.S. National Library of Medicine Association for Promotion and Cultural and Scientific Research of Breastfeeding, Spain	<a href="https://toxnet.nlm.nih.gov/newtoxnet/lactmed.htm">https://toxnet.nlm.nih.gov/newtoxnet/lactmed.htm</a> <a href="http://www.e-lactancia.org">www.e-lactancia.org</a>
Infant Risk Center	Texas Tech University Health Sciences Center, TX	<a href="http://www.infantrisk.org">www.infantrisk.org</a> and +1 806-352-2519
Breastfeeding and Human Lactation Study Center	University of Rochester, NY	+1 585-275-0088
Mother to Baby	Organization of Teratology Information Specialists	<a href="https://motherbabylab.org">https://motherbabylab.org</a> and +1 866-626-6847
Motherisk	Hospital for Sick Children, Toronto Canada	<a href="http://www.motherisk.org">www.motherisk.org</a> and +1 877-439-2744

87

## Ressources

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LactMed E-Lactancia	U.S. National Library of Medicine Association for Promotion and Cultural and Scientific Research of Breastfeeding, Spain	<a href="https://toxnet.nlm.nih.gov/newtoxnet/lactmed.htm">https://toxnet.nlm.nih.gov/newtoxnet/lactmed.htm</a> <a href="http://www.e-lactancia.org">www.e-lactancia.org</a>
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88

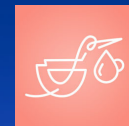
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89



Infant Risk



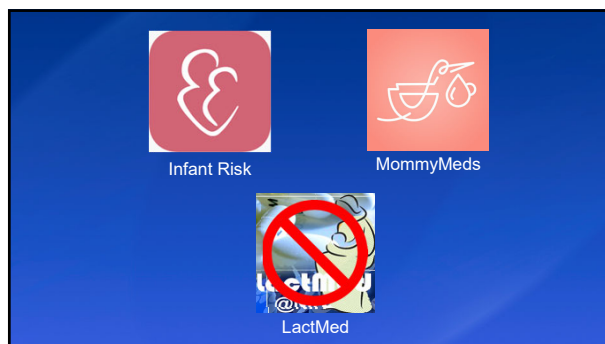
MommyMeds



LactMed

90



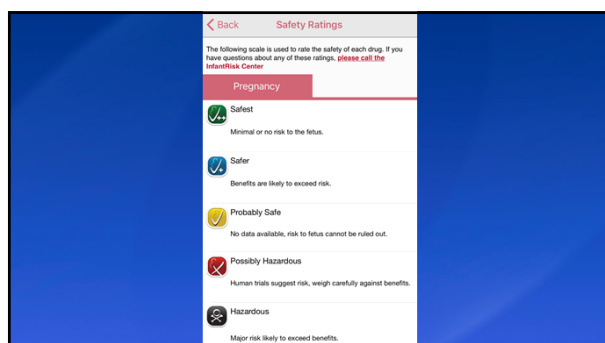


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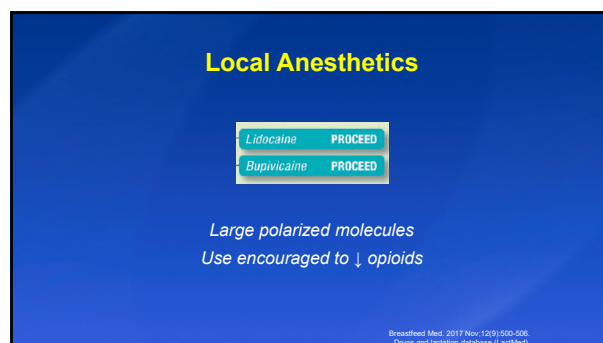
Category	Description
<b>L1 Safest</b>	Drug that has been taken by a large number of breastfeeding mothers without any observed increase in adverse effects in the infant. Controlled studies in breastfeeding women fail to demonstrate a risk to the infant and the possibility of harm to the breastfeeding infant is remote. Or the product is not orally bioavailable to an infant.
<b>L2 Safer</b>	Drug that has been studied in a limited number of breastfeeding women without an increase in adverse effects in the infant and/or the evidence of a demonstrated risk that is likely to follow use of this medication in a breastfeeding woman is remote.
<b>L3 Moderately Safe</b>	There are not controlled studies in breastfeeding women; however, the risk of untoward effects to a breastfed infant is possible, or controlled studies show only minimal, nonthreatening adverse effects. Drugs should be given only if the potential benefit justifies the potential risk to the infant.
<b>L4 Hazardous</b>	There is positive evidence of risk to a breastfed infant, or to breast milk production, but the benefits from use in breastfeeding mothers may be acceptable despite the risk to the infant (e.g., if the drug is needed in a life-threatening situation or for a serious disease for which safer drugs cannot be used or are ineffective).
<b>L5 Contraindicated</b>	Studies in breastfeeding mothers have demonstrated that there is significant and documented risk to the infant based on human experience, or it is a medication that has a high risk of causing significant damage to an infant. The risk of using the drug in breastfeeding women clearly outweighs any possible benefit from breastfeeding. The drug is contraindicated in women who are breastfeeding an infant.

Hale's Medications and Mothers' Milk, 2021

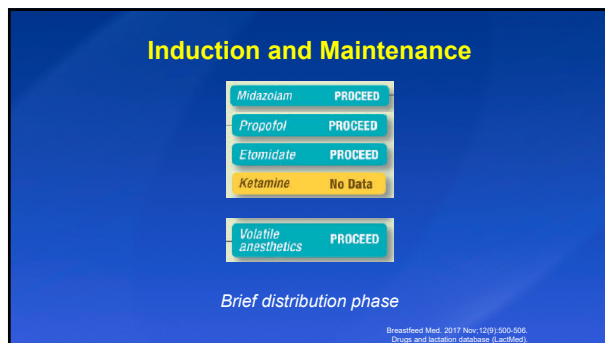
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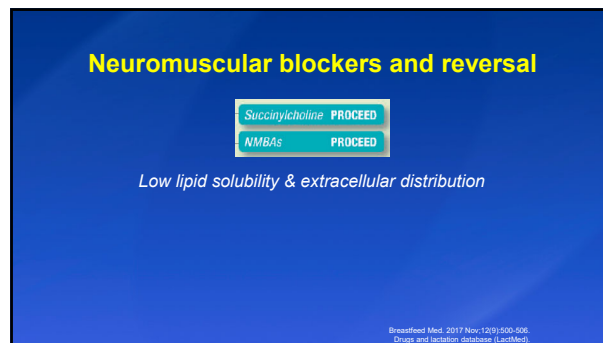
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94



95



96



## Neuromuscular blockers and reversal

Succinylcholine **PROCEED**  
NMBAs **PROCEED**

Low lipid solubility & extracellular distribution

Neostigmine/  
glycopyrrolate **PROCEED**

Negligible quantity in breastmilk

Suggamadex: no human studies

Breastfeed Med. 2017 Nov;12(9):500-506.  
Drugs and lactation database (LactMed).

97

## Antiemetics

Ondansetron **PROCEED**  
Dexamethasone **PROCEED**  
Metoclopramide **PROCEED**

Safe – lack of sedation

Breastfeed Med. 2017 Nov;12(9):500-506.  
Drugs and lactation database (LactMed).

98

## Opioids

Fentanyl (single dose IV) **PROCEED**  
Morphine **Monitor closely**  
Hydromorphone **Monitor closely**  
Meperidine **AVOID**

Breastfeed Med. 2017 Nov;12(9):500-506.  
Drugs and lactation database (LactMed).

99

## Would you administer opioids to a lactating patient?

### Audience Vote:

Yes, only certain opioids with judicious use and for short periods

No, opioids should be avoided completely



100

## ABM Clinical Protocol #15: Analgesia and Anesthesia for the Breastfeeding Mother, Revised 2017

Sarah Reece-Stremtan,<sup>1</sup> Matilde Campos,<sup>2</sup> Lauren Kokajko,<sup>3</sup> and The Academy of Breastfeeding Medicine  
BREASTFEEDING MEDICINE  
Volume 12, Number 9, 2017

### Recommendations General principles

The most concerning class of medications used for anesthesia and analgesia in breastfeeding mothers is opioids, as these medications transfer into breast milk and may cause infant sedation or apnea. Judicious use of opioids for short periods is likely to be safe for most breastfeeding mothers and infants.<sup>6,12-14</sup> (IV)

101

## Opioids preferred

Morphine and Hydromorphone  
Fentanyl, Sufentanil, Remifentanil

Breastfeed Med. 2017 Nov;12(9):500-506.  
Drugs and lactation database (LactMed).

102



**Opioids preferred**

Morphine and Hydromorphone  
Fentanyl, Sufentanil, Remifentanyl

**Opioids to avoid**

Meperidine  
Codeine  
Tramadol

Brasfield Med. 2017 Nov;19(5):505-506.  
(Drugs and lactation database [accessed])

103

Codeine and tramadol should not be used by the following:

JAMA, October 17, 2017, Volume 318, Number 15

104

**Pearls**

- Judicious use of opioids for short periods
- Preferred opioids:
  - Fentanyl, sufentanil, remifentanyl
  - Morphine, Hydromorphone
- Avoid meperidine and drugs via CYP2D6

105

**Dexmedetomidine (Precedex™)**

106

Detection of dexmedetomidine in human breast milk using liquid chromatography–tandem mass spectrometry: Application to a study of drug safety in breastfeeding after Cesarean section  
Rika Nakanishi<sup>a,c</sup>, Maruho Yoshimura<sup>a,c</sup>, Maruho Song<sup>a,c</sup>, Kento Yamamoto<sup>a</sup>, Haruka Ito<sup>a</sup>, Yohei Uchimine<sup>a</sup>, Takashi Toriumi<sup>b</sup>, Atsushi Kurosawa<sup>a</sup>, Ami Sugawara<sup>a</sup>, Takayuki Kunisawa<sup>a</sup>  
Journal of Chromatography B, 1040 (2017) 209–213

**Intravenous dexmedetomidine for cesarean delivery and its concentration in colostrum**  
M. Yoshimura,<sup>a</sup> T. Kunisawa,<sup>b</sup> M. Suno,<sup>c</sup> A. Sugawara,<sup>b</sup> A. Kurosawa,<sup>b</sup> R. Nakanishi,<sup>c</sup> K. Aoki,<sup>c</sup> T. Toriumi<sup>a</sup>  
International Journal of Obstetric Anesthesia (2017) 32, 28–32

M/P	RID (%)
6	6
0.88	0.098
0.76	0.048
0.82	0.040

M/P ratio	6 h RID (%)
6 h	0.023
0.53	0.098
0.88	0.024
0.76	0.024
0.45	
0.95	0.032
0.57	0.036
0.76	0.048
0.82	0.040

107

Impact of Intraoperative Infusion and Postoperative PCIA of Dexmedetomidine on Early Breastfeeding After Elective Cesarean Section: A Randomized Double-Blind Controlled Trial  
Yu Wang<sup>1</sup>, Xiang Fang<sup>2</sup>, Chao Liu<sup>1</sup>, Xiaotong Ma<sup>1</sup>, Yutong Song<sup>1</sup>, Ming Yan<sup>1</sup>  
Drug Design, Development and Therapy 2020;14: 1083–1093

Figure 2 Kaplan-Meier curves for ratio of exclusive breastfeeding after delivery between the two groups.

108





109

## Other Considerations

- Pump or breastfeed just before entering the OR
- 1<sup>st</sup> case of the day to reduce fasting time
- Euvolemia
- Avoid iodine disinfection
- Multimodal analgesia
  - Prioritize regional analgesia
  - Limit narcotics

Breastfeed Med. 2017 Nov; 12(9):500-506.  
Drugs and lactation database (LactMed)

110

## Summary of Pearls – Non-obstetric Surgery in Pregnancy

Proceed with surgery when clinically indicated  
 Involve an obstetrician prior to surgery  
 Document fetal heart rate pre and postoperatively
 

- Continuous intraoperative monitoring on case-by-case basis

 Anesthetic agents are not known to be teratogenic in humans
 

- Still, medication exposure to fetus should be minimized

 "What's good for mom is good for baby"
 

- Maternal hypotension/hypoxia/acidosis pose greatest fetal risk

 No anesthetic technique or agent has been shown to affect outcome
 

- Regional anesthesia preferred if all else equal

111

## Summary of Pearls – Surgery in the Early Postpartum Period

Separating the mom/baby dyad can cause engorgement and mastitis  
*Pump and dump* is no longer recommended  
 Mom **awake, stable, alert** can breastfeed  
 Multimodal analgesia  
 Avoid meperidine and drugs via CYP2D6

112

## Best References

AOCC Committee Opinion No. 775. Obstet Gynecol 2019;133:285-6  
 Cohen-Kerem R, et al. Am J Surg 2005;190:467-73  
 ABM protocol #15. Breastfeed Med. 2017 Nov;12(9):500-506.  
[www.infantrisk.org](http://www.infantrisk.org)

113

## Questions?




[sviggum.hans@mayo.edu](mailto:sviggum.hans@mayo.edu)

[valerie@zaphiratos.ca](mailto:valerie@zaphiratos.ca)



114






**Building & Moving  
Bridges & Forward**

**#SOAPAM2021**

## Airway management during pregnancy

**Mary Mushambi**

DAS Professor of anaesthesia and Airway management  
Hon. Consultant Anaesthetist  
Associate Medical Director  
University Hospitals of Leicester  
Leicester, UK



1

## Airway management during pregnancy

- 1. Rapid sequence induction**
- 2. Unanticipated difficult airway**
- 3. Extubation**

2

### Obstetric GA morbidity and mortality

	Obstetrics	General
Hypoxia during RSI		
<90%	9.4%	1.4%
<95%	20%	6.6%
Incidence of FI	1: 390 - 443	1: 2,000
FON incidence	1: 30,000 (FI 1: 60)	1: 50,000
Mortality	1: 43,000 (FI 1:100)	1: 180,000
Awareness	1:670	1:19,000

Failed tracheal intubation during obstetric general anaesthesia: A literature review  
M. Kinsella, A.J. Wynn, M.C. Maheshwari, K. Rameshwar, H. Sridhar, C. D'Souza, A. K. S. Srinivasan

Incidence and risk factors for maternal hypoxemia during induction of general anaesthesia for non-elective Caesarean section: a prospective multicentre study  
M. Kinsella, A.J. Wynn, M.C. Maheshwari, K. Rameshwar, H. Sridhar, C. D'Souza, A. K. S. Srinivasan

NAPS  
National Audit of Paediatric Sedation  
National Audit of Paediatric Sedation  
National Audit of Paediatric Sedation

3

### Morbidity after FI in pregnant woman

Morbidity	FI	Uneventful GA
Hypoxia	71%	2%
Lowest oxygen saturation	40%	84%
Aspiration	8%	1%
Neonatal ITU admission	34%	20%

Failed tracheal intubation in obstetric anaesthesia: 2 yr national case-control study in the UK  
A. C. Quinn, D. Mihal, M. Columb, H. Gordon and M. Knight  
Neonatal outcomes after failed tracheal intubation during obstetric general anaesthesia for caesarean section: Secondary analysis of a UKOSS case-control study  
European Journal of Obstetrics & Gynecology and Reproductive Biology 207 (2017) 179-184

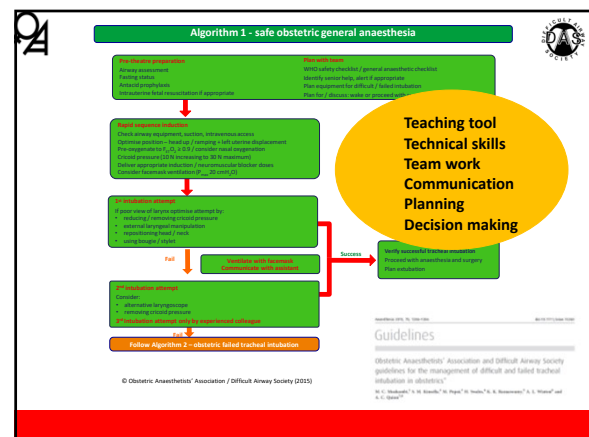
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### Failed intubation in obstetrics

- Emergency CS – fetal distress
- BMI  $\pm$  40
- 2<sup>nd</sup> theatre/2<sup>nd</sup> anaesthetist
- Pt in theatre already
- Attempted spinal – failed
- Supine with tilt
- RSI – mask pre-O<sub>2</sub>/STP/Sux
- Cannula disconnection
- Failed to intubate with Macintosh
- Desaturation
- Call for help
- GA continued with face mask, CP & SV

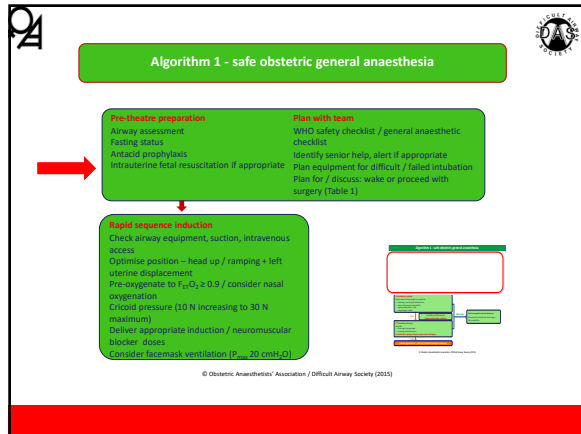
- > Pre-theatre planning and preparation
- > RSI technique
- > Management after FI

5

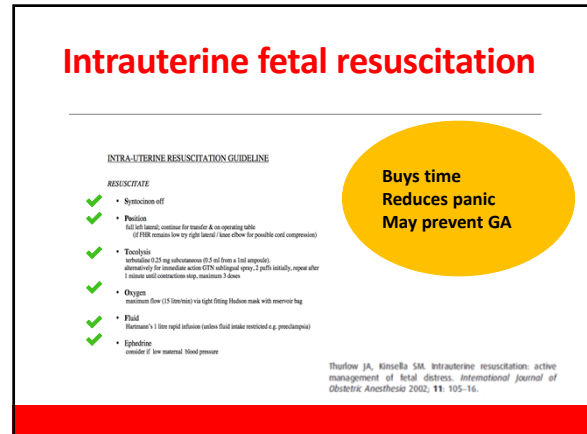


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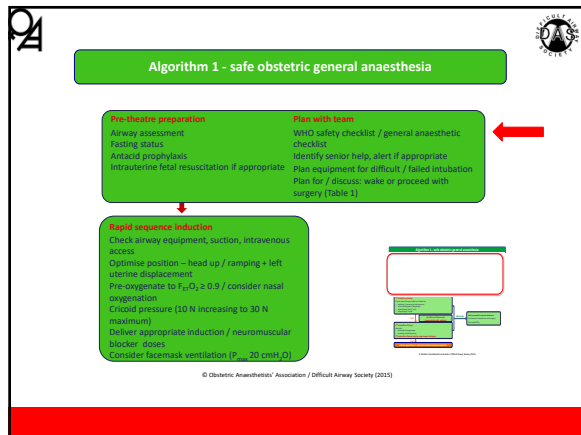




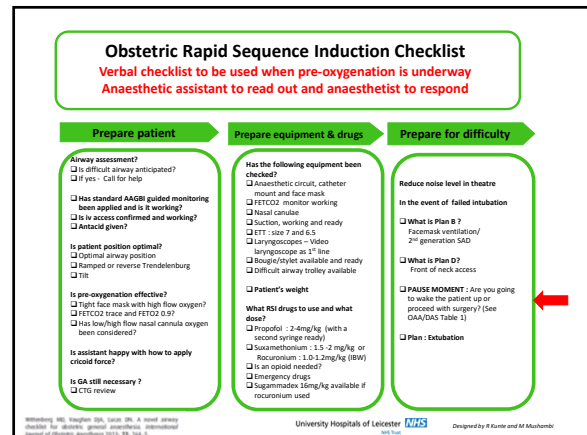
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**Table 1 - proceed with surgery?**

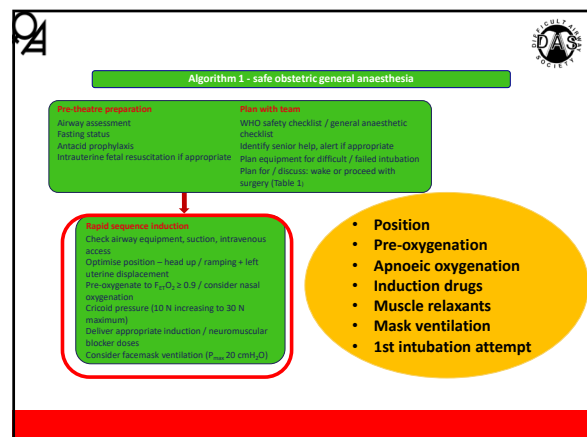
	WAKE	PROCEED
<b>Maternal condition</b>	• No compromise	• Mild acute compromise • Haemorrhage responsive to resuscitation
<b>Fetal condition</b>	• No compromise	• Compromised fetal heart rate abnormally despite intrauterine resuscitation • pH < 7.2 but > 7.25
<b>Anaesthetic</b>	• None	• Senior trainee • Consultant / specialist
<b>Identify</b>	• Supervised	• Consultant
<b>Surgical factors</b>	• Complex surgery or major haemorrhage anticipated	• Multiple uterine scars • Single uterine scar
<b>Aspiration risk</b>	• Recent food	• No recent food
<b>Alternative anaesthesia regional</b>	• No anticipated difficulty	• Predicted difficulty
<b>After failed intubation</b>	• Difficult facemask ventilation • Front of neck	• First generation supraglottic airway device • Second generation supraglottic airway device
<b>Respiratory hazards</b>	• Bleeding • Stridor	• Secretions • None evident

© Obstetric Anaesthetists' Association / Difficult Airway Society (2015)

Criteria to be used in the decision to wake or proceed following failed tracheal intubation. In any individual patient, some factors may support waking and others proceeding. The final decision will depend on the anaesthetist's clinical judgement.

**Final decision at a stressful time**  
**Human factors & situational awareness**

11



12



## Mask Pre-oxygenation

**ETO<sub>2</sub> ≥ 90%**

>50% unable to achieve this

9.4% SaO<sub>2</sub> <90% during induction

20% SaO<sub>2</sub> < 95% during induction

**Figure 5** Apnoeic desaturation following pre-oxygenation is shown for three patient types: normal 70 kg patient (●), obese 100 kg patient (▲), and critically ill 70 kg patient (■). The time to 90% and 80% recovery of desaturation (time after succinylcholine 1 mg kg<sup>-1</sup>) are shown bounded by the dashed lines. Figure adapted from Bennett [1].

Incidence and risk factors for maternal hypoxaemia during induction of general anaesthesia for non-elective Caesarean section: a prospective observational study. Newsham KH, Doherty D, Mehta S, et al. Anaesthesia 2015; 70: 145-51. Copyright 2015, published by the British Society of Anaesthetists.

13

## Apnoeic oxygenation

**Rapid sequence induction**  
Check airway equipment, suction, intravenous access  
Optimise position – head up / ramping + left uterine displacement  
Pre-oxygenate to F<sub>IO2</sub> ≥ 0.9 / consider nasal oxygenation  
Cricoid pressure (only increasing to 30 N maximum)  
Deliver appropriate induction / neuromuscular blocker doses  
Consider facemask ventilation (P<sub>peak</sub> 20 cmH<sub>2</sub>O)

**Nasal Cannula**  
5-15L/min  
Patent airway

Ramchandani SK, Gnanasekaran A, Shanks A, Janner UK. Apnoeic oxygenation during prolonged laryngoscopy in obese patients: a randomised, controlled trial of nasal oxygen administration. Journal of Clinical Anaesthesia 2010; 22: 164-8. Weingart SO, Levitan RM. Preoxygenation and prevention of desaturation during emergency airway management. Airway of Emergency Medicine 2013; 99: 145-75.

14

## High Flow Humidified Nasal Oxygenation (HFHNO)

Patel and Nozari | THORNTON oxygenation in difficult intubation. Anaesthesia 2015; 70: 323-329

**Nasal Cannula**  
Humidified O<sub>2</sub> 30-70L/min  
Patent airway  
>15mins safe apnoea time

Figure 1 The Optiflow high-flow humidified oxygen delivery system. The oxygen humidification with (a) receives oxygen from a standard oxygen regulator and delivers humidified oxygen to a custom-built transnasal oxygen cannula (b) and (c) like a standard nasal oxygen cannula (d).

Patel A, Nozari SAR. Transnasal Humidified Rapid-Insufflation Ventilatory Exchange (HFHNO): a physiological method of increasing apnoea time in patients with difficult airways. Anaesthesia 2015; 70: 323-9.

15

## HFHNO pre-oxygenation in Pregnant women

Preoxygenation	ETO <sub>2</sub> (%) Median (range)
<b>Shippam</b>	
HFHNO	89 (70-95)
Mask	93 (75-97)
<b>Tan</b>	
HFHNO	91 (58-96)

➤ Not as effective as mask pre-O<sub>2</sub>

➤ ?Safe apnoea time

Tan PCF et al. BJA 2015;122:86-91. Shippam Anaesthesia 2015;74:458-6.

16

## Efficacy of HFHNO during RSI in pregnant women

- 34 parturients
- 17 HFHNO – 50L/min
- 17 Mask
- BMI <35
- Arterial line prior to GA
- RSI
- PaO<sub>2</sub> post intubation

	HFNO	FM
PaO <sub>2</sub> (mmHg)	441 ± 47	328 ± 73
ETO <sub>2</sub> (%)	87 ± 4	77 ± 8

**Conclusion**  
HFHNO is safe as a method of oxygenation during RSI in parturients

EJA. The efficacy of high-flow nasal oxygenation for maintaining maternal oxygenation during rapid sequence induction in pregnancy. A prospective observational study. Anaesthesia 2015; 70: 145-51. Copyright 2015, published by the British Society of Anaesthetists.

17

## P dvn#zhqwlodwlrq#yxlqj #JVL

**Rapid sequence induction**  
Check airway equipment, suction, intravenous access  
Optimise position – head up / ramping + left uterine displacement  
Pre-oxygenate to F<sub>IO2</sub> ≥ 0.9 / consider nasal oxygenation  
Cricoid pressure (30 N increasing to 30 N maximum)  
Deliver appropriate induction / neuromuscular blocker doses  
Consider facemask ventilation (P<sub>peak</sub> 20 cmH<sub>2</sub>O)

- Historically – mask ventilation in RSI not permitted
- Fear of gastric insufflation
- Studies disproved this if Peak inspiratory pressure <20cm H<sub>2</sub>O and cricoid pressure applied

Lawes EG, Campbell I, Meier D. Inflation pressure, gastric insufflation and rapid sequence induction. British Journal of Anaesthesia 1987; 59: 315-8. Petto SR, Russell WJ. The prevention of gastric inflation – a neglected benefit of cricoid pressure. Anaesthesia and Intensive Care 1988; 16: 139-43.

18



## Induction for RSI in Obstetrics

**Accidental awareness**  
General 1:19,000  
GA for CS 1:670

An additional syringe of intravenous hypnotic agent should be immediately available to maintain anaesthesia in the event of airway difficulties.....

**NAPS**  
National Audit of Paediatric Sedation  
Accidental Awareness during General Anaesthesia in the United Kingdom and Ireland  
Report and findings  
September 2014

**16**  
AAGA in obstetric anaesthesia

**16**  
AAGA in obstetric anaesthesia

19

## Videolaryngoscopes in Obstetrics

**Better C&L views**

**Higher success rates**

**Rescued FI with D/L**

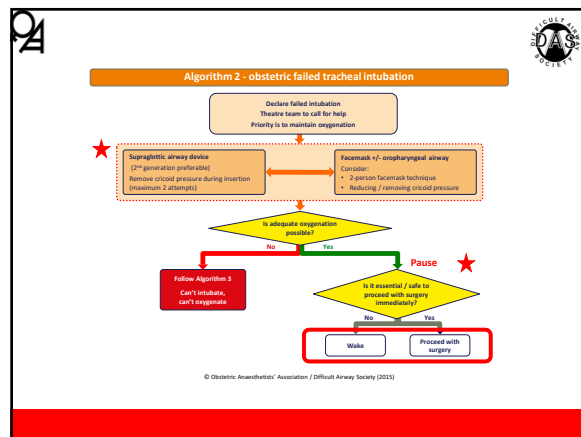
**Teaching tool**

**Human factors**

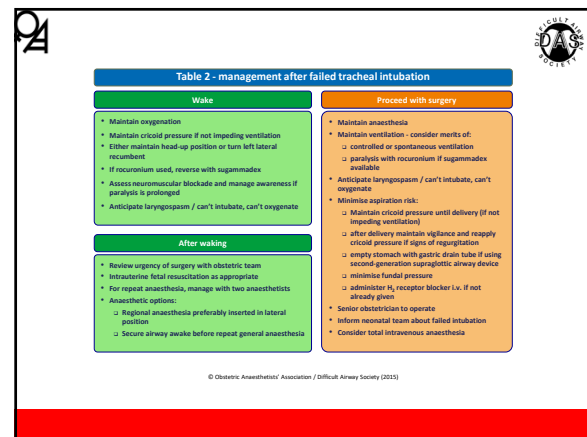
**Use videolaryngoscope as 1<sup>st</sup> line**

**Comparison of videolaryngoscopy and direct laryngoscopy for tracheal intubation in obstetrics: a mixed-methods systematic review and meta-analysis**  
Ryan Howie<sup>1</sup>, Desire Onwuche<sup>2</sup>, Siew-Ling Harrison<sup>2</sup>, Neil Desai<sup>2</sup>

20



21



22

## Proceed with GA

- Maintain anaesthesia
- Rocuronium (with sugammadex available)
- IPPV
- 2<sup>nd</sup> generation SAD
- Anticipate CICO (US to mark CTM and FON equipment)
- +/- CP
- Reduce/avoid fundal pressure
- Neonatal team

23

## Failed intubation in obstetrics

**Emergency CS – fetal distress**

**BMI ± 40**

**2<sup>nd</sup> theatre/2<sup>nd</sup> anaesthetist**

**Pt in theatre already**

**Attempted spinal – failed**

**Supine with tilt**

**RSI – mask pre-O<sub>2</sub>/STP/Sux**

**Cannula disconnection**

**Failed to intubate with Macintosh**

**Desaturation**

**Call for help**

**GA continued with face mask, CP & SV**

**Intra-uterine fetal resuscitation**

**Checklist**

**Position**

**Peri-intubation oxygenation techniques**

**Induction agents (2<sup>nd</sup> syringe)**

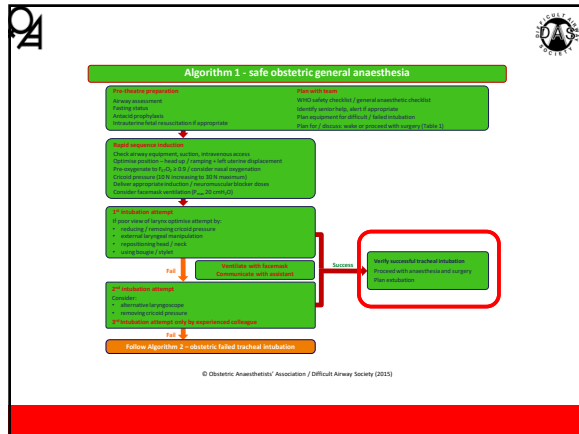
**CP**

**Laryngoscope**

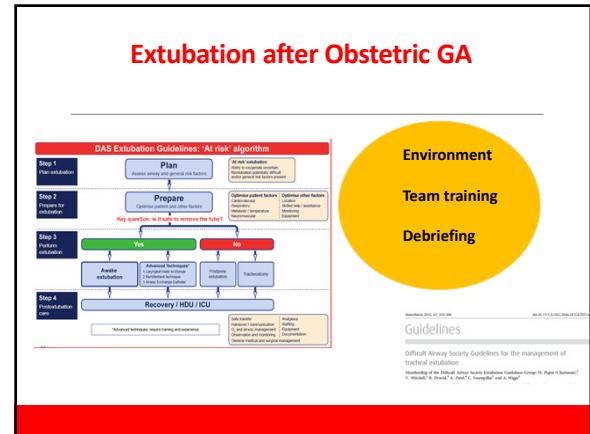
**Management after FI**

24

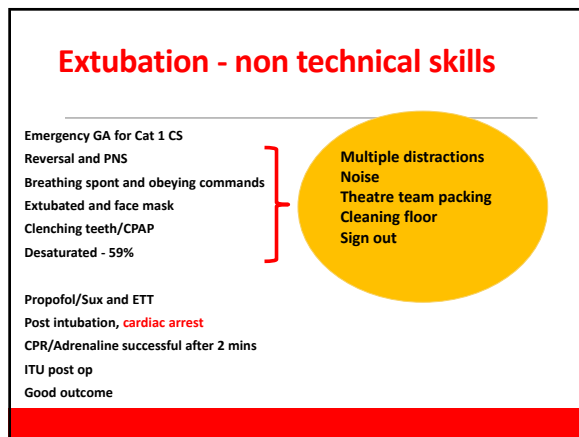




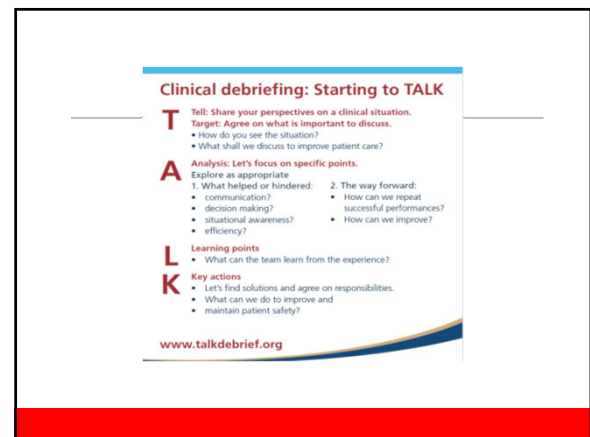
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28

# Airway management during pregnancy

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1. Rapid sequence induction
2. Unanticipated difficult airway
3. Extubation

29

**Thank you**

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**Any comments /questions?**

30



## References

1. Mushambi MC, Kinsella SM, Popat M, et al. Obstetric Anaesthetists' Association and Difficult Airway Society guidelines for the management of difficult and failed tracheal intubation in obstetrics. *Anaesthesia*. 2015;70(11):1286-1306. doi:10.1111/anae.13260
2. Kinsella SM, Winton AL, Mushambi MC, et al. Failed tracheal intubation during obstetric general anaesthesia: a literature review. *Int J Obstet Anesth*. 2015;24(4):356-374. doi:10.1016/j.ijoa.2015.06.008
3. Thurlow JA, Kinsella SM. Intrauterine resuscitation: active management of fetal distress. *International Journal of Obstetric Anaesthesia* 2002; 11: 105-16.
4. Bonnet M-P, Mercier FJ, Vicaut E, et al. Incidence and risk factors for maternal hypoxaemia during induction of general anaesthesia for non-elective Caesarean section: a prospective multicentre study. *Br J Anaesth*. 2020;125(1):e81-e87. doi:10.1016/j.bja.2020.03.010

31

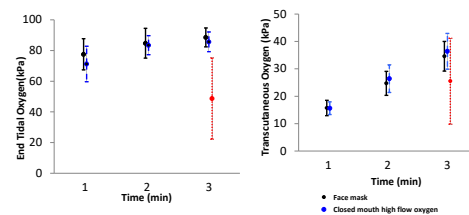
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9. Popat M, Mitchell V, Dravid R, Patel A, Swampillai C, Higgs A. Difficult Airway Society Guidelines for the management of tracheal extubation. *Anaesthesia* 2012; 67: 318-40.

32

## High flow humidified nasal pre-oxygenation

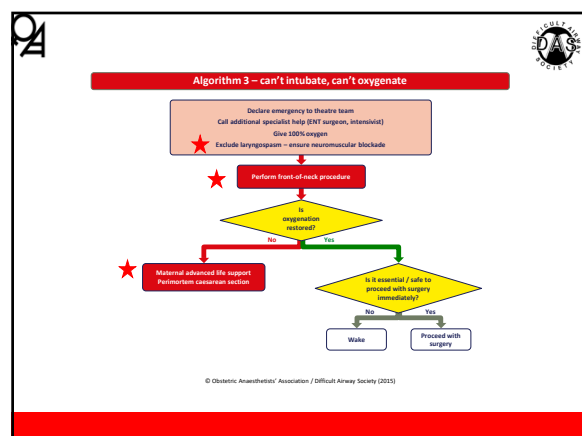
Comparison of pre-oxygenation with HFHNO to standard facemask technique in healthy volunteers



Pillai, Daga, et al *Anaesthesia* 2016;71:1280-3

34

33



35



Total Cardiac arrests	66
Anaesthetic cardiac arrests	16 (25%)
Intubation failure	3
Perimortem CS	49

Beckett V et al *BJOG* 2017;124:1374-81

36



## Muscle relaxant for RSI in Obstetrics

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### Suxamethonium vs Rocuronium

1. Anaphylaxis risk
2. Dose calculation (TBW/IBW/LBM)
3. Reversal/sugammadex availability
4. Failed intubation - laryngeal spasm

Suxamethonium - 92% use in the UK



## Post-partum Veno-Venous Extracorporeal Membrane Oxygenation in a COVID-19 patient as a bridge to lung transplantation

**Presenting Author:** Ioannis Angelidis, MD, MSPH

**Presenting Author's Institution:** Northwestern University, Feinberg school of Medicine

**Co-Author:** Lindsay Holland, MD; Paul Tamul, DO

**Abstract :** Pneumonia in pregnant patients is associated with increased morbidity and mortality compared to non-pregnant patients.<sup>1</sup> A COVID-19 infection can have a poor prognosis<sup>2</sup> leading to severe Acute Respiratory Distress Syndrome (ARDS) and subsequent death. According to Centers for Disease Control, pregnant women with COVID-19 in the US are at increased risk for severe symptoms and are more likely to be admitted to the intensive care unit (ICU) compared with non-pregnant women.<sup>3</sup>

We present a case of a 28-year old female with no significant past medical history, who was diagnosed with COVID-19 pneumonia at 35 weeks of gestation. She was initially asymptomatic but developed signs of respiratory failure at 37 weeks of gestation that lead to her admission at an outside hospital. The patient was subsequently intubated and had an emergent cesarean section. There was difficulty extubating her post-section due to poor arterial PO<sub>2</sub> levels. The patient was self-extubated five days later with worsening chest x-ray imaging consistent with severe ARDS. Due to concerns for aspiration she was started on antibiotics. The patient was placed on Veno-Venous (V-V) Extracorporeal Membrane Oxygenation (ECMO). She also had a diminished heart function post-partum with an Ejection Fraction (EF) of 40%, that had recovered by her arrival to our center. She was transferred to our hospital for a lung transplant work-up. The patient had a successful bilateral lung transplantation. Her post-transplantation course had no complications and she was able to get transferred out of the ICU on the eighth postoperative day.

The symptoms of COVID-19 include fever, cough, sore throat, myalgia, and can further escalate to severe illness requiring advanced critical-care support, such as pneumonia with ARDS, renal failure, and multiorgan dysfunction.<sup>2</sup> Treatment varies from medications in mild disease to more invasive measures such as mechanical support in severe cases. Remdesivir is used for hospitalized patients who require supplemental oxygen. It is not recommended for patients on mechanical ventilation due to the lack of data showing benefit at this advanced stage of the disease. Dexamethasone can improve survival in hospitalized patients who require supplemental oxygen, with the greatest on mechanically ventilated patients.<sup>3</sup> Lastly, V-V ECMO can successfully be used as a bridge to lung transplant for severe illness which is refractory to mechanical ventilation.

### References:

- Severe COVID-19 infection in pregnancy requiring intubation without preterm delivery: A case report Leah Hong, Nicolina Smith, Madhurima Keerthy et al.
- Emergency Cesarean Section at 38 Weeks of Gestation with COVID-19 Pneumonia: A Case Report. Priya Patel, Sayali Kulkarni, Manrique Guerrero et al.
- CDC



# POST-PARTUM VENO-VENOUS EXTRACORPOREAL MEMBRANE OXYGENATION IN A COVID-19 PATIENT AS A BRIDGE TO LUNG TRANSPLANTATION

IOANNIS ANGELIDIS MD, MSPH, LINDSAY HOLLAND MD, PAUL TAMUL DO



Department of Anesthesiology, Northwestern University, Feinberg School of Medicine, Chicago, Illinois

## Introduction

Pneumonia in pregnant patients is associated with increased morbidity and mortality compared to non-pregnant patients.<sup>1</sup> A COVID-19 infection can have a poor prognosis<sup>2</sup> leading to severe Acute Respiratory Distress Syndrome (ARDS) and subsequent death. According to Centers for Disease Control, pregnant women with COVID-19 in the US are at increased risk for severe symptoms and are more likely to be admitted to the intensive care unit (ICU) compared with non-pregnant women.<sup>3</sup>

## Case Report

We present a case of a 28-year-old female with no significant past medical history, who was diagnosed with COVID-19 pneumonia at 35 weeks of gestation. She was initially asymptomatic but developed signs of respiratory failure at 37 weeks of gestation that lead to her admission at an outside hospital. The patient was subsequently intubated and had an emergent cesarean section. There was difficulty extubating her post-section due to poor arterial PO2 levels.

## Case Report Continued

The patient was self-extubated five days later with worsening chest x-ray imaging consistent with severe ARDS. Due to concerns for aspiration, she was started on antibiotics. The patient was placed on Veno-Venous (V-V) Extracorporeal Membrane Oxygenation (ECMO). She also had a diminished heart function post-partum with an Ejection Fraction (EF) of 40%, that had recovered by her arrival to our center. She was transferred to our hospital for a lung transplant work-up. The patient had a successful bilateral lung transplantation. Her post-transplantation course had no complications, and she was able to get transferred out of the ICU on the eighth postoperative day.

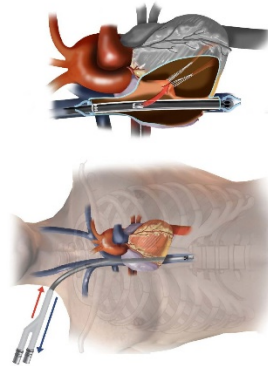


Fig.1 VV ECMO

## Conclusion

The symptoms of COVID-19 include fever, cough, sore throat, myalgia, and can further escalate to severe illness requiring advanced critical-care support, such as pneumonia with ARDS, renal failure, and multiorgan dysfunction.<sup>2</sup> Treatment varies from medications in mild disease to more invasive measures such as mechanical support in severe cases. Remdesivir is used for hospitalized patients who require supplemental oxygen. It is not recommended for patients on mechanical ventilation due to the lack of data showing benefit at this advanced stage of the disease. Dexamethasone can improve survival in hospitalized patients who require supplemental oxygen, with the greatest on mechanically ventilated patients.<sup>3</sup> Lastly, V-V ECMO can successfully be used as a bridge to lung transplant for severe illness which is refractory to mechanical ventilation.

## References

1. Case Reports in women's health 27 (2020) e00217.
2. Am J Case Rep, 2020; 21: e926591
3. CDC



## **Chloroprocaine Labor Epidural for Parturient with Local Anesthetic Resistance**

**Presenting Author:** Nohamin Ayele

**Presenting Author's Institution:** Loyola University Medical Center

**Co-Author:** Michael Brule, MD

**Abstract :** Inadequate epidural anesthesia is often due to technical and pharmacologic reasons, with failure rates of up to 32% reported<sup>1</sup>. True local anesthetic (LA) resistance is challenging to diagnose and very few cases have been described. LA resistance may involve genetic variations of the voltage-gated sodium channels themselves<sup>2</sup>. We present a rare case of a parturient with a history of presumed amide LA resistance and idiopathic ventricular tachycardia (VT) who desired epidural analgesia for vaginal delivery of a stillborn infant.

**Case report:** A 34 y.o. G4P2012 obese female presented at 34.5 weeks' gestation for an induction of labor of a stillborn infant. She had presumed amide LA resistance given a reported history of inadequate dental local anesthesia (with the exception of the ester LA, articaine) and ineffective ropivacaine labor epidurals for her previous deliveries. She also had a significant history of occasional syncopal episodes due to idiopathic VT for which she had an implantable loop recorder in place. The patient was placed on continuous telemetry during her labor course. Initially, she elected to trial an IV ketamine infusion, however it provided minimal relief and resulted in unpleasant side effects. The decision was made to perform a skin patch test using chloroprocaine. The chloroprocaine patch test was successful, so a 0.3% 3-chloroprocaine epidural infusion was subsequently administered for labor. Seventy-five micrograms of fentanyl and 40 mg of 3% chloroprocaine was used as the test dose. She received a continuous epidural infusion of 0.3% chloroprocaine at 12 cc/hour, while intermittent epidural boluses of 5 cc of 3% chloroprocaine plus 50 mcg of fentanyl was given for breakthrough pain. The patient reported adequate pain relief for her uneventful vaginal delivery.

**Discussion:** True LA resistance is poorly understood and epidemiologic data is lacking. In the event of true amide LA allergy or resistance, standard epidural infusions may be harmful or ineffective. As in this case, the use of a continuous ester LA infusion is an effective alternative. Chloroprocaine is typically available for pharmacies to compound for an epidural infusion. The optimal chloroprocaine concentration and infusion rate is unknown, however, 0.75 - 1.5% 2-chloroprocaine have been safely used for labor epidurals<sup>3</sup>.

Additionally, this patient had idiopathic VT, which was likely related to her amide LA resistance. Management strategies for these patients rely on efficient diagnosis of suspected channelopathy, maintaining hemodynamic stability during labor, and escalating care when necessary<sup>4</sup>. Epidural analgesia with ropivacaine has been safely administered in this patient population<sup>5</sup>.

### **References:**

- Hermanides et. al., BJA. 2012; 109: 2 (144-54).
- Clendenen et. al., Minerva A. 2016; 82 (10).
- Lee et. al., A & A Case Reports. 2017; 10 (1213).
- Kotchetkov et. al., Clin Med Insights Cardiol. 2010; 4 (39-44).
- Van der Knijff-van Dortmont et al., Case Rep Anesthesiol. 2016; 10 (1155).



## Combined Craniotomy and Cesarean Section in an Acutely Neurologically Compromised Parturient

**Presenting Author:** Andrew Iglesias, MD

**Presenting Author's Institution:** Medical University of South Carolina

**Co-Author:** David Gutman, MD, MBA;; Katherine Herbert, MD; Michael Marotta, MD; Joel Sirianni, MD

**Introduction:** Intracranial masses in pregnancy present a host of challenging considerations in regards to the timing and mode of delivery. Likewise, the safety and utility of neuraxial anesthesia for these patients is controversial and not definitive. We present a parturient with an enlarging intracranial mass requiring urgent cesarean section and immediate craniotomy for a space occupying lesion.

**Case Report:** Patient was a 21 year old G4P2 at 34 weeks that was admitted following a generalized tonic-clonic seizure. The seizure was preceded by sudden onset of left-sided paresthesias, weakness, ataxia, headache and blurry vision. Infectious workup, toxicology screen, and workup for eclampsia were all negative. Imaging of the head showed a right frontoparietal mass measuring 5.4 x 4.8 x 4.5 cm via MRI. Given the reassuring EEG and reliable fetal surveillance, she was discharged with planned cesarean section at 39 weeks, followed by mass resection. She returned at 37 weeks following deteriorating neurologic symptoms. Brain MRI revealed an increased size of the intracranial mass (6.7 x 5.3 x 5.3 cm), new hemorrhage, increased mass effect with surrounding vasogenic edema, and a 6 mm leftward midline shift. The patient was urgently scheduled for a cesarean section immediately followed by craniotomy for mass resection.

Neuraxial anesthesia was avoided for delivery despite conflicting literature of its safety. Ultimately the patient underwent general anesthesia following placement of a pre-induction arterial line. Total intravenous anesthesia with propofol and remifentanyl commenced with ICP precautions. Following delivery of a viable infant and adequate uterine tone with oxytocin, craniotomy utilizing neuromonitoring was completed uneventfully. She required two units of packed red blood cells but was otherwise hemodynamically stable. Bilateral quadratus lumborum nerve blocks were performed prior to extubation and she was transferred to the neurosurgical ICU in stable condition. Left-sided weakness and neurologic symptoms improved postoperatively, and she was discharged with a subsequent histologic diagnosis of anaplastic ependymoma.

**Discussion:** Perioperative management of parturients with intracranial lesions by a multidisciplinary team is critical for the safety of both mother and fetus. The decision to use neuraxial anesthesia in parturients with space occupying lesions is controversial, but it is reasonable to avoid in a parturient with active neurologic symptoms and midline shift. If stable, delivery should be delayed appropriately for fetal maturity and neuraxial anesthesia can be considered on a case-by-case basis especially. This is especially true if vaginal delivery and valsalva are deemed safe by the consulting neurosurgical team. Ultimately, our patient did well perioperatively but did have recurrence requiring re-resection and continues to undergo adjuvant radiation therapy and chemotherapy.



# Combined Craniotomy and Cesarean Section in an Acutely Neurologically Compromised Parturient

Joel Sirianni MD, David Gutman MD MBA, Jose Iglesias MD, Katherine Herbert MD, Michael Marotta MD  
Medical University of South Carolina- Department of Anesthesia and Perioperative Medicine



## INTRODUCTION

Intracranial masses in pregnancy present a host of challenging considerations in regards to the timing and mode of delivery. Likewise, the safety and utility of neuraxial anesthesia for these patients is controversial and not definitive. We present a parturient with an enlarging intracranial mass requiring urgent cesarean section and immediate craniotomy for a space occupying lesion.

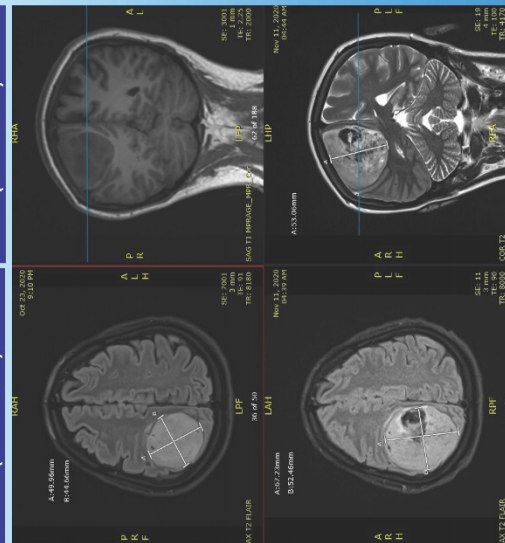
## CASE (Continued)

Neuraxial anesthesia was avoided for delivery despite conflicting literature of its safety. Ultimately the patient underwent general anesthesia following placement of a pre-induction arterial line. Total intravenous anesthesia with propofol and remifentanyl commenced with ICP precautions. Following delivery of a viable infant and adequate uterine tone with oxytocin, craniotomy utilizing neuromonitoring was completed uneventfully. She required two units of packed red blood cells but was otherwise hemodynamically stable. Bilateral quadratus lumborum nerve blocks were performed prior to extubation and she was transferred to the neurosurgical ICU in stable condition. Left-sided weakness and neurologic symptoms improved postoperatively, and she was discharged with a subsequent histologic diagnosis of anaplastic ependymoma.

## CASE

Patient was a 21 year old G4P2 at 34 weeks that was admitted following a generalized tonic-clonic seizure. The seizure was preceded by sudden onset of left-sided paresthesias, weakness, ataxia, headache and blurry vision. Infectious workup, toxicology screen, and workup for eclampsia were all negative. Imaging of the head showed a right frontoparietal mass measuring 5.4 x 4.8 x 4.5 cm via MRI. Given the reassuring EEG and reliable fetal surveillance, she was discharged with planned cesarean section at 39 weeks, followed by mass resection. She returned at 37 weeks following deteriorating neurologic symptoms. Brain MRI revealed an increased size of the intracranial mass (6.7 x 5.3 x 5.3 cm), new hemorrhage, increased mass effect with surrounding vasogenic edema, and a 6 mm leftward midline shift. The patient was urgently scheduled for a cesarean section immediately followed by craniotomy for mass resection.

Top: 5.4 x 4.8 x 4.5 cm  
(10/23/2020)



Bottom: 6.7 x 5.3 x 5.3 cm  
(11/11/2020)

## DISCUSSION

When considering anesthetic management in a parturient patient with an intracranial mass, we recognize that ICP may increase with painful uterine contractions and valsalva, then dural puncture may result in fatal brain herniation, thus the common consideration to avoid neuraxial techniques. However, general anesthesia precludes concurrent neurologic assessment and potentially increases ICP during intubation/extubation. Maintaining hemodynamics are also crucial to preserve cerebral and uteroplacental perfusion. Further, as minute ventilation is increased during pregnancy, additional hyperventilation may cause a shift in the oxyhemoglobin curve and compromise uterine perfusion.

## CONCLUSION

Perioperative management of parturients with intracranial lesions by a multidisciplinary team is critical for the safety of both mother and fetus. The decision to use neuraxial anesthesia in parturients with space occupying lesions is controversial, but it is reasonable to avoid in a parturient with active neurologic symptoms and midline shift. If stable, delivery should be delayed appropriately for fetal maturity and neuraxial anesthesia can be considered on a case-by-case basis especially. This is especially true if vaginal delivery and valsalva are deemed safe by the consulting neurosurgical team. Ultimately, our patient did well perioperatively but did have recurrence requiring resection and continues to undergo adjuvant radiation therapy and chemotherapy.

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## Anesthetic Management of a Parturient with Recurrent Pulmonary Artery Sarcoma and Severe Pulmonary Hypertension for Cesarean Section: A Case Report

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**Presenting Author's Institution:** Memorial Healthcare System

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**Abstract :** This case report describes the peripartum management and cesarean delivery of a 38-year-old G2P1 female with recurrent pulmonary artery sarcoma. The patient presented at 23 weeks gestation with dyspnea, lower extremity edema (NYHA II) and severe pulmonary artery hypertension (RVSP 66 mm Hg, severe TR). Past medical history was significant for two prior excisions of pulmonary artery sarcoma, left main pulmonary artery dilation, left pulmonary stent placement, postoperative external beam radiation and chemotherapy. She was referred to our multidisciplinary navigation team (comprised of obstetrics, anesthesiology, cardiology, neonatology, oncology, cardiac surgery and radiology) based on her history and CARPREG II risk assessment score of 7 (prior cardiac event=3, ventricular dysfunction=2, and pulmonary hypertension=2). A CARPREG II score >4 is associated with >40% risk of a primary cardiac adverse event in the peripartum period (1). Her pulmonary hypertension was managed with furosemide and sildenafil, and she received betamethasone at 27 weeks to promote lung maturity. At 32 weeks her functional status declined (NYHA Class III), and cesarean delivery under general anesthesia with transesophageal echocardiography (TEE) was scheduled at 34 weeks. A cardiac surgery team was available on standby. Intraoperative inhaled nitric oxide and dobutamine were utilized to manage right heart failure, and a viable infant was delivered with Apgars of 9/9 and EBL 766 mL. The patient was transferred to the ICU and extubated 3 hours later. Following extubation, she was placed on oxygen via high flow nasal cannula and weaned from nitric oxide over 5 hours. Oral sildenafil was resumed, and both the parturient and infant were discharged home on day 3 with close cardiology followup.

Pulmonary artery sarcoma in parturients is extremely rare and is associated with significant morbidity and mortality (2). CARPREG II risk assessment enabled timely referral of this patient for multidisciplinary navigation, and our team collaborated to manage her pulmonary hypertension, coordinate successful cesarean delivery with minimal blood loss, and manage postoperative care (3,4). We performed cesarean section under general anesthesia because it permitted administration of nitric oxide, use of TEE to guide anesthetic management, and if needed, median sternotomy or ECMO cannulation. In this patient, a pulmonary artery catheter was avoided due to her surgical history. Postoperative ICU care was essential to manage right heart failure following delivery, wean vasopressor and nitric oxide therapy, ensure adequate pain management, and maintain oxygenation and ventilation following extubation (5).

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5. Rex S and Devroe S. Curr Opin Anesth (2016) 29: 273-281



# Management and Cesarean Delivery of a Parturient with Recurrent Primary Pulmonary Artery Sarcoma and Severe Pulmonary Hypertension

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## Introduction

Pulmonary artery sarcoma (PAS) is an extremely rare tumor from the mesenchymal cells of the pulmonary artery that is frequently asymptomatic until significant pulmonary artery obstruction and pulmonary hypertension occur (1,2). This case report describes the risk stratification, multidisciplinary management and successful cesarean delivery of parturient with recurrent PAS.

## Case Report

A 38-year-old G2P1 female with recurrent PAS presented at 23 weeks gestation with increasing dyspnea, lower extremity edema (NYHA II) and severe pulmonary artery hypertension (RVSP 66 mm Hg, severe TR; Figure 1). Past medical history was significant for two prior excisions of pulmonary artery sarcoma, left main pulmonary artery dilation, left pulmonary stent placement, postoperative external beam radiation and adjuvant chemotherapy. She was referred to our multidisciplinary team (comprised of obstetrics, anesthesiology, cardiology, neonatology, oncology, cardiac surgery and radiology) based on her history and CARPREG II risk assessment score of 7 (prior cardiac event=3, ventricular dysfunction=2, and pulmonary hypertension=2). Patients with a CARPREG II risk score >4 have a greater than 40% risk of a primary cardiac adverse event in the peripartum period (Figure 2, 3). Her pulmonary hypertension was managed with oral furosemide and sildenafil, and she underwent planned cesarean delivery under general endotracheal anesthesia with intraoperative TEE monitoring at 34 weeks gestation due to worsening functional physical status (NYHA III, Figure 3). A viable male was delivered with Apgars 9/9. Intraoperatively and postoperatively, inhaled nitric oxide and dobutamine were utilized to manage right heart failure. The patient was extubated 3 hours after admission to the ICU and placed on oxygen via high flow nasal cannula for 24 hours. She was weaned from nitric oxide 5 hours following extubation, and oral sildenafil 20 mg PO BID was resumed. Both the parturient and infant were discharged home on postpartum day 3.

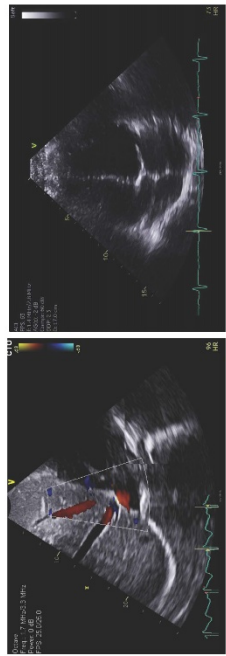


Figure 1. Preoperative TEE images showing increased venous pressure and RV dilation

Score	Risk of Peripartum Cardiac Event
1	5%
2	10%
3	15%
4	22%
> 4	41%

Figure 2. CARPREG II Risk Assessment Score (adapted from reference 3)

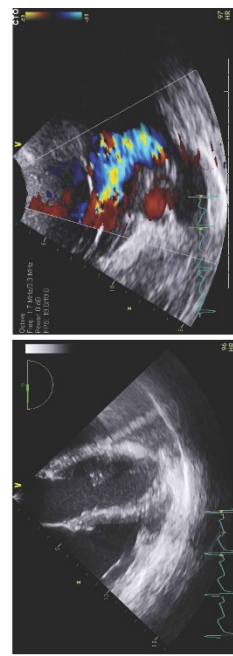


Figure 3. Intraoperative TEE images showing dilated RV and TR Jet

## Discussion

Pulmonary artery sarcoma in parturients is extremely rare and is associated with significant morbidity and mortality (1,2,4,5). Our multidisciplinary navigation team facilitated early CARPREG II risk stratification, outpatient management of pulmonary hypertension, and determination of clinical endpoints for delivery. This work enabled a successful cesarean delivery in the setting of high venous pressures without maternal or fetal complications.

Arterial and central venous access were placed prior to induction of anesthesia to closely monitor hemodynamic and fluid status. We utilized general endotracheal anesthesia for this case because it permitted intraoperative monitoring of cardiac function via TEE (figure 3), administration of inhaled nitric oxide, and if needed, median sternotomy or cannulation for ECMO. In this patient, placement of a pulmonary artery catheter was avoided due to her prior pulmonary artery resections. Postoperative ICU care was essential to manage right heart function and postpartum fluid shifts, wean vasopressor and nitric oxide therapy, ensure adequate pain management, and maintain oxygenation and ventilation following extubation (6).

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## **Management of a pregnant patient on dual anti-platelet therapy**

**Presenting Author:** Jiaxin Huang, MD

**Presenting Author's Institution:** Washington University in St. Louis

**Co-Author:** Mark Hanak, MD; Mingchun Liu, MD; Danish Jaffer, MD; Swarup Varaday, MD

**Introduction:** Although ischemic heart disease in pregnancy is uncommon (0.01% incidence), it is associated with high mortality (1). To our knowledge, this is the first report of a parturient with CAD on dual-antiplatelet therapy (DAPT) receiving cangrelor as a bridge for delivery via neuraxial anesthesia.

**Case:** Our patient was a 40-year-old G7P4 with history of CAD and extreme poverty scheduled for IOL. Prior to pregnancy, she had an NSTEMI and DES placement in the LM/LAD and LCx. She was non-compliant with DAPT and presented with another NSTEMI at 21 weeks gestation. PCI revealed 95% LM stent restenosis and TTE was unremarkable; another DES was placed. She was seen by cardiology and categorized as WHO Pregnancy Risk Class III.

A multidisciplinary team including anesthesiology, obstetrics, and cardiology planned to minimize her time off DAPT - ideally 24 hours at most. She was admitted at 35 weeks for prasugrel washout and cangrelor bridge for IOL. Upon admission, prasugrel was held for 3 days. She was started on cangrelor infusion on day 4 and scheduled for IOL on day 7, but this was moved to day 12 for logistical reasons. The fetus was non-vertex on morning of IOL. Cangrelor was stopped 3 hours prior to an uncomplicated CSE. After an attempted ECV, the patient underwent primary c-section and BTL. EBL was 900cc and the neonate had APGARs of 6 and 8 at 1 and 5 minutes, respectively. The epidural was removed at the end of the case. Given good hemostasis, the patient received a loading dose of prasugrel 6 hours after epidural removal. In total, the patient was off DAPT for 11.5 hours. She had an uncomplicated postoperative course and was discharged home on POD4.

**Discussion:** The use of DAPT has significant peripartum implications affecting bleeding risk and anesthetic technique (1). Aspirin is likely safe in pregnancy, but the safety of P2Y12 inhibitors (clopidogrel and prasugrel) is unclear (2,3). Prasugrel has faster onset, higher potency, and more consistent effects compared to clopidogrel, but is associated with more bleeding. ASRA recommends holding prasugrel 7-10 days before neuraxial anesthesia and resuming a loading dose 6 hours after catheter removal (4).

Cangrelor is a rapidly reversible P2Y12 inhibitor with an onset of 2 minutes and a half-life of 3-6 minutes (4,5). After discontinuation, 90% of platelet recovery can occur by 90 minutes (4). ASRA recommends holding cangrelor 3 hours before neuraxial anesthesia and restarting it 8 hours after catheter removal (4).

With multidisciplinary planning, a parturient on DAPT can minimize risks of stent restenosis and peripartum hemorrhage and still benefit from neuraxial anesthesia.

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## Urgent Cesarean Delivery of a COVID-19 Parturient in the Intensive Care Unit

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**Presenting Author's Institution:** UC Irvine Department of Anesthesiology

**Co-Author:** Kyle Ahn, MD; Dmitry Portnoy, MD

**Background:** Hospitalized parturients with COVID-19 have a greater severity, higher rate of cesarean delivery (CD) and preterm delivery (1). This case discusses an urgent CD for a parturient with COVID-19 acute hypoxic respiratory failure in the Intensive Care Unit (ICU)

**Case:** A 23 year old G1P0 at 30-weeks gestation was admitted to the ICU for worsening hypoxia due to COVID-19 pneumonia. Within 24 hours, she could not maintain oxygen saturations (SPO<sub>2</sub>) above 90% despite high flow nasal cannula (HFNC) 70 L/min, 100% FiO<sub>2</sub>, and lateral positioning. She was emergently intubated for acute hypoxia, SPO<sub>2</sub> less than 80%. Fetal Heart Rate remained in the 150s throughout.

Post intubation, SPO<sub>2</sub> slowly improved and remained in the high 80s despite 100% FIO<sub>2</sub>, 20 mmHg PEEP, and with head of bed (HOB) elevated to 45 degrees. A multidisciplinary team (Obstetrics, Pulmonary Critical Care, Anesthesiology, Neonatology) elected to proceed with CD in the ICU given the patient's respiratory status was expected to deteriorate without delivery. Also, the ICU ventilator was not transport-capable and the patient's respiratory status precluded reconnection to a transport ventilator for risk of alveolar derecruitment.

The patient's negative pressure ICU room was decontaminated and simulated an operating room (OR) with appropriate surgical instruments, sterile equipment, OR staff. 3 anesthesiology physicians were present given the limited space. Uterotonics, a fluid warmer, rescue medications, and 4 units of typed and crossed packed red blood cells were in the room. Sedation with propofol was increased to induce general anesthesia. Fentanyl and cisatracurium infusions were continued. HOB remained elevated. Arterial blood gases were used in the absence of capnography. Baby was delivered via vertical incision and immediately given to the NICU team waiting outside. Besides oxytocin, no additional uterotonics nor blood products were needed.

Postoperatively, the patient remained intubated alternating from supine to prone. On post operative day (POD) 11, she was extubated to BIPAP and weaned to HFNC. On POD 20, she was discharged home on room air.

**Discussion:** CS in a non-OR setting is usually reserved for extreme situations such as a maternal code or death. This case offers a novel example of a non-OR CD for an intubated COVID-19 parturient. Delivery can dramatically improve the respiratory status of a parturient in respiratory distress (2) similar to the presented case. Preparing an ICU room to simulate an OR takes time, effort, and coordinated multidisciplinary teamwork.

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## Diagnosis of Peripartum Cardiomyopathy Prompted by "Smart" Watch

**Presenting Author:** Chawla LaToya Mason, MD, FASA

**Presenting Author's Institution:** University of Mississippi Center

**Co-Author:** Myrna Alexander Nickens, MD; Rachael Morris, MD; Arthur Calimaran, MD

**Introduction:** "Smart" watches continue to grow in popularity and are an evolving area of interest to the medical community. The biosensor technology and wireless data communication used therein present opportunities for use in clinical practice. Peripartum cardiomyopathy (PPCM), a rare yet significant form of reversible dilated cardiomyopathy, is a pregnancy-associated cardiovascular disease that anesthesiologists may encounter when caring for obstetrical patients. This report describes the first case of PPCM wherein initial suspicion was prompted by tachycardia detected via the patient's "smart" watch.

**Case:** A healthy 43-year-old G2P1 delivered a male infant at term via elective repeat cesarean delivery under spinal anesthesia. Her prenatal course, operative delivery, and postoperative care were unremarkable. Two weeks after delivery, the patient (an obstetric anesthesiologist by training) noted fatigue and persistent, dry cough. Alarmed by tachycardia alert from her "smart" watch that indicated resting heart rate >120 beats per minute (bpm), she immediately consulted maternal fetal medicine and cardiology colleagues. Upon presentation to cardiology clinic, her blood pressure and pulse were 172/120 mm Hg and 137 bpm. Transthoracic echocardiography (TTE) was performed and revealed an ejection fraction of ~20%. Beta-natriuretic peptide (BNP) was elevated at 4900 ng/L. Chest radiograph showed a dilated cardiac silhouette. Diagnoses of PPCM and superimposed preeclampsia were made. The patient was admitted and underwent diuresis and hemodynamic management. Upon hospital discharge, she received a regimen of low-dose aspirin, bromocriptine, carvedilol, sacubitril/valsartan, and atorvastatin. Three months after diagnosis, TTE revealed an improved EF of 45% with a normal BNP. At 1-year follow-up, TTE demonstrated an EF of 62% and otherwise normal parameters.

**Discussion:** Cardiovascular disease is a leading cause of maternal mortality and severe maternal morbidity in the United States. PPCM is defined as heart failure with left ventricular systolic dysfunction quantified by echocardiography. Early use of echocardiography is paramount to accurate PPCM diagnosis and differentiation of heart failure from other causes and from respiratory disease. Anesthesiologists may be involved in the care of such patients. This patient's excellent outcome was likely impacted by her ability to directly access care. It is important that patients receive close follow up regarding postpartum care and have a means to contact providers as needed even after they have been discharged home. Work must continue to be done to eliminate disparities and improve access to health care. "Smart" watches are sophisticated biosensors capable of wireless transmission of physiological data. These qualities present unique opportunities for their innovative use in diagnosis, treatment, data collection, and delivery of healthcare.

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# Diagnosis of Peripartum Cardiomyopathy Prompted by “Smart” Watch

C. LaToya Mason, MD, FASA<sup>1</sup>; Myrna E. Alexander, MD<sup>2</sup>; Rachael F. Morris, MD<sup>3</sup>; Arthur L. Callamaran, MD<sup>1</sup>  
Departments of Anesthesiology<sup>1</sup>, Internal Medicine - Cardiology<sup>2</sup>, and Obstetrics & Gynecology<sup>3</sup>  
University of Mississippi Medical Center, Jackson, Mississippi



## INTRODUCTION

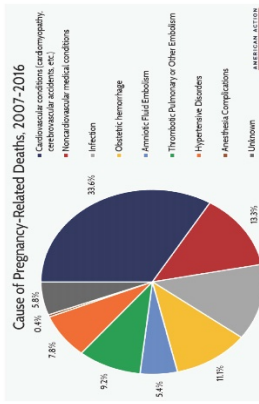
“Smart” watches are growing in popularity and an evolving area of interest to the medical community. Their biosensor technology and wireless data communication present opportunities for their clinical use. Peripartum cardiomyopathy (PPCM), a rare yet significant form of reversible dilated cardiomyopathy, is a leading cause of maternal death in the U.S. Anesthesiologists may encounter PPCM when caring for obstetrical patients.

This report describes the first case of PPCM wherein initial suspicion was prompted by tachycardia detected via the patient’s “smart” watch.

## CASE PRESENTATION

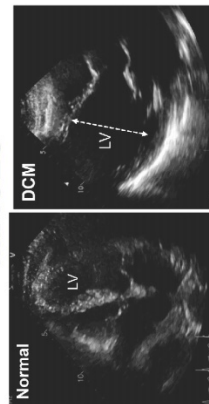
A 43-year-old African-American G2P1 delivered a male infant at term via elective repeat cesarean delivery under spinal anesthesia. Her prenatal course was only complicated by advanced maternal age. Two weeks after delivery, the patient (an obstetric anesthesiologist by training) noted fatigue and a persistent, dry cough. Alarmed by a tachycardia alert from her “smart” watch that indicated a resting heart rate >120 beats per minute (bpm), she immediately consulted maternal fetal medicine and cardiology colleagues. Upon presentation to cardiology clinic, her blood pressure and pulse were 172/120 mm Hg and 137 bpm. Transthoracic echocardiography (TTE) demonstrated ejection fraction of ~20%. Beta-natriuretic peptide (BNP) was elevated at 4900 ng/L. Chest radiograph showed a dilated cardiac silhouette. Diagnoses of PPCM and preeclampsia with severe features were made. The patient was admitted for diuresis and hemodynamic management. Upon hospital discharge, she was prescribed a regimen of low-dose aspirin, bromocriptine, carvedilol, sacubitril/valsartan, and atorvastatin. Three months after diagnosis, TTE revealed an improved EF of 45% with a normal BNP. At one-year follow-up, TTE demonstrated an EF of 62% and otherwise normal parameters.

## FIGURES



Source: [www.CincinnatiChildrens.org](http://www.CincinnatiChildrens.org)

## ECHOCARDIOGRAPHY IMAGES



Source: SemanticScholar.org

## DISCUSSION

PPCM is defined as heart failure with left ventricular systolic dysfunction quantified by echocardiography. It may occur in the antenatal, intrapartum, or postpartum periods. While there is no single identifiable underlying cause of PPCM, literature suggests several risk factors including advanced maternal age, teenage pregnancy, African ethnicity, pregnancy with multiple fetuses, hypertension, and family history. Dyspnea, orthopnea, cough, swelling, excessive weight gain, and palpitations are common presenting symptoms. Signs and symptoms of PPCM may be varying and non-specific, often making it difficult to differentiate from other cardiorespiratory diseases or normal physiologic changes associated with pregnancy. Treatment mirrors standard pharmacologic therapy for heart failure including diuretics, vasodilators, inotropes, ACE inhibitors, beta-blockers, and digoxin. The addition of bromocriptine to regimens represents a novel disease-specific treatment concept that reduces morbidity and mortality in PPCM patients.

Maternal mortality and severe maternal morbidity have increased in the US with cardiovascular diseases being one of the leading causes. Racial/ethnic disparities exist in pregnancy-related deaths. Reducing disparities will require multidisciplinary coordinated strategies aimed at improving women’s health and access to quality care at the patient, community, provider, and systemic levels.

“Smart” watches are sophisticated biosensors capable of wireless transmission of physiological data. These qualities present unique opportunities for their innovative use in diagnosis, treatment, data collection, and delivery of meaningful healthcare to patients.

## CONCLUSIONS

- Cardiovascular disease associated with pregnancy such as PPCM is a leading cause of maternal mortality and severe maternal morbidity in the United States.
- Early use of echocardiography is paramount to accurate PPCM diagnosis and differentiation of heart failure from other causes and from respiratory disease.
- This patient’s excellent outcome was likely impacted by her ability to directly access care. Early diagnosis, awareness, and initiation of appropriate treatment are integral to achievement of optimal outcomes. Work must continue to be done to eliminate disparities and improve access to healthcare.
- Tachycardia detected by the patient’s “smart” watch raised initial suspicion leading to PPCM diagnosis. While it is not prudent to solely rely on such findings, it may be reasonable to further investigate the validity of suspicious findings via more conventional approaches.
- The innovative utilization of “smart” devices may prove beneficial to both patients and clinicians as they provide unique opportunities for use in data collection, diagnosis, and treatment.

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## Acute Fatty Liver of Pregnancy Leading to a Delayed Hepatic Failure Necessitating Liver Transplantation: A Case Report

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**Presenting Author's Institution:** Zucker School of Medicine at Hofstra/Northwell Program, Department of Anesthesiology

**Co-Author:** Rutuja Sikachi, M.D.; Gregory Palleschi, M.D.; Madina Gerasimov, M.D.; Judith Aronsohn, M.D.

**Abstract :** Acute Fatty Liver of Pregnancy (AFLP) is a potentially fatal metabolic disorder in pregnant patients that requires urgent delivery and aggressive medical and anesthetic management of maternal complications associated with acute liver failure.

A 41yo-F G1P0 at 31 weeks gestation, with past medical history of Factor V Leiden and gestational diabetes mellitus, presented with nausea, vomiting, pruritus and jaundice. Her initial set of labs was significant for AST 2595 u/L, ALT 1999 u/L, Hgb 13.8 g/dL, alkaline phosphatase 227 u/L, total bilirubin 20.0 mg/dL, INR 2.5, and PT 30.1. Patient was normotensive with fibrinogen levels at 314 mg/dL and platelet count of 289,000, making DIC, pre-eclampsia and HELLP Syndrome less likely. The diagnosis of severe liver dysfunction likely secondary to AFLP was made. We proceeded with urgent delivery via a caesarean section under general anesthesia rather than neuraxial anesthesia due to an elevated INR. She received 2 units of FFP preoperatively, DDAVP infusion and tranexamic acid intraoperatively, and carboprost along with oxytocin following delivery. She had an estimated blood loss of 800ml and urine output of 50ml. She received 2200ml of IV fluids. Though blood products were available, the patient did not require administration. The patient gave birth to a viable female infant with Apgar scores of 7 and 8. The patient tolerated the procedure well and was transferred to the SICU for post op monitoring and subsequently transferred to the surgical floor. However, given the lack of further recovery of hepatic function, a transjugular liver biopsy was performed, revealing persistent AFLP. She received N-Acetylcysteine infusion and plasma exchange with no improvement. With signs of acute worsening of mental status, asterixis, elevated serum ammonia levels to 131  $\mu$ mol/L, INR to 5.5, lactate 4.2, and MELD-Na score of 37, she was listed as United Network for Organ Sharing (UNOS) status 1A on POD 19. The patient underwent a successful deceased donor orthotopic liver transplantation and was discharged on POD 14 of liver transplant.

This case report highlights the need for close observation and continuous vigilance when taking care of patients with a rare disorder like AFLP. Our patient developed hepatic encephalopathy and profound coagulopathy 3 weeks following an urgent delivery, necessitating liver transplantation. This timeline of disease progression sets out case apart from other reports of AFLP leading to liver transplantation.

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## Acute Fatty Liver of Pregnancy Leading to a Delayed Hepatic Failure Necessitating Liver Transplantation: A Case Report

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DONALD AND BARBARA  
ZUCKER SCHOOL of MEDICINE  
AT HOFSTRA/NORTHWELL

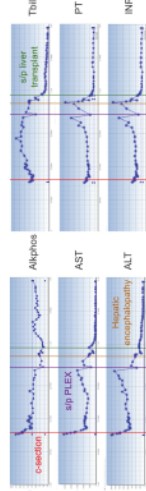
### Introduction

- AFLP is a potentially fatal metabolic disorder with reported incidence of 1 to 3 cases per 10,000 deliveries.<sup>1</sup>
- One of the most common findings in patients with AFLP is multiorgan fatty infiltration, which is theorized to increase fatty acids within the placenta, resulting in impaired oxygen delivery to the fetus.<sup>1</sup>

### Case Report

- 41F G1P0 at 31 weeks gestation, with PMH of Factor V Leiden and gestational diabetes mellitus, presented with nausea and jaundice for 3 days.
- Home Rx: aspirin, enoxaparin, prenatal vitamins, and H-2 blocker
- Pt normotensive and initial set of labs significant for hgb 13.8, plt 289, total bilirubin 20.0, AST 2595 u/L, ALT 1999 u/L, alkaline phos 227 u/L, INR 2.5, PT 30.1, fibrinogen levels 314.
- Serum Acetaminophen level was normal. Viral hepatitis panel and autoimmune hepatitis markers were negative. A doppler ultrasound study confirmed fatty infiltration with patent hepatic vasculature.
- Following a multidisciplinary discussion that included obstetrician, hepatologist, neonatologist and anesthesiologist, the decision was made to proceed with urgent delivery via caesarean section.
- Caesarean section:
  - Due to elevated INR, the pt received 2 units FFP preoperatively and general anesthesia, rather than neuraxial anesthesia
  - Induced with Propofol, Fentanyl, and Succinylcholine, followed by uneventful endotracheal intubation using
  - Maintained on sevoflurane with oxygen and hydromorphone
  - Hemodynamic stability was measured with standard monitors
  - EBL 800 ml, IVF 2200 ml, UOP 50 ml
  - Delivered 1.5kg female neonate with Apgar scores 7 and 8 at 1 and 5 minutes respectively
- Over the next two weeks, the pt remained stable but hepatic function did not show recovery. A transjugular liver biopsy demonstrated extensive microvesicular steatosis with centrilobular hepatocyte dropout, consistent with persistent AFLP

### Case Report



- On POD 15 of c-section, the pt experienced further worsening hepatic function with MELD-Na score of 37 and INR 4.58. She received N-Acetylcysteine infusions (24g over 24 hours), and 4 cycles of plasma exchange with no improvement. Due to worsening mental status, pt was listed in a liver transplant program as high priority on POD 19 and underwent orthotopic liver transplant on the same day
- Liver transplant:
  - General anesthesia was induced with Propofol and Succinylcholine
  - Radial arterial line and a 9 Fr multi-lumen left internal jugular catheter were inserted. In anticipation of intraoperative veno-venous bypass, 16 Fr venous cannulas were inserted in the right internal jugular and left femoral veins.
  - In order to reduce intracerebral pressure and the risk of cerebral edema, mannitol was administered.
  - Anesthesia was maintained with Fentanyl, Propofol and Rocuronium infusions
  - Arterial blood gas analysis was performed at frequent intervals and electrolytes were repleted as needed
  - TEG was used to guide blood product replacement. Over 12 hours of operating time, the pt received 2800ml of crystalloids, 750 of 5% albumin, 8 units pRBC's plus 300ml of blood from cell saver, 8 units FFP's, 3 units platelets, and 4 units cryoprecipitate
  - The total urine output was 2700ml and estimated blood loss was approximately 3L.

### Follow up

- She was successfully extubated the morning after liver transplant
- The pt was discharged home on POD 14 of liver transplant

### Discussion

- Acute liver failure from any cause is associated with decreased production of coagulation factors as well as a decrease in procoagulant proteins, leading to coagulopathy in coexistence with hypercoagulability. A functional platelet defect may also occur secondary to uremia and endothelial abnormalities and is related to the degree of liver dysfunction.
- Hepatic encephalopathy is frequently seen in AFLP and can range from mild to severe with increased intracranial pressure.
- Management of this patient presented several challenges. Neuraxial anesthesia is typically favored for the operative delivery but the coagulopathy and increased intracranial pressure presented potential risks associated with this approach in our patient. On the other hand, general anesthesia carries the risk of difficult airway, pulmonary aspiration, exacerbation of hepatic dysfunction and intracranial hypertension.
- Our patient successfully delivered via caesarean section under general anesthesia, but her liver function failed to improve, and she progressed to fulminant liver failure in the following two weeks, necessitating emergent liver transplantation that was successfully performed at our institution. Without a liver transplant, the patient would likely not have survived as other bridging treatments like N-acetylcysteine infusion and plasma exchange were already used and exhausted. This timeline of disease progression sets our case apart from other reports of AFLP leading to liver transplantation.<sup>3,4</sup> According to published case reports, patients with AFLP experience complete recovery of liver function within a few days of delivery with no evidence of cirrhosis or chronic hepatitis. Rather, a majority of patients will have normal liver function tests by 4 to 8 weeks post-delivery.<sup>2</sup>

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## Management of the difficult airway in obstetric patients for cesarean delivery

**Presenting Author:** Olivia Valencia, MD

**Presenting Author's Institution:** Vanderbilt University Medical Center

**Co-Author:** Michael G. Taylor, MD; Britany L. Raymond, MD; Jeanette Bauchat, MD MS

**Introduction:** Difficult airway management in obstetric patients presents a unique challenge due to anatomic and physiologic changes that occur in the pregnant airway.<sup>1</sup> We present a case where such changes worsened an underlying difficult airway, necessitating repeat cesarean delivery prior to term.

**Case:** A 24-year-old G7P2042 presented status post motor vehicle accident complicated by prolonged intubation and tracheostomy. Her recovery was complicated by tracheal stenosis requiring tracheal resection and multiple dilations. She presented to laryngology clinic at 36 and 2/7 weeks gestation with worsening dyspnea, stridor, and inability to lie flat. Fiberoptic endoscopy demonstrated significant supraglottic edema with partial laryngeal introitus obstruction (image: fiberoptic exam, first trimester). She was hospitalized for intravenous steroids and delivery planning. A multidisciplinary meeting with otolaryngology, maternal-fetal medicine, cardiothoracic surgery, obstetric anesthesia, and nursing was convened. Discussion included poor candidacy for neuraxial anesthesia due to accessory muscle paralysis, anticipated difficult intubation requiring awake intubation, inability to perform awake tracheostomy due to anatomical distortion, and airway rescue in the event of failed intubation, including potential need for ECMO. Ultimately, an awake transoral fiberoptic intubation followed by cesarean delivery and tracheostomy was planned. Preoperatively, she received glycopyrrolate and a dexmedetomidine infusion while her upper airway was topicalized with 5% lidocaine ointment and inhaled 4% lidocaine. Superior and recurrent laryngeal nerve blocks were performed and dexmedetomidine and remifentanyl infusions were started for sedation. After multiple attempts with a 5-0 microlaryngoscopy tube and fiberoptic scope, the trachea was intubated with ETCO<sub>2</sub> confirmation. However, the endotracheal tube (ETT) was dislodged with cuff inflation and coughing. Mask ventilation, jet ventilation, and tracheostomy were unsuccessful. Placement of a rescue laryngeal mask airway (LMA) provided adequate ventilation. Cesarean delivery was followed by scar resection and tracheostomy. She was discharged home on postpartum day five. Debrief of this case revealed several complicating factors: difficulty anesthetizing an edematous airway, prior tracheal resection preventing visual estimation of ETT depth, and distorted anatomy complicating jet ventilation.

**Discussion:** Recent guidelines for management of the difficult airway in obstetric patients emphasize the importance of preparation, thorough physical exam, backup planning, and multidisciplinary communication, all of which are demonstrated in this case.<sup>2</sup> Our patient's airway proved challenging and was ultimately secured with a LMA, which is a well-documented rescue technique.<sup>3</sup> Preparation, adaptability, and a multidisciplinary approach ensured successful outcomes for our patient and her neonate.

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- PMID 18292672
- PMID 26449292
- PMID 28218212



# Management of the Difficult Airway in Obstetric Patients for Cesarean Delivery

Olivia Valencia, MD; Michael Taylor, MD; Britany Raymond, MD; Jeanette Bauchat, MD, MS

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## CASE SUMMARY

We present a case where the upper airway changes associated with pregnancy worsened an already underlying difficult airway, necessitating repeat cesarean delivery for respiratory distress prior to term. We discuss our approach to fiberoptic intubation, which ultimately failed, and how we rescued the airway when an emergent tracheostomy and rescue jet ventilation also failed.

## PREOPERATIVE DETAILS

### PATIENT DETAILS:

- 24-year-old G7P2042 with previous MVC c/b prolonged intubation, tracheostomy, and tracheal stenosis requiring surgical resections and dilations
- PMH: MVC-related descending thoracic aortic rupture status post repair, asthma, tobacco use, seizure disorder, recurrent domestic violence, and prior suicide attempt

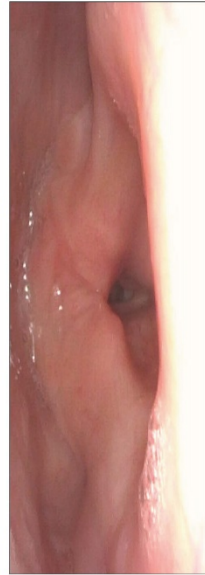
### RESPIRATORY DETERIORATION:

- Presented to ENT clinic at 36.2 weeks gestation with worsening dyspnea, stridor, and inability to lie flat
- Fiberoptic endoscopy showed significant supraglottic edema with partial laryngeal obstruction (Figure 1)
- Hospitalized for delivery planning in setting of worsened respiratory function

### DELIVERY PLANNING:

- Multidisciplinary meeting with ENT, MFM, CT surgery, OB anesthesia, and nursing was held to discuss various aspects of her complex case:
  - ENT: Awake tracheostomy too difficult given anatomical distortion
  - Neuraxial block not an option due to patient's inability to lie flat
  - Anticipated difficult intubation with plan for airway rescue (jet ventilation, emergency tracheostomy, LMA, ECMO as back-up)
- Plan: Awake transoral fiberoptic intubation followed by CD and tracheostomy

Figure 1: Fiberoptic Endoscopy, 2nd Trimester



## AIRWAY AND OPERATIVE MANAGEMENT

### PREMEDICATION:

- Secretions: Glycopyrrolate, scopolamine patch
- Localization:
  - 5% lidocaine ointment into tonsillar pillars and inhaled 4% lidocaine
  - Superior and recurrent laryngeal nerve blocks
- Sedation: Dexmedetomidine and remifentanyl infusions

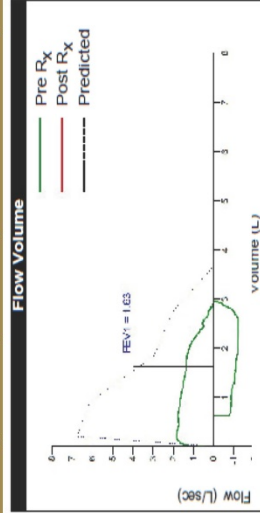
### AIRWAY MANAGEMENT:

- After multiple fiberoptic attempts with a 5-0 microlaryngoscopy tube, the trachea was finally intubated with ETCO<sub>2</sub> confirmation; however, the tube became dislodged with cuff inflation and subsequent coughing
  - Patient began to quickly desaturate
  - Mask ventilation, jet ventilation, and emergent trach were unsuccessful
  - Placement of a rescue LMA provided adequate ventilation

### OPERATIVE COURSE:

- CD was performed with LMA, followed by laryngeal scar resection and formal tracheostomy
- Fiberoptic scope before emergence revealed worsened supraglottic edema
- Discharged home on postpartum day five in stable condition

Figure 2: Spirometry Prior to Delivery



## DISCUSSION

- Debrief of this case revealed several complicating factors:
  - Difficulty anesthetizing an edematous airway
  - Tracheal resection skewing visual estimation of ETT depth
  - Distorted anatomy complicating jet ventilation and emergency tracheostomy
- Recent difficult airway guidelines for obstetric patients emphasize the importance of preparation, thorough physical exam, backup planning, and multidisciplinary planning, all of which are demonstrated in this case
- Our patient's airway was ultimately secured with a laryngeal mask airway, which is a well-documented rescue technique
- Preparation, adaptability, and a multidisciplinary approach ensured successful outcomes for our patient and her neonate

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**Intraoperative POCUS in the management of dilated cardiomyopathy and pericardial effusion for cesarean delivery**

**Presenting Author:** Danielle White, MD

**Presenting Author's Institution:** McGovern Medical School

**Co-Author:** Ana-Lisa Ramirez-Chapman, M.D.; Ryan Phelan, MD

**Abstract :** As the medical landscape becomes more technologically-driven, the goal of advanced diagnostic testing is to give providers quick, reliable, and safe point-of-care access to previously cumbersome tests. With the advent of point-of-care ultrasound (POCUS), physicians are able to diagnose, monitor, and treat a wide variety of pathologies in real time. Obstetric anesthesiology proves to be an ideal field for its utilization given the necessity to monitor mother & fetus, evaluate changing hemodynamics, establish line access, diagnose potentially devastating pathology, and provide analgesia using both neuraxial and regional techniques.

28-year-old female G3P2002 at 35w6d, scheduled for Cesarean section, who presented with a known history of dilated cardiomyopathy of unknown etiology (NYHA Class 1 systolic CH, EF ~ 25%).

On day of admission, TTE showed severely dilated LV with severely reduced systolic function (EF < 20%), grade III LV diastolic dysfunction without pericardial effusion. EKG showed sinus rhythm with left axis deviation with prolonged QT interval & a rate of 85 bpm. Vitals signs were all within normal limits. Patient was asymptomatic in regards to her heart failure.

In the OR, an awake, pre-epidural arterial line was placed. Once in place, the epidural catheter was slowly infused with 10ml of 2% lidocaine with epinephrine until a sufficient anesthetic level was reached. The arterial line was transduced through a Vigileo, allowing us to trend cardiac output, cardiac index, and stroke volume variation. Intraoperatively, a Butterfly iQ Ultrasound was used to observe the patient's cardiac function. A moderate pericardial effusion was noted in both the parasternal short axis and parasternal long axis. The effusion did not appear to have a tamponade effect on the myocardium. Cardiac indices were stable on the Vigileo, and the effusion was continually monitored. 5mg of Furosemide was given in order to potentially reduce the size of the effusion. Postoperative evaluation revealed reduction of the effusion.

Major adverse events associated with maternal dilated cardiomyopathy include cardiac, fetal, neonatal, & obstetric complications[1]. Thus, monitoring hemodynamic changes is vital to the well-being of both mother & fetus. Use of POCUS allowed us to monitor in real time the effects of cesarean delivery on our patients' cardiac function. This case highlights the utility of POCUS in clinical decision making in the obstetric population. As cardiovascular disease continues to be an important contributor to maternal mortality around the world, it is incumbent upon obstetric anesthesia providers to continue to learn techniques such as POCUS that will assist in the assessment and management of this disease.

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## SOAP 2021 ANNUAL MEETING

### POCUS in the management of dilated cardiomyopathy and pericardial effusion for cesarean delivery

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**Introduction:** As the medical landscape becomes more technologically-driven, the goal of advanced diagnostic testing is to give providers quick, reliable, and safe point-of-care access to previously cumbersome tests. With the advent of point-of-care ultrasound (POCUS), physicians are able to diagnose, monitor, and treat a wide variety of pathologies in real time. Obstetric anesthesiology proves to be an ideal field for its utilization given the necessity to monitor mother & fetus, evaluate changing hemodynamics, establish line access, diagnose potentially devastating pathology, and provide analgesia using both neuraxial and regional techniques.

**PMH:** 28-year-old female G3P2002 at 35w6d, scheduled for Cesarean section, who presented with a known history of dilated cardiomyopathy of unknown etiology (NYHA Class 1 systolic CH, EF ~ 25%).

**Diagnostics:** TTE showed severely dilated LV with severely reduced systolic function (EF < 20%), grade III LV diastolic dysfunction without pericardial effusion. EKG showed sinus rhythm with left axis deviation with prolonged QT interval & a rate of 85 bpm.

**Physical Exam:** Vitals signs were all within normal limits. Patient was asymptomatic in regard to her heart failure.



**Clinical Course:** In the OR, an awake, pre-epidural arterial line was placed. Once in place, the epidural catheter was slowly infused with 10ml of 2% lidocaine with epinephrine until a sufficient anesthetic level was reached. The arterial line was transduced through a Vigileo, allowing us to trend cardiac output, cardiac index, and stroke volume variation. Intraoperatively, a Butterfly IQ Ultrasound was used to observe the patient's cardiac function. A moderate pericardial effusion was noted in both the parasternal short axis and parasternal long axis. The effusion did not appear to have a tamponade effect on the myocardium. Cardiac indices were stable on the Vigileo, and the effusion was continually monitored. 5mg of Furosemide was given in order to potentially reduce the size of the effusion. Postoperative evaluation revealed reduction of the effusion.

**Conclusion:** Major adverse events associated with maternal dilated cardiomyopathy include cardiac, fetal, neonatal, & obstetric complications[1]. Thus, monitoring hemodynamic changes is vital to the well-being of both mother & fetus. Use of POCUS allowed us to monitor in real time the effects of cesarean delivery on our patients' cardiac function. This case highlights the utility of POCUS in clinical decision making in the obstetric population. As cardiovascular disease continues to be an important contributor to maternal mortality around the world, it is incumbent upon obstetric anesthesia providers to continue to learn techniques such as POCUS that will assist in the assessment and management of this disease.



## Hazards Associated with Epidural Placement During Labor in Uncontrolled Seizure

**Presenting Author:** Mohannad Abushora

**Presenting Author's Institution:** University of Florida Health- Jacksonville

**Co-Author:** Kristen Vanderhoef; Igor Ianov

**Abstract :** Background: Seizures are not an uncommon problem during pregnancy. Most patients with a history of seizures are well controlled with medication prior to admission for labor and delivery. Uncontrolled seizures presents an anesthetic challenge at the time of epidural placement.

**Clinical Case:** A 26-year old G3P2002 with intrauterine pregnancy at 38 weeks estimated gestational age presented to the emergency department(ED) by rescue due to witnessed seizures. She had 2 witnessed seizures at home, received 4g Magnesium and 5mg midazolam intravenously before reaching hospital. Immediately upon arrival to the ED, the patient had 3 more witnessed seizures. She was given another 4mg midazolam and 2g magnesium bolus then loaded with Levetiracetam. Patient was then seen by neurology and stated she had not taken her Levetiracetam in two weeks. Decision was made to admit patient for induction of labor. She had another seizure and received a second loading dose of Levetiracetam and was placed on an infusion. Anesthesia was called for epidural placement. Patient positioning for the procedure was discussed, side lying would make epidural placement more difficult, but risks associated with seizure during the procedure would be diminished. Conversely, sitting position would make epidural placement easier, but increase patient risk should a seizure occur during placement. Epidural placement was performed in the sitting position, secondary to obesity, without complication. Shortly after epidural placement, anesthesia called to the room for another seizure. Intravenous line found to be infiltrated; anticonvulsant not flowing. Patient was loaded again with Levetiracetam per neurology recommendation. Seizure stopped and patient gave birth to a viable infant.

**Discussion:** Uncontrolled seizures in a laboring patient is a challenging scenario. Placing an epidural can be risky, as it might put the patient at increased risk of needle injury. Patient position also makes a difference; side lying versus sitting. Other factors such as obesity may impact the decision.

**Conclusion:** Controlling seizures is the main point for providing safe epidural placement for the patient. Epidural placement in this high risk population should be performed by a senior provider. Avoiding the sitting position is best, but sometimes impossible.

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## A Stress Test on the Eye: How Labour and Delivery Can Reveal Hidden Intracranial Pathology

**Presenting Author:** Yousif Ali, MB BCh BSc FRCA

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### Introduction:

Cerebral cavernous malformations (CCMs) are low-flow, low-pressure vascular lesions that are typically asymptomatic but have the potential to result in hemorrhage, focal neurologic symptoms and mass effect.[1] Orbital CCMs may increase in size or bleed during pregnancy, resulting in orbital compression and visual disturbance.[1] We report the management of a parturient with a retrobulbar orbital CCM discovered following vaginal delivery.

**Case:** A 29 year old primigravida at 40 weeks gestation presented in spontaneous labour. A labour epidural was sited uneventfully. She had a healthy pregnancy course and no relevant past medical or family history. She was managed on a programmed intermittent epidural bolus maintenance infusion and did not experience any symptoms initially. However, during second stage labour, the patient was noted to be flushed and complained of a right temporal headache. After 90 minutes of pushing, she ultimately required a vacuum-assisted delivery. Immediately after delivery, the patient noticed a persistent pressure behind her right eye. There was reduced right eye movement with associated ipsilateral blurred vision, conjunctival injection and mild proptosis. A contrast head CT revealed a right, retrobulbar, ovoid mass in keeping with a CCM (figure 1) with no evidence of bleeding. Her symptoms all resolved spontaneously by day 2 postpartum. She was referred to oculoplastic surgery for further evaluation and discussion of management options.

**Discussion:** We postulate that repeated Valsalva manoeuvres during second stage pushing increased intracranial pressure and induced venous engorgement, causing a dynamic vascular lesion to temporarily increase in size and produced the ocular symptoms shown. Labour and delivery can induce unique physiological stresses on occult intracranial lesions.[2] The key learning point here is that paying careful attention to new symptoms around the time of delivery and immediately postpartum can help uncover intracranial lesions that would otherwise remain undetected.

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## Intraoperative Medication Error and Mishap Mitigation: a Tale of Two Syringes

**Presenting Author:** Yousif Ali, MB BCh BSc FRCA

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**Abstract :** Introduction: Unintended administration of an incorrect drug is a common cause of anesthesia critical incidents in the operating room (OR). In our institution, succinylcholine is routinely pre-drawn in a 10 mL syringe and stored on the anesthetic cart in preparation for any stat cesarean delivery (CD) under general anesthetic. Standard procedure is for carbetocin to be drawn up by our anesthetic assistant (AA) at the start of each case. It is also diluted up to 10 mL and placed in a designated location on the ventilator workspace, which is separate from the anesthetic cart. We report a case of a syringe swap resulting in an intraoperative airway emergency during a scheduled CD.

**Case:** A 41yo G2P1, with no significant medical history, was scheduled for an elective CD to be cared for by the anesthetic team consisting of an anesthesia fellow, anesthesia resident, AA, and medical student. Following delivery of the placenta, a 10 mL syringe of succinylcholine, which was erroneously thought to be carbetocin, was slowly administered. After 5 mL, the patient reported dyspnea and an immediate label check confirmed that she had been given 100mg of succinylcholine. After an emergency was declared, the case was rapidly converted to general anesthesia and the patient intubated without difficulty. The supervising staff was outside of the OR at the time of the incident but arrived immediately. The rest of the procedure was uneventful. A full disclosure and apology were offered, along with counselling services. There was an immediate team debrief of all care providers involved in the case. Several areas were identified as contributing factors in this incident. First, carbetocin was not pre-drawn in this case, leaving the usual expected location vacant for a similar 10 mL syringe to be mistakenly placed there. Second, succinylcholine was not secured in its predefined location, thus making it easy to translocate by mistake. Finally, spatial separation of the syringes was assumed to uniformly safeguard against any syringe swap, so a standard label check by all anesthetic team members prior to administration was bypassed.

**Discussion:** Immediate systemic changes were instituted and the incident reviewed by the hospital Safety and Quality Committee. We developed further strategies to minimize the possibility of a syringe swap with succinylcholine and carbetocin. Succinylcholine is now placed in a closed container, along with other medications needed for a general anesthetic. It remains immediately accessible, but less easily misplaced (figure). The carbetocin label has been changed to a vibrant pink colour. A scheduling change has been made so junior learners are no longer assigned to slates with anesthesia fellows until fellows are fully familiar with the institution and its systems.



**Sonographic resolution of B-lines after diuresis in a pregnant patient with preeclampsia associated pulmonary edema.**

**Presenting Author:** Mohamad Ayoub, MD

**Presenting Author's Institution:** Cleveland Clinic Foundation

**Co-Author:** Ryan Hanson, MD; Philip Ramirez, MD; Stephen Bacak, DO, MPH, FACOG; Cesar R. Padilla, MD;

**Abstract :** We describe a case of a 23 year-old pregnant patient at 30 weeks and 1 day of gestation admitted for the management of preeclampsia with severe features. Lung ultrasonography facilitated the diagnosis of acute pulmonary edema while also showing real-time resolution after diuresis.

A limited point of care cardiac ultrasound was performed due to worsening respiratory status (increase in oxygen requirement) shortly after admission to evaluate for pulmonary edema. Ultrasonography confirmed the presence of "B-Lines", radiographic findings suggestive of excess extravascular water (Figure 1). After multidisciplinary discussion the decision was made to administer furosemide.

Approximately 1 hour later the patient was transported to the operating room for a cesarean section (for non-reassuring fetal heart tracing) where a repeat lung ultrasound was performed which showed resolution of B-lines bilaterally with A lines present (Figure 2). A combined spinal epidural (12 mg of 0.75% hyperbaric bupivacaine, 20 mcg fentanyl, 100 mcg morphine) was then performed and the patient was placed in a 15-degree left uterine tilt position. The obstetrics team proceeded with a cesarean delivery via a primary low transverse cesarean section. A 1.2 kg male was born with Apgar scores of 7 and 8, respectively. The patient was maintained on 3 liters of oxygen (via nasal cannula) for the duration of the case with stable hemodynamics. In the post anesthesia care unit, a repeat TTE was performed which confirmed absence of B lines bilaterally (A-lines). The patient's recovery was uneventful and the patient was weaned off oxygen on post-operative day 2. The patient was successfully discharged on day 4 of hospitalization with an antihypertensive regimen of labetalol.

References:



## Cesarean Hysterectomy in a Patient with Squamous Cell Carcinoma of the Cervix

**Presenting Author:** Morganne Beard

**Presenting Author's Institution:** University of Illinois at Chicago

**Co-Author:**

### Introduction:

The incidence of cancer in pregnancy is low, complicating ~0.1% of pregnancies, with cervical cancer most common [1]. Combined obstetric and oncologic surgery may be chosen for delivery and treatment, leading to anesthetic challenges. We present a patient with cervical carcinoma requiring cesarean hysterectomy.

**Case Report:** The patient is a 31 year old G1 with stage IB3 squamous cell carcinoma of the cervix diagnosed at 26 weeks, status post 2 cycles of chemotherapy. Minimal tumor response prompted cesarean delivery and hysterectomy at 36 weeks. Medical history includes morbid obesity, asthma, and recent COVID-19 infection.

Both neuraxial and general anesthesia were considered; the patient opted for neuraxial for cesarean with conversion to general for hysterectomy. Surgical anesthesia was achieved with combined spinal-epidural. Radial arterial line and large bore peripheral IVs were placed.

A viable infant was delivered. Uterine atony was treated with intrauterine oxytocin and IM methylergonovine. Rapid sequence intubation with videolaryngoscopy was done and hysterectomy was completed. Estimated blood loss was 1100 mL, and the patient received 2 units of packed red blood cells. She was extubated and taken to recovery, and had an uncomplicated post-op course.

**Discussion:** Anesthetic management in cesarean hysterectomy should be guided by the indication and urgency of the procedure and patient comorbidities. Neuraxial anesthesia confers many advantages in the obstetric population. However, due to the potential for excessive blood loss, intraoperative complications, and lengthy surgical time, general anesthesia may be preferred from the start. This avoids emergent induction of anesthesia mid-surgery and potentially worsened hemodynamics, and allows for preparation and use of advanced airway equipment if needed. Blood loss and massive transfusion increases the risk of neuraxial complications, and long surgical time may cause discomfort or anxiety in an awake patient.

Alternatively, factors in obstetric anesthesia make neuraxial preferable to general, including risk of difficult airway, aspiration pneumonitis, fetal exposure to anesthetics, and increased blood loss. A planned cesarean hysterectomy allows for pre-op crossmatching of blood, invasive blood pressure monitoring, and additional IV access. The particular indication for hysterectomy and sufficient preparation made combined neuraxial and general anesthesia a safe option. However, given her asthma and recent COVID-19 infection, the risk of pulmonary complications from intubation and mechanical ventilation were discussed. If neuraxial anesthesia is used, providers should prepare patients for the possibility of emergent conversion to general anesthesia.

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## **Epidural Anesthesia for a Parturient with Associated Spina Bifida Occulta, Tethered Cord and Lipomyelomeningocele**

**Presenting Author:** Maria C. Borrelli, D.O.

**Presenting Author's Institution:** Beth Israel Deaconess Medical Center

**Co-Author:** Yunping Li, M.D.; Philip E. Hess, MD; John J. Kowalczyk, M.D.; ;

**Introduction:** Spinal dysraphism, a broad spectrum of congenital defects due to incomplete neural tube closure, presents a unique challenge for obstetric anesthesiologists including need for advanced imaging, possibility of mechanical interference, neurologic injury or unpredictable local anesthetic spread.<sup>1</sup> Lipomyelomeningocele is a rare disorder characterized by a subcutaneous lipoma that extends through a defect in the lumbodorsal fascia, vertebral arch, epidural space and dura, and attaches to an elongated, tethered spinal cord.<sup>2</sup> We present a case of successful neuraxial anesthesia in a parturient with spina bifida occulta, tethered cord and lipomyelomeningocele.

**Case:** A 24 yo G2P0 (BMI 44.5) at 38 weeks with PMHx of spina bifida occulta, tethered cord and large lipomyelomeningocele presented for augmentation of labor for category two FHR tracing. Patient reported a congenital lower back mass previously followed by neurology (Fig 1a). She denied neurological deficits and did not require surgery. Recent MRI revealed a fatty lesion measuring 5x1x2 cm extending from L2-L4, with both intra- and extradural components, incomplete fusion of L4-S1 and distal cord tethering (Fig 1b). After careful assessment with ultrasound (Fig 1c), an epidural catheter was placed at L1-L2 in the sitting position for labor analgesia without complication. Labor analgesia was adequate using standard labor solution. Fetal intolerance to labor persisted and she underwent a primary cesarean delivery. 10 ml of 2% lidocaine were administered and T4 sensory level was achieved. Her surgical and postpartum course were unremarkable.

**Discussion:** In cases of spina bifida occulta, it is recommended that the neuraxial procedure be performed above the level of the lesion.<sup>3</sup> Tethered cords may be more susceptible to conus/nerve injury with unintentional dural puncture. MRI and ultrasonography aid in safe placement of neuraxial catheter.<sup>1,4</sup> Lipomyelomeningocele is largely undescribed. One case report in a parturient with a lipomyelocele describes successful epidural for labor and cesarean section after placement above the level of the lesions.<sup>5</sup> Similarly, in our patient, after careful assessment using advanced imaging, epidural placement was performed above the affected spinal levels. Sensory blockade was adequate for labor, but careful titration of surgical anesthesia is imperative since she achieved excellent surgical anesthesia with a lower than usual dose of local anesthetic. We showed that with thorough clinical and imaging assessment, safe epidural anesthesia can be achieved in a patient with spina bifida occulta, tethered cord and lipomyelomeningocele.

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## **Streptococcus intermedius Ventriculitis in Pregnancy**

**Presenting Author:** Kaitlyn Brennan, DO MPH

**Presenting Author's Institution:** Vanderbilt University Medical Center

**Co-Author:** Laura Sorabella, M.D.

**Introduction:** Ventriculitis is a rare cause of altered mental status and seizure and has not been described in pregnancy. It is usually related to a central nervous system (CNS) procedure or meningitis. Initial management consists of placement of pressure relieving devices, such as extra ventricular drains (EVDs), antibiotics- including intrathecal antibiotics, and serial imaging.<sup>1</sup> *Streptococcus intermedius* is associated with suppurative infections in multiple organs, with predisposing conditions to central nervous system (CNS) infection including mucosal infection, alcohol abuse, diabetes, or coexisting pneumonia.<sup>2</sup> We present a case of a parturient with *S. intermedius* ventriculitis diagnosed at 32w5d.

**Case:** A 35-year-old G7P4 with a past medical history of opioid use disorder, hepatitis C, and tobacco use presented as a transfer for a precipitous decline in mental status. She had initially presented to the with nausea, vomiting, and seizures at 32w5d and was found to have increased intracranial pressure (ICP) and evidence of ventriculitis on magnetic resonance imaging (MRI) (Figure 1). Two EVDs were placed for bilateral hydrocephalus and monitor for increases in ICP; and subsequent cerebrospinal fluid (CSF) culture from the EVDs showed *S. intermedius*. She was started on intrathecal vancomycin and ampicillin. Her initial course was complicated by ventricular debris, necessitating repeated manipulation of her EVDs, and resulting waxing and waning mental status. Her obstetric monitoring consisted of daily non-stress tests (NSTs). On hospital day 17, she had an episode of seizure like activity, and her mental status declined abruptly, with a GCS of 6. She was intubated for airway protection and was taken for a cesarean delivery (CD) under general anesthesia. ICP monitoring was continued during her CD via her bilateral EVDs, and the pressures did not rise above 10 mmHg at any point. She was extubated post operatively, however she subsequently developed worsening hydrocephalus secondary to intraventricular debris and despite additional bilateral temporal EVD placement, she had a catastrophic and sustained increase in ICP to greater than 60 mmHg. Despite aggressive measures to lower her intracranial pressure, this increase resulted in herniation and progression to brain death.

**Discussion:** Primary ventriculitis in pregnancy is a rare event, and management is limited to extrapolated data from the non-pregnant patient population. Worsening mental status may be indicative of increasing ICP and may warrant CD to allow for maternal stabilization. Patients with primary CNS pathology may require intubation for airway protection and may arrive for their CD with an artificial airway already in place. Neuraxial anesthesia is generally contraindicated in the setting of both increased ICP, concomitant CSF infection, and severely altered mental status.

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- PMID: 28203777
- PMID: 17612921



## Pregnancy Complications in Severe Ehlers Danlos Syndrome: The Issue is the Tissue

**Presenting Author:** Kaitlyn Brennan, DO MPH

**Presenting Author's Institution:** Vanderbilt University Medical Center

**Co-Author:** Laura Sorabella, M.D.

**Introduction:** Ehlers Danlos syndrome (EDS) is a heterogeneous group of disorders including thirteen subtypes, some with unknown effects during pregnancy due to their rarity.<sup>1</sup> Patients can have overlapping characteristics of multiple types, making exact diagnosis difficult. Parturients with EDS are at an increased risk of complications, including a threefold increase in the risk for postpartum hemorrhage (PPH).<sup>2</sup> In addition, some subtypes of EDS have an increased risk of both uterine rupture and bowel rupture.<sup>3</sup> We present a parturient who encountered several serious problems related to EDS during the peripartum period.

**Case:** A 25-year-old G1P0 with a history of EDS, neuromuscular scoliosis, congenital short stature, mitral valve prolapse, severe mitral regurgitation (MR), and a dilated aortic root at 4.3 cm presented at 16w0d for atrial fibrillation with rapid ventricular response (AFRVR). She required cardioversion and sotalol initiation to control her atrial fibrillation. She represented at 37w0d for a planned cesarean delivery due to breech presentation. Due to a history of T2-sacrum spinal fusion (fig 1) and failed attempts at neuraxial anesthesia for two previous hip replacements, the patient preferred general anesthesia.

General anesthesia was induced with 80mg ketamine and 60mg of rocuronium and was maintained with a nitrous oxide sevoflurane combination. Her cesarean was uncomplicated, with an estimated blood loss of 800mL. Six hours postpartum, our emergency response system was activated for PPH. Despite blood product replacement and concentrated fibrinogen, the hemorrhage progressed, and the patient was taken emergently to the operating room for exploratory laparotomy and hysterectomy. EBL at this time was 6L. She was taken intubated to the intensive care unit and was extubated on post-operative day (POD) 1. She was discharged initially on POD 7 and represented on POD 11 with complaints of severe nausea and vomiting. She was found to have pneumoperitoneum with pneumatosis intestinalis and was taken for an emergent laparotomy. Her small bowel was found to be perforated, and a primary resection was carried out. She was discharged on POD 5 from that procedure.

**Discussion:** EDS is a heterogeneous group of disorders, and parturients may present with mild symptoms, or they may have severe disease. Cardiac complications related to EDS include AFRVR due to left atrial dilation in the setting of MVP and aortic root dilation. These patients should have close cardiac follow up due to an increased risk of aortic dissection in the peripartum period.<sup>4</sup> Parturients with severe forms of EDS are at risk of primary uterine rupture and also hollow viscous rupture during the peripartum period.<sup>2</sup> In addition, patients with EDS have a high risk of PPH.<sup>1</sup> Close follow up and a high index of suspicion may mitigate the morbidity associated with these complications in this patient population.

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- PMID: 28306225
- PMID: 1195245
- PMID: 6129381
- PMID: 27492904



## **Methamphetamine-associated cardiomyopathy with acute heart failure in the setting of pregnancy**

**Presenting Author:** Sabrina Burn, MD

**Presenting Author's Institution:** University of Minnesota

**Co-Author:** Yasuko Yamamura, MD

**Abstract :** Management of heart failure in pregnancy poses unique challenges as maternal cardiac and respiratory compromise can directly affect the fetal status. This case involves a 30 year old G4P3003 female at 34w4d gestation who presented to her local hospital for evaluation of dyspnea and acute chest pain. Her past medical history was remarkable for chronic hepatitis C and ongoing intravenous methamphetamine use, with last use 4 days prior to presentation. On initial physical exam, she was noted to be tachycardic, tachypneic, and hypoxic on room air. Her clinical work-up revealed an elevated troponin and BNP; EKG with sinus tachycardia and probable left ventricular hypertrophy; and a chest X-ray with cardiomegaly and bilateral pulmonary edema. Urgent echocardiogram was notable for severe left ventricular dysfunction (EF 30%), severe aortic insufficiency, and severe mitral regurgitation. Continuous external fetal monitoring demonstrated reassuring fetal status. Due to concern for potential acute decompensation upon delivery, it was recommended that she transfer to a tertiary care center for delivery and cardiac management. Upon arrival, the patient was immediately taken to the operating room, where she underwent placement of an arterial and central venous catheter prior to induction of anesthesia. Epinephrine was administered for cardiac support and cardiac suppressants were avoided. She underwent cesarean section under general anesthesia with cardiothoracic surgery on standby for possible emergent aortic valve (AV) replacement and possible temporary LVAD placement. She was not a candidate for ECMO due to severe aortic and mitral insufficiency. Intra-operative transesophageal echocardiogram (TEE) demonstrated an EF 25%, left ventricular dilation to 7.7 cm, severe aortic insufficiency, and moderate functional mitral regurgitation. She and her infant tolerated the procedure without incident. In the post-operative period, she was continued on diuretics and started on hydralazine for afterload reduction. She also underwent serial TEE, dental extractions, right heart catheterization, addiction medicine consultation, and medical optimization for valve replacement surgery. On hospital day 14, she underwent an AV replacement with a bioprosthesis. She thereafter developed post-operative complete heart block and required a pacemaker placement. She was discharged in stable condition on hospital day 19. While parturients with aortic regurgitation and preserved systolic function generally do well in pregnancy, their condition can be compounded by factors such as methamphetamine use and result in acute heart failure such as in this case. Unfortunately, cases of methamphetamine-associated cardiomyopathy are on the rise due to the endemic spread of methamphetamine use. Careful history and awareness of a patient's history are essential for rapid diagnosis and management of heart failure prior to irreversible decompensation.

References:



## **Anesthetic Management of a patient with Goldenhar syndrome undergoing cesarean delivery and subsequent debridement of mandibular abscess**

**Presenting Author:** Meghan Cook, MD

**Presenting Author's Institution:** The Ohio State Wexner Medical Center

**Co-Author:** Alix Zuleta Alarcon, MD; Blair H. Hayes, MD

**Introduction:** Goldenhar syndrome (GS) is a rare genetic disorder that has characteristics of mandibulofacial dysostosis and hemifacial microsomia and can involve many organ systems (1). It occurs in 1 in 3000 to 5000 newborns (2). Tracheal intubation can be difficult as a result of micrognathia with asymmetry, limited neck motion and instabilities of the craniocervical junction (3).

**Case Report:** A 31-year-old G4P2102 parturient presented at 37w4d with right jaw pain and swelling. PMH significant for GS including left sided hemifacial microsomia, congenital solitary lung, dextrocardia, mild scoliosis, torticollis, unicornuate uterus and recurrent TMJ graft infections. On PE: oral opening < 1cm; clear pitch/clarity of her voice; no stridor on inspiration or expiration.

A multidisciplinary approach was taken for her care including MFM, OB anesthesiology, OMFS and ENT. Due to worsening clinic status of the TMJ graft abscess, it was decided to proceed with repeat cesarean delivery followed immediately by debridement of her jaw.

Epidural anesthesia to T4 was obtained using 20ml of 2% lidocaine with 1:200K epi in divided doses. Cesarean delivery (CD) was performed without complication.

Following closure, the patient was placed in a semi sitting position and an awake fiberoptic intubation (AFOI) was performed. Once the airway was confirmed, general anesthesia (GA) was induced and infected graft was successfully debrided. The patient was extubated and ultimately discharged home on POD5.

**Discussion:** Anesthetic techniques for patients with GS depend on the extent of craniofacial and vertebral involvement, associated cardiac or respiratory abnormalities, and the type and course of surgery.

Although regional anesthesia can rarely lead to a situation that requires emergency intubation, we elected to proceed with a carefully titrated epidural for CD. This multidisciplinary decision was made in concert with the patient and allowed her to meet her newborn before induction of GA.

Additional considerations for this case included calculating the maximum dose of local to avoid local anesthetic toxicity. At 65kg, the toxic dose of lidocaine with epi was 455mg. She received 400mg of lidocaine in the epidural and we began to topicalize for AFOI ~1 hour after last epidural dose. We reasoned that with an elimination half life of 87-108 min (with IV administration), approximately 1/2 of the injected lidocaine would have undergone hepatic clearance (4). Assuming that we had ~1/2 of the max dose of lidocaine to use, we topicalized with 4ml of 4% lidocaine.

This case presents a unique challenge of having to consider an anesthetic technique for CD where difficult intubation is anticipated with the subsequent need for GA. Careful multidisciplinary management of parturients with craniofacial anomalies is of the utmost importance.

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4. Circulation. 1974;50(6):1217-1230.







## **Labor epidural analgesia in a patient with multifocal acquired demyelinating sensory and motor (MADSAM) neuropathy**

**Presenting Author:** Christopher Cosden, MD

**Presenting Author's Institution:** UCSF Medical Center

**Co-Author:** Peter Yeh, MD; Pedram Aleshi, MD

**Background:** Determining the safety of neuraxial procedures in parturients with existing neurological disease is a challenging aspect of obstetric anesthesia. Multifocal acquired demyelinating sensory and motor (MADSAM) neuropathy, known as Lewis-Sumner Syndrome, is a dysimmune disease of the peripheral nerves defined by multifocal motor and sensory loss. There is little data on neuraxial anesthesia in this disease, but patients with similar neurologic conditions have safely received neuraxial anesthesia (1, 2).

**Case Report:** A 46 y.o. G3P1 with a history of MADSAM and hypothyroidism was seen in OB anesthesia clinic at 30 weeks gestation. She was diagnosed in 2012 via EMG after presenting with bilateral arm paresthesias, right biceps weakness, and right thigh numbness. She took no medications and this pregnancy had only transient left index finger paresthesias. For her 2015 vaginal delivery she was not offered an epidural and was dissatisfied with the remifentanyl PCA.

Neurology was consulted and stated an epidural should not present her additional risk beyond a subclinical autonomic neuropathy.

She presented at 38 weeks gestation for an elective induction of labor without new neurologic symptoms. The patient was counseled extensively on the risk of residual block and was offered neuraxial anesthesia.

The patient labored 5 hours using nitrous oxide before requesting an epidural, which was placed without difficulty at L3-4. She was bolused with 10ml of bupivacaine 0.125%, followed by PIB dosing of bupivacaine 0.0625% - fentanyl 2mcg/ml at 8ml q30 minutes, with PCEA of 5ml q10min. She reported excellent pain control after initial bolus though with motor blockade. She had an uncomplicated vaginal delivery 45 minutes later. After the epidural was stopped, full motor function returned within 2 hours and full sensation within 8 hours.

On post-partum day 2, she noticed transient paresthesias on the balls of both feet. There was no motor deficit and the symptoms did not interfere with her ability to walk or function. Two weeks later, her paresthesias were present but stable.

**Discussion:** This case highlights the need for literature review, expert consultation, and appropriate patient counseling when dealing with rare neurologic diseases in pregnancy. Though she did have a motor blockade, the degree and duration were not outside the normal spectrum. It is possible that the epidural contributed to her post-partum foot paresthesia, though their mild nature and her overall happiness with the birth experience suggest neuraxial was an appropriate choice in this case.

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## Laser Division of Subglottic Stenosis in a 28-Year-Old Parturient

**Presenting Author:** Paul Davis, MD

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**Co-Author:** Robert Chantigian, MD

**Introduction:** Induction of general anesthesia in patients with subglottic stenosis can be a frightening situation as it can result in an "unable to intubate and unable to ventilate" situation. Surgical treatment is often required, and the physiologic changes of pregnancy increase the risk of anesthetic complications, particularly aspiration, inadequate ventilation or oxygenation, and difficult or failed airway management. We present this case of a parturient undergoing general anesthesia for a laser division of a subglottic stenosis.

**Case Report:** 28-year old female G3P2 at 33w4d gestation with a history of idiopathic subglottic stenosis, gastroesophageal reflux disease, and postoperative nausea and vomiting with recurrence of her subglottic stenosis. Symptoms included increasing shortness of breath, productive cough, wheezing and fatigue. Physical exam showed a wheeze audible without a stethoscope. For the case she had a 20-gauge IV and standard ASA monitors. Nonparticulate antacid and metoclopramide for aspiration precautions, induced with propofol, fentanyl, lidocaine, and succinylcholine with cricoid pressure, muscle relaxation was maintained with vecuronium, and primary anesthetic with propofol and remifentanyl. After induction, she was mask ventilated with cricoid pressure, stomach contents suctioned with an oral gastric (OG) tube, then ENT surgeon placed a Kleinsasser laryngoscope and ventilated by intermittent apnea technique requiring 7 apnea cycles with SpO<sub>2</sub> as low as 68%. Blood pressure measured in arm and leg post-induction, and MAP was 26mmHg lower in the leg. With greater degree of left lateral tilt, MAP improved by 7mmHg, and blood pressure cuff remained on the leg until the completion of the case. The stenosis was located 1cm below the glottis, 3x7mm in AP, approximately a 70% stenosis. Kenalog was injected around the stenosis pre and post CO<sub>2</sub> laser excision of scar. At the end of surgery gastric contents were suctioned with an OG tube, muscle relaxation was reversed with sugammadex and she was mask ventilated until awake and breathing spontaneously. Fetal heartrate monitoring was used pre and postoperatively, showing a reactive pre and postoperative baseline of 125 bpm with moderate variability, and no decelerations. She was discharged to home after recovering in PACU, and later delivered via a vaginal delivery at 39w6d with fetal Apgar scores of 8 and 9.

**Discussion:** This case presents an uneventful perioperative course for an uncommon clinical presentation and highlights some of the important anesthetic considerations required for a nonobstetric surgery during pregnancy requiring general anesthesia without a controlled airway. Considerations include a discussion about the difficult airway algorithm in the setting of an intratracheal lesion, preoperative aspiration prophylaxis, positioning adjustments for avoidance of aortocaval compression, neuromuscular reversal in the pregnant population, and perioperative fetal monitoring.



## **From Novice to Expert: Beside Echocardiography Using Artificial Intelligence Ultrasound Software for Perioperative Management of a Patient with Hypertrophic Cardiomyopathy**

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**Introduction:** Hypertrophic cardiomyopathy (HCM) can be exacerbated by pregnancy and is associated with increased maternal morbidity in severe cases. Patients who are symptomatic and have reduced exercise tolerance prior to conception are at higher risk during pregnancy due to increases in heart rate and blood volume, necessitating careful management by a multidisciplinary team.

**Case:** A 32 year old 60kg G1P0 with known history of hypertrophic cardiomyopathy, NYHA class II at baseline, and medically controlled asthma presented at 7 weeks and 2 days for evaluation of intrauterine pregnancy. The patient noticed increased fatigue with walking, inability to take stairs, and worsening dyspnea on exertion resulting in self-limiting activity. Transthoracic echocardiography was performed and showed a resting LVOT gradient of 100 mmHg and Valsalva gradient of 122 mmHg at a heart rate of 77 bpm. She also had moderate-to-severe mitral regurgitation (MR) and severe pulmonary hypertension (PHTN) with RVSP of 60 mmHg. With these echocardiographic findings in the setting of worsening clinical status, a multidisciplinary team recommended termination of pregnancy (TOP) and subsequent surgical myectomy and mitral valve repair. The patient was started on metoprolol for rate control and scheduled for TOP under monitored anesthesia care for the procedure. For cardiac stability and maintenance of systemic vascular resistance, sedation was achieved using fentanyl, lidocaine, and etomidate with a continuous background of a phenylephrine infusion with oxygen via nasal cannula. Intravenous fluids were administered during the case cautiously. In the immediate postoperative period, the patient was evaluated using prescriptive ultrasound guidance using artificial intelligence. The AI-guided image acquisition software consists of interconnected DL algorithms that provide real-time feedback on the quality and correctness of probe positioning. The echocardiographic findings showed good left ventricle filling, good global wall motion, and no worsening of the patient's baseline LVOT obstruction.

**Discussion:** Multidisciplinary team planning led to the decision of TOP for this patient with worsening symptoms and change from NYHA class II to class III in the first trimester. The management of obstetric patients with cardiac conditions can be aided by the use of bedside tools such as echocardiography. Facilitating this skill for obstetric anesthesiology team members and reducing delays in performing such exams have the potential to improve quality of care and maternal outcomes.

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## Volume Overload in a Pregnant Heart Transplant Patient

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**Presenting Author's Institution:** Mount Sinai Hospital

**Co-Author:** Vasilije Mijovic, MD; Erica Kane, MD; Joshua Hamburger, MD; Menachem Weiner, MD; Yaakov Beilin, MD

**Abstract :** A 26y G3P0 s/p orthotopic heart transplant (OHT) in 2005, complicated by cardiac allograft vasculopathy and PCI in 2007, presented to L&D complaining of orthopnea at 23 weeks gestation. Other history included HTN, anemia, gout, GERD, CKD III, obesity, and seizure disorder. She had normal allograft function with no evidence of rejection.

She was admitted, diagnosed with sinusitis, and treated with antibiotics and steroids. She was re-admitted a month later with worsening orthopnea, chest congestion, and dry cough. Workup revealed a negative COVID test, respiratory viral panel, and legionella test. CXR was normal and TTE was unchanged from 1 month prior: EF 67%, mildly thickened LV, LA dilatation consistent with OHT, & normal RV size & function. She was diagnosed with likely OSA, given inhalers, and discharged home.

She was re-admitted at 31w with acutely worsening dyspnea and chest pain. Differential included decompensated heart failure, PE, and preterm labor. Her cervix was closed & long and she was not contracting. Lower extremity Dopplers were negative for DVT. EKG was negative for acute ischemia and TTE was unchanged. Lung ultrasound showed pulmonary edema. She underwent diuresis with symptomatic improvement and was admitted until her delivery.

Due to concern for decompensated heart failure after delivery, she was taken to a cardiac OR for 10 CS at 33w. She received 2 units PRBCs prior to surgery. Following placement of an arterial line and PA catheter, a DPE was placed for anesthesia. 20cc of 2% lidocaine with 5mcg/ml epinephrine was administered epidurally over 45 min. Adequate anesthesia was confirmed and the CS commenced, which was uncomplicated. Phenylephrine infusion maintained MAP >80mmHg. Mean PAP averaged 28mmHg throughout the case. A 2330g male infant, APGARs 8,8, was delivered. Oxytocin 20U IV was administered over 45 minutes. She received 300mL of crystalloid and made 200mL of urine. EBL was 600mL and the patient was not transfused. Epidural morphine 3mg was given for post-operative pain. The patient was stable at case end and transported to CICU for recovery. On arrival, ABG revealed Hct 26 (stable) and lactate 1.1. She recovered and was discharged home on postpartum day 6.

Pregnant patients with OHT are at risk for acute decompensation as pregnancy progresses. An interdisciplinary meeting with Obstetric and Cardiac Anesthesia, MFM, Perfusion, Cardiac Transplant and Heart Failure, and CICU colleagues was held to plan this delivery. The patient was optimized with diuresis, fluid restriction, and PRBC transfusion. In the OR, a PAC was placed for close monitoring of cardiac function, neuraxial anesthetic was slowly titrated to reduce the speed and severity of sympathectomy, and crystalloid was limited. She recovered in the CICU with close monitoring. Planning and preparation resulted in the safe delivery of a healthy neonate.

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**Neuraxial anesthesia for C-section in a patient with brain Arteriovenous malformation with history of rupture during pregnancy**

**Presenting Author:** Sherif E. Elsayed Ali Ali, MD

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**Co-Author:** Yelena Spitzer, MD; Heather Craig, MD

**Abstract :** A 27 year old female, G1P0, with no past medical history, presented to the emergency department at 29 weeks gestation with headache, vomiting and vision changes. MRI revealed left occipital intracranial hemorrhage from a ruptured AVM (arteriovenous malformation). An AVM is an abnormal connection between arterial and venous vessels with an incidence of 1/100,000. AVMs usually remain asymptomatic during pregnancy. However, the rupture of an AVM can lead to subarachnoid hemorrhage and serious neurologic deficits.

Patient was evaluated by neurosurgery in the ED. As the patient's symptoms resolved spontaneously, definitive neurosurgical intervention was deferred post-delivery. The main goal was to keep the AVM from re-bleeding during the remainder of the pregnancy. The risk of re-bleeding in pregnancy is about 27%, and associated with a 40% higher mortality as compared to age matched non-pregnant women<sup>1</sup>.

After a multidisciplinary meeting with obstetrics, anesthesiology and neurosurgery, a primary elective cesarean delivery was recommended. There was concern for increased intracranial pressure with Valsalva in case of vaginal delivery, which could result in a subsequent rupture of the AVM.

Anesthetic management for cesarean delivery consisted of a spinal anesthetic with strict blood pressure control with a phenylephrine infusion. It was felt that the risk of AVM rupture was small with a 26G Gertie Marx needle and carried less risk for the patient than a general anesthetic utilizing a brain protective strategy. The patient did well and is awaiting definitive surgical intervention.

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## Peripartum Management of a Parturient with Ornithine Transcarbamylase Deficiency

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**Introduction:** Ornithine Transcarbamylase deficiency (OTD) is a rare X-linked genetic disorder, resulting in impaired breakdown of nitrogen. Patients with OTD are at risk of hyperammonemic crisis during the peripartum period.(1) We describe the successful peripartum management of a parturient with OTD.

**Case Report:** A 35 year-old G1P0 had known OTD (W265R mutation) diagnosed at birth. Her only symptoms were intermittent headaches and nausea with no prior episodes of hyperammonemia. During pregnancy, oral citrulline 3g BID was started to promote ammonia metabolism. Glutamine remained below the treatment target ( $< 1000\mu\text{mol.L}^{-1}$ ). Chorionic villus sampling revealed an affected female fetus.

The patient presented at term with spontaneous rupture of membranes requiring labor augmentation with oxytocin. To minimize the catabolic response to stress, pain, and fasting, intravenous dextrose, intralipid 20% and insulin were given throughout labor. An early labor epidural was placed and normal oral diet permitted. The patient was monitored for evidence of hyperammonemia with serum ammonia, urea, electrolytes, glucose, and liver function checked Q4H. An intrapartum care plan for hyperammonemia, monitoring and anesthetic management for emergency cesarean delivery was developed by the peripartum care team.(Table 1)

Dextrose and intralipid infusions were stopped after an uneventful vaginal delivery. Sufficient protein intake of  $90\text{g.day}^{-1}$  and oral citrulline 3g BID was reintroduced. The baby was breastfed with formula top-ups Q3H to avoid a catabolic state. Ammonia levels peaked at  $26\mu\text{mol.L}^{-1}$  for the mother and  $50\mu\text{mol.L}^{-1}$  for the baby prior to discharge together on postpartum day 4.

**Discussion:** Pregnant patients with OTD are at risk of hyperammonemic crisis and require meticulous planning and metabolic monitoring throughout the peripartum period. Several case reports have described adverse outcomes including maternal death, usually when the first presentation of OTD occurred during the puerperium.(1) Neuraxial techniques are preferred in most cases and are advocated to reduce the maternal stress response. General anesthesia has been used safely in adult patients with OTD (2) but no cases of its use in obstetric patients have been reported. The key to successful management is early referral to a tertiary obstetric centre with multidisciplinary input so that a detailed, personalized intrapartum and emergency care plan can be developed for the maternal-infant dyad.

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## **An Epidural Knot**

**Presenting Author:** Anna Gabrielian, MD

**Presenting Author's Institution:** Johns Hopkins Hospital

**Co-Author:** Anna Gitterman, MD; Falin Patel, MD; Scott Mittman, MD, PhD; David Berman, MD;

### **Abstract : Clinical Course**

Our patient was an 18 year old female, G2P0 with a gestational age of 37 weeks 6 days, directed for induction of labor due to newly diagnosed gestational hypertension. Her past medical history was significant only for bipolar disorder and anxiety, as well as BMI of 35.

The patient requested epidural analgesia for pain relief during labor. After thorough informed consent, a dural puncture epidural (DPE) technique was attempted, however, no CSF flow was obtained on two separate attempts. During the second attempt, given convincing loss of resistance and lack of paresthesia, the decision was made to thread the catheter. Loss of resistance was at 8 cm and 5 cm of catheter was threaded. The test dose did not produce neurologic or hemodynamic changes and the epidural catheter provided T10 dermatomal coverage with patient comfort endorsed when dosed appropriately for the duration of labor and delivery.

On postpartum evaluation our team encountered difficulties with catheter removal and the patient endorsed back discomfort during the attempt. Position changes including back flexion were also unsuccessful in dislodging the catheter. The catheter was left in place under traction, under a sterile dressing. Several hours later another removal attempt was made and the catheter was successfully extracted with intact visualized tip. A knot was visualized approximately 1 cm from its tip. The patient denied any paresthesia, neuropathy, or other pain. Her postpartum course was uneventful, and she underwent uncomplicated serial neurologic exams by our team prior to discharge. No imaging was performed as the patient remained asymptomatic and the catheter was removed in its entirety.

**Discussion:** An epidural catheter knot, although extremely rare, should be considered when difficulties are encountered during catheter removal. Although excessive catheter length in the epidural space has been theorized to contribute to knot formation, our case demonstrates that as little as 5 cm is sufficient for knot formation to occur. Flexed positioning of the patient, loosening of the knot by flushing the catheter, or alternatively tightening the knot to decrease its size by putting the catheter on traction can all be attempted to facilitate removal. Although not necessary in our case, surgical intervention may be warranted.

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## **Puerperium Stroke and Subsequent Tissue Plasminogen Activator-Induced Hemorrhage: A Case Report**

**Presenting Author:** Ryan Hanson, MD

**Presenting Author's Institution:** Cleveland Clinic Foundation

**Co-Author:** Peter Brown, DO; Mary Temple-Cooper, MS, PharmD; McCallum Hoyt, MD, MBA, FASA; ;

**Abstract :** An otherwise healthy 35-year-old right-handed G2P1 presented in labor and quickly delivered under neuraxial block. In recovery, the patient's nurse noted sudden onset expressive aphasia, right-sided facial droop, and right arm weakness prompting a "code stroke." Her NIH Stroke Scale was found to be 8, indicating moderate stroke and candidacy for tissue plasminogen activator (tPA). tPA was administered as CT scan did not show intracranial hemorrhage. She subsequently underwent endovascular mechanical thrombectomy (EMT) to recanalize her occlusion. As the procedure ended, she was noted to have profuse vaginal bleeding not responsive to uterotonics. She was sedated, intubated, and massive transfusion protocol was initiated. Pelvic embolization was deferred as hemostasis was achieved upon correction of coagulopathy. The next day, her symptoms resolved and MRI revealed minimal infarct volume. Work-up to elucidate stroke etiology was notable for patent foramen ovale which has since been closed.

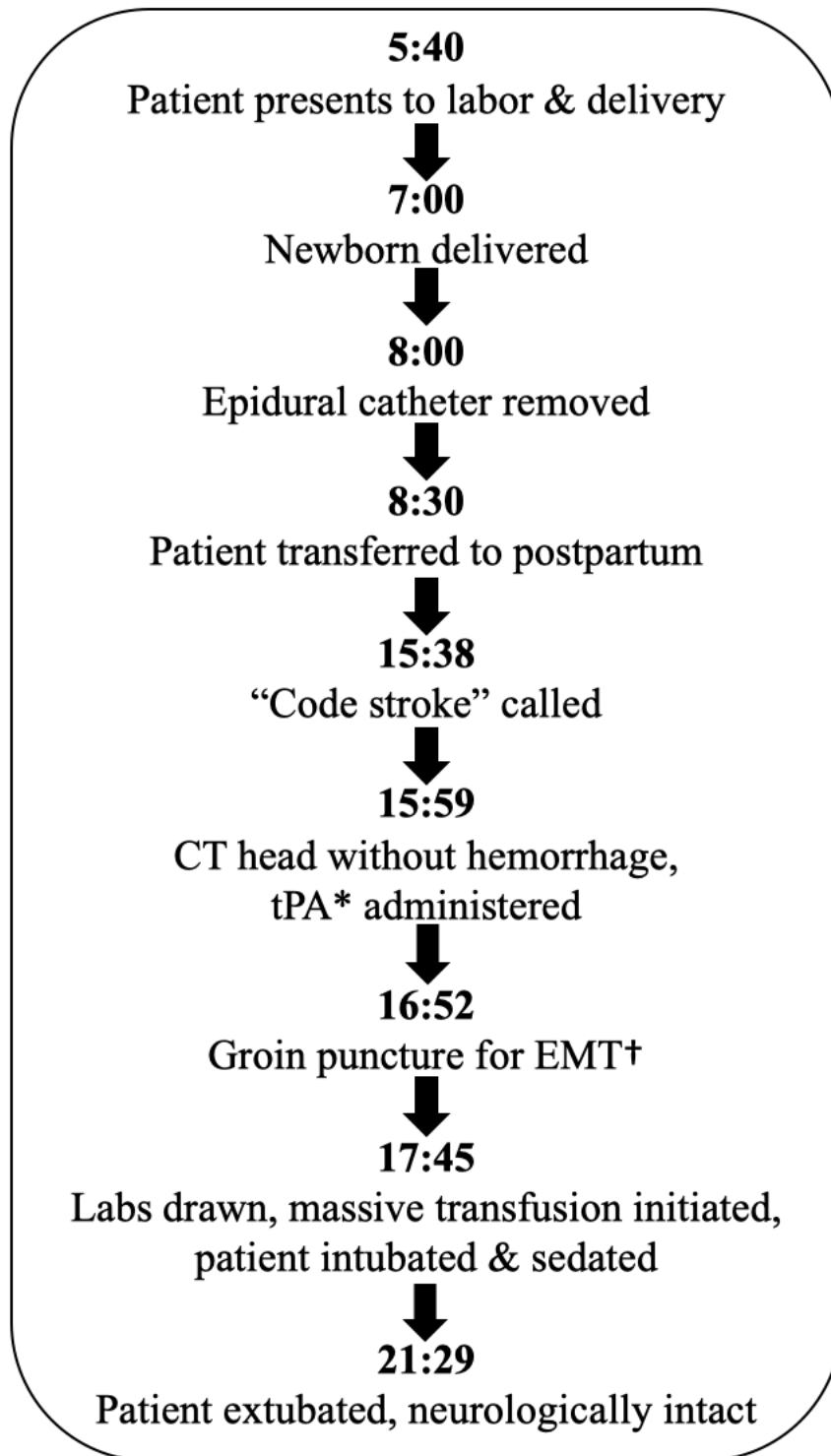
While rare, stroke is a devastating complication of pregnancy, occurring in 34.2/100,000 deliveries.<sup>1</sup> Women are 3 times more likely to suffer a stroke during pregnancy/postpartum as compared to aged-matched non-pregnant women. This elevated risk is mediated by the pregnancy-induced physiologic changes and hypercoagulable state. Puerperium portends particular susceptibility for such events as ~50% of strokes occur during this time.<sup>2</sup> There is scant data assessing the safety of tPA in the postpartum period.<sup>2,3</sup> The AHA/ASA report insufficient evidence to recommend thrombolysis during this time.<sup>4</sup> Of 13 women receiving tPA within 48 hours of delivery, all but one required transfusion.<sup>5</sup> The Canadian guidelines on acute stroke management in pregnancy suggest proceeding directly to EMT without administering tPA if available/appropriate as a handful of trials have safely employed EMT in pregnancy.<sup>3</sup>

In our case, tPA was the only established treatment and those treated within 3 hours are 30% more likely to have no disability a year after stroke.<sup>6</sup> A feared complication of tPA is hemorrhage, and this case bolsters the need to anticipate significant bleeding after exposure. The patient's recent epidural was also a concern as 6 cases of hematoma have been reported in patients who specifically underwent neuraxial puncture and then received unplanned thrombolytics.<sup>7</sup> Current guidance addressing this rare event is based on expert opinion given limited data.<sup>8</sup> As such, tPA administration after dural puncture must be made on a case-by-case basis and frequent, serial neurological monitoring is advised.

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**Figure 1.** Timeline of events.

\*Tissue Plasminogen Activator

†Endovascular Mechanical Thrombectomy



## **When Real Life Mimics Oral Boards: Massive Venous Air Embolism Detected by End-Tidal CO2 Decrease and Transthoracic Echocardiography During Cesarean Delivery in a Profoundly Thrombocytopenic Patient**

**Presenting Author:** Dan B. Hoang, DO

**Presenting Author's Institution:** Stanford School of Medicine

**Co-Author:** Erin Loeliger, MD, PhD; Mary J. Im, MD, MPH; Clemens M. Ortner, MD, MSc, DESA; Naola Austin, MD;

**Abstract :** A 22 year old G2P1 was admitted at 37 weeks with idiopathic pancytopenia during this pregnancy. Extensive workup in coordination with hematology including blood smears and bone marrow biopsy revealed vitamin B12 deficiency and asymptomatic COVID positivity at 34 weeks. Labs were most notable for profound thrombocytopenia, nadir of 13 K/uL platelets on admission and not responsive to prednisone, IVIG, iron and B12 supplementation, nor platelet transfusions.

Labs the day prior to delivery:

Hemoglobin 8.6 g/dL

Platelets 13 K/uL

Fibrinogen 255 mg/dL

The plan was for Cesarean delivery under general anesthesia. Anticipating massive transfusion needs, large bore IV access, rapid infusion system and additional crossmatched units were prepared. Prior to induction, the patient received 3 units of platelets, 1 unit of packed red blood cells (PRBC), 1 pooled unit of cryoprecipitate, and 2 g of fibrinogen concentrate. Following an uneventful general anesthetic induction and initial delivery, the uterus was exteriorized as the obstetricians worked to achieve hemostasis with uterine massage.

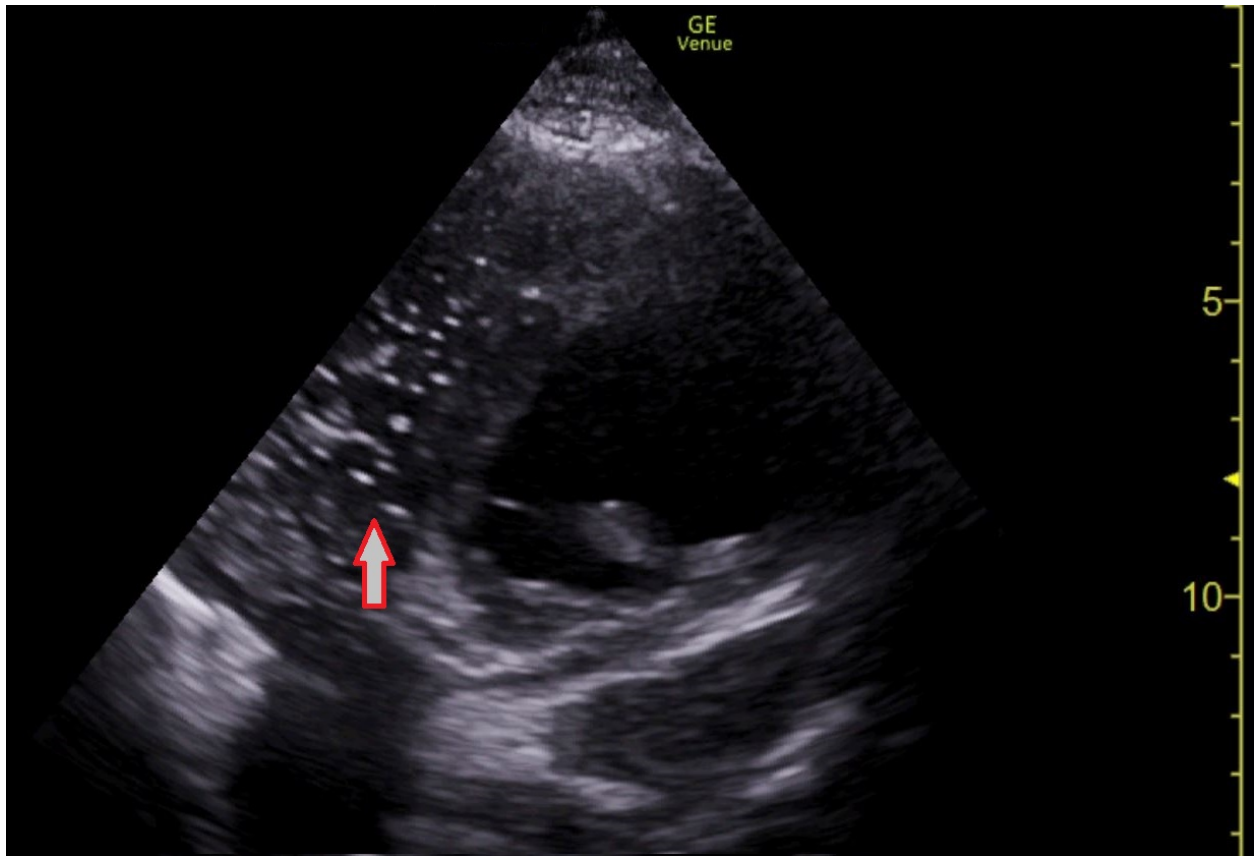
As resuscitation continued for postpartum hemorrhage, a sudden decline in end-tidal CO<sub>2</sub> (EtCO<sub>2</sub>) from 34 to 18 mmHg was noted. Oxygen saturation and blood pressure were unchanged. Nitrous oxide was turned off, oxygenation was supported with 100% FiO<sub>2</sub>, and circulation was supported with Trendelenburg bed position. Focused transthoracic echocardiography (TTE) exam showed a large amount of air bubbles in the right ventricle with preserved biventricular systolic function (Figure 1). Lines were checked and free of air bubbles, and surgery continued once hemodynamic status was confirmed to be stable.

A repeat TTE exam was performed after 30 minutes with near complete resolution of air emboli (Figure 2). Total estimated blood loss was 3000 mL and intraoperative resuscitation included 4 units PRBCs, 4 units platelets, 4 units fresh frozen plasma, 1 unit cryoprecipitate, 2g of fibrinogen concentrate, and 2g calcium chloride. Postoperatively, she was extubated uneventfully in the ICU the next day. Remaining course was uneventful, except for a decrease in platelets from 112 K/uL postoperatively to 40 K/uL on two consecutive days prior to discharge with hematology follow up.

Venous air embolism (VAE) has been seen in up to 97% of patients undergoing general anesthesia during cesarean delivery<sup>1</sup>. To our knowledge, this case represents the first reported utilization of TTE to diagnose VAE during cesarean delivery and enabled us to differentiate from other major causes of abrupt EtCO<sub>2</sub> decline such as pulmonary embolism and amniotic fluid embolism. Although initially detected by EtCO<sub>2</sub> decline, focused TTE may have a role alongside precordial Doppler in diagnosing and following the treatment of VAE during cesarean delivery in awake patients.

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## Management of Severe Maternal Cardiac Disease for Cesarean Section

**Presenting Author:** Hanna Hussey, MD

**Presenting Author's Institution:** Department of Anesthesiology & Perioperative Medicine, University of Alabama at Birmingham

**Co-Author:** Patrick Hussey, MD; Benjamin Tuck, MD; Mark F. Powell, MD; ;

**Introduction:** Maternal cardiac disease complicates 1-4% of pregnancies and this is expected to increase as there is improved survival of women with congenital heart disease.<sup>1</sup> Although vaginal delivery is preferred, cesarean delivery (CD) rates trend higher in this population. This cases describes the anesthetic management for women with severe cardiac disease undergoing CD in a cardiac operating room where advanced specialized care was readily available.

**Case Series Description:** These cases includes 2 patients with severe mitral stenosis. Both women underwent CD in the cardiac operating room where a cardiac surgeon, a cardiac anesthesiologist, and a perfusionist were available in the event of acute decompensation. Prior to CD, both patients had a pre-induction arterial line placed. Patients received central venous access, pulmonary artery catheter placement, and prophylactic extracorporeal membrane oxygenation (ECMO) groin sheaths placement. For the primary anesthetic, all patients received low dose combined-spinal epidural with 5mg isobaric bupivacaine, 150mcg morphine, 15 mcg fentanyl, and 20 mcg clonidine. No patient required ECMO intraoperatively or post-operatively. Post CD, both patients were transferred to the intensive care unit (ICU) for postpartum monitoring.

**Discussion:** The leading cause of death among pregnant women in the US is cardiac disease<sup>2</sup>. Vaginal delivery with adequate epidural analgesia is usually the preferred mode of delivery. However, if CD is required, providers need to be aware of unique challenges this patient population presents. These women require and deserve a multidisciplinary team approach for management.<sup>3</sup> This team can include but is not limited to the following: cardiac surgeons, cardiologist, obstetricians, neonatologists, perfusionists, cardiac anesthesiologists, obstetric anesthesiologists, critical care physicians, L&D nurses, neonatology nurses, and ICU nurses. Neuraxial anesthesia is the preferred anesthetic of choice for CD. Under advanced specialized care and hemodynamic monitoring, these cases highlight that low dose CSE can be safely utilized in patients with cardiac disease.

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## **Anesthetic management of a grand multiparous parturient with placenta percreta and severe asthma**

**Presenting Author:** Hebah Ismail, MD, JD

**Presenting Author's Institution:** Wake Forest Baptist Medical Center

**Co-Author:** Jessica Meister Berger, MD, JD; Amanda Johnson, CRNA; Medge Owen, MD; ;

**Introduction:** Anesthetic management of parturients with placenta percreta involves preparing for massive hemorrhage and resuscitation. Some institutions favor the use of neuraxial anesthesia followed by conversion to general anesthesia (GA) after delivery due to the potential for hemodynamic instability and prolonged surgery.<sup>1</sup> However, the presence of other co-morbidities, such as severe asthma, could complicate GA, leading to bronchospasm with airway instrumentation. We present a case of successful lumbar epidural anesthesia (LEA) use for cesarean hysterectomy in a grand multiparous parturient with placenta percreta and severe asthma.

**Case Report:** A 42-year-old G19P16 parturient with 5 prior cesarean deliveries presented at 34 weeks gestation for delivery. Her history was complicated by hypertension, anxiety, severe asthma, polysubstance abuse, and tobacco use. Her pregnancy was complicated by placenta percreta, superimposed pre-eclampsia, and poorly controlled asthma resulting in several hospitalizations, including ICU admission for acute hypoxic respiratory failure at 30 weeks gestation.

The night before cesarean hysterectomy, nebulization treatments were given for respiratory optimization. Wheezing was noted the day of surgery, but the patient denied breathing difficulty. An arterial line was placed for hemodynamic monitoring. After dural-puncture LEA was performed, 2% lidocaine with 1:200,000 epinephrine was given in 2-3 ml increments over 30 min and throughout surgery to achieve a T4 level bilaterally. Placenta percreta with invasion into bowel was confirmed upon entering the peritoneum. Intravenous midazolam and morphine were titrated incrementally for anxiolysis and pain control. The patient received ipratropium nebulizer treatments intraoperatively and tolerated the 5.5 hr surgery without respiratory distress. Blood loss was 2500 and 2 u pRBC were transfused.

Post-op pain was controlled with 3 mg epidural PF morphine and breathing was stable. An ileus required nasogastric tube placement; however, the patient was eating by POD 8 and discharged on POD 11.

**Discussion:** In cesarean hysterectomy for placenta percreta, anesthesia management requires careful consideration. GA may be favored for airway control, especially when hemorrhage and hypotension are likely. LEA is titratable and avoids airway manipulation in pregnancy, but may be poorly tolerated during lengthy surgeries. In this patient, with severe asthma, we administered LEA with careful titration to avoid fast onset and extended block levels that could trigger anxiety or accessory respiratory muscle use. Midazolam and morphine keep the patient calm and comfortable for the duration of the procedure.

**References:** Curr Opin Anesthesiol 2018, 31:280-289



## Early Third Trimester Cesarean Delivery in COVID-19 Positive Patient on V-V Extracorporeal Membrane Oxygenation: Clinical and Ethical Considerations

**Presenting Author:** Paige Keasler, DO

**Presenting Author's Institution:** Washington University in Saint Louis

**Co-Author:** Danish Jaffer, MD; Allison Mitchell, MD; ; ;

**Introduction:** The current pandemic has led to a significant rise in COVID-19 related Adult Respiratory Distress Syndrome (ARDS). Maternal mortality in pregnant/postpartum women admitted with severe ARDS or cardiac arrest has been reported to be up to 40%.<sup>1</sup> Extracorporeal membrane oxygenation (ECMO) is an option for salvage therapy in pregnancy with acute reversible causes. Most evidence for its use in the obstetrical population comes from the H1N1 epidemic. Maternal, fetal, and ethical considerations should be addressed.

**Case Report:** A 28-year-old G2P1 woman who presented at 26 weeks' gestation with cough and fever tested positive for COVID-19. Her respiratory status declined requiring intubation and Veno-Venous ECMO. The patient's power of attorney declined preterm cesarean delivery (CD). Her condition worsened and the ethics team was involved. A decision was made at 29 weeks' gestation with family to proceed with CD on V-V ECMO. Treatment of an intraperitoneal hematoma in the peri-operative period was required. The fetus did well, and the patient was decannulated after 25 days with discharge 41 days after admission.

**Discussion:** Multidisciplinary management was discussed including obstetric anesthesia, maternal-fetal medicine, neonatal, and cardiothoracic surgery teams. Delivery plan included challenges such as delivery mode, timing, anti-coagulation, and uterotonics. Special considerations include cannulation site/timing and risk of vascular compression by the gravid uterus. Fetal circulation during ECMO has not been well-investigated. Fetal monitoring and ECMO flow adjustments may be required for increased metabolic demands and to ensure adequate placental homeostasis to optimize the fetus for potential preterm delivery.

Data suggests ARDS is a common ECMO indication. Mortality due to ARDS during pregnancy is not significantly different than that in nonpregnant patients (23-39%) and is associated with a high rate of fetal loss (23%).<sup>3</sup> The largest review of obstetrical patients to date found that COVID is associated with a high incidence of preterm birth via cesarean delivery.<sup>5</sup> Registry data on ECMO cases show therapy was initiated more commonly for respiratory indications (59%) versus cardiac (42%).<sup>2</sup> V-V ECMO patients had a longer mean duration and higher complication rates than those on ECMO for cardiovascular indications.<sup>4</sup>

Guidelines for ARDS need to be altered for pregnancy and early initiation of ECMO may be considered. Despite hemorrhage being a common complication of ECMO (31.9%), the risk of bleeding should not be considered a contraindication.<sup>4</sup> A review studying ECMO during pregnancy found a 77.8% survival rate for mothers and 65.1% for fetuses.<sup>3</sup> ECMO is a viable support modality during pregnancy and early postpartum period and can result in adequate outcomes despite advanced respiratory or circulatory failure.

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## **Electroconvulsive Therapy at Term Gestation: Successful Multidisciplinary Management with Unique Challenges**

**Presenting Author:** Paige Keasler, DO

**Presenting Author's Institution:** Washington University in Saint Louis

**Co-Author:** Amber C. Benhardt, MD

**Introduction:** Use of electroconvulsive therapy (ECT) for psychiatric conditions in pregnant women at term gestation is poorly understood. Treatment of mental disorders in pregnancy pose a unique challenge secondary to timing and modality of psychiatric treatment, options for mode of delivery, and potential effects on the fetus from the intervention.

**Case Report:** A healthy 36 yo F, G1P0, at 38w5d gestation presented with acute mania, psychosis, and catatonia, after enduring several acute life stressors. Her condition precluded active involvement in the process of labor and delivery. A trial of ECT prior to proceeding with delivery was agreed upon as an intervention to optimize the chance of a successful labor and vaginal delivery. A court order for emergent ECT was obtained. Her second ECT treatment resulted in a prolonged seizure. Her fetal monitoring was notable for a deceleration in the setting of a tetanic contraction unresponsive to intrauterine resuscitation, necessitating an emergency cesarean delivery. Her infant was delivered with Apgar scores of 2 and 7 at 1 and 5 min, respectively. Postpartum, she received 4 additional ECT treatments and was discharged with improvement in her condition and ability to care for her newborn.

**Discussion:** Given the patient's full-term pregnancy, this case presented multiple ethical, legal, and delivery-of-care issues for the multi-disciplinary team that consisted of Maternal-Fetal Medicine, Anesthesiology, and Psychiatry. These included issues (i) related to informed consent, (ii) lack of active participation in a birth plan, (iii) appropriate location for delivery of clinical care, and importantly (iv) her ability to care for her newborn. Available literature suggests that ECT during pregnancy is effective in more than 80% of patients with affective disorders and the effectiveness in patients with psychosis is 61%-66%.<sup>3</sup> Our primary goal was to utilize ECT to improve pathology to the extent that it would allow her to be a participating member in her care.

ECT can pose risks to the fetus. Reviews suggest that in more than one-fourth (29%) of the cases, use was associated with fetus-related adverse outcomes.<sup>2</sup> In a small proportion of cases (7.1%), use of ECT was linked to mortality of the fetus/newborn.<sup>3</sup> Those who received ECT during the third trimester had risk factors for poor fetal outcomes.<sup>2</sup>

Monitoring is imperative during and after ECT, as seizures may cause a rise in oxytocin levels and uterine contractions, inducing preterm labor. <sup>4</sup> Our patient underwent a total of 6 ECT treatments, lower than the mean 9.4 ECTs reported in literature.<sup>1</sup> Centers providing perinatal psychiatric care must form multidisciplinary teams to improve the outcome of pregnancies in patients with mental illnesses and all potential risks, considering both the mother and fetus, should be weighed.

**References:** 1 Psychosom Med 2009;71:235-42

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## **New Diagnosis of Caval Leiomyosarcoma in the Third Trimester of Pregnancy**

**Presenting Author:** Samantha Lu, MD

**Presenting Author's Institution:** Northwestern University, Feinberg School of Medicine

**Co-Author:** Emery H. McCrory, MD; Rachel Bandi, MD; Elizabeth M. Lange, MD

**Abstract :** Primary leiomyosarcomas of the inferior vena cava (IVC) are rare sarcomas, and there are no reports of new diagnosis in pregnancy. Typical symptoms include abdominal pain, back pain, fatigue, dyspnea, and lower extremity edema, and may confound diagnosis in a parturient.<sup>1</sup> Differential diagnosis may include preeclampsia, peripartum cardiomyopathy, and pulmonary embolism.

We present a 44-year-old G4P1 at 30 weeks gestation with a one-month history of progressive dyspnea with exertion and lower extremity swelling. MRI revealed a 5.0 x 5.0 x 13 cm intrahepatic IVC mass extending superiorly into the right atrium and posteriorly through the caval wall with severe compression of the IVC. Despite IVC compromise, she was hemodynamically stable due to sufficient collateral circulation. Biopsy revealed grade one leiomyosarcoma.

A staged intervention was coordinated with cesarean delivery at 31.1 weeks gestation with cardiopulmonary bypass (CPB) on standby, and the tumor resection 3 days afterwards. With her large right atrial mass encompassing the majority of her atrium, the anesthetic for cesarean delivery focused on maintaining preload. A low-dosed combined spinal-epidural with slow titration of epidural was chosen given its greater efficacy for reliable, dense anesthesia and muscle relaxation while allowing for accommodations to hemodynamic changes. Intraoperatively, the patient intermittently became tachycardic with only minimal decreases in her blood pressure. The neonate was delivered without issue.

Three days later she underwent resection of her retroperitoneal leiomyosarcoma with IVC thrombectomy, right atrial tumor resection with thrombectomy, and vena cava reconstruction under CPB. Timing of the surgical intervention weighed the safety of the parturient and the fetus. Cardiac surgical morbidity and mortality in a parturient is higher than nonpregnant patients.<sup>2</sup> Fetal mortality rates with cardiac surgery are as high as 29%.<sup>3</sup> Given the viability of the fetus and hemodynamic stability of the mother, it was safer to plan for delivery of the fetus before the complex tumor resection under CPB. She was discharged home post-cesarean day 16.

This unique case presentation of a large IVC leiomyosarcoma extending into the right atrium in a third trimester parturient showed the importance of maintaining a broad differential. Prompt workup and intervention by our multidisciplinary team collectively resulted in the healthy delivery of an infant and a successful resection of a large tumor.

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## Anesthetic Management of a Complex Parturient with Holt-Oram Syndrome, Covid-19 pneumonia and Endocarditis

**Presenting Author:** Jessica Meister Berger, MD, JD

**Presenting Author's Institution:** Wake Forest Baptist Health

**Co-Author:** n/a

**Abstract :** A 35yo G2P0 was admitted at 26wga for recurrent fevers. She had been recently hospitalized for COVID-19 infection with superimposed bacterial pneumonia and had persistent respiratory sequelae. History was notable for Holt-Oram Syndrome (HOS) with ASD repair complicated by sick sinus syndrome requiring PPM implantation at age 7. She was pacer dependent. TEE was performed under general anesthesia (GA) as part of the workup for persistent fever, revealing a large 1.5cm x 1.2cm vegetation on the RV lead, severe TR, and moderate pulmonary hypertension. GA was notable for significant bronchospasm on emergence, likely due to airway reactivity in the setting of recent COVID-19. A PICC was placed for long term antibiotics. At 32wga, she presented with an erythematous and edematous upper extremity near PICC due to DVT; enoxaparin was initiated. Induction was at scheduled at 33w6d due to risk of septic emboli, and worsening TR and pHTN. She was transitioned from enoxaparin to a heparin infusion at time of cervical ripening. Heparin was discontinued once latent labor began and 4 hours later a PTT was drawn. An epidural was then placed without difficulty and gently titrated to attenuate hemodynamic and respiratory exacerbations. At the prompting of the obstetric anesthesiology team, the PPM was interrogated prior to induction and remained in DDDR mode, with a plan to place a magnet (VVO) in event of cesarean. Subsequent vaginal delivery was unremarkable. She remained on telemetry throughout admission. On PPD5, the patient was taken to the operating suite for lead extraction. Due to tortuous anatomy, the lead was not reachable by thoracotomy, and sternotomy with bypass was required. She recovered in the CVICU. HOS occurs in 0.7 of 100,000 births, and is a rare autosomal dominant condition due to a mutation in the TBX5 gene. Most mutations are de novo. First described in 1960, HOS is often called "heart-hand syndrome" because it results in extensive cardiac effects and forelimb malformation. TBX5 signaling is critical in signaling for endocardial cushion and forelimb development. Most commonly, HOS defects include ASD, arrhythmias, and brady- or polydactyly with absent radii. Anesthetic considerations must be tailored to the nature of cardiac disease and pulmonary sequelae. Vascular access may be challenging due to forelimb malformation including absent or malformed distal arteries, and invasive hemodynamic monitoring should be considered in cases of difficult non-invasive monitoring or severe cardiopulmonary disease. PPMs should be recently interrogated and the patient's underlying rhythm determined prior to anesthetic management.

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## **Obstetric Management of a Patient with Osteogenesis Imperfecta Type III**

**Presenting Author:** Jessica Meister Berger, MD, JD

**Presenting Author's Institution:** Wake Forest Baptist Health

**Co-Author:** Leah Templeton, MD

### **Abstract :**

Osteogenesis imperfecta (OI) is a rare genetic disorder occurring in 1/20,000-60,000 births. Mutations in type I collagen result in bone fragility and short stature, scoliosis, cervical spine deformities, hearing loss, and blue sclerae. There are at least 7 types of OI. Type I is most common, type II is fatal early in life, and types III-VII have variable but severe expression. The optimal mode of delivery is controversial; vaginal delivery risks maternal pelvic fractures and cephalopelvic disproportion. Patients are at increased risk of uterine atony, postpartum hemorrhage, restrictive lung disease and difficult airway.

A 30yo G2P0010 with OI type III presented in labor at term. She had hundreds of prior fractures, orthopedic rods in all extremities, scoliosis and difficult airway. Recent PFTs and an EKG were normal. Labs revealed platelets of 126 and normal TSH. Due to height (3'9"), cesarean section with limited fundal pressure was planned to minimize injury to patient and fetus, whose disease status was unknown. An arterial line was placed. After numerous unsuccessful attempts at neuraxial blockade, the decision was made to proceed with general anesthesia. Superior laryngeal, glossopharyngeal and transtracheal blocks were performed prior to awake fiberoptic intubation (AFOI) with a 5.0 cuffed ETT. General anesthesia and surgical delivery were uneventful. Post-operative course was complicated by cecum perforation requiring emergent laparotomy and hemicolectomy. The patient refused AFOI; RSI with cervical spine precautions and video laryngoscopy was performed without complication. She was discharged on POD#4.

General and neuraxial techniques for delivery in OI III have been successfully utilized, but few cases are reported as most patients do not survive to childbearing age. There are important anesthetic considerations for OI patients. Bony anomalies may preclude neuraxial blockade. PFTs should be obtained due to chest wall deformities. Prior fractures of the thoracic cage and difficult ventilation should be anticipated. Invasive hemodynamic monitoring should be considered. Airway management may be challenging in the difficult obstetric airway compounded by cervical spine involvement and fragility inherent. Films of the cervical spine and basilar skull should be reviewed. Collagen abnormalities increase risk of uterine atony, hemorrhage, and rupture, so patients should be crossmatched and adequate vascular access established prior to delivery. OI is associated with derangements of cellular metabolism, which may result in intraoperative hyperthermia though there is no known association with MH. 40% of parturients with OI have hyperthyroidism; therefore, thyroid function should be evaluated throughout pregnancy.

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## **Recurrent Dysautonomia and Pre-Eclampsia in a Grand Multipara**

**Presenting Author:** Vasilije Mijovic, MD

**Presenting Author's Institution:** Mount Sinai Hospital

**Co-Author:** Monica DiLorenzo, MD; Yaakov Beilin, MD; Nakiyah Knibbs, MD; ;

**Abstract :** The autonomic nervous system is designed to maintain physiologic homeostasis. Its widespread connections make it vulnerable to disruption by many disease processes resulting in numerous symptoms involving cardiovascular, gastrointestinal, and urogenital system. (1) Patients with autonomic dysfunction (AUD) often have peripheral and/or cardiac denervation leading to impairment of the baroreflex, which is known to play a major role in determining hemodynamic outcome during orthostatic stress. We present a case of AUD and resulting cardiovascular manifestations during pregnancy in an otherwise healthy woman. A 35 year old G8P7 with a history of recurrent pre-eclampsia (PEC) and AUD presented to L&D at 27 weeks for management of headaches associated with severe range BP (up to 215/111). On admission, she was treated with IV labetalol then 24 hours of IV magnesium. She was admitted for close BP monitoring. Her hospital course was complicated by extreme BP lability (73-217/33-129), nocturnal O2 desaturation, and periods of somnolence concerning for seizures. Severe hypertensive episodes were treated with low dose Labetalol IVP (2.5-5mg) due to risk of profound hypotension. The patient's differential diagnosis included: preeclampsia, pulmonary embolus, seizures, pheochromocytoma, and pseudo-pheochromocytoma. Her work-up including laboratory tests for pre-eclampsia and pheochromocytoma, EEG, CTA, doppler ultrasonography, and echocardiogram were all unremarkable. The pulmonology consult team recommended CPAP, after PE was excluded, though it failed to show any improvement. Finally, the patient underwent psychiatric evaluation for a high suspicion of pseudo-pheochromocytoma. Clonazepam was added to her existing regimen of PO labetalol with PRN dosed IV labetalol, hydralazine and nifedipine. Due to worsening HTN with an unpredictable response to treatment, the patient underwent an uncomplicated vaginal delivery with an epidural in situ at 32 weeks. After delivery, her symptoms significantly improved, with no further episodes of profound hypotension. During her previous pregnancies, the patient experienced the same signs/symptoms of AUD, which lead to preterm deliveries. Her hemodynamic status during non-gestational periods was unremarkable. We present a unique case of pregnancy-limited AUD where delivery leads to resolution of symptoms and improved hemodynamic stability. The work-up, both during pregnancy and outside of pregnancy, has always been unremarkable. This could represent an atypical presentation of PEC since it only occurs during pregnancy. However, it is also possible that pregnancy exacerbates her underlying AUD, although it is unclear why this would happen. Treatment of AUD is supportive as described and with close monitoring a successful outcome for mother and baby can be achieved.

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## **Headache and Facial Palsy in the Early Postpartum Period**

**Presenting Author:** Vasilije Mijovic, MD

**Presenting Author's Institution:** Mount Sinai Hospital

**Co-Author:** Monica DiLorenzo, MD; Yaakov Beilin, MD; Nakiyah Knibbs, MD; ;

**Abstract :** Headaches occur in up to 40% of parturients in the first six weeks after delivery. Although postdural puncture headache (PDPH) is occasionally the culprit, imaging will often elucidate the etiology of headaches associated with neurologic deficits. Postpartum cerebral angiopathy, more broadly known as reversible cerebral vasoconstriction syndrome (RCVS) is caused by reversible multifocal narrowing of the cerebral arteries. Patients typically present with acute-onset thunderclap headache and in some cases, neurologic deficits related to brain edema, stroke, or seizure. (1)

We present a case of a 38 year old G2P2 who presented to the ER with a frontal headache 6 days after uncomplicated cesarean delivery under spinal anesthesia. The headache started suddenly and was associated with hypertension (BP 170/90) and right-sided facial droop. She received an emergent CT scan, which was negative for acute infarct or hemorrhage. She was then admitted to L&D for further evaluation with high suspicion for pre-eclampsia (PEC) or PDPH, with neurology consulting. Her laboratory work-up for PEC and HELLP were unremarkable. Since the nature of the headache was not positional, PDPH was quickly ruled out. She received nifedipine followed by IV magnesium for presumed PEC and was sent for further brain imaging. CT angiogram was unremarkable. MRI was remarkable for small scattered foci of increased FLAIR signal, which are nonspecific and may be seen in a variety of clinical settings, including chronic headache, early small vessel ischemic changes and vasculitis. However, based on the acute-onset of the headache with focal neurologic deficit in the early postpartum and supported by the MRI findings, the neurology team established RCVS as working diagnosis. Symptomatic treatment with analgesics and strict BP control with calcium channel blockers (CCB) was recommended. Besides BP control, CCB were recommended to treat cerebral vasospasm as well. After initiation of the treatment, the patient's headache resolved in 24h and the facial palsy gradually improved. She was discharged home in stable condition on nifedipine and PRN analgesics.

RCVS has been associated with a variety of conditions, including pregnancy. The resolution of the different components of RCVS, including headaches, focal deficits, and angiographic narrowing, does not always follow the same time course. Although the syndrome is benign in 90% of patients, early recognition and supportive care are key components in order to prevent severe irreversible deficits or death from strokes or cerebral edema.

**References:** Singhal, A. Reversible cerebral vasoconstriction syndrome. In UpToDate, Goddeau, R (Ed), UpToDate, Waltham, MA, 2021.



## **Viridans streptococci Bacterial Meningitis Following Neuraxial Anesthesia, Labor and Cesarean Delivery**

**Presenting Author:** Ryan Militana, DO

**Presenting Author's Institution:** MGH

**Co-Author:** Tiffany Hsiang, MD; Kevin Ard, MD; Ellen Nagami, MD; Kate Cohen, MD; Lisa Leffert, MD

**Introduction:** Streptococcus salivarius is part of normal human oral flora and rarely, a source of meningitis. Most reported cases were associated with iatrogenic or traumatic CSF contamination without any clear evidence of predisposing co-morbid conditions[1]. This case describes postpartum Streptococcus salivarius meningitis.

**Case Presentation:** An otherwise healthy 24yo G1P0 at 39+5 patient presented to L&D for augmentation of labor in the setting of active contractions. Patient was afebrile with stable vital signs and her admission labs were remarkable for a mild leukocytosis (15.9 K/uL). Following request for epidural analgesia, an epidural catheter (via DPE) was successfully placed with strict adherence to aseptic technique including a surgical mask, eye protection, and sterile gloves. The patient ultimately underwent an uncomplicated PLTCS under epidural anesthesia secondary to arrest of descent.

On POD1 patient was evaluated for HA. She described experiencing a mild HA postoperatively that developed into a sudden onset pounding frontal and occipital HA not positional in nature. Patient was treated conservatively with hydration, caffeine, and acetaminophen.

On the evening of POD1, patient c/o worsening HA, nuchal rigidity, new N/V and was seen speaking nonsensically. A CTA head/neck was obtained and ruled out an acute stroke. On POD2, patient's leukocytosis progressed to 31 K/uL with continued mental status changes. An LP revealed elevated total CSF protein (620 mg/dL; ref range 5-55) and hypoglycorrhacia (< 2 mg/dL; ref range 50-75). A preliminary analysis revealed GPC in pairs suggestive of Streptococcus pneumonia. The patient was started on IV vancomycin (1g q8h), ceftriaxone (2g q12h), ampicillin (2g q4h) and dexamethasone (10mg q6h x 4 days) for bacterial meningitis. Patient had improvement in her symptoms (neurological baseline) on evaluation on POD 3 and her leukocytosis resolved on POD4. PCR of her CSF ultimately showed Streptococcus salivarius group with a negative CSF culture.

The patient was discharged home with a 4 week course of IV ceftriaxone (2g q12h) via PICC line due to concern of ventriculitis on MRI. Patient was evaluated by neurology on POD 28 where she endorsed occasional headache and blurry vision but states these symptoms continue to improve.

### **Discussion:**

Bacterial meningitis in otherwise healthy obstetric patients is extremely rare. Potential sources for this patient's unusual bacterial meningitis include contamination during the neuraxial procedure or subsequent neuraxial anesthetic versus seeding of the CNS via transient bacteremia from the genital tract. Strict adherence to aseptic technique must be maintained during neuraxial placement to avoid iatrogenic causes of CNS infection. A diagnosis of Streptococcus salivarius meningitis should be considered in a patient who underwent a procedure involving the meninges and subsequently developed symptoms concerning for CNS infection.

**References:** [1] Wilson et al. CM&R 2012:1(February)



## Post Dural Puncture Headache: Four years review of a Tertiary Maternity Hospital in Qatar

**Presenting Author:** Umar Mushtaq

**Presenting Author's Institution:** Hamad medical corporation

**Co-Author:** Graziana Massolini; Seema Nahid

**Introduction:** Post-dural puncture headache(PDPH) following accidental dural puncture(ADP) with an epidural needle is a well known complication for women receiving labor analgesia. Rates of ADP with an epidural needle are estimated to be 0.19-3.6%,with approximately 60% of these women developing PDPH.

**Methods:**Following approval of our local audit committee, we reviewed 4 years of our practice to benchmark our hospital with international standards. We conducted a retrospective audit from 1st January to 31st December 2020 of all women who received neuraxial analgesia. We looked at the rate of epidurals, incidence of ADP and PDPH. We also examined how we treated PDPH patients and analyzed the rate of epidural blood patch(EBP).As in 2020,we established a telephonic 4-6 weeks patient follow up, we evaluated the outcome of patients who received EBP and patients who were treated conservatively.

**Results:**A total of 45.964 vaginal deliveries were recorded during that period of which 22,502 received labor analgesia which corresponds to an average of 469 epidurals per month. Epidural rate has slowly increased during that period:44% in 2017,48% in 2018,49% in 2019 and 54% in 2020. The incidence of witnessed ADP was found to be 1% and the PDPH rate to be 0.6%.Conservative management was used in two thirds of PDPH patients.

One third of PDPH patients has moderate to severe symptoms requiring EBP. Of the 2020 PDPH patients follow up, all were found to be free of symptoms, both the ones treated conservatively and the ones who received EBP.

**Discussion:**Our audit found the overall incidence of witnessed ADP of 1% and the incidence of PDPH of 0.6% which is in line with international standards.Regular analgesia with paracetamol and NSAIDS was adequate for patients with minor symptoms but when patients complained of moderate and severe symptoms, an EBP was needed. Because PDPH does not invariably follow ADP and PDPH may resolve with multimodal pain relief medications, it is our practice to postpone performing an EBP until at least 48 hours following ADP. A survey of UK practice showed that many other units also postpone performing EBP until conservative measures have been shown to be inadequate. EBP must be performed meticulously to avoid complications. Because of the incidence of success of only 70%, and the risk of repeated ADP, blood patches should only be performed by an experienced anesthetist. In our review, there was never the need for a second EBP.

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## Anesthetic Considerations for Conjoined Twins – Separation as a Pediatric Anesthesia Fellow and Delivery as an Obstetric Anesthesia Fellow

**Presenting Author:** Claire Naus, MD

**Presenting Author's Institution:** Columbia University

**Co-Author:** Ruthi Landau, MD

**Introduction:** Conjoined twins are rare with an approximate incidence of 1:200,000 live births.<sup>1</sup> The unique anatomy of conjoined twins has significant ramifications for anesthetic management due to concerns about delivery, maternal hemorrhage, airway management, possible cross-circulation, positioning, and the logistics of running two anesthetics in one OR.<sup>2,3</sup>

**Case 1:** A 25-year-old nulliparous woman with preeclampsia presented for CD at 37w in the setting of thoraco-omphalopagus conjoined twins. A CSE (spinal dose HB 0.75% 12mg, fentanyl 15mcg, PF morphine 300mcg) and second IV was placed. Delivery was via a classical uterine incision, and nitroglycerin was administered. The case was complicated by atony requiring IM carboprost in addition to oxytocin; TXA 1g was also given. Blood loss was > 2L (Hct from 39% to 24%), but no transfusion was required. Post-op pain was managed with PIEB/PCEA for 24h followed by epidural PF morphine 3mg on POD1&2. This case demonstrates the challenges of delivering conjoined twins and potential maternal complications, including hemorrhage and pain from more extensive surgery.

**Case 2:** This set of ex-38w thoraco-omphalopagus conjoined twins, fused from xiphisternum to abdomen, shared a band of liver and pericardium. At 4 months, they presented for tissue expander placement. IV access was secured under N2O prior to induction. An IV atropine 'test' was given to one twin with no change in heart rate in the other, indicating that cross-circulation was likely minimal. They were placed on a custom-made pillow (photo) for optimal positioning and then induced and intubated one at a time. Monitors, medications, equipment, and teams for each twin were differentiated by color, which was important for turning the twins to place tissue expanders on the opposite side. They were turned back to their original positions and extubated sequentially. At 5 months, the twins returned for the separation. Pre-induction IV access and intubation were performed in the same manner, and additional IVs, radial arterial lines, and internal jugular central venous catheters were placed for each. After separation, they were moved to different tables in the same OR. Given large defects and limited available skin, both closures were completed with a patch. The postoperative course was complicated by prolonged mechanical ventilation, compartment syndrome, multiple infections, and swallowing issues.

This case demonstrates the complexities of providing anesthesia for conjoined twins. Careful planning is necessary, particularly for critical aspects of the case, namely being prepared to manage two airways simultaneously, determining how giving medication to one twin affects the other, and addressing the logistics of position changes. Color-coding lines, monitors, medications, and personnel not only defined the teams for each twin but helped to keep a confined space organized.

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- IJOA 2008;17(2):174-6
- A&A Practice 2018;10:298-301



## Peripartum Diagnosis of Currarino Syndrome with Anterior Sacral Meningocele: A Case Report

**Presenting Author:** Kaitlyn E. Neumann, MD

**Presenting Author's Institution:** Northwestern University, Feinberg School of Medicine

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**Intro:** Neurologic conditions without prenatal optimization can pose challenges as neuraxial techniques are the mainstay of obstetric anesthesia and analgesia. We present a case of Currarino Syndrome; an autosomal dominant triad of agenesis of the sacrum, anterior sacral meningocele (ASM) with sacral teratomas, and anorectal stenosis; diagnosed during pregnancy, and the subsequent anesthetic considerations.

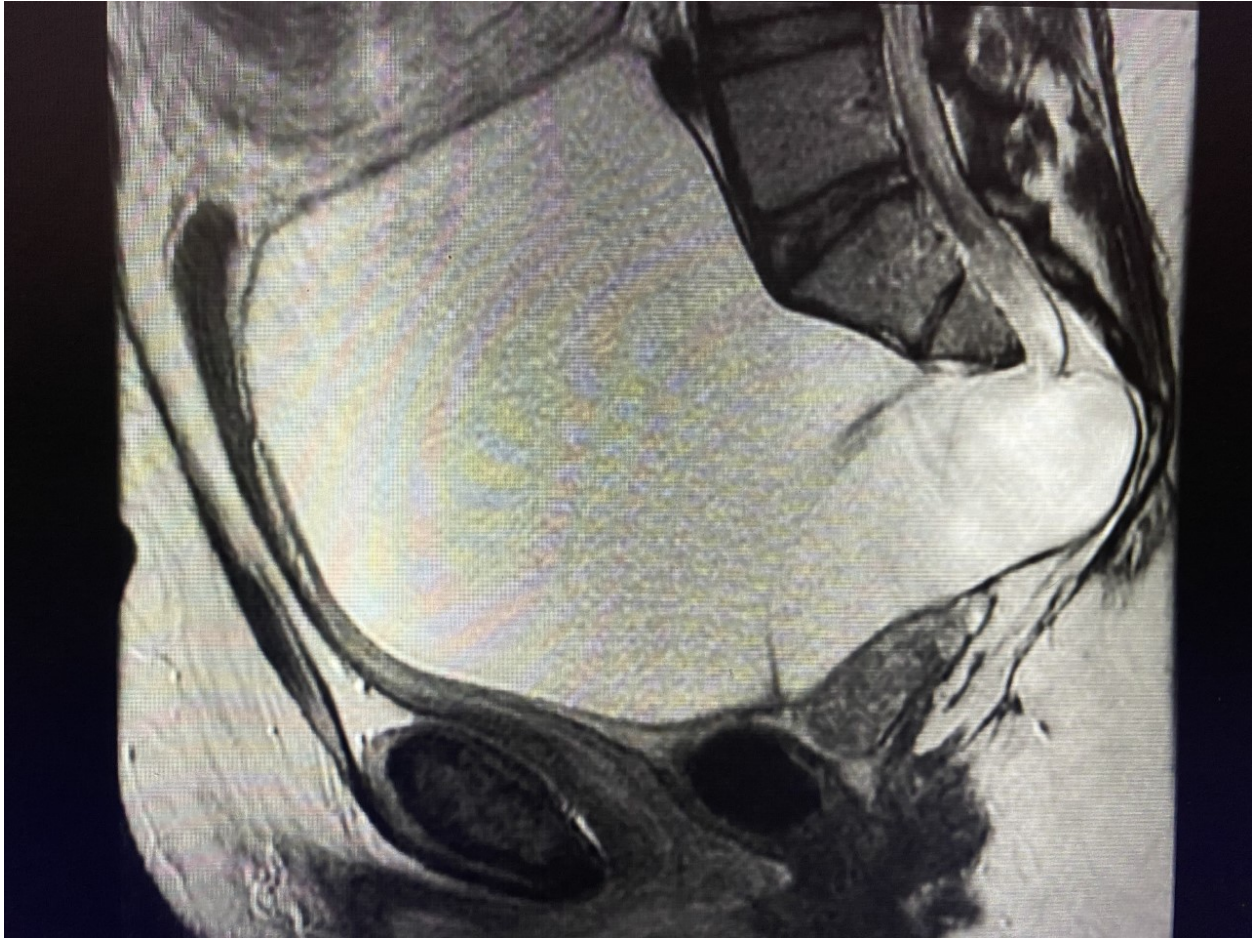
**Case:** A 27-year-old G1P0 female with a history of chronic constipation presented in the first trimester with abdominal fullness. MRI imaging showed a ventral sacral spina bifida, large anterior meningocele with possible protrusion of neural tissue, sacral teratoma, tethered spinal cord and 7mm Chiari malformation. Significant uterine displacement from the ASM defect and teratoma raised concern for obstruction of the fetus from entering the pelvis during vaginal delivery. Additionally, increased intracranial pressure with valsalva maneuvers while pushing could risk ASM rupture. Despite a scheduled cesarean delivery, she presented early in labor requiring multidisciplinary coordination to permit heightened staffing, including neurosurgery, should complications arise during the procedure. Given her complex neurological pathologies, the patient was not considered a candidate for neuraxial anesthesia, thus general anesthesia was instituted. Concern for catastrophic neurological sequelae secondary to disruption of the ASM prompted invasive blood pressure monitoring and frequent pupil evaluation. The ASM was noted in the retroperitoneum and was not disturbed during the procedure. The patient had no surgical or anesthetic complications and was discharged with plans for interval surgical correction of her ASM 6-12 months postpartum.

**Discussion:** While neural tube defects typically present and are repaired in childhood, ASMs rarely present until adulthood. Patients may be asymptomatic or present with nonspecific symptoms such as chronic constipation, urological symptoms, back pain, dysmenorrhea or rarely neurological symptoms.<sup>1</sup> Currarino Syndrome is a rare syndrome with a constellation of pathologies previously described including ASM, with a primary symptom of constipation since birth<sup>2</sup>, as seen in this case. The location and size of ASM, as well as the risk of rupture with subsequent meningitis or herniation create significant obstacles to delivery. MRI imaging can help inform decision making. In this case, the patient's tethered cord and likely myelomeningocele prohibited neuraxial techniques; however, neuraxial anesthesia is not contraindicated in all ASMs. Deficits should be clearly documented allowing prompt identification and intervention should any complications arise. Multidisciplinary team coordination is vital in rare clinical scenarios to help facilitate maternal safety.

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## Management of pericardial effusion in a pregnant woman- A multi-disciplinary approach.

**Presenting Author:** Shri Vidya Niranjana Kumar, MBBS, MD

**Presenting Author's Institution:** Department of Anesthesia, McMaster University

**Co-Author:** Richard Kolesar, MSc, MD, FRCPC; Lloyd Semelhago, MD, FRCSC; Stephanie Winsor, MD, FRSCS

**Abstract :** Hemodynamically significant pericardial effusions during pregnancy are fortunately uncommon. Acute or chronic effusions of any etiology can subsequently cause cardiac tamponade and require emergent intervention to preserve the life of mother and baby.

We present a 33yr old G3T2L2 woman with opioid use disorder diagnosed with pericarditis at 24 weeks of pregnancy. Transthoracic echocardiography (TTE) confirmed presence of a pericardial effusion. She was treated with a course of prednisone and NSAIDs. Shortly thereafter, she developed rapid atrial fibrillation, ultimately requiring cardioversion with procainamide and maintenance therapy with sotalol. Follow-up TTE at 32 weeks gestation showed an increase in the pericardial collection. Pericardiocentesis was performed with limited benefit due to loculations; culture of the pericardial fluid grew MRSA. Due to progressive decompensation a cardiac surgeon was consulted and recommended pericardial window.

Prior to surgery, anaesthesiologist, cardiac surgeon, obstetrician (MFM) and neonatologist met to devise a well-defined plan of care. Despite concerns regarding the gravid uterus impeding sub-xiphoid access to the pericardium, the multidisciplinary team agreed to proceed with a conventional window and "pump standby." Emergency Caesarean section was reserved for persistent maternal hemodynamic instability. All teams were expected to be present in the operating room.

On admission to the OR, the patient was in extremis. After placement of standard monitors, general anaesthesia was induced, the airway was secured, and an arterial line was placed. The surgery proceeded as planned, without complication; and 800ml of purulent fluid was drained from the pericardium of purulent fluid was drained. Hemodynamic remained stable. Immediately post-procedure the MFM team verified normal fetal heart movement via 2D ultrasound. Patient remained intubated in CCU for 3 days primarily for pain management. During this time, daily fetal assessments were performed by the MFM team. After extubation care was transferred back to the obstetric, maternal medicine, infectious disease and addiction medicine services. Her remaining hospital stay was uneventful and she delivered a healthy female baby at 33 weeks.

A multi-disciplinary approach not only brings essential expertise to the patient's side, but also brings resources necessary to deal with life-threatening consequences of both the underlying disease and treatment of it. The multi-disciplinary approach taken in this case provided mother and baby with best chances of a favorable outcome.

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## Spontaneous intracranial hypotension in pregnancy treated with a single epidural blood patch: A case report

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**Co-Author:** Anthony Chau, MD FRCPC MMSc; Wee-Shian Chan, MD FRCPC; Daniel Moller, MD; Simon Massey, MBBCh MRCP FRCA FRCPC;

**Introduction:** Spontaneous intracranial hypotension (SIH) is rare, resulting from idiopathic cerebrospinal fluid (CSF) leak. Patients with SIH develop a postural headache that mimics postdural puncture headache (PDPH). Treatment often requires an epidural blood patch (EBP) to mitigate against serious complications such as cerebral venous thrombosis and subdural hematoma.(1) However, management of SIH during pregnancy is challenging. First, determining the exact CSF leak location requires gadolinium based radiological studies, which are contraindicated in pregnancy. Second, there are limited data to guide the volume of blood to be used for EBP in pregnant patients; however, large volumes up to 85 ml have been used in a non-obstetric case.(2) We describe a case of SIH presenting in the third trimester.

**Case :** A 35 year-old G3P2 at 34+4 weeks gestation presented with a 6-day history of worsening severe left-sided orthostatic headache associated with neck pain, nausea, vomiting, hyperacusis and photophobia. Her symptoms had been present with varying degrees of severity for 3 months. Her history and examination were unremarkable with no trauma or previous neuraxial techniques. Non-contrast brain MRI revealed dural thickening, venous sinus distension, and sagging of the brainstem consistent with intracranial hypotension. Conservative management involving intravenous hydration, caffeine, and oral opioids failed to resolve her symptoms and she underwent an EBP. In the lateral position, an epidural was placed at L2/L3 level. A total of 40 mL of autologous blood was withdrawn, but administration stopped at 35 mL when the patient complained of back pressure and right-sided radicular pain. After 1 hour of bed rest, she mobilized with complete resolution of her headache. Over the next week, her headache returned with associated vomiting but abated with caffeine and acetaminophen. She had a spontaneous delivery at 40 weeks, during which her headache did not recur, and she did not require an epidural. At 4 months post-partum, she reports occasional mild orthostatic headaches of short duration which spontaneously resolve.

**Discussion:** The pathophysiology of PDPH and SIH are similar but SIH in pregnancy presents unique challenges. The location of CSF leak was never identified in this patient but a lumbar EBP was successful. Case reports in non-obstetric patients with SIH suggest that larger EBP blood volumes than those traditionally used to treat PDPH(3) have led to successful treatment of the headache.(1,4) In obstetric cases, most have used 25-35mls.(1) We injected the upper limit of blood volume reported, using onset of mild neurological symptoms as the EBP end point. This report adds evidence to guide the management of this condition and we advocate utmost care and monitoring during EBP to avoid known serious complications.

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**Peripartum hysterectomy for placenta accreta in a patient with situs inversus and scoliosis under combined spinal-epidural anesthesia.**

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**Presenting Author's Institution:** UTMB, Galveston

**Co-Author:** Shobana Murugan, MD; Michelle Simon, MD; Mohamed Ibrahim, MD; Rovnat Babazade, MD;  
Rakesh Vadhera, MD

**Background:** Situs inversus is a rare condition with a predicted incidence of one in 10,000 among the general population. Spinal deformities like split cord, spina bifida, meningomyelocele, scoliosis, etc. have been described in the literature for patients with situs inversus. The present case report lays an emphasis on the potential difficulties during anesthetic management and its various implications.

**Case:** We present the case of a 32 year old African American G3P2 who presented to our high risk labor and delivery unit for an elective repeat cesarean section. Her medical history was significant for situs inversus with dextrocardia, uncontrolled pre gestational diabetes on insulin, sickle cell trait, previous 2 cesarean sections. The patient was seen by the anesthesia team on the morning of surgery. On examination it was noted that the patient had severe scoliosis of the lumbar spine. The patient also gave a history of difficult epidural placements during the previous cesarean section requiring general anesthesia. Combined spinal epidural was placed successfully. After delivery of the baby, there was difficulty in removing the placenta intact. After manual placental removal, there were multiple areas of thickened tissues on the uterus, concerning for retained placenta secondary to possible placenta accreta. The obstetric team performed supracervical hysterectomy and bilateral salpingectomy was done. Epidural catheter was removed before the patient was shifted out from the recovery unit. Post operative course was complicated by anemia requiring blood transfusion. Patient was discharged from the hospital on post operative day 3.

**Discussion:** We suggest that any patient with situs inversus if planned for neuraxial anesthesia should be evaluated thoroughly given the high risk of spinal deformities like scoliosis associated with the condition. The diagnosis of situs inversus and a thorough pre-operative evaluation can minimize difficulties and the various potential challenges associated with its anesthetic management.



**Stat Breech Delivery in a Patient with Undiagnosed Cardiac Pathology.**

**Presenting Author:** Jonathan Rogerson, DO

**Presenting Author's Institution:** University of Colorado Anschutz

**Co-Author:** Paulina Cárdenas, MD

**Abstract :** 20 yo G1P0 @35 weeks 2 days was transferred from a rural hospital for a breech lie, pre-term, premature, rupture of membranes, and a significant heart murmur. Patient questioning reveals that she has had little medical care throughout her life including scant prenatal care, however, she admits to several childhood hospital admission for "turning blue". The patient was stable, not laboring with no cervical change so rapid cardiology evaluation was performed revealing significant right-sided cardiac abnormalities. Prompt middle of the night multidisciplinary planning after evaluation resulted in a plan for cesarean delivery via intrathecal catheter, and pulmonary artery catheter placement as the exact cardiac pathology was unknown at the time of presentation. Cervical change prompted rapid initiation of the delivery plan.

After the intrathecal catheter was placed in the operating room, the patient was placed supine with left uterine displacement for placement of a MAC catheter and Swan-Ganz catheter. As the MAC catheter was being placed, the patient stated she had the urge to push and exam showed that she was fully dilated, 100% effaced, and the baby's sacrum was at her introitus. This prompted rapid modification of the delivery plan and the baby was delivered vaginally in the breech presentation. Delivery was successful and she was transported to the cardiac ICU after delivery. Post delivery cardiac catheterization revealed severe pulmonic valve dysfunction and total anomalous pulmonary venous return and a large atrial septal defect. This case highlights the dynamic nature of obstetrics which sometimes requires prompt flexible care while coordinating with other specialties.

**References:** Arendt K.W., Lindley K.J. Obstetric anesthesia management of the patient with cardiac disease. International Journal of Obstetric Anesthesia (2019) 37, 73-85



## **Born from a Horn: Anesthetic Management of a Primary Cesarean Delivery for Unicornuate Uterine Pregnancy**

**Presenting Author:** Nora Martin, MD

**Presenting Author's Institution:** Montefiore Medical Center

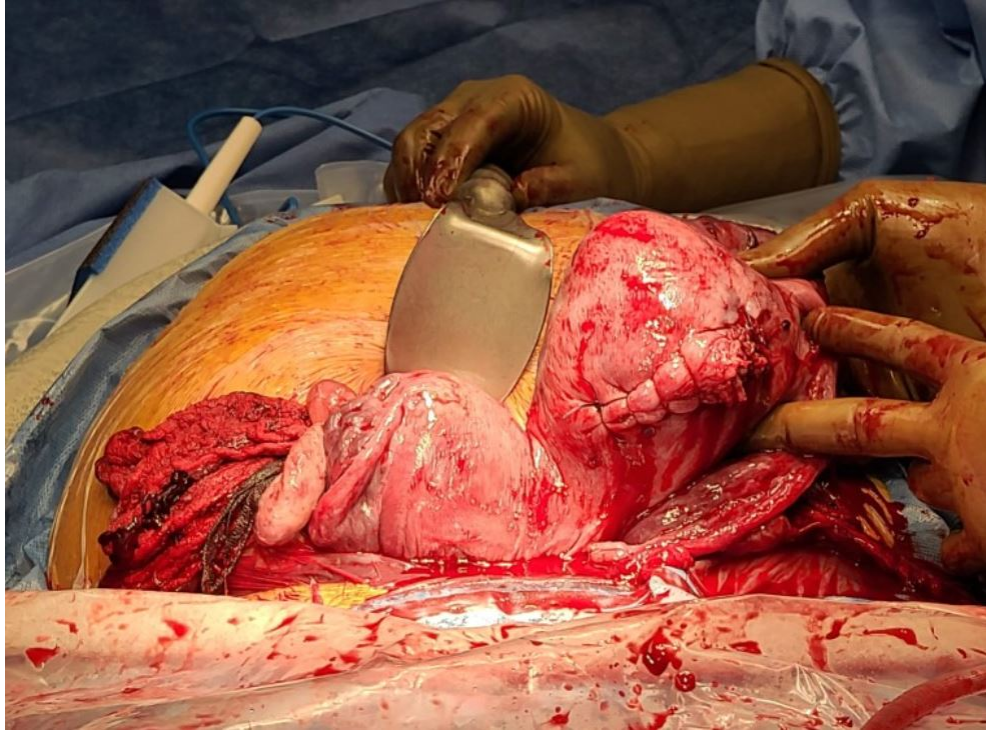
**Co-Author:** Shamantha Reddy, MD; Yelena Spitzer, MD; Erik Romanelli, MD, MPH

**Abstract :** We present a case of a 35 year-old G5P2022 woman with a medical history significant for gestational diabetes, gestational thrombocytopenia and chronic hypertension who was found to have a unicornuate uterus with the fetus lodged in the left rudimentary horn (first seen on MRI at 23 weeks gestation). It was noted that the myometrium was severely thinned in the superior regions. She had 2 prior vaginal deliveries at 40 weeks gestation without complication. It was collaboratively decided amongst the MFM, OB Anesthesia, and NICU teams that the patient would deliver no later than 32 weeks gestation given concern for her severe myometrial thinning and consequential risk for uterine rupture. The patient was scheduled for a classical cesarean section via midline vertical skin incision, removal of left rudimentary horn, and bilateral tubal ligation, however contingency plans were in place in the event earlier delivery became necessitated and the patient was admitted to the antepartum service beginning at 26 weeks gestation. Her antepartum course was generally uneventful. Preoperatively, two large bore peripheral intravenous lines were placed and four units of packed red blood cells were cross-matched. After standard monitors were placed, a combined spinal-epidural was completed under sterile precautions. She received 12mg 0.75% bupivacaine, 200 mcg morphine, and 15mcg fentanyl intrathecally. A phenylephrine infusion was initiated to counteract effects of neuraxial-induced sympathectomy. Following delivery, the patient received 30 units total of oxytocin for uterine contraction and there were no signs of overt uterine atony. The technical difficulty of the subsequent rudimentary horn removal lead to an increased operating time, and hence activation of the epidural catheter with an additional 5ml of 2% lidocaine and 80mcg of epidural clonidine were given for additional pain control, in addition to 2mg of versed and a low-dose propofol infusion for general patient discomfort. The quantitative blood loss was 1900cc. A total of 3000ml of crystalloid was given, and urine output was 150ml. Vitals had been stable throughout the intraoperative course, however postoperatively, she was found to have intermittent hypotension with occasional MAPs of 40, requiring pressor support however she never became tachycardic in this setting. A bedside ultrasound was completed to rule-out signs of bleeding and was deemed negative. She was prophylactically transfused 1 unit of packed red blood cells while lab studies were pending and she continued to exhibit hypotensive blood pressures. As the transfusion completed and sedation dissipated, her vitals stabilized (CBC returned shortly thereafter noting a drop in hemoglobin from baseline 10.5 to 8.6 g/dL). No further complications ensued.

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2. Int J Fertil Steril. 2018;11(4):318-320
3. PLoS One 2019;14(1)







## Paralysis after a failed spinal: epidural hematoma or conversion syndrome?

**Presenting Author:** Nayema K. Salimi, MD

**Presenting Author's Institution:** Yale New Haven Hospital

**Co-Author:** Rima Aouad, MD; Antonio Gonzalez-Fiol, MD

**Abstract :** Psychogenic paresis is a type of conversion disorder where patients present with altered sensory or motor function unexplained by medical causes<sup>1,2</sup>. We describe a case of psychogenic paresis after a failed lumbar spinal.

A 28-year-old G3P1 with a history of preterm delivery presented for an ultrasound indicated cerclage at 18 weeks gestation. A spinal was placed at the L3-4 level with a 25g Sprotte; 7.5mg hyperbaric bupivacaine and 10mcg fentanyl were administered. The placement was uncomplicated, but 20 minutes later, the patient did not have a sensory level, she denied motor weakness and was able to lift her pelvis off the table. The decision was made to convert to general anesthesia, and the remainder of the intraoperative procedure was uneventful.

Eight hours after spinal placement, she reported progressive lower extremity numbness, difficulty voiding, and motor weakness. A bilateral T8 sensory level and minimal motor function of her lower extremities were noted on physical exam. MRI showed a small dorsal thoracic epidural fluid collection at T4/T5 level, potentially due to an epidural hematoma (see Figure 1a). Neurosurgery and Orthopedics were consulted. On their exam, she had diminished sensation below the umbilicus and 1-2/5 strength in her bilateral extremities. However, after several repetitions of her lower extremity exam, her strength slowly improved to a 4/5. The thoracic hematoma on imaging did not correlate with the patient's symptomatology. Repeat MRI showed mild asymmetry within the epidural space at the T4 level, which was thought to reflect epidural fat asymmetry (see Figure 1b). It did not show evidence of acute cord compression, epidural or subdural hematoma. Without any organic cause of disease, she was seen by psychiatry, who diagnosed her with conversion syndrome and noted that she had la belle indifference. Of note, she did not have any known psychiatric illnesses but did have some personal stressors due to the recent loss of her father. Notably, she also reported a history of a failed spinal for cesarean section with a subsequent successful epidural placement.

Psychogenic paresis is a potential cause of paralysis after a neuraxial. In this case, an artifact from the initial MRI study gave concern for an epidural hematoma. The first imaging results were an alarming distractor for the ultimate (non-organic) etiology of her symptoms. The patient was discharged in a wheelchair with home physical therapy and reported resolution of her lower extremity weakness two months after the event. In summary, our case highlights that although imaging is essential for ruling out cases of paresis after neuraxial anesthesia, clinical assessment/judgment is as crucial.

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- Nguyen J, et al. Int J Obstet Anesth 2013; 22:160-3



	Spine- Mean [95% CI] N= 29		Transverse Abdominis plane Mean [95% CI] N = 15		Obstetric images Mean [95% CI] N = 30	
	Sonosite	Butterfly iQ	Sonosite	Butterfly iQ	Sonosite	Butterfly iQ
Resolution	6.0 [5.5, 6.5]	6.6 [6.2, 7.0]	5.9 [5.5, 6.5]	6.0 [5.3, 6.5]	8.4 [8.2, 8.6]	6.7 [6.3, 7.1]
Detail	6.0 [5.5, 6.4]	6.8 [6.4, 7.1]	6.0 [5.5, 6.5]	6.8 [6.5, 7.1]	8.6 [8.4, 8.8]	7.0 [6.6, 7.4]
Image Quality	5.9 [5.3, 6.4]	6.8 [6.5, 7.1]	5.9 [5.5, 6.3]	6.4 [6.0, 6.7]	8.2 [7.9, 8.4]	7.1 [6.7, 7.5]

Table 1.



## Multimodal pain management for cesarean delivery in a patient with metastatic breast cancer

**Presenting Author:** Nayema K. Salimi, MD

**Presenting Author's Institution:** Yale New Haven Hospital

**Co-Author:** Peter Mancini, M.D; Ana Lobo, MD, MPH; Antonio Gonzalez-Fiol, MD

**Abstract :** Breast cancer affects 1 in 3000 pregnancies<sup>1</sup>. Once a diagnosis is made, prompt treatment of the cancer is recommended<sup>1</sup>. We present a patient with metastatic cancer to the spine who declined intrapartum therapy and developed severe pain necessitating cesarean section at 31 weeks.

A 38-year-old G7P4 with recurrent Stage 2A ER+/PR+ HER2- invasive ductal carcinoma was admitted at 29+3 weeks gestation with intractable immobilizing back pain. She underwent a right partial mastectomy and radiation in 2019 and prematurely stopped Tamoxifen for an intended pregnancy. She developed progressive sacral pain and radiculopathy with MRI evidence of diffuse bony metastases and an L4 compression fracture which was biopsy-confirmed metastatic breast cancer. She was 18 weeks at that time, determined to continue the pregnancy and was reluctant to start chemotherapy before delivery.

At the time of admission, her outpatient pain regimen included oxycodone 20 mg q3 hours and methadone 5 mg 3 times a day (TID). A multidisciplinary team of obstetrics, palliative care, neurosurgery, medical oncology, radiation oncology and anesthesia was formed and worked closely with her outpatient oncologist. She was started on a hydromorphone patient-controlled analgesia (PCA) pump. She had rapid up-titration of her medications, requiring over 200mg of IV hydromorphone a day, in addition to methadone (now 15 mg TID), acetaminophen, gabapentin, dexamethasone, lidocaine patches and still had insufficient pain relief. Options for pain management and palliative treatment for her metastatic disease were limited due to her pregnancy and the decision was made to have a primary cesarean delivery at 31 weeks.

The concern for uncontrollable post-operative pain was weighed against the risks of neuraxial in the setting of spinal metastases and limitations in positioning. This was discussed with the patient and her teams. An ultrasound guided L2-3 combined spinal epidural was placed with 12mg hyperbaric bupivacaine, 15mcg fentanyl, 100mcg morphine, and 30mg of clonidine administered intrathecally. The spinal rapidly relieved her pain and the patient tolerated cesarean delivery well. Intraoperatively, she received IV acetaminophen, ketorolac and transverse abdominis plane blocks with Exparel. The epidural was used for post-operative pain and her previous pain regimen was continued. Her hydromorphone PCA dosing was slowly decreased. MRI was performed after delivery (see Figure 1) in preparation for surgery, radiation and chemotherapy to commence shortly afterwards.

Although there is evidence that pregnancy after a breast cancer does not increase the chance of recurrence<sup>2</sup>, pregnancy associated breast cancer should be aggressively treated once it is diagnosed<sup>1</sup>. However, patient autonomy should be respected and managed with a multidisciplinary team.

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## Using Shared Decision-Making to Navigate a Complex Obstetric Scenario in a Patient with Contraindications to Intubation and Neuraxial Anesthesia

**Presenting Author:** F. Arran Seiler, MD

**Presenting Author's Institution:** University of Chicago

**Co-Author:** Barbara Scavone, MD

**Case:** A 30 year old G1P0 patient at 37 weeks estimated gestational age presented with morbid obesity (BMI 69), chronic hypertension with superimposed preeclampsia, asthma, OSA, diabetes, sinus tachycardia, and Pierre Robin syndrome. She had undergone multiple airway surgeries as a child and previously had tracheostomy. During pregnancy her previously repaired cleft palate began to dehiscence. One year prior to pregnancy she had undergone a prolonged and traumatic awake fiberoptic intubation for abdominal surgery. The patient's medications included enoxaparin 80mg BID due to limited mobility due to obesity. The patient's hospital would offer only an elective cesarean delivery under general anesthesia with an awake intubation so she transferred care, desiring to avoid both cesarean delivery and general anesthesia with attendant awake intubation. After transfer of care she was admitted to our labor and delivery unit for worsening superimposed preeclampsia. She had taken 80mg enoxaparin shortly before arriving. The patient, her maternal fetal medicine specialist, and her anesthesiologist discussed risks and benefits of vaginal versus cesarean delivery, delaying delivery, and the use of neuraxial versus general anesthesia. We decided to manage her blood pressure medically and perform cesarean delivery the following day to permit neuraxial anesthesia. She underwent an uncomplicated combined spinal epidural placement under ultrasound guidance and cesarean delivery. She was discharged on postpartum day 3.

**Discussion:** This patient's case is notable for complex medical decisions necessitating multidisciplinary consultation and shared decision-making with the patient. The patient desired vaginal delivery due to the increased maternal risks associated with cesarean delivery; however, the neonatal risks of breech vaginal delivery were judged to be high, especially considering her obesity and nulliparity<sup>1</sup> and so the patient agreed to cesarean delivery. We then weighed risks of delaying delivery in the setting of preeclampsia versus the risks of proceeding immediately under general anesthesia<sup>2</sup> with previously documented challenging awake intubation and decided on medical management overnight. Current guidelines recommend delaying neuraxial anesthesia placement for 24 hours in patients on high dose low molecular weight heparin, but also remind the provider to consider "all the circumstances presented by an individual patient."<sup>3</sup> If the patient or fetal heart rate tracing deteriorated before 24 hours had passed since the last dose of enoxaparin the plan was to weigh risks and benefits of proceeding with neuraxial anesthesia at various time intervals less than 24 hours but most likely sufficiently long that the risk of spinal epidural hematoma was low. High risk obstetric care requires multidisciplinary planning and shared decision-making.

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## **Mechanical Valve Thrombosis, Acute Myocardial Infarction, and Acute Heart Failure in Late Pregnancy: Pearls and Pitfalls**

**Presenting Author:** Marwa Sidani, MD

**Presenting Author's Institution:** University of North Carolina

**Co-Author:** David C. Mayer, MD; Katherine Mills, MD

**Introduction:** Cardiovascular disease is the leading cause of maternal mortality in the US. Although pregnancy is a hypercoagulable state, the risk of de novo thrombotic cardiac events is low. This risk is significantly increased in patients with mechanical valves. We hereby present a multidisciplinary management strategy of such challenging situations.

**Case Description:** A 32 y.o. with Hx of mechanical mitral valve replacement presents with acute chest pain and shortness of breath at 33 wks gestation. Cardiac catheterization revealed acute myocardial infarction with distal occlusion of the right post. descending artery secondary to arterial dissection. She was promptly started on heparin infusion.

A TTE showed a mean gradient of 16mmHg across the mitral valve but did not show an obvious thrombus. She continued to have chest pain without significant EKG changes. Her troponin level was suggestive of increased demand rather than ongoing ischemia. A repeat TTE showed decreased ejection fraction to 35% with basal and inferolateral wall hypokinesis. Upon closer review of her TTE loops, it turned that she had a supralvalvular thrombus of the mechanical valve. A multidisciplinary team involving cardiology, maternal fetal medicine, and obstetric anesthesia resulted in a plan for induction at 36 wks of gestation. Heparin drip was held 4 hours before placing an epidural catheter. Subcutaneous heparin 5000U q8h was started one hour after epidural placement. Vaginal delivery was successful with forceps assistance. The patient delivered without significant bleeding or need for additional uterotonics. She was discharged home 5 days later.

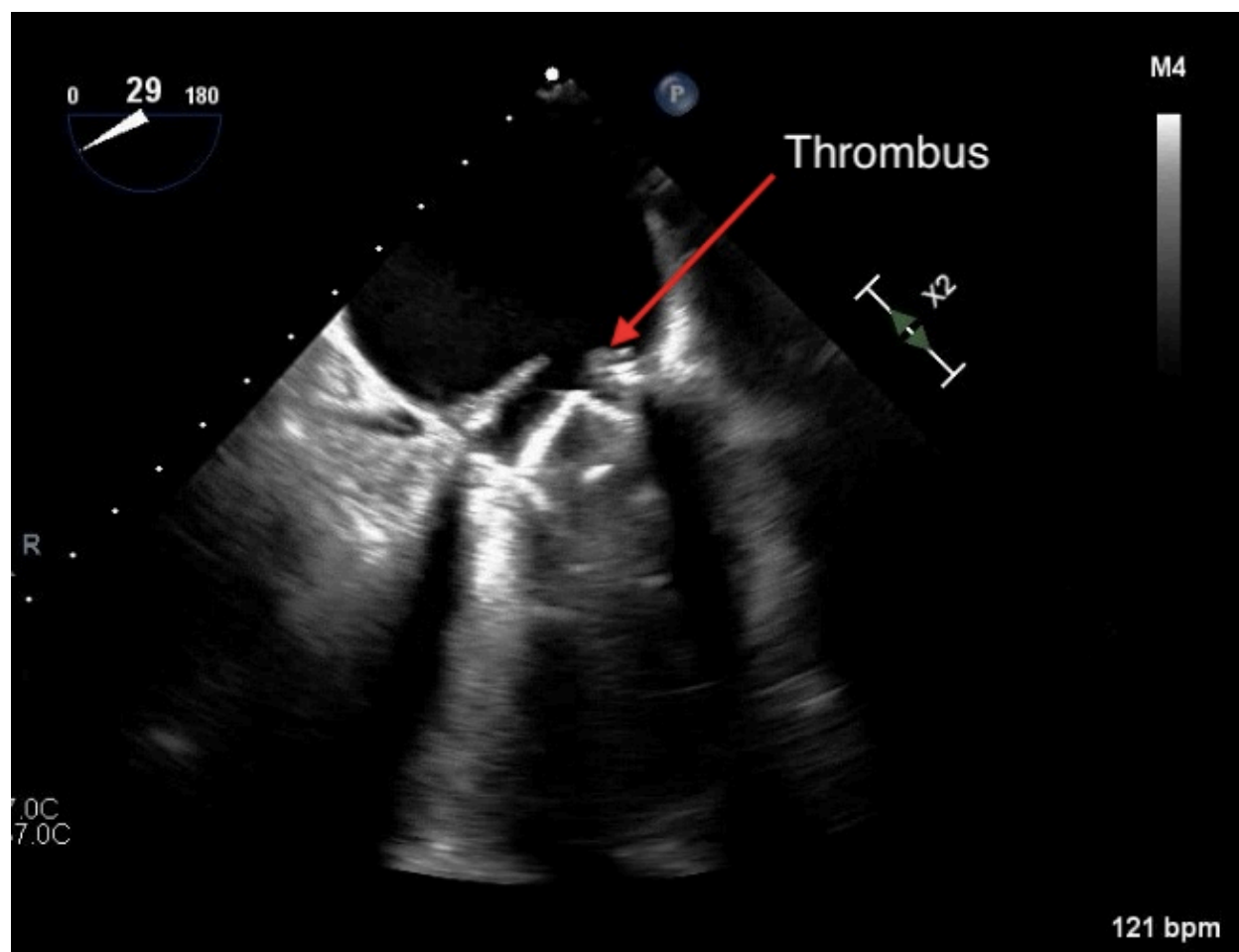
**Discussion:** During pregnancy, the physiologic changes in flow and gradients are not well-tolerated in patients with mitral stenosis. Our patient suffered thrombosis of her mechanical valve which caused significant increase in the gradient across the valve and, together with acute infarction, rapidly worsened her cardiac function. In these situations, it is imperative to formulate a multidisciplinary plan to determine the optimal timing of delivery. Neuraxial anesthesia remains the safest approach to prevent severe hypotension and tachycardia. However, placement should be carefully timed after holding heparin. Fluid management is also critical to prevent pulmonary edema. Oxytocin was concentrated and albumin was used.

During the 2nd stage of labor, the goal is to minimize increases in afterload and tachycardia. Therefore, elective assisted delivery was utilized. Finally, preparing for potential hemorrhage is key. Blood products, uterotonics, and Bakri balloons should be readily available in the OR.

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## **Multidisciplinary Management of a Parturient with a Hemorrhagic Renal Mass: A Rare Case of Wunderlich Syndrome in Pregnancy**

**Presenting Author:** Christopher T. Smith, MD

**Presenting Author's Institution:** Northwestern University Feinberg School of Medicine

**Co-Author:** Stephanie K. Woodward, MD; Joseph B. Bavaro, MD

**Introduction:** Spontaneous, nontraumatic renal subcapsular and retroperitoneal hemorrhage, also known as Wunderlich syndrome, is a rare condition usually associated with angiomyolipomas, renal cell carcinoma (RCC), or other renal masses.<sup>1</sup> We describe a pregnant patient with a hemorrhagic renal mass and the management of both parturient and fetus.

**Case:** A 40-year-old G3P2 female presented at 32w1d with left flank pain. On admission, she was hemodynamically stable, with creatinine 0.48, hemoglobin 10.8, and negative urinalysis. Renal imaging showed a 5.9cm hyperechoic lesion in the left kidney and a 9.6cm heterogeneous hyperechoic region suggestive of a left renal angiomyolipoma with hemorrhagic rupture. Urology and Interventional Radiology (IR) were consulted. Urology recommended immediate IR embolization to reduce the risk for catastrophic hemorrhage, followed by postpartum radical nephrectomy. However, given risk of ionizing radiation exposure to the fetus, IR recommended delaying embolization until after delivery. Following extensive multidisciplinary discussions involving obstetrics, urology, IR, obstetric anesthesiology, nursing, and the patient and her partner, the decision was made to induce labor in the ICU at 34 weeks' gestation, with actual delivery (via assisted second stage) occurring in an operating room. Meanwhile, plans were made for emergent delivery and concomitant nephrectomy and/or embolization if the patient became suddenly unstable due to hemorrhage of her renal mass.

Prior to induction in the ICU, the patient had large bore IV access but refused an arterial line, and a combined spinal epidural was placed. At 6 cm dilation the patient was moved to the OR for assisted delivery. Massive transfusion protocol was activated with arterial line and central line equipment ready. Urology and trauma surgery were prepared for emergent nephrectomy should the patient become unstable. Ultimately, the patient had an uncomplicated forceps-assisted vaginal delivery. Two hours later, she underwent a successful left renal artery embolization, followed by left nephrectomy the next day; pathology revealed the mass to be high grade renal cell carcinoma papillary type 2.

**Discussion:** Renal cell carcinoma (RCC) accounts for only 3% of cancers in the general population and is even more rare in the parturient,<sup>2</sup> but can be complicated by sudden, catastrophic hemorrhage.<sup>3</sup> Although this patient was hemodynamically stable on presentation, she remained very high risk for antepartum complications, and this case illustrates the necessity of early, detailed, multidisciplinary planning for the parturient with a hemorrhagic intrabdominal mass. Important considerations included timing, route, and location of delivery; timing of IR embolization and nephrectomy; and contingencies in the event of sudden hemorrhage and/or hemodynamic instability.

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## **Management of a Parturient Patient for Urgent Cesarean Section with Acute Posterior Encephalopathy Syndrome**

**Presenting Author:** Derek Sundermann, MD

**Presenting Author's Institution:** University of Pennsylvania

**Co-Author:** James Kim, MD

**Abstract :** A 26-year-old parturient patient (G1P0 at 32 weeks' gestation) with a past medical history of gestational hypertension presented to the ED complaining of a two day history of worsening headache associated with recent sudden onset complete vision loss and right arm numbness. Vital signs at the time of arrival to the ED were remarkable for BP 231/125, HR 55, SpO2 99 and RR 14. A stroke alert was called. The CT head without contrast was negative for acute intracranial bleeding, but it did however demonstrate subtle bilateral posterior hypodensities. Subsequent MRI imaging revealed scattered areas of cortical and subcortical signal abnormality favoring the diagnosis of posterior reversible encephalopathy syndrome. The patient was diagnosed with superimposed pre-eclampsia by the consulting OB team, and she was started on magnesium for seizure prophylaxis and hydralazine for blood pressure management. Considering the patient's significant neurologic symptoms along with her new diagnosis of pre-eclampsia, the decision was made to transfer the patient to the OR for emergent cesarean delivery.

Upon arrival to the OR, an arterial line had been inserted for invasive blood pressure monitoring, and an epidural catheter was placed for neuraxial anesthesia. An approximate 20% drop in blood pressure was achieved following the epidural bolus, and this blood pressure was maintained briefly with a phenylephrine drip intraoperatively and administration of two 10mg labetalol pushes in the immediate post-operative period. The surgery was otherwise without complications, and the patient was transferred initially to the PACU for post-op monitoring.

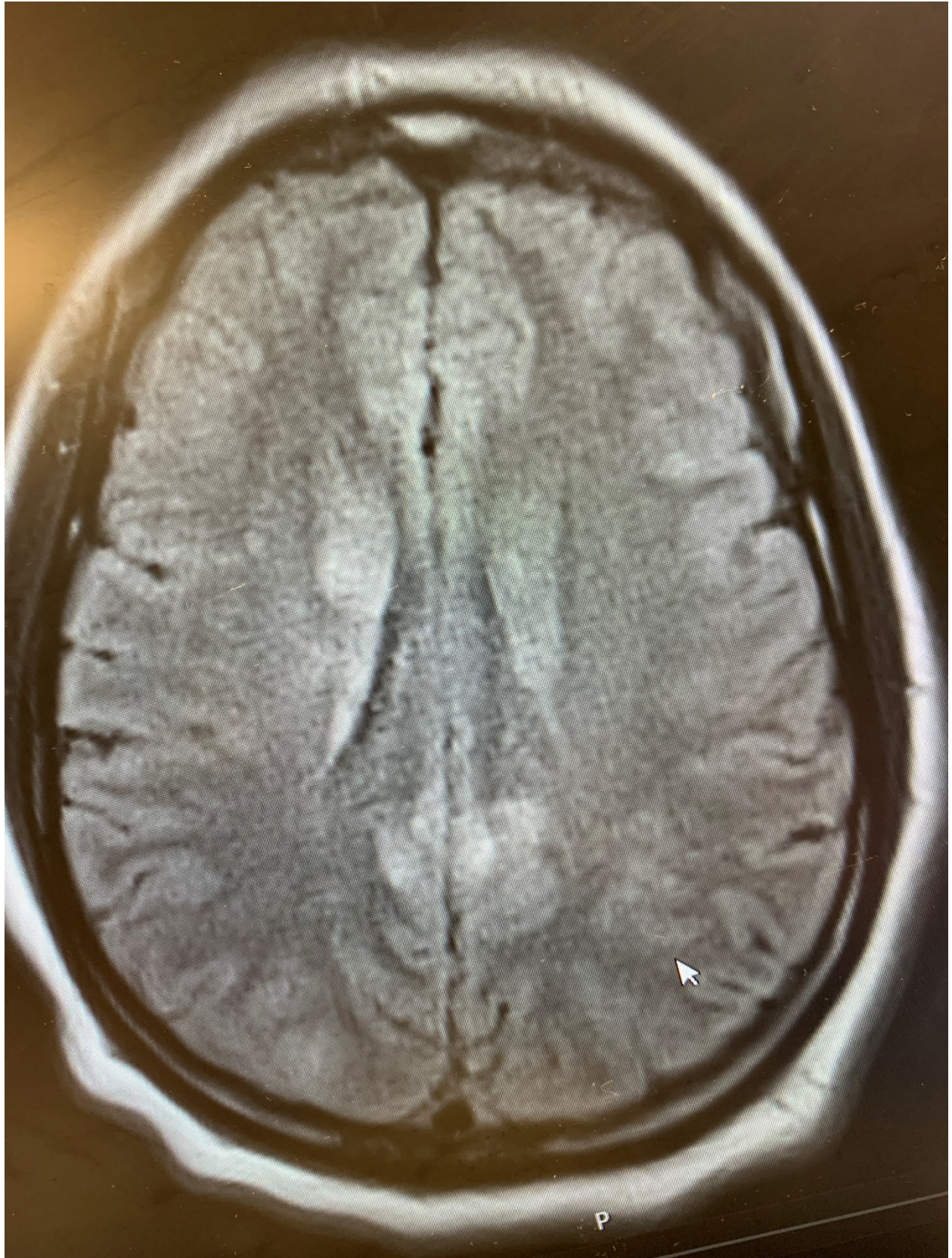
In the PACU, the patient reported that her vision began to improve; however, given her increasingly persistent severe range blood pressures refractory to multiple additional pushes of labetalol, the patient was transferred to the surgical critical care unit for initiation of a nicardipine drip. The patient's vision continued to improve throughout her overnight ICU stay returning to baseline the following morning as the nicardipine drip was weaned off.

This case is representative of the classic presentation of PRES, including headache, sudden onset visual loss, various focal neurologic symptoms (in this case right arm numbness) and supporting radiographic findings. This case also emphasizes the reversible nature of the syndrome given prompt blood pressure control and removal of the underlying etiology, hypothesized here to be delivery of the fetus with subsequent resolution of pre-eclampsia. Furthermore, this case highlights the notable overlap between the diagnoses of severe pre-eclampsia and PRES, which have caused some to suggest that eclampsia represents 'obstetric PRES,' triggering further discussion of the nomenclature's clinical significance.

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**Cardiac sarcoid and acute worsening of heart block in the parturient, a case report.**

**Presenting Author:** Justin Swengel, MD

**Presenting Author's Institution:** University of North Carolina

**Co-Author:** David C. Mayer, MD

**Abstract :** 35 year old G4P1021 at 26 weeks was admitted to the hospital for nonreassuring fetal heart tracing during a nonstress test. Upon further evaluation, the fetus was IUGR and had AEDF. Her medical history included gestational hypertension and 2nd degree AV block. Her rhythm abnormality was first diagnosed in 2015 as 1st degree AV block at rest with occasional segments of Mobitz Type 1. She was asymptomatic so intervention was planned. Re-evaluation in 2020 showed her abnormalities had progressed to occasional instances of Mobitz type 2 and 3rd degree AV block on holter monitor. She was asymptomatic during all instances and could increase her own heart rate so no interventions were planned. While admitted to the hospital she was placed on continuous telemetry and found to intermittently show rhythms of 1st degree AV block, 2nd degree AV block Mobitz type 2, 3rd degree AV block, and NSVT- all at increased frequency. Cardiology suspected that this was cardiac sarcoid, but cardiac MRI with contrast is usually avoided in pregnancy. She was initiated on steroids, with a goal for a permanent pacemaker insertion after delivery. With acute progression of rate and rhythm issues, a transjugular temporary pacemaker was inserted. Without pacing, her underlying rhythm was now found to be 3rd degree heart block.

Two days after the temporary pacer was placed, delivery of the fetus was required due to FHR changes, a new diagnosis of Pre-E with severe features (HTN), and concerns for deteriorating cardiac function. A primary cesarean delivery was planned, 2 large bore peripheral IVs and an arterial line were placed before going to the OR. A CVICU nurse accompanied the patient to the OR to help with manage her temporary pacer. Cardiology was notified of the changes and available for immediate consultation during the case. The pacer was set to a rate of 80 BPM with capture at 3mA. Once in the OR, an epidural was placed and dosed incrementally with 13 ml of 2% lidocaine with bicarbonate and epinephrine. She had a surgical level and tolerated the surgery well. There were no intraoperative or early postpartum complications. A permanent, single-chamber pacemaker was inserted 5 days later without issue. A cardiac MRI was performed which confirmed the diagnosis of cardiac sarcoidosis.

Sarcoidosis during pregnancy is very rare. Cardiac sarcoid is only noted in about 5% of those with sarcoidosis<sup>1</sup>.

Cardiac sarcoid is a rare case of maternal cardiac disease and can confer severe morbidity in the parturient and fetus due to the high risk of arrhythmia, cardiomyopathy, and sudden cardiac death. This case demonstrates the importance of multidisciplinary decision making to ensure appropriate and safe care in the leading causes of maternal mortality in the United States.

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**Pharmacologic management of hemorrhage in a COVID positive parturient with HELLP syndrome and a breech twin vaginal delivery, a case report.**

**Presenting Author:** Justin Swengel, MD

**Presenting Author's Institution:** University of North Carolina

**Co-Author:** Benjamin Cobb, MD

**Abstract :** A 39 year-old GP3003 with dichorionic-diamniotic twins at 38 weeks gestational age with a history significant for gestational hypertension presented to labor and delivery in labor with superimposed preeclampsia (SIPE). Per protocol, she was tested for COVID-19 with real time PCR on admission. Although she denied a history of flu like symptoms, she was found to be COVID-19 positive. Her lab work was also consistent with HELLP syndrome with severe thrombocytopenia (platelets 48K).

After an extensive discussion with the patient and her partner, a decision was made to proceed with expectant management of a vaginal delivery for Baby A and a potential breech extraction for baby B in the operating room (OR). Given her contraindication to neuraxial analgesia in the setting of severe thrombocytopenia, a remifentanil PCA was initiated. At 9cm cervical dilation, she was taken to the OR and baby A was delivered without complication. The breech extraction of baby B required analgesic supplementation with remifentanil PCA, midazolam, fentanyl, and ketamine. After placental delivery, the patient had a postpartum hemorrhage (quantitative blood loss 1250 mL) requiring carboprost x2, tranexamic acid (TXA), platelet transfusion, and Bakri placement.

The rate of adverse reactions to pharmacologic treatment of uterine atony in a COVID-19 parturient is unknown. Carboprost has been shown to increase airway reactivity by constricting smooth muscle via prostaglandin F receptor activation, in severe cases requiring intubation and/or bronchodilators. The risk of bronchospasm from carboprost in COVID-19 patients is unknown, however, given a contraindication to methergine in the setting of SIPE and hemorrhage refractory to manual maneuvers, carboprost was administered. No apparent respiratory complication was observed. Given the severity of PPH in this high risk parturient, TXA was also administered given a demonstrated mortality benefit in the setting of PPH1. However, TXA administration may warrant additional caution in COVID-19 patients given reports of vascular/thrombotic complications2. Pharmacologic treatment of hemorrhage from uterine atony with carboprost and TXA in a COVID-19 patient likely warrants a case-by-case risk benefit analysis pending further research.

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## Grand Multiparous Mother with Phenylketonuria

**Presenting Author:** Anne Wanaselja, MD

**Presenting Author's Institution:** University of Pittsburgh Medical Center, University of Pittsburgh School of Medicine, Pittsburgh, PA

**Co-Author:** Patricia L. Dalby, MD

**Introduction:** Phenylketonuria (PKU) is the most common inborn error of amino acid metabolism. Many women with PKU that have received proper dietary treatment are now living to childbearing age, becoming pregnant, and presenting to labor and delivery suites to give birth.

**Case:** Our patient was a 43-year-old G9P7016 at 39+2 who presented for a 5th repeat c/s due to newly elevated blood pressure for 1 week without headache, chest pain, SOB, RUQ pain or visual changes. Fetal status was reassuring. Pregnancy had been complicated by insulin dependent gestational diabetes, polyhydramnios, and PKU, which had been well controlled this pregnancy with a phenylalanine goal of 2-6 mg/dl. Two prior children had heart defects: one who passed in infancy and one with hypoplastic left heart still living. Vital signs notable for BP 156/92. Physical exam notable for MP 3 airway, gingival hyperplasia, poor dentition, and obesity (BMI 35). Labs wnl. She had been counseled about the risk of placenta accreta and was agreeable to a combined spinal epidural (CSE) and placement of 2 18 gauge IVs. Patient did not desire a tubal ligation despite counseling concerning risk of multiple cesareans. CSE was performed and her c/s proceeded uneventfully. Patient was discharged on the 5th postoperative day to home with normal blood pressures and a healthy infant.

**Discussion:** PKU is due to either a deficiency of phenylalanine hydroxylase (PAH), the enzyme that converts phenylalanine (Phe) to tyrosine (Tyr), or a deficiency of its cofactor, tetrahydrobiopterin (BH4), which is needed for normal enzyme function. PAH deficiency results in elevated blood phenylalanine levels. Early neonatal detection and special diets have been utilized to prevent the severe cognitive disability associated with the untreated disease. However, daily dietary adherence is difficult for many. Pregnant women with PKU who do not adhere to their dietary regimen develop maternal PKU syndrome: microcephaly, cardiac defects, and cognitive impairment in the baby. PKU is inherited in an autosomal recessive fashion. Our patient's partner had never been tested but none of the live children had PKU. She had been compliant with her special diet. Her diet consisted of formula for PKU patients, provided 10-15 grams protein, and was designed to encourage mild weight loss in light of her obesity. Until 2007, early detection and dietary management were the only treatment modalities available for PKU. Since 2007 the low Phe diet and chaperone therapy (sapropterin, a synthetic form of tetrahydrobiopterin (BH4) or low Phe diet and enzyme substitution therapy (pegvaliase) have been developed. Manipulation of the microbiome through a probiotic organism programmed to digest Phe in the gut and the possibility of gene substitution therapy provide hope for PKU patients in the future. See diagram.

**References:** Drugs (2019) 79:495-500 <https://doi.org/10.1007/s40265-019-01079-z>



## Chiari Conundrum: A Case Report and Literature Review

**Presenting Author:** Sarah Kroh, MD

**Presenting Author's Institution:** University of Pittsburgh Medical Center, University of Pittsburgh School of Medicine, Pittsburgh, PA

**Co-Author:** Anne Wanaselja, MD; Michelle Yanik, MD; Jonathan Waters, MD; Ryan Romeo, MD;  
Patricia L. Dalby, MD

**Intro:** A paucity of literature exists concerning labor epidural analgesia (LEA) in Chiari 1 malformations and perineural cysts: only case reports/series and no randomized-control trials. We present a case where LEA was offered to a patient following conflicting consultant opinion, literature review, and shared decision making with the patient.

**Case:** 24 yo G1 w/ history of congenital deafness (Leopard Syndrome) w/ cochlear implant, decompressed Chiari 1 malformation, cervical thoracic syrinx, perineural cysts, dural ectasia, and headaches presented for IOL and requested LEA. Her last MRI was done 7 years ago, she had mild truncal sensory changes, no new onset symptoms, and no bowel or bladder symptoms. Unable to repeat MRI due to cochlear implant. Conflicting consultations obtained: neurology reported no contraindication to LEA and neurosurgery recommended avoidance of LEA. After literature review and discussion with patient, LEA was performed without complication. Ultimately LEA was used for cesarean delivery anesthesia. Her course was complicated by PPH but no neurologic complications at time of discharge or at her follow up visit.

**Discussion:** The most robust literature to support safe LEA includes a case series of 63 deliveries in patients with uncorrected Chiari 1 malformation who had either spinals or epidurals. None of the patients had any neurologic complications [1]. This is supported by several other case reports/series. Only one case report reported an adverse outcome in a patient who had recurrent post-dural puncture headache (PDPH) following LEA and subsequent difficult spinal placement for cesarean. Chiari 1 malformation found incidentally during diagnostic MRI for recurrent headache [2]. Dural ectasia may place the patient at increased risk of PDPH due to scalloping [3]. Case reports have demonstrated unreliable spinal anesthesia with dural ectasia due to increased volume [4]. Perineural cysts have been implicated in failed spinal anesthetics [5], and in one case report in a non-obstetric patient, neuraxial anesthetic may have unmasked a previously asymptomatic cyst [6]. Ultimately, our patient was offered LEA after reviewing the literature and discussing with her the potential for increased risk of PDPH, unmasking previously asymptomatic perineural cyst, and neurosurgery's theoretical concern of herniation that is not supported in literature review.

**Conclusion:** Literature review did not reveal contraindication to neuraxial placement. This case highlights the need for shared decision making with our patients.

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## **Point of care ultrasound used in management on pulmonary edema in the setting of undiagnosed preeclampsia**

**Presenting Author:** Danielle White, MD

**Presenting Author's Institution:** McGovern Medical School

**Co-Author:** Adam Gordon, MD; Sudipta Sen, MD

**Introduction:** Pulmonary edema is categorized as a severe feature of preeclampsia significantly increasing the morbidity and mortality of the disease. Point of care ultrasound(POCUS) has been shown to be useful in the diagnosis of pulmonary edema in a wide range of patient populations. We report a case of POCUS used to diagnose pulmonary edema & preeclampsia & the management following.

**Case:** 26 year old G3P3 at 36+3 weeks gestation with diamniotic dichorionic twin pregnancy with past medical history of chronic hypertension presented to our institution for scheduled cesarean section. The patient was noted to have mild range blood pressure during preoperative assessment. The Preeclampsia panel was negative & urine protein creatinine level noted to be 0.33. Intraoperatively the patient received 12 mg bupivacaine, 10mcg Fentanyl and 0.2mg Morphine intrathecally achieving adequate level of neuraxial anesthesia. Baby A & Baby B were delivered without difficulty. During incisional closure the patient became increasingly dyspneic with concurrent decrease in pulse oximeter to 91%. Supplemental oxygen was administered via facemask. Lung POCUS was performed while awaiting chest X-ray and was notable for B lines consistent with pulmonary edema. Intravenous fluids total was 700 mL. The patient's blood pressure was also noted to be in the severe range and an arterial catheter for closer monitoring and assessment of oxygenation status. At that time the patient was diagnosed with preeclampsia with severe features given severe range blood pressure & pulmonary edema on lung POCUS. Furosemide 25 mg was administered intravenously to improve respiratory status. Intravenous Labetalol & Hydralazine were administered to improve hemodynamics. Intravenous Magnesium was started for neuroprotection. Chest x-ray performed in OR prior to PACU transfer was negative for signs of pulmonary edema. The patient's respiratory status improved and supplemental oxygen was weaned. Post operative blood gas indicated adequate oxygenation with a paO2 of 111.

**Discussion:** The presence of pulmonary edema in preeclampsia is associated with high maternal & perinatal morbidity & mortality. Historically diagnostic criteria has included shortness of breath, tachypnea, hypoxia by pulse oximetry or arterial blood gas & chest x-ray findings consistent with pulmonary edema. POCUS is an efficient diagnostic tool that can be used intraoperatively, decreasing the time to diagnosis & treatment.

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## Anesthetic management of a parturient with Marfan Syndrome and scoliosis for cesarean delivery

**Presenting Author:** Danielle White, MD

**Presenting Author's Institution:** University of Texas Health Science Center at Houston

**Co-Author:** Linden Lee, MD

**Introduction:** Marfan Syndrome is a connective tissue disorder characterized by skeletal and cardiac abnormalities. Tight hemodynamic control is necessary to avoid aortic dissection and spinal anesthesia may be challenging due to possible dural ectasias. Patients with prior spine surgery may also have epidural spaces that are not contiguous, resulting in patchy or incomplete blocks. We report the perioperative management of a patient with Marfan Syndrome and spinal fusion undergoing cesarean delivery with bilateral tubal ligation.

**Case Presentation:** A 31 year old G3P2 with Marfan Syndrome with mild aortic root dilation and scoliosis with cervical and lumbar spinal fusion presented at 37 weeks for scheduled cesarean delivery. A multidisciplinary meeting was held prior to admission with the obstetrics, cardiovascular surgery and anesthesia teams. An arterial line and large bore IV access were obtained and combined spinal epidural was performed without significant difficulty. Intrathecal administration of 0.75% hyperbaric bupivacaine 13.5 mg, 0.2 mg morphine and 10 mcg Fentanyl produced only limited analgesia. 600mg of 2% Lidocaine was bolused through the epidural resulting in a T5 anesthetic level. The patient tolerated the procedure until fascial dissection but was then too uncomfortable to proceed. General anesthesia was induced and hemodynamic stability was maintained throughout the delivery. The remainder of the surgery and hospital course were uneventful.

**Discussion:** Providing adequate anesthetic coverage for cesarean delivery in patients with Marfan Syndrome has been widely documented as being difficult. Dural ectasias may contribute to these difficulties. We attempted spinal anesthesia which unfortunately did not provide adequate anesthesia. An incomplete surgical block occurred after bolusing the epidural catheter possibly due to post-surgical changes from her prior spine surgery.

Patients with Marfan Syndrome are at increased risk of aortic dissection and rupture due to their connective tissue pathology. Although our patient had mild aortic dilation, we placed an arterial catheter for close monitoring throughout the procedure and prepared vasoactive medications to maintain intraoperative hemodynamic stability. The procedure was performed in the institution's Heart & Vascular Institute with a cardiovascular surgeon available for any intraoperative emergencies. This case highlights the anesthetic concerns and challenges of pregnant patients with Marfan syndrome.

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## A Critical Role for Critical Care Obstetric Anesthesiologists

**Presenting Author:** Michael Y. Williams, MD

**Presenting Author's Institution:** Brigham and Women's Hospital

**Co-Author:** Michaela K. Farber, MD, MS

**Introduction:** The incidence of pulmonary embolism (PE) in pregnancy is approximately 0.5 to 3 in every 1,000 parturients, causing up to 11% of all pregnancy related deaths (1, 2). Thrombectomy and cardiopulmonary bypass presents unique challenges for maternal and fetal well-being. Although maternal outcomes are typically favorable, fetal risk is significantly elevated (4). We describe a parturient who successfully underwent pulmonary embolectomy under cardiopulmonary bypass at 30 weeks followed by vaginal delivery at term gestation.

**Case Presentation:** A 34 y/o G1P0 at 30&6 with a history of hypothyroidism presented after two days of dyspnea. CT revealed bilateral, nearly occlusive emboli along the distal branches of the main pulmonary arteries. She also had evidence of right heart strain on CT and TTE. An early, multidisciplinary team meeting was held the evening of presentation including CT and vascular surgery, MFM, and the CCU team whose attending was an obstetric anesthesiologist. It was agreed that the next morning the patient would undergo a thrombectomy while on cardiopulmonary bypass. Continuous fetal monitoring was conducted with the assistance of a scrubbed L&D nurse to manipulate the fetal Doppler. MFM was present throughout the case and a c-section surgical table was set up in the OR. An OB anesthesia fellow was in the OR as a consultant. Pump time was 22 minutes. The mother and fetus tolerated the procedure well and the patient was discharged home on LMWH on POD 6. She was readmitted at 38 weeks for a bridge to heparin drip and during admission underwent an uncomplicated SVD under epidural analgesia. Decision points and challenges are presented in the Table.

**Discussion:** PE remains a significant cause of maternal morbidity and mortality. Management decisions must be nuanced to consider gestational age, acuity, and resources. Obstetric anesthesiologists with critical care expertise can reinforce maternal and fetal considerations from the time of presentation and intervention through the delivery period.

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## **Cesarean delivery in a parturient with repaired Ebstein's anomaly and chronic right ventricular dysfunction**

**Presenting Author:** Michael Wong, MD

**Presenting Author's Institution:** University of Maryland School of Medicine

**Co-Author:** Seung Choi, MD; Shobana Bharadwaj, MBBS; Ashanpreet Grewal, MD

**Abstract :** A 38-year-old G3P2 with diagnosis of COVID-19 pneumonia and chronic right ventricular (RV) dysfunction presented at 38 weeks with worsening dyspnea (NYHA Class III), pedal edema and jugular venous distention. She had Ebstein's anomaly, corrected during adolescence with tricuspid valve (TV) replacement, atrial septal closure, and arrhythmia ablation resulting in a baseline dilated RV with moderate systolic dysfunction and mild prosthetic TV stenosis.

On admission, transthoracic echo showed severe RV dysfunction, inferior vena cava and hepatic venous dilation with flow reversal, coronary sinus drainage into her RV, and a worsened TV mean gradient (13 mmHg). A multidisciplinary team decision was made to optimize her cardio-pulmonary status prior to scheduled cesarean delivery 3 days from admission. Intraoperative contingencies planned: inotropes, vasopressors, pulmonary artery dilators, defibrillator, transesophageal echo, and ECMO team on standby.

A cardiac anesthesiologist experienced in obstetric anesthesiology was a part of the management team. Arterial and central venous catheters were placed prior to rapid sequence induction with etomidate and propofol. Anesthesia was maintained with sevoflurane and propofol infusion, prior to and after fetal delivery, respectively. Intraoperative course was uneventful, with delivery of a healthy neonate. Uterine tone was acceptable with a slow oxytocin infusion. A furosemide bolus was given after hemostasis was achieved. A dobutamine infusion was started after extubation, to maintain cardiac output. The patient was monitored overnight in the ICU and uneventfully discharged home after 4 days.

**Discussion:** Ebstein's anomaly is an uncommon congenital heart defect with TV apical displacement causing heterogeneous features that may not present until adulthood (Table).<sup>1,2</sup> After repair, there can be residual RV dysfunction among other abnormalities. This case shows pregnancy physiology interacting with a repaired Ebstein's anomaly, and highlights individualization of hemodynamic goals.

In our patient, third trimester plasma volume expansion amplified the pressure gradient across a stenotic TV, straining a chronically-overloaded right atrium and risking decompensation of a known dysfunctional RV due to postpartum autotransfusion. Given her abnormal coronary sinus drainage, RV back-pressure would directly impede coronary artery perfusion, with potential for biventricular ischemia. Coronary perfusion depended on adequate systemic vascular resistance, which over-zealous diuresis could impair. Also, avoidance of arrhythmias and tachycardia would facilitate forward flow through the stenotic TV.

With regards to uterotonics, Oxytocin induces systemic hypotension, while methylergonovine and prostaglandin-F<sub>2α</sub> could raise pulmonary vascular resistance in addition to hypoxemia from pneumonia and increase afterload on a dysfunctional RV.

### **References:**

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2. Expert Rev Cardiovasc Ther (2015) 13:1101.



## Elective cesarean delivery in a patient with VACTERL

**Presenting Author:** Michael Wong, MD

**Presenting Author's Institution:** University of Maryland School of Medicine

**Co-Author:** Allison Ulrich, MD; Edwin Villamater, MD; Shobana Bharadwaj, MBBS

**Abstract :** A 28-year-old primigravida was scheduled for elective cesarean delivery at 36 weeks. Past medical history included VACTERL association, with known sacral agenesis and complex congenital heart defects (repaired aortic coarctation, ventricular septal defect, and cleft mitral valve; residual atrial septal defect). Due to extensive scarring from childhood repairs for urogenital abnormalities and bladder exstrophy, vaginal delivery was not advisable, and the location of the reconstructed bladder also required a supraumbilical surgical approach. High-Risk Obstetric Surgery, Cardiology, Urology, and Obstetric Anesthesia services were involved in delivery planning. Prior vertebral imaging was unavailable and her mitral valve clip was not MRI-compatible. Thus ultrasound and x-ray were used to assess her vertebral anatomy, showing marked sacral hypoplasia but grossly normal upper lumbar anatomy (Figure). Third trimester echo revealed good biventricular function, and left-to-right atrial shunt, without pulmonary hypertension. She had excellent exercise tolerance, a normal neurologic exam, and a reassuring airway. Preoperative bloodwork was unremarkable. On the day of surgery, a combined spinal epidural was performed easily, and her epidural was periodically redosed to maintain a T4 sensory level. Cesarean delivery was uneventful, producing a live infant with Apgars of 9. A transversus abdominis plane block was performed for postoperative analgesia. Her hospitalization and subsequent her postpartum follow-up were uncomplicated.

**Discussion:** VACTERL association (vertebral defects, anal atresia, cardiac defects, tracheoesophageal fistula, renal dysplasia, limb abnormalities) is a heterogeneous syndrome of congenital malformations, with an incidence of 1 in 30 000 live births. Cardiac and vertebral anomalies each affect a majority of patients with VACTERL. Previous repairs for urogenital and abdominal wall anomalies may contraindicate vaginal delivery or a Pfannenstiel approach for cesarean delivery. Multidisciplinary consultation and planning are required based on each patient's unique constellation of manifestations.

Hemodynamic goals should be tailored to each patient's specific cardiac defects. For our patient with intracardiac shunt, we sought to avoid paradoxical embolism by using air filters on intravenous lines, as well as a saline loss-of-resistance technique for neuraxial anesthesia since air may enter the circulation via epidural veins. Tethered spinal cord and spina bifida are sometimes seen in VACTERL, so spinal MRI is recommended if possible. Neurologic symptoms should be queried and deficits documented. Cesarean delivery may be prolonged due to surgical complexity, so single-shot spinal may provide inadequate duration of anesthesia. Some patients may have significant scoliosis resulting in difficult airway and pulmonary insufficiency.

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## Labor Analgesia Management for a Patient with Gluteal Implant Migration

**Presenting Author:** Stephanie K. Woodward, MD

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**Co-Author:** Helen E. Pappas, MD

**Introduction:** Gluteoplasty with silicone implants or injections is an increasingly popular cosmetic operation. Silicone implants or injections can migrate or rupture, a complication most commonly seen after breast augmentation, although there are case reports of this occurring in the buttock.<sup>1,2</sup> Anesthetic management of a parturient with superiorly migrated silicone buttock implants over the level of the lumbar spine has not previously been described in the literature.

**Case:** A 38-year-old female G1P0 at 40w0d gestation with a history of gluteoplasty with silicone implants presented to labor and delivery with spontaneous rupture of membranes desiring epidural analgesia. Her gluteoplasty was performed 10 years prior in Venezuela and was complicated by implant migration during this pregnancy. An anesthesia consult had been obtained at 37 weeks gestation, after which a formal ultrasound revealed "subcutaneous shadowing foci at the level of L4/L5, which likely represent the silicone injections, extending across the entire back beginning in the midline approximately 1 cm superior to the level of the iliac crest and extending inferiorly into the gluteal regions bilaterally." A thorough risk and benefit discussion at the time of consult allowed the patient time to consider options prior to labor. When she presented in labor, palpation of back was notable for multiple midline, irregularly-shaped and spaced nodules without overlying discoloration or erythema. Decision was made to proceed with epidural placed by an experienced provider in an attempt to avoid introduction of silicone into the CSF. Bedside ultrasound was used by anesthesia providers to locate an interspinous space more cephalad to L4/L5, however this proved to be difficult given the echogenic dropout below the area of the silicone. Epidural was easily placed at L2/L3 on first attempt. The patient had an uneventful delivery with a well-functioning epidural. No complications were noted during her hospitalization or subsequent follow up appointments.

**Discussion:** Gluteoplasty with silicone implants or injections is becoming increasingly popular. It is thought a high percentage of gluteal implants rupture or migrate.<sup>2</sup> Anesthesia providers should be aware that silicone implants may migrate over the lumbar spine. Theoretically, if the dura was punctured, there is a risk of introduction of silicone into the CSF, which could provoke an inflammatory response and potentially cause arachnoiditis. However, silicone is frequently used as a material for CSF shunts, so proceeding with an epidural/combined spinal epidural for labor or a spinal in the setting of cesarean delivery is likely a safe option. Ultrasound could be a useful modality for determining the extent of the silicone spread in patients with buttock implants.

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## A Case of Atrial Fibrillation Requiring Synchronized Cardioversion on Labor and Delivery

**Presenting Author:** Lakshmi A. Nemani, MD

**Presenting Author's Institution:** Northwestern University Feinberg School of Medicine

**Co-Author:** Stephanie K. Woodward, MD; Matthew G. Hire, MD

**Introduction:** Atrial fibrillation (AF) is a commonly diagnosed arrhythmia among the general population but is rare in the parturient, with an estimated incidence of only 0.3%<sup>1</sup>. Hyperthyroidism, structural heart disease, and administration of tocolytics are known risk factors for AF in pregnancy, however increasing maternal and gestational age may also be associated.<sup>1,2</sup> Electrical cardioversion is indicated when chemical cardioversion has failed, or as first line treatment in hemodynamically unstable patients.<sup>3</sup>

**Case:** A 40-year-old female G2P1001 at 37w5d gestation with gestational diabetes presented for a scheduled cesarean delivery for complete placenta previa. A standard single shot spinal was used for anesthesia. The patient had a normal sinus rhythm (NSR), with a heart rate (HR) between 74-115 beats per minute (BPM), with occasional premature ventricular contractions, for 57 minutes. After delivery, oxytocin 300milli-units/min was initiated for 35 minutes, after which, the patient had a sinus arrhythmia with a heart rate of 110-120 BPM. The rate of oxytocin was decreased to 60milli-units/min and the patient was given a fluid bolus. Loss of p-waves was then noted. The patient's blood pressure (BP) was supported with a phenylephrine infusion at 25-50mcg/min and intermittent boluses, weaned off 10 min prior to surgery completion. Estimated blood loss was 1250mL. On arrival to the post-anesthesia care unit, the patient was tachycardic with an irregular rhythm but otherwise hemodynamically stable; labs and an EKG were ordered. The patient then became acutely hypotensive with a heart rate of 130 BPM. EKG showed AF with rapid ventricular response. Bedside echo was normal, without evidence of right ventricular enlargement or left atrial appendage clot. The patient was cardioverted with 125J after midazolam sedation. Post cardioversion, the patient had a normal HR, NSR, and normal BP. Cardiology was consulted and she was transferred to a telemetry unit for 36 hours. A formal transthoracic echocardiogram on POD1 was noted to be normal. The patient had no further arrhythmias and was discharged on hospital day 4.

**Discussion:** It is uncommon for women without underlying heart disease to develop peri-partum AF.<sup>1,2</sup> However, the physiologic changes of pregnancy, labor, and delivery may make women more susceptible to this tachyarrhythmia and subsequent hemodynamic compromise, affecting both maternal and fetal well-being.<sup>2,3</sup> While use of certain pharmacologic agents may be limited during pregnancy and breast-feeding, treatment strategies include rate control, chemical cardioversion, electrical cardioversion, and in some cases anticoagulation. Synchronized cardioversion is the treatment of choice for hemodynamically unstable AF.<sup>3</sup>

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## Management of Acute Type-B Aortic Dissection in a Pregnant Woman with Marfan Syndrome and Worsening Pre-eclampsia—A Case Report

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**Co-Author:** Davin Singh, MD

**Background:** Acute aortic dissection is a rare but potentially lethal complication of pregnancy for women with Marfan syndrome and their fetuses with an estimated incidence of 3%.<sup>1</sup> While the majority of these are Stanford type-A aortic dissections, Stanford type-B aortic dissections (TBAD) present a significant mortality risk to these patients. Conservative medical treatment focusing on strict blood pressure control is the current standard of care for uncomplicated TBAD in this population; however, delivery timing and planning remains institution dependent, and care for these patients requires complex multidisciplinary coordination throughout the peripartum period.<sup>2</sup>

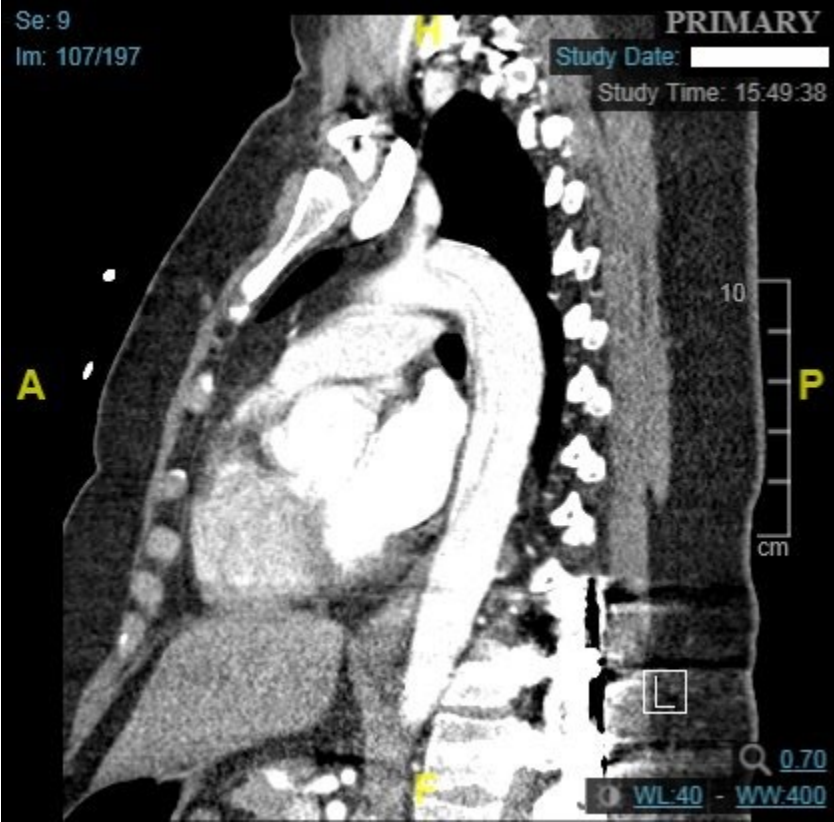
**Case:** 27-year-old multigravid woman with Marfan syndrome presented at 28 weeks gestation with acute TBAD extending from the left subclavian artery into the bilateral common iliac arteries. Initial blood pressure was 138/83. Hemodynamic stability was achieved with prompt anti-impulse therapy and continued in the ICU with labetalol infusion and opioid analgesia. Subsequently, she was transitioned to oral medications but developed refractory hypertension despite requiring 5 oral antihypertensives. A new finding of proteinuria, onset of headache and mild recurrent chest pain in the setting of continued elevated blood pressures above 130/90 brought on the concern for preeclampsia with severe features. For fear of further maternal decompensation from dissection extension, aortic rupture or eclampsia, cesarean delivery was planned at 30+2 weeks gestation by the MFM team with vascular and cardiac surgery on standby. A right radial arterial line was placed preoperatively for close hemodynamic monitoring. Neuraxial anesthesia was attempted but unsuccessful due to the patient's prior T10-pelvis spinal fusion. General anesthesia was then induced successfully with the addition of esmolol and fentanyl for sympathetic blockade. A baby girl was delivered, and no intraoperative complications occurred. Transesophageal echo was used to confirm absence of retrograde dissection during delivery. The patient was extubated at the end of surgery without any significant hemodynamic changes. During the postpartum period, there was no evidence of refractory hypertension and aortic imaging remained unchanged. The patient was discharged on postoperative day 7.

**Conclusion:** Pregnancy associated increases in cardiac output and hypervolemia can potentially exacerbate TBAD. Achieving blood pressure control in the setting of pre-eclampsia remains challenging and needs to be balanced with the risk of continued gestation. Excellent peri-cesarean hemodynamic management is paramount to the mother's survival.

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## The unrecognized burden of "Persons under Investigation" on obstetric anesthesia services during the COVID-19 pandemic

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**Introduction:** The COVID-19 pandemic has impacted medical care across all specialties. However care to delivering mothers has continued uninterrupted, although not unchanged. Labor by necessity involves close unplanned contact with healthcare providers. While COVID-19 positive deliveries garner most of the attention, the obstetric patient under investigation (PUI) is treated no differently(1). PUI cases present an unacknowledged burden to obstetric anesthesiologists. Considerations include the change in anesthetic approach to care for an unwell mother and the additional time needed to safely don and doff personal protective equipment. We sought to quantify the impact of PUI care on our practice.

**Methods:** Following REB approval, health records of women with PUI deliveries and COVID-19 pregnancies were reviewed. PUI deliveries were examined from March to July 2020. COVID-19 confirmed pregnancies were examined from March to November 2020. For both we recorded demographics, symptoms, co-morbidities, mode of delivery and anesthetic management.

**Results:** 137 PUI records were analysed (see table A). 111 women delivered while PUI with 55% having an anesthetic intervention during this time. Cesarean section accounted for 65% of these interventions. Epidural top-up was the anesthetic provided to 80% of cesarean sections performed under PUI precautions. No general anesthesia was administered while PUI. Fever was the reason for PUI designation in 86%. 76% of PUI designations occurred either afterhours or at the weekend. 23 pregnancies were infected with COVID-19. 21 were antenatal. The median gestational age at diagnosis was 34 weeks [IQR 20-31]. 5 were considered COVID-19 positive intrapartum with 1 patient diagnosed intrapartum. The most common symptoms if known were cough (35%), fever (26%) and sore throat (22%). 1 patient with sickle cell disease presented with a crisis requiring exchange transfusion therapy. Another patient with familial neutropenia developed disseminated intravascular coagulation. Of those patients with intrapartum COVID-19, 4 delivered vaginally (3 with epidural anesthesia) and 1 delivered by cesarean under spinal anesthetic.

**Discussion:** With 23 COVID-19 positive pregnancies, our institution fortunately did not experience a significant COVID-19 caseload, although we did not test universally. Most of those affected had mild symptoms, however two women with chronic diseases did experience complications. In our analysis, women with PUI status represented 6% of the laboring population, 55% of these had an anesthetic intervention. Most of the delivering women became PUI afterhours or at the weekend. Care provided to delivering mothers is unique in many respects: it cannot be deferred until COVID-19 status is known; and conditions in labor may mimic COVID-19. PUI care represents the unseen burden of the COVID-19 pandemic to the obstetric anesthesiologist.

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## Obstetric Outcomes of SARS-Cov-2 Positive Parturients with Labor Analgesia

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**Co-Author:** Rovnat Babazade, MD; Kristine S. Lane, n/a; Lakshmi Ram, MD; James Lane; Shobana Murugan, MD

**Introduction:** Severe acute respiratory coronavirus 2 (SARS-Cov-2) is the most recent and major global public health crisis [1]. Limited data exists for obstetric maternal outcomes impacted with COVID-19 at delivery [2]. This study is to examine obstetric outcomes on SARS-Cov-2 parturients requiring labor analgesia.

**Materials and Methods:** With approval of IRB (IRB# 20-0278), we conducted a retrospective review of COVID+ parturients on admission who had labor analgesia from March 2020 through September 2020. Data was collected from electronic health records with maternal age range 16-45. We defined severe COVID symptoms as either: a fever of over 100°F, requiring oxygen support, or ICU admission. Emergent c-sections were defined as presentation at the hospital without prior plan for cesarean delivery.

**Results:** Displayed in Table 1 are the patient demographics and characteristics separated into 2 categories: symptomatic and asymptomatic. Among the 69 patients that met the inclusion criteria, the age range was 16-43 with an average maternal age of 27.43. Of the 69 patients 26 were symptomatic with cough being the most prevalent symptom (46%). Symptomatic patients had a lower average gestational age (37.1 vs 37.9 weeks) and higher BMI (34.8 vs 33.9) than asymptomatic patients. Symptomatic patients were more likely to have an ASA score of 3 (58.3% vs 30.2%), had a longer admission length (2.7 vs 2.6) with an ICU admission 11.5% of the time and requiring oxygen support 15.4% of the time. In addition, symptomatic patients were more likely to require C-section delivery (57.7% vs 46.5%) than asymptomatic. Emergent c-sections in symptomatic patients accounted for 19.2% of deliveries vs 9.3% for asymptomatic. 50% of symptomatic patients experienced severe COVID symptoms, with 4 requiring oxygen support, and 3 requiring ICU admission.

**Discussion:** In our large, single-institution cohort study, SARS-CoV-2 infection during pregnancy the symptomatic group had a higher incidence of emergency cesarean sections and a higher rate of admission to ICU after delivery. Also, our analysis showed a significantly higher number of symptomatic (15.4%) and asymptomatic (7%) mothers delivered under 34 weeks' gestation compared to the 2019 national average of 2.77% [3].

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Table 1 Patient Demographics and Characteristics		Symptomatic	Asymptomatic
Patient Sample Size		26	43
Gestational Age	Mean	37.1	37.9
	Standard Deviation	2.7	2.4
	Lowest Value	30	27
	Highest Value	40	40
	< 30 (%)	0%	2%
	30-34 (%)	15.4%	7.0%
	35-37 (%)	26.9%	16.3%
Mothers BMI	> 38 (%)	57.7%	74.4%
	Mean	34.8	33.9
	SD	9.5	7.5
	Lowest	27	20
Blood Loss (mL)	Highest	75.5	61.4
	Mean	528.8	540.7
	SD	225.8	339.5
	Lowest	200	100
ASA score	Highest	1000	2000
	Mean	2.4	2.3
	SD	0.7	0.5
	Percentage of 2s	41.7%	69.8%
Parity	Percentage of 3s	58.3%	30.2%
	Primiparous (%)	19.2%	27.9%
Admission Length	Multiparous (%)	80.8%	72.1%
	Mean	2.7	2.6
	SD	2.8	1.3
	Lowest	0.0	0.0
Higher Level of Care	Highest	12.0	7.0
	Intensive Care Submission (%)	11.5%	0.0%
Delivery	Requiring Oxygen Support (%)	15.4%	0.0%
	Vaginal Delivery (%)	44.0%	53.5%
	C-section Delivery (%)	57.7%	46.5%
Maternal Symptoms	Emergent C-section (%)	19.2%	9.3%
	Fever Present (%)	42.3%	0.0%
	Myalgia Present (%)	19.2%	0.0%
	Malaise Present (%)	19.2%	0.0%
	Chills Present (%)	15.4%	0.0%
	Cough Present (%)	46.2%	0.0%
	Headache Present (%)	7.7%	0.0%
	Shortness of Breath Present (%)	26.9%	0.0%
	Runny Nose Present (%)	3.8%	0.0%
	Sore Throat Present (%)	11.5%	0.0%
	Diarrhea Present (%)	7.7%	0.0%
	Chest Pain Present (%)	11.5%	0.0%



## **Anaesthetic considerations and outcomes in 90 pregnant women with coronavirus disease 2019: a prospective observational study**

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**Co-Author:** Jessica Lee, MBBS FRCA; Ania Dean, MBBS FRCA; Emma Bryson, MBBS BSc; Charlotte Smith, MBChB; Nat Nguyen-Lu, BMedSci, BM BS, FRCA

**Introduction:** The coronavirus disease 2019 (SARS-CoV2) global pandemic has devastated the UK with deaths totalling >112,000.<sup>1</sup> We aim to describe the risk factors, disease severity and anaesthetic input in a case series of COVID-19 positive pregnant women presenting to our inner London tertiary hospital.

**Method:** After trust approval was obtained, we conducted a single-centre, prospective observational study covering both waves of the pandemic from March 2020 to January 2021. We included all pregnant women with a positive polymerase chain reaction swab result for COVID-19. Data collected included demographics, co-morbidities, disease presentation and severity, anaesthetic input with maternal outcomes.

**Results:** Ninety women (1.6% total deliveries) were included. The average age was  $32.3 \pm 5.4$  years, body mass index  $28.0 \pm 6.2$  kg/m<sup>2</sup>, 69% were from a Black, Asian and Minority Ethnic (BAME) ethnicity, 21.1% women had diabetes mellitus and 4.4% hypertension. The average gestation was  $30 \pm 7$  weeks. 46.7% presented to labour ward with COVID-19 symptoms, 25.5% of patients were asymptomatic. 63.3% of women did not require any respiratory support, but 14.4% women needed critical care. Eight (9%) were inter-hospital transfers for extra corporeal membrane oxygenation (ECMO). At the time of writing, 76 women (84%) had delivered (44.7% by spontaneous vaginal delivery and 44.7% by caesarean section) with 2 intrauterine deaths. Of the 51 women (56.6%) who had an anaesthetic, 35.3% of women had an epidural (70.5% inserted at 4cm or less and 55.5% topped up for use in theatre), 35.3% had a spinal anaesthetic and 9.8% had a combined spinal and epidural. Three (3.3%) women had a general anaesthetic (GA).

**Discussion:** This study identifies that BAME background, high BMI, diabetes and the third trimester are risk factors for COVID-19. Severity of disease was greater in our cohort than demonstrated by the recent UK Obstetric Surveillance System (UKOSS) data with 14.4% vs. 5% requiring critical care and 8.9% requiring ECMO (UKOSS < 1% of symptomatic patients) explained by the nature of our tertiary referral institution with ECMO provision.<sup>2</sup> Early epidural insertion minimised respiratory complications and may explain our low GA rate.<sup>3</sup> Essential early escalation of respiratory support and a cohesive multidisciplinary approach led to the successful delivery of our COVID-19 positive women.

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## **SARS-CoV-2 Infection Does not Affect the Incidence and Severity of Preeclampsia with Severe Features: A prospective observational study of 106 pregnant patients**

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**Presenting Author's Institution:** Beth Israel Deaconess Medical Center

**Co-Author:** John J. Kowalczyk, M.D.; Meredith Colella, MD; Erin J. Ciampa, MD, PhD; Justin Stiles, MD; Philip E. Hess, MD

**Introduction:** Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) pandemic has presented many diagnostic challenges and uncertainties in pregnant women. The majority of reports have focused on maternal outcomes and fetal transmission. Recent studies suggested an association between COVID-19 and preeclampsia (1,2). Little is known whether the pathologic changes during active COVID-19 predispose women to preeclampsia.

**Methods:** This prospective observational study analyzed clinical data from 43 pregnant women with COVID-19, compared to a pregnant cohort (Control, n=63) who presented with COVID-related symptom(s), but subsequently were found to be negative SARS-CoV-2 PCR test. All cases presented between March 15, 2020 and June 30, 2020. Incidences of preeclampsia with severe features (sPEC) and obstetric outcomes were compared between the two groups.

**Results:** 77% of COVID-19 patients were symptomatic at admission; 28% required supplemental oxygen and 11.6% were admitted to ICU. Women with COVID-19 were more likely to experience fever, cough and tachypnea (Table 1), were more likely to require oxygen and ICU admission. The incidences of sPEC, thrombocytopenia, abnormal liver function tests and lymphocytopenia were not significantly different than the cohort group. Transaminitis was present without elevation in blood pressure in 17.6% of COVID-19 patients and 0 in the Control. Cesarean delivery was more common in the Control than the COVID-19 patients, but other adverse obstetric outcomes (premature birth and postpartum hemorrhage) were similar. Neuraxial labor analgesia and neuraxial anesthesia for cesarean delivery were predominately utilized in both groups. There was no maternal or neonatal mortality.

**Discussion:** Although systemic inflammation and endothelial dysfunction are hallmarks of both COVID-19 and preeclampsia, we did not find that SARS-CoV-2 Infection affected the incidence or severity of preeclampsia with severe features. Overlapping laboratory abnormalities (transaminitis and lymphocytopenia) in COVID-19 and preeclampsia can present a diagnostic dilemma (3). Careful differential diagnosis is imperative to avoid iatrogenic preterm delivery. In Control group, the incidence of cesarean delivery was higher than in COVID-19 patients, reflecting more nulliparous women in the control group. Multicenter, cohort studies are needed to better elucidate the role of SARS-Cov-2 infection during pregnancy, and any association with sPEC.

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- Mendoza M et al. BJOG 2020 Jun 1



## Excess maternal deaths associated with coronavirus disease 19 (COVID-19) in Mexico during 2020

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**Presenting Author's Institution:** Brigham and Women's Hospital

**Co-Author:** Kara G. Fields, MS; Michaela K. Farber, MD, MS

**Introduction:** Pregnant women infected with severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) have a higher risk of mortality and severe morbidity<sup>1</sup>. Using data from the Mexican Ministry of Health (MMH), we previously reported the excess of maternal deaths during the first 32 weeks of 2020 compared to previous years (2011-2019)<sup>2</sup>. Including all the data for 2020 (53 epidemiological weeks), we aimed to determine the number of excess deaths from all causes that could be directly or indirectly attributed to coronavirus disease 19 (COVID-19).

**Methods:** Weekly maternal death counts for 2020 were compared with documented trends from prior years to determine whether mortality was higher than expected. Namely, Farrington surveillance algorithms<sup>3</sup> based on Poisson generalized linear models with overdispersion were used to estimate the upper bound (i.e., upper limit of the 95% prediction interval) for the predicted number of deaths per week of 2020. This was based on weekly death counts from 2011, when the MMH epidemiologic reports first became available, through 2019. The number of excess deaths was estimated as the difference between the observed count and the predicted upper bound by week. The total number of excess deaths reflected a summation of the number of excess deaths between the 1st and 53rd week of 2020.

**Results:** With 934 deaths, the maternal mortality ratio for Mexico in 2020 was 46.6 per 100,000 live births. COVID-19 was the leading cause of maternal mortality (202 deaths). Importantly, respiratory causes represented 31% (286/934) of the total of maternal deaths, a significant contrast with the 5% observed from 2011-2019. The weekly number of excess maternal deaths from all causes for 2020 are presented in the figure. Overall, there were 140 excess maternal deaths reported from all causes in 2020.

**Discussion:** There was higher mortality among pregnant women in Mexico during the COVID-19 pandemic in 2020. Accessibility to preventative treatment including vaccines in low- and middle-income countries is of paramount importance to limit maternal mortality associated with COVID-19. The limitation of our study is that MMH data are provisional and our analysis of excess deaths is limited to evaluation of death from all causes.

### References:

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## Differences Between Neonatal Outcomes in Symptomatic and Asymptomatic COVID-19 Positive Patients

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**Presenting Author's Institution:** UTMB School of Medicine

**Co-Author:** Shobana Murugan, MD; Dania Hussein, n/a; James Lane, n/a; Alexandria Lehrmann, n/a; Rovnat Babazade, MD

**Introduction:** COVID-19 potential to cause severe systemic effects and pregnant mothers are particularly susceptible to severe respiratory infections, thromboembolic complications, and endothelial cell dysfunction (1). Concerning vertical transmission, there is limited evidence that in utero infection is a significant risk factor (2). Current isolation protocols have altered maternal and fetal interactions, adding a plastic barrier during skin-to-skin to reduce the risk of physical transmission to the newborn after delivery. Our primary outcome in this study was to examine preterm deliveries and NICU admissions in babies born to COVID positive women.

**Material and Methods:** We conducted a retrospective review of patients who were COVID positive upon admission for delivery. This project has been approved by the IRB (IRB# 20-0278). We identified patients aged 16-45 years and admitted for delivery between 3/1/2020 and 9/31/2020. For emergent delivery, we included any patient who had complications, ex. non-progressing labor, fetal malpresentation, preeclampsia, comorbidities, and required either an induction of labor or cesarean section (CS).

**Results:** Table 1.1 shows the demographics and outcomes collected in our patient population broken down into two categories, symptomatic and asymptomatic COVID positive mothers. The table compares maternal characteristics with the neonatal outcomes. In total, 59 patients met the criteria and were COVID positive on admission, with 18 symptomatic patients. One patient who was an asymptomatic G10P6 female who presented at 27 weeks with intrauterine fetal demise and was excluded from further review.

**Discussion:** Comparing the symptomatic and asymptomatic patients, it was seen that the symptomatic mothers had a higher percentage of CS deliveries with an increase in emergent circumstances during delivery. This increase in the prevalence of emergent CS with symptomatic infection could be caused by the reduced oxygenation and endothelial cell dysfunction. This potential for poor oxygenation could also contribute to the difference in neonatal outcomes recorded. Compared to the asymptomatic mothers, the neonates with symptomatic mothers were more likely to need respiratory support (27.8% compared to 19.5%) and go to the NICU (50% compared to 43.9%).

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Table 1.1 Patient Demographics and Characteristics		Symptomatic	Asymptomatic
Patient Sample Size		18	41
Gestational Age	Mean	37.3	38.2
	Standard Deviation	2.7	1.5
	Lowest Value	30	33
	Highest Value	40	40
	< 30 (%)	0%	0%
	30-34 (%)	16.7%	4.9%
	35-37 (%)	22.2%	19.5%
	> 38 (%)	61.1%	75.6%
Mothers BMI	Mean	35.3	33.6
	SD	11.0	7.3
	Lowest	27	20
	Highest	76	61
Apgar 1	Mean	8.1	8.0
	SD	0.6	0.6
	Lowest	7	6
	Highest	9	9
	1-3 (%)	0.0%	0.0%
	4-7 (%)	11.1%	12.2%
	>7 (%)	88.9%	87.8%
Apgar 5	Mean	8.9	8.9
	SD	0.3	0.3
	Lowest	8	8
	Highest	9	9
	1-3 (%)	0%	0%
	4-7 (%)	0%	0%
	>7 (%)	100%	100%
Birth Weight (grams)	Mean	2955.6	3208.4
	SD	810.7	417.9
	Lowest	1050	2210
	Highest	3710	4410
Neonatal Outcomes	Meconium Present (%)	0.0%	0.0%
	Had Respiratory Support (%)	27.8%	19.5%
	Went to NICU (%)	50.0%	43.9%
	Intracranial or Subgaleal Hemorrhage (%)	0.0%	2.4%
	Birth Trauma (%)	0.0%	0.0%
Delivery	Seizures (%)	0.0%	0.0%
	Vaginal Delivery (%)	44.4%	56.1%
	C-section delivery (%)	55.6%	43.9%
Maternal Symptoms	Emergent Circumstances (%)	44.4%	34.1%
	Fever Present (%)	44.4%	0.0%
	Myalgia Present (%)	22.2%	0.0%
	Malaise Present (%)	22.2%	0.0%
	Chills Present (%)	16.7%	0.0%
	Cough Present (%)	44.4%	0.0%
	Headache Present (%)	5.6%	0.0%
	Shortness of Breath Present (%)	27.8%	0.0%
	Runny Nose Present (%)	5.6%	0.0%
	Sore Throat Present (%)	16.7%	0.0%
	Diarrhea Present (%)	0.0%	0.0%
	Chest Pain Present (%)	5.6%	0.0%



## Virtual compared to in-person obstetric anesthesiology trainee education during the COVID-19 pandemic

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**Co-Author:** Gillian Abir, MBChB, FCARCSI, FRCA;; Brendan Carvalho, MBBCh, FRCA, MDCH; Aidan Spring, MD

**Introduction:** The COVID-19 pandemic brought many changes to medical training, including in-person education platforms being disbanded and replaced with virtual education. (1,2) At our institution, dedicated obstetric anesthesiology teaching for residents and fellows occurs daily, and is highly valued and rated. In March 2020 due to the COVID-19 pandemic, we changed the teaching platform from in-person to virtual teaching (via video communication). We subsequently surveyed residents, fellows and attendings to determine the impact of virtual compared with in-person teaching.

**Methods:** To differentiate between those who have and have not experienced in-person didactic teaching in obstetric anesthesiology, an electronic survey was sent to 10 anesthesiology residents on their 2nd obstetric anesthesiology rotation, and 10 residents on their 1st rotation, respectively. The electronic survey was also sent to 3 fellows and 8 obstetric anesthesiology attendings. The survey questions are outlined in Table 1. Answers were based on a 5-point Likert scale (1 = strongly disagree, 5 = strongly agree). The survey response rate was 80% for both resident groups, and 100% for the fellow and attending groups.

**Results:** The results for 1st rotation residents were higher in all domains compared with 2nd rotation residents and fellows, where 'quality' achieved statistical significance ( $p=0.009$ ) between 1st and 2nd rotation residents (Table 1). The lower results for virtual teaching for the 2nd rotation residents are most likely explained by their prior experience of in-person teaching that is quoted by residents as being 'exceptional teaching', 'one of the most educationally valuable rotations' and 'the daily protected teaching should be a model for all other rotations'. 'Engagement' was overall the most impacted domain for trainees. Attendings did not feel that virtual teaching impacted their ability to provide adequate education, however learner engagement was again the lowest rated domain, and teachers strongly favored resuming in-person teaching.

**Discussion:** In-person, compared to virtual teaching was overall preferred by both learners and teachers. Engagement was particularly impacted with virtual teaching, however overall evaluations were reasonable, suggesting that virtual teaching is an appropriate alternative when in-person teaching is not possible. Future initiatives are needed to improve engagement and better facilitate virtual teaching of technical skills, for example point-of-care ultrasound with demonstrations.

### References:

- 1) Br J Anaesth. 2020;125:e432-434
- 2) Br J Hosp Med (Lond). 2020;81:1-4



## Anesthesia for cesarean delivery in Africa: a review of publications (2010-2021)

**Presenting Author:** Anjan Saha

**Presenting Author's Institution:** University of Michigan

**Co-Author:** Ruthi Landau, MD

**Background:** A recent systematic review and bibliometric analysis identified a hierarchy for the research output on anesthesia and critical care medicine in Africa, with a total of 886 articles published between 1946 and 2020.[1] Malawi, Sierra Leone, and Togo had the highest number of articles per physician anesthesia provider (PAP), and most studies had an observational study design. Data on anesthesia practice and outcomes after cesarean delivery (CD) in Africa remains scarce, even though one third of all surgical procedure are CDs,[2] and maternal mortality is associated with peripartum hemorrhage and complications from anesthesia.[3] We decided to conduct a literature search to identify clinical trials reporting on anesthesia practice for CD in Africa and compile all relevant findings here.

**Methods:** A PubMed search for publications between 2010 and 2021 using the terms “Africa”, “cesarean”, “caesarean”, “anesthesia”, “anaesthesia”, “clinical trial”, “South Africa”, “Malawi”, “Sierra Leone”, “Togo”, “Nigeria”, “Uganda” was conducted. All citations were screened for relevance and confirmed to report on CD conducted in African hospitals. Systematic reviews, review articles, editorials, case-reports were not included, nor were reports on maternal mortality or CD without description of anesthesia.

**Results:** We identified 34 articles (randomized control trials (RCT), retrospective or prospective trials; Table). The country with the largest publication volume was Nigeria (N=13; PAP density 0.53; MMR 917) followed by South Africa (N=10; PAP density 16.18; MMR 119), Uganda (N=6; PAP density 0.18; MMR 375), Sierra Leone (N=2; PAP density 0.03; MMR 1120), Zimbabwe (N=1; PAP density 0.83; MMR 458), Kenya (N=1; PAP density 0.44; MMR 342), and Eritrea (N=1; PAP density 0.00; MMR 480). There were 20 RCTs, of which 1 enrolled women undergoing urgent general anesthesia. Overall, there were 12 studies on preventing/predicting/managing spinal-induced hypotension, 6 on post-cesarean analgesia (2 with spinal morphine, 1 comparing spinal morphine vs TAP block, 1 with spinal pethidine, 1 with IV ketamine, 1 with spinal fentanyl), 4 on spinal shivering, 2 on maternal satisfaction, and 1 on PONV. Spinal anesthesia was mostly performed with pencil-point needles, although in studies indicating needle type, 6 used cutting-edge needles. In 9 studies, spinal dose consisted of only bupivacaine with no adjuvant.

**Conclusion:** We identified 34 articles reporting on clinical trials assessing various approaches for anesthesia for CD, a majority of which evaluated vasopressors for spinal hypotension management and fewer on post-cesarean pain strategies. Additional academic inquiry into anesthetic practices in the setting of CD in Africa are needed to gain a deeper understanding of actionable drivers optimizing obstetric anesthesia practice and outcomes in low resource settings.

### References:

- BMC Anesthesiol 2020,20(1):247
- Lancet 2018, 391(10130):1589-98
- Lancet Glob Health 2019,7(4):e513-e522



## Can epidural labor analgesia reduce the cesarean section rate?

**Presenting Author:** Karunakaran Ramaswamy, FRCA, MBA

**Presenting Author's Institution:** Sidra Medicine

**Co-Author:** Zofia Kotyra, FRCA MBA; Nicolas Hooker, FRCA; Sam Soltanifar, FRCA; Duraiswamy Muthuswamy, FRCA; Monzer Sadek, MD, FANZCA

**Introduction:** It has been generally disproved that epidural labor analgesia (ELA) increases the risk of cesarean section, however, the association between ELA and mode of delivery remains contentious. We reviewed data from our institution to analyze the association between ELA and different modes of delivery in a recently opened tertiary care Women's and Children's hospital.

**Methods:** We retrospectively analyzed anonymized data extracted from the electronic patient records from 2365 consecutive women who attempted labor at our institution. We divided women into those who chose to have ELA (ELA group) and those who chose other methods (non-ELA group) and compared rates of spontaneous vaginal delivery (SVD), instrumental delivery (ID), and Cesarean Delivery (CD) between groups using the chi-square test. Our sample size calculation was based on institutional data on CD which was 30%. To power our analysis, we assumed a 10% reduction in CD in the ELA group would be a clinically significant difference. A minimum sample size of 784 patients was calculated (382 per group) with an alpha error of 0.05, and a power of 90%. The primary outcome was a reduction in CD.

ELA was provided 24/7 by senior consultants only. The standard practice of initiation of ELA is with divided doses of a mixture of levobupivacaine 0.1% and fentanyl 2 micrograms/ml (LDM), and maintenance using LDM programmed intermittent epidural boluses (PIEB) 7 ml hourly mandatory bolus and 6 ml PCEA bolus with a twenty-minute lockout. A physician obstetrician (fellowship) is the primary decision-maker.

**Results:** 1174 (49.64%) women chose to have ELA. There was no significant difference in demographics, parity, birth weight, or medical conditions. We found a lower CD rate in the ELA group vs non-ELA group (18.14% vs 39.7% ) and a higher ID rate (18.22% vs 4.1%). A chi-square test to assess the statistical significance of these variables was significant,  $\chi^2 (1, N=2365) = 206.9734, p < 0.00001$ .

**Discussion:** Our results show that the use of ELA during labor is associated with reduced CD rates at the expense of increased assisted vaginal delivery (ID). This has significant implications. CD is a more complex procedure compared to ID, has increased morbidity, and implications on future pregnancies<sup>6</sup> prolongs hospital stay and is more expensive. Reducing CD is an internationally accepted goal and will also save bed days which can potentially be used for other patients.

Although the reasons for these findings are likely to be multifactorial, we speculate that the presence of effective ELA may have facilitated the obstetrician to choose and successfully achieve instrumental delivery in some cases thereby avoiding CD. Further work to confirm this finding in other institutions and prospective evaluations would be useful.

**References:** Capogna G, et al; The effects on maternal motor function and labor outcome. *Anesth Analg* 2011;113(4):826-31



## Time of greatest decisional conflict about labor analgesia in pregnancy: a survey study

**Presenting Author:** Arthur Chyan, DO

**Presenting Author's Institution:** Brigham and Women's Hospital

**Co-Author:** Michaela K. Farber, MD, MS; Kara G. Fields, MS; Naida Cole, MD; ;

**Introduction:** Choice of labor analgesia is a highly personalized, value-based decision-making process. Many parturients learn about their labor analgesia options from nonmedical sources, which may be inaccurate or misleading. An antepartum anesthesia consultation may decrease uncertainty and distress, supporting a more informed decision about labor analgesia. However, the ideal timing for this is unclear. The aim of this survey-based study is to identify the gestational age (GA) of maximal decisional conflict about labor analgesia.

**Methods:** Antepartum patients were contacted to complete a voluntary, anonymous survey from November 2020 to the present. Demographic information, GA, sources of information about labor analgesia, labor analgesia plans, and decisional conflict (using the Decisional Conflict Scale [DCS]) were collected. The DCS results in a score ranging from 0 to 100 points, with 100 representing the highest decisional conflict. Based on a within-group standard deviation in DCS of 13.4, 176 responses per GA group will allow for an 80% power at a Bonferroni-corrected 2-sided alpha of 0.0083 to detect a 5-point difference in mean DCS scores between GA group pairs using 2-sample t-tests. The plan is for 706 total responses representing 4 GA groups: 12-18, 19-25, 26-31, and 32-38 weeks. A preliminary multivariable linear regression analysis for relationships between decisional conflict and self-reported demographic information, information sources about labor analgesia, and labor analgesia plans was performed.

**Results:** To date, 394 of 704 surveys have been completed, with 389 included for preliminary analysis of 2 groups: 12-25 weeks GA (n= 200) and 26-38 weeks GA (n= 189). The response rate is 45.3%. Respondents in the 12-25 week group had a higher mean DCS score (43.4 vs. 37.2; difference in means 6.2; 95% CI 3.8, 8.5). Across all GAs, there was no significant difference in decisional conflict based on age, level of education, marital status, or race (Table). The most common information source about labor analgesia was family and/or friends, but it was not associated with lower decisional conflict. In contrast, the least common source was nurses, midwives and/or doctors; respondents who consulted these medical professionals had the lowest DCS score. 61.5% expressed a preference for a labor epidural; this group had a lower DCS score than those who preferred other medicated options or were undecided.

**Conclusion:** Our preliminary findings suggest decisional conflict is highest at earlier GAs among parturients who have not consulted a medical professional or who are undecided or planning non-epidural medication for labor analgesia. Targeted counseling of patients by an anesthesiologist at an early GA may support informed decision-making and reduced decisional conflict about labor analgesia.

### References:

- O'Connor AM. Med Dec Making 1995; 15(1): 25-30.
- Raynes-Greenow CH, et al. BMC Pregnancy and Childbirth 2010, 10:15.



## **A systematic review of patient-reported outcome measures used to assess global outpatient postpartum recovery using COSMIN guidelines**

**Presenting Author:** Perman Pandal, MD

**Presenting Author's Institution:** Stanford University School of Medicine

**Co-Author:** Nadir Sharawi, MD; Brendan Carvalho, MD; Deirdre Lyell, MD; Nishant Sadana, MD

**Objective:** The aim of this systematic review was to evaluate patient-reported outcome measures of global outpatient postpartum recovery using Consensus based Standards for the selection of health Measurement Instruments (COSMIN) guidelines.<sup>1,2</sup>

**Data Sources:** Initial literature search performed in July 2019 to identify measures and validation studies. Secondary search in July 2020 to identify further validation studies. Both searches performed using 4 databases (Web of Science, Embase PubMed and CINAHL) with no date limiters.

Methods of study selection: Studies were included if they evaluated any psychometric property as defined by the COSMIN guidelines in a postpartum cohort of women. Psychometric properties assessed included: content validity, structural validity, internal consistency, cross cultural validity / measurement invariance, reliability, measurement error, hypothesis testing and responsiveness.

**Study appraisal and synthesis methods:** The Psychometric properties were assessed in each included study using the COSMIN criteria by assessing: 1) methodological quality (very good, adequate, doubtful, inadequate or not assessed); 2) overall rating of results as: sufficient (+), insufficient (-), inconsistent (+/-) or indeterminate (?); 3) level of evidence assessed using the GRADE assessment tool; 4) level of recommendation either: A (adequate content validity with at least low quality evidence for sufficient internal consistency), B (not A or C) or C (not recommended).

**Results:** 15 patient-reported outcome measures (7 obstetric-specific measures and 8 non-obstetric specific measures) were used to evaluate outpatient global recovery health in 46 studies that involved 19,165 patients. Most studies were graded as very low or low level of evidence. The best performing measures that received recommendation level A were the Maternal concerns questionnaire (MCQ), Postpartum Quality of Life tool (PQoL) and World Health Organization Quality of Life BREF (WHOQOL-BREF). Remaining measures currently have insufficient evidence to make recommendations regarding their use (class B recommendation).

**Conclusion:** The best performing measures of outpatient global postpartum recovery are the MCQ, PQoL and WHOQOL-BREF, however these tools have shortcomings. This study demonstrates the need to further validate these tools or develop and validate a new instrument that can comprehensively evaluate all recovery domains.

**References:** 1. Mokkink L, Prinsen C, Patrick D, et al. COSMIN methodology for systematic reviews of Patient-Reported Outcome Measures (PROMs) user manual [Internet]. Amsterdam: 2018. Available from: [https://cosmin.nl/wp-content/uploads/COSMIN-syst-review-for-PROMs-manual\\_version-1\\_feb-2018.pdf](https://cosmin.nl/wp-content/uploads/COSMIN-syst-review-for-PROMs-manual_version-1_feb-2018.pdf)  
2. Sharawi N et al. Anaesthesia [Internet] 2019;74(11):1439-55.



## **The Influence of a Kybele Teaching Program on the Use of Regional Anesthesia for Labor and Cesarean Delivery, During COVID-19 Pandemic, in Tuzla, Bosnia and Herzegovina**

**Presenting Author:** Ivan Velickovic, MD., FASA

**Presenting Author's Institution:** SUNY Downstate Medical Center

**Co-Author:** Nada Pejic, MD; Senida Keser, M.D., Prim.; Dobrica Simic, M.D., Prim.; Igor Hudic, M.D. Doc.; Jasmina Smajic, M.D., Prof.

**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 during 2020.

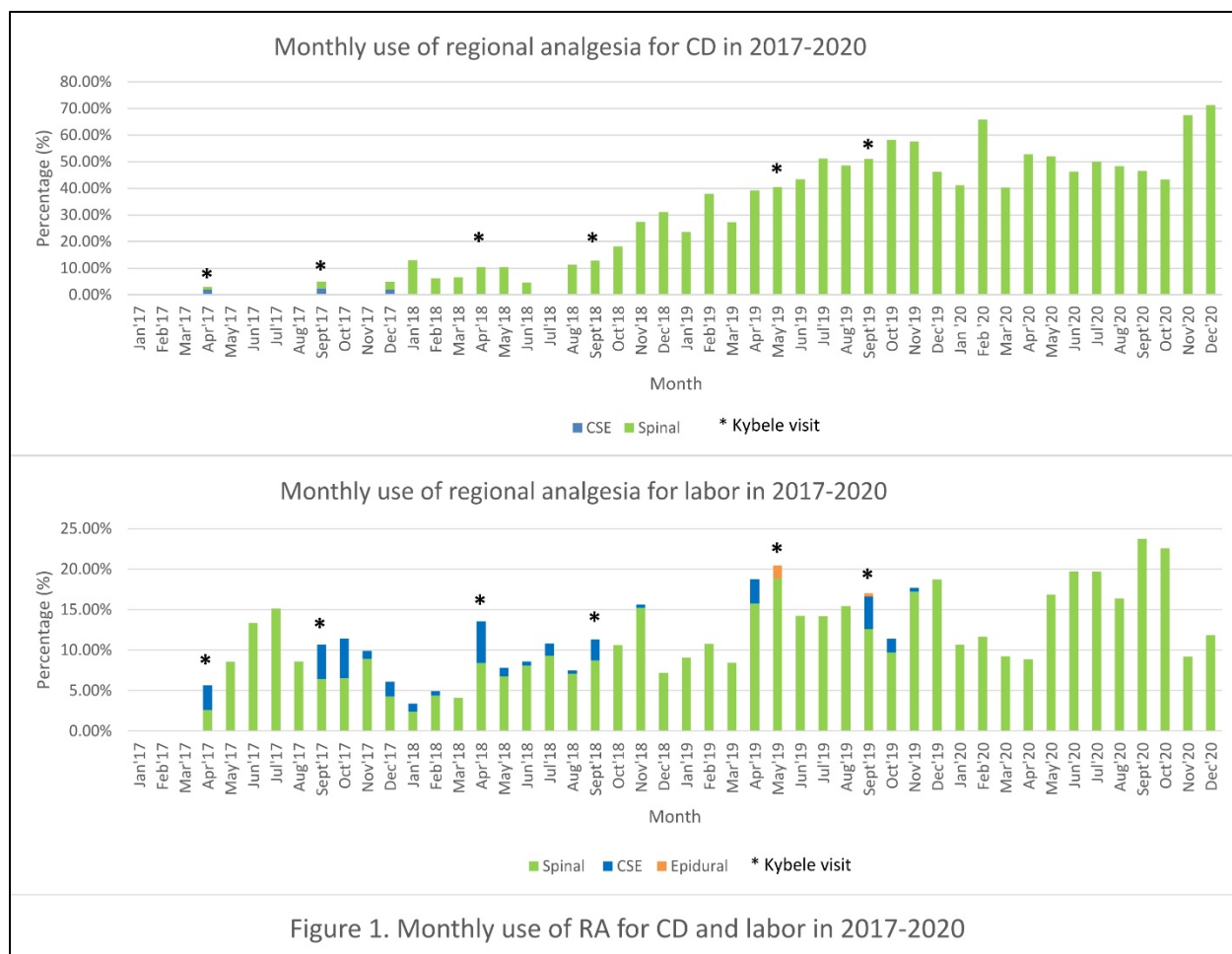
**Method:** During 2020, two planned visits by a Kybele team were canceled. Obstetric anesthesia team in Tuzla was given task to provide all medical and critical care of COVID positive pregnant patients in addition to their regular work at Department of Obstetrics and Gynecology. A phone consultations with a local team were done several times each month. The data were retrospectively collected on the use of RA for CD and on the use of RA for labor for the period of January 1st, 2020 to December 31st, 2020. Chi-Square test was used for comparison with 2019 data. Data was also collected on number of COVID positive patients with type of delivery and anesthesia technique used.

**Results:** The monthly and annual use of RA for labor and CD is shown in the Figure 1. Comparing 2020 with 2019 there was an increase in percentage of patient that received RA for CD (51.6% vs. 44.2%,  $p < 0.001$ ) and slight increase in RA for labor (15.4% vs. 14.4%,  $p = 0.34$ ). Out of 25 COVID positive patients, 23 had CD, all under RA and 2 delivered vaginally.

**Discussion:** This data show increase in usage of RA techniques even without Kybele visits. During the last two months of 2020 percentage of patients that got labor analgesia went down (Figure 1.) and percentage of patients that had RA for CS went up. At the same time local anesthesiologist took care of majority (15/25) of their COVID positive patients. Local team communicated with us that RA for CD was strongly encouraged in COVID positive patients in order to decrease the risk of transmission to anesthesia and OR team. Without our presents local team was reluctant to perform CSE and labor epidurals.

**Conclusion:** Regional anesthesia usage at UCCT improved during 2020. Staff at UCCT performed only spinal anesthesia so further visits are necessary to continue training in CSE and epidural anesthesia. Increase in RA for CD during the COVID epidemic needs to be sustained in the following months.





Abstract # FRI\_RP1 - 2-International - 06

## Obstetric anesthesia practice and outcomes in low and middle-income countries: a review of publications

**Presenting Author:** Anjan Saha

**Presenting Author's Institution:** University of Michigan

**Co-Author:** Lindsay Rosenthal; Hana Murphy; Kathryn Flaharty; Bela Parekh; Ruthi Landau, MD



**Background:** Research output on obstetric anesthesia from low and middle-income countries is largely unexplored. This is particularly relevant since maternal mortality after cesarean delivery (CD) is 50 times higher in Africa compared to high-income countries and is driven by peripartum hemorrhage and anesthesia complications.[1] The World Federation for the Societies of Anesthesiology (WFSA) has recommended a minimum physician anesthesia provider (PAP) density of 5 to ensure safe patient care, and a PAP density of 4 has been suggested to correlate with the median maternal mortality ratio (MMR) of 60 worldwide.[2] We assessed articles related to obstetric anesthesia in Africa and Southeast Asia and Eastern Mediterranean (SEA/EM) and examined the relationship between PAPs and publication volume.

**Methods:** Using the WFSA data for PAP density in Africa (known for 37 countries) and SEA/EM (24 countries), we assessed articles related to obstetric anesthesia. PubMed search terms included “obstetric anesthesia/anesthesiology”, “perioperative outcomes”, “anesthesiology/anesthesia”, “maternal mortality”, and “cesarean section/delivery”. We performed a correlation analysis between PAPs (number of anesthesiologists) and publications. Next, based on PAP density, the top 5 and bottom 5 countries within each region were identified (N=20 countries), and relevant publications were collated.

**Results:** In both Africa and SEA/EM, the number of PAPs correlated with publication volume (Fig). Narrowing to the 20 selected countries, the number of publications related to obstetric anesthesia or even CD is relatively low (Table). The country with the largest number of publications is South Africa, which also has the highest PAP density (16.18) and number of anesthesiologists (N=8,814), but not the lowest MMR (119). The country with the lowest number of publications is Mauritius, despite having a PAP density of 4.32 (but only 55 anesthesiologists) and an MMR of 61.

**Conclusion:** Physician anesthesia workforce capacity as reported by the WFSA is a relatively good predictor for publication volume on maternal mortality, CD, and obstetric anesthesia, but we identified several countries with few publications reporting on obstetric anesthesia practice. While this may certainly be driven by a scarcity in obstetric anesthesia providers, it may also be a reflection of cultural preferences regarding maternal health reporting. With a global health emphasis, identifying factors that drive data reporting related to obstetric anesthesia outcomes could guide funding opportunities and initiatives designed to improve obstetric anesthesia practices, maternal health and pregnancy outcomes.

#### **References:**

- Lancet Glob Health 2019, 7(4):e513-e522
- BMJ Glob Health 2018, 3(6):e001005

**Abstract # FRI\_RP1 - 2-International - 07**

### **A systematic review of patient-reported outcome measures used to assess sleep in postpartum women using COSMIN guidelines**

**Presenting Author:** Perman Pandal, MD

**Presenting Author's Institution:** Stanford University School of Medicine

**Co-Author:** Fiona Barwick, MD; Makoto Kawai, MD; Deirdre Lyell, MD; Brendan Carvalho, MD



**Study Objectives:** We aimed to identify the best patient-reported outcome measure of sleep in postpartum women through a systematic review of the literature using Consensus Based Standards for the Selection of Health Measurement Instruments (COSMIN) guidelines.<sup>1</sup>

**Methods:** We searched 4 databases for validated measures that have been used to assess postpartum sleep. Studies were considered if they evaluated at least 1 psychometric measurement properties of instruments. An overall rating was assigned for each psychometric property of each instrument based upon COSMIN analysis. The GRADE approach was used to assess the level of evidence and recommendations were made regarding each measure.

**Results:** We identified 15 validation studies of 8 instruments, in 9,070 postpartum women. An adequate number of sleep domains was assessed by 5 measures: Bergen Insomnia Scale (BIS), Pittsburgh Sleep Quality Index (PSQI), General Sleep Disturbance Scale (GSDS), Athens Insomnia Scale (AIS) and the Sleep Symptom Checklist (SSC). BIS and GSDS were the only instruments to demonstrate adequate content validity and at least a low level of evidence of sufficient internal consistency, resulting in a Class A recommendation. The BIS was the only measure achieving Class A recommendation, is easily accessible and free to use for non-commercial research.

**Conclusion:** The BIS is the best currently available measure of sleep in postpartum women. However, this patient-reported outcome measure fails to assess several important domains such as sleep duration, daytime sleepiness and need for medication. Future studies should focus on evaluating the psychometric properties of BIS, or to develop a more specific measure of sleep in the postpartum population.

**References:** 1. Mokkink L, Prinsen C, Patrick D, et al. COSMIN Methodology for Systematic Reviews of Patient-Reported Outcome Measures (PROMs) User Manual. 2018. [https://cosmin.nl/wp-content/uploads/COSMIN-syst-review-for-PROMs-manual\\_version-1\\_feb-2018.pdf](https://cosmin.nl/wp-content/uploads/COSMIN-syst-review-for-PROMs-manual_version-1_feb-2018.pdf) Accessed 18th January, 2021.

**Table; Summary of findings table**

Patient-reported outcome measures	Content validity # domains	Structural validity			Internal consistency			Cross-cultural validity/ measurement invariance			Reliability			Measurement Error			Hypothesis testing			Responsiveness			Recommendation
		Methods	Results	LoE	Methods	Results	LoE	Methods	Results	LoE	Methods	Results	LoE	Methods	Results	LoE	Methods	Results	LoE	Methods	Results	LoE	
BIS	6	NA	+	NA	Very good	+	Low	NA	+	NA	NA	+	NA	NA	+	NA	Very good	+	Low	Very good	+	Very low	A
Pittsburgh SQI	7	NA	+	NA	Very good	+	Low	NA	+	NA	NA	+	NA	NA	+	NA	Very good	+	Low	NA	+	NA	B
GSDS	6	NA	+	NA	Very good	+	Low	NA	+	NA	NA	+	NA	NA	+	NA	Very good	+	Low	NA	+	NA	A
PSQI	5	Very good	+	Low	Very good	+	Low	NA	+	NA	Very good	+	Low	NA	+	NA	Very good	+	Low	NA	+	NA	C
ISI	5	NA	+	NA	NA	+	NA	NA	+	NA	NA	+	NA	NA	+	NA	Very good	+	Low	NA	+	NA	C
ESS	7	NA	+	NA	Very good	+	Low	NA	+	NA	NA	+	NA	NA	+	NA	Very good	+	Low	NA	+	NA	C
Athens IS	6	NA	+	NA	NA	+	NA	NA	+	NA	NA	+	NA	NA	+	NA	Very good	+	Very low	NA	+	NA	B
Sleep 36	9	NA	+	NA	NA	+	NA	NA	+	NA	NA	+	NA	NA	+	NA	Very good	+	Low	NA	+	NA	B

BIS=Bergen insomnia scale; Pittsburgh SQI=Pittsburgh Sleep Quality Index; GSDS=General Sleep Disturbance Scale; PSQS=Postpartum Sleep Quality Scale; ISI=Insomnia Severity Index; ESS=Epworth Sleep Scale; Athens IS= Athens Insomnia Scale; SSC=Sleep Symptom Checklist; PSQI=Postpartum Sleep Quality Index

Methodology reported as either: 'very good,' 'adequate,' 'doubtful,' 'inadequate' or 'not applicable'

Ratings for overall quality reported as either: sufficient (+), insufficient (-), inconsistent (±), indeterminate (?)

LoE=Level of evidence using GRADE reported as: "High," "Moderate," "Low" or "Very low"

Recommendation: (A) evidence for sufficient content validity (≥6 domains assessed) and at least low-quality evidence for sufficient internal consistency (measures can be recommended for use); (B) measures categorized not in A or C; (C) high quality evidence for an insufficient measurement property; Measures with a class B recommendation require further evaluation to assess quality if these measures prior to recommendation for use; Measures with a class C recommendation are not recommended for use.



**Abstract # FRI\_RP1 - 3-Hemoglobin, Hemorrhage and Transfusion - 01**

**Effect of Oral Iron Therapy on Hemoglobin Levels prior to Delivery in Pregnant Inpatients with Anemia**

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**Co-Author:** Britany L. Raymond, MD; Robert E. Freundlich, MD, MS, MSCI; David McIlroy, MB.BS., MD, MClInEpi, FANZCA; Xiaoke Feng, MS; Jeanette Bauchat, MD MS

**Introduction:** In North America, prevalence of anemia during pregnancy ranges from 17-31%.<sup>1</sup> Anemia is most commonly caused by iron deficiency in pregnancy and is associated with adverse maternal and neonatal outcomes.<sup>1</sup> The current standard of care for iron deficiency anemia is oral iron replacement, but a delayed response and uncertain compliance may limit its effectiveness.<sup>1</sup> Pregnant women hospitalized for medical indications prior to delivery, with co-incident anemia, represent a cohort in whom oral iron intake can be monitored and its clinical effectiveness measured. We hypothesized that the change in hemoglobin ( $\Delta$ Hb) from admission to delivery in hospitalized pregnant women with anemia would be greater among those treated with oral iron therapy compared to those who were not treated with oral iron therapy.

**Methods:** We conducted a retrospective analysis of all pregnant women admitted for  $\geq 3$  days to a single academic medical center from 2018-2020, meeting criteria for anemia in pregnancy (Hb  $< 11.0$  g/dL at 28 weeks' gestation or Hb  $< 10.5$  g/dL at  $< 28$  weeks' gestation), and who delivered during the same admission. The primary outcome was  $\Delta$ Hb, measured from admission to the last Hb measurement available within 24 hours prior to delivery. The time interval from admission to delivery and dose of administered iron were recorded. Results were compared between women receiving at least one dose of oral iron (not including multivitamins) and women receiving no specific iron supplementation. Statistical significance was assessed by the Wilcoxon and Pearson chi-squared tests.

**Results:** The study cohort comprised 70 women with mean baseline Hb  $10.01 \pm 0.75$  g/dL and with a mean duration of hospitalization prior to delivery of  $13.9 \pm 13.1$  days. Basic characteristics of women were matched with no significant differences between groups in admission diagnoses or comorbidities. At least one dose of oral iron was administered to 29 (41%) of the cohort. Compared to women who did not receive iron, women administered 1 dose of oral iron had a lower baseline Hb concentration and a longer duration of admission prior to delivery. There was no difference in Hb from admission to delivery within either subgroup, nor did  $\Delta$ Hb differ between women treated with an oral iron regimen compared to those without iron ( $0.362 \pm 1.120$  g/dL versus  $-0.052 \pm 1.144$  g/dL;  $p = 0.14$ ). [Table 1].

**Discussion:** The change in Hb concentration from admission to delivery did not differ in anemic inpatient pregnant women who received oral iron therapy compared to women who did not receive oral iron therapy. This analysis can



inform future studies which should evaluate the effectiveness of alternate methods for iron replacement in inpatient pregnant women.

**References:**

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## Retrospective Review of Peripartum Blood Transfusion Practices

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**Co-Author:** John J. Kowalczyk, M.D.; Yunping Li, M.D.; Philip E. Hess, MD

**Introduction:** Postpartum hemorrhage (PPH) is a leading cause of maternal morbidity and mortality worldwide (1), and the incidence has trended up in several developed nations, including the US. Rates of transfusion have also increased; however, transfusion is not without significant risk. Women who received blood transfusions account for greater than 50% of severe maternal morbidity in the US (2). We investigated peripartum blood transfusion to assess the incidences of avoidable transfusions and of transfusion complications.

**Methods:** A multidisciplinary team reviewed peripartum transfusions occurring at our tertiary referral center from Jan 2017 to Dec 2019. We evaluated each transfusion based on the 1) decision to transfuse and 2) the management of transfusion (i.e. units administered). A priori transfusion criteria were created to screen transfusion events as appropriate or requiring further evaluation (Fig 1). Cases requiring further evaluation underwent chart review and classification as avoidable or unavoidable by two physicians from obstetric anesthesia, obstetrics, or transfusion medicine. In the event of a tie, a third individual served as the tie breaker.

**Results:** A total of 14,540 deliveries occurred in the 36-month study period of which 294 patients received transfusions. 221 (75.2%) of transfusions were considered appropriate based on predefined criteria. Of the remaining transfusions, 28 (9.5%) were deemed avoidable due to decision (Hct >21% or Hct >24% without symptoms) and 45 (15.3%) were avoidable due to management process (post-transfusion Hct > 28% in non-acute setting and > 33% in acute setting). This accounted for a total of 66 units of pRBC. The majority of avoidable transfusion occurred on the postpartum floors, 61.6% (compared to 38.4% on labor and delivery unit). We identified 11 (4%) complications from transfusions (including febrile non-hemolytic, febrile hemolytic, allergic reaction, TACO, and new antibody development). Six of 11 (55.5%) complications occurred from avoidable transfusions.

**Discussion:** We investigated the incidence of avoidable transfusions and overall complication rates. Results revealed a predominance of avoidable transfusions occurred in management (i.e. number of units given), occurred postpartum and contributed to 55.5% of transfusion reactions. Given the fact that each unit of product carries risk, this practice may be significantly reduced by implementing "one unit at a time" approach with monitoring for symptom resolution (in stable, non-bleeding patients), as proposed by the American Association of Blood Banks (3). We plan to develop multidisciplinary postpartum transfusion guidelines and evaluate whether this can lead to a meaningful reduction in transfusions.

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## Identification of Factors that Lower the Accuracy of Quantitative Blood Loss During Cesarean Delivery: Pre-Delivery Fluid and Omission of Gravimetry

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**Background:** Quantitative blood loss (QBL) at the time of delivery is a nationally recommended standard of care for the early detection of postpartum hemorrhage (PPH).<sup>1</sup> QBL can trigger PPH management for the prevention of postpartum anemia, so it is clinically important to assess and optimize the accuracy of QBL devices. Our institution's QBL cesarean delivery (CD) device combines colorimetric analysis of surgical sponges, densitometry scanning of suction canisters, and gravimetry (weight) of under-buttocks pads (Triton QBL, Gauss Surgical, Los Altos California). The primary aim of the study was to compare magnitude of difference between QBL and hematocrit-based calculated blood loss (cBL) in patients undergoing scheduled or unscheduled CD, with or without use of gravimetry. Our hypothesis was that the magnitude of difference between QBL and cBL will be greater in cases of unscheduled vs. scheduled CD cases due to pre-delivery intravenous (IV) fluid administration, and also if gravimetry is neglected vs. utilized.

**Methods:** CD cases at our institution in January and February 2020 were identified. Total QBL, gravimetry-derived QBL (a subset of total QBL), pre- and post-delivery hematocrit (Hct), maternal height and weight, and pre-, intra-, and post-operative IV fluid volumes were recorded. The cBL was determined with a previously described pregnancy-specific formula.<sup>2</sup> Delta blood loss (dBL [cBL-QBL]) was calculated. Cases with no QBL, blood transfusion, missing variables, or negative cBL were excluded. dBL was compared between 4 scenarios using analysis of variance (ANOVA) followed by pairwise 2-sample t-tests: unscheduled (laboring) CD using gravimetry; unscheduled CD without gravimetry; scheduled CD using gravimetry; scheduled CD without gravimetry.

**Results:** 218 CD cases were evaluated. Mean QBL was  $498.5 \pm 307.7$  mL compared to mean cBL of  $970 \pm 538$  mL and dBL was  $471.5 \pm 520.4$  mL ( $P < 0.001$ ). Preoperative IV fluid administration was greater for unscheduled vs. scheduled cases ( $1708.5$  mL [ $296, 3118.5$ ] vs  $0.0$  mL [ $0.0, 283$ ],  $P < 0.001$ ). The smallest dBL was in scheduled cases with gravimetry ( $292.3 \pm 468.3$  mL), and the largest dBL was in unscheduled cases without gravimetry ( $696.3 \pm 535.9$  mL),  $P < 0.001$  (Figure).

**Conclusion:** Accurate QBL may enhance PPH detection. In this retrospective cohort analysis using cBL as a reference, difference between QBL and cBL was smallest for scheduled CD and with inclusion of gravimetric measurement. QBL underestimation in laboring patients may be attributed to higher pre-delivery IV fluid administration and may warrant adjusted calibration of the QBL device. In addition, inclusion of gravimetry for QBL should be reinforced.

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## TOP MOM: Treatment and Optimisation of Iron Deficiency Anemia in Peripartum Women

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**Introduction:** Gestational anemia, defined by hemoglobin levels lower than 110g/L, occurs in 14% of pregnant women and increases in frequency with each trimester.[1] Iron deficiency is the most common cause of gestational anemia[2] and is linked with adverse neonatal and obstetric outcomes, such as low birth weight, prematurity and post-partum depression[3]. To avoid such complications, it is crucial to diagnose and optimize treatment for anemia during pregnancy.

**Objectives:** The primary aim of this study was to determine the incidence of anemia and the effectiveness of treatment in our obstetric population. Our secondary aim was to describe treatment modalities used and to compare maternal, obstetrical, and neonatal outcomes according to hemoglobin values at childbirth.

**Methods:** In this retrospective study, we included patients with hemoglobin values less than 110 g/L at 28 weeks of pregnancy and who gave birth between May 1, 2017, and November 1, 2018 (n = 2525). We excluded patients with a diagnosed coagulation disorder, hemoglobinopathy, allergy to oral or intravenous iron, or a B12 and/or folate deficiency. Demographic data, risk factors for anemia, hemoglobin values before and after delivery, iron treatments, cofounding factors (comorbidities, socioeconomic status, smoking, diet), maternal, obstetrical and fetal outcomes were also collected. We used chi-square, Fischer's exact and Wilcoxon rank sum tests in our statistical analysis and a p-value of < 0.05 was considered statistically significant. This study was approved by our institutional Research and Ethics Board.

**Results:** From our study population (n=2525), 479 patients (19.0%) presented as anemic at 28 weeks of pregnancy. Treatment was initiated in 309 patients and 296 with oral iron, 2 with IV iron and 11 with both oral and IV iron. At childbirth, 129 patients remained anemic, including 77 that received treatment. Of the patients that received treatment, 229 had resolution of anemia at childbirth (see Figure 1). Women with persistent anemia at childbirth showed lower gestational age, lower rates of breastfeeding, higher likelihood of transfusions and higher rates of elective caesarean delivery.

**Conclusion:** The management and follow-up of anemic pregnant patients could be improved to optimize their hemoglobin levels before childbirth. This study helped to develop an algorithm to screen and treat iron deficiency anemia during pregnancy at our institution.

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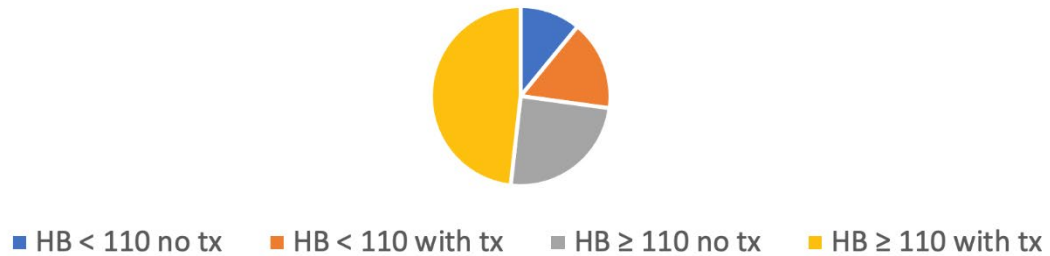
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Figure 1. Hemoglobin values at childbirth in the anemic population at our institution with and without treatment





**Use of labor neuraxial analgesia and reduced risk of blood transfusion among women who delivered vaginally in the United States, 2017-2018.**

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**Background:** Postpartum hemorrhage (PPH) is the leading cause of preventable severe maternal morbidity and maternal mortality nationwide, and disproportionately affects racial/ethnic minority women (Ref. 1). PPH is also the main indication for maternal blood transfusion or intensive care unit (ICU) admission. Labor neuraxial analgesia (LNA) is suggested to be associated with reduced odds of PPH among women who delivered vaginally but is underutilized among racial/ethnic minority women (Ref. 2, 3). A possible explanation linking LNA and reduced odds of PPH is that the presence of an epidural catheter at the time of delivery reduces delays in managing PPH because obstetrical procedures needed to stop the obstetric hemorrhage require anesthesia. We tested the hypothesis that LNA is associated with reduced odds of peripartum maternal blood transfusion and ICU admission among women who delivered vaginally.

**Methods:** Data for this retrospective study came from the restricted access natality file 2017-2018 compiled by the National Vital Statistics System of the National Center for Health Statistics. This data system relies on the revised US Standard Certificate of Live Birth, implemented in the 50 states and DC. It includes check boxes to report whether LNA was provided, blood transfusion performed, and maternal ICU admission occurred. Hospital characteristics were abstracted from the county-level Area Health Resource File. Women who delivered vaginally with (exposed) or without (unexposed) LNA were analyzed. The primary outcome was blood transfusion and the secondary outcome maternal ICU admission. Adjusted odds ratios (aOR) and 95% confidence intervals (CI) for the primary and secondary outcomes associated with LNA were estimated using propensity score matching and stratified according to race/ethnicity (non-Hispanic White vs. racial/ethnic minority women).

**Results:** During the study period, 5,032,795 vaginal delivery cases were analyzed. Of them, 12,576 (0.25%) recorded blood transfusion and 2981 (0.06%) recorded ICU admission. After matching, LNA was associated with 17% reduced odds of blood transfusion (aOR 0.83; 95% CI: 0.78, 0.88) (Table). Reduced odds were observed among both racial/ethnic minority women (aOR 0.88; 95% CI: 0.81, 0.91) and non-Hispanic White women (aOR 0.78; 95% CI: 0.71, 0.85). There was insufficient evidence in these data that LNA was associated with reduced odds of maternal ICU admission (aOR 0.90; 95% CI: 0.80, 1.01). Results were unchanged in a sensitivity analysis using the propensity score weighting method.

**Conclusions:** LNA is associated with significantly reduced odds of peripartum blood transfusion among women who delivered vaginally. Increasing access to and utilization of LNA, especially for racial/ethnic minority women, might be an actionable intervention to improve maternal health and reduce disparities.

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## Development of a Clinical Risk Prediction Model for Uterine Atony

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**Introduction:** Uterine atony is the greatest contributor to postpartum hemorrhage (PPH), accounting for >70% of cases.<sup>1</sup> PPH causes substantial maternal morbidity and mortality, and current risk-assessment tools demonstrate only moderate predictive ability in validation studies.<sup>2</sup> By utilizing more sophisticated statistical analysis and limiting prediction to a single etiology of PPH, namely atony, predictive ability may be increased. More accurate prediction methods could improve patient outcomes, as treatment delays correlate with severity of PPH and need for transfusion.<sup>3</sup> We sought to develop a multivariable prediction model for uterine atony using predefined risk factors identified by a systematic review of the literature.<sup>4</sup>

**Methods:** This retrospective cohort study included all women who underwent vaginal or cesarean delivery at a single institution between 1990 and 2019. Cases of uterine atony were identified by administration of a second line uterotonic agent, namely methylergonovine or carboprost. Deliveries without administration of these medications constituted the control group. Two logistic regression models were fit to quantify the contribution of prespecified risk factors on the occurrence of atony: an “anteartum model” included information available at the time of admission; an “intrapartum model” added labor- and delivery-related factors that may evolve throughout a patient’s hospitalization. Receiver operating characteristic curves (c-statistic) and bootstrap calibration were used to quantify the predictive performance of the models.

**Results:** The models were developed using 5,494 cases of atony and 44,460 controls. The anteartum model included 22 variables, with obesity, multiple gestation, polyhydramnios, and Hispanic ethnicity exhibiting strongest contribution (Figure 1A). This model showed moderate discriminatory ability (c-statistic: 0.65; 95% CI: 0.64-0.66). The intrapartum model included 29 risk factors, with obesity, chorioamnionitis, perineal laceration, and multiple gestation contributing most significantly (Figure 1B). With the addition of intrapartum factors, the c-statistic increased to 0.69 (95% CI: 0.68-0.70). Both models were well calibrated. In subgroup analyses, the models performed equally well for spontaneous vaginal, assisted vaginal, and cesarean deliveries, as well as in White, Black, Asian, and Hispanic populations.

**Conclusion:** We developed prognostic models for uterine atony that demonstrated moderate predictive performance. Because different etiologies of PPH have different risk factors, we hoped to enhance prediction by focusing on the single etiology of atony. Future work should include improving these models, by refining the definitions of risk factors and outcomes, as well as performing external validation.

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- PMID 33417319



## Uterine atony during intrapartum cesarean delivery: a retrospective cohort study

**Presenting Author:** Z Bekemeyer

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**Introduction:** Postpartum hemorrhage (PPH) is the leading cause of maternal mortality worldwide [1]. The International PPH Collaborative group has called for more studies using clinically rich data to understand relevant risk factors associated with PPH [2]. Although both cesarean delivery (CD) generally and intrapartum CD particularly are known risk factors for uterine atony (UA) and PPH [3], few studies have specifically assessed incidence and risk factors for PPH among women who undergo intrapartum CD [4,5].

**Methods:** We performed a single-center, retrospective cohort study of all women who underwent intrapartum CD in the active phase of labor (cervical dilation  $\geq$  5cm) between 9/2018 and 9/2019 (n=176). 185 scheduled cesarean deliveries from the same timeframe were also analyzed for comparison. Data were manually abstracted from patients' medical records. We retrospectively analyzed the incidence of uterine atony, defined as requirement for a second line uterotonic (methylergonovine, carboprost, misoprostol) or a Bakri balloon, and potential maternal and obstetric risk factors for uterine atony. Univariable log linear regression modeling was used to calculate unadjusted relative risk.

**Results:** Uterine atony occurred in 38% (n=66) of 176 intrapartum CD compared to only 13% (n=24) of 185 scheduled CD controls (RR 2.8, 95% CI 1.9 to 4.3,  $p < 0.001$ ). 14% of patients who had intrapartum CD required transfusion during their hospitalization compared to 1.7% of those who underwent scheduled CD (RR 8.3, 95% CI 2.5 to 27.0,  $p < 0.001$ ). When comparing intrapartum CD patients who experienced uterine atony (n=66) to those who did not (n=110), we observed no between-group difference in the indication for CDs, cervical dilation before delivery, and rates of induction or spontaneous labor (Table 1). Women with atony were more likely to receive magnesium infusion (RR 1.82, 95% CI 1.17 to 2.83,  $p = 0.008$ ) and have chorioamnionitis (RR 1.95, 95% CI 1.35 to 2.80,  $p < 0.001$ ) than non-atonic women. Compared to non-atonic women, women with atony received a longer duration of oxytocin for labor augmentation (median 18 vs. 10 hours exposure,  $p = 0.001$ ).

**Discussion:** Uterine atony (necessitating a second line uterotonic agent or Bakri balloon) complicated 2 in 5 intrapartum CD in our institution, and more than 10% of women who received intrapartum CD required blood transfusion. Further studies are necessary to assess whether the high atony and PPH risks among women who require intrapartum CD can be mitigated, particularly in the presence of chorioamnionitis or magnesium infusion.

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## Long-Term Symptoms Following inadvertent dural puncture: A Systematic Review and Meta-analysis

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**Co-Author:** Katherine W. Sun, MD; Ashraf S. Habib, MBBCh, MSc, MHSc, FRCA

**Introduction:** Inadvertent dural puncture in obstetric patients is associated with a high risk of post-dural puncture headache (PDPH). Some studies have suggested that inadvertent dural puncture may also lead to long-term symptoms including chronic headache, chronic backache, chronic neckache and depression. We performed this systematic review and meta-analysis to assess long-term symptoms in women who suffered an inadvertent dural puncture or had PDPH compared to those who had uncomplicated neuraxial techniques.

**Methods:** We searched PubMed, Google Scholar and publication reference lists for studies that evaluated long-term outcomes following inadvertent dural puncture in obstetric patients. We included studies that compared outcomes of parturients receiving neuraxial analgesia/anesthesia who suffered an inadvertent dural puncture and/or developed PDPH with patients who had an uneventful neuraxial technique and reported on chronic headache, backache, neckache and/or depression. We estimated pooled risk ratios (RR) and 95% confidence intervals (CI) using random effect models.

**Results:** Seven studies met the inclusion criteria and were included in the analysis (4 retrospective cohort studies and 3 retrospective case control studies).<sup>1-7</sup> Across all studies, there were 5,375 patients in the inadvertent dural puncture group and 1,004,143 in the control group. Four studies included patients who had an inadvertent dural puncture and/or PDPH<sup>2,3,5,7</sup> and three studies examined patients who specifically experienced PDPH.<sup>1,4,6</sup> Six studies included patients who were treated with an epidural blood patch.<sup>1,2,4-7</sup> Follow-up ranged from six months to ten years after the index neuraxial procedure. Three studies defined "long-term" or "chronic" as symptoms lasting greater than six weeks<sup>3,4,5</sup>, two studies examined symptoms lasting longer than six months<sup>6,7</sup> and one study considered "long-term" symptoms as those lasting 1 month to 1 year and >1 year.<sup>2</sup> One study did not define long-term or chronic symptoms but assessed maternal complications identified up to one year post-delivery.<sup>1</sup> Compared to women who had an uneventful neuraxial technique, patients who suffered an inadvertent dural puncture or had PDPH had higher risk of chronic headache [RR 4.57 (2.22, 9.41)], chronic backache [RR 3.02 (2.02, 4.51)], chronic neckache [RR 5.27 (2.81, 9.88)], and depression [RR 3.12 (1.44, 6.77)] (Figure 1).

**Conclusion:** Inadvertent dural puncture and PDPH may increase the risk of long-term/chronic symptoms in obstetric populations.

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## Proposed domains for postpartum recovery: A concept elicitation study

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**Co-Author:** Sally Jensen, PhD; Yasser Y. El-Sayed, MD; David Cella, PhD; Brendan Carvalho, MD; Pervez Sultan, MD

**Background:** Worldwide, approximately 140 million women recover from childbirth annually.<sup>1</sup> Understanding domains of postpartum recovery will enable development of instruments capable of measuring this construct and identifying population norms.<sup>2</sup> The primary aim of this study was to identify and propose postpartum recovery domains. Secondary aims were to perform weighted rankings according to perceived importance, list frequency rankings of factors influencing recovery health domains, and determine maternal challenges faced in the postpartum period.

**Methods:** We conducted semi-structured concept elicitation interviews with key stakeholders using a validated process involving alternating interviews and focus group meetings until theoretical saturation was achieved. Interviews were digitally recorded and transcribed, and an iterative coding process was utilized to extract recovery health domains, symptoms and concerns discussed by stakeholders. Discussion frequency and perceived importance scores (0-100; 0=not at all important to recovery; 100=vitally important to recovery) were used to rank domains. Discussion frequency was used to rank factors helping and hindering recovery, and determine the greatest challenges experienced at 1-, 3- and 6-weeks postpartum.

**Results:** Proposed recovery domains were based on input from 10 study authors and 50 stakeholders (23 patients, 9 general obstetricians, 5 maternal fetal medicine specialists, 8 nurses and 5 obstetric anesthesiologists), who participated in a total of 34 interviews and 2 focus group meetings. We identified 13 postpartum recovery domains. The weighted rankings for these domains (highest to lowest) were: psychosocial distress, surgical / medical factors, feeding and breast health, psychosocial support, pain, physical function, sleep, motherhood experience, infant health, fatigue, appearance, sexual function and cognition. The most frequently discussed factors facilitating recovery were: family support, lactation / breastfeeding support and partner support. The most frequently discussed factor hindering recovery was inadequate social support. The most frequent challenges reported by women were: breastfeeding (week 1), breastfeeding (week 3) and sleep (week 6).

**Conclusion:** We propose 13 domains, which comprehensively describe the construct of postpartum recovery, weight their relative importance based on stakeholder input and frequency of discussion, and list factors that hinder or facilitate recovery. As such, we provide a novel framework to study the recovery process in women following childbirth.

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## A High Incidence of Inadequate Anesthesia for Postpartum Tubal Ligation

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**Introduction:** Neuraxial anesthesia is preferred for postpartum tubal ligations (PPTL). The most common options are spinal anesthesia (SA) or reactivation of a labor epidural catheter (REC). Because there is a high failure rate associated with REC for PPTL(1), our OB anesthesia service decreased the use of RECs and increased SA. This quality improvement (QI) project aimed to assess the failure rates of REC's, de novo SA, and rescue SA performed for PPTL.

**Methods:** After IRB approval, data of consecutive patients from March 2016 to February 2020 that underwent a PPTL were retrospectively collected from electronic medical records. Type of anesthetic, drugs used, sedatives/anxiolytics given, and practitioner experience (generalist vs. fellowship-trained obstetric anesthesiologist) were recorded. The primary outcome of anesthetic block failure was defined as any of the following: neuraxial block replacement, local anesthetic administered on the surgical field, conversion to general anesthesia or deep sedation.

**Results:** A total of 300 women undergoing PPTL were identified. Anesthetic outcomes are reported in Figure 1. The REC failure rate was 35%. De novo SA failure rate was 15%; 13% in those who did not have epidurals in labor (n=85) and 17% who had labor epidurals (n= 105). SA failure rate after failed REC or SA was 23%. Neuraxial drug dosage, the use of REC in labor, time since epidural placement or delivery, labor CSE vs. epidural, supplemental "top-up" doses in labor, and anesthesiologist experience did not reliably predict SA or REC block failure. The median (IQR) dose of bupivacaine for SA was 10.5 (9.75-11.25) mg and 15 (15-20) mcg of fentanyl was added to the bupivacaine.

**Discussion:** Our QI analysis revealed an unexpectedly high neuraxial anesthesia failure rate even when de novo SA was used for PPTL, which was unassociated with the dose of local anesthetic. This is consistent with the recent findings from other institutions and is markedly higher than SA failures for cesarean delivery despite similar intrathecal dosages (2-4). Further clinical and mechanistic studies are required to explain high block failures in this setting, to guide practice changes that will ensure safe and effective anesthesia for PPTL.

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## Prospective study to assess relationship of a postpartum recovery survey (ObsQoR-10) within 24 hours and mode of delivery

**Presenting Author:** Carolyn F. Weiniger

**Presenting Author's Institution:** Tel Aviv Sourasky Medical Center, Israel

**Co-Author:** Din Ben hayoun, Med Student; Nan Guo, PhD; Pervez Sultan, MD; ;

**Background:** The validated Obstetric Quality of Recovery-10 scoring tool (ObsQoR-10) (1,2) was recently translated into Hebrew. (3) We aimed to assess measures of validity, reliability and feasibility of ObsQoR-10 Heb.

**Methods:** Prospective observational study of postpartum women (delivery  $\geq 37$  wk, healthy non-anomalous neonate). Following written informed consent, women completed ObsQoR-10 Heb, and EQ5D global health numerical reporting scale (NRS) (GHNRS) (0-100 mm; 0=worst and 100=best health status) at 24 h postpartum. All delivery modes (spontaneous vaginal (SVD), instrumental, planned cesarean delivery (CD), unplanned CD) were considered, analyzed as a total cohort and separately. Validity was assessed by: convergent validity (spearman correlation of ObsQoR-10 Heb vs. GHNRS) and discriminant validity (correlation with good vs. poor recovery (GHNRS of  $\geq 70$  vs.  $< 70$  mm, respectively) and difference in ObsQoR-10 Heb scores according to delivery mode. Reliability was assessed by: Cronbach's alpha, inter-item correlation, split-half reliability, and floor and ceiling effects. Feasibility was tested by completion and recruitment rate.

**Results:** 299/347 (86%) consented women completed ObsQoR-10 Heb at 24 h. ObsQoR-10 Heb scores correlated moderately with GHNRS for total cohort ( $r = 0.59$  [95% CI 0.50 to 0.67],  $P < 0.001$ ); and SF36 Physical component ( $r=0.46$  [95% CI 0.37 to 0.56],  $p < 0.001$ ); and Mental component ( $r=0.12$  [95% CI 0.01 to 0.24],  $p=0.041$ ) at 24 h; and discriminated well between good (VAS  $\geq 70$ ) vs. poor (VAS  $< 70$ ) recovery (80.29 [95% CI 78.42 to 82.15] vs. 63.34 [95% CI 60.77 to 65.90]; difference 16.95 [95% CI 13.70 to 20.20]  $p < 0.001$ ).

ObsQoR scores differed significantly between delivery modes ( $p < 0.0001$ ; Figure, Table).

There was a weak correlation between ObsQoR-10 Heb score and parity ( $r=0.16$ ,  $p=0.007$ ).

Cronbach's alpha was 0.84 and inter-item correlation was 0.35 indicating good internal consistency. Split half reliability using Spearman-Brown Prophecy Reliability Estimate was very good (0.81). No floor or ceiling effects were demonstrable.

**Conclusions:** ObsQoR-10 Heb performed well in measures of validity, reliability and feasibility. ObsQoR-10 Heb appears to be a tool that can assess quality of recovery following childbirth in the Israeli, Hebrew speaking population. Further work is needed to determine minimal important change values, differences in ObsQoR-10 scores between countries and its impact on outpatient recovery outcomes.

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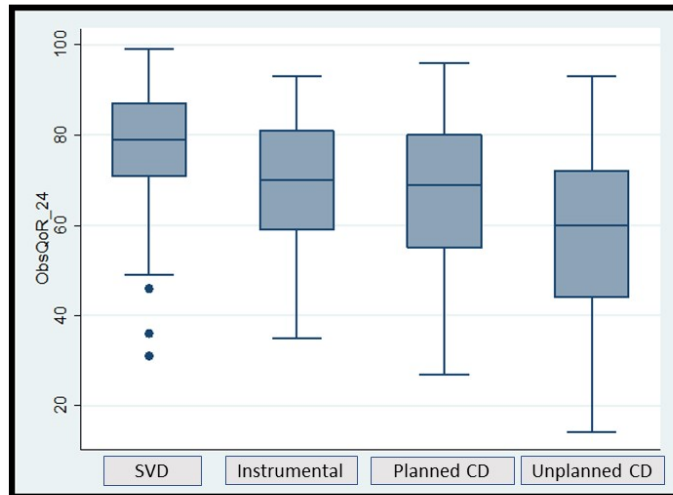


Table: ObsQoR-10 Heb correlation with mode of delivery, mean (standard deviation)

SVD	Instrumental	Planned CD	Unplanned CD
N=153	N=33	N=81	N=32
77.1 (13.7)	69.8 (15.0)	66.5 (16.2)	56.7 (18.6)



## Association of 24 hour postpartum recovery with depression and quality of life measures at 6 and 12 weeks: A prospective observational study

**Presenting Author:** Din Ben Hayoun, Med Student

**Presenting Author's Institution:** TelAviv University Medical School

**Co-Author:** Pervez Sultan, MD; Nan Guo, PhD; Carolyn F. Weiniger, n/a; ;

**Background:** The Obstetric Quality of Recovery-10 (ObsQoR-10) instrument was developed specifically for postpartum women to measure inpatient quality of recovery up to 72 h postpartum. (1) A translated Hebrew version (ObsQoR-10 Heb) was recently validated. (2) We aimed to evaluate whether inpatient ObsQoR-10 Heb scores correlated with recovery up to 3 months postpartum, specifically with measures of depression and quality of life at 6 and 12 wk postpartum.

**Methods:** Prospective observational study of postpartum women (delivery  $\geq$  37wk, healthy non-anomalous neonate). Women were approached 24 h postpartum. Following written informed consent, and were asked to complete surveys: ObsQoR-10 Heb, and Short Form 36 (SF36; giving Mental and Physical components). Women agreed to be contacted at 6 and at 12 wk postpartum, to complete Edinburgh Postnatal Depression Scale (EPDS) and Short Form12 (SF12) surveys. All delivery modes were considered and analyzed as a total cohort and separately (vaginal, instrumental, planned cesarean and unplanned cesarean delivery) for comparison. Primary outcome was correlation between 24 h ObsQoR-10 Heb score for total cohort, and 6 and 12 wk EPDS and SF12 scores.

**Results:** Of 347 women approached (Aug 2020 - Feb 2021)299 (86%) women completed 24 h ObsQoR-10 Heb. At time of abstract submission 230/299 (77%) and 179/299 (60%) women have completed 6 and 12 wk EPDS and SF12 surveys.

ObsQoR-10 Heb correlated moderately with 6wk EPDS ( $r=-0.36$  [95% CI -0.47,-0.25];  $p< 0.001$ ) and 12 wk EPDS scores ( $r=-0.322$  [-0.45,-0.18];  $p< 0.001$ ).

ObsQoR-10 Heb correlated moderately with 6wk SF12 Mental and Physical component ( $r=0.32$ ;  $p< 0.001$  and  $0.44$ ;  $p< 0.001$ ) and 12 wk scores ( $r=0.30$   $p< 0.001$  and  $0.158$   $p=0.035$ ). 24 h SF36 Mental component scores moderately correlated with 6 wk SF12 Mental component scores ( $r=0.39$ ,  $p< 0.001$ ) and 12 wk ( $r=0.32$ ,  $p< 0.001$ ). 24 h SF36 physical scores correlated with 6 wk SF12 Physical component ( $r=0.42$ ,  $p< 0.001$ ) but not at 12 wk ( $r=0.10$ ,  $p=0.19$ ).

Correlations between 24 h ObsQoR-10 Heb and: 24 h SF36, 6wk EPDS and SF 12, and 12 wk EPDS and SF12 scores according to delivery mode are presented in the Table.

**Conclusions:** 24 h ObsQoR-10 Heb scores are associated with higher EPDS and worse QoR measures at 6 and 12 wk postpartum. Our study suggests that inpatient recovery measures within 24 h postpartum may have a role in identifying women at risk of experiencing negative outpatient recovery up to 3 months postpartum. Further work is needed to determine ObsQoR-10 cut-off values for specific patient populations, which are associated with worse outpatient recovery outcomes.

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## Acute Pain and Ambulation after Vaginal Delivery With or Without Neuraxial Analgesia: A Prospective Cohort Study

**Presenting Author:** Ayumi Maeda, MD

**Presenting Author's Institution:** Brigham and Women's Hospital and Harvard Medical School

**Co-Author:** Rimu Suzuki, RN; Sumie Kurokawa, RN; Osamu Takahashi, MD, PhD; Tokujiro Uchida, MD, PhD; Yasuko Nagasaka, MD, PhD

**Background:** While enhanced recovery after cesarean delivery prioritizes early ambulation,<sup>1</sup> there is a paucity of data on physical activity levels relative to pain after vaginal delivery, or potential influence of neuraxial labor analgesia. The aim of this study is to evaluate mobilization and pain after vaginal delivery in women who did or did not have neuraxial labor analgesia.

**Methods:** Primiparous women with no comorbidities anticipating uncomplicated vaginal delivery were recruited from January 2020 to the present; recruitment is ongoing. Use of neuraxial analgesia during labor was noted. Ambulation from 2 hours postpartum through a standard 5-day hospitalization period was measured with a wristband activity tracker.<sup>2</sup> Pain by either visual analog scale (VAS) or numeric rating scale (NRS) was recorded (1) antepartum at time of enrollment, (2) at the time of phlebotomy before and after delivery, (3) 4-5 times a day postpartum, both at rest and with movement during hospitalization and (4) at the 1-month postpartum visit. Analgesic use and obstetric outcomes were extracted from the electronic medical record. Categorical and continuous variables were assessed with Chi-square and Mann-Whitney U tests, respectively. Correlation between ambulation and dynamic pain score was evaluated using Pearson's correlation coefficient.

**Results:** To date, 179 women have completed the study for preliminary analysis; 107/117 with neuraxial analgesia (NA group) and 72/117 without (NCB group). The NA group was older, had longer labor duration, and had increased incidence of postpartum hemorrhage (> 500 mL);  $p < 0.05$  for all (data not shown). Postpartum ambulation was similar in both groups and increased daily (Fig 1). There were no differences in VAS scores between the groups at baseline or with phlebotomy. NRS scores 2h postpartum were lower in the NA group compared to the NCB group (median 1 [IQR 0-2] vs 3 [2-5.25],  $p < 0.01$ ), but otherwise did not differ throughout the postpartum hospitalization period (Fig 1). There was no correlation between daily ambulation and NRS with movement (absolute value correlation coefficient < 0.2 for each 24-hour period). Women in the NA group had higher analgesic consumption in the 5 days postpartum, compared to the NCB group: oral or rectal diclofenac (median 150mg [IQR 0-262.5] vs 25mg [0-200],  $p < 0.01$ ); oral or intravenous acetaminophen (median 5500mg [IQR 3250-7500] vs 5000mg [2250-7500],  $p = 0.25$ ).

**Conclusion:** By preliminary analysis, postpartum ambulation was not impacted by use of labor epidural analgesia. Women in the NA group had no increase or decrease in postpartum ambulation despite higher analgesic consumption, older age, longer labor, and increased blood loss. These findings suggest that postpartum ambulation is neither hindered nor facilitated by neuraxial analgesia during labor. Analgesic utilization did not correlate with higher or lower postpartum ambulation.

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## Racial and ethnic disparities in epidural blood patch utilization for postdural puncture headache among obstetric patients

**Presenting Author:** Anne-Sophie Janvier, MD

**Presenting Author's Institution:** Columbia University

**Co-Author:** Jean Guglielminotti, MD, PHD; Ruthi Landau, MD; Allison Lee, MD, MS

**Background:** Postdural puncture headache (PDPH) is the most serious complication associated with neuraxial techniques in obstetric patients.[1] Epidural blood patch (EBP) is the gold standard treatment for severe PDPH. Early recognition and management are crucial to avoid debilitating symptoms and potentially devastating outcomes.[2] Research remains scant regarding racial and ethnic disparities in obstetric anesthesia care in the United States. [3] Though the interaction between race/ethnicity and expected and actual use of neuraxial labor analgesia has been evaluated,[4] the impact of disparities on PDPH management has not. We examined whether provision of EBP for PDPH treatment after a neuraxial procedure during childbirth occurred (i) less frequently and (ii) later, among racial/ethnic minority women compared to non-Hispanic White women.

**Methods:** Data for this retrospective study of women with PDPH after neuraxial techniques for childbirth came from the New York State Inpatient Database (1998-2016), a census of hospital discharge records. The primary outcome was EBP utilization (yes/no; ICD-9(10) codes 03.95 & 3E0S3GC) in the racial/ethnic categories: White, Black, Hispanic and Other. The secondary outcome was the interval between hospital admission and EBP. The adjusted relative risks (aRR) and 95% confidence interval (CI) of EBP associated with race/ethnicity were estimated using log-binomial models. Temporal trend in EBP utilization were estimated using the adjusted annual percentage change (aAPC).

**Results:** The PDPH rate was 0.47% among women delivering with a neuraxial procedure (N=389,211/1,909,062); of those, 4196 received an EBP (47%) (Figure 1). Compared with White women, Black women and those in the category "Other" were less likely to receive an EBP (aRR 0.90; 95% CI:0.82, 0.98, and aRR 0.87; 95% CI: 0.81, 0.95 respectively), which was not the case for Hispanic women (aRR 1.05; 95% CI:0.97, 1.13),  $P < 0.001$ . Compared to White women, Black, Hispanic and Other women received EBP 1 day later (Table 1). During the 19-year study period, trends for EBP utilization occurred with an increase among Hispanic women (aPC+3.3%; 95% CI:0.4, 6.3), but not among other groups (Figure 2).

**Discussion:** As hypothesized, compared to White women, a lower proportion of minority women receive EBP for PDPH during the peripartum period and, when treatment occurs, it is delayed. Although the underlying causes may be complex, this adds further evidence for disparities in obstetric anesthesia care which must be urgently addressed. The trend for increased EBP utilization among Hispanic women over time may reflect increased attention to communication and engagement with this patient population.[4,5,6]

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## Weight-related Disparities in Acute Treatment of Severe Hypertension in the Postpartum Period

**Presenting Author:** Amal Javaid, BS

**Presenting Author's Institution:** University of Pittsburgh School of Medicine

**Co-Author:** Camila Cabrera, MD; Latima Collins, MD; Aarti Kumar, BS; Arundhati Jeyabalan, MD; Alisse Hauspurg, MD

**Background and Objective:** Hypertensive disorders of pregnancy are associated with maternal morbidity and mortality, particularly in the postpartum period. Further, hypertension can persist or arise in the postpartum period and close blood pressure monitoring is warranted. Multiple studies have demonstrated implicit and explicit bias among medical providers against overweight and obese individuals which leads to long-term harm and poorer outcomes.

According to the American College of Obstetricians and Gynecologists (ACOG) guidelines, patients with sustained severe range blood pressures, defined as recurrent sequential blood pressures greater than or equal to 160/110 mmHg in the postpartum period, should receive aggressive management with rapid-acting anti-hypertensive therapy. We sought to investigate the relationship between body mass index (BMI) and time to administration of short-acting anti-hypertensives in severe postpartum hypertension per ACOG guidelines. Based on prior studies, we hypothesized that obese patients would have longer time to treatment resulting in longer times to resolution of severe hypertension when compared to non-obese patients BMI.

**Methods:** This was a retrospective cohort study at a single tertiary care center utilizing data of women that delivered between 2017 and 2019. Patients with sustained severe hypertension in the postpartum period were identified. Time to treatment (TTT) defined as the time from the first severe range BP to administration of short-acting antihypertensives and time to resolution (TTR) defined as the time from first severe ranging BP to BP < 150/100mmHg were obtained from the EMR. A univariate analysis was performed, using a Wilcoxon-rank sum test to compare the two based on obesity status (obese, BMI  $\geq 30$  kg/m<sup>2</sup> vs non obese, BMI < 30 kg/m<sup>2</sup>).

**Results:** 302 women had complete blood pressure treatment data (151 obese, 151 non-obese). 49.0% of non-obese women and 51.6% of obese women were treated with short-acting anti-hypertensives according to ACOG guidelines for sustained severe hypertension (p-value = 0.6). Median TTT for non-obese women was 47 min [IQR= 31-74] compared to 46 min [IQR=31-85] for obese women (p=0.7) and time to resolution was 113 min [IQR=60-199] vs 109 min [IQR 56-203] for non-obese and obese women respectively (p-value =0.9).

**Conclusion:** There was no difference in treatment with rapid-acting anti-hypertensive agents, time to treatment or time to resolution for severe sustained hypertension based on BMI. Overall, the rates of treatment with rapid-acting anti-hypertensive agents in accordance with ACOG guidelines were around 50%, warranting better provider education and quality improvement interventions to improve treatment of postpartum hypertension.



## Understanding the Effect of Different Short Acting Anti-hypertensives on the Time to Resolution of Severe Sustained Postpartum Hypertension Stratified by BMI

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**Co-Author:** Camila Cabrera, MD; Latima Collins, MD; Aarti Kumar, BS; Arundhati Jeyabalan, MD; Alisse Hauspurg, MD

### Background:

Hypertensive disorders of pregnancy (HDPs) are a leading cause of maternal morbidity and mortality. Further, severe sustained hypertension defined as recurrent sequential blood pressures (BP) greater than or equal to 160/110 mmHg can arise in the postpartum period in women with HDPs. If left untreated, patients are at high risk of developing complications including stroke. According to American College of Obstetricians and Gynecologists (ACOG) guidelines, patients with sustained severe hypertension in the postpartum period should be treated aggressively with rapid-acting anti-hypertensive agents' IV hydralazine, IV labetalol or PO nifedipine. Current guidelines do not reflect the need for dose adjustments in obese women. Our study aimed to determine if time to resolution of severe blood pressure after administration of treatment differed by body mass index (BMI).

**Methods:** This was a retrospective cohort study at a single tertiary care center. Women with a diagnosed HDP that delivered between 2017-2019 were included in our study. Hypertension and treatment data was collected from the Electronic Medical Record for women with severe sustained hypertension on the postpartum floor. Women were stratified by BMI  $\geq$  non-obese ( $< 30$  kg/m<sup>2</sup>) and obese ( $\geq 30$  kg/m<sup>2</sup>). The time to resolution of hypertension ( $< 160/110$  mmHg) and time to BP control ( $< 150/100$  mmHg) after administration of treatment was recorded and compared for obese and non-obese women.

**Results:** 302 women with severe sustained postpartum hypertension were identified, 151 (50%) obese, 151 (50%) non-obese. In total, 153 women received treatment with short-acting anti-hypertensive agents (51.0% of total cohort), with no difference in time to receiving short-acting treatment based on BMI ( $p=0.7$ ). In the women that received treatment, median time to resolution of severe range hypertension was 77 min [46-122] and 94 min [45-118] for obese and non-obese women ( $p=0.8$ ). Median times to BP control after administration of medication between obese and non-obese women were as follows:

- Labetalol: 11 min [0-33] for obese vs 22 min [9-56] for non-obese women ( $p=0.1$ )
- Hydralazine: 30.5 [0-58] min for obese vs 16 min [9-20] for non-obese women ( $p=0.5$ )
- Nifedipine: 35 min [22-86] for obese vs 49 min [28-72] min for non-obese women ( $p=0.6$ )

**Conclusions:** We found no significant difference in time to BP control using short-acting anti-hypertensive agents based on obesity status. Our findings support current recommendations, in that there is no need for dose adjustments of rapid-acting anti-hypertensive agents based on BMI for treatment of severe postpartum hypertension.



## Trends in Eclampsia in the United States, 2009 to 2017: A population-based study

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**Presenting Author's Institution:** Faculty of Medicine, University of Alberta

**Co-Author:** Dylan Whitney, BAsC; Nan Guo, PhD; Gary M. Shaw, PhD; Maurice Druzin, MD; Alexander J. Butwick, MBBS, FRCA, MS

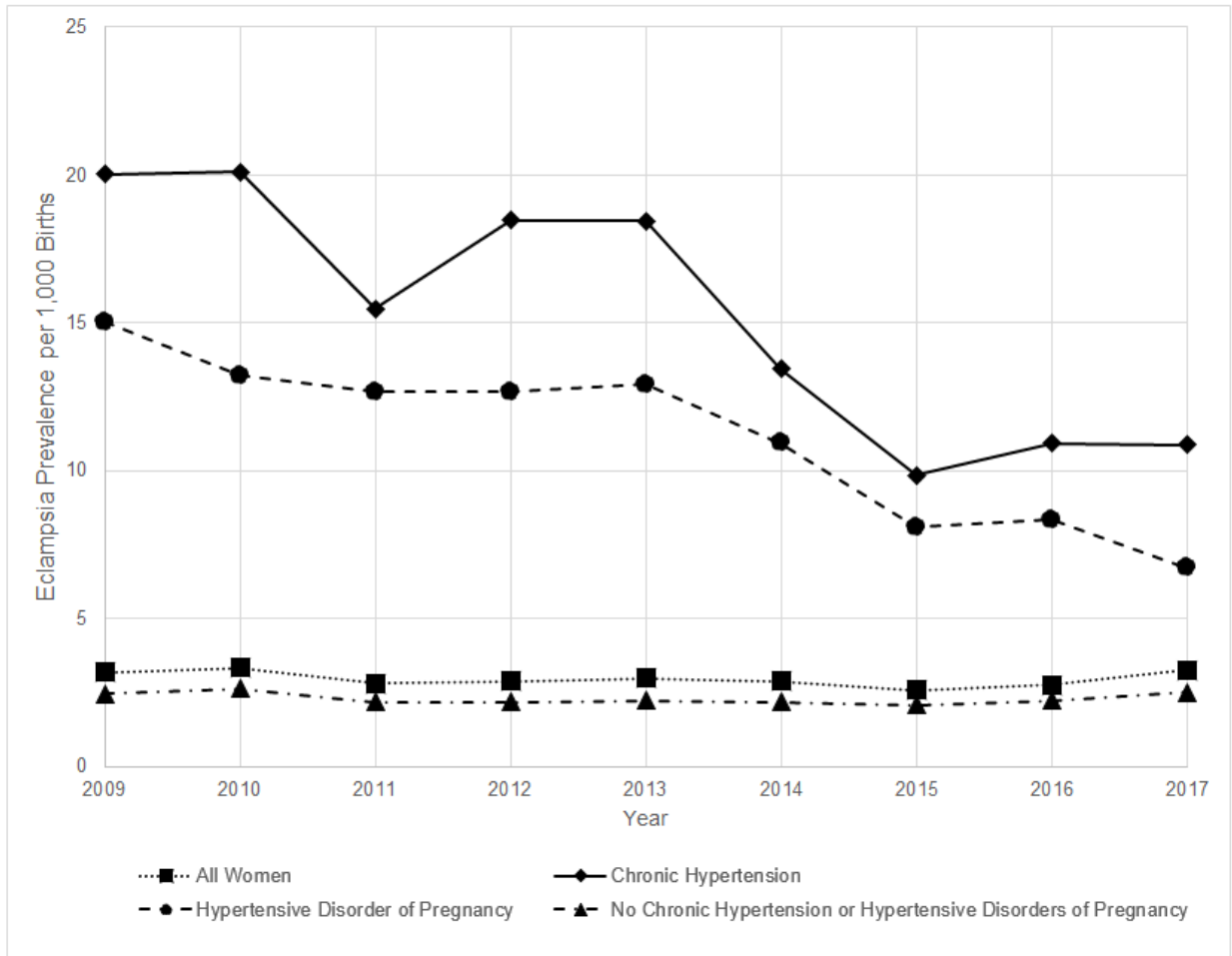
**Background:** Eclampsia is a major cause of maternal and perinatal morbidity. Our aim was to assess temporal trends in eclampsia prevalence in the United States from 2009 to 2017.

**Methods:** This population-based cross-sectional study included live births in 43 U.S. states and the District of Columbia between 2009 and 2017. The eclampsia prevalence among all women, women with chronic hypertension, and hypertensive pregnancy disorders were reported by 1,000 births. Risk ratio (RR) adjusted for maternal characteristics were used to assess temporal trends.

**Results:** Of 30,006,857 live births between 2009 and 2017, 87,602 (0.29%) were associated with eclampsia. The annual prevalence of eclampsia among all women and stratified by hypertensive disease are presented in the Figure. The overall prevalence decreased by 8.0% between 2009 and 2017, from 0.32% to 0.29%. The adjusted risk of eclampsia decreased 13% during the 7 most recent years of the cohort, with an adjusted RR of 0.87 (95% CI: 0.85 - 0.90) in 2017 relative to 2009. The adjusted risk of eclampsia decreased substantially between 2009 and 2017 among women with chronic hypertension (adjusted risk ratio [aRR]: 0.53; 95% CI: 0.48 - 0.59) and women with hypertensive pregnancy disorders (aRR: 0.45; 95% CI: 0.42 - 0.48). Among non-hypertensive women, there was a slight increase in the adjusted risk between 2009 and 2017 (aRR: 1.07; 95% CI: 1.04 - 1.11).

**Conclusions:** Despite reductions in the eclampsia prevalence among women with chronic hypertension and hypertensive disorders of pregnancy, public health initiatives are needed to reduce the overall eclampsia prevalence, especially in non-hypertensive women.







## Association between Intrapartum Magnesium Administration and Incidence of Maternal Fever in Preeclamptic Parturients: A Retrospective Study

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**Presenting Author's Institution:** Northwestern University, Feinberg School of Medicine

**Co-Author:** Nancy Su, B.A.; Paloma Toledo, MD, MPH; Elizabeth M. Lange, MD; ;

**Introduction:** Maternal fever, defined as a temperature of 100.4°F or greater, has been associated with several adverse maternal and neonatal outcomes.<sup>1</sup> In a retrospective cross-sectional study intrapartum magnesium therapy was associated with lower incidence in maternal fever.<sup>2</sup> However, in the same study, preeclamptic parturients had less maternal fever than those parturients that were not preeclamptic.<sup>2</sup> Since preeclampsia is an indication for magnesium therapy, there is the critique that magnesium therapy itself may not be protective, but there may be something unique to the pathophysiology of preeclampsia that protects against fever. We hypothesized that there would be a lower incidence of maternal fever in preeclamptic patients treated with magnesium compared to those who did not receive magnesium.

**Methods:** We conducted a retrospective study using a dataset of parturients with a diagnosis of preeclampsia from the electronic data warehouse. Data included deliveries from November 2005 to April 2017. Only parturients greater than 32.0 weeks gestation admitted to labor and delivery with intent to labor, who received neuraxial labor analgesia, and were pre-eclamptic were included in the analysis. Extracted data included parity, gestational age, race, mode of delivery, admission temperature, interval temperatures, antibiotic use, number of vaginal examinations during labor, total amount and total time on magnesium therapy, and umbilical cord blood gases. The primary outcome was the diagnosis of maternal fever. After initial univariate analyses, variables with  $P < 0.1$  were entered into a multivariable model.

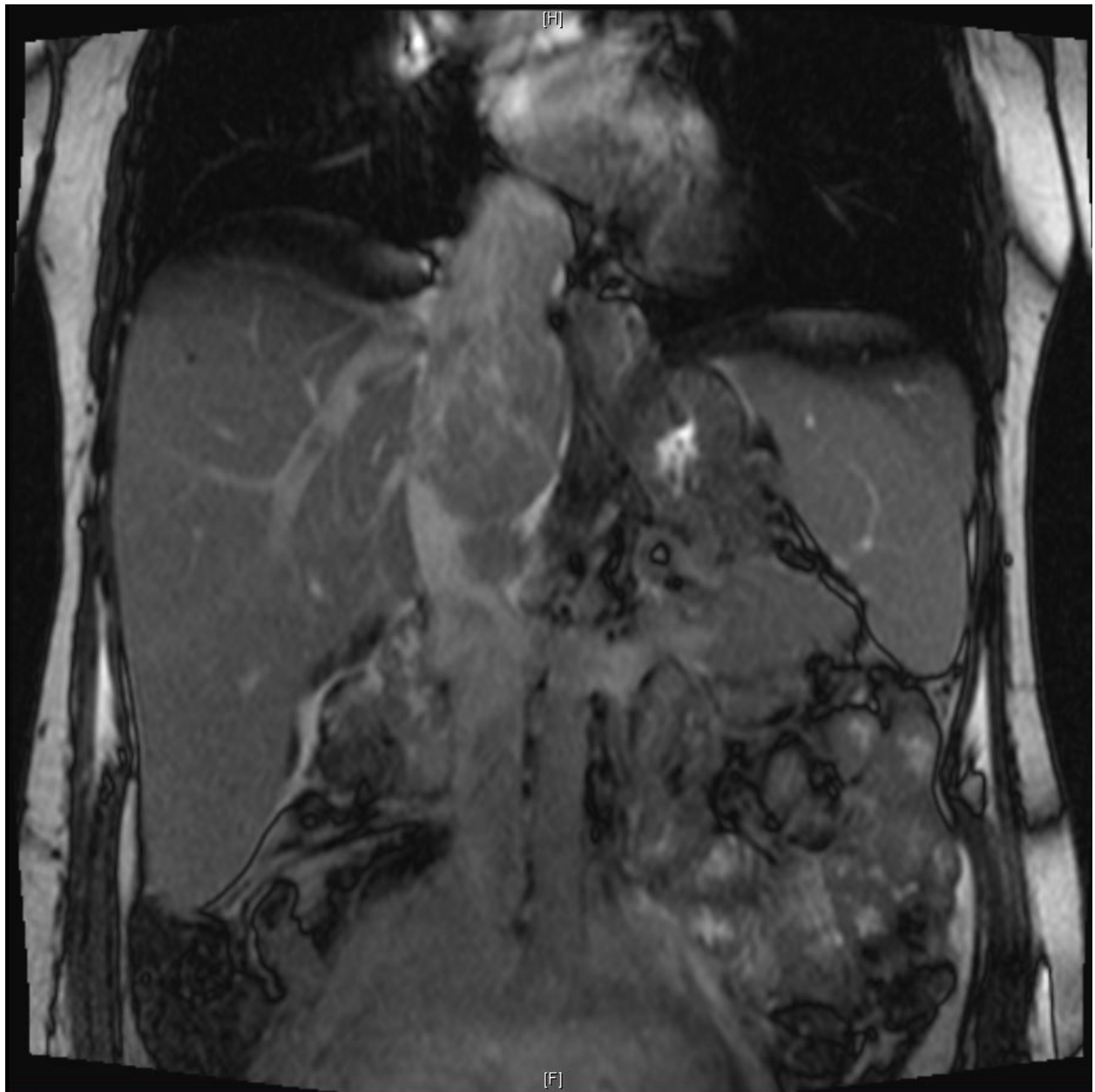
**Results:** A total of 701 patients met inclusion criteria; 58 (8.3%) parturients developed fever. Patient demographics stratified by fever status are shown in Table 1. Median maximum temperature in labor was 100.9°F (IQR 100.5-101.3°F) in the febrile cohort compared to 98.8°F (IQR 98.4-99.1°F) in the afebrile cohort ( $P = 0.0001$ ). The median change in temperature from baseline was 2.6°F (IQR 2-3.4°F) in the febrile cohort, compared to 0.66°F (IQR 0.2-1.1°F) in the afebrile cohort ( $P=0.0001$ ). In the multivariable logistic regression model, women exposed to magnesium were less likely to develop a fever (adjusted odds ratio 0.24, 95% CI 0.13-0.43).

**Conclusions:** Though the development of intrapartum maternal fever is likely multifactorial, this study reiterates that magnesium may play a protective role against its development. Studies should be performed to study the use of magnesium as a potential intervention for maternal fever.

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Patient demographics:

	Febrile (n=58)	Afebrile (n=643)	<i>P</i>
Age	33 (30-36)	32 (28-36)	0.44
Race			0.086
White	34 (60.7%)	325 (50.5%)	
Hispanic	6 (10.7%)	68 (10.6%)	
Black/African American	3 (5.4%)	111 (17.3%)	
Asian	6 (10.7%)	32 (5.0%)	
Other/Declined to answer	7 (12.5%)	74 (11.5%)	
BMI	31.9 (29.5-35.5)	32.1 (28.7-36.3)	0.84
Nulliparous	51 (87.9%)	458 (71.2%)	0.006
EGA	38.1 (37.2-39.4)	38.0 (37.0-39.2)	0.2
Multiple gestation	4 (6.9%)	41 (6.4%)	0.88
Labor description			0.86
Spontaneous	12 (20.7%)	127 (19.8%)	
Induction	46 (79.3%)	516 (80.2%)	
Labor duration (hr)	24.6 (15.1-31.5)	16.1 (11.1-23.5)	<0.001
Number of vaginal exams	8 (6-9)	6 (5-8)	<0.001
Magnesium Administration	23 (40.4%)	429 (66.9%)	<0.001
Rupture of membranes			0.93
Artificial	19 (32.8%)	214 (33.3%)	
Spontaneous	39 (67.2%)	429 (66.7%)	
Group B streptococcus positive	5 (8.6%)	126 (19.6%)	0.04
Mode of delivery			0.05
Vaginal delivery	36 (62.1%)	476 (74.0%)	
Cesarean delivery	22 (37.9%)	167 (26.0%)	
Chorioamnionitis	35 (61.4%)	3 (0.5%)	<0.001



## Racial Differences in Cardiovascular Complications Following Cesarean Delivery in Women with Preeclampsia in the United States

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**Co-Author:** Vijay Krishnamoorthy, MD, PhD; Ashraf S. Habib, MBCh, MSc, MHSc, FRCA; Karthik Raghunathan, MBBS, MPH; Matthew Fuller, MS; Zachary Frere, Statistician

**Introduction :** Black women have a higher risk of preeclampsia (PreX) and higher rates of maternal morbidity compared to White women. Among women with PreX undergoing cesarean delivery (CD) in the United States, we sought to determine whether racial disparities exist with regard to postpartum major adverse cardiac events (MACE) and inpatient processes of care.

**Methods:** After IRB approval, we used the Premier Database to conduct a retrospective cohort study of women aged 18-50 years who underwent CD (January 1, 2016-June 30, 2018) with a diagnosis of PreX and complete data for race and ethnicity. The primary outcome was MACE at CD admission or readmission for MACE within 90 days. MACE was defined as a composite of death, cardiac arrest, cardiogenic shock, myocardial infarction, respiratory failure, arrhythmia, stroke, embolic event or cardiac diagnosis. Covariates examined were demographics, location of care and potential confounding factors for MACE. The secondary outcomes examined inpatient processes of care, including utilization of transthoracic echocardiography (TTE), lab orders for BNP, and (among patients with PreX with severe features) anti-hypertension medication use at hospital discharge. Descriptive statistics were used to compare demographic and clinical characteristics between racial/ethnic groups, and multivariable logistic regression was used to examine the association of race/ethnicity with primary and secondary outcomes.

**Results:** In the cohort of 541,488 women, 48,896 (9.03%) had PreX, mean age was 30, racial/ethnic distribution was Black Hispanic 0.3%, Black non-Hispanic 16%, other Hispanic 5.7%, other non-Hispanic 11.4%, White Hispanic 11.3% and White non-Hispanic 55.3%. Among women with PreX, the primary outcome of MACE at delivery hospitalization or at 90-day readmission was higher in Black women compared to white women [OR 1.34 (CI 1.1-1.6, P=0.0004)]. Among women with PreX, BNP testing and the utilization of TTE were significantly higher in Black non-Hispanic women compared to white women [OR 1.44, (CI 1.3-1.6, P=0.0001) and OR 1.51 (CI 1.3-1.7, P=0.0001), respectively]. Among women with PreX with severe features, the odds of receiving anti-hypertensive medication at hospital discharge was higher in Black non-Hispanic women compared to White women [OR 1.93 (CI 1.7-2.2, P=0.0001)].

**Discussion:** In patients with PreX who had CD, the risk of MACE and cardiac readmission was higher in Black patients compared to White patients, despite higher rates of utilization of anti-hypertensive medications, TTE and BNP testing. Recognizing the risk of acute cardiac events in women with PreX may result in enhanced surveillance and rapid treatment especially in high-risk populations. Maternal morbidity and mortality due to PreX and cardiovascular causes may not wholly be due to disparities in acute care. The systemic influences over health that may result in cardiovascular morbidity after PreX in Black women must be examined in future studies.



## Extracellular Vesicles from Women with Severe Pre-eclampsia Impair Vascular Endothelial Function

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**Co-Author:** Saravanakumar Murugesan, postdoctoral fellow; Adam Sturdivant, MPH; Mark F. Powell, MD; Rachel Sinkey, MD; Dan Berkowitz, MD

**Introduction:** Pre-eclampsia (PE) affects 5-8% of pregnancies worldwide and causes maternal and neonatal mortality and morbidity.<sup>1</sup> The pathogenesis is unclear, but the placenta plays a key role.

A novel signal transduction mechanism has recently emerged which involves the biology of extracellular vesicles (EVs). EVs, small membrane-bound extracellular particles, are transported from one tissue to another carrying cargo such as proteins and miRNA that impact organ function.<sup>2</sup> Emerging literature demonstrates that PE is triggered by placental derived EVs (pEVs) cargo produced after placental spiral artery remodeling.<sup>3</sup>

The placenta is a major source of nitric oxide (NO) and decreased levels may be associated with the development of PE.<sup>4</sup> Moreover, syncytiotrophoblast EVs containing endothelial nitric oxide synthase (eNOS) were decreased in PE.<sup>4</sup> Given these observations, we hypothesize that pEVs cargo are altered in PE pregnancies, and may contribute to reducing NO, eNOS, and endothelial dysfunction. We report that EVs cargo from patients with severe pre-eclampsia (sPE) can impair the endothelial function in part by impaired NO signaling through downregulated eNOS and p-eNOS protein in human aortic endothelial cells (HAECs).

**Methods:** We obtained plasma samples from sPE and control pregnant women for the isolation of EVs. EVs-CD63 and total EVs were quantified by nanoparticle tracking analysis and the Elisa kit method. pEVs levels were measured by placental alkaline phosphatase. Vascular endothelial functional assays were determined by cell migration, Electric Cell-substrate Impedance Sensing in HAECs, and wire myography in isolated blood vessels, preincubated with EVs from control and sPE women.

**Results:** Plasma EVs and pEVs levels were increased in sPE without a significant size distribution difference in sPE and control EVs. Impaired endothelial repair and proliferation, reduced endothelial barrier function, reduced endothelial-dependent vasorelaxation and decreased endothelial nitric oxide indicate that sPE-EVs induced vascular endothelial dysfunction. Moreover, sPE-EVs downregulated endothelial nitric oxide synthase.

**Conclusions:** sPE-EVs mediated efficient transfer of EVs cargo to HAEC impairs endothelial-dependent vascular functions, likely contributing to the vascular complications in PE patients.

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## Extracellular vesicle VASORIN is a Vascular Protectant: Downregulation as a Mechanism for Pre-eclampsia Induced Vascular Dysfunction

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**Introduction:** Pre-eclampsia (PE) is a leading cause of maternal death and prematurity.<sup>1</sup> Recently, extra-cellular vesicles (EVs) containing protein and miRNA cargo have been shown to be involved in cell-to-cell signaling and the endothelial pathobiology of PE.<sup>2</sup> Our recent data suggest that incubation of EVs isolated from the women with severe PE (sPE) induces significant endothelial cell dysfunction, including decreased barrier function. While circulating antiangiogenic factors that interfere with VEGF and TGF- $\beta$  signaling pathways such as sFlt-1 and Endoglin have been shown to contribute to PE pathobiology, we hypothesized that other protein cargo in EVs may contribute to PE induced endothelial dysfunction. We used an unbiased proteomic approach to compare the EVs protein cargo profile from women with sPE and normotensive controls (C).

**Methods:** We obtained urine and plasma samples from pregnant women with sPE (n=15) and C (n=15) for the isolation of EVs. EVs-CD63 and total EVs were quantified and isolated urinary EVs proteomic profile were evaluated from sPE and C sample using a standard high-resolution nano-liquid chromatography, tandem mass spectrometry approach. Vascular endothelial functional assays were determined by cell migration, and ECIS (Electric Cell-substrate Impedance Sensing) in human aortic endothelial cells (HAECs).

**Results:** Plasma EVs levels were increased in sPE compared to C. In an unbiased proteomic approach of EVs from urine of sPE and C women, principal component analysis (PCA) and Heat map revealed 40 proteins in EVs from sPE women and C were differentially expressed. EVs from sPE women showed proteins that were both up and downregulated when compared to C. Interestingly, a TGF- $\beta$  receptor protein vasorin (VASN) was significantly decreased in abundance in sPE women compared to C. VASN in EVs isolated from plasma and urine as well as placental tissue was significantly decreased in sPE women compared to C. siRNA Knockdown of VASN in HAECs recapitulates the phenotype observed with sPE-EVs, including decreased endothelial proliferation as measured by wound healing assay, and increased permeability measured by ECIS. Moreover, overexpression of VASN attenuates the effect of sPE-EVs on endothelial cell permeability and migration/proliferation.

**Conclusion:** VASN, a TGF- $\beta$  receptor, is a positive regulator of endothelial cell proliferation and function, specifically in pregnancy. Decreased EVs-VASN, seen in sPE women contributes to endothelial dysfunction in HAECs. Targeting EVs-VASN may represent a novel, effective and cell specific approach to prevent vascular complications in PE.

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## CESAREAN SECTION UNDER GENERAL ANESTHESIA: WHY IS OUR INCIDENCE GREATER THAN 5%?

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**Background:** Historically, general anesthesia (GA) for cesarean section (CS) has been associated with increased risk of maternal morbidity compared to neuraxial anesthesia.<sup>1</sup> With neuraxial, the fetus is exposed to less anesthesia and mothers can actively participate in the delivery. SOAP requires a GA rate < 5% to be designated as a center of excellence. This study was conducted to assess the incidence of GA for CS at our center and to evaluate if an educational session for obstetricians would impact the rate of GA for subsequent cases.

**Methods:** IRB approval was waived for this QI project. A retrospective chart review of all parturients undergoing GA for CS was conducted from July to December 2019. Collaborating with obstetricians, we gave a presentation to obstetric faculty and house staff in February 2020 to evaluate the rate of GA for CS over the last six months of 2019. After this intervention, data was analyzed from March to June 2020, correlating with the beginning of the COVID-19 pandemic. Data collected included: anesthesia and obstetric faculty, procedure urgency, fetal heart rate (FHR) tracing category, prior indication of FHR changes, pre-existing epidural status, and arterial cord gas values. Descriptive and comparative statistics were calculated.

**Results:** In 2019, the rate of GA for CS was 14.8% (51/350). 49% were stat (25/51) and 66.7% did not have a functioning epidural (34/51). 5.89% of arterial cord gases had pH < 7 (3/51) and 13.7% had base deficit  $\geq$  12 mmol/L (7/51). 21.6% of cases had prior indications of FHR changes (11/51), 25.5% did not, and 52.3% were indeterminate from the medical record. In 2020, the rate of GA for CS was 4.3% (7/163). 85.7% were stat (6/7) and no patient had an existing epidural (7/7). 14.3% of arterial cord gases had pH < 7 (1/7) and 14.3% had base deficit  $\geq$  12 mmol/L (1/7). There were no prior indications of FHR changes in these cases (0/7).

**Conclusion:** Our center's rate of GA for CS decreased by 10.5% during the COVID-19 pandemic. Improvement was likely related to COVID-19 conditions rather than obstetrician education. This was likely due to improved communication between obstetricians and anesthesiologists, concern for higher morbidity and mortality for patients with COVID-19 undergoing general anesthesia, desire to reduce staff exposure to COVID-19 during intubation, and improved communication during the pre-evaluation and informed consent process between anesthesia provider and patient. Future directions include incorporating more data from 2020 to determine if this trend has continued. Education can further be employed for both obstetrical and anesthesiology services to optimize neuraxial anesthesia and analgesia and overall preparedness for cesarean sections.

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## Implementation of the oxytocin 'rule of threes' algorithm for cesarean section in a Japanese tertiary hospital: a retrospective cohort study using propensity score matching

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**Co-Author:** Takaya Hojo, n/a; Hirotooshi Yamamoto, n/a; Ruthi Landau, MD; Izumi Honda, n/a;

**Background:** An international consensus for uterotonic administration during cesarean section (CS) was recently published.[1] In our center, oxytocin administration was not standardized until 2018, and may have contributed to the occurrence of postpartum hemorrhage. We decided to implement a protocol based on the "rule of threes" algorithm (R3),[2] which involves administering oxytocin 3IU in the first 3min, assessing uterine tone every 3min, and repeating the entire sequence 3 times. We hypothesized that guiding our practice with a R3 algorithm

**Methods:** Based on R3, we created an algorithm stratified by women's initial risk for uterine atony (low risk: planned repeat CS or breech; high risk: placenta previa twins, post-induction), and based on uterine atony (Figure 1). Using before/after study design, charts with CS cases between 11/2016 and 5/2018 (PRE group) and 7/2018 and 12/2019 (POST group) were retrospectively reviewed. Outcomes were blood loss (ml), total oxytocin dose (5IU ampules), proportion of women receiving the 'low dose' vs. 'high dose' oxytocin, intraoperative blood transfusion, uterine atony and additional uterotonics. Factors associated with increased blood loss (gestational diabetes or hypertension, induction of labor, premature rupture of membrane) were adjusted by 1:1 matching on propensity score.

**Results:** Data from 1588 consecutive CS cases (787 in pre group and 801 in post group) were analyzed, with 708 cases per group after propensity score matching. There was no change in blood loss or transfusion use between groups; however oxytocin and additional uterotonics use were both significantly increased with R3 (Table). The proportion of women receiving more than 10IU of oxytocin intraoperatively was 44.2% in the PRE group vs 55.6% in the POST group ( $p=0.00006712$ ).

**Conclusion:** There was no reduction in blood loss after implementation of a risk-stratified oxytocin protocol, despite a higher dose of intraoperative oxytocin and increased usage of 2nd line uterotonics. Obstetricians' impression was that uterine tone was significantly improved with the new protocol. We acknowledge that our protocol may result in relatively high oxytocin dosing in women with initial high-risk or with poor uterine response, and that we did not evaluate the hemodynamic effects of high oxytocin dosing. We will continue to explore whether refining the protocol, particularly to reduce the infusion rate in the high-risk arm, may be beneficial.

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## Neuraxial Ultrasound Educational Card for Preprocedural Ultrasound Use on Labor and Delivery

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**Co-Author:** Emily Naoum, MD; Rebecca Minehart, MD, MSHPEd

**Introduction:** Ultrasound guidance for neuraxial regional procedures assists conventional landmark-based techniques for epidural catheter placement, allowing practitioners to precisely identify needle insertion points, spinal midline, optimal angle of needle insertion, and the approximate depth of the epidural space[1]. This can greatly facilitate higher first pass success rates, reduce the number of attempts, reduce procedure-related complications, and improve quality of analgesia as well as patient satisfaction[2]. We designed an educational tool to aid novice neuraxial ultrasound adopters to more consistently use ultrasound prior to performing neuraxial anesthetic techniques and introduced it as a quality improvement initiative.

**Methods:** In January 2021, a neuraxial ultrasound educational card (NUEC) was developed as a guide for obtaining and optimizing common neuraxial ultrasound imaging planes, focusing on oblique parasagittal and transverse views (Fig 1). It consisted of instructions of how to obtain each view and how to optimize the view with corresponding images. Prior to its implementation, we assessed frequency of ultrasound use over a 2-week period for all elective neuraxial regional anesthetics on the labor and delivery floor at MGH. Following a brief tutorial and introduction of the teaching tool, a subsequent 2-week period was assessed for frequency of preprocedural neuraxial ultrasound.

**Results:** During the 2-week period prior to implementation of the NUEC there were a total of 43 non-emergent neuraxial anesthetics administered to patients (7 preprocedural ultrasound; 16.2% utilization rate). Following introduction and implementation (where the NUEC was emailed to all residents), the following 2-week period showed a total of 42 non-emergent neuraxial anesthetics provided (31 preprocedural ultrasound; 73.8% utilization rate,  $X^2 = 28.4479$ ,  $p < 0.001$ ).

Fig 1 uploaded separately

**Discussion:** In a short time period, we demonstrated significantly enhanced use of neuraxial ultrasound associated with introducing our educational tool. We aim to determine whether the NUEC supports sustained use of neuraxial ultrasound. Limitations of the results of this study include a brief duration of usage, and implementation at a single site, along with other confounders not yet identified that may explain increased use. Although debate exists around whether neuraxial ultrasound increases the success rate for patients with palpable landmarks, there is generalized consensus of its benefits in obese parturients and patients with abnormal anatomy[3]. Future aims include further analysis on whether neuraxial imaging increases the success rate of epidural catheter replacements, which is currently ongoing.

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## Cost of Care of COVID-19 Positive Parturients Delivered with Labor Epidural Analgesia

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**Co-Author:** Shobana Murugan, MD; Kristine S. Lane; James Lane, n/a; Alexandria Lehrmann, Rovnat Babazade, MD

**Introduction:** Labor epidural analgesia (LEA) is one of the most effective methods in pain management for obstetric population (REF). Management of COVID-19 disease in pregnancy needs understanding of physiology of pregnancy, fetoplacental unit, and ability to adapt and apply the critical care principles to this population. Though majority of pregnant patients, who test positive for SARS-CoV-2, remain asymptomatic or have mild disease and recover, a significant number develop critical illness and may have prolonged and complex disease courses. To our knowledge there is no study to explore the cost of care of COVID-19 positive patients during labor with LEA. The purpose of our study is to find whether there is increase in cost of care of COVID-19 positive patients admitted for vaginal delivery with LEA.

**Materials and methods:** The study has been approved by the Institutional Review Board (IRB#20-0278). This is a retrospective study of 27 COVID-19 positive pregnant patients between the dates of March 2020 and September 2020 who received LEA. The study included pregnant women between 16 to 45 years of age of any parity, who tested COVID-19 positive at the time of admission or in three days of admission for labor. The data regarding their cost of care from admission to discharge from hospital perspective, epidemiological factors, complications, medications, imaging, laboratories, anesthetic management and pregnancy outcomes were recorded. The patients included in the study were uncomplicated patients who had no epidural replacements, post dural puncture headache and epidural blood patch done. The total cost of epidural placement was obtained for COVID positive patients and the values were compared with standard cost of epidural placement in labor and delivery unit at our institution.

**Results:** The COVID-19 positive patient demographics are shown in Table 1. The cost of care from hospital perspective for delivery with LEA in COVID is in Table 2. The total cost associated with uncomplicated epidural placement in COVID positive patient for vaginal delivery was 22108.20\$. The minimum cost 12703.13\$ and the maximum was 89437.66\$. The median value was 17896.15\$. 1st quartile was at 16571\$ and 3rd quartile was at 22000.26\$. In comparison, the cost of care from hospital perspective for planned vaginal delivery in non COVID patients in our institution was 17414.53 ± 6335.22 \$with median value of 16272.40\$

**Discussion:** To our knowledge this is the first study from USA which analyzed cost of care of COVID-19 positive patients admitted for vaginal delivery with LEA. Our study showed that the median cost associated with the cost of care of COVID-19 positive patients was 1,624\$ greater than the average cost of care in non COVID patients for planned vaginal delivery with LEA.

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## Candidate Gene Association Study of Severe Acute Pain Following Cesarean Section

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**Introduction:** Severe post cesarean pain occurs in 1 in 5-10 patients and is associated with decreased breastfeeding, increased hospital length of stay, and the development of chronic pain and postpartum depression.<sup>1-3</sup> Many studies have demonstrated associations with genetic variants and postoperative pain in the general surgical population.<sup>4</sup> However, only a handful of studies have evaluated their roles in post cesarean pain.<sup>4</sup> In this study, we investigated whether single-nucleotide polymorphisms (SNPs) previously associated with acute postoperative or labor pain could predict severe acute pain following cesarean section in a cohort from our tertiary care center.

**Methods:** After a literature review, we identified 7 genes from at least one study that were associated with acute postoperative or labor pain. The following SNPs were selected for statistical analysis: ABCB1 rs1045642, OPRM1 rs1799971, ADRB2 rs1042714, COMT rs4680, HTR2A rs6313, KCNS1 rs734784, and P2RX7 rs1718125. We next obtained the genotype status for these SNPs for patients of European ancestry who underwent cesarean section under neuraxial anesthesia from January 2015 through December 2020 from the Mass General Brigham Biobank. For each patient, we extracted the in-hospital postoperative pain scores. Our primary outcome was area under the curve for pain scores over the first 48 hours after surgery. Multivariable linear regression analysis was used to assess the relationship between SNP frequency and post cesarean pain.

**Results:** For inclusion in this study, we identified a total of 97 cesarean sections under neuraxial anesthesia that had genetic and clinical information available. 65 were performed under spinal anesthesia and 32 under epidural. The median (IQR) area under the pain curve for the first 48 hours was 126.2 (103.8  $\geq$  160.1), with an average mean (SD) pain score of 2.9 (1.2). Using a multivariable linear regression model, no associations were detected between any of the single-nucleotide polymorphisms and area under the pain curve (Table 1).

**Discussion:** In our study, we did not detect any associations between the selected candidate genetic variants and pain scores in the first 48 hours following cesarean section. The relationship between specific SNPs and pain after cesarean section is complex and may involve additional environmental and epigenetic factors. In the future, larger patient sample may be needed to validate genetic variants as predictors and would allow for inclusion of other covariates in the analysis.

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<b>Gene</b>	<b>SNP</b>	<b>Difference in mean area under the 0-48 hour postoperative pain curve between patients with and without SNP (95% CI)</b>	<b>P value</b>
<i>ABCB1</i>	rs1045642	7.7 (-15.9, 31.3)	0.521
<i>OPRM1</i>	rs1799971	13.5 (-20.6, 47.6)	0.437
<i>ADRB2</i>	rs1042714	-5.7 (-46.8, 35.4)	0.786
<i>COMT</i>	rs4680	4.2 (-24.3, 32.8)	0.771
<i>HTR2A</i>	rs6313	12.3 (-10.7, 35.3)	0.295
<i>KCNS1</i>	rs734784	7.5 (-17.7, 32.7)	0.560
<i>P2RX7</i>	rs1718125	-7.0 (-34.8, 20.8)	0.621



## Association of acute kidney injury and adverse maternal outcomes: a multistate analysis, 2007-2018

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**Introduction:** Acute kidney injury (AKI), a condition described as an abrupt decrease in kidney function, is a well-known complication during hospitalization that increases morbidity and mortality. Although there are a limited number of studies to date, initial research suggests an association between AKI during the delivery hospitalization and poor maternal outcomes. The goal of this study was to use a large multistate administrative database to better understand the relationship between AKI in pregnancy and adverse maternal outcomes.

**Methods:** We performed a retrospective analysis of delivery hospitalizations in California, Florida, New York, Maryland, Kentucky, and Washington State (age 18+) using the State Inpatient Databases (SID), Healthcare Cost and Utilization Project (HCUP) for years 2007-2018. We compared unadjusted rates of patient demographics, comorbidities, and peripartum complications by acute kidney injury (AKI) status. We fit multilevel multivariable models clustered on hospital to calculate the adjusted association of AKI with inpatient mortality, severe maternal morbidity (SMM), hospital length of stay, and total charges. Outcomes are reported as percentage (N), adjusted odds ratios (aOR), 99% confidence interval (CI), or adjusted incidence rate ratios (aIRR). All analyses were conducted in SAS 9.4 and Stata SE 16.

**Results:** The sample consisted of 9,561,813 parturients, of which 3,196 carried a diagnosis of AKI (0.03%). Patients with AKI were more likely to have preexisting hypertension, known chronic kidney disease, congenital heart disease, and preexisting diabetes than patients without AKI. After adjustment for patient demographics, pregnancy-related comorbidities, and hospital characteristics, patients with AKI were more likely to die in-hospital (aOR 97.42, 99% CI 67.26-141.11), experience SMM (aOR 60.59, 99% CI 54.15-67.79), have a longer length of stay (logged, aIRR 1.30, 99% CI 1.26-1.34), and higher total charges (logged, aIRR 1.93, 99% CI 1.89-1.98) than those without AKI.

**Conclusions:** Patients with AKI in pregnancy have a significantly higher likelihood of in-hospital mortality and SMM as compared to those who do not develop AKI. They also are more likely to have longer lengths of hospital stay and higher total charges incurred during the delivery hospitalization. More research and collaborative efforts are needed to reduced pregnancy-related AKI and its associated adverse maternal outcomes.

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**Neuraxial to general anesthesia conversion has equitable intraoperative and improved postoperative outcomes compared to general anesthesia in cesarean hysterectomy for Placenta Accreta Spectrum (PAS)**

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**Abstract :**

Placenta Accreta Spectrum (PAS) represents a series of placental invasive disorders with an estimated incidence of 1:1000. Delivery and subsequent cesarean hysterectomy for PAS is associated with significant maternal morbidity and mortality. In the multidisciplinary management of PAS cesarean with subsequent hysterectomy, urinary stent placement, central vascular access and preparation for interventional radiology procedures can result in prolonged pre-operative timing. Neuraxial anesthesia may be utilized initially with subsequent conversion to general anesthesia after delivery of the fetus as an alternative to initiating with general anesthesia. We analyzed 85 cases of pathology-confirmed PAS patients who underwent cesarean hysterectomy in singleton, non-anomalous, viable pregnancies. All patients were delivered at our institution's established Placenta Accreta Program from 2005-2020. Fifty-two (61%) patients underwent general anesthesia and thirty-three (39%) patients underwent neuraxial anesthesia (collectively spinal, epidural and combined spinal-epidural) converted to general anesthesia after cesarean delivery. Baseline demographics between groups were similar. Pre-operative ASA airway assessment of III/IV was equivalent between groups (94% and 82%,  $p=0.08$ ). Intraoperatively, neuraxial conversion and general anesthesia were equal with respect to operative time (241 vs 261 min,  $p=0.47$ ), estimated blood loss (6039 vs 8134 mL,  $p=0.51$ ) and lowest mean arterial pressure (57.9 vs 61.63). Post-operatively, ICU admission (47% vs 46%,  $p=1.0$ ) and intensive care length of stay was equivalent ( $p=0.07$ ), yet total post-operative length of stay was significantly reduced in patients who underwent neuraxial anesthesia (3.76 vs 6.35 days,  $p=0.02$ ). In addition, while general anesthesia was associated with a greater sonographic suspicion for placenta percreta (40% vs 12%,  $p=0.007$ ), final pathology was equivalent (52% vs 60%,  $p=0.5$ ). Taken together, our data shows neuraxial conversion to general anesthesia has equivalent intra-operative parameters with improved post-operative outcomes when compared to general anesthesia alone in the case of cesarean hysterectomy for Placenta Accreta Spectrum disorders.



**Application of the Surgical APGAR Score (SAS) to predict intensive care unit admission and post-operative outcomes in cesarean hysterectomy for Placenta Accreta Spectrum (PAS)**

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**Abstract :** Placenta Accreta Spectrum (PAS) disorders are a continuum of abnormal placentation conditions associated with significant maternal and fetal morbidity. Management of PAS requires coordinated cesarean hysterectomy at 34-36 weeks gestation. Associated morbidities include blood transfusion (82%), coagulopathy (29%) and intensive care unit (ICU) admission (26-50%). Accurate prediction of ICU admission allows for enhanced multidisciplinary management, coordination of care and utilization of resources. The Surgical APGAR Score (SAS) is a 10-point scale which assesses lowest heart rate, mean arterial pressure and estimated blood loss and has been validated for the prediction of ICU-level care requirements within 72 hours post-operatively. A SAS score of 0-4 is considered high risk for ICU admission. In this study, we analyzed 115 cases of pathology-confirmed PAS patients who underwent cesarean hysterectomy in singleton, non-anomalous, viable pregnancies. All patients were delivered at our institution's established Placenta Accreta Program from 2005-2020. Fifty patients (43%) were admitted post-operatively to the ICU while, 65 patients (57%) were admitted for routine care to the post-anesthesia care unit. Baseline demographics were similar between groups. 37 patients (67%) admitted to the ICU and 40 patients with routine post-operative care (61%) had a SAS score < 4. ICU admission was associated with greater estimated blood loss (2585 vs 10645 mL,  $p=0.0005$ ), no difference in lowest MAP (59 vs 61,  $p=0.24$ ) or lowest heart rate (69 vs. 74,  $p=0.06$ ). Logistic regression analysis of SAS score and ICU admission revealed a low predictive value (65.38%, AUC =0.759) as well as ICU length of stay (67%, AUC 0.755). Given the overall surgical morbidity associated with PAS cesarean hysterectomy, the SAS score is a poor tool for the prediction of ICU admission and further risk factor assessment will be required to optimize patient outcomes.



## **Selection of general anesthesia negatively impacts neonatal outcomes in cesarean hysterectomies for placenta accreta spectrum**

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**Abstract :** Placenta accreta spectrum (PAS) represents a continuum of placental invasion pathologies characterized by significant maternal morbidity and mortality. The recommended approach to PAS management is cesarean hysterectomy at time of delivery at approximately 34-36wk gestation. Given multidisciplinary approach to PAS cesarean hysterectomy, the selection of general vs neuraxial anesthesia depends on many maternal and pathology-specific factors. However, the impact of anesthetic selection on neonatal outcomes has not yet been assessed. In this study, we analyzed 115 maternal/neonatal dyads from pathology-confirmed PAS patients who underwent cesarean hysterectomy in singleton, non-anomalous, viable pregnancies. All patients were delivered at our institution's established Placenta Accreta Program from 2005-2020. Fifty-two (45%) patients underwent general anesthesia and sixty-three (55%) patients underwent neuraxial anesthesia (collectively spinal, epidural and combined spinal-epidural). Baseline demographics between groups were similar. General anesthesia was found to be associated with earlier gestational age at delivery (33.1 vs 35.1 weeks,  $p=0.003$ ) and greater suspected severe PAS pathology (21 vs 4 percreta,  $p<0.001$ ). There was no difference in the number of prior cesarean sections ( $p=0.59$ ) or emergent deliveries ( $p=0.150$ ). With respect to neonatal outcomes, general anesthesia was associated with lower overall birthweight (2203g vs 2683g,  $p=0.001$ ), greater rate of intubation (30 vs 7,  $p<0.001$ ), longer length of neonatal ICU admission (31.3 vs 11.5 days,  $p=0.003$ ), and higher rates of APGAR scores  $<5$  at 1 minute (29 vs 2,  $p<0.001$ ) and at 5 minutes (13 vs 2,  $p=0.006$ ). Subgroup analysis for neonates  $<34$  weeks receiving general anesthesia remained significant for APGAR scores  $<5$  at 1 minute (29 vs 2,  $p<0.001$ ), and the number of neonates requiring intubation (28 vs 6,  $p=0.004$ ). Subgroup analysis of neonates  $>34$  weeks of whom received general anesthesia was significant for APGAR scores  $<5$  at 1 min (5 vs 1,  $p=0.001$ ), APGAR at 5 min (2 vs 0,  $p=0.047$ ), and lower birthweight (2667g vs 3087g,  $p=0.008$ ). Although general anesthesia was associated with worse suspected pathology, final pathology for percreta was not statistically significant (27 vs 30,  $p=0.71$ ). These findings were independent of antenatal steroid administration (30 vs 36,  $p=1.0$ ). Overall, we conclude that while general anesthesia is more commonly utilized for earlier gestations with suspected severe PAS pathology, the impacts on neonatal outcomes such as intubation, suppressed APGAR scores, and neonatal ICU length of stay proved to be significant, despite no difference in final pathology. Thus, when undergoing multidisciplinary planning for PAS cesarean hysterectomy, we recommend patient counseling on overall neonatal impact and consideration of initiating neuraxial anesthesia with the capability of conversion to general anesthesia after delivery and in preparation for hysterectomy.



## Carbetocin versus oxytocin following vaginal and cesarean delivery: a before-after study

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**Co-Author:** Kristi Downey, MSc; Bernard Ma, n/a; Wendy Whittle, n/a; Jose Carvalho, MD PhD;

**Introduction:** Oxytocin is the routine postpartum uterotonic drug at our institution. A nationwide shortage of oxytocin resulted in an abrupt temporary switch from oxytocin to carbetocin for all postpartum patients at our institution. This temporary change in practice offered a unique opportunity to conduct a pragmatic comparative assessment of the efficacy of carbetocin and oxytocin to prevent postpartum hemorrhage.

**Method:** This was a retrospective before-after study. Medical records from 641 and 752 women were retrospectively reviewed and included in the analysis in the carbetocin and oxytocin groups respectively. The standard carbetocin dosing was 100 mcg intravenous bolus following vaginal delivery and intrapartum cesarean delivery, while for elective cesarean delivery it was 50 mcg intravenous bolus, with an additional 50 mcg bolus used if required. The standard oxytocin dosing was 5 IU intravenous bolus followed by 20 IU/L maintenance at a rate of 120 ml/hour for 4-6 hours following vaginal delivery, while for cesarean delivery it was 1-3 IU boluses, 3 minutes apart, up to 10 IU, followed by 20 IU/L maintenance infusion at a rate of 120 ml/hour. In both modalities of delivery, if uterine tone was suboptimal, the maintenance solution could be changed to 40 IU/L with the same infusion rate, and additional uterotonic drugs were used as required. Outcomes of interest were the need for additional uterotonic drugs, estimated blood loss and calculated blood loss (only for cesarean deliveries), the occurrence of postpartum hemorrhage and the need for blood transfusion.

**Results:** The incidence of postpartum hemorrhage was higher in the carbetocin group compared to the oxytocin group (10.3% versus 6.6% respectively,  $p=0.01$ ). More women in the carbetocin group required a second uterotonic drug as compared to those in the oxytocin study group (12% versus 8.8%, respectively,  $p=0.05$ ). In addition, more women in the carbetocin group required blood transfusion as compared to those in the oxytocin group (1.4% versus 0.3% respectively,  $p=0.02$ ).

**Conclusion:** Oxytocin is superior to carbetocin for both vaginal and cesarean deliveries when used according to our institutional protocol.

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**Impact of oxytocin administration prior to cesarean hysterectomy for placenta accreta spectrum**

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**Objective:** Placenta accreta spectrum (PAS) is a rare but serious condition with significant risk of severe maternal morbidity and mortality and increased neonatal complications. There is limited evidence to guide intraoperative management to decrease the risk of hemorrhage and other surgical complications. There are no prior studies or clear society guidance regarding use of oxytocin in the delivery of these patients. In a preliminary review of a de-identified multicenter database (TriNetX), we identified considerable differences in practice. Of 622 patients across 22 health care organizations with a diagnosis of placenta accreta spectrum the day of cesarean hysterectomy, 36.6% had had oxytocin ordered while 63.3% did not. Given the lack of consensus in practice, the objective of this study was to assess whether oxytocin administration before cesarean hysterectomy reduces blood loss (EBL) in women with antepartum or intraoperative diagnosis of PAS.

**Study Design:** This was a retrospective cohort study of patients who underwent cesarean hysterectomy for preoperative or intraoperative diagnosis of (PAS) in a single academic institution between 2009 and 2020. PAS diagnoses were confirmed by surgical pathology. The primary outcome was EBL. Secondary outcomes included transfusion, intraoperative time, intensive care unit (ICU) admission, and re-operation.

**Results:** Sixty women underwent cesarean hysterectomy for PAS, including 44 who received oxytocin and 16 who did not. Demographics and disease characteristics including age, body mass index, race, number of prior cesarean deliveries, degree of invasion, and urgency of operation were not different between those who did and did not receive oxytocin. Women who received oxytocin were statistically more likely to have concurrent previa (91% vs 62%) and were delivered at earlier gestational age (31 vs 33 weeks gestation). There was no difference in median EBL between those who did and did not receive oxytocin (2 L [1.5-2.4] vs (2 L [1.5-3] P = .98). Intraoperative time and whether a patient received a transfusion, was admitted to the ICU, or required re-operation were not statistically different between the two groups.

**Conclusion:** Our study demonstrates that receiving oxytocin before cesarean hysterectomy for PAS has no significant effect on EBL or other surgical complications. To our knowledge, this study provides the first report on oxytocin use and surgical outcomes in women with PAS. Filling this knowledge gap is important as there is no current consensus in recommending oxytocin use for women with PAS. Some providers avoid use in this context due to concern uterine contraction will lead to placental disruption and increased bleeding. Some providers routinely use it with the consideration that an atonic uterus is more challenging to operate on and carries its own risk of hemorrhage. Therefore, concerted efforts need to be made to assess the impacts of oxytocin and other uterotonics in the management of PAS.



**Comparison of Carbetocin administration as a Bolus or as an Infusion on maternal heart rate using a phenylephrine infusion for cesarean delivery under spinal anesthesia.**

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**Introduction:** Carbetocin is a structural analog of oxytocin with an approximate half-life of 40 minutes, thus providing the advantage of a single dose injection rather than a continuous infusion. Carbetocin and oxytocin have similar mechanisms of action and hemodynamic profiles, with maternal tachycardia being a frequently reported side effect. 1, 2 Phenylephrine infusion prevents spinal anesthesia-induced hypotension during cesarean delivery. 3 The goal of this study was to compare the effect of a slow infusion to a rapid bolus of carbetocin on maternal heart rate.

**Methods:** In this prospective, double-blinded, controlled trial, 70 healthy parturients undergoing an elective cesarean delivery under spinal anesthesia were randomised in 2 groups. At cord clamping, the subjects either received carbetocin 100 µg as a rapid intravenous bolus, or received carbetocin 100 µg slowly over 10 minutes. All parturients received a phenylephrine infusion adjusted to maintain systolic blood pressure within 20% of baseline value. We aimed to detect a decrease by 10% in maximum heart rate in the infusion group in comparison with the bolus group, with an  $\alpha$  value set at 0.05 and power of 80%.

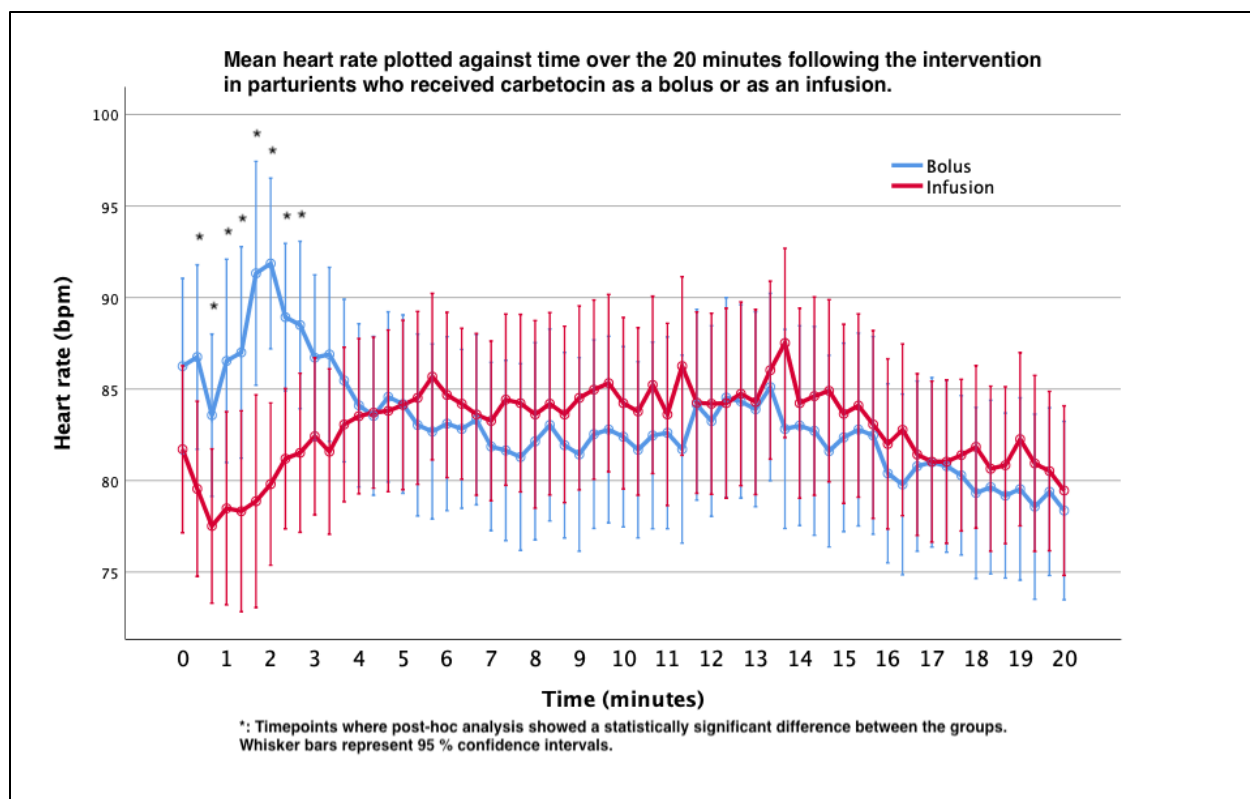
**Results:** 60 patients completed the study. There was no difference between the groups with regards to baseline characteristics, hemodynamic parameters and intraoperative data. The maximum heart rate measured at any timepoint during the 20 minutes following cord clamping was similar between the groups (Bolus :  $111 \pm 19$  bpm vs Infusion :  $103 \pm 18$  bpm ;  $P = 0,098$ ). The increase in heart rate occurred significantly earlier in the bolus group than in the infusion group (105 [69-570] seconds vs 485 [255-762] seconds ;  $P = 0,021$  and RM-ANOVA group\*time :  $P = 0,0299$ ). There was no significant difference between the groups in systolic and mean arterial blood pressure.

**Conclusion:** When parturients are receiving a prophylactic phenylephrine infusion, carbetocin infused over 10 minutes does not reduce the maternal tachycardia when compared to a rapid bolus. However, the slow infusion of the uterotonic delays maternal tachycardia. This combination of phenylephrine infusion and a short carbetocin infusion may provide an alternative strategy for parturients at risk of cardiac events at delivery and for those with preexisting cardiomyopathy.

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## **Cesarean Hysterectomy for Placenta Accreta Spectrum: Comparison of Two Management Strategies**

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**Objective:** The objective of this study is to compare maternal outcomes during 2 time periods (T1 10/2016 - 09/2018; T2 10/2018 - 09/2020) using 2 strategies in the multidisciplinary management of placenta accreta spectrum (PAS).

**Study Design:** This is a retrospective cohort study of viable singleton pregnancies with a confirmed pathologic diagnosis of PAS who underwent elective surgical management. During T1, the multidisciplinary approach included the use of interval hysterectomy in the most severe cases of PAS at the discretion of the covering surgical team. In the T2 period, primary hysterectomy at the time of cesarean delivery was performed by a consistent and dedicated multidisciplinary team. The main outcome variables included estimated blood loss (EBL), maternal transfusion, surgical complications, and patient complications during the waiting period in the interval hysterectomy group. Comparisons were made using the X2 test, Fisher's exact test and the Wilcoxon rank sum test.

**Results:** 51 women were included in the study (T1 25; T2 26). Results are summarized in Table 1.

The proportion of women with placenta increta/percreta was similar in both groups (64% during T1 and 77% during T2,  $p=.31$ ). The median EBL was 3L during T1 and 1L during T2 ( $p<.0001$ ). The percentage of women requiring any RBC transfusion was 92% during T1 and 42% during T2 ( $p=.0002$ ), and 60% required more than 4uRBC during T1, whereas 12% did during T2 ( $p=.0002$ ). The rate of urinary tract complications was 20% in T1 and 7.7% in T2 ( $p=.25$ ). During the waiting period in the interval hysterectomy group, 3/10 (30%) women developed a complication requiring an emergency hysterectomy.

**Conclusions:** The use of the delayed hysterectomy approach was not associated with improvement in outcomes. The institution of a consistent multidisciplinary team may be associated with improvement in maternal outcomes, however further studies are warranted to assess its effect in the management of PAS.



# The Effects of Bolusing Fentanyl Through the Labor Epidural Upon Initiation of Labor Epidural Analgesia

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Neuraxial analgesia is considered the gold standard for managing labor pain.<sup>1</sup> Its contribution to labor progression and maternal and fetal outcomes has long been disputed. However, its use has become widespread as its benefits seem to outweigh the negative effects. Fetal bradycardia is a known negative effect associated with spinal opioids.<sup>3</sup> Multiple studies suggest that other fetal heart tracing abnormalities can present in the setting of both spinal and or epidural opioids.<sup>1</sup> This study intends to clarify whether neuraxial opioid's deleterious effects are just associated with spinal or also extend to epidural analgesia.

We conducted an IRB-approved retrospective chart review of the Henry Ford West Bloomfield campus labor and delivery. Of the 581 patients screened for labor epidural initiation from June–December 2017, 321 had an epidural placed with a 100mcg fentanyl bolus in conjunction with a local anesthetic. We worked with our institutional obstetricians to interpret fetal heart tracings: before (control) and after (test) the epidural for one hour each. We hypothesized that 100mcg fentanyl bolus on the initiation of labor epidural would not affect fetal and maternal wellbeing and outcomes. Variables analyzed included demographics, fetal heart tracing changes, maternal mean arterial pressure (MAP), cesarean section conversion, Apgar score and fetal blood gases. Notably, fetal heart tracings were evaluated for bradycardias, repetitive late decelerations (RLD), repetitive variable decelerations (RVD) and long-term variability (LTV).

Among the 256 patients with no prior RLD, 22 experienced RLD after receiving the fentanyl bolus (statistically significant  $p < 0.001$ ). In those who developed RLD, the cesarean section rate was significantly higher (35%) compared to those who did not develop RLD (13.9%). BMI was also significantly higher in the RLD group (median 32.4) compared to the non RLD group (median 30.0). No difference was found in maternal MAP between the RLD group and the non RLD group. There was no difference observed for RVD and LTV before and after the fentanyl bolus.

After epidural analgesia initiation with fentanyl bolus, a significant number of patients developed RLD. This group was also associated with significantly higher BMI and cesarean section rates. Further research is needed to investigate the safe and effective use of epidural fentanyl boluses taking into account neonatal outcomes, quality of labor analgesia, and maternal satisfaction and wellbeing.

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## Evaluation of the Safety of Labor Analgesia Initiated with Low-Dose Local Anesthetic Injection Through Epidural Needle Prior to Epidural Catheter Placement

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**Background:** Initiation of epidural labor analgesia with local anesthetic injected through the epidural needle prior to catheter placement is a controversial technique in the obstetric anesthesia literature. Concerns include potential intrathecal and intravascular injection of local anesthetic. This study was conducted to better define the risks of intravascular injection or high spinal anesthetic level secondary to the injection via epidural needle technique.

**Methods:** This single center, retrospective chart review proof of safety study identified patients receiving epidural labor analgesia between 2015 and 2018 for whom labor analgesia was initiated with the injection of a high volume of low-dose local anesthetic (15 to 20 cc's of either bupivacaine 0.125% or bupivacaine 0.0625% + fentanyl 2 µg/mL). Risk estimates of intrathecal or intravascular injection at the time of initiation of labor analgesia were calculated based on the incidence identified in this sample.

**Results:** A total of 957 parturients receiving initiation of labor analgesia using the epidural needle loading technique were identified. No evidence of intrathecal administration (signs of high spinal anesthetic block) or intravascular injection was found. The upper bound of the 95% CI for both high spinal blockade and symptomatic intravascular injection due to the injection via epidural needle technique is 0.3%.

**Conclusions:** While a limited number of studies have described the initiation of labor analgesia with injection of local anesthetic through the epidural needle prior to catheter placement, concern for severe negative consequences remain. This study provides support for the safety of this technique.



## Labour Epidural Information cards in multiple languages – A survey for the necessity and ensuring availability

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**Background:** Labour wards regularly admit patients with limited proficiency of English language. Performing an epidural for labour analgesia can be difficult in these patients due to lack of effective communication. The effective use of an interpreter over a telephone line or finding a translator at short notice is both cumbersome and impractical. Hence we have consciously made an attempt to rectify this issue with a simple but practical solution.

**Materials and Methods:** Hospital audit committee approval was sought and granted for this study. Midwives were surveyed through a questionnaire to find out the incidence of patients who did not speak english as their first language, commonest languages encountered and current practice to give the patients the relevant information about the epidural analgesia.

**Results and Discussion:** 90% of the midwives practicing in our labour ward have encountered patients with limited English knowledge and have requested epidural analgesia. Hindi, Polish and Urdu being the most common out of a total of seventeen languages listed by midwives. Some of the common methods resorted to explain the epidural procedure included use of locally available translators, requesting the birthing partners to translate if they were fluent in English, use of NHS language line, translation apps when available on smartphones or even sign language when everything else failed.

We have since then managed to source printed epidural information sheets in thirty seven different languages. These information sheets were sourced from the Association of Obstetric Anaesthetists. These were printed, laminated and kept in every epidural trolley on the labour ward of our hospital. This information was disseminated to the midwives and other staff who regularly work on the labour ward and we continue to inform everyone on a regular basis during induction programmes to enable and encourage them to use this resource when appropriate.

The utilisation of this resource was reaudited after one year. 97% of the current midwife workforce in our hospital is aware about the availability of this resource. All of them have used this on appropriate occasions over the past year and feel that this has improved care delivery and satisfaction among the patient population.

**Conclusion(s):** Provision of early labour epidural information in a language that the patient understands through use of professional interpretation services or through other means is a recommendation of OAA/AAGBI . This effort of ensuring the availability of Labour epidural information cards in multiple languages has benefitted patients and improved patient care satisfaction and safety.

References: [www.oaa-anaes.ac.uk](http://www.oaa-anaes.ac.uk)



## "To PIE (B) or not to PIE (B)?" - A prospective audit of patient controlled epidural analgesia (PCEA) efficacy for labour at a large tertiary centre

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**Co-Author::** Ania Dean, MBBS, FRCA; Olivia Sherwood, BSc MBBS MRCP FRCA; Nat Nguyen-Lu, BMedSci, BM BS, FRCA

**Introduction:** The optimal protocol for epidurals in labour remains unknown. Our institution aims to introduce a programmed intermittent epidural bolus (PIEB) protocol. We wanted to prospectively review our PCEA labour regime (10mL bolus, 20 minute lockout, no background infusion, 0.1% Bupivacaine and 2mcg/mL Fentanyl) to see if there was a need for change.

**Method:** After hospital audit committee approval, we collected prospective data over two months including patient demographics, cervical dilatation, maternal satisfaction scores, breakthrough pain, need for anaesthetic troubleshooting, degree of mobility, mode of delivery and whether women would like an automatic top-up.

**Results:** Forty-nine women with a mean age of  $32 \pm 4.9$  years and body mass index of  $25 \pm 5.8$  kg/m<sup>2</sup> were included. 93% of epidurals were sited by trainee anaesthetists at an average cervical dilatation of  $3.8 \pm 2.1$  cm with only 8.5% epidurals sited at  $>7$  cm. 44.9% patients said the epidural wore off at some point. Anaesthetists were asked to troubleshoot 32.7% of epidurals, with 43.8% of these requiring anaesthetist top ups. Resite rate of epidurals was 8.5%. Subjectively, 51% patients reported they were not mobile. 85% of women scored their epidural satisfaction as 7/10 or greater and 91.8% would have an epidural again. Only 26.5% women had a spontaneous vaginal delivery, 36.7% had an instrumental delivery and 34.7% underwent caesarean section.

**Discussion:** Our epidural satisfaction rate is below the Royal College of Anaesthetists' standard (98%) suggesting a need for improvement<sup>1</sup>. We have a high degree of breakthrough pain with need for anaesthetic troubleshooting perhaps due to a high number (93%) of trainee operators<sup>2</sup>. Our resite rate meets the standard of  $< 15\%$ <sup>1</sup>. Operative vaginal deliveries are high at 36.7% compared with UK rates of 10-13%,<sup>3</sup> possibly explained by our high-risk patient cohort. With 63% women reporting they would like an automatic top up, the introduction of PIEB has the potential to improve breakthrough pain, maternal satisfaction, motor block and instrumental delivery rate<sup>4</sup>. A re-audit is planned using a PIEB protocol to allow comparison against PCEA.

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## Gravity Flow Technique to Validate Proper Location of Epidural Needle Tip in High BMI Parturients

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**Co-Author:** Jeffrey Bernstein, MD; Andrew P. Agoliaty, MD; Jerome Lax, MD; Ghislaine C. Echevarria, MD; Gilbert J. Grant, MD

**Introduction:** The primary failure rate of epidural analgesia for childbirth is greater in high BMI parturients, e.g., 3% for BMI 31.1 kg/m<sup>2</sup> vs. 17% for BMI 53.4 kg/m<sup>2</sup> (1). The gravity flow technique has been used after standard loss-of-resistance procedures to confirm that the Tuohy needle tip is properly positioned in the epidural space (2), but the technique has not been assessed in high BMI parturients. This study was designed to test the hypothesis that the gravity flow technique is a reliable means to confirm proper Tuohy needle placement in high BMI parturients.

**Methods:** This prospective observational study was designed to enroll 100 high BMI parturients receiving epidural analgesia for labor or epidural anesthesia for cesarean delivery. After written informed consent, a 17g Tuohy needle was used to putatively locate the epidural space using loss-of-resistance to air. Next, a 20 mL syringe was filled with analgesic solution (bupivacaine 0.04%, epinephrine 1.66 mcg/mL, sufentanil 0.4 mcg/mL for labor or 2% lidocaine with epinephrine 5 mcg/mL and sodium bicarbonate 10% v/v for cesarean delivery) and attached via a 3-way stopcock to an 81 cm I.V. extension tubing, which was then primed with the solution. The tubing was then attached to the Tuohy needle hub, the syringe was elevated, and the stopcock opened to entrain an air bubble, which was observed for fluctuation in sync with the maternal pulse. Presence of in sync fluctuation was taken as a confirmation that the Tuohy needle tip was positioned in the epidural space. After the fluctuation was observed, 15 to 20 mL of solution was allowed to flow through the Tuohy by gravity, and a catheter was then threaded. Block success was assessed by bilateral abdominal hypesthesia to ice. In the event that in sync fluctuations were not identified, the operator had the option to repeat the loss-of-resistance technique to locate the epidural space.

**Results:** To date, we have studied 71 parturients: 3 with BMI 30 to 34.9 kg/m<sup>2</sup>, 22 with BMI 35 to 39.9 kg/m<sup>2</sup>, 41 with BMI 40 to 49.9 kg/m<sup>2</sup>, and 5 with BMI 50 to 59.9 kg/m<sup>2</sup>. We observed in sync fluctuations in 69 of the 71 parturients, and bilateral hypesthesia was achieved in these 69 women. In the 2 patients in whom in sync fluctuations were not observed, hypesthesia was absent, pain relief was not obtained, and the epidural procedure needed to be repeated. We continue to enroll patients in this study.

**Discussion:** The presence of epidural pressure fluctuations in sync with maternal pulse accurately predicted epidural analgesic/anesthetic success in high BMI parturients. Conversely, absence of pulsatile fluctuation predicted primary epidural failure. In view of the high primary failure rate reported in high BMI parturients, we suggest using gravity flow to complement the loss-of-resistance technique in order to confirm the proper positioning of the Tuohy needle tip.

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## **Epidural Analgesia for Labor: Comparing the Effects of Continuous Epidural Infusion (CEI) and Programmed Intermittent Epidural Bolus (PIEB) on Obstetric Outcomes**

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**Objective:** In the last few years there is a trend, based on many studies, of transiting from the Continuous epidural infusion (CEI) method for epidural analgesia to a new method -program intermittent epidural analgesia (PIEB). This change brings a betterment of the quality of epidural analgesia, thanks to an increased spread of the anesthetic in the epidural space and a higher maternal satisfaction. Nevertheless, we must make sure that such change of method does not lead to worse obstetric and neonatal outcomes; Therefore, we conducted this work.

**Materials and Methods:** Aretrospective observational case control study. During 2018, we changed the epidural analgesia administration method at our institution, switching from the CEI method to the PIEB method. We compared several obstetrical outcomes between the CEI and PIEB groups, such as the rates of instrumental delivery (primary outcome), rates of cesarean section, duration of first and second stages of labor as well as APGAR scores at 1 and 5 minutes. We further segmented the subjects and examined them in groups of nulliparous and multiparous parturients'.

**Results:** 2696 parturients were included in this study. 1387 (51.4%) parturients' in the CEI group and 1309 (48.6%) parturients' in the PIEB group. No significant difference was found in instrumental or cesarean section delivery rates between groups. This result held even when the groups were differentiated between nulliparous and multiparous. No differences were revealed regarding first and second stage duration or APGAR scores.

**Conclusion:** Our study demonstrates that the transition from the CEI to the PIEB method does not lead to any statistically significant effects on neither obstetric nor neonatal outcomes. We are positive that such an examination must be conducted regarding any change to the anesthetic management of labor in order to guarantee the absence of any negative effects on the process of labor and on the newborn.



## **Timing of epidural catheter insertion and removal in laboring patients with thrombocytopenia**

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**Presenting Author's Institution:** Department of Anesthesia and Pain Management, Mount Sinai Hospital, University of Toronto

**Co-Author:** Kristi Downey, MSc; Jose Carvalho, MD PhD

**Introduction:** Thrombocytopenia in pregnancy, traditionally defined as a platelet count of  $< 150,000/\text{mm}^3$ , comprise of up to 10% of parturients. In this patient population, the fear of serious neurologic complications has led to recommended safe platelet cut-offs ranging from  $70,000/\text{mm}^3$  (1) to as low as  $50,000/\text{mm}^3$  prior to epidural catheter insertion or removal. However, many anesthesiologists are reluctant to place indwelling epidural catheters in women with thrombocytopenia, even with platelets above the most conservative safety cut-offs, for fear of being unable to remove the catheter should the patient's platelet count subsequently fall below this level. While this safety concern is understandable, it often denies gold standard labor analgesia to women for whom neuraxial labor analgesia is the most ideal and effective, such as those with severe preeclampsia. To date, no studies have examined the trend of platelet counts in women with thrombocytopenia in the immediate postpartum period, when the issue of epidural catheter removal might be a concern.

**Methods:** This was a retrospective chart review approved by REB. We included women admitted to the Labour and Delivery floor at our institution between 2014 to 2020 with electronic charting indicating a platelet count of less than  $100,000/\text{mm}^3$  at any point during their admission and placement of an epidural catheter. Their epidural catheter management over the course of their admission was analyzed. Outcomes of interest included platelet count at epidural catheter placement, trends in platelet count, platelet count at epidural catheter removal and length of catheter stay.

**Results:** We identified 453 women who met the inclusion criteria, of which 350 had electronic charting documenting both epidural insertion and removal times. The charts of the remaining 103 women are being reviewed manually. Of the 350 women reviewed electronically, 34 (9.7%) had a platelet count below  $70,000/\text{mm}^3$  at some point after catheter insertion. Of these women, 15 (4.3%) had a platelet count less than  $70,000/\text{mm}^3$  at the time of catheter removal. The lowest platelet count just prior to epidural catheter removal in this group was  $53,000/\text{mm}^3$ . The average length of time that the epidural catheter stayed in after delivery in this group of 34 women was 20 hours compared to 6.4 hours among all 350 women.

**Discussion:** Our preliminary results show that among women with thrombocytopenia receiving an indwelling epidural catheter, more than 95% had platelet count above  $70,000.\text{mm}^{-3}$  within 72 hours after delivery. This finding may offer reassurance to obstetric anesthesia providers who wish to offer epidural analgesia to women presenting with thrombocytopenia.

**References:** 1) American College of Obstetricians and Gynecologists. "Committee on Practice Bulletins, Turrentine M. ACOG practice bulletin no. 207: thrombocytopenia in pregnancy." *Obstet Gynecol* 133 (2019): e181-e193.



# Program Material

## Friday, May 14, 2021

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### Fellows Case Reports

Moderators: Corrine Weinstein, MD; Mark Rollins, MD, PhD; Trish Dalby, MD;  
Laura Sorabella, MD; Joy Schabel, MD

### Research Poster Session #1

Moderators: Gillian Abir, MD; Meredith Albrecht, MD; Katherine Arendt, MD;  
Emily McQuaid-Hanson, MD; Anton Chau, MD; Sharon Reale, MD;  
John Kowalczyk, MD; Emily Dinges, MD

### The Obese Patient for Obstetric Anesthesia

Speaker: C. LaToya Mason-Bolden, MD; Jennifer E. Dominguez, MD

### Labor Analgesia: State of the Art

Speakers: Jeanette R. Bauchat, MD, MS; Elizabeth M.S. Lange, MD





**SOAP 2021**  
Annual Meeting  
Building Bridges & Moving Forward

*A Virtual Event*  
May 13-16  
#SOAPAM2021

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Society for Obstetric Anesthesia and Perinatology

## The Obese Patient for Obstetric Anesthesia

C. LaToya Mason, MD, FASA  
Associate Professor  


Jennifer Dominguez, MD  
Associate Professor  


1

## The Obese Patient for Obstetric Anesthesia

### Identifying Factors in the Preoperative Setting

C. LaToya Mason, MD, FASA  
Associate Professor  
Department of Anesthesiology  
The University of Mississippi Medical Center


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2

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Umbrella can't stop the rain, but can make you stand in the rain.  
Confidence may not bring success but give us power to face any challenge in life.



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3

## Objectives



- Improve care of the obese parturient through a better understanding of associated comorbidities and complications.
- Improve care of the obese parturient through utilization of effective communication practices.
- Improve knowledge of anesthetic considerations for labor analgesia and cesarean delivery in the obese parturient.

4

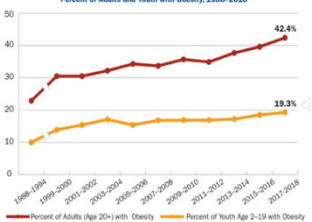
## W.H.O. Classifications of Obesity

BMI range	Classification
25 ≤ BMI < 30	Overweight
30 ≤ BMI < 35	Obesity Class I
35 ≤ BMI < 40	Obesity Class II
40 ≤ BMI < 50	Obesity Class III/morbid obesity
50 ≥ BMI	Super morbid obesity
70 ≥ BMI	Ultra obesity

5

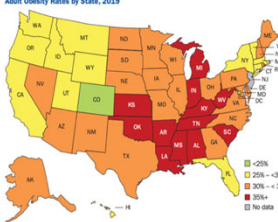
## Adult Obesity is Increasing in the U.S.

**Percent of Adults and Youth with Obesity, 1988-2018**



Source: NHANES

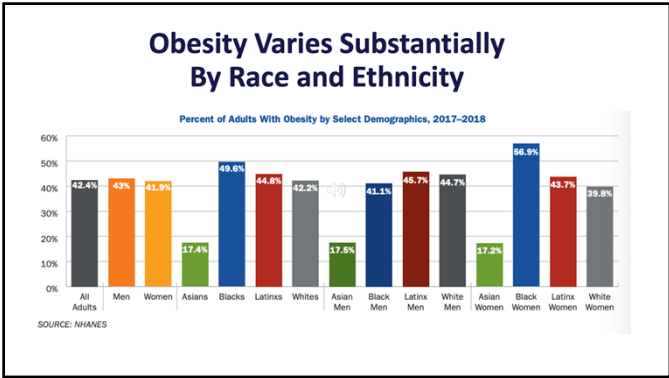
**Adult Obesity Rates by State, 2019**



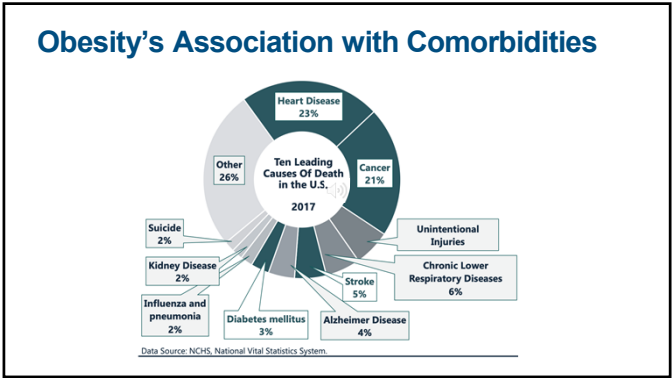
Source: TFH analysis of BRFSS data

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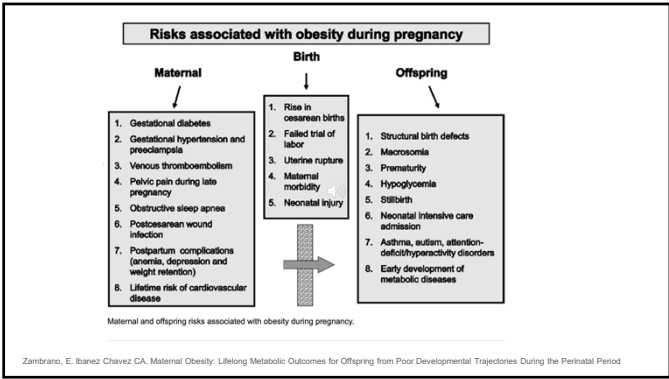




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### Obesity's Impact on Anesthesia

- Longer neuraxial procedure times
- Higher risks of neuraxial failure
- Higher rates of cesarean delivery

**Has been implicated in anesthesia-related deaths**

Taylor CR, Dominguez JE, Habib AS. Obesity and Obstetric Anesthesia: Current Insights. Local and Regional Anesthesia 2019;12: 111-124.

10

**OBESITY IS A RISK FACTOR FOR ANESTHESIA-RELATED MATERNAL MORTALITY.**

UK Confidential Enquiry 2015-17  
Mhyre et al. Anesthesiology 2007; 106: 1096-104.


11



12




## Pre-delivery Planning



**Key Components to Achieving Optimal Outcomes**

- Preconception counseling
- Screening for obesity (using BMI)
- BMI Monitoring throughout pregnancy
- Limiting weight gain
- Multidisciplinary communication
- Anesthetic Consultation (as soon as possible)




Taylor CR, Dominguez JE, Habib AS. Obesity and Obstetric Anesthesia: Current Insights. Local and Regional Anesthesia 2019;12: 111-124.

13

## Proactive Measures by Anesthesia Team

**Key Components to Achieving Optimal Outcomes**

- Early (as possible) Assessment by Anesthesia Team
  - Achieved through pre-anesthesia clinic visits
  - Assessment of *all* patients admitted to intrapartum unit
- Endorsement of standardized handoff practices



14

## Standardized Handoff for Obstetric Anesthesia

**Obstetric Anesthesia Tangible Handoff**

**Introduction**

1. Patient (Identify)

2. Assessment

3. Situation

4. Safety Concerns

5. The

6. Background

7. Actions

8. Timing

9. Ownership

10. Next

**Obstetric Anesthesia Tangible Handoff**

If the patient has one of the following disorders, please answer these questions:

**Hypertensive Disorder of Pregnancy**

**Maternal Diabetes**

**Maternal Pre-eclampsia**


**Other Maternal Issues:**

15

## Proactive Measures by Anesthesia Team

**Key Components to Achieving Optimal Outcomes**


- Preoperative Assessment of *all* patients admitted to L&D
- Awareness of patients admitted to obstetric intake area (via routine review of EMR)
- Maintaining dialogue with obstetrical and nursing colleagues



16

## Multidisciplinary Communication


- Team "Huddles"
- Regular attendance at Obstetric Board Rounds
- Collegial Relationships
- "Watching the Board"



17

## Preparedness and Equipment

- Immediate availability of equipment
- Difficult airway equipment dedicated for L&D
- Positioning pillow
- Routine use of ultrasound to assist in neuraxial placement



18



## Anesthetic Considerations

### Neuraxial techniques are preferred

- Early placement of a well-functioning epidural catheter
- Reliably offers flexible extension of anesthesia regardless of delivery mode
- Assess catheter function at regular intervals and document this accordingly
- Replace "problem" / "high-maintenance" catheters early to minimize risk of failure

Taylor CR, Dominguez JE, Habib AS. Obesity and Obstetric Anesthesia: Current Insights. Local and Regional Anesthesia 2019;12: 111-124.



19

## Anesthetic Considerations

### Neuraxial techniques for labor analgesia

- Epidural
- Combined spinal epidural
- Dural puncture epidural
- Continuous spinal



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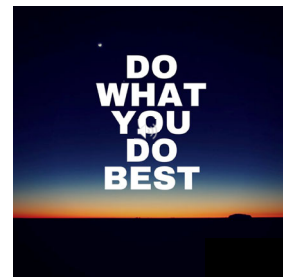
## Anesthetic Considerations

### Management of Spinal Catheters

- Be meticulous in LABELING (catheter and pump)
- Inform the patient, labor nurse, and anesthesia team members
- Documentation
- Maintain sterility: dose through the pump and slowly titrate to effect
- If Cesarean delivery becomes necessary, titrate to T4 surgical level using bupivacaine 0.5% or 0.75%
- Post-cesarean analgesia: 150 mcg preservative-free morphine (per your practice)



21



22

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## References

- Taylor CR, Dominguez JE, Habib AS. Obesity and Obstetric Anesthesia: Current Insights. Local and Regional Anesthesia 2019;12: 111-124.
- Habib A. Obesity in Chestnut's Obstetric Anesthesia.
- UK Confidential Enquiry 2015-17
- Mhyre et al. Anesthesiology 2007; 106: 1096-104
- Zambrano, E. Ibanez Chavez CA. Maternal Obesity: Lifelong Metabolic Outcomes for Offspring from Poor Developmental Trajectories During the Perinatal Period



23


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24





## The Obese Patient for Obstetric Anesthesia: Identifying Factors in the Preoperative Setting


Jennifer E. Dominguez, MD, MHS  
Associate Professor of Anesthesiology  
Program Director, Obstetric Anesthesiology Fellowship Program  
Division of Women's Anesthesia  
Duke Department of Anesthesiology, Durham, NC

 Duke Anesthesiology

1

## Learning Objectives


- Improve care of the obese parturient through a better understanding of associated comorbidities and complications.
- Improve care of the obese parturient through utilization of effective communication practices.
- Improve knowledge of anesthetic considerations for labor analgesia and cesarean delivery in the obese parturient.

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## Learning Objectives


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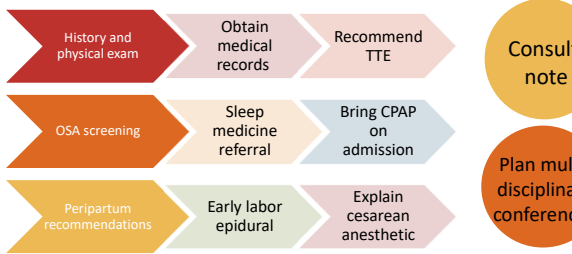
## Obstetric anesthesia consult clinic

- BMI 40-50 kg/m<sup>2</sup> with co-morbidities
- BMI > 50 kg/m<sup>2</sup>
- Obstructive sleep apnea
- Cardiovascular Disease
- Hx major anesthetic complications

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## Obstetric anesthesia consult clinic



```

graph LR
    A[History and physical exam] --> B[Obtain medical records]
    B --> C[Recommend TTE]
    C --> D[Consult note]
    E[OSA screening] --> F[Sleep medicine referral]
    F --> G[Bring CPAP on admission]
    G --> D
    H[Peripartum recommendations] --> I[Early labor epidural]
    I --> J[Explain cesarean anesthetic]
    J --> K[Plan multi-disciplinary conference?]
    K --> D
  
```


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## Prevalence of OSA in Pregnant Women

	Facco et al. 2017	Louis et al. 2012	Facco et al. 2012	Pien et al. 2014	Lockhart et al. 2015	Dominguez et al. 2018	Dominguez et al. unpublished
Cohort	N = 3600 NuMom2B	N = 182 BMI > 30	N = 114 BMI ≥ 30 or high risk	N = 108 Mean BMI = 32	N = 248 Mean BMI = 30	N = 80 BMI ≥ 40	N = 100 50 CHTN; Mean BMI = 38
Early gestation	3%	15%	28%	11%	--	--	cHTN: 64% Controls: 38%
Third trimester	8%	--	--	27%	12%	24%	--

Louis J et al. Obstet Gynecol 2012;120(5):1085-92  
Facco et al. ASAM 2012, 8(4)  
Pien G et al. Thorax 2014;69:971-977  
Dominguez et al. AJOG 2018, 219 (6):611.e1-611.e10.

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### Risk factors for OSA in Pregnant Women

	Louis et al. 2012	Facco et al. 2012	Pien et al. 2014	Lockhart et al. 2015	Dominguez et al. 2018	Louis et al. 2018	Dominguez et al. unpublished
BMI	+	+	+	+	+	+	+
AGE	+	+	+		+	+	+
CHTN	+	+		+			+
Freq Snoring		+				+	
Witnessed apneas					+		
Fall asleep while talking				+			
Fall asleep while driving					+		
Neck circumference					+		+

Louis J et al. Obstet Gynecol 2012;120(5):1085-92  
Facco et al. JCSM 2012, 8(4)  
Pien G et al. Thorax 2014;69:372-377  
Lockhart et al. ASOG 2018, 219 (6):613-615  
Dominguez et al. ASOG 2018, 218 (5):521.e1 - 521.e12

7

### Screening for OSA in Pregnant Women

Validated outside derived cohort:

15 pts - If Frequent loud snoring ( $\geq 3x/\text{week}$ )  
+ 15 pts - If Chronic HTN  
+ Age  
+ Pre-pregnancy BMI

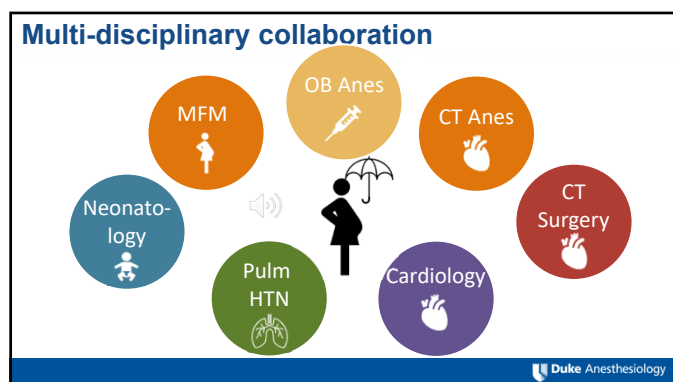
$\geq 75$  pts = RISK OF OSA (Sens 86%, Spec 74%)  
Facco et al. JCSM 2012, 8(4).

Not validated outside derived cohort:

Frequent loud snoring ( $\geq 3x/\text{week}$ )  
+ Age  
+ Pre-pregnancy BMI. **AUC = 0.86**

Louis et al. ASOG 2018, 218 (5): 521.e1 - 521.e12.

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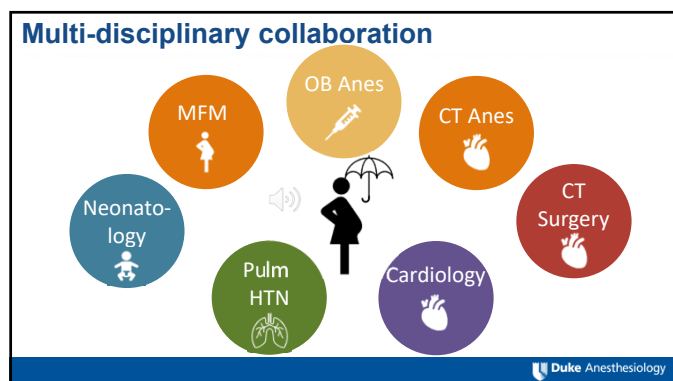
9

### Case - history

33 yo, 22 weeks GA, G2P1, one prior c-section, BMI = 77 kg/m<sup>2</sup>

<b>Cardiovascular disease</b> <ul style="list-style-type: none"> <li>Right heart dysfunction: severe</li> <li>Pulmonary HTN: severe</li> <li>Chronic HTN</li> <li>Recent ICU Admission – volume overload, respiratory failure</li> </ul>	<b>Severe OSA/OHS</b> <ul style="list-style-type: none"> <li>BiPAP (non-adherent)</li> <li>4L Home Oxygen</li> <li>Smoker</li> </ul>	<b>Prior classical c/s</b> <ul style="list-style-type: none"> <li>26 wks – severe prex</li> </ul>
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### Case- plan

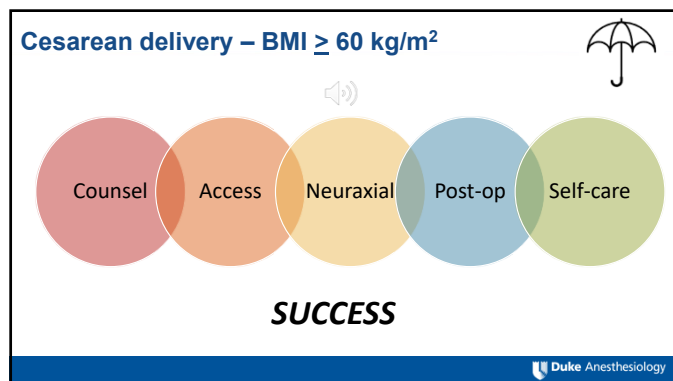
33 yo, G2P1, one prior c-section, BMI = 77 kg/m<sup>2</sup>

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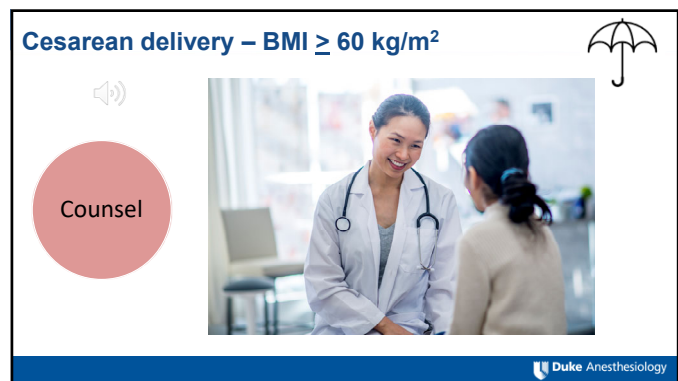
What?	When?	Who?	Where?	How?
<ul style="list-style-type: none"> <li>Mode of delivery</li> </ul>	<ul style="list-style-type: none"> <li>Timing of delivery</li> <li>Plan if off-hours</li> </ul>	<ul style="list-style-type: none"> <li>Which consultants notified/available.</li> <li>How to notify</li> <li>MFM coordinates</li> </ul>	<ul style="list-style-type: none"> <li>Cardiac OR</li> <li>Notify Neonatology</li> <li>ICU post-op</li> </ul>	<ul style="list-style-type: none"> <li>Mode of anesthesia</li> <li>Plan for invasive lines</li> <li>Post-op pain</li> <li>Other resources?</li> </ul>

12





13



14

**Cesarean delivery – BMI  $\geq 60$  kg/m<sup>2</sup>**

Access

1. Obtain a 2nd IV in pre-op
2. Consider ultrasound guidance
3. Consider arterial blood pressure monitoring
4. Cross-match

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**Cesarean delivery – BMI  $\geq 60$  kg/m<sup>2</sup>**

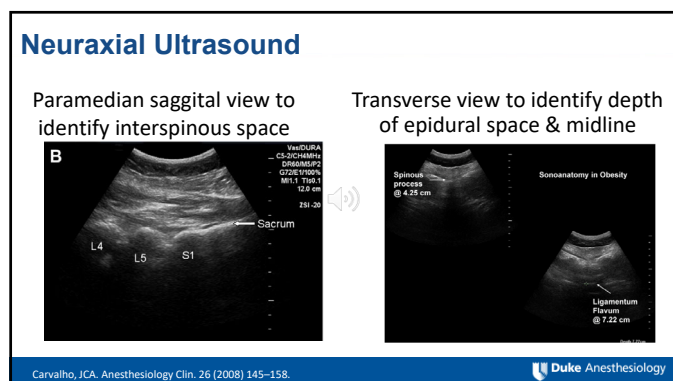
Neuraxial

1. Thoracic epidural
2. Ultrasound guidance
3. Caution with adjuncts

Photo: Polin, CM. Int Journal of Obstetric Anes. 2015; 24(3):276-280.

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17

**Cesarean delivery – BMI  $\geq 60$  kg/m<sup>2</sup>**

Post-op

PF Morphine 100 - 150 mcg  
Acetaminophen  
Ketorolac  
+/- Thoracic Epidural  
PRN oral opioids  
Non-sedating anti-emetics

**AVOID:**  
IV PCA opioids  
Sedating anti-emetics

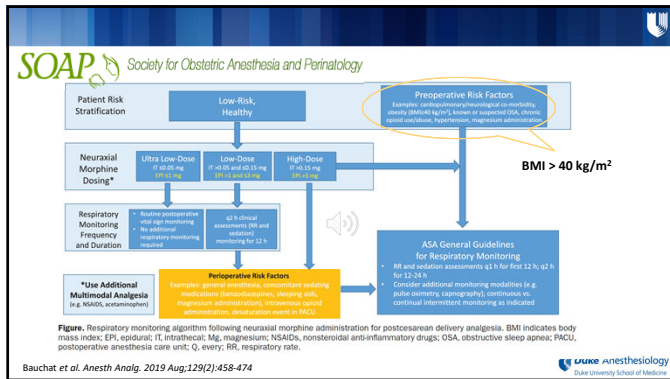
**CAUTION:**  
Intrathecal clonidine  
Concurrent magnesium

Appropriate post-operative monitoring/ Need ICU?

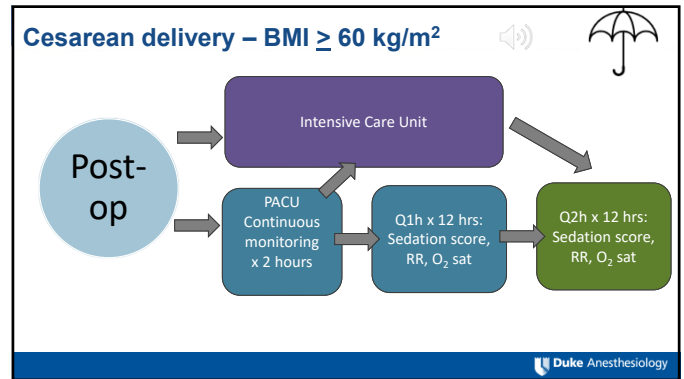
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18

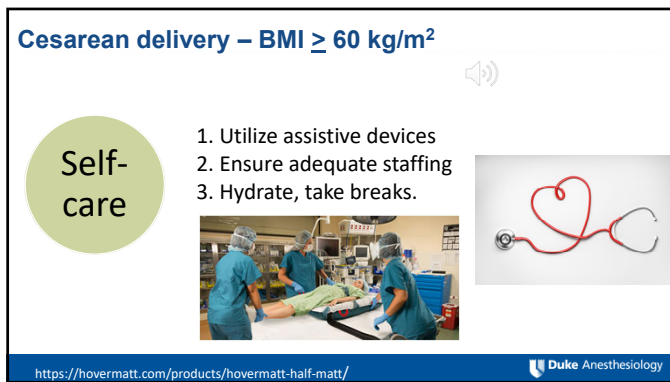




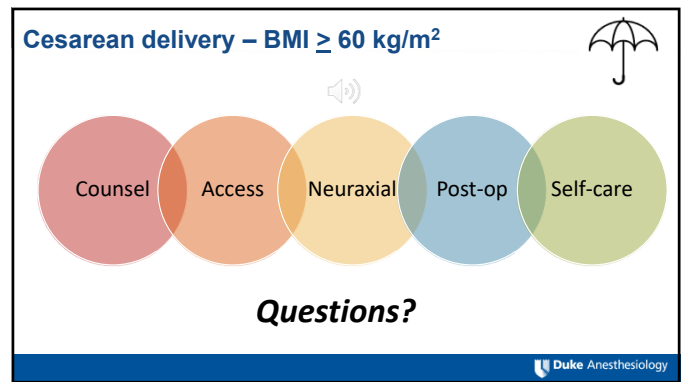
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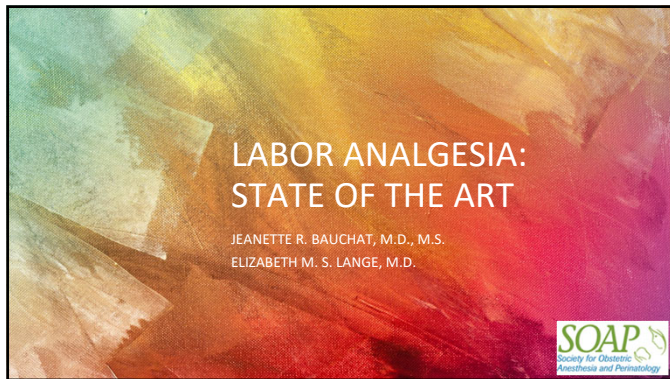


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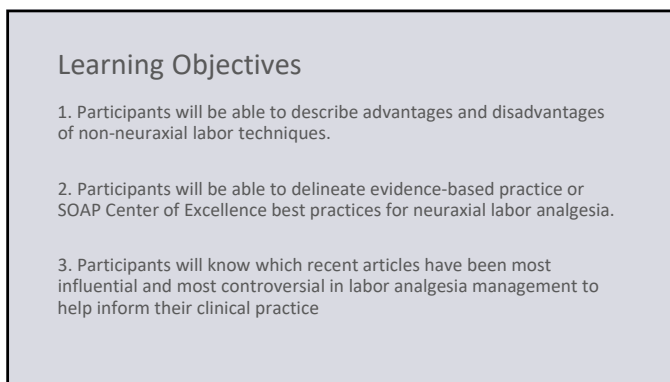




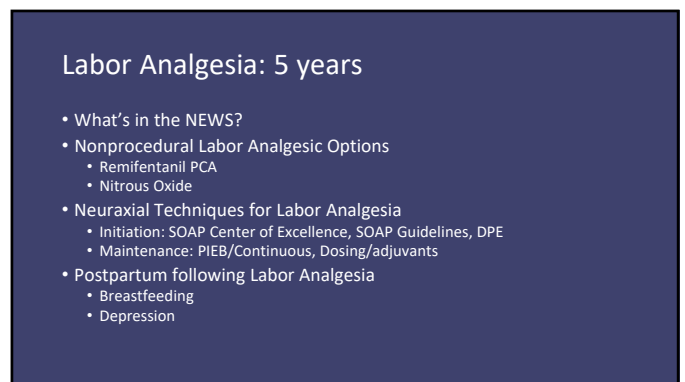
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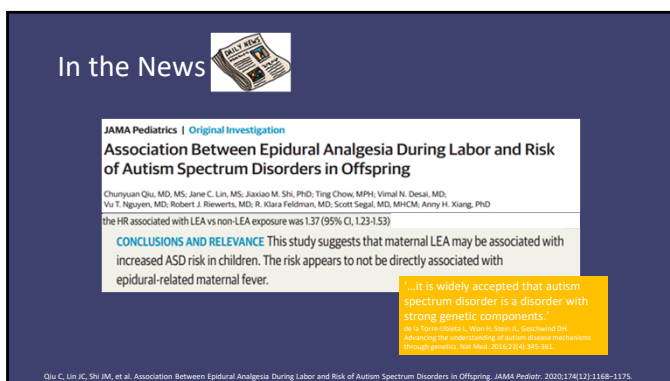
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5



6



## Patient Controlled Opioid Analgesia: Labor

Indications	Limitations	Remifentanyl PCA
<ul style="list-style-type: none"> <li>Neuraxial Contraindication</li> </ul>	<ul style="list-style-type: none"> <li>Maternal opioid-related side effects</li> <li>Neonatal respiratory depression concerns</li> </ul>	<ul style="list-style-type: none"> <li>Neuraxial labor analgesia &gt;&gt; Remifentanyl PCA &gt;&gt; all other Opioid</li> <li>No neonatal respiratory concerns</li> <li>HIGH maternal respiratory concerns</li> </ul>

Weibel S, Jelling Y, Afshari A, et al. Patient-controlled analgesia with remifentanyl versus alternative parenteral methods for pain management in labour. Cochrane Database Syst Rev. 2017 Apr 13;4(4):CD011389.

7

## Patient Controlled Opioid Analgesia: Labor

**THE LANCET**  
Intravenous remifentanyl patient-controlled analgesia versus intramuscular pethidine for pain relief in labour (RESPITE): an open-label, multicentre, randomised controlled trial

Lancet 2018; 392: 662-72

The Lancet / Impact factor  
**60.392**  
2019

8

## This Pain-Relieving Drug Could Reduce The Need For Epidurals In Labour

The findings "challenge the routine use of pethidine" for women giving birth.

By Louise Ridley  
14/08/2018 10:45am BST

**INDEPENDENT**

Pain relief drug could halve number of women needing epidurals during labour, study finds

Remifentanyl is more effective than commonly used medicine, scientists say

**THE LANCET**

Podcast: Pain relief in labour  
"Certain units across the country and in Northern Ireland have already adopted remifentanyl as standard care and it is available on maternal request."

9

## Patient Controlled Opioid Analgesia: Labor

• RESPITE Trial

- Remifentanyl PCA 19% vs pethidine 41% requested epidural
- 13.6% enrollment rate (2950 eligible-> 401 randomized)
- Respiratory depression HIGH in Remifentanyl PCA group

	Remifentanyl PCA group (n=202)	Pethidine group (n=199)	Estimate (95% CI)	p-value
Supplementary oxygen				
Yes	35/96 (44%)	12/61 (20%)		
No	41/76 (54%)	75/78 (96%)	35/97 (45% to 149/42)	<0.001
Reasons for supplementary oxygen				
Low oxygen saturation	31/35 (89%)	11/104 (10%)		
Maternal admission score at	0	0		
Physician request	6/35 (17%)	0		
Low respiration rate (<8 breaths per minute)	1/35 (3%)	0		

10

## Nitrous Oxide: Labor Analgesia

Disadvantages	Advantages
<ul style="list-style-type: none"> <li>In vivo studies demonstrate neuroapoptosis</li> <li>Crosses placenta</li> <li>Pollutant/work exposure</li> <li>Mild analgesic</li> </ul>	<ul style="list-style-type: none"> <li>Not a procedure</li> <li>Maintain movement and perceived control</li> <li>High satisfaction if chosen analgesic route</li> <li>Used for decades in Europe</li> </ul>

11

## Nitrous Oxide: Labor Analgesia

• ESA Task Force N2O in Obstetrics:

- N2O vs placebo- better analgesia, more N/V
- N2O vs pethidine- better analgesia and satisfaction
- N2O vs Remifentanyl- inferior analgesia, less sedation and N/V
- Side Effects in OB:
  - Nausea 8.4%
  - Vomiting 2.3%
  - Dizziness 22.6%
  - Drowsiness 15.4%

Major adverse clinical effects	Evidence level (grade classification)	Incidence
Neurotoxicity (spinal cord)	A	<1/100,000
Hyperoxia	C	<1/100,000
Megalo-blastic anaemia	B	
Pneumothorax (major air leak)	C	3%
Expansion of gas filled spaces	N/A	
Influence on risk of awareness	C	1/1,000
Minor adverse clinical effects		
Increased risk of PONV	A	10-40%
Lung atelectasis (major surgery)	B	1/10
Other		
Occupational air pollution	N/A	
Drug abuse	N/A	
Atmospheric pollution	B	

12



# Initiation Neuraxial Labor Analgesia

SOAP Center of Excellence Criteria

SOAP Consensus Statement on Neuraxial Procedures in Obstetric Patients With Thrombocytopenia

SOAP Consensus Statement on the Anesthetic Management of Pregnant and Postpartum Women Receiving Thromboprophylaxis or Higher Dose Anticoagulants

Epidural vs CSE vs DPE\*

13

# Initiation Neuraxial Labor Analgesia

Practice Guidelines for Obstetric Anesthesia 2015

## Practice Guidelines for Obstetric Anesthesia

An Updated Report by the American Society of Anesthesiologists Task Force on Obstetric Anesthesia and the Society for Obstetric Anesthesia and Perinatology\*

Prior to Initiation	Neuraxial Technique- Labor Analgesia
History/Physical	Continuous infusions*
Labs:	Low Dose w/ opioid
T&S/T&C (if indicated)	Bupivacaine ≤0.125%*
Platelets (if indicated)	
Communication with OB	Patient-controlled epidural analgesia (PCEA)
FHR (pre/post)	Pencil Point Needles
No cervical dilation requirement	
Early/Prophylactic Epidural (ie. TOLAC, Obesity, Difficult Airway)	

14

# SOAP Center of Excellence Criteria 2019

- Expert Opinion
  - Personnel and Staffing
  - Equipment, Protocols, Policies
- Evidence-Based OB Anesthesia Practices
  - Cesarean and Labor Analgesia Practices
- National Guideline Implementation
  - Council on Patient Safety in Women's Health Care
  - SOAP Consensus Statements
- Quality Improvement
  - Anesthesiologist integral member

15

# SOAP Center of Excellence Criteria 2019: Labor Analgesia

COE Topic	Example Recommendations
Staffing	-Supervision presence -Rounding 2-4 hours during maintenance -Follow-up visits
Equipment	-Ability to offer CSE/DPE -Emergency equipment/carts
National Guideline Implementation- SOAP Consensus Guidelines	-Thrombocytopenia -Anticoagulation
Maintenance of Labor Analgesia	-PIEB -Low dose 0.1% bupr or lower
Quality Improvement Efforts	-GA rates for CD -Wet tap rates

16

# Initiation Neuraxial Labor Analgesia: Thrombocytopenia

- Assess Bleeding history
- Underlying Etiology
- Platelet count

Bauer ML, Arendt K, Bollen V, et al. The Society for Obstetric Anesthesia and Perinatology Interdisciplinary Consensus Statement on Neuraxial Procedures in Obstetric Patients With Thrombocytopenia. *Anesth Analg*. 2018;126:928-944.

17

# Initiation Neuraxial Labor Analgesia: Anticoagulation

- Decision Aids
  - Urgent and Nonurgent Cesarean delivery
  - Pregnancy Doses of Low Molecular Weight Heparin
  - Pregnancy Doses of Unfractionated Heparin

Leffert L, Butwick A, Carvalho R, 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;126:928-944.

18



## Labor Analgesia: Anticoagulation

- Summary of Recommendations
  - UFH and LMWH
  - Pregnancy Dosing
  - Intrapartum Neuraxial Timing
  - Postpartum Neuraxial Timing
  - Reinitiation of Anticoagulation

 <b>ASHG</b> 2014 Annual Meeting <b>Abstracts</b>			<b>Abstract</b>		<b>Program</b>	
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Leffert I, Butwick A, Carvalho B, 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;126:928-944



# Program Material

## Saturday, May 15, 2021

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### Case Reports Session #1

Moderators: David Stahl, MD; Manny Vallejo, MD; Naida Cole, MD

### Oral Presentation #1

Moderator: Thomas Klumpner, MD

### Gertie Marx Research Competition

Moderator: Richard Smiley, MD

Judges: Joanna Kountanis, MD; Ruth Landau, MD; Cynthia Wong, MD;  
Philip Hess, MD; Allison Lee, MD

### Why Do You Need an OB Anesthesia Fellowship?

Moderator: Bryan Mahoney, MD

Speakers: Jackie Galvan, MD; Agnes Lamon, MD; Greg Palleschi, MD

### Disparities in Maternal Care: Providers, Patients and Outcomes

Speakers: Allison Lee, MD; Cesar Padilla, MD; Paloma Toledo, MD, MPH



## Type A Aortic Intramural Hematoma in a Parturient with Marfan Syndrome

**Presenting Author:** Willie A. Agee, M.D., Ph.D.

**Presenting Author's Institution:** Vanderbilt University Medical Center

**Co-Author:** Michael G. Taylor, MD; Michael Mantinan, M.D.; Susan Dumas, MD

**Introduction:** Marfan syndrome (MFS) is an autosomal dominant connective tissue disorder with a prevalence of 1 in 5000. MFS occurs as a result of defects in fibrillin-1, a component of microfibrils abundant in the aorta, ligaments, and eyes. This distribution correlates with the symptoms of MFS including skeletal abnormalities, lens subluxation, and aortic dilation. We describe the management of a parturient with MFS and known aortic dilation who presented with a type A aortic intramural hematoma.

**Case:** A 26-year-old G2P0 at 33 and 5/7 weeks gestation with a history of MFS on metoprolol 25 mg BID with an aortic root diameter of 46 mm presented to the ED after sudden onset of 10/10 chest pain radiating to her right arm with numbness and dyspnea. Vital signs were notable for HR 91 and BP 156/96 mmHg. Labs were significant for troponin < 0.01 ng/mL, hemoglobin 13.6 g/dL, platelets 256,000/ $\mu$ L, fibrinogen 366 mg/dL. Bedside ultrasound revealed a dilated aortic root of 60 mm and CT angiogram showed an intramural hematoma extending from the anterior margin of the aortic root to the distal aortic arch. She was started on an esmolol infusion and consults were made to cardiology, CT surgery, vascular surgery, MFM, OB anesthesia, and CT anesthesia. A multidisciplinary team decision was made to proceed with cesarean delivery followed by recovery prior to aortic root replacement. The cesarean was performed under GETA with an arterial line, CVC, and TEE. While delivery was uncomplicated, TEE performed during closure revealed a dissecting flap extending through the arch into the descending aorta. Once the uterus was closed, the CT surgery team initiated cardiopulmonary bypass followed by aortic root, hemiarch, and mechanical aortic valve replacement. The intraoperative course was complicated by episodes of SVT treated with cardioversion, amiodarone, and magnesium. Postoperatively, she was transferred to the CVICU for management of a type B aortic dissection.

**Discussion:** Parturients with MFS are at increased risk for arterial dissection or rupture particularly during the third trimester (50%) and peripartum period (33%) (1). This is likely due to increased blood volume and other changes in cardiovascular physiology. Half of patients with an aortic root diameter > 40 mm will require surgery or experience aortic rupture during pregnancy. Our patient was at increased risk due to her aortic root diameter of 46 mm, and despite being on recommended beta blocker therapy she progressed to dissection. Optimal management of MFS parturients requires a multidisciplinary team approach for development of a safe peripartum plan.

### References:

- Hiratzka, L. et. al. (2010) Guidelines for the Diagnosis and Management of Patients With Thoracic Aortic Disease. Circulation. 121:266-369



## Holistic care of transgender patients on the Labor and Delivery Floor: a case report

**Presenting Author:** Miriam Alghothani

**Presenting Author's Institution:** The Ohio State University

**Co-Author:** Meghan Cook, MD; Blair H. Hayes, MD; Scarlett Marshall, DO; ;

**Case:** A 20-year-old G1P0 female to male transgender (TG) patient presented for a 41wk IOL. Early in his pregnancy, the patient reported to a teen pregnancy clinic that he had socially transitioned, and self-identified as a male, preferring he/his pronouns. He was not on hormonal therapy. The patient's preferred name and pronouns were clearly displayed in the electronic medical record (EMR). He had an uncomplicated vaginal delivery with epidural analgesia. Although the patient was willing to initiate chest feeding, he did not feel comfortable maintaining it. He was D/C'ed home on PPD 2.

**Discussion:** This case highlights needs that are unique to the TG population. An estimated 1 million people identify as TG in the US (1). They face social stigma that translates to the hospital setting, particularly when TG males decide to carry a full-term pregnancy. TG obstetric patients benefit from preconception counseling and care unique to their transformation (2). Care must be taken to avoid transphobia, stigma and microaggressions that can lead to adverse health outcomes. The patient's preferred name and pronouns should be displayed in a meaningful way in the EMR by asking gender identity and sex assigned at birth. During emergencies, staff should avoid referring to TG patients as "mom" and consider utilizing their name rather than mischaracterize the desired parental name and elevate tension, especially in emergencies. Our patient was repeatedly referred to as a "female patient," "she" and "mom" until close to his IOL. Misgendering greatly effects the patients' experience and negatively impacts emotional safety and wellbeing (3). Staff should be informed verbally among the care team and written with patient's documentation. Special attention must be paid to TG patients' mental health pre and postpartum due to the increased baseline risk of suicide, depressive disorders and gender dysphoria during pregnancy, labor, delivery, and chest feeding (5). Support groups of patients with similar experiences may enhance the entire process for patients. Reproductive options should be discussed between TG patients, their transition providers as well as their PCPs. Often, through the process of transitioning, fertility preservation and hormonal therapy during pregnancy are not discussed. Testosterone treatment for TG males may affect fertility, fetal development and chest feeding success, but there are few studies about the topic. This leaves little knowledge on how TG patients can build genetically related families while affirming their gender identities (4,5). Future directions should investigate how to implement systemic change in appropriate pronoun use through early exposure of medical students as well as discussion of reproductive and peripartum needs within this patient population.

### References:

- Anes Analg. 2018 Aug; 127(2): 359-366
- 2019 Oct;128:17-21.
- BMC Pregnancy Childbirth. 2017 Nov 8;17(Suppl 2):332.
- Obstet Gynecol. 2017 Jun;129(6):1031-1034.
- Obstet Med. 2016 Mar; 9(1): 4-8.



## NEURAXIAL ANESTHESIA FOR CESAREAN SECTION WITH UNREPAIRED TETRALOGY OF FALLOT

**Presenting Author:** Karishma Batra, Senior Resident

**Presenting Author's Institution:** VMMC & Safdarjung Hospital

**Co-Author:** Suniti Kale, Consultant

**Introduction:** Survival of uncorrected Tetralogy of Fallot (TOF) to adulthood is extremely rare, and presents with an great challenge to the anesthesiologist in the perioperative period. Physiological changes of pregnancy further lead to cardiac decompensation, with maternal mortality rate approaching 10%<sup>1</sup>. Due to the extremely low survival rate, there is a paucity of literature on the anesthetic management of such patients. While subarachnoid block remains relatively contraindicated<sup>2</sup>, combined spinal-epidural can provide an alternative anesthetic technique for such patients undergoing cesarean section. We report the case of a 23 year old parturient with uncorrected TOF managed under combined spinal-epidural anesthesia for cesarean section.

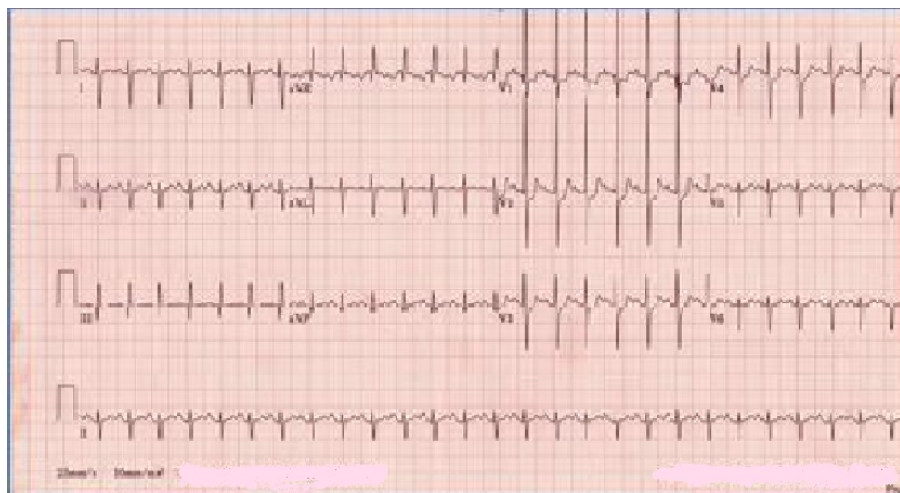
**Case Report:** A 23 year old female, 5th gravida, presented at 35 weeks of gestation with dyspnea (grade II) and cyanosis. SpO<sub>2</sub> (Peripheral oxygen saturation) was 84% on room air. ECG revealed features suggestive of Right Ventricular Hypertrophy with sinus tachycardia. Cardiac Echocardiography showed a large sub aortic Ventricular Septal Defect (VSD) with a predominant right to left shunt, aortic override of < 50%, severe infundibular pulmonary stenosis with 85 mmHg gradient. A diagnosis of TOF was made and Tablet Propranolol 20mg was started. Patient presented for emergency cesarean section due to fetal growth retardation with non-progress of labor. Combined Spinal-Epidural anesthesia was placed at L3-4 intervertebral space and 5mg 0.5% hyperbaric bupivacaine with 25 mcg fentanyl administered intrathecally. Through the epidural catheter, 8ml of 2% lignocaine was administered in titrated aliquots of 4ml every 10 minutes, till a sensory level of T4 was achieved. After delivery of the baby, injection oxytocin 3U was administered slow intravenously over a period of 30 minutes. Intraoperative Mean Arterial Pressure remained  $\geq$  70mmhg and SpO<sub>2</sub> maintained at >92-93% on a FiO<sub>2</sub> of 100%. Postoperatively, patient was shifted to the High Dependency Unit and analgesia was maintained on epidural Morphine and intravenous Paracetamol.

**Conclusion:** By choosing a regional technique, all the cardiorespiratory changes associated with general anesthesia drugs, laryngoscopy and tracheal intubation were avoided. The fall in systemic vascular resistance was minimized by a low dose, opioid predominant drug via intrathecal route, and graded epidural aliquots to achieve adequate level of block. Combined Spinal-Epidural anesthesia provides a safe anesthetic technique for unrepaired TOF undergoing cesarean section, thereby avoiding the untoward complications associated with general anesthesia or subarachnoid block.

### References:

- Cunningham FG, Gant NF, Leveno KJ, Gilstrap LC III, Hauth JC, Wenstrom KD. Williams Obstetrics. 21st ed. New York: McGraw-Hill;2001:1193.
- Gomar C, Errando CL. Neuraxial anesthesia in obstetrical patients with cardiac disease. Curr Opin Anaesthesiol. 2005;18:507-12.







## ANESTHETIC MANAGEMENT OF GRANULOMATOSIS WITH POLYANGIITIS IN PREGNANCY

**Presenting Author:** Sara Boldt, DO

**Presenting Author's Institution:** Rush University Medical Center

**Co-Author:** Michael Holland, MD

**Introduction:** Granulomatosis with polyangiitis (GPA) is a rare disease often presenting in the 4th and 5th decades of life.<sup>1</sup> Given the delayed presentation, there is limited data regarding anesthetic management of the obstetric patient with GPA.<sup>2</sup> GPA is an autoimmune vasculitis that primarily effects the upper respiratory tract, lungs, and kidneys. Organs less commonly involved include the eyes, nerves, and heart. It is characterized by necrotizing granulomatous inflammation of small- and medium-sized vessels.<sup>1</sup>

**Case:** A 23-year-old, G1P0 female was scheduled for induction of labor at 37 weeks and 2 days given complex past medical history. She was diagnosed with GPA (cANCA, PR3) at 18, presenting with ARDS from diffuse alveolar hemorrhage requiring VV ECMO. ECMO was complicated by chronic sternal osteomyelitis. Past medical history also notable for pulmonary emboli on anticoagulation, mild pulmonary hypertension, aspergillosis on isavuconazole, subglottic stenosis, chronic anemia, and anxiety. Her GPA was well controlled with 150 mg azathioprine and 10 mg prednisone daily with only one flare at age 20.

Four hours after induction, fetal heart rate (FHR) monitoring showed recurrent variable decelerations that persisted after Cervidil removal and 1L bolus. A L3-4 epidural was placed and dosed with a 5mL mixture of 0.5% lidocaine and 0.125% bupivacaine followed by a PEIB infusion of 2mcg fentanyl-0.0625% bupivacaine set at 10 mL every 45 minutes was started. 15 minutes later, FHR monitoring showed a prolonged deceleration for 8 minutes. The patient was taken emergently to c-section. 15 mL of 2% lidocaine with 1:200,000 epinephrine in 5mL aliquots and 50 mcg of fentanyl were given epidurally. She underwent an uncomplicated c-section with an estimated blood loss of 550 mL. On post-operative day (POD) 1, our patient received 1-unit PRBC for a hemoglobin of 7.7 g/dL. She was stable for discharge on POD 2. On POD 7 our patient was admitted to the ICU for acute hypoxic respiratory failure with SaO<sub>2</sub> of 50% due to an acute flare of GPA. She was stabilized with 10 L O<sub>2</sub> via non-rebreather mask and high dose steroids.

**Discussion:** Patients with GPA often have upper airway abnormalities, renal disease, and pulmonary manifestations that should be considered when forming an anesthetic plan.<sup>1,2</sup> Common presentations of upper respiratory tract involvement in GPA include saddle nose deformity and subglottic stenosis.<sup>1</sup> Early epidural placement is likely a safer anesthetic management to avoid airway manipulation in an already edematous and difficult obstetric airway as well as reducing work of breathing.<sup>2</sup> An anesthetic consult and interdisciplinary discussion of delivery management is recommended early in pregnancy.

**References:** 1 Lamprecht P, Gross WL. Wegener's granulomatosis. (2004) Herz 29:47-56.

2 Murphy J. et al. (2018) Granulomatosis with Polyangiitis. In: Mankowitz S. (eds) Consults in Obstetric Anesthesiology. Springer, Cham.



## Allergic to the cold? Cold urticaria in a parturient and implications for anesthetic management

**Presenting Author:** Anjali Doshi, BS

**Presenting Author's Institution:** OSU College of Medicine

**Co-Author:** Blair H. Hayes, MD; Robert Small, MD; Yen Vuong, MD

**Case:** 26 yo G1P0 presented at 39w5d for cesarean delivery with unclear hx of autoimmune disease. In preop, she developed an immediate urticarial rash above her IV site tracking proximally on the L arm with administration of LR--no medications. Same reaction was elicited by a new IV running 0.9NS placed in the right arm. 50mg diphenhydramine and 20mg famotidine IV were given. 500mL was infused via fluid warmer and no rash developed. OR was warmed to 21C and forced air warmers were utilized for the case. A presumptive diagnosis of cold urticaria was made.

**Discussion:** Cold urticaria is a rare, allergic condition that affects skin exposed to cold with onset in early adulthood. It can be idiopathic but has been associated with infectious diseases, medications, etc (1). It presents with a red, itchy rash typical of urticaria resulting from mast cell activation and basophil degranulation followed by histamine-mediated inflammation ranging from mild edema to severe anaphylaxis (2). Some studies show that it may affect women twice as often as men indicating why this patient may have been at higher risk (3). Diagnosis can be made using cold stimulation or a simple ice cube test on the patient's arm or leg to elicit a reaction.

Thermoregulation in surgical patients is important not only for reducing consequences of intraoperative hypothermia, such as increased blood loss, wound infections, and cardiac arrhythmias, but also for mitigating the risks of uncommon disorders like cold urticaria. Fluid administration alone can lead to anaphylaxis and lethal drop in core temp if rewarming efforts are not initiated in a timely fashion (3). Premedication with antihistamines is also recommended in patients who have had similar reactions in the past. In addition, epinephrine and other supportive measures should be readily available in case of an emergency and precautions should be taken to ensure normothermia (3).

### References:

- Rarediseases.info.nih.gov. 2020. Cold Urticaria | Genetic And Rare Diseases Information Center (GARD) - An NCATS Program
- Maurer, M., 2020. Uptodate. [online] Uptodate.com. Available at: < <https://www.uptodate.com/contents/cold-urticaria>
- Agbenyefia, Priscilla & Shilliam, Lance & Stoicea, Nicoleta & Roth, Andrew & Moran, Kenneth. (2017). Perioperative Management of a Patient with Cold Urticaria. *Frontiers in Medicine*. 4. 10.3389/fmed.2017.00222.



**Maternal Death due to Multi-organ Failure secondary to COVID infection in the second trimester.**

**Presenting Author:** Mohit Garg, MBBS

**Presenting Author's Institution:** Maimonides Medical Center

**Co-Author:** Lana Glantz, MD; Kalpana Tyagaraj, MD

**Introduction:** Various case reports and review articles suggest similar morbidity of COVID-19 pneumonia among pregnant females compared with similar age group non-pregnant females<sup>1, 2, 3</sup>. We are presenting a 33 years female in early third trimester with severe acute respiratory syndrome coronavirus disease (SARS COV2). She underwent a C-section for non-reassuring fetal heart rate with worsening hypoxia. She later required life support for worsening respiratory failure and succumbed to multi-system organ failure in the critical care unit.

**Case Report:** This is a 33 years old multiparous parturient at 27 weeks of gestation presented with worsening cough for four days associated with shortness of breath and low grade fever (highest up to 99.1 degree Fahrenheit). Her history was significant for lymphoma, which was treated with chemotherapy and radiation of chest and neck area about 9 years ago. Her cardiac history was significant for asymptomatic mitral valve prolapse. Her weight is 86.5kg and height 65 inches with BMI of 31.7. Her physical examination was significant for tachypnea, bilateral rales on auscultation and oxygen saturation of 86-88% at 4 lit/min. She tested positive for RT-PCR COVID-19 test.

The patient's Chest X-ray (CXR) showed patchy infiltrates in the lungs predominantly right lower lobe and left mid and lower lung that increased on follow up CXR on hospital day 3. Echocardiography done after admission showed ejection fraction of 61-65%, with mild to moderate mitral valve regurgitation (MVR), elevation of pulmonary artery systolic pressure and mild dilatation of Right heart.

Treatment was started with Remdesivir, Dexamethasone, antibiotics (Azithromycin and Ceftriaxone) with oxygen supplementation with High Flow Oxygen (60L and 100% FiO<sub>2</sub>) and hospital day 3-4 her saturations were in range from 92-95% on full support with occasional dip to 85% during the bouts of cough.

At this time, the obstetrician was monitoring fetal status using Nonstress testing (NST) continuously which was reassuring and a plan of delivery was made if maternal or fetal condition worsens. As the oxygen saturation of mother decreased to 80% during a bout of cough, the patient was being evaluated for possible intubation which the patient refused adamantly. With the fetal heart rate persisting as non-reassuring, the plan was to proceed with C-section. Her overall condition continued to worsen rapidly in the postoperative period as she developed multi-organ failure and required hemodialysis. The patient was pronounced dead within 48 hours.

**Discussion:** Severe acute respiratory syndrome due to SARS-Coronavirus-2 pandemic is associated with pre-existing cardiovascular and respiratory diseases<sup>4</sup>. There was no documented immunocompromised state except for pregnancy in our patient but altered pulmonary architecture with prior lymphoma disease and treatment (both chemo and radiation) could be the reasons for severe manifestation and progression of the disease in our patient.



## Multiple Epidural Attempts and Placements in a Morbidly Obese Parturient with Normal Thrombocytes Levels Resulting in Emergent Spinal Epidural Hematoma Decompression

**Presenting Author:** Liliana Goelkel-Garcia, MD

**Presenting Author's Institution:** University of Minnesota

**Co-Author:** Vinh Nguyen, DO

**Background:** Lumbar epidural complications are exceedingly rare, but potentially devastating. The two major risk factors for spinal epidural hematoma (SEH) associated with epidural anesthesia are traumatic insertion or removal, and coagulation abnormalities. We present a case of symptomatic SEH following several epidural attempts in a morbidly obese parturient without other risk factors.

**Case Report:** 27 year old morbidly obese primigravida with preeclampsia without severe features. While laboring, she received four different epidural punctures. Epidural catheter provided some analgesia during labor and through her vacuum assisted delivery. Delivery was complicated by retained placenta requiring manual extraction, peripartum hemorrhage of 2.2L, shoulder dystocia and intensive care requirement for her newborn. Patient transferred to our institution for ongoing neonatal intensive care. Anesthesia was consulted after she reported acute onset of sharp lower back pain, radiating bilaterally to buttocks and lower extremities, associated with lower extremities numbness and weakness. Spinal MRI showed L2-L3 SEH which prompted emergent L1- L4 laminectomies for decompression and SEH evacuation. Case was uneventful and she had a complete resolution of her sensorimotor symptoms.

**Discussion:** Two major risk factors for SEH after epidural anesthesia are traumatic insertion or removal (including multiple punctures), and coagulation abnormalities. The most important factor predicting number of needle passes is presence of palpable spinal apophyses and patient's ability to flex her back. (1) Weight, body constitution, or anesthesiologist's experience influence success rate to a lesser degree. (1)(2). Pre-procedural or real-time ultrasound are potential aids when approaching challenging neuraxial blocks. Limitations include level of proficiency required, and potential difficult visualization of spinal structures in obese patients. (3) Anesthesiologists must be cognizant of when repeated attempts at the same procedure is becoming fruitless, especially if repeatedly using the same technique. Even though epidural catheter placement is considered the goal standard of labor analgesia, some alternatives include use of nitrous oxide, continuous intravenous infusion or patient-controlled administration of remifentanyl.

**References:** (1) Palencia M, et al. Factores asociados a la dificultad de punción epidural en analgesia obstétrica [Difficulty of epidural puncture for obstetric analgesia: risk factors]. *Rev Esp Anesthesiol Reanim.* 2006 Mar;53(3):139-44. Spanish. PMID: 16671256.  
(2) Uyl N, et al. Difficult epidural placement in obese and non-obese pregnant women: systematic review and meta-analysis. *Int J Obstet Anesth.* 2019 Nov;40:52-61. doi: 10.1016/j.ijoa.2019.05.011. Epub 2019 May 30. PMID: 31235212.  
(3) Şahin T, Balaban O. Lumbar Ultrasonography for Obstetric Neuraxial Blocks: Sonoanatomy and Lit. Review. *Turk J Anaesthesiol Reanim.* 2018;46(4):257-267. doi:10.5152/TJAR.2018.90277





*Left to Right: (Fig. A) Initial MRI of SEH., (Fig. B). Postsurgical changes at 3 month follow up.*



## UNEXPECTED THROMBOCYTOPENIA IN A PARTURIENT WITH EVANS SYNDROME COMPLICATED BY COVID-19 INFECTION

**Presenting Author:** Shuchi Jain, D.O.

**Presenting Author's Institution:** Henry Ford Hospital

**Co-Author:** Ami Attali, DO; Joshua Younger, M.D.

**Introduction:** Evans syndrome (ES) is a rare hematologic condition causing immune thrombocytopenia (ITP) with concomitant autoimmune hemolytic anemia (AIHA). There are a few case reports of obstetric patients developing ES without a prior known diagnosis [1]. Here we present the first case of an obstetric patient who received neuraxial anesthesia for early labor and was subsequently found to have severe thrombocytopenia in the setting of ES complicated by subsequent COVID-19 infection.

**Case:** A healthy, 23-year old female G1P1 at 38 weeks presented in active labor. Her last recorded platelet count was 223K/uL during her third trimester of pregnancy. Patient had admission labs drawn, including CBC. However, labs had not resulted prior to epidural placement. Patient delivered less than two hours after epidural placement without major bleeding. Epidural was removed without checking complete blood count (CBC) results. The initial CBC drawn at the time of patient's admission returned with platelets < 10,000 and hemoglobin was 5.6. Following the confirmation of these aberrant labs, she was closely monitored for 48 hours post-delivery. She was assessed for signs and symptoms of spinal-epidural hematoma.

A diagnosis of Evan's syndrome was confirmed when she had a positive direct antiglobulin test, thrombocytopenia, and anemia. However, four weeks after delivery she presented to the Emergency Department (ED) complaining of pleuritic chest pain and shortness of breath. She was diagnosed with acute pulmonary emboli on CT and bilateral diffuse ground glass opacities. The ground-glass opacities prompted a COVID-19 infection test, which was positive.

**Discussion:** The pathophysiology of ES is believed to be due to immune system dysregulation [3]. To date, there is one case discussing the association between COVID-19 and ES [3]. This patient's immunosuppressed state on steroid therapy in addition to autoimmune dysregulation as a result of ES, may have resulted in more favorable conditions for a COVID-19 infection. The sequence of events may never be fully known. Moreover, ASA and SOAP guidelines currently state that a routine platelet testing is not necessary in healthy obstetric patients [2]. However, this case of a previously healthy and currently asymptomatic parturient who received an epidural for labor and was subsequently found to have severe thrombocytopenia with platelets < 10,000K/uL, makes one reconsider these recommendations. Perhaps in this era of pandemic and uncertainty, hypervigilance should be employed and admission labs should be present.

### References:

- Parveen et. al. Evans Syndrome and pregnancy: A case report with literature review. J Pak Med Assoc 2019;69:1047.
- Apfelbaum et al. Practice Guidelines for Obstetric Anesthesia: An Updated Report by the ASA Task Force on Obstetric Anesthesia and the SOAP. Anesthesiology 2016;124(2):270-300.
- Li et. al. Evans syndrome in a patient with COVID-19. Br J Haematol 2020.



## Management of Urgent Pre-Term Cesarean Delivery in a Parturient with Prior Lung Resection, Severe Progressive Peripartum Cardiomyopathy and Pulmonary Hypertension

**Presenting Author:** Taimoor Khan, MD

**Presenting Author's Institution:** Memorial Hospital System

**Co-Author:** Rebecca Anderson, MD; George Semien, MD, MPH, FASA; Jean Miles, MD, FASA; Xiwen Zheng, MD; Benjamin Houseman, MD, PhD, FASA

**Introduction:** This case report describes management of urgent, pre-term cesarean delivery in a patient with prior lung resection, peripartum cardiomyopathy (PPCM) and severe pulmonary hypertension (PAH). PPCM is diagnosed based on peripartum systolic heart failure without another identifiable cause and is frequently associated with worsening PAH [1,2]. This patient was referred to our service at 34 weeks gestation for multidisciplinary management due to worsening functional status in setting of prior lung lobectomy and reduced ejection fraction, and CARPREG II risk score of 5 (late assessment = 1, ventricular failure = 2, pulmonary hypertension = 2), which placed her at >40% risk for a primary peripartum cardiac event [3].

**Case Report:** A 42-year-old G3P1011 Hispanic female presented with an ejection fraction of 19% (decreased from 40% at 26 weeks gestation), moderate tricuspid and mitral regurgitation, and severe PAH (PASP 60 mmHg; WHO group 2). Past medical history was significant for prior pulmonary embolism, left bundle branch block, and metastatic osteosarcoma treated with left arm amputation, left lung lobectomy, and adjuvant chemotherapy. Past obstetric history was significant for prior c-section due to pre-eclampsia and one prior first trimester spontaneous abortion.

Our multidisciplinary team recommended urgent c-section under general anesthesia with ECMO available on standby. Prior to c-section, she was admitted to the cardiovascular ICU for optimization of anticoagulation / heart failure / pulmonary hypertension as well as placement of an arterial line and pulmonary artery catheter for hemodynamic monitoring. A milrinone infusion was initiated to support cardiac contractility without worsening PAH. Anesthesia was induced with etomidate, succinylcholine, and norepinephrine. Hypertension during laryngoscopy was treated with nitroglycerin. TEE imaging revealed an EF of 17% with global hypokinesis and permitted titration of fluid / inotrope / vasopressor therapy. A viable infant was delivered, and the patient was transferred to the ICU intubated for continued management of PPCM, PAH, anticoagulation, and pain. She was extubated several hours later, and both mother and infant were discharged home on postpartum day 8.

**Discussion:** This case report illustrates the importance of risk assessment and multidisciplinary planning in the urgent cesarean delivery of a parturient with prior lung resection, PAH, and severe PPCM. Invasive monitoring in both the OR and ICU permitted peripartum management of PPCM, PAH, and fluid shifts, while endotracheal anesthesia permitted TEE imaging and if needed, inhaled nitric oxide. Adequate diuresis and conservative fluid management ensured that autotransfusion after delivery did not cause circulatory overload in this patient with reduced lung volume.

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## Inhaled Tranexamic Acid for Management of Hemoptysis in a Parturient with Severe Cystic Fibrosis

**Presenting Author:** Sung M. Kim, MD

**Presenting Author's Institution:** Vanderbilt University Medical Center

**Co-Author:** Michael G. Taylor, MD; Holly Ende, MD; ; ;

**Introduction:** Cystic fibrosis (CF) is caused by a variety of genetic mutations that primarily affect exocrine function within the respiratory, gastrointestinal, and endocrine systems. As quality of life and survival rates improve, more women with CF are becoming pregnant. These patients are at increased risk of pulmonary complications during pregnancy including respiratory failure, pneumonia, and hemoptysis. We present a patient with CF admitted with sub-massive hemoptysis and treated with inhaled tranexamic acid (TXA).

**Case:** A 30-year-old G1P0 at 37+2 weeks gestation with severe CF (FEV1 33%, FEV1/FVC 64%, 2-3L home oxygen) presented with sub-massive hemoptysis of 180mL. She was admitted to the intensive care unit for medical management and delivery planning, where she remained stable with slightly increased oxygen requirements. Laboratory results were notable for hemoglobin 12.8g/dL, platelets 271,000/mcL, and fibrinogen 736mg/dL. CT angiogram showed no evidence of pulmonary embolism or active bronchial artery extravasation. Due to the high risk of recurrent hemoptysis, she was initiated on inhaled TXA before undergoing planned cesarean delivery.

To avoid high thoracic motor block and respiratory depression, cesarean anesthesia was initiated with a low-dose combined spinal-epidural with intrathecal bupivacaine 10.5mg, fentanyl 15mcg, and morphine 150mcg. No epidural medication was administered. She tolerated the surgery well with stable oxygen requirement. She was discharged home on postpartum day (PPD) 3; however, she returned on PPD 5 with acute on chronic hypoxemic respiratory failure secondary to pneumonia and poor airway clearance. BiPAP, antibiotics, and mucolytic therapy were initiated. She was weaned from BiPAP and discharged home 2 days later at baseline respiratory status.

**Discussion:** While the peripartum period is generally well tolerated in patients with mild to moderate CF, women with severe CF (FEV1 < 50%) experience greater respiratory morbidity and mortality.<sup>1</sup> Respiratory physiology in CF patients can be adversely impacted in a variety of ways during pregnancy - (1) elevated estrogen levels lead to increased capillary congestion and mucus secretion, (2) limited diaphragmatic excursion and decreased functional residual capacity lead to atelectasis and impaired mucus clearance, (3) increased pulmonary blood flow can predispose to hemoptysis. Retrospective studies indicate that hemoptysis may complicate up to 40% of deliveries with CF, and currently there is a lack of consensus regarding how to optimally treat hemoptysis in these patients.<sup>2,3</sup> While inhaled TXA has been shown to effectively treat hemoptysis in the non-pregnant population<sup>4</sup>, it has not yet been described for use during pregnancy. Our patient did not experience additional episodes of hemoptysis after initiating inhaled TXA, suggesting a possible benefit.

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## **Two Zebras in One: Management of a Parturient with Full-Term Submassive Pulmonary Embolism and Undiagnosed Placenta Accreta Spectrum**

**Presenting Author:** Joseph E. Klaus, MD

**Presenting Author's Institution:** Johns Hopkins School of Medicine

**Co-Author:** Anna Gabrielian, MD; Matthew Reschke, MD; David Berman, MD

**Abstract :** This case describes a 37 year old G1P0 who presented to our institution at 40 weeks and 3 days' gestation by IVF dating with submassive bilateral pulmonary emboli. She was admitted to the labor and delivery unit, an arterial line was placed, and a heparin infusion was started. A TTE revealed signs of RV overload, severe dilation, dysfunction, and mild hypokinesis. Fetal status was reassuring. Without any indications for immediate delivery, the plan was to induce labor after several days of anticoagulation, and to monitor fetal and maternal perfusion. Based on duplex evidence of large clot burden in her femoral vein, an IVC filter was placed to prevent further embolism. Her heparin infusion was stopped for epidural placement and then during the active stage of labor. A vacuum was used due to maternal chest pain with expulsive efforts. She delivered a live born female infant. Her delivery was complicated by uterine atony and postpartum hemorrhage. With blood loss of 2.5L in the delivery room, decision was made to transfer to the OR.

The obstetric team found adherent placental tissue and a cervical laceration. 4.5L of blood was lost prior to decision made for hysterectomy. Decision to convert to general was made at this time. She had a total blood loss of 6L and massive transfusion. She remained hemodynamically stable without inotrope support and was extubated at the end of the case. She was stable in the postpartum period, and was later transitioned to warfarin and discharged on postpartum day 8, with full recovery.

Her uterine pathology was consistent with previously-undiagnosed placenta accreta spectrum.

**Discussion:** The management of a term patient with a massive or submassive pulmonary embolism is complicated, and is best made on an individual basis. Some of the traditional therapies used for PE are not feasible or well-studied in the pregnant population and therefore our options were somewhat limited.

We prioritized preventing further thrombus by placing an IVC filter and starting anticoagulation.<sup>1</sup> We also prioritized limiting fluid shifts, thus our obstetrics team felt strongly that a vaginal delivery was in this patient's best interests.

The unfortunate aspect of her case was her undiagnosed placenta accreta spectrum. Without traditional risk factors besides IVF and advanced maternal age, her anticipated risk for placenta accreta spectrum for a primary cesarean section would be approximately 0.03%.<sup>2</sup>

This case serves to demonstrate how patients with complex intrapartum courses and undiagnosed abnormal placentation can be managed at centers with cohesive multidisciplinary teams.

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## Obstructive, Non-Toxic Goiter in Morbidly Obese Parturient with an “Impossible-to-Intubate” Airway

**Presenting Author:** Eva Martinez, MD

**Presenting Author's Institution:** University of Illinois at Chicago

**Co-Author:** Morganne Beard, MD; Jacqueline M. Galvan, MD; Heather C. Nixon, MD

**Introduction:** Obstructive goiters with tracheal compression are rare and occur in < 1% of the US population<sup>1</sup>. There is evidence that pregnancy constitutes a goitrogenic stimulus, but guidance on the management in the full-term parturient population is scarce. We present a case of successful management of a parturient undergoing induction of labor with non-toxic goiter and severe upper airway obstruction.

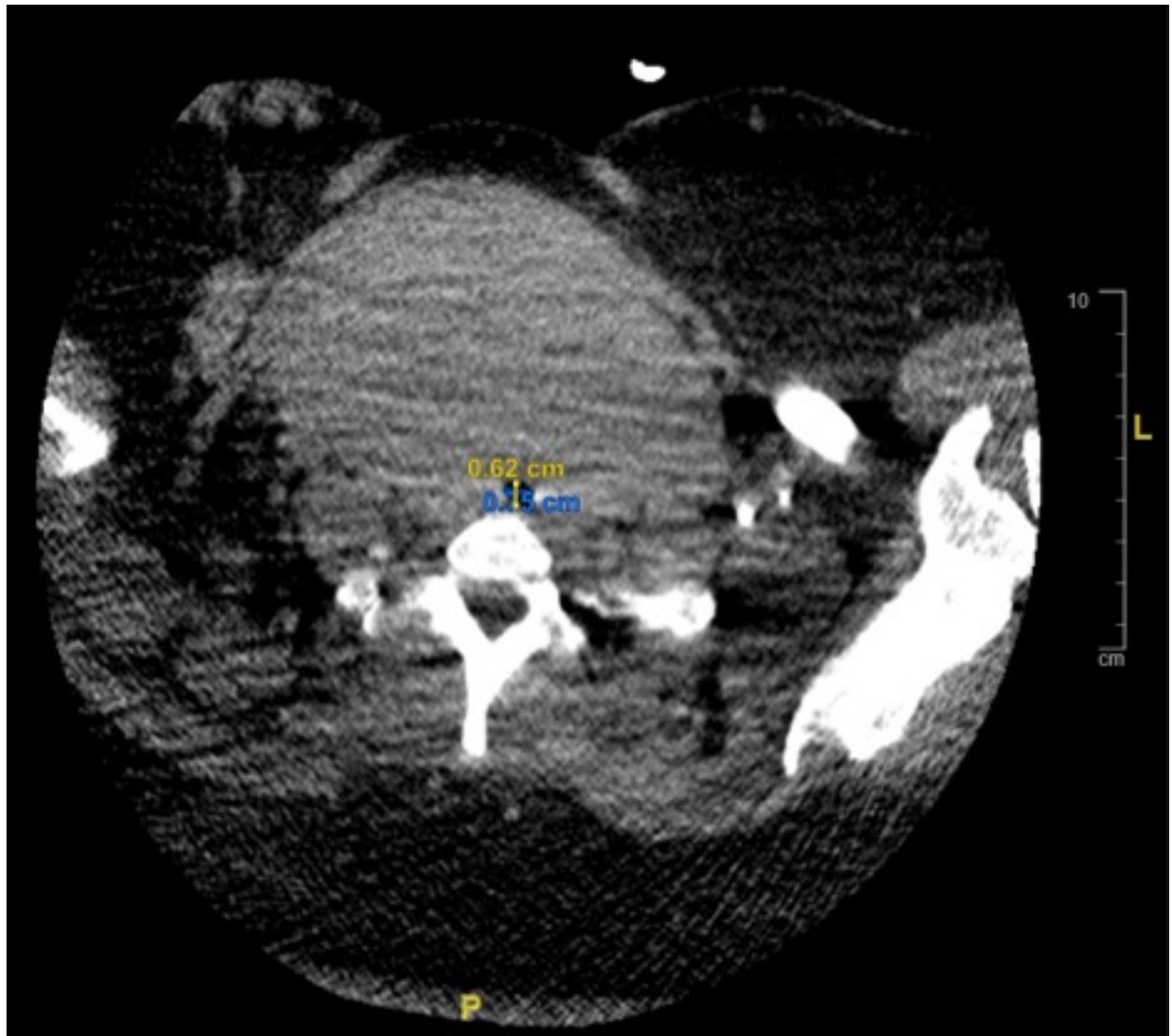
**Case:** 38yo F G10P6026 @ 38+2 weeks, BMI 57kg/m<sup>2</sup>, PMH of cHTN and an enlarged thyroid who presented for coordination of delivery. Prior to this pregnancy, the patient had an attempted but aborted thyroidectomy due to inability to obtain tracheal intubation with multiple awake fiberoptic attempts. On presentation to our institution, she had audible stridor and was unable to lie flat but had stable vitals. The goiter measured 12.5cm with retrosternal extension and severe narrowing of the trachea. The ENT service attempted a nasal fiberoptic exam, but the patient's dyspnea resulted in agitation and poor cooperation limiting the view. Arytenoid collapse and an enlarged base of tongue were visualized, and she was considered to have a high probability of “impossible to intubate.” Cardiothoracic surgery was consulted but limitations for the feasibility of ECMO or bypass in an obstetric emergency were discussed. Given the patient's clinical picture, tenuous airway, poor candidacy for urgent or planned tracheostomy, and her proximity to delivery with favorable obstetric history it was agreed that the patient should undergo an elective induction of labor with early labor epidural placement. During multidisciplinary planning, it was agreed that the patient would not proceed to an emergent Cesarean for fetal indications despite the risk of fetal demise, only proceeding with definitive treatment once a neuraxial anesthetic would be confirmed. Her delivery was uncomplicated following induction and early DPE placement and a viable, healthy male infant was delivered vaginally without complications.

**Discussion:** Management of goiter with significant airway compromise in the full-term parturient necessitates extensive multidisciplinary discussion, especially when the case extends to multiple specialty areas of expertise. The ENT service should evaluate patients for airway compromise. In this “impossible-to-intubate” patient, reliance on neuraxial analgesia with frequent assessments for catheter function was key. Securing adequate labor analgesia provided the best chance for the patient to undergo Cesarean delivery if needed and avoid the necessity of endotracheal intubation. Despite a good outcome, preparation for the most difficult scenarios by involving other surgical subspecialties helped develop our plan.

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## **BILATERAL PARAPARESIS AFTER CESAREAN SECTION UNDER COMBINED SPINAL EPIDURAL AND TRANSVERSUS ABDOMINIS PLANE BLOCK**

**Presenting Author:** Christopher Munoz

**Presenting Author's Institution:** Maimonides Medical Center

**Co-Author:** Logan Fairchild; Oksana Bogatryyova; Kalpana Tyagaraj, MD

**Introduction:** We would like to present a case of bilateral lower extremity paraparesis after cesarean section under combined spinal epidural with bilateral transversus abdominis plane block.

**Case Description:** 26 year old, healthy G6P5 undergoing 5th repeat Cesarean section underwent uneventful surgery under combined spinal epidural, with transversus abdominis plane block at the end of surgery for pain supplementation

6h post C/S: Severe bilateral lower extremity weakness with loss of sensation to pain and temperature below knee.

8h post C/S: No improvement stat MRI - negative for space occupying lesion.

Neuro consult: Unable to flex knee or hip against gravity. Motor function was intact for her feet bilaterally. Sensation deficit was present in L4-L5 distribution, with decreased light touch and pinprick up to knees bilaterally, sparing posterior calf.

24h post C/S: Sensory lost was resolved, motor no improvement. MRI of the lumbar and thoracic spine repeated: negative for space occupying lesion or cord trauma.

48h post C/S : Complete resolution of the motor block

**Discussion:** Prolonged Motor and sensory loss after neuraxial anesthesia has to be evaluated immediately to prevent permanent morbidity with function deficit. Differential diagnosis includes direct trauma of the spinal cord, chemical injury to the cord, ischemia of the cord, compression of the cord (hematoma, tumor, abscess), delayed recovery from the block. We want to introduce another cause of prolonged bilateral motor block as a result of bilateral TAP blocks with liposomal bupivacaine. The unexpected spread of the local anesthetic into L2-L4 levels can hypothetically cause a mixed bilateral femoral or sciatic nerve palsy, which led to partial lumbar plexus block bilaterally. TAP blocks target the lower abdominal dermatomes (T7 and T11) via anesthetizing the nerves that traverse the transversus abdominis plane (intercostal, ilioinguinal, subcostal, and iliohypogastric nerves). Complications related to TAP blocks include local anesthetic systemic toxicity, damage to adjacent viscera and hematoma. Some case reports have shown femoral nerve involvement with TAP blocks. Proposed mechanisms for TAP blocks causing palsy/parasthesias in other nerves/plexi are based on the continuity of adjacent fascial planes ( Fascial Iliaca which contains the Femoral Nerve); medications deposited in one fascial plane can extend further than the targeted desired plane and spread to other areas.

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5: <https://pubmed.ncbi.nlm.nih.gov/22967210>



## Anticoagulation During Labor Epidural in Patient with History of Transposition of the Great Arteries Status Post Mustard Procedure

**Presenting Author:** Daniel P. O'Reilly, MD

**Presenting Author's Institution:** The Ohio State Wexner Medical Center

**Co-Author:** Meghan Cook, MD; Blair H. Hayes, MD; Kasey Fiorini, MD

**Case:** A 34-year-old G5P1122 with a PMH of transposition of the great arteries s/p Mustard procedure, complete heart block with pacemaker, mod-sev RV dysfunction, and renal infarcts/brainstem CVA while subtherapeutic on warfarin presented at 35W0D with vaginal bleeding. IOL was started for concern for placental abruption. A multidisciplinary plan, in concert with the patient, was developed to continue her on therapeutic enoxaparin through pregnancy, with transition to IV heparin prior to induction due to her high risk for embolism. Risks and alternate methods of pain control were discussed yet she expressed a strong desire for labor epidural and minimal time off AC. AC was held by the patient for 48hr due to vaginal bleeding. Epidural was placed atraumatically at L3/4, and IV heparin started 1h later. Heparin was stopped at 6cm dilation to mitigate the risk of bleeding with delivery. She delivered a healthy baby with minimal blood loss. Therapeutic enoxaparin was restarted 6h after epidural removal. Postpartum TTE showed no significant change. Patient D/C'ed post-delivery day 3.

**Discussion:** LMWH is recommended for pregnant patients on AC and is generally held 24h before delivery(1). ASRA recommends IV heparin be held 4-6h before epidural placement/removal and not be restarted < 1hr after. The 3 main risk factors for spinal hematomas are IV heparin given within 1h of placement, traumatic needle placement, and the concomitant use of other hemostasis altering medications(2).

The estimated incidence of epidural hematoma after neuraxial procedures is 1:222,000 (2). For a patient started on IV heparin >1hr after the procedure, the incidence is 1:100,000 (RR 2.18). The estimated incidence rises to 1:8700 (RR 25.2) in patients when IV heparin is started within 1hr(2).

Complications following repair of this patient's congenital anomalies include loss of sinus rhythm, increased rates of atrial flutter, and RV dysfunction(3). Our patient had a history of CVA, TIAs, and renal infarcts while on warfarin and was in a prothrombotic state with pregnancy placing her at extremely high risk of embolism. Here, patient autonomy and shared decision making are paramount for optimal patient care and planning. With her strong desire for an epidural and to avoid interruptions in AC, the benefit of continuing her on AC with an epidural in place was believed by all parties to outweigh the risk of epidural hematoma.

This case illustrates anticoagulation management during a labor epidural in a patient at high embolism risk with a complex cardiac history. It is important for the OB anesthesiologist to be familiar with AC guidelines during pregnancy, to appropriately weigh the risks and benefits of intrapartum AC in the setting of neuraxial procedures, and to involve the patient in the decision making process when caring for these patients.

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**TABLE 6.** Risk Factors and Estimated Incidence for Spinal Hematoma and Neuraxial Anesthesia

	Relative Risk of Spinal Hematoma	Estimated Incidence for Epidural Anesthesia	Estimated Incidence for Spinal Anesthesia
No heparin			
Atraumatic	1.00	1:220,000	1:320,000
Traumatic	11.2	1:20,000	1:29,000
With aspirin	2.54	1:150,000	1:220,000
Heparin anticoagulation following neuraxial procedure			
Atraumatic	3.16	1:70,000	1:100,000
Traumatic	112	1:2000	1:2900
Heparin >1 h after puncture	2.18	1:100,000	1:150,000
Heparin <1 h after puncture	25.2	1:8700	1:13,000
With aspirin	26	1:8500	1:12,000
Data from Stafford-Smith, <sup>45</sup> with permission.			



## Pregnancy-related Spontaneous Coronary Artery Dissection: A Tale of Two Outcomes

**Presenting Author:** Max Schubert, MD

**Presenting Author's Institution:** Emory Dept of Anesthesiology

**Co-Author:** Dawn Manning-Williams, MD; Ratna Vadlamudi, MD

**Abstract :** Spontaneous coronary artery dissection (SCAD) is a rare form of acute coronary syndrome (ACS) with presentation ranging from mild angina to frank STEMI. SCAD occurs much more commonly in females, who comprise about 90% of cases. Pregnancy-related SCAD (pSCAD) accounts for less than five percent of all SCAD cases, but it accounts for greater than forty percent of myocardial infarctions within the pregnant population. The outcome of pSCAD is largely dependent on severity at presentation. This paper will describe two cases of pSCAD, a mild case and a severe case.

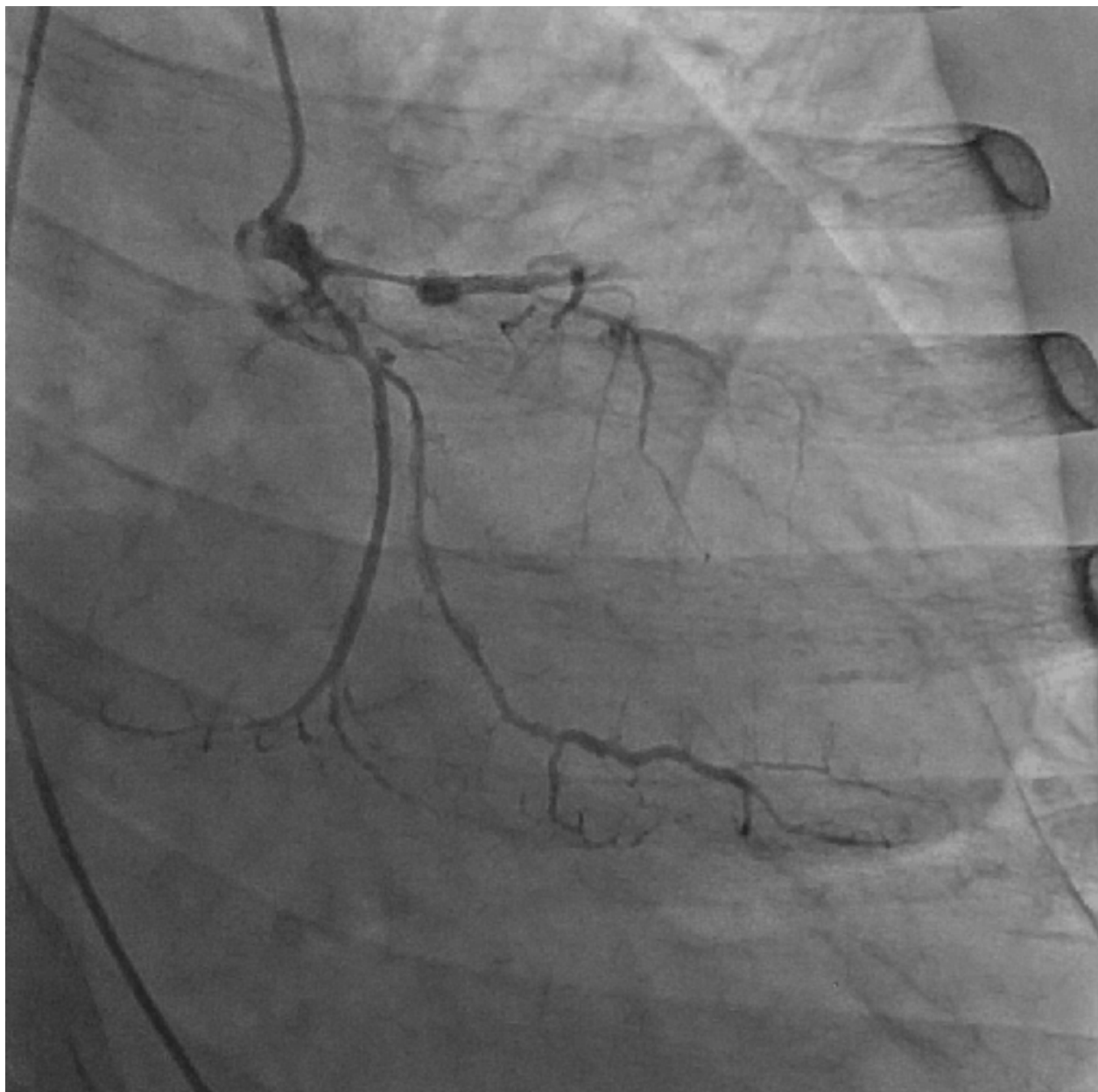
### Case 1

A 43-year-old G5P3013 female at 38+4 presented to the hospital with severe chest pain that woke her from sleep. She reported never having chest pain like this before, and her PMH was only significant for NSVD x3 and one spontaneous abortion. Troponin was found to be elevated so she was sent to the cath lab. LHC demonstrated mid-distal focal 70% stenosis of LAD concerning for SCAD with TIMI 3 flow. The patient was transferred to the CVICU where nitro and heparin drips were started. Multidisciplinary planning with the anesthesiology, obstetric, and cardiology teams took place. CT surgery was alerted to the patient as well, though no acute surgical interventions were indicated. The patient underwent uneventful scheduled cesarian section with combined spinal-epidural anesthesia a week after presentation. Both the mother and baby did well and were discharged together from the hospital three days later. The patient returned to clinic three weeks post-partum for follow up visit and was doing well. Unfortunately, the patient was lost to further follow-up.

### Case 2

A previously healthy 28-year-old G3P3003 presented with chest pain one-week post-partum. She was found to have pSCAD and was admitted then discharged from OSH on aspirin and Plavix after LHC without complications. She presented to our hospital three days later with worsened chest pain despite medical intervention. Repeat LHC demonstrated 100% stenosis of LAD (TIMI 0 flow beyond dissection), 70% stenosis of OM1, 40% stenosis of distal RCA. The patient was emergently taken to the OR. Coronary artery bypass grafting was performed with LIMA to LAD and rSVG to OM1. LV function was improved but still incompatible with life. The decision was made to put the patient on ECMO. The patient later returned to the OR for LVAD. The patient was then found to have moderate AI, so a transcaval TAVR was performed. The patient was ultimately discharged from the hospital with LVAD. She is doing well and currently being worked up for heart transplant, although she has numerous antibodies from multiparity. As demonstrated by the cases above pSCAD can range from mild to severe. Severity is largely dependent on TIMI grade flow. Diagnosis was rapid in both cases, but the latter case required far more intervention than the former. While rare, more research is needed to determine optimal treatment strategies for SCAD.







## Shared decision-making in the management of a medically complex parturient with CML and high thrombotic risk

**Presenting Author:** Margaret E. Smith, MD

**Presenting Author's Institution:** University of Chicago Medical Center

**Co-Author:** F. Arran Seiler, MD; Barbara Scavone, MD

**Case:** A 27 yo G2P0010 patient at 36 wk EGA with Factor V Leiden mutation presented to an outside hospital with hemoptysis and was diagnosed with bilateral PE. She was hemodynamically stable without respiratory distress and started on enoxaparin 90mg BID. CML had been diagnosed in pregnancy and peripheral smears throughout pregnancy contained 0% blasts. She was found to be COVID-19 positive. She developed contractions and vaginal bleeding and was transferred to our institution. On arrival the patient was in active labor with her last dose of enoxaparin 12 hr prior. The MFM specialist recommended vaginal delivery to avoid the prothrombotic state associated with surgery but the patient was concerned about holding anticoagulation and not willing to proceed with labor without epidural analgesia. She also inquired about the risk of CNS leukemic seeding in the absence of blasts. A multidisciplinary team including the MFM, anesthesiologist, and hematologist discussed risks and benefits with the patient who took part in shared decision-making. We agreed to hold anticoagulation for 12 hr more and administer neuraxial labor analgesia for vaginal delivery. Twenty-four hr after her last dose of enoxaparin we placed an epidural catheter. The patient labored for another 6 hr and had an uncomplicated vaginal delivery. Heparin infusion was started 8 hr after delivery. Recovery was uneventful and the patient was discharged 2 d later on an oral anticoagulant.

**Discussion:** This clinical course was notable for VTE risk in the setting of recent PE. Pregnancy increases VTE risk 5-fold, with a 60-fold risk postpartum;<sup>1</sup> Factor V Leiden mutation increases risk 4- to 8-fold;<sup>2</sup> malignancy 5-fold.<sup>3</sup> Approximately 21% of patients hospitalized with COVID develop VTE.<sup>4</sup> The MFM wished to avoid cesarean delivery which further quadruples VTE risk compared to vaginal delivery.<sup>5</sup> Although literature reports VTE rates from various pathologies, predicting precise risk in individual patients remains challenging, as does predicting labor duration and the total anticoagulation hold time. Additionally, spinal-epidural hematoma from performance of a neuraxial procedure in a patient inadequately removed from anticoagulation can be a devastating complication. Decision-making was further complicated by the risk of blast crisis. Introducing malignant cells into the CNS can alter disease staging and worsen outcome.<sup>6</sup> In our assessment, the thrombotic risk associated with surgery was greater than the risk of temporarily holding anticoagulation for labor and epidural analgesia; the risk of CNS seeding was low in the absence of blasts; the patient agreed with this risk-benefit analysis. The presence of competing risks and benefits requires multidisciplinary assessment and inclusion of the patient in shared decision-making.

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## Suspected Case of Amniotic Fluid Embolism Complicated by Undiagnosed Patent Foramen Ovale

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**Presenting Author's Institution:** Department of Anesthesia & Perioperative Medicine, University of Louisville, Louisville, Kentucky

**Co-Author:** Justin Feldmann, MD; Lady Ong Sio, MD; Daisy Sangroula, MD; Jiapeng Huang, MD, PhD;

**Introduction:** Amniotic fluid embolism (AFE), also known as the anaphylactoid syndrome of pregnancy is a rare life-threatening complication of pregnancy.<sup>1</sup> It is characterized by: sudden onset of hemodynamic instability, hypoxia, and coagulopathy in the setting of labor or within 30 mins of placental delivery.<sup>2</sup>

**Case Report:** A 31yo G7P3 at 29wk gestation presented to labor and delivery triage with concern for preterm premature rupture of membranes. In triage, patient's vitals were within normal limits. On vaginal exam, patient was 4cm dilated, with positive pooling and nitrazine test. There were visible decelerations on fetal monitoring with difficulty keeping the fetus on the monitor. Bedside ultrasound revealed fetus to be in a footling breech position with no amniotic fluid. Patient was confirmed to be ruptured and emergency cesarian section was called.

Spinal anesthesia was successfully performed in the operating room. After laying the patient supine, patient's SpO<sub>2</sub> was found to be in the 70's, with normal blood pressure and heart rate. SpO<sub>2</sub> improved to the 80's with oxygen mask. Patient was alert, oriented, conversive, without any visible signs of hypoxia.

After baby was delivered, patient's SpO<sub>2</sub> abruptly declined to the 30's and she developed extreme hypotension. At this point, rapid sequence intubation was performed and patient's blood pressure was supported with epinephrine. Patient was hypoxic to the 40's on 100% FiO<sub>2</sub>. CPR was initiated and patient's SpO<sub>2</sub> improved to 70%. Oxygen saturations quickly declined upon cessation of chest compressions; hence, CPR was continued to maintain oxygen saturation. During CPR, patient began bleeding from the vagina and Hgb was 5g/dL on ABG. Massive transfusion was initiated and a Bakri balloon was placed by the obstetric team. On repeat labs, Hgb was 8.4g/dL and fibrinogen was 113mg/dL post transfusion with 5 units of pRBC, 5 units of FFP, and 2 units of platelets.

AFE was suspected and cardiothoracic surgery at outside hospital was quickly consulted for ECMO. TEE during the code revealed a severely dilated right ventricle and atrium with significant bowing of the septum into the left side. A large PFO was observed with right to left shunting. Resuscitation efforts continued for a total of 2.5 hours until ECMO services arrived and patient was placed on VA ECMO and transferred to outside hospital for further management.

**Discussion:** AFE is a fatal condition, hence prompt recognition and optimal early cardiac resuscitation management is imperative. ECMO is an adjuvant to sustain life in patients who experience severe cardiopulmonary collapse which can be seen in AFE patients. Therefore, ECMO should be considered early and mobilized as soon as possible if your facility does not have ECMO capabilities.

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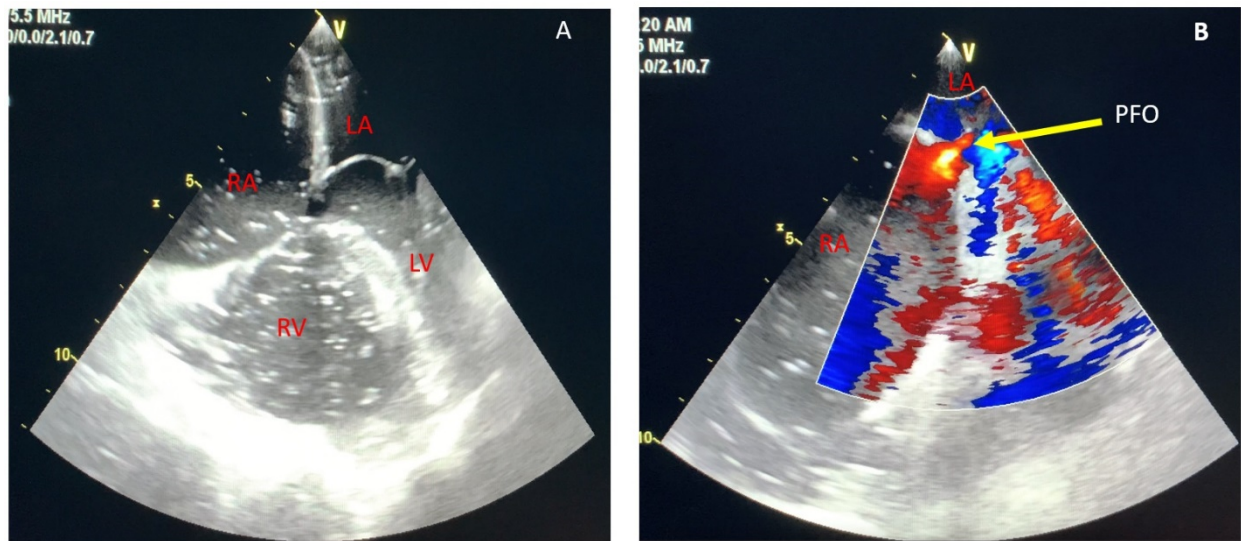


Figure 1: Transesophageal echocardiography of patient. 1A demonstrates severely dilated right ventricle and right atrium and severely underfilled left atrium and left ventricle. 1B shows a large patent foramen ovale with right to left shunting.  
 LA=left atrium; LV=left ventricle; RA=right atrium; RV=right ventricle; PFO=patent foramen ovale.



## Failed Uterine Artery Embolization x2 Resulting in Hysterectomy

**Presenting Author:** Arjun Varadarajan, M.D

**Presenting Author's Institution:** Ochsner Medical Center

**Co-Author:** Rustin Lance Roberts, MD; Liane Germond, MD

**Introduction:** Uterine arteriovenous malformation is a rare cause of post-partum hemorrhage (1-2%) that may lead to increased morbidity and mortality (2). Management depends on the severity of the hemorrhage, age of the patient, and the desire for future fertility(1). There are multiple treatment strategies with embolization being highly successful in women who desire continued fertility. Unfortunately, we discuss a unique case that failed multiple UAEs resulting in a hysterectomy.

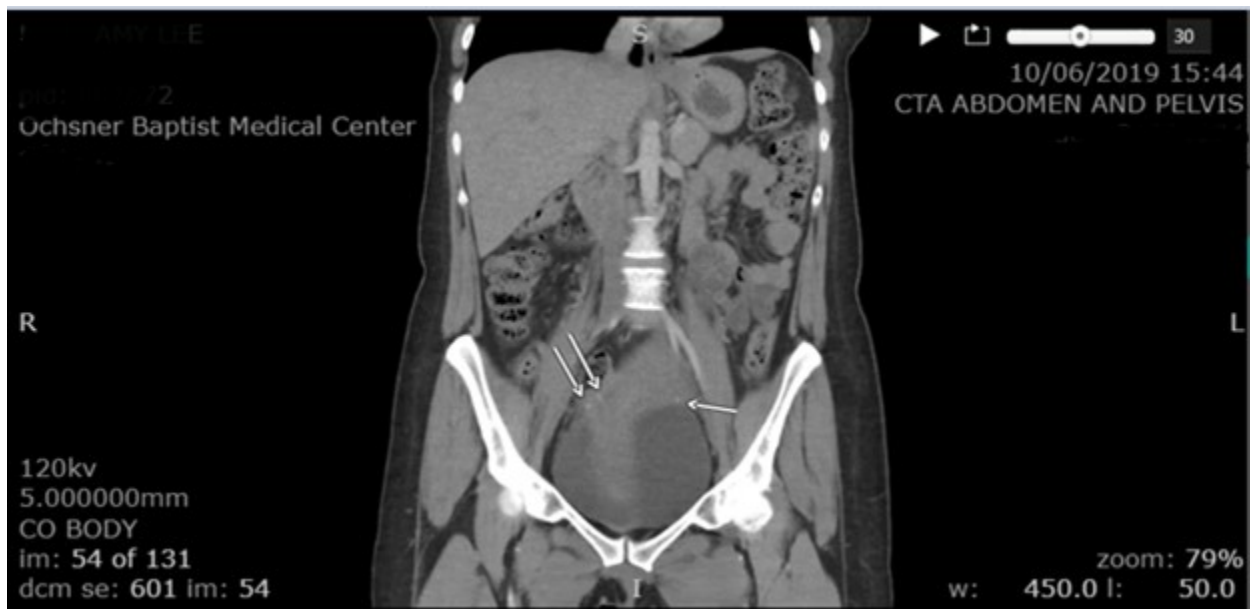
**Case report:** A 36 y/o G2P0 at 40 weeks EGA presented for a primary c section due to breech presentation. A postpartum hemorrhage ensued during the procedure with resulting EBL of 1680mL. Her hemoglobin dropped from 12 to 10, but she was otherwise asymptomatic and discharged on POD#3. POD#4, the pt returned to the ED with heavy vaginal bleeding. Multiple clots were evacuated and EBL was 1600mL. She was transfused 2U PRBCs, placed on a methergine series, and admitted for observation. On POD#6, the pt had another bleed, prompting her to be taken to the OR for a D&C and Bakri balloon placement. She was also given methergine and hemabate (Hgb 5.9). She was transfused 2U PRBCs and taken to IR for uterine artery embolization for continued bleeding. The radiology report noted active bleeding from the right uterine artery, but bilateral embolization was completed to stasis. She was discharged home 3 days later. On POD #17, the pt again presented to the ED with heavy vaginal bleeding, EBL of 400mL. A CTA confirmed endometrial bleeding. She continued to bleed after her scan and became hypotensive (80/30) with this episode. She was given cytotec, transfused another 2U PRBCs, and taken emergently to IR for a second UAE. Her right uterine artery was found to be completely embolized, so a left embolization was performed again. The pt remained in the hospital for 3 days when a final bleeding episode took place (EBL 950mL). She was given misoprostol, methergine, and estrogen with no cessation of her bleeding. An emergent hysterectomy was then performed and the pt was discharged 4 days later with no additional sequelae.

**Discussion:** Embolization of the uterus is possible due to the highly vascular bed along with multiple anastomoses, resulting in the treatment of certain vessels while still preserving function of the uterus. Possible explanations for the failed attempts in our patient include residual extra-uterine fine feeders such as an ovarian-uterine anastomotic connection or retained products of conception (2). Although bleeding from an AVM is rare, it needs to remain in the differential for women of childbearing age.

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## Unusual leg pain in pregnancy - a case report of acute compartment syndrome

**Presenting Author:** Simon Wydall, MBBS

**Presenting Author's Institution:** Guy's and St. Thomas' NHS Trust

**Co-Author:** Nat Nguyen-Lu, BMedSci, BM BS, FRCA; Kate Cheesman, MBBS

**Introduction:** Acute compartment syndrome (ACS) is a rare but potentially fatal condition. Chronic compartment syndrome (CCS) is well described, but its incidence may be more common in pregnancy than previously understood. We describe a case of acute on chronic compartment syndrome that led to fasciotomy post emergency caesarean delivery.

**Case Report:** We present a 36 year old woman who had an epidural top up for emergency caesarean section at 39 weeks following 13 hours of labour. Four hours post operatively she was resuscitated for haemorrhagic shock. Blood tests demonstrated significant acute blood loss, acute kidney injury and severe hyperkalemia which was treated, the patient acutely transfused and a pelvic ultrasound revealed a large pelvic haematoma as the cause of the acute blood loss. Eight hours post delivery, the patient reported right sided anterior lower leg pain and mild swelling. This progressively worsened, extending from knee to ankle and refractory to opioid analgesia. Additional history revealed symptoms of anterior leg pain and cramping following exercise in the preceding 4 weeks. Additional blood tests revealed rhabdomyolysis. Eighteen hours post delivery, the orthopaedic surgical opinion was to proceed with fasciotomy revealing a tense anterior compartment with dusky muscles, confirming the diagnosis of ACS on a background of CCS.

**Discussion:** This case demonstrates both CCS and ACS in pregnancy and aims to highlight both presentations to obstetric care providers. The common symptom of leg cramps experienced after week 25 of pregnancy may be due to CCS and this should be considered in women experiencing analgesic resistant lower limb cramping or pain which interrupts sleep<sup>1</sup>. Unilateral ACS is a rare phenomenon in pregnancy with bilateral presentations being more common. Bilateral ACS is estimated to have a prevalence of approximately 1 in 5,000 births<sup>2</sup>, however, the authors have been directly involved in the care of two obstetric patients with ACS in the last 6 months, both presenting with worsening lower leg pain after neuraxial anaesthesia which may have masked initial milder pain. The functional outcome following ACS is directly related to time until surgical intervention<sup>1</sup>, therefore it is of paramount importance that midwives, obstetricians and anaesthetists consider this diagnosis in obstetric patients who often have neuraxial blocks which may mask pain and those with the following risk factors; large volume blood loss, prolonged hypotensive episodes, lithotomy position, sympathetic blockade, use of oxytocin, external compartment compression and peripheral vascular disease.

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## **Common Immunologic Underpinnings for Amniotic Fluid Embolism and Reversible Cerebral Vasoconstriction Syndrome after Cell Salvage: A Case Report and Pathophysiology Review**

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**Introduction:** Amniotic Fluid Embolus (AFE) and anaphylactoid reactions are rare childbirth complications. Reversible Cerebral Vasoconstriction Syndrome (RCVS), a vasculopathy that may co-occur with pre-eclampsia, is also an under-reported pregnancy complication that can be incited by exposure to vasoactive substances and can result in stroke [1]. We describe a patient who developed signs potentially indicative of both complications after intraoperative cell salvage (ICS). We discuss potential immunologic commonalities between the two pathologies.

**Case:** A 40 yo woman with no PMH and 2 prior cesarean deliveries (CD) presented in spontaneous labor for a third CD. After spinal anesthesia, phenylephrine infusion started; mean arterial pressure rose to 120 mmHg and resolved after stopping the infusion. She then had a severe, bifrontal headache not associated with focal deficits, resolving with acetaminophen. Operative course was complicated by hemorrhage from hysterotomy extensions; at estimated loss of 1000 mL, intraoperative cell salvage (ICS) was deployed; reinfusion of ICS resulted in rash, hypotension, and throat tightness. Diphenhydramine was administered, steroids summoned, and ICS stopped. She then became unresponsive with ventricular arrhythmia, had seizure activity, and lost pulses. Cardiopulmonary resuscitation, atropine/ ondansetron/ ketorolac, and massive transfusion protocol were activated with ROSC after 7 minutes. Immediate post-ROSC point of care ultrasound was notable for RV dilation and a "D" shaped ventricle. Immediate post-operative CT showed a small frontoparietal subarachnoid hemorrhage without midline shift or aneurysm. She was extubated on postoperative day 2, neurologically intact. A digital subtraction angiogram revealed large vessel vasculopathy in "string of pearls" consistent with reversible cerebral vasoconstriction syndrome (RCVS).

**Discussion:** When maternal blood and amniotic fluid are filtered through a leukoreduction filter, vasoactive and immunologic factors are not completely filtered [2]. Factor XII and platelets exposed to the filter's negative charge can lead to hypotension due to bradykinin release [3]. Several cytokines that are common to both AFE and RCVS may account for the previously reported observed associations between AFE and hypertensive disorders of pregnancy, the latter of which is also associated with RCVS [4] (Figure).

**Conclusion:** Common mediators may exist between RCVS and AFE, potentially making pregnant women with vasculopathies like pre-eclampsia more susceptible to rare anaphylactoid events. Even with leukoreduced ICS in obstetric hemorrhage, bradykinin and other immunologic mediators may potentially incite rare anaphylactoid responses. Definitive evidence that ICS does not increase risk for AFE or anaphylactoid events is lacking.

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## ANTERIOR MEDIASTINAL MASS AND CARDIAC TAMPONADE IN PREGNANCY

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**Presenting Author's Institution:** Ohio State University

**Co-Author:** Michael Essandoh, MD; Kasey Fiorini, MD; Christian Mitchell, MD; Jasmine Ryu, MD; William Perez, MD

**Abstract :** Anterior mediastinal masses (AMM) present challenges as they can cause cardiovascular and airway obstruction. Pericardial effusions can cause cardiac tamponade, and both can cause systemic malperfusion. A multidisciplinary approach is essential to prevent catastrophic airway obstruction and cardiovascular collapse.

A 26 y.o. G3P2 30w1d female with no PMH presented with dyspnea, orthopnea, and dysphagia. A chest CT revealed a 9x13x13 cm AMM compressing the brachiocephalic trunk, SVC, trachea, and bilateral mainstem bronchi. A TTE also revealed cardiac tamponade. Emergent percutaneous drainage was required to prevent imminent cardiopulmonary catastrophe. The decision to perform percutaneous pericardiocentesis to alleviate her malperfusion syndrome was made by a multidisciplinary team. Unfortunately, she did not tolerate pericardiocentesis and required a left anterolateral mini thoracotomy. Plans for emergent VA-ECMO and simultaneous crash C-section in case of cardiopulmonary collapse were made. In the OR standard ASA monitors, a right radial a-line and bilateral IV access were placed. We performed a 5th intercostal nerve block to facilitate the pericardial window in the upright, sitting position. Light inhalational induction with gentle masking assisted spontaneous ventilation was needed given intolerance to the pericardiotomy. The patient tolerated the pericardial window and was transferred to the ICU. Perioperative NST was reassuring and reactive. Biopsy showed aggressive B cell lymphoma. She was started on EPOCH-R. Predelivery CT confirmed improvement of vascular and pulmonary compression, but persistent SVC occlusion. A multidisciplinary team developed a plan for induction of labor at 36w. C-section was not recommended due to potential dynamic airway and vascular compression. She presented at 36w6d for induction with plan for an a-line in case of epidural placement. As with her two previous pregnancies the patient opted for unassisted natural vaginal delivery. She had an uncomplicated delivery of a male infant, APGARs of 8 and 9.

The concomitant occurrence of an AMM and a large pericardial effusion with tamponade physiology, in a parturient from B-cell lymphoma, makes anesthetic care difficult. In our case, we were able to achieve the emergent drainage of a large pericardial effusion with regional anesthesia and minimal sedation. This case presents a unique challenge as common methods of safely securing the airway would not overcome the bilateral tracheobronchial compression. In addition, rescue methods of cardiopulmonary support like ECMO, although theoretically feasible, were limited by SVC occlusion, positioning, and dynamic IVC compression by the gravid uterus. This case describes the successful anesthetic management for cardiac tamponade drainage and biopsy and successful peripartum multidisciplinary planning tailored to the unique needs of the pregnant patient with an AMM.

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## Post-cesarean analgesia with epidural morphine following epidural 2-chloroprocaine

**Presenting Author:** Linden Lee, MD

**Presenting Author's Institution:** University of Texas Health Science Center at Houston

**Co-Author:** Ana Lisa Ramirez-Chapman, MD; Danielle White, MD; Maya Suresh, MD

**Introduction:** Chloroprocaine has a more rapid onset of action compared to lidocaine, making it a valuable medication in emergent cesarean deliveries. Studies have suggested that administration of epidural chloroprocaine prior to epidural morphine results in decreased effectiveness of epidural morphine, however this is controversial and may be an effect of chloroprocaine wearing off prior to the peak action of epidural morphine rather than true antagonism.

**Methods:** We performed a randomized controlled trial between epidural 2% lidocaine with 1:200,000 epinephrine and 3% 2-chloroprocaine on the analgesic effect of epidural morphine. Patients with labor epidurals in place scheduled for cesarean delivery were recruited and randomized to one of two groups (lidocaine, chloroprocaine) with 20 subjects in each.

Epidurals were initially dosed with 3% 2-chloroprocaine or 2% lidocaine with 1:200,000 epinephrine to a T4 level. A T4 level was maintained throughout cesarean deliveries with additional epidural doses of lidocaine with epinephrine for BOTH groups. This was the critical component to bridge the latency period between the offset of chloroprocaine and the peak action of epidural morphine. Epidural morphine 3mg was given after delivery. Scheduled acetaminophen and ibuprofen, and oxycodone as needed were ordered for all patients.

The primary outcome was total opioid use for 24h. The secondary outcomes were time until first opioid request, pain (0-10 scale), nausea and pruritis.

**Results:** The median and interquartile ranges for total opioid consumption in morphine milligram equivalents for the first 24 hours for the lidocaine group was 15(6.3, 22.5) and for the chloroprocaine group was 0(0,15.6) with a p-value of 0.08. The median and interquartile ranges for time to first opioid request in hours for the lidocaine group was 14.8(7.9, 22.7) and for the chloroprocaine group was 24.7(2.7, 36.6) with a p-value of 0.26.

The 24 hour opioid consumption for chloroprocaine was less than the non-inferiority margin of 10mg compared to lidocaine ( $p < 0.01$ ).

**Conclusion:** These results suggest that epidural chloroprocaine is non-inferior to lidocaine on post-cesarean analgesia when given prior to epidural morphine. The previous results seen in the literature are likely a result of a latency period between chloroprocaine wearing off and the peak action of epidural morphine, not antagonism of epidural morphine.

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**Effect of Dexmedetomidine as an adjuvant in Quadratus Lumborum block in patients undergoing caesarean section- A randomized controlled study.**

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**Presenting Author's Institution:** Resident

**Co-Author:** Neha Singh, MD; Suma R. Ahmad, MD

**Title:** Effect of Dexmedetomidine as an adjuvant in Quadratus Lumborum block in patients undergoing caesarean section- A randomised controlled study.

**Background:** Postoperative pain management after caesarean section (CS) is important for patient satisfaction and recovery. Quadratus lumborum block (QLB) is an upcoming block used for pain relief in abdominal surgeries. (1) Dexmedetomidine, an alpha 2 agonist, was used as adjuvant for regional blocks but it's not been explored for QLB. We have planned this study to evaluate the effect of Dexmedetomidine in prolonging analgesia after CS.

**Methods:** After Institutional Ethics approval and CTRI registration, sixty patients with singleton term pregnancies scheduled for CS under spinal anaesthesia were enrolled after taking written informed consent. Bilateral QLB was given in the recovery area. Group A received 30ml of 0.25% bupivacaine and group B received 30ml 0.25% bupivacaine with dexmedetomidine 1 mcg/kg. Primary objective was to compare time to the first request of rescue analgesia. All the patients received inj. Paracetamol 1 gm intravenously TDS and Inj. Tramadol 1mg/kg was kept for rescue analgesia (if NRS Score  $\geq 4$ ). Secondary objective was to compare the number of doses of rescue analgesia in first 24 hours, patient satisfaction scores, Ramsay sedation score (RSS) and Numeric rating scale (NRS) scores at 2, 4, 6, 8, 12, 18, and 24hrs.

**Results:** Age and weight of the participants were comparable. Mann Whitney U test was used for outcome analysis. The time to request of first rescue analgesia was significantly prolonged in group B Mean  $\pm$  SD (95% CI) (831.18  $\pm$  374.21 (638.77 – 1023.58) min. vs group A 436.67  $\pm$  217.04 ( 355.62 – 517.71 ) min.,  $p < 0.001$ ). Significantly low dose of rescue analgesic was used in group B Mean  $\pm$  SD (95% CI) 58.82  $\pm$  19.65 (48.72 – 68.93) mg vs group A 80  $\pm$  24.91 (70.70 – 89.30) mg., ( $p < 0.05$ ). There was a significant difference in the pain scores between the groups up to 18 hrs. (Table 1) and patient satisfaction scores ( $p < 0.05$ ). RSS was comparable among the groups.

**Conclusion:**

Dexmedetomidine significantly delayed the time to request of rescue analgesia & reduces pain scores postoperatively up to 18 hrs. It also decreases opioid analgesics in postoperative period. We conclude that Dexmedetomidine can be considered as an effective adjuvant for QLB in CS.

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## High flow humidified nasal oxygen versus face mask oxygen for preoxygenation of pregnant women – a prospective randomized controlled crossover study

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**Presenting Author's Institution:** Department of Anaesthesia, Royal Women's Hospital (VIC) and Department of Obstetrics and Gynaecology, The University of Melbourne

**Co-Author:** Philip J. Peyton, MD PhD MBBS FANZCA; Julia Unterscheider, MD PhD MRCPI MRCOG FRANZCOG DDU; Adam Deane, MBBS PhD FRACP FCICM; Liz Leeton; Alicia Dennis, MBBS PhD MPH PGDipEcho FANZCA

**Introduction:** Airway management guidelines recommend the preoxygenation of obstetric patients to an end tidal oxygen (etO<sub>2</sub>) concentration of  $\geq 90\%$  prior to general anaesthesia. A previous study showed that despite a plausible role for high flow humidified nasal oxygen (HFNO) in this context, only 60% of participants achieved this target after three minutes of HFNO<sup>1</sup>. This was vastly lower than reported rates with face mask (FM) oxygen. We conducted a randomized controlled crossover trial to determine if HFNO is non-inferior to FM oxygen for increasing etO<sub>2</sub> concentration after simulated preoxygenation of women in late pregnancy (gestational age  $\geq 36$  weeks).

**Methods:** After ethics approval, trial registration and consent, 70 women underwent simulated preoxygenation protocols with HFNO and FM oxygen sequentially. They were randomized to receive HFNO first then FM oxygen or vice versa. Baseline variables were measured including etO<sub>2</sub> concentration to ensure adequate oxygen washout between protocols. Protocols were three minutes long and conducted with the women in a ramped position and left lateral tilt. HFNO was delivered at highest tolerable flow rate with a maximum of 70 l.min<sup>-1</sup> and FM oxygen was delivered at 10 l.min<sup>-1</sup>. The primary outcome was first etO<sub>2</sub> concentration after each protocol with a chosen non-inferiority margin of 5%. Recruitment occurred prior to COVID-19 pandemic restrictions.

**Results:** 70 women were randomized. 62 women completed the study without complications. Eight women were excluded due to technical faults or incomplete protocols. Participant characteristics were age (mean  $\pm$  SD, 34.7  $\pm$  4.6 years) and body mass index (BMI) (median (IQR), 28.5 (26.6- 32.4) kg.m<sup>-2</sup>). First etO<sub>2</sub> concentration after HFNO protocol was non-inferior to first etO<sub>2</sub> concentration after FM oxygen protocol (mean difference, 1.45; 95% CI, 0.19- 2.72; two-tailed p-value, 0.025). 71% of participants achieved first etO<sub>2</sub> concentration of  $\geq 90\%$  after the HFNO protocol versus 43.5% after the FM protocol. There was no evidence of correlation between first etO<sub>2</sub> concentration after either modality and BMI or gestation. First etO<sub>2</sub> concentration after HFNO was weakly correlated to percentage of time of mouth closure (Pearson's coefficient, 0.287). First etO<sub>2</sub> concentration after FM oxygen was moderately correlated to respiratory rate in the final protocol minute and minute ventilation (Pearson's coefficient, 0.426 and 0.339 respectively).

**Conclusion:** HFNO was non-inferior to FM oxygen for increasing etO<sub>2</sub> concentration after simulated preoxygenation of women in late pregnancy. These results suggest that HFNO may be a suitable alternative to FM oxygen for preoxygenation of pregnant women prior to general anaesthesia.

**Disclosure:** Fisher & Paykel Healthcare provided equipment for this trial.

### References:

Tan PCF, Millay OJ, Leeton L, Dennis AT. High-flow humidified nasal preoxygenation in pregnant women: a prospective observational study. *British Journal of Anaesthesia* 2019; 122: 86-91.



## **Heart rate variability (HRV) can identify parturients at risk for maternal hypotension and fetal bradycardia following combined spinal epidural analgesia (CSEA)**

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**Co-Author:** Robert C. Parry, B.S.; William Dan, B.S.; Yoko Onishi, M.D.; George Gallos, M.D.;  
Toshiyuki Okutomi, M.D.

**Background:** Heart rate variability (HRV) is a well published surrogate for autonomic nervous system integrity and resilience. Recently, the analgesia nociception index (ANI) was developed for both qualitative and quantitative measurements of HRV. Induction of labor analgesia by combined spinal epidural analgesia (CSEA) may be associated with maternal hypotension and fetal heart rate (FHR) abnormalities - These potential complications are hypothesized to be related to autonomic dysregulation induced by CSEA. This study questioned if baseline HRV measurements could be used as a non-invasive predictive tool to identify parturients at significant risk for hypotension and FHR abnormalities following CSEA.

### **Methods:**

This IRB approved study (no. B18-182) included 85 normotensive American Society of Anesthesiologists Class 1 or 2 parturients. Patient demographics included: maternal age, gestational age, parity, height, weight, cervical dilation, and the visual analog scale score for pain at the time of the labor analgesia request. The primary endpoint was hypotension, defined as a  $\geq 15\%$  decrease in mean arterial pressure after CSEA, and the secondary endpoint was FHR abnormalities (late or variable decelerations) within 30 minutes after CSEA. Maternal baseline ANI, ECG, blood pressure, heart rate, oxygen saturation, and FHR tracings were digitally recorded for 15 minutes before CSEA. Monitoring continued for 30 minutes after intrathecal bupivacaine (2.0 mg) and fentanyl (10  $\mu$ g) administration. ECG recordings were analyzed with LabChart software to derive linear time and frequency domain HRV metrics. A HFVi (High frequency variability index) monitor provided real time ANI scores over the same 15 and 30 minute intervals. Parturients were grouped based on whether they remained normotensive or became hypotensive after CSEA. Patient demographics and HRV measurements were compared between the two populations. Results were reported as mean  $\pm$  standard error (SE) and differences in mean values were analyzed by unpaired t- or chi-squared tests. P-values  $< 0.05$  were considered significant.

### **Results:**

A total of 81 parturients were included in the analyses, with n=31 (hypotensive group) and n=50 (normotensive group). No significant differences were detected in the patient characteristics between the groups. Several HRV metrics including ANI scores were significantly different between the two groups at baseline (Figure 1A). Similarly, HRV metrics were significantly different between parturients who developed FHR abnormalities (n=19) and those who maintained reassuring FHR during their labor (n=62) (Figure 1B).

### **Conclusion:**

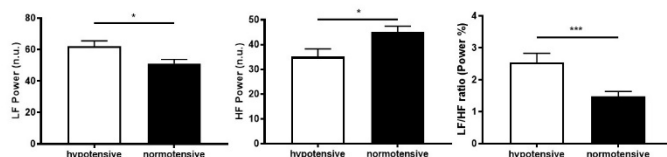
Non-invasive HRV measurements (including real-time ANI scores) can predict the propensity of an individual parturient for developing hypotension and FHR abnormalities following CSEA. These findings could help stratify women at higher risk for adverse outcomes and potentially result in safer perinatal management.



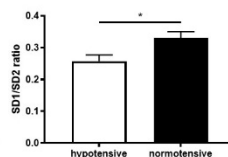
Figure 1

### 1A. Maternal hypotension

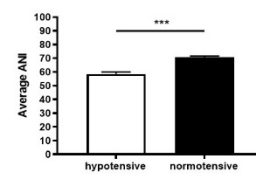
Frequency domain analysis



Time domain analysis

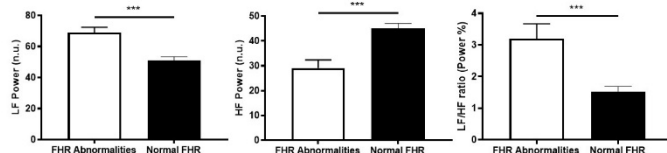


ANI

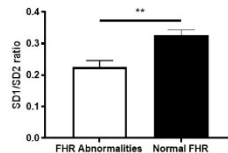


### 1B. FHR abnormalities

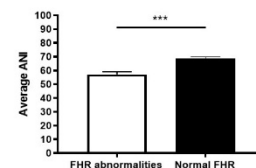
Frequency domain analysis



Time domain analysis



ANI



**Figure.1 Baseline heart rate variability (HRV) can predict which parturient are at greatest risk for maternal hypotension and fetal heart rate (FHR) abnormalities following combined spinal and epidural analgesia for labor.**

1A. Maternal hypotension; HRV metrics (LF power, HF power, LF/HF ratio, SD1/SD2 ratio) and ANI are significantly different between hypotensive and normotensive patients at baseline. \* $p < 0.05$ , \*\* $p < 0.01$ , \*\*\* $p < 0.001$

1B. FHR abnormalities; HRV metrics (LF power, HF power, LF/HF ratio, SD1/SD2 ratio) and ANI are significantly different between reassuring fetal status and FHR abnormalities at baseline. \* $p < 0.05$ , \*\* $p < 0.01$ , \*\*\* $p < 0.001$



## Treatment of Hypertension in Pregnancy: A Network Meta-Analysis of Randomized Control Trials

**Presenting Author:** Paige Keasler, DO

**Presenting Author's Institution:** Washington University in St. Louis School of Medicine

**Co-Author:** Preet M. Singh, MD; Lavanya Kolluru

**Background:** A variety of anti-hypertensive therapies are available for the treatment of hypertension in pregnancy and there is lack of consensus on relative efficacy. A previous meta-analysis showed that a similar efficacy was observed between hydralazine and calcium channel blocker (CCB) nifedipine compared to beta blocker (BB) labetalol.<sup>1</sup> To address additional studies comparing anti-hypertensive drugs in pregnancy, we performed a network meta-analysis (NMA) to include recent data comparing the efficacy between medications and as well as further categorizing drugs by route of administration.

**Methods:** Randomized clinical trials (RCTs) comparing more than one drug used for the treatment of hypertension and pre-eclampsia in pregnancy were searched for using electronic databases (EMBASE, Cochrane, PubMed). The primary outcome was the number of patients achieving the target blood pressure, defined by the study. Secondary outcomes included time to target blood pressure (min) and fetal outcomes, i.e. Neonatal Intensive Care Unit (NICU) admissions.

**Results:** Seventy-four RCTs with 8324 patients were eligible and included into this network meta-analysis. Fifty-five studies were included in the analysis of the primary outcome with a sample size of 5518 patients. The network plot for the primary outcome is shown in Figure 1. Most trials compared IV Labetalol and PO Nifedipine followed by IV Labetalol and IV Hydralazine. The ranking distribution was summarized by calculating the surface under the cumulative ranking curve (SUCRA) for the primary and secondary outcomes. The probability rank order and associated SUCRA values demonstrated that in the 13 drug therapies, CCB PO (0.84) followed by BB PO (0.78) are most likely to be effective in patients achieving target blood pressure, while IV hydralazine was lower (0.48). After sub-grouping patients into hypertension versus pre-eclampsia, CCB PO ranked the highest for both (0.82) vs. (0.77), respectively for success number. For secondary outcomes, serotonin antagonists (IV Ketanserin) (0.99) and nitroglycerin (0.88) were more rapidly able to achieve target blood pressure in minutes (Fig. 2). NICU admissions were lowest for alpha-2 agonists (0.89), followed by BB PO (0.82), Hydralazine IV (0.49), and BB IV (0.48) (Fig. 3).

**Conclusion:** This network meta-analysis evaluated the relative efficacy of 13 different combinations of drug class and route of administration for our primary outcome. Secondary outcomes such as time to target blood pressure and NICU admissions was compared between 10 and 6 drug therapies, respectively. Results from our NMA support subtle differences in efficacy between drug therapies and similar success utilizing calcium channel blockers such as Nifedipine. However, SUCRA values may not show whether the difference between interventions is clinically meaningful, as the absolute difference between the best treatment and others may be trivial.

**References:** 1 Brit J Clin Pharm 2018;84:1906-16



## **Bupivacaine Pharmacokinetics After Labor Epidural Analgesia, Intrapartum Cesarean Delivery Anesthesia, and Transversus Abdominis Plane Block With Liposomal Bupivacaine**

**Presenting Author:** Daniel Katz, MD

**Presenting Author's Institution:** Mount Sinai Hospital

**Co-Author:** Matthew Carangelo, PhD; Jia Song, MS; Roy Winston, MD; Ruthi Landau, MD

**Introduction:** The cumulative doses and possible toxicity resulting from bupivacaine received during labor epidural analgesia (LEA), intrapartum cesarean delivery (CD) anesthesia, and post-CD analgesia with transversus abdominis plane (TAP) block with liposomal bupivacaine (LB) have not been examined. We modeled bupivacaine pharmacokinetics (PK) in 6 clinical scenarios that may occur during intrapartum CD with LEA, neuraxial or general anesthesia, and TAP block.

**Methods:** Bupivacaine plasma concentrations were modeled using PK data from previous studies.<sup>1-3</sup> LEA dosing was bupivacaine 12.5 mg followed by 12.5 mg/h (assuming 10 mL/h of bupivacaine 0.125%). Variables included bupivacaine infusion duration (6 or 24 h), local anesthetic given for CD (epidural lidocaine, spinal bupivacaine, or none), interval between end of LEA and TAP block (0, 1, or 2 h), and TAP block dosing (LB 266 mg ± bupivacaine hydrochloride [HCl] 52 mg). A 2-compartment distribution model with first-order absorption and clearance was implemented for epidural infusion to capture PK and interindividual variability. Each scenario was modeled in 100,000 hypothetical individuals. The geometric mean and standard deviation were plotted to show potential outcomes.

**Results:** In a simulated common clinical scenario (LEA for 24 h followed by epidural lidocaine 400 mg for CD with TAP block 1 h later (LB 266 mg + bupivacaine HCl 52 mg), the geometric mean peak bupivacaine plasma concentration was 1342 ng/mL (scenario 1; Figure). In a model of LEA for 6 h, no local anesthetics for CD (simulating general anesthesia if epidural was nonfunctional), and TAP block 2 h later (LB 266 mg only), the geometric mean peak bupivacaine concentration remained < 300 ng/mL (scenario 2; Figure). Geometric mean peak concentrations remained < 1000 ng/mL for all other scenarios (Figure).

**Conclusions:** Labor epidural bupivacaine, with or without additional neuraxial anesthesia for CD, followed by TAP block with LB and bupivacaine HCl after CD is unlikely to result in bupivacaine plasma concentrations exceeding previously estimated neurologic and cardiac toxicity thresholds (~2000-4000 ng/mL) associated with local anesthesia systemic toxicity (LAST).<sup>4,5</sup> While our model did not replicate current LEA practice (combined spinal-epidural with low-concentration bupivacaine via programmed intermittent epidural bolus/patient-controlled epidural analgesia), modeling with a high-concentration bupivacaine infusion (0.125%) probably overestimated plasma concentrations and supports LAST being unlikely with TAP block with LB even after LEA was provided for 24 h.

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## The Effect of High Dose versus Low Dose Epidural Fentanyl on Gastric Emptying in Non-Fasted Parturients: A Double-Blinded Randomized Controlled Trial

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**Presenting Author's Institution:** Tel Aviv Sourasky Medical Center, Israel

**Co-Author:** Boris Aptekman; Yuval Baar; Carolyn F. Weiniger, MD

**Background:** Laboring women have increased aspiration risk in the event of general anesthesia. However, liberal food policies in labor have become widespread. In light of this, it is crucial to elucidate factors that may increase a laboring woman's risk for aspiration. Epidural fentanyl dose  $>100\mu\text{g}$  has been shown to reduce gastric emptying in fasted laboring women, using the paracetamol absorption test<sup>1</sup>, but has not been studied using gastric ultrasonography (US). We investigated the effect of fentanyl dose on gastric emptying using US in non-fasted laboring women.

**Methods:** Double-blinded randomized controlled trial with written informed consent. We included ASA II laboring women, cervical dilation  $\leq 5\text{cm}$ ; excluded chronic opioid consumption,  $\text{BMI} \geq 40 \text{ kg m}^{-2}$ , factors increasing risk of cesarean delivery or of aspiration. Women were randomized to receive high ( $>100\mu\text{g}$ ) or low ( $< 100\mu\text{g}$ ) cumulative epidural fentanyl dose. After request, epidural was performed and all women received bolus, bupivacaine 0.1% 10mL + fentanyl, then patient-controlled analgesia (PCEA) infusion, bupivacaine 0.083% + fentanyl. High dose fentanyl bolus was  $100\mu\text{g}$  and  $2\mu\text{g ml}^{-1}$  in PCEA, and low dose fentanyl bolus was  $25\mu\text{g}$  and  $1\mu\text{g ml}^{-1}$  in PCEA. Gastric US was performed immediately after the initial bolus, measuring antral cross-sectional area (CSA) in supine position with head elevated 45 degrees using the free tracing tool provided by the US device. The US was repeated two hours later (T2h). Oral intake 8 hours preceding epidural initiation until T2h was recorded. Primary outcome: CSA at T2h for high vs low dose fentanyl. Secondary outcomes: change in CSA between baseline and T2h, sub-group analysis according to baseline stomach content (empty,  $\text{CSA} < 381$  or full,  $\text{CSA} \geq 381 \text{ mm}^2$ ) comparing high vs low dose fentanyl. Data were analyzed using independent sample t-tests for our primary outcome and paired t-tests for our subgroup analysis. Sample size was calculated as 40 women/group.

**Results:** Data from 80 women were analyzed. The CSA at T2h was not statistically different for high, mean  $334.9$  (SD  $133.2$ )  $\text{mm}^2$ , vs low dose fentanyl, mean  $334.5$  (SD  $171.7$ )  $\text{mm}^2$ ,  $P = 0.991$ . Change in CSA from baseline to T2h was  $45.5$  (SD  $149.36$ )  $\text{mm}^2$  for high vs  $48.5$  (SD  $162.7$ )  $\text{mm}^2$  low dose,  $P = 0.931$ . At baseline, 63 women had empty and 17 had full stomach. The sub-group analyses according to baseline stomach content (empty/high vs empty/low; full/high vs full/low) showed no statistically significant differences in CSA at T2h.

**Conclusions:** Our study is the first to assess the effect of fentanyl dose on gastric emptying using US in non-fasted laboring women. CSA at T2h was similar for women who received high vs low dose epidural fentanyl. This supports food policies in labor that are tailored to individual aspiration risk regardless of labor epidural fentanyl dose.

### References:

Porter JS et al. The influence of epidural administration of fentanyl infusion on gastric emptying in labor. *Anaesthesia* 1997; 52: 1151-1156.



## Maternal Tranexamic Acid Plasma Concentration and Coagulation Status During Cesarean Delivery

**Presenting Author:** Sara M. Seifert, MD

**Presenting Author's Institution:** Brigham and Women's Hospital

**Co-Author:** Mario I. Lumberras-Marquez, MBBS, MMSc; Daniela A. Carusi, MD; Brian T. Bateman, MD, MSc; Susan M. Goobie, MD; Michaela K. Farber, MD, MS

**Introduction:** Tranexamic acid (TXA) is frequently administered for postpartum hemorrhage (PPH) as the World Maternal Antifibrinolytic (WOMAN) trial showed 1g IV significantly reduced death.<sup>1</sup> The optimal dose of TXA to achieve antifibrinolysis during PPH is unknown, but a systematic review suggests a plasma concentration of 10-20 ug/mL yields 80-90% antifibrinolysis.<sup>2</sup> Determining the pharmacokinetics (PK) and pharmacodynamics (PD) for TXA in obstetrics may facilitate antifibrinolysis and minimize adverse events such as thrombosis or renal cortical necrosis.<sup>3</sup> The primary aim of this study was to evaluate the PK/PD of TXA administered during CD to patients at risk for PPH. Plasma TXA level correlation with patient demographics and rotational thromboelastometry (ROTEM®) coagulation changes were also analyzed.

**Methods:** In this prospective pilot study we recruited 20 women age 18-50y,  $\geq 23$  weeks gestation undergoing CD with at least (1) major (placenta previa, suspected accreta, active bleeding) or (2) minor ( $>2$  prior CDs, prior PPH, chorioamnionitis, polyhydramnios, macrosomia, obesity, or suspected placental abruption) risk factors for PPH. Patients with an allergy to TXA, inherited thrombophilia, prior or current thrombosis, seizure history, renal or liver dysfunction, anticoagulation, or category III fetal heart tracing were excluded. TXA 1g was administered after umbilical cord clamping during CD. Blood samples were drawn at 3, 7, 15, and 30 minutes, then at 30-minute intervals up to 5 hours. TXA plasma concentrations were evaluated as mean (SD) and 95% confidence intervals. Serial ROTEM® testing was performed.

**Results:** All patients have completed the study, with 19/20 analyzed to date. Mean BMI was 30 kg/m<sup>2</sup> (range 21-46 kg/m<sup>2</sup>) and mean blood loss was 1500 mL (range 379-10,000 mL). TXA mean peak plasma concentration was 47.4 ug/mL (range 30.2 - 76.6 ug/mL) and time above 10 ug/mL was 150 min (range 30-210 min; Figure). Correlation coefficients of plasma TXA concentration with BMI and blood loss were -0.5 ( $p = 0.03$ ) and 0.12 ( $p = 0.63$ ). Correlation coefficients of plasma TXA concentration and ROTEM® were: EXTEM-CT 0.19 ( $p = 0.02$ ), EXTEM-MCF 0.3 ( $p < 0.001$ ), EXTEM-LI30 0.11 ( $p = 0.2$ ).

**Conclusions:** This is the first study to our knowledge evaluating maternal plasma TXA levels after the standard 1g IV dosing during CD in patients at risk of PPH. Our findings suggest a wide range of therapeutic TXA duration with some patients having therapeutic levels  $< 60$  min. TXA level variability correlated with BMI, which suggests the need for weight-based dosing and re-dosing for longer cases. Our study shows no correlation between TXA level and blood loss, but positive correlations with ROTEM parameters were identified. Future studies can explore these relationships for optimal PPH dosing strategies.

### References:

1. WOMAN Trial. Lancet. 2017; 389 (10084): 2105-2116.
2. Picetti, R. Blood Coagulation and Fibrinolysis 2019; 30:1-10.
3. Ducloy-Bouthors AS et al. Crit Care. 2011; 15(2): R117.



## **Carbetocin vs Oxytocin at elective cesarean deliveries: a double-blind, randomized controlled non-inferiority trial of high and low dose regimens**

**Presenting Author:** Fergal McDonagh, MB BCh BAO BSc FCAI FANZCA

**Presenting Author's Institution:** Department of Anesthesia and Pain Management, Mount Sinai Hospital, University of Toronto

**Co-Author:** Jose Carvalho, MD PhD; Sadiq Abdulla, MD; Daniel Cordovani, MD; Kristi Downey, MSc; Mrinalini Balki, MD

**Introduction:** Oxytocin or carbetocin are recommended for routine administration after delivery of the fetus during cesarean delivery (CD) to prevent post-partum hemorrhage (PPH) [1]. Traditionally, higher doses of these drugs have been used. However, there is increasing evidence that lower doses may be as effective and produce less side effects [2-4]. We sought to compare the effect of (i) low and high dose oxytocin, and (ii) low and high dose carbetocin, on uterine tone at elective CD. Our hypothesis was that the low dose (LD) would be non-inferior to the high dose (HD) for both drugs.

**Methods:** We included ASA 2-3 women with no risk factors for PPH undergoing elective CD under spinal anesthesia. Women were randomized into 4 groups: (OxyLD) oxytocin 0.5IU bolus + infusion of 40 mIU/min for 8 hours; (OxyHD) oxytocin 5IU bolus + infusion of 40mIU/min for 8 hours; (CarLD) carbetocin 20µg + placebo infusion; (CarHD) carbetocin 100µg + placebo infusion. The study drug was given as a slow IV bolus after delivery of the fetus. The obstetrician was asked to assess uterine tone intensity at 2, 5 and 10 minutes after administration of the study drug using a verbal numerical rating scale (VNRS) of 0-10 (0=boggy, 10=firm). The primary outcome was uterine tone 2 minutes after study drug administration. The pre-specified non-inferiority margin of 1.2 points on the 11 point scale was chosen, and the Student's t-test was used for the primary comparison. Secondary outcomes were uterine tone after 5 and 10 minutes, use of additional uterotonics, blood loss and side effects.

**Results:** We included 277 women in the analysis. Results for the primary outcome and some secondary outcomes are shown in Table 1. The mean (SD) uterine tone at 2 minutes was similar across all groups, with OxyLD [7.1 (1.4)] being non-inferior to OxyHD [7.3 (1.9)], mean difference (95% CI) -0.20 (-0.76, 0.36); and CarLD [7.4 (1.7)] being non-inferior to CarHD [7.6 (1.5)], mean difference (95% CI) -0.18 (-0.71, 0.36). A secondary analysis using F test (ANOVA) demonstrated no significant differences for the primary outcome across all four groups (p=0.33). Uterine tone at 5 and 10 minutes was non-inferior when OxyLD and CarLD were compared to OxyHD and CarHD respectively. Use of additional uterotonics, blood loss and side effects were similar across all groups.

**Discussion:** At elective cesarean delivery, the uterine tone produced by low dose oxytocin (0.5IU) is non-inferior to that produced by high dose oxytocin (5IU); similarly, the uterine tone produced by low dose carbetocin (20µg) is non-inferior to that produced by high dose carbetocin (100µg). Low dose and high dose regimens of both oxytocin and carbetocin seem to be associated with similar need for additional uterotonic drugs, blood loss, and similar side effects.

**References:** 1) Heesen et al. *Anaesthesia* 2019; 74:1305-1319; 2) Carvalho et al. *Obs Gyn* 2004; 104:1005-1010; 3) Khan et al. *CJA* 2014; 61:242-248; 4) Tabl et al. *Anaesthesia* 2019; 74:190-196.



	Oxytocin 0.5IU N=69	Oxytocin 5IU N=69	Carbetocin 20mcg N=70	Carbetocin 100mcg N=69	p-value
Uterine tone, mean (SD)					
2 min	7.1 (1.4)	7.3 (1.9)	7.4 (1.7)	7.6 (1.5)	0.33
5 min	7.4 (1.4)	8 (1.5)	7.8 (1.2)	7.9 (1.3)	0.049
10 min	7.9 (1.4)	8 (1.5)	8 (1.4)	8.3 (1.5)	0.35
Additional uterotonics intraoperatively, N(%)	17 (24.6)	11 (15.9)	11 (15.7)	12 (17.4)	0.48
Additional uterotonics in 1st 24 hours post-op, N(%)	7 (10.1)	5 (7.3)	4 (5.7)	2 (2.9)	0.37
Blood Loss, median (IQR)	777 (492,1090)	829 (502,1169)	844 (502,1163)	887 (484,1186)	0.83



## The ED90 of intrathecal chloroprocaine for cervical cerclage placement: an up-down sequential allocation dose-response study

**Presenting Author:** Riley A. Landreth, D.O.

**Presenting Author's Institution:** Division of Women's Anesthesiology, Duke University Hospital

**Co-Author:** Nadir Sharawi, MD; Paul Tan, M.D.; Cameron Taylor, M.D.; Jill M. Mhyre, M.D.; Ashraf S. Habib, MBBCh, MSc, MHSc, FRCA

**Introduction:** Cervical cerclage placement is commonly performed as an outpatient procedure in pregnant women with cervical incompetence. Bupivacaine is commonly used for spinal anesthesia for this short procedure, but can be associated with prolonged block leading to delayed discharge from hospital. Chloroprocaine has a shorter duration of action and may be a more suitable agent for anesthesia for cerclage placement. The optimum dose of spinal chloroprocaine that provides adequate anesthesia and facilitates rapid recovery is unknown. We performed a multicenter prospective double-blinded study to determine the dose of intrathecal chloroprocaine that provides effective anesthesia for cervical cerclage placement in 90% of patients (ED90) using an up-down sequential allocation method with a biased-coin design.

**Methods:** Following IRB approval, we enrolled women scheduled for elective transvaginal cervical cerclage placement. A combined spinal epidural technique was performed using a predetermined dose of chloroprocaine mixed with fentanyl 10mcg. The study drug was prepared in a total volume of 2mL by adding preservative free saline as needed by a provider not involved in clinical care or data collection to maintain blinding. The initial intrathecal dose was 45mg of chloroprocaine. Doses for subsequent subjects were adjusted based on the outcome of the prior subject using a biased coin up-down sequential allocation technique in increments of 3mg. A bilateral block to T12 level was considered adequate for the start of surgery. The primary outcome was the success or failure of anesthesia. A dose was considered effective (a success) if a T12 block was achieved within 15 minutes of spinal injection and there was no requirement for intraoperative analgesic supplementation. If the subject reported discomfort or requested analgesia, this was treated at the discretion of the blinded anesthesiologist using epidural or intravenous supplementation, and the dose was considered a failure. Exploratory outcomes included time to block regression and readiness for PACU discharge. Blinded investigators performed all clinical assessments and data collection. Isotonic regression was used to estimate the ED90.

**Results:** 45 patients were included in the analysis [median [IQR] age 32 [29, 37] years, BMI 33 [26, 37] kg/m<sup>2</sup>, gestational age 15 [14, 19] weeks and duration of the procedure 15 [10, 24] minutes]. 16 patients received 45mg 3% Chloroprocaine, 7 received 48mg and 22 patients received 51mg (Figure). The estimated ED90 (95% confidence interval) was 49.5 (45.0, 50.1) mg. Time to resolution of sensory block was 90 (75, 105) minutes, of motor block was 68 (45, 75) minutes and of readiness to PACU discharge was 155 (140, 190) minutes.

**Conclusion:** This study estimated the ED90 of intrathecal 3% chloroprocaine in combination with fentanyl 10mcg for cervical cerclage placement. The use of chloroprocaine was associated with a relatively rapid recovery of sensory and motor block.



**Review of post C-Section Analgesia during Covid Crisis: Bilateral TAP (Tranversus Abdominis Plane) blocks with liposomal bupivacaine and neuraxial morphine reduces use of narcotics and length of stay**

**Presenting Author:** Jason Kim, MD

**Presenting Author's Institution:** Maimonides Medical Center

**Co-Author:** Dennis Feierman, MD; Christina Dgheim, DO; Kalpana Tyagaraj, MD

**Background:** During the Covid crisis, we sought to reduce the length of stay and expedite discharge of C-section patients in a collaborative effort with our obstetric colleagues. Previous research has shown that the use of a bilateral TAP blocks using liposomal bupivacaine significantly reduced post C-Section pain in patients that also received neural-axial morphine. We performed the TAP block with liposomal bupivacaine on a large number of our post C-Section patients, and hypothesize it will result in extended postoperative pain control with decreased opioid use, which can facilitate early discharge from the hospital.

**Methods:** After IRB approval, a retrospective study of patients who underwent Cesarean delivery under spinal or epidural anesthesia was conducted comparing standard of care (SOC), preservative free morphine neuraxial administration, with SOC with addition of bupivacaine only TAP blocks or SOC with bupivacaine plus liposomal bupivacaine TAP blocks. The primary endpoints were postsurgical pain throughout hospital stay, hospital length of stay, and amount of opioid administered within 24 hours, 24-48 hours, 48-72 hours, after 72 hours post-surgery.

**Results:** The percentage of subjects who used opioids throughout their hospital stay was significantly different between those who received SOC without TAP blocks (60%) or bupivacaine only TAP Blocks (54%) versus the liposomal bupivacaine TAP blocks group (18%,  $p < .001$ ). Additionally, length of stay was significantly decreased in the TAP-liposomal bupivacaine group (2.29 days,  $p < .001$ ) compared to non-TAP (3.16 days) and TAP-Bupivacaine (3.14 days). The use of liposomal bupivacaine in the TAP blocks also decreased opioid usage at all time points when compared to the other groups

**Conclusion:** We conclude that intrathecal and neuraxial opioids combined with bilateral TAP Blocks with liposomal Bupivacaine will provide significant pain relief for post C-Section patients, leading to significantly decreased use of post-operative narcotics and decreased length of stay.

**References:**

- Baker BW, Villadiego LG, Lake YN, et al. Transversus abdominis plane block with liposomal bupivacaine for pain control after cesarean delivery: a retrospective chart review. *J. Pain Res.* 2018;11:3109-3116.
- Feierman DE, Kronenfeld M, Gupta PM, Younger N, Logvinskiy E. Liposomal bupivacaine infiltration into the transversus abdominis plane for postsurgical analgesia in open abdominal umbilical hernia repair: results from a cohort of 13 patients. *J. Pain Res.* 2014;7:477-482.
- McMorro RC, Ni Mhuircheartaigh RJ, Ahmed KA, et al. Comparison of transversus abdominis plane block vs spinal morphine for pain relief after Caesarean section. *Br. J. Anaesth.* May 2011;106(5):706-712.



	Non-TAP	TAP-bupi	TAP-liposomal bupivacaine
Average # of days.	3.16	3.14	2.29 <sup>a</sup>
Median # of days	3.17	3.05	2.04
p (vs TAP-Ex)	p<2.14x 10 <sup>-13</sup>	p<8.41x10 <sup>-14</sup>	
p (vs Non-TAP)		p<0.84	Student t-test (average 3 of days)
Overnights=2	6	11	89 <sup>b</sup>
Overnights>2	54	71	26
p (vs TAP-Ex)	P<0.0001	P<0.0001	
p (vs Non-TAP)		P<0.54	Chi Square test

The data for the Non-TAP and TAP bupi (plan bupivacaine) was obtained from reviewing charts from 2012. Length of stay was calculated as the time from arrival in the PACU until discharge. <sup>a</sup> A Student t-test was used to compare the average number of days. <sup>b</sup> A Chi-square test was used to compare two categorical variables i.e., Overnight equal to 2 days vs overnight > 2 days.



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## Use of WhatsApp to improve high risk obstetric referrals in Accra, Ghana

**Presenting Author:** Hebah Ismail, MD, JD

**Presenting Author's Institution:** Wake Forest Baptist Medical Center

**Co-Author:** Medge Owen, MD; Adeyemi Olufolabi, MBBS, FRCA; Emmanuel Srofenyoh, MD

**Background:** Smartphones have become common communication tools in everyday life. They are widely utilized, even in low resource settings (LRS), and m-health technology is promoting information exchange.<sup>1</sup> In LRS, such as Ghana, poor communication capability prevents access to timely and appropriate emergency obstetric care. The Greater Accra Regional Hospital (GARH) conducts 8,000 deliveries per year, of which 70% are high-risk referrals. Patients often arrive, without warning, in compromised states. This project aimed to improve communication among clinicians regarding high-risk cases, guide treatment interventions, and facilitate referrals through the use of WhatsApp.

**Methods:** WhatsApp was utilized to create the Kybele Referral Platform (Platform). This was a private network of obstetricians, midwives and administrators from GARH, 8 primary health centers, 4 district hospitals, members of Kybele and the Ghana Health Service. Beginning March 1, 2017, participants posted deidentified patient information on the Platform for advice regarding patient care and referral. Platform transcripts from March to August 2017 were downloaded and individually analyzed.

**Results:** Platform users increased from 69 to 81 within 6 months and 618 cases were posted, ranging from 75 to 136 per month. All facilities participated, although 3 accounted for 54% of Platform postings. The median posting to response time was 17 min and a receiving hospital was identified in 511 (83%). The leading referrals indications were: hypertensive disorders of pregnancy (37%), failure to progress/cephalopelvic disproportion (25%), prematurity/preterm labor (24%), fetal compromise (14%), and acute maternal hemorrhage (10%). Pre-referral treatment was initiated in 341 (55%) of cases. In addition to referrals, the Platform enabled advice on treatment, investigations and diagnosis while also preserving patient confidentiality. If a participating hospital had supply chain disruptions, such as blood or oxygen shortages, or major equipment malfunctions, such as anesthesiology machine disrepair, this was announced and referrals were diverted.

**Conclusions:** The Platform has enhanced the referral process for high-risk obstetric patients in Accra, Ghana. Communication has been facilitated among users, improving pre-referral treatment, on-site management when referral was not feasible and receiving hospital preparedness. Although project specific data was analyzed for 6 months, the Platform use continues and is expanding and now includes 147 users, including the National Ambulance Service.

**References:** DOI: 10.3233/978-1-61499-712-2-82



## Identifying the Practical and Non-obvious Tools and Skills Obtained in an Obstetric Anesthesia Fellowship

AGNES M. LAMON, MD  
ATTENDING ANESTHESIOLOGIST  
DIRECTOR OF OB ANESTHESIA  
PENN MEDICINE PRINCETON HEALTH

1

## Opening considerations

- ❖ Our fellowship is so much more than just putting in a labor epidural
- ❖ Skills and knowledge learned distinguish us throughout our career
- ❖ Creates many paths for career growth- and most do not follow a straight line

2

## Expert in a field of medicine

- ❖ Point person for your practice and colleagues in other specialties
- ❖ Implement safety bundles, protocols, safety review committee
- ❖ Critical eye for critiquing literature and emerging research

3

## Leader in a multi-disciplinary team

- ❖ Be an advocate the Anesthesia department and help communicate their concerns and goals
- ❖ Ob PI, perinatal, pharmacy review, "laborhood"
- ❖ Board Runner/ team leader

4

## Perioperative care

- ❖ Pre Admission testing/ Planning
- ❖ Intrapartum care
- ❖ Post partum
- ❖ ERAS
- ❖ Debriefs/ Review committees

5

## QI skills

- ❖ Systemic action and improvements that lead to measurable outcomes
- ❖ Unit/ hospital/ system level

6



## Lifelong educator

❖ Whether or not you stay in academia, education will continually be an important part of your career....

- ❖ Residents
- ❖ Nurse Anesthetist/ student Nurse Anesthetist
- ❖ Anesthesia technicians
- ❖ Nurses
- ❖ OB/midwives
- ❖ Patients
- ❖ Community Educators



7

# Thank You!

AGNES.LAMON@PENNMEDICINE.UPENN.EDU



8





# Obstetric Anesthesiology Fellowship

From the  
Private Practice Perspective

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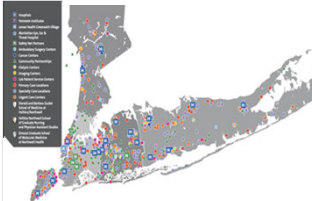
Gregory T. Palleschi, MD  
Director, Obstetric Anesthesia  
North Shore University Hospital  
Long Island Jewish Medical Center

1


# Northwell Health System

- New York's largest healthcare provider
- Serves NYC, Long Island and Westchester
- Five tertiary hospitals
  - Lenox Hill Hospital, Manhattan
  - Long Island Jewish Medical Center
    - Katz Women's Hospital
  - North Shore University Hospital
    - Katz Women's Hospital
  - South Shore University Hospital
  - Staten Island University Hospital
- Three Specialty Care Hospital
- 11 Community Hospitals
- Four Affiliate Hospitals



2

# North Shore University Hospital



- 783 beds
- Level 1 trauma center
- Katz Women's Hospital
- ~6800 deliveries/yr
- 12 Labor rooms
- 4 OB ORs
- 51 bed Level 3 NICU
- SOAP Center of Excellence 2018

3

# Long Island Jewish Medical Center





- 583 beds Tertiary Care
- 15 miles east of Manhattan
- Cohen Children's Medical Center~202 beds. Level 1 Pediatric Trauma Center
- >7000 deliveries/yr
- 16 Labor rooms
- 4 Obstetric ORs
- Level 3 NICU
- SOAP Center of Excellence 2021

4

# Donald and Barbara Zucker School of Medicine

At  
Hofstra/Northwell Health


5

# Residency in Anesthesiology at the Donald and Barbara Zucker School of Medicine at Hofstra/Northwell

- 6 residents in each PGY1-PGY-4 (24 total)
- Fellowship Training: Pediatrics, Pain Medicine

## Recent Graduate Fellowship Placement

- Cardiothoracic Anesthesiology
  - University of Pittsburgh
  - Cleveland Clinic
  - University of Texas HSC at Houston
  - Icahn School of Medicine at Mount Sinai
- Multidisciplinary Pain Medicine
  - Cleveland Clinic Foundation
  - Feinberg School of Medicine at Northwestern
  - University of Colorado
- Regional and Acute Pain
  - University of Colorado
  - University of Michigan
  - Texas Children's Hospital
- Clinical Informatics
  - Beth Israel Deaconess Medical Center
- Neurosurgical Anesthesia
  - Johns Hopkins




6



### North American Partners in Anesthesia

**Your Partner in Perioperative Care**



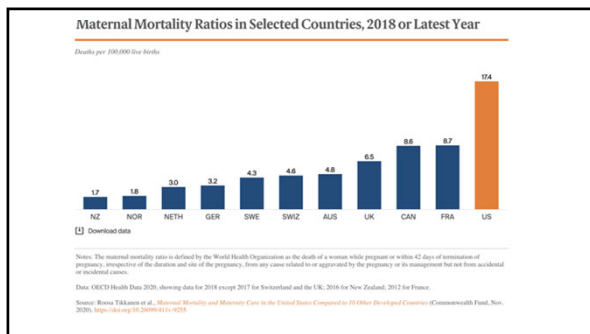
- Founded in 1986
- Clinician-led, single-specialty
- Serves more than 3 million patients annually in more than 500 healthcare facilities nationwide.

7

### What are Some of the Challenges Facing the USA?

- High and Increasing Maternal Mortality Rate
- Need to Recognize and Follow Bundles/Protocols
- Older and More Complex Patients
- Racial/ethnic Disparities


8



9

### Education/Need for Bundles


**CMQCC**  
California Maternal Quality Care Collaborative



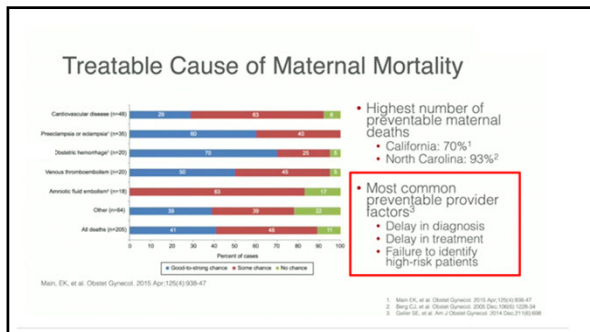
## Planning for and Responding to Obstetric Hemorrhage

California Maternal Quality Care Collaborative  
Obstetric Hemorrhage Version 2.0 Task Force

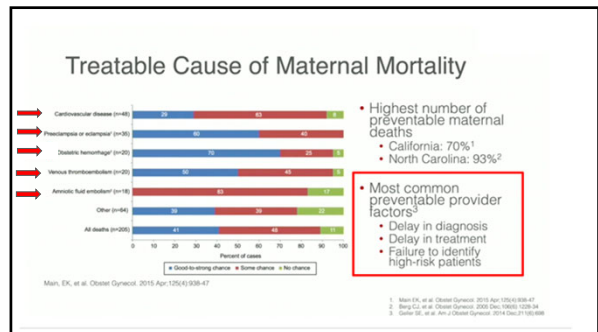
This project was supported by Title V funds received from the California Department of Public Health, Maternal, Child and Adolescent Health Division



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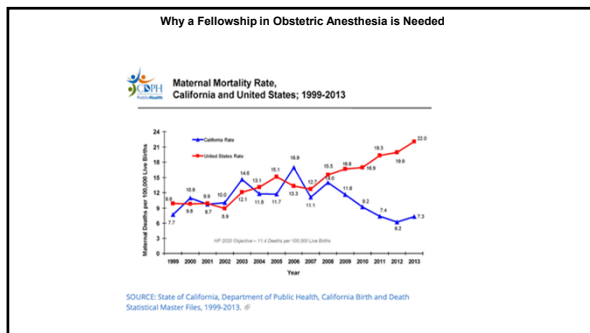


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### Older and Increasingly Complex Parturients

May 1, 2015, William D. D'Almeida, MD

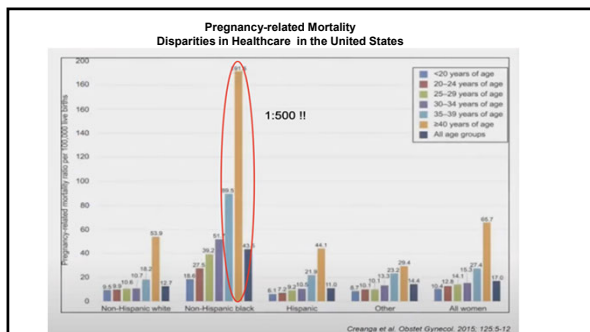
#### New Study: Millennial Women Are Delaying Having Children Due To Their Careers

Anthony D'Almeida, Contributor

Forbes, May 2020

- Increasing Maternal Age Increases:
  - Fetal loss
  - Hypertensive Disorder of Pregnancy
  - Multiple pregnancy
  - Gestational DM
- Increase in cardiovascular disease
  - #1 Cause of mortality in USA
  - Congenital heart disease
  - Cardiomyopathy
- Increasing Cesarean Delivery rate
  - Invasive placenta

14



15

### Levels of Maternal Care 2019

ACOG

Level of Care	Definition	Indications	Contraindications
Level 1: Basic Obstetric Care	... (text) ...	... (text) ...	... (text) ...
Level 2: Regional Anesthesia	... (text) ...	... (text) ...	... (text) ...
Level 3: Comprehensive Care	... (text) ...	... (text) ...	... (text) ...

16

- ### Private Practice
- General:**
- Remain cutting edge
    - Initiation of "best practice" (CMQCC, National Partnership, SOAP Consensus Statements)
      - Decrease mortality
    - Management of complex cases
      - Triage and stabilization of patients from lower level hospitals → higher level hospitals
        - PPH
        - Hypertensive Emergencies
    - Latest techniques: POCUS/Ultrasound—regional blocks, PIEB.
  - Deliver the best possible care
    - Disparities
  - Leader within the department serving as liaison with administration, outside services
    - COE
    - Leverage
  - Liaison with SOAP and other professional organizations—recognition of clinical relevance
    - Inclusivity

17

- ### Private Practice
- Our Private Practice—All of the Above, Plus:**
- Complex patient population
  - Mission of the medical school
  - Requirements of the residency program
    - Teaching
    - Research endeavors
  - Serving as a model/inspiration for residents as the next generation of physician leaders (whether entering private or academic practice—it is not "all or none")
  - Development of an Obstetric Anesthesia Fellowship
  - Leadership
    - Locally
      - Division Chief
    - Nationally

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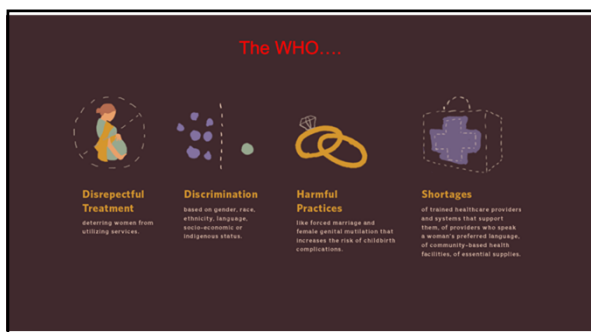




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# Why Do You Need an OB Anesthesia Fellowship?

## Patient Care and Safety

Jacqueline M. Galvan, MD  
Associate Professor of Anesthesiology  
Obstetric Anesthesia Fellowship Director  
University of Illinois at Chicago Hospital and Health Science Systems

1

Driving into work on a Friday....



2



3

### Faculty and Staff

role models for future generations...demonstrating compassion, commitment to excellence in teaching and patient care, professionalism, dedication to lifelong learning

#### No Fellowship



#### Fellowship



Role models  
Ensure highest quality care  
Fellowship or equivalent trained  
Maintains educational environment

4

- Faculty
- Collaborative Care
- Technical Skills: Cool Tricks .. To Optimize Care
- Safety: Keeping Up with the Latest Data

5

### Collaborative care

Fellows must demonstrate competence in the comprehensive analgesic/anesthetic management of deliveries, including high risk vaginal, CD, 1<sup>st</sup>/2<sup>nd</sup>/3<sup>rd</sup> trimester procedures

#### No Fellowship

Entropy ... doing random things



#### Fellowship

- Low dose neuraxial techniques
  - CSE, DPE
  - ECV and neuraxial anesthesia
- Neuraxial anesthesia is good!
- Epidural analgesia → Surgical anesthesia
- Epidural success (85-90%)
- Catheter placement and anesthetic quality
- Catheter manipulation
- Incorporation of maternal/fetal status
- Robust team communication



Bauer MD, MS / Obstet Anesth. 2012 Oct; 21(10):204-209

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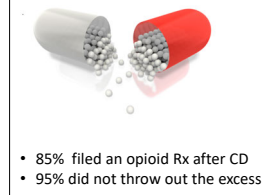
- Faculty
- Collaborative Care
- Technical Skills: Cool Tricks ... To Optimize Care
- Safety/Keeping Up with the Latest Data

7

### Technical Skills: Cool Tricks ... to Optimize Patient Care

*postpartum pain management in the parturient, including consequences of post-Cesarean delivery pain*

#### No Fellowship



- 85% filed an opioid Rx after CD
- 95% did not throw out the excess

#### Fellowship

- US: POCUS and Lumbar Epidural
- Truncal blocks and post-op pain



Brian T. Salzman, MD et al. Obstet Gynecol. 2017 Jul;130(2):29-35.

8

- Faculty
- Collaborative Care
- Technical Skills Cool Tricks ... To Optimize Care
- Safety: Keeping Up with the Latest Data

9

### Safety: Keeping Up with the Latest Data

*demonstrate the ability to investigate and evaluate their care of patients, to appraise and assimilate scientific evidence, and to continuously improve patient care based on constant self-evaluation and lifelong learning*

#### No fellowship:



#### Fellowship:



10

### Why Do You Need an OB Anesthesia Fellowship?

Patient Care and Safety

- Inspires
- Promotes
- Encourages



11

Thank You!

12



**SOAP**  
Society for Obstetric  
Anesthesia and Perinatology

## Disparities in Maternal Care: Providers, Patients and Outcomes

Allison Lee, MD, MS  
Associate Professor of Anesthesiology at CUMC  
Columbia University, New York, NY

SOAP Officer of Diversity and Inclusion  
Officer of Diversity, Equity and Inclusion,  
Department of Anesthesiology, Columbia University

Allison Lee @AllisonLeeNY

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## Learning Objectives

- Explain the evidence for structural racism/provider bias on healthcare outcomes
- Explain the benefits of diversification of the anesthesia workforce

I have no disclosures

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# Are you racist?

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JAMA @JAMA\_current

No physician is racist, so how can there be structural racism in health care? An explanation of the idea by doctors for doctors in this user-friendly podcast from the great @DrKatzNYCHH and @ehIJAMA!

11:40 AM · Mar 4, 2021

13 13 Share this Tweet

Ed Livingston, MD  
Deputy Editor for clinical reviews and education, JAMA

"What you're talking about isn't so much racism ... it isn't their race, it isn't their color, it's their socioeconomic status."

"Minorities ... aren't [in those neighborhoods] because they're not allowed to buy houses, or they can't get a job because they're Black or Hispanic. That would be illegal," Livingston says

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JAMA @JAMA\_current

No physician is racist, so how can there be structural racism in health care? An explanation of the idea by doctors for doctors in this user-friendly podcast from the great @DrKatzNYCHH and @ehIJAMA!

11:40 AM · Mar 4, 2021

13 13 Share this Tweet

Mitchell Katz, MD  
President and CEO of NYC Health + Hospitals

"...it is woefully naïve to say that no physician is a racist, just because the Civil Rights Act of 1964 forbade it."

*This tweet has since been deleted*

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## Structural Racism

"The totality of ways in which societies foster racial discrimination, through mutually reinforcing inequitable systems (in housing, education, employment, earnings, benefits, credit, media, health care, criminal justice, and so on) that in turn reinforce discriminatory beliefs, values, and distribution of resources, which together affect the risk of adverse health outcomes"

Bayley Z, et al. Lancet. 2017;389:1453-63.



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## EXAMPLE Residential Segregation

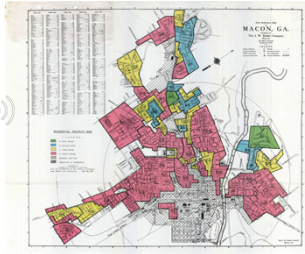
### Redlining -

Legal practice initiated 1934 by Federal Housing Administration (until 1968)

Maps marked with red lines to delineate neighborhoods where mortgages denied to marginalized, racialized groups to steer them away from white neighborhoods

3 out of 4 neighborhoods "redlined" 80 years ago continue to struggle economically – locked in concentrated poverty

Redlining was banned 50 years ago. It's still hurting minorities today.



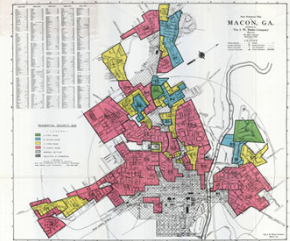
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## Consequences

- Racialized and economically segregated neighborhoods
- Dilapidated built environment
- Exposure to pollutants and toxins
- Limited opportunities for quality education
- Limited opportunities for employment
- Limited access to quality health care
- Higher violence and crime – punitive policing, "stop and frisk", "war on drugs".

Redlining was banned 50 years ago. It's still hurting minorities today.



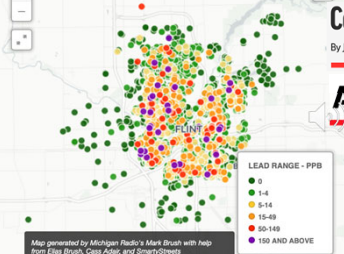
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## Commission: 'Systemic racism'

### AP at root of Flint water crisis

Flint Drinking Water Tests for Lead - January 2016



LEAD RANGE - PPB

- 1-4
- 5-14
- 15-49
- 50-149
- 150 AND ABOVE

"Would the Flint water crisis have been allowed to happen in Birmingham, Ann Arbor or East Grand Rapids? We believe the answer is no, and that the vestiges of segregation and discrimination found in Flint made it a unique target. The lack of political clout left the residents with nowhere to turn, no way to have their voices heard."

J Public Health Manag Pract 2019;25:S84-S90.

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## Genocide

Forcible removal of indigenous people from their lands; forcible removal of children

### Jim Crow

Legalized discrimination during Reconstruction after Civil War - until 1968

## anti-immigrant

### ENSLAVEMENT

But slavery was so long ago....

AMERICAN SLAVERY 339 years

SEGREGATION 89 years

1526 1700 1800 1865 1954 2000

Religious Discrimination (e.g. anti-muslim)

Klu Klux Klan - 1865 - present

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11

## Health Consequences Structural Racism

- Psychosocial stressors - mental health suffers, substance use, allostatic load, inflammatory markers and hormonal dysregulation
- Residential segregation - exposure to pollutants and toxins
- Healthcare quality and access

### Henrietta Lacks and Her Remarkable Cells Will Finally See Some Payback

Research labs and companies gained financially from the Black woman's cancer cells. Decades later, two entities are donating money to her foundation.

### Mistrust

#### The New York Times

##### Black Doctor Dies of Covid-19 After Complaining of Racist Treatment

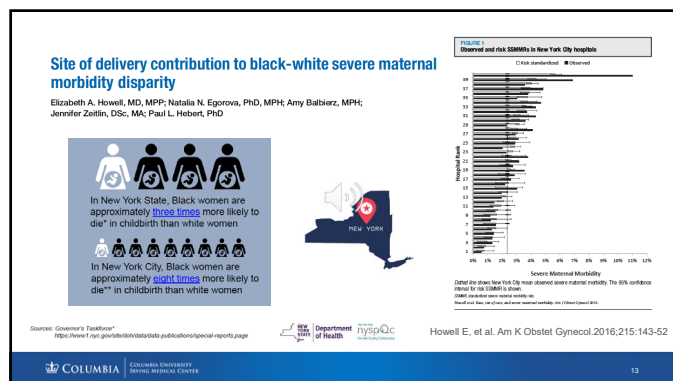
"He made me feel like a drug addict," Dr. Susan Moore said, accusing a white doctor of downplaying her complaints of pain and suggesting she should be discharged.

In Tuskegee, Painful History Shadows Efforts To Vaccinate African Americans

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12





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### Racism and Health

CDC Centers for Disease Control and Prevention  
CDC 24/7: Saving Lives. Protecting People™

Confronting the impact of racism will not be easy...I know that we can do this if we work together. I certainly hope you will lean in and join me.

— Rochelle P. Watkins, MD, MPH  
Director, CDC and Administrator, ATSDR

www.cdc.gov

14

### Hidden in Plain Sight — Reconsidering the Use of Race Correction in Clinical Algorithms

Darshali A. Vyas, M.D., Leo G. Eisenstein, M.D., and David S. Jones, M.D., Ph.D.

#### Vaginal Birth After Cesarean Risk Calculator

**VAGINAL BIRTH AFTER CESAREAN**  
Height & weight optional; enter them for automatically calculate BMI

Maternal age: 18 years

Height (range 54-80 in.): 60 in

Weight (range 80-310 lb.): 150 lb

Body mass index (BMI, range 15-75): 25 kg/m²

African-American? no

Hispanic? no

Any previous vaginal delivery? no

Any vaginal delivery since last cesarean? no

Indication for prior cesarean of arrest of dilation or descent? no

Calculate

A new calculator without race and ethnicity is under development.

**Equity Concern**

Lower success predicted for Black or Hispanic

Although marital status and insurance status also correlated!

Dissuades obstetricians from offering TOLAC to people of color

N ENGL J MED 383:9 NEJM.ORG AUGUST 27, 2020

15

### Comparison of US Federal and Foundation Funding of Research for Sickle Cell Disease and Cystic Fibrosis and Factors Associated With Research Productivity

Fahiem Farooq, MD, Peter J. Maggioni, MD, PhD, Sophie Landerson, MD, Carlton Haywood, PhD, John J. Strouse, MD, PhD

Less federal/foundation research funding

"Drug-seekers"

Lack of treatment options

	Sickle Cell Disease	Cystic Fibrosis
US population affected	90,000	30,000
Federal (NIH) funding / person*	\$ 812	\$ 2807
Research articles*	926	1594
FDA drug approval*	1	4

Farooq F, et al. JAMA Netw Open. 2020;3:e201737

16



17

### Antiemetic Prophylaxis as a Marker of Health Care Disparities in the National Anesthesia Clinical Outcomes Registry

Michael H. Andreas, MD,\* Jonah S. Galt, MA,† Ben Goodrich, PhD,‡ Robert S. White, MD § and Charles Hall, PhD§

Strong association between SES (insurance status or median income in home zip code) and utilization of antiemetic medication (ondansetron or dexamethasone)

Odds Ratio of getting ondansetron Medicaid vs. Commercially Insured = 0.85 (0.81- 0.89)

Andreas et al. Anesth Analg 2018;126:588-99.

18



## Does recognition of a poor patient make the clinician less compulsive?



Published 2018

19

## Racial and ethnic disparities in severe maternal morbidity and anesthetic techniques for obstetric deliveries: A multi-state analysis, 2007–2014

Virginia E. Tangel (MA)<sup>a</sup>, Kathy C. Matthews (MD)<sup>b</sup>, Sharon E. Abramovitz (MD)<sup>c</sup>, Robert S. White (MD, MS)<sup>a,c</sup>

Black women more likely than white women to:

Experience any SMM  
• Adjusted odds ratio = 1.38 (95% CI: 1.35–1.41)

Receive GA for CD  
• Adjusted odds ratio = 1.44 (95% CI: 1.39 – 1.49)

No analgesia for vaginal delivery  
• Adjusted Odds Ratio = 1.45, (95% CI: 1.43 – 1.47)]

Even after adjustment for primary insurance and median household income

Tangel et al. J Clin Anesth.2020;65:109821.

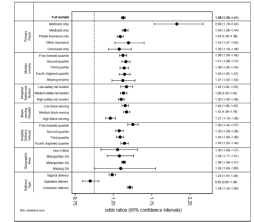


Fig. 1. Adjusted odds ratios for SMM compared to other women (95% confidence intervals) for any severe maternal morbidity, by delivery.

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safehealthcareforeverywoman.org

College-educated Black women are more than twice as likely to experience severe complications from childbirth than white women without a high school diploma.

21



22

## Black Pregnant Women "Get the Most Judgment": A Qualitative Study of the Experiences of Black Women at the Intersection of Race, Gender, and Pregnancy

Renee Mehra, PhD<sup>a,c</sup>, Lisa M. Boyd, PhD<sup>b</sup>, Urania Magriples, MD<sup>c</sup>, Trace S. Kershaw, PhD<sup>d</sup>, Jeannette R. Ickovics, PhD<sup>d,e</sup>, Danya E. Keene, PhD<sup>d</sup>

- Stereotypes stigmatizing Black motherhood - devalued Black pregnancies
- Regardless of socioeconomic status, marital status or parity – assumption:
  - Low incomes
  - Single
  - Multiple children
- Racialized pregnancy stigma in everyday contexts
  - Difficult to complete tasks without scrutiny
  - Source of stress

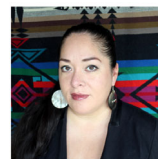
WOMEN'S HEALTH ISSUES  
www.whjournal.com



Mehra R, et al. Women's Health Issues 30-6 (2020) 484-92.

23

NIH National Institutes of Health  
All of Us Research Program



**ABIGAIL ECHO-HAWK, MA**  
Chief Research Officer for the Seattle Indian Health Board  
Director of the Urban Indian Health Institute  
Pawnee Nation, Oklahoma

Consequence: She didn't go back for any medical care until the end of her second trimester.

"The very first thing she did was ask me to push up my sleeves so she could look at my arm, and I didn't understand why."

"I told her I wasn't drinking; I hadn't been drinking at any point before."

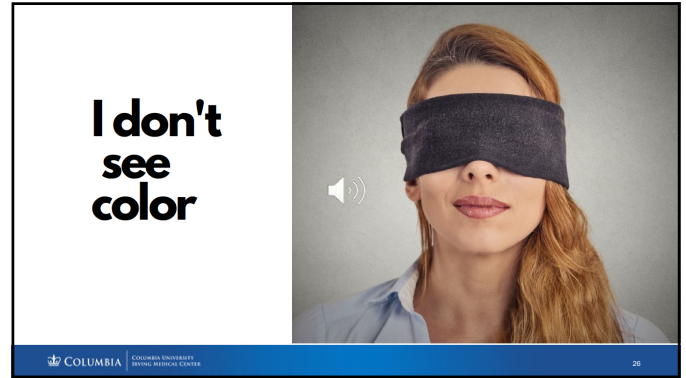
https://www.nbcnews.com/health/indian-american-maternal-mortality-2020-01-11

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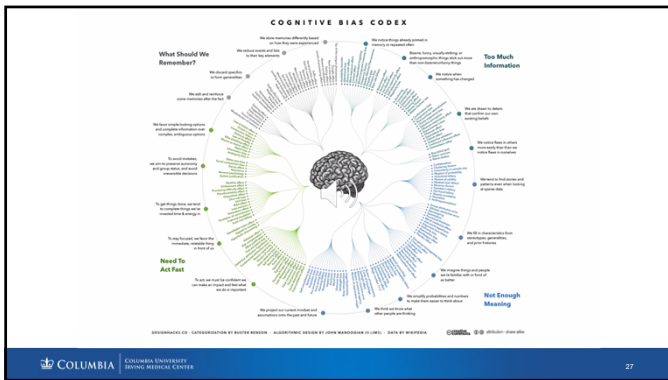




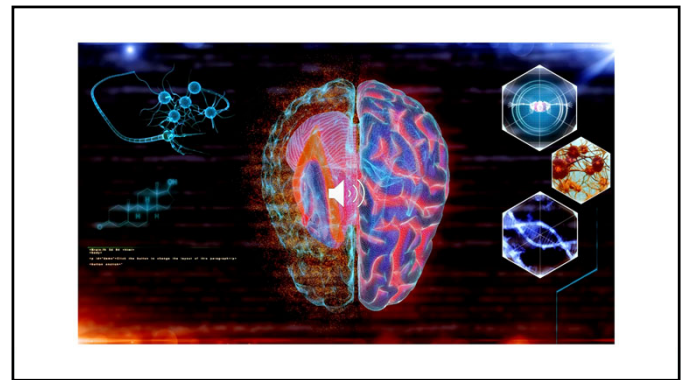
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### Can Implicit Bias be Measured?

**Implicit Association Test (IAT)\***

- Simultaneous classification task
- Responses faster with preexisting associations
- Reliable group differences
- So what? Doesn't indicate behavior
- Criticisms: \*\*
  - Attitudes not stable over time
  - Weak correlation with other implicit measures
  - Unclear construct validity

\*Greenwald, A. et al. Journal of Personality and Social Psychology 1998;74:1464-80.  
\*\*Schimack U. Perspectives for Psychological Science 2019;1-19

www.medium.com

Implicat Harvard.edu

29

### Physicians and Implicit Bias: How Doctors May Unwittingly Perpetuate Health Care Disparities

Elizabeth N. Chapman, MD<sup>1,2</sup>, Anna Kaatz, MA, MPH, PhD<sup>4</sup>, and Molly Carnes, MD, MS<sup>1,2,3,4,5</sup>

**Studies showing implicit bias in physicians via the Implicit Association Test (IAT)**

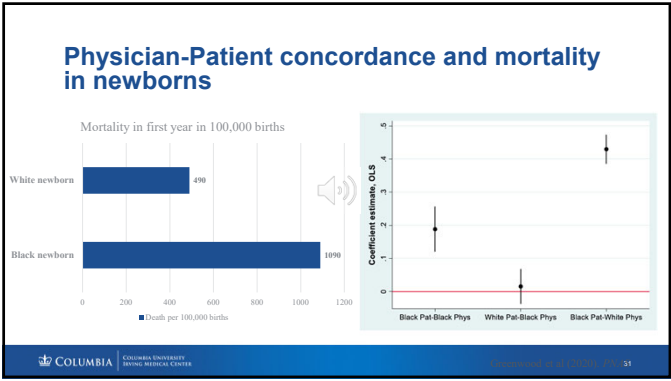
**Studies linking IAT-measured bias with clinical decision-making or patient perceptions**

**Vignette studies suggesting the presence of implicit bias**

**Real clinical scenarios where bias is suggested**

30





31

### Physician-Patient concordance and mortality in newborns

On implicit racial prejudice against infants

Lukas J. Wolf,<sup>1</sup> Gregory R. Maio,<sup>1</sup> Johan C. Karremans,<sup>2</sup> and Caroline Leygue<sup>3</sup>

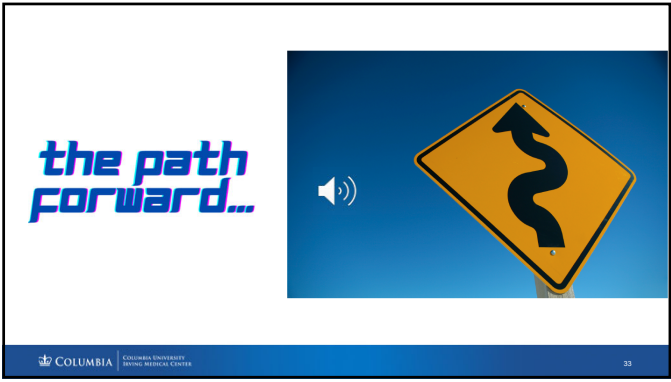
“Robust preference for in-group children over out-group children.”

Call for diversification of physician workforce

Wolf L, et al. Group Processes and Intergroup Relations.2017;20: 789-800

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Downloaded from https://www.cambridge.org/core. Columbia University Libraries, on 02 Jun 2020 at 17:00:34

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34

### Facing Reality

It is our duty as physicians to act

Disparities are unacceptable

The data are robust AND consistent

たせき Ta seki

jiseki 自責

It's OUR PROBLEM TO SOLVE!

Andreas et al. Anesth Analg 2018;126:588-99.  
Berwick D. Qual Saf Health Care. 2003;12(Suppl 1): 2-6.

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35

35

### Hear Personal Stories of Pregnancy-Related Complications

HEAR

Learn more at: [cdc.gov/HearIt](https://cdc.gov/HearIt)

Allison Lee @AllisonLeeNYC

Email: [al3196@cumc.columbia.edu](mailto:al3196@cumc.columbia.edu)

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36

36



# Program Material

## Sunday, May 16, 2021

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### Case Reports Session #2

Moderators: Erin Haggerty, MD, Amy Lee, MD, Kristen Vanderhoef, MD

### Oral Presentation #2

Moderator: Philip Hess, MD

### A unit in crisis --how do I fix it? Patient Safety on Labor and Delivery

Speakers: Rachel Kacmar, MD; Grant Lynde, MD

### Best Paper Competition

Moderator: Cynthia Wong, MD

Judges: Arvind Palanisamy, MD; Carolyn Weiniger, MD; Jill Mhyre, MD;  
Daniel Katz, MD; Jose Carvalho, MD

### Research Poster Session #2

Moderators: Ron George, MD; Barbara Scavone, MD; Pamela Flood, MD;  
Yaakov Beilin, MD; Ashraf Habib, MD; Pervez Sultan, MD;  
Christine Warrick, MD; David Gambling, MD, MS; Mark Zakowski, MD



# A unit in crisis, how do I fix it?

## *Patient Safety on Labor and Delivery*

SOAP Annual Meeting  
May 14, 2021  
Moderated by Brandon Togioka, MD

**Rachel M. Kacmar, MD**  
Associate Professor of Anesthesiology  
Anesthesiology Residency Program Director  
University of Colorado School of Medicine

**Grant Lynde, MD**  
Associate Professor of Anesthesiology  
Chief of Practice and Process Improvement  
Emory University School of Medicine

1

## Financial/ Industry Disclosures

- Brandon Togioka – None
- Rachel Kacmar – None
- Grant Lynde – None

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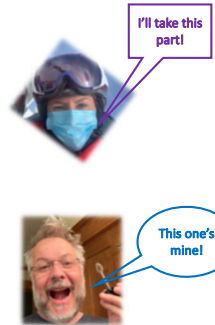
At the end of the session, the learner will be able to:

List	List sources of patient safety related metrics and initiatives related to obstetric anesthesia
Implement	Implement quality improvement activity
Critique	Critique their medical practice as it relates to national patient safety initiatives

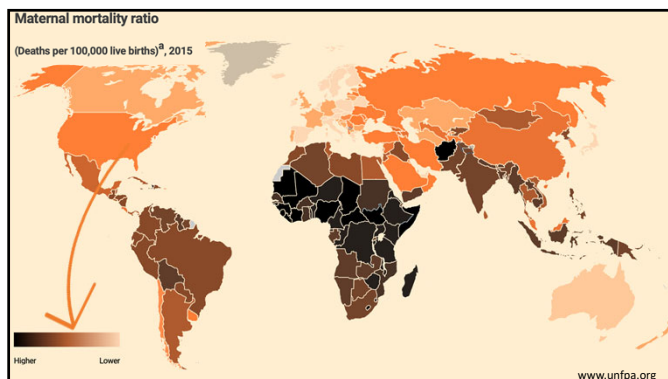
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## Outline

- Why is this important, where do I look to get started, and what should I do first?
- And...now what do I do? How do I get started and how do I keep my team engaged?

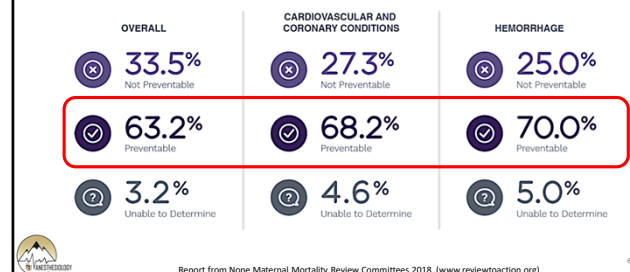


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## And...much of this is PREVENTABLE



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### Regulatory requirements

Standard PC.06.01.03: Reduce the likelihood of harm related to maternal hemorrhage.

<b>Requirement</b>	EP 1: Complete an assessment using an evidence-based tool for determining maternal hemorrhage risk on admission to labor and delivery and on admission to postpartum. (See also PC.05.02.01, EPs 1 and 2; PC.05.02.03, EP 3; PC.05.02.04, EP 2).
<b>Rationale</b>	Assessing and discussing patients' risks for hemorrhage allows the team to identify high-risk patients and be prepared. The risk of hemorrhage may change during a patient's stay depending on the clinical situation.
<b>Reference</b>	Henry CA. "Evidence-Based Strategies for Maternal Stabilization and Rescue in Obstetric Hemorrhage." <i>Advanced Critical Care</i> . 2018;33(2):258-66.
<b>Requirement</b>	EP 2: Develop written evidence-based procedures for stage-based management of program and postpartum patients who experience maternal hemorrhage that includes the following: <ul style="list-style-type: none"> <li>The use of an evidence-based tool that includes an algorithm for identification and treatment of hemorrhage.</li> <li>The use of an evidence-based set of emergency response medications that are immediately available on the obstetric unit.</li> <li>Required response team members and their roles in the event of severe hemorrhage.</li> <li>How the response team and procedures are activated.</li> <li>Blood bank plan and response for emergency release of blood products and how to initiate the organization's massive transfusion procedures.</li> <li>Guidance on when to consult additional experts and consider transfer to a higher level of care.</li> <li>Guidance on how to communicate with patients and families during and after the event.</li> <li>Criteria for when a team debrief is required immediately after a case of severe hemorrhage.</li> </ul>
<b>Rationale</b>	Note: The written procedures should be developed by a multidisciplinary team that includes representation from obstetrics, anesthesiology, nursing, laboratory, and blood bank. Having defined procedures to manage patients experiencing severe hemorrhage is integral to ensuring that everyone caring for a patient functions well as a team to deliver critical processes are streamlined. Communication between team members during an emergency is a key factor for success. It is important for an organization to establish the emergency team members will use to identify patients with severe hemorrhage and trigger a predetermined response from staff. Post-emergency debriefs are valuable for examining how well the team followed procedures and to determine if there are opportunities for improvement.
<b>Reference</b>	Committee on Practice, Bulletin/Obstetrics. "Practice Bulletin No. 188: Postpartum Hemorrhage." <i>Obstetrics &amp; Gynecology</i> . 2017;130(4):e158-e165. Fugate BM and Vaughn AJ. "Postpartum Hemorrhage: Blood Product Management and Massive Transfusion." <i>Services in Hematology</i> . 2019;8(3):144-50. American College of Obstetricians and Gynecologists. "Preparing for Clinical Emergencies in Obstetrics and Gynecology." ACOG Committee Opinion No. 590. Obstetrics & Gynecology.

8

## PPH and HTN Bundle Implementation

Provision of Care, Treatment, and Services standards for maternal safety

Effective July 1, 2020, 13 new elements of performance (EPs) will be applicable to Joint Commission-accredited hospitals. These new requirements are within the Provision of Care, Treatment, and Services (PC) chapter at PC.06.01.01 and PC.06.01.03 and are designed to improve the quality and safety of care provided to women during all stages of pregnancy and postpartum. The United States ranks 65<sup>th</sup> among industrialized nations in terms of maternal death.<sup>1</sup> Because of worsening maternal morbidity and mortality, The Joint Commission evaluated expert literature to determine what areas held the most potential impact. The literature review revealed that prevention, early recognition, and timely treatment for maternal hemorrhage and severe hypertension/preeclampsia had the highest impact in states working on decreasing maternal complications. This approach was supported by a technical advisory panel assembled by The Joint Commission, resulting in the development of EPs that focus on these

TIC R3 Report 2019/24:1-6.

9

Hemorrhage Elements of Performance	Hypertension Elements of Performance
1. Risk assessment	1. Protocol for BP evaluation
2. Stage-based management of PPH	2. Protocol for HTN/ Pre-E management
3. Standardized, dedicated PPH supply kit	3. Education about HTN/ Pre-E for staff/ providers
4. Education about PPH management to all members of L&D care team	4. Conduct HTN drills at least annually
5. Conduct PPH drills at least annually	5. Review severe HTN/ Pre-E cases
6. Review hemorrhage cases	6. Educate patients/ families
7. Educate patients/ families	

TIC R3 Report 2019/24:1-6.

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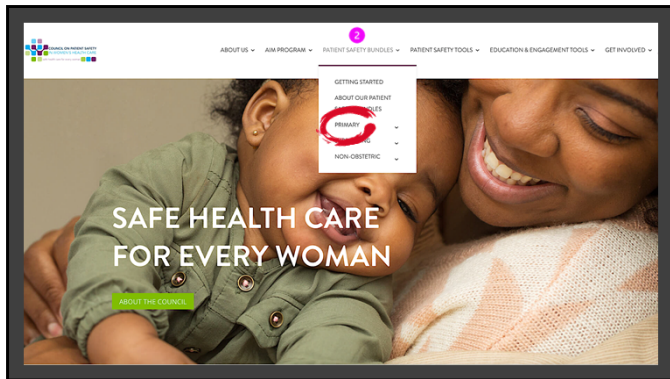


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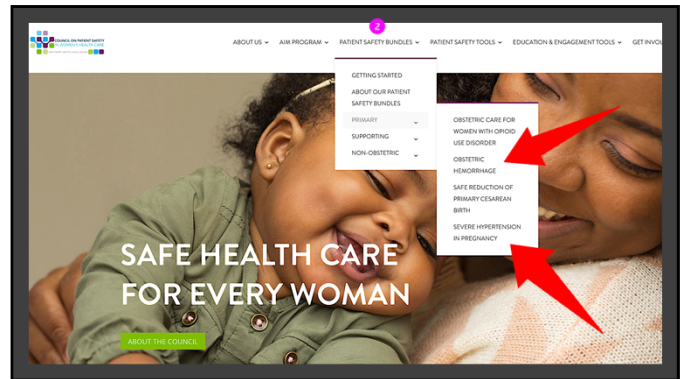


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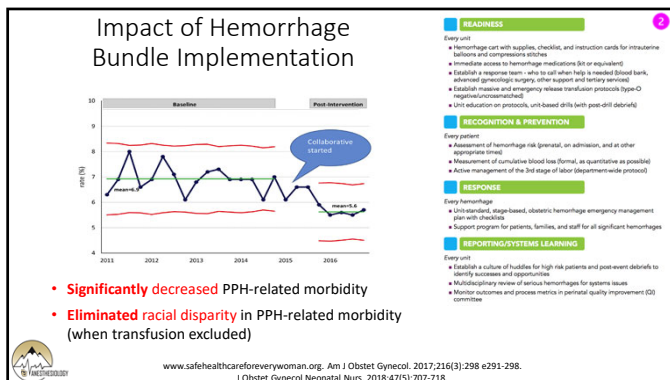




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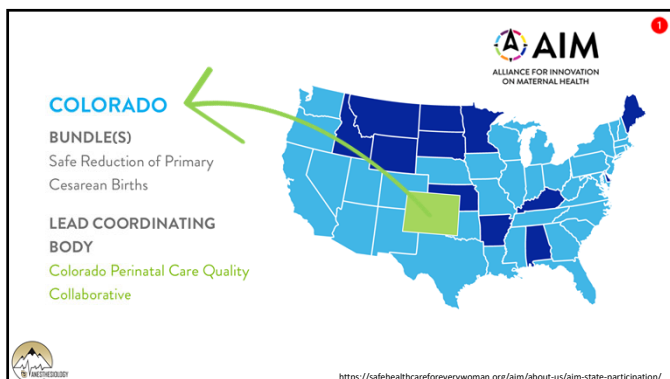
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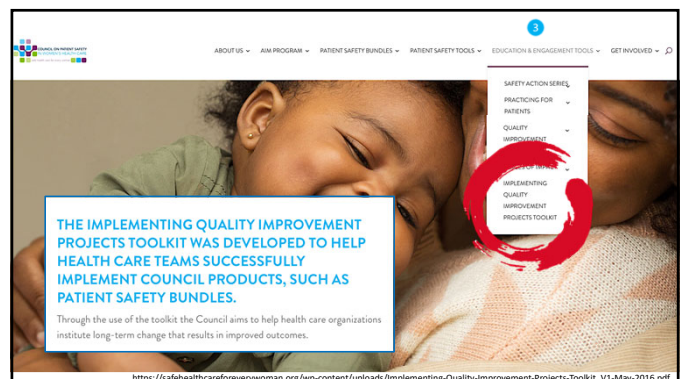
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18



A Virtual Course for OBGYNs, MFMs, Midwives, Nurses, Nurse Practitioners, Women's Health Nurse Practitioners, and Hospital Safety and Quality Staff



**A VIRTUAL MULTI-DISCIPLINARY EDUCATIONAL COURSE**  
Friday, October 23, 2020  
Saturday, October 24, 2020

**New Joint Commission Standards for Maternal Safety**  
Practical Strategies for Implementation

**Society for Maternal-Fetal Medicine**

<https://www.smfm.org/events/303-new-joint-commission-standards-for-maternal-safety-practical-strategies-for-implementation>

19

**apsf NEWSLETTER**  
THE OFFICIAL JOURNAL OF THE ANESTHESIA PATIENT SAFETY FOUNDATION

**National Partnership for Maternal Safety – Maternal Safety Bundles**

Jennifer M. Banayan, MD; Barbara M. Scavone, MD

**Episode #21 Part 1: Maternal Safety Bundles**  
November 24, 2020

**Episode #22 Part 2: Maternal Safety Bundles**  
December 1, 2020

The United States is one of only eight countries worldwide and the only developed nation where maternal mortality has increased since 1990.<sup>1</sup> Parturients in this country are three times more likely to die from pregnancy-related complications than women in Britain, Germany, or Japan.<sup>1</sup> These statistics are shocking, especially considering that prior to 1982 maternal mortality in the United States had improved dramatically over the last century.<sup>2</sup> Improvement in survival can be attributed to medical care, more hospital deliveries by those trained in obstetrical care, and better techniques.<sup>3</sup>

<https://www.apsf.org/article/national-partnership-for-maternal-safety-maternal-safety-bundles-21>

20

**Obstetrics**

ABX-01-OB: Antibiotic Timing for Cesarean Delivery

BP-04-OB: SBP < 90 in Cesarean Deliveries

GA-01-OB: General Anesthesia During Cesarean Deliveries

**SUCCESS** → Avoid prolonged (≥ 5 minutes) SBP < 90mmHg during the time period of spinal placement to delivery

<https://spec.mpog.org/Measures/Public>

21

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

The SOAP Center of Excellence (COE) designation was created to recognize institutions and programs that demonstrate excellence in obstetric anesthesia care and to set a benchmark of expected care to improve standards nationally and internationally. It is an annual program, with new designees announced each spring. Read on to learn more about the COE program, processes, benefits and

**... set a benchmark of expected care to improve standards nationally and internationally.**

The criteria were generated by expert consensus and incorporate evidence-based recommendations. They cover all aspects of obstetric anesthesia care and include: personnel and staffing; equipment, protocols, and policies; simulation and team training; obstetric emergency management; cesarean delivery and labor analgesia care; recommendations and guidelines implementation; and quality assurance and patient follow-up systems. Criteria are reviewed annually by the COE committee and updated as appropriate.

[www.soap.org](http://www.soap.org)

22

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

**Obstetric hemorrhage management:**

- Outline hemorrhage risk stratification algorithm and management protocol
- Describe massive transfusion protocol
- Describe hemorrhage quality assurance review process
- Describe and provide the institution's obstetric hemorrhage toolkit (protocols, checklists, algorithms)

**Stanford University Sample Application**

Our obstetric hemorrhage management protocol combines elements of the National Partnership Bundle, the CMQCC protocol as well as the ACOG hemorrhage management recommendations. The protocol is regularly updated, and is distributed to all anesthesiologists who cover the labor and delivery unit, and is also displayed as a poster in each obstetric operating room. There are also very detailed guidelines displayed in the call rooms, which have also been distributed electronically.

We have availability of an obstetric-specific massive transfusion protocol and immediate release of blood products from blood bank (which is on-site). The protocol includes 6 units PRBCs, 4 units of FFP and 1 unit of pooled platelets. When the obstetric-specific massive transfusion protocol is activated, we have a streamlined and coordinated response, which includes a runner to obtain the blood products, and nurses with specific roles to help both the anesthesia and obstetric teams.

[www.soap.org](http://www.soap.org)

23

**SOCIETY FOR OBSTETRIC ANESTHESIA AND PERINATOLOGY INTERDISCIPLINARY CONSENSUS STATEMENT ON NEURAXIAL PROCEDURES IN OBSTETRIC PATIENTS WITH THROMBOCYTOPENIA (2021)**

- Consensus Statement and Recommendations for Enhanced Recovery After Cesarean (2020)
- SOAP COVID-19 Toolkit (2020)
- Monitoring Recommendations for Prevention and Detection of Respiratory Depression Associated With Administration of Neuraxial Morphine for Cesarean Delivery Analgesia (2019)
- SOAP Labor Epidural Billing Statement (2019)
- SOAP Sugammadex During Pregnancy and Lactation Statement (2019)

**SOAP CONSENSUS STATEMENT**

[www.soap.org](http://www.soap.org)

24



## Wrap Up

- Preaching to the choir but...**maternal safety initiatives must be a priority** on every obstetric unit.
- **Start small** and build up to a comprehensive program
- Choose topics (at least at first) based on where **organizational and regulatory focus** lies
  - And where resources / help is available
- **SOAP website and the COE application are excellent tools** for safety efforts





**Case report: Hypofibrinogenemia and neuraxial for elective cesarean section.**

**Presenting Author:** Kevin Barkley, MD

**Presenting Author's Institution:** University of Arkansas for Medical Sciences

**Co-Author:** Muhammad Athar, MD

**Abstract :** A 33 year-old G2P1 female at 40 weeks gestation presented to labor and delivery for an elective repeat cesarean section with a past medical history of asymptomatic idiopathic intracranial hypertension. Previous cesarean section was due to placental abruption and was undertaken emergently under general anesthesia without anesthetic complications. Patient has allergies to lysine which results in anaphylaxis, latex and amoxicillin.

At 27 weeks gestation, the patient tripped and fell onto her hands and knees without hitting her abdomen. Non-stress test following the fall was reactive and reassuring with fetal heart rate baseline of 150 bpm with moderate variability and accelerations, without decelerations or contractions. She reported good fetal movement and no vaginal bleeding or loss of fluid. Labs were significant for fibrinogen of 87 mg/dL. Fibrinogen was repeated at 29 weeks gestation and was 87 mg/dL. The day before admission for delivery fibrinogen was 89 mg/dL with hemoglobin of 13.4, platelet count of 258k, PT 11.9, PTT 26.7 and INR 1.0. Rotational thromboelastometry was collected prior to cesarean section and was normal. Hematology was consulted and recommended cryoprecipitate transfusion only in the event of significant bleeding.

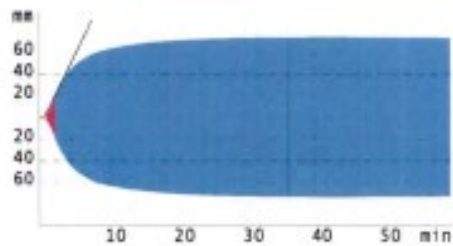
Neuraxial anesthesia was obtained using a 25g 3.5 inch Pencan spinal needle in the midline, palpated at the L3-4 interspace, with clear CSF. Intrathecal injection of 1.6 ml bupivacaine 0.75% with dextrose 8.25% created a T4 level of anesthesia which was adequate throughout surgery. Blood pressure was supported with phenylephrine and was titrated off by the end of surgery. There was an estimated blood loss of 800cc and patient remained hemodynamically stable without significant blood loss postoperatively. The patient did not receive any blood products during her stay. Postoperatively fibrinogen was 81 mg/dL and the following day was 85 mg/dL. ROTEM was not repeated as there were no clinical signs of bleeding or coagulopathy. Patient was discharged on post-operative day 2 without complications.

Hypofibrinogenemia in pregnancy creates a complex situation that the anesthesiologist must be aware of. The risk of peripartum hemorrhage, placental abruption, and epidural or spinal hematoma must be considered when caring for these patients. Clinical signs of acute blood loss, lab values demonstrating hypofibrinogenemia in pregnancy, availability of cryoprecipitate, and abnormal coagulation studies, such as viscoelastic tests to guide management. Neuraxial anesthesia was considered favorable over the well-known risks of general anesthesia in pregnancy, as the patient's fibrinogen was consistently low throughout pregnancy combined with normal coagulation studies.

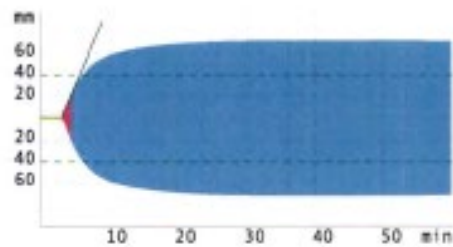
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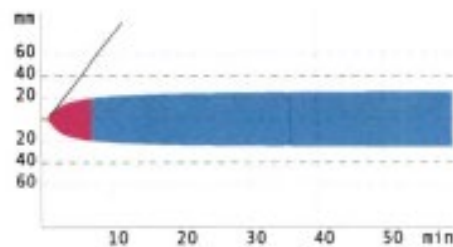




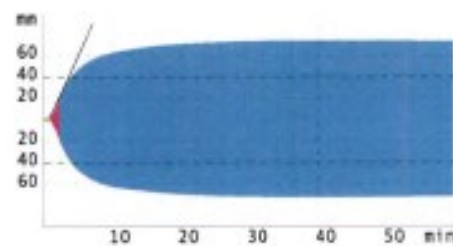
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## Anesthetic Management Of A Parturient With Charcot-Marie-Tooth Disease

**Presenting Author:** Yveline A. Blot, BS

**Presenting Author's Institution:** CUNY School of Medicine

**Co-Author:** Donna Bracken, MD; Mark Haham, MD

**Abstract :** CMT disease is the most common inherited neuropathy and shows a genetically and phenotypically heterogeneous pattern. We report the case of a parturient with CMT disease who received an uneventful combined spinal-epidural anesthetic for Cesarean section.

**Case Presentation:** WJ is a 36 year old G1P0 female presenting to L&D at 39+ weeks in early labor with persistent breech presentation to undergo Cesarean section. Her past medical history is significant for CMT disease type 2, syphilis, GERD, sparse marijuana use, and possible laryngitis (patient reports and demonstrates decreased voice for 2-3 days). Also of note, she was hospitalized at 14 weeks gestation for influenza A complicated by pneumonia and sepsis. She did not require intubation. Preanesthetic neurologic exam was notable for distal muscular weakness and atrophy with impaired deep tendon reflexes.

### Anesthetic Management

Combined spinal-epidural anesthesia was administered at the L3-L4 level, and the patient received 1.4 mL of 0.75% hyperbaric bupivacaine, 20 mcg of fentanyl, and 150 mcg of duramorph intrathecally. The case proceeded uneventfully, and the patient was monitored in PACU for 24 hours given her higher risk for respiratory decompensation. No worsening of CMT disease was noted on follow-up exam, and the patient was discharged home on Postpartum Day 3.

**Discussion:** CMT disease affects approximately 1 in 2500 people, often beginning during childhood or adolescence. Typical signs and symptoms include extreme motor weakness and muscle wasting within the distal lower extremities and feet, gait abnormalities, loss of tendon reflexes, and numbness within the lower limbs. Pregnancy alone has been reported to cause exacerbations in CMT, increasing the risk for complications during labor and delivery. The reported use of regional anesthesia in CMT patients has been limited to small case series and anecdotal case reports. Despite the theoretical risk of worsening neurological symptoms following regional anesthesia, all patients made uneventful recoveries without worsening of their neurologic conditions. Considerations when administering general anesthesia to CMT patients include potential cardiac impairment; respiratory and vocal cord dysfunction; increased sensitivity to non-depolarizing neuromuscular blocking agents and inhalational agents; and potential risk for hyperkalemia and malignant hyperthermia with triggering agents. In conclusion, our case report further confirms the developing consensus that regional anesthesia is a safe and effective alternative to general anesthesia in CMT patients.

### References:

- 1) Jae Won Kim MD, Jin Ho Choi MD, Goo Kim MD, Keon Hee Ryu MD, PhD, Sun Gyoo Park, MD, PhD, Chang Young Jeong MD, PhD, Dong Ho Park MD, PhD. Anesthetic Management of Charcot-Marie-Tooth Disease. Archives of Clinical and Medical Case Reports 4 (2020): 138-152.
- 2) Kopp SL, Jacob AK, Hebl JR. Regional Anesthesia in Patients With Preexisting Neurologic Disease. Reg Anesth Pain Med. 2015; 40(5): 467-478.







## **Failed intrathecal catheter in a parturient with primary pulmonary hypertension and history of spinal fusion for scoliosis**

**Presenting Author:** Paulina Cárdenas, MD

**Presenting Author's Institution:** UT Health San Antonio

**Co-Author:** Andrew Giordano, MS DO

**Introduction:** Primary pulmonary hypertension (PPH) in pregnancy can lead to significant maternal mortality. PPH is defined by a mean pulmonary artery pressure (PAP) greater than 25mmHg at rest in the absence of cardiac etiology. Maternal mortality has been reported to be as high as 30-50%. Physiologic changes of pregnancy in these patients may lead to right heart dilatation or failure. The increased cardiac output during pregnancy may not be accommodated due to the relatively fixed right-sided pressures. Pregnancy in these patients is strongly discouraged and termination is advised should it occur.

**Case:** A 34 y/o G2P0010 presented at 29 weeks with persistent cough, dyspnea and orthopnea. The patient had no known history of lung disease prior to presentation, however, she was a daily smoker. Her initial transthoracic echo showed severe right atrium, right ventricular and pulmonary artery enlargement. The septum was flattened in systole and diastole. Right heart catheterization mean PAP was 49mmHg. The patient had a history of scoliosis and posterior spinal fusion. The patient was admitted for medical management and optimization of PPH. Elective cesarian delivery was scheduled for 32 weeks. The plan was to proceed with an attempt for an intrathecal catheter with general anesthesia if neuraxial was not attainable due to surgical changes/scarring. Cardiac anesthesia was available and extracorporeal membrane oxygenation was on standby.

**Discussion:** The patient was medically optimized with the use of a trepostinil IV infusion and sildenafil 20mg TID in the intensive care unit during the two weeks prior to delivery. She also received betamethasone and was maintained on a heparin infusion for deep vein thrombosis prophylaxis. Inhaled nitric oxide (NO) was started the night before surgery via a non-rebreather. The morning of surgery the patient was transported to the operating room (OR) with all medications continued during transport including the inhaled NO. Upon arrival in the OR any arterial line was placed as well as a central line for vasopressor infusion. An intrathecal catheter was successfully placed and the patient was placed in left uterine displacement. A vasopressin infusion was started as the intrathecal catheter was dosed to help counteract the sympathectomy expected from the spinal medications. A total of 38mg of bupivacaine were given without an adequate level of anesthesia attained. General anesthesia was then induced with etomidate and succinylcholine. The inhaled NO was placed in line with the breathing circuit. The cesarian delivery proceeded without complications. A norepinephrine infusion was added to help maintain adequate blood pressures. The patient was extubated at the end of the procedure.

### **References:**

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2. Guglielminotti Matern Child Health J 2019
3. Schisler Semin Cardiothorac Vasc Anesth 2017



## Undiagnosed Thrombotic Thrombocytopenic Purpura In The Setting Of An Urgent Primary Cesarean Section

**Presenting Author:** Paula Escobar, DNP/CRNA

**Presenting Author's Institution:** New York Presbyterian/Lower Manhattan

**Co-Author:**

**Case:** A 39-year-old African American female G2P2 presented to labor and delivery at 36 weeks with a scheduled induction of labor (IOL) for intrauterine growth retardation, oligohydramnios, and hemolysis, elevated liver enzymes, low platelet count (HELLP) syndrome. Her past medical history includes a preterm normal spontaneous vaginal delivery of twins, gestational hypertension, and a BMI of 51.6. Her platelet count on admission was 15,000. After her IOL, she presented with a category 2 tracing, which resulted in a primary cesarean section (CS) using general anesthesia. Her intraoperative management included a transfusion of 1 unit of platelets, magnesium sulfate intravenous infusion, and the administration of tranexamic acid 1 G. She was extubated and hemodynamically stable with an estimated blood loss of 2,810 ml. Postoperatively, she was transferred to the medical intensive care unit (MICU) for worsening HELLP syndrome and suspected thrombotic thrombocytopenic purpura (TTP). Through a multidisciplinary team, she was diagnosed with TTP, which was confirmed with a lab result reflecting a severe deficiency of plasma ADAMTS13 activity of less than 5%. Her treatment modalities in the MICU included several sessions of therapeutic plasma exchanges (TPEs), methylprednisolone, prednisone, and rituximab.

**Discussion:** TTP is hematologic disease characterized by microangiopathic hemolytic anemia, severe thrombocytopenia, and organ ischemia linked to disseminated microvascular platelet-rich thrombi. TTP pathophysiology is based on a deficiency of ADAMTS13, a disintegrin and metalloprotease, that is responsible for cleaving von Willebrand factor. Deficiency of plasma ADAMTS13 activity of less than 10% differentiates it from other thrombotic microangiopathies (TMAs). Predisposing factors include the female gender, black ethnicity, obesity, and human leukocyte antigen DRB1\*11. The incidence of TTP ranges from 3 to 11 cases per million people every year, with the first acute episode primarily occurring during adulthood. TTP's mortality rate is 10% to 20% in spite of therapeutic management, which makes its prompt diagnosis from other TMAs increasingly more important. Differential diagnosis of TTP include atypical hemolytic uremic syndrome, preeclampsia, HELLP syndrome, disseminated intravascular coagulation, malignant hypertension, and cancer. TPEs are the first-line therapy for TTP, but also include immunosuppressive therapies such as corticosteroids, cyclophosphamides, rituximab, vincristine; and a salvage splenectomy. With a known history of TTP, it is important to involve this patient with prenatal counseling for a safe subsequent pregnancy.

**References:** Joly BS, Coppo P, Veyradier A. Clinical platelet disorders: thrombotic thrombocytopenic purpura. *Blood* 2017; 129 (21): 2836-2846.

Saha M, McDaniel JK, Zheng XL. Thrombotic thrombocytopenic purpura: pathogenesis, diagnosis and potential novel therapeutics. *J Thromb Haemost* 2017; 15: 889-900.



## Eclamptic Seizure Prophylaxis in patients with renal failure.

**Presenting Author:** Rudo Goto, MD

**Presenting Author's Institution:** Vanderbilt University Medical Center

**Co-Author:** Michael G. Taylor, MD; Jeanette Bauchat, MD MS

**Introduction:** Eclampsia is the severe, convulsive manifestation of pre-eclampsia and directly contributes to maternal morbidity and mortality.<sup>1</sup> Treatment includes antihypertensive agents, seizure prophylaxis, and timely delivery. Magnesium sulfate is the gold standard for seizure prophylaxis. However, there is a small group of patients for whom this medication requires careful considerations<sup>2</sup> and/or alternatives. Our case highlights the clinical course of a patient with chronic kidney disease (CKD) who required treatment for HELLP and experienced seizure activity with supratherapeutic magnesium (Mg) levels.

**Case:** An 18-year-old G2P0010 presented at 35 and 6/7 weeks gestation with pruritus in her hands and feet. Her history was significant for stage 3 CKD from bilateral renal hypoplasia. Laboratory work demonstrated elevated total bile acids, creatinine 3.29 mg/dL (baseline 1.6-1.9 mg/dL), and newly diagnosed fetal growth restriction. Labor was induced for suspected cholestasis and worsening renal function.

Following an unremarkable labor and delivery, she developed severe range blood pressures, worsening renal function, thrombocytopenia, and increasing lactate dehydrogenase. Given the concern for HELLP syndrome in the setting of acute on chronic renal failure, intravenous Mg therapy was initiated with a 2G bolus followed by a 1 G/h infusion. Mg levels were checked every 4 hours and overnight her Mg level increased to >9.5 mg/dL. The magnesium infusion was discontinued and calcium gluconate 500 mg was administered, however repeat Mg level remained >9.5 mg/dL. Deep tendon reflex examinations did not indicate magnesium toxicity.

The patient experienced a witnessed seizure that terminated without intervention. Several minutes later, she experienced another witnessed seizure, treated with midazolam 2 mg. She remained postictal, necessitating transfer of care to the intensive care unit (ICU). Following dialysis, the Mg level 3 hours post seizure was 8.9 mg/dL. Head MRI revealed posterior reversible encephalopathy syndrome (PRES). She was treated in the ICU and discharged home on postpartum day 7.

**Discussion:** Our patient experienced a seizure either due to PRES, a breakthrough eclamptic seizure in the setting of supratherapeutic Mg, or seizure with reversal of Mg by calcium gluconate administration. Despite lower bolus and maintenance doses of Mg, precision and timeliness of laboratory results reporting at any individual institution must be considered if Mg is used in a patient with renal failure. Additionally, second line eclamptic seizure prophylactic medications, such as levetiracetam, benzodiazepines, and nimodipine may serve a role in unique clinical settings.<sup>3,4</sup>

### References:

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- PMID: 12540643



## **To Delay or Not to Delay: Cesarean Delivery in an Extremely Dyspneic Parturient with a Massive Anterior Mediastinal Mass**

**Presenting Author:** David Gutman, MD, MBA

**Presenting Author's Institution:** Medical University of South Carolina

**Co-Author:** Joel Sirianni, MD; Katherine Herbert, MD; Michael Marotta, MD; Andrew Dudas, MD

**Abstract :** The decision to undergo chemotherapy for an aggressive cancer versus postponing intervention due to perceived harm to a fetus is an incredibly difficult decision for a parturient. There are special physiologic and psychologic considerations in patients that have an anterior mediastinal mass. We present the case of a parturient with an anterior mediastinal mass requiring semi-urgent delivery in light of a rapidly deteriorating clinical picture.

Patient was a 30 year old G2P1 who presented at 35 weeks due to acute onset of shortness of breath. Her past medical history was significant for anxiety, depression, and one prior vaginal delivery. A week prior to presentation, she began to feel short of breath and noticed that her right arm was red and swollen. She was experiencing extreme orthopnea, shortness of breath, and complete inability to lie flat. Biopsy revealed a 14cm primary B-cell lymphoma with complete obstruction of the SVC, right bronchial compression, and extreme leftward shift of the mediastinum and heart.

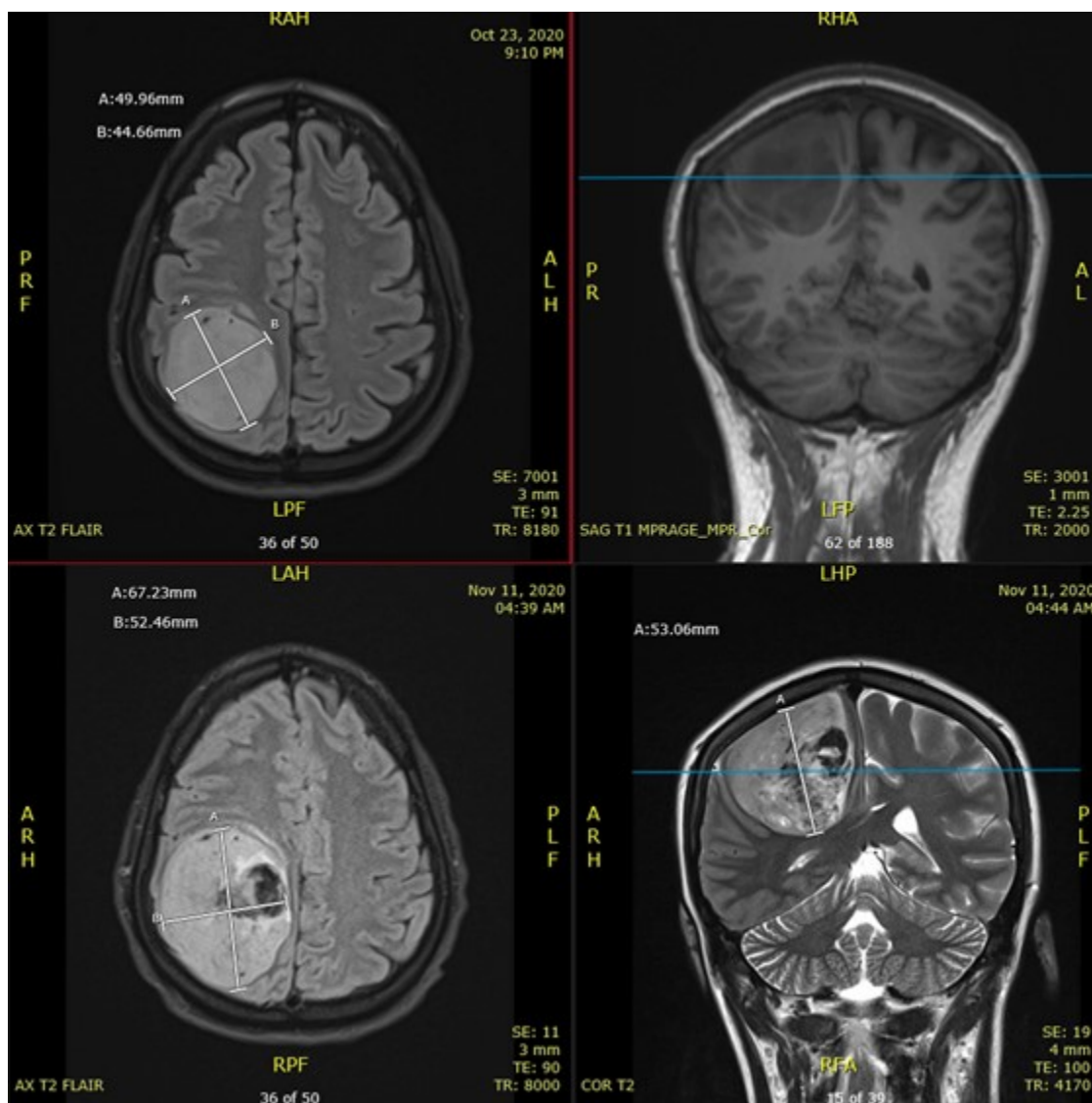
The patient was initially treated with rituximab and a multidisciplinary meeting was urgently held. Initially, it was unclear whether to proceed with a primary C-section followed by aggressive chemotherapy versus chemotherapy and radiation therapy to shrink the mass followed by delivery at a later gestational age. Due to the concern for neonatal B-cell depletion, decision was made to proceed with cesarean delivery first.

Risks and benefits of general anesthesia versus neuraxial anesthesia were extensively discussed with patient. The decision was complicated by the patient's significant dyspnea, inability to lie flat, concern for distal trachea compression, and the potential inability to ventilate or possible prolonged intubation should general anesthesia be required. Ultimately, a slow load epidural with venous and arterial cannulation in the event of decompensation and need for ECMO was agreed upon.

We placed an epidural and left radial arterial line. The epidural was slowly loaded over 50 minutes using 2% lidocaine with the patient in reverse Trendelenburg until a T4 level was achieved. She received mild sedation throughout and the cardiothoracic team pre-emptively placed bilateral femoral lines. The cesarean section proceeded without surgical difficulty, although the patient's blood pressure and heart rate was extremely labile throughout and required countless adjustments with vasopressin. She was taken to the ICU afterwards and remained in the hospital for 3 months receiving advanced EPOCH-R chemotherapy.

Anterior mediastinal masses present unique challenges to obstetrical anesthesiologists. Slow load epidural anesthesia in the reverse Trendelenburg position gave the patient the best chance of maintaining spontaneous ventilation, hemodynamic stability, and avoided the uncertainties of general anesthesia. Extensive preparation and coordination is important in order to allow for the best and safest care of both mother and baby.







**Venous Air Embolism Mediated Near-Cardiac Arrest During Cesarean Delivery for Placenta Accreta**

**Presenting Author:** David Gutman, MD, MBA

**Presenting Author's Institution:** Medical University of South Carolina

**Co-Author:** Katherine Herbert, MD; Joel Sirianni, MD; Daniel Geating, MD; Michael Marotta, MD

**Abstract :** Intraoperative decompensation is not uncommon with morbidly adherent placentation. A multidisciplinary team must be proactive in preparation, constantly vigilant, and highly responsive to unexpected events. One event is venous air embolism, which is our working diagnosis after a near intraoperative fatality during a challenging cesarean delivery.

The patient was a 36-year-old G10P8 with Di-Di twins who presented at 14 weeks with placenta accreta. Her PMH included HIV, anemia (Hgb 9.7), morbid obesity (BMI 35), DVT/PE, opioid use disorder, 4 cesarean sections, and a large uterine window. After extensive counseling, delivery was scheduled for 34 weeks. In the OR, she was intubated in rapid sequence fashion followed by quadratus lumborum blocks for post-operative pain control. The anesthesia team inserted a radial arterial line and a 7Fr right internal jugular line while the surgery team inserted a resuscitative endovascular balloon occlusion device. The case progressed unremarkably until Twin B delivery.

After Twin A delivery, 2 units PRBCs were initiated due to blood loss and her baseline anemia. 5 minutes separated twin delivery due to extensive intra-abdominal adhesions and difficult uterine mobilization. After prolonged uterine manipulation and Twin B delivery, sudden hypotension and tachycardia ensued. The pulse oximeter fell quickly from 100% to 91%. Peak airway pressures increased from the 20s to mid 40s. An emergent call for help was sent. Epinephrine 100 mcg was administered as a TEE probe was inserted, demonstrating a massively dilated RV with trans-septal bowing into the LV. The top differentials were PE, AFE, air embolism, hemorrhagic shock, and anaphylaxis. For 6 minutes the patient was profoundly hypotensive (MAP 50). Multiple interventions were implemented: defibrillator pad application, milrinone and vasopressin infusions, epinephrine boluses, Trendelenburg with left side down, and frequent aspiration of the central venous line. During the acute decompensation, an ABG showed PaO<sub>2</sub> 71 on 100% FIO<sub>2</sub>. At minute 7, the critical vital signs reversed and TEE imaging normalized. The surgery finished uneventfully and she was extubated. Her postoperative course was uneventful followed by hospital discharge post-op day 4.

Anesthesiologists train extensively for acute intraoperative decompensation as timely interventions are the difference between life and death. While air embolism is associated with beach chair positioning, in our case the Trendelenburg lithotomy position, the multigravid uterus, the engorged venous plexuses of a placenta accreta, and IVC compression were contributors to catastrophic decompensation. With prompt interventions, our patient survived the ordeal and upon follow-up was doing well at home with her 11 children, without further sequelae.

**References:** Marek A. Mirski, Abhijit Vijay Lele, Lunei Fitzsimmons, Thomas J. K. Toung, David C. Wartier; Diagnosis and Treatment of Vascular Air Embolism. *Anesthesiology* 2007; 106:164-177



**Challenges in the management of the parturient with hyperosmolar hyperglycemic state complicated by intrauterine fetal demise, septic shock and stress-induced cardiomyopathy**

**Presenting Author:** Christian Hurst, MD

**Presenting Author's Institution:** New York Presbyterian Hospital - Columbia University Irving Medical Center

**Co-Author:** Natasa Grancaric, MD; Laurence E. Ring, MD

**Abstract :** Diabetic ketoacidosis (DKA) and hyperosmolar hyperglycemic state (HHS) are life-threatening complications of uncontrolled diabetes mellitus. Though less common than DKA, HHS can develop in parturients with poorly managed or undiagnosed diabetes amidst physiologic changes and pathologic conditions associated with pregnancy (1,2). A 32-year-old obese woman G1P0 without prenatal care presented to the hospital at 32 weeks gestation following two days of lethargy, emesis, and decreased fetal movement. Primary evaluation was concerning for altered sensorium, maternal hyperglycemia (>600 mg/dL) on point-of-care testing, and intrauterine fetal demise on ultrasound. Early management was challenged by marked difficulty drawing blood and establishing intravenous access for administration of fluids and insulin. Subsequent diagnostic workup was consistent with HHS in the setting of likely undiagnosed pregestational type 2 diabetes (HbA1C 13.2%). Despite initial resuscitation measures and uneventful cesarean section, the patient's condition deteriorated in the setting of mixed septic and cardiogenic shock requiring broad spectrum antibiotics, mechanical ventilation, VA ECMO, and IABP insertion. Following a two-week ICU course, the patient was successfully extubated and weaned from mechanical circulatory support. The rising prevalence of obesity and type 2 diabetes among women of childbearing age may highlight the importance of recognizing HHS as a life-threatening complication of pregestational diabetes in the parturient (3,4).

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## **Urgent Cesarean Birth for Worsening Pulmonary Hypertension Performed in Intensive Care Unit under Combined Spinal-Epidural - case report**

**Presenting Author:** Teshi Kaushik, MD

**Presenting Author's Institution:** Emory University

**Co-Author:** Cathleen Peterson-Layne, PhD, MD

**Abstract :** Pulmonary arterial hypertension (PAH) is exacerbated by changes of pregnancy and associated with maternal and neonatal morbidity and mortality. We report case of 30-year-old female, G2P1 at 23weeks gestation with PAH secondary to scleroderma who presented with worsening hypoxemia and PAPs due to presumed community-acquired pneumonia. Prior to presentation she reported functional status with PAH treatment with sildenafil 20mg oral TID, IVIG, rituximab, prednisone 5mg and continuous nasal cannula O2 at 5 liters/minute. After 3 days of treatment at OSH for shortness of breath and orthopnea without improvement, she was transferred to our tertiary center for care. On admission, at 22/5 weeks gestational age, vital signs were significant for mean arterial pressures (MAPs) in the 50s, HR 130-140s, RR 50-70, SpO2 68 -72%, afebrile; notable TTE findings included LVEF 60%, severe TR, RAP 15mmHg and RVSP 98.5mmHg, dilated IVC with less than 50% respiratory variation; COVID-19 test negative, VQ scan negative for defect. Initial treatment included fentanyl IV, lasix 40mg BID, methylprednisolone 40mg Q6H IV, plus 5 day course of antibiotics (ceftriaxone, azithromycin); betamethasone for fetal lung maturity. Over the next 24 hours, her cardiac and pulmonary status worsened with PAP rising to over 100mmHg by TTE, SpO2 70% on FiO2 100% delivered via nasal high flow oxygen therapy @ 50 liters/minute, MAPs 50 maintained on Dopamine @ 8mcg, HR130s, ABG 7.40/46/56/28. Continuous fetal heart rate monitoring interpreted as reassuring for gestational age. A multi-disciplinary team comprised of OB, MFM, critical care, obstetric anesthesiology, neonatology, and palliative care convened to consider the best course. Given poor maternal prognosis, with or without delivery, due to worsening cardiac and pulmonary status, the consensus was to proceed with cesarean birth at 23/0 weeks gestation. Due to concern for hemodynamic intolerance of positive pressure ventilation one goal was to avoid intubation, if possible; ECMO was not available and unlikely option in non-transplant candidate. Transfer to the OR for delivery was precluded by dependence on non-portable, high-flow nasal O2. Surgery was performed in the ICU under CSE (IT chlorprocaine15mg, fentanyl 15mcg, morphine-PF 150mcg, plus EPD chlorprocaine 450mg total dose over about 15minutes) to bilateral T6 level with patient in 30-degree reverse trendelenberg; no changes to dopamine infusion, no fluids. After delivery, oxytocin IV infusion 3U/hr without bolus, tranexamic acid 1gm IV empirically, furosemide 200mg IV. Female neonate (APGARs 5 and 7; 0.525kg) was stabilized and intubated by the neonatal team. Neonate continues to meet predicted growth milestones. Maternal postpartum course significant for intraabdominal hematoma (hgb 6.8) treated with 2 units PRBCs. On PPD10, transferred to the floor on 6l O2 via nasal cannula. On PPD15, discharged to home on pre-admission doses of oxygen and sildenafil.



## Maternal exhaustion or hyponatremia: delay in diagnosis

**Presenting Author:** Christine P. McKenzie, M.D.

**Presenting Author's Institution:** University of North Carolina

**Co-Author:** Matthew Givens, M.D.; Chad Spencer, M.D.; Jasmine Johnson, M.D.; Nasir Khatri, M.D.

**Case Description:** A 34-year-old gravida 1 at 41+1 weeks gestation transferred from a birth center for induction of labor due to oligohydramnios. On admission, she was in early labor and desired a low-intervention birth. After 14 hours of latent labor, she transitioned into active labor and progressed to complete dilation over 7 hours. After 3 hours of pushing, interventions were recommended. The anesthesia team was called to place an epidural. The patient was noted to be in severe pain, anxious and uncooperative. She was given a 500mL bolus of lactated ringers during epidural placement. Pitocin was initiated and promptly discontinued due to fetal intolerance. The OB team was consulted and recommended cesarean delivery (CD). At this point, the patient was increasingly anxious and was not responding to the provider team. It was reported when the patient was alone with her nurse, midwife, and husband, she was responsive. The midwife's assessment was the patient was having an acute stress response related to the need for interventions. The patient and her husband agreed to a CD. Her epidural catheter was loaded with 15mL of lidocaine 2% with epinephrine. Midazolam 1mg was given for anxiety with good effect. Unfortunately, despite T4 level to pinprick and negative "Allis" test, she complained of pain after incision and the decision was made to convert to general anesthesia. The CD was uncomplicated, however neonatal resuscitation was complicated by meconium aspiration, neonatal apnea, and subsequent intubation. Following CD, continued deterioration in maternal mental status was noted - with agitation and abnormal movements of her upper extremities. Neurology was consulted. An arterial blood gas and complete metabolic profile revealed a sodium of 112 mmol/L. A serum sodium added to her admission labs 30 hours earlier revealed a sodium level of 132 mmol/L. Simultaneously, the NICU team identified hyponatremia in the neonate. Hypertonic saline 3% 100mL was given over 20 minutes and she was transferred to the ICU. The table shows laboratory trends and interventions. The patient's mental status improved and was transferred to the floor after 24 hours. Her diagnosis was SIADH potentiated by liberal free water intake.

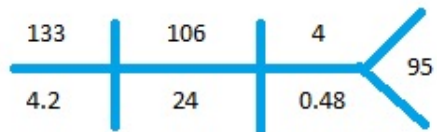
**Discussion:** Hyponatremia is a common, but underrecognized occurrence in laboring parturients. There is increased release of anti-diuretic hormone during labor due to triggers such as pain, stress, and nausea. Other contributors to hyponatremia in labor and delivery include liberal free water intake, pre-eclampsia, and reduce urinary output. Our case describes one of the most precipitous drops in sodium reported in a parturient. The case highlights the need to remain vigilant for subtle changes in mental status which may result from hyponatremia.

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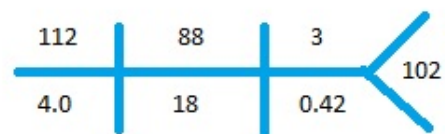
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### Hospital Day 0

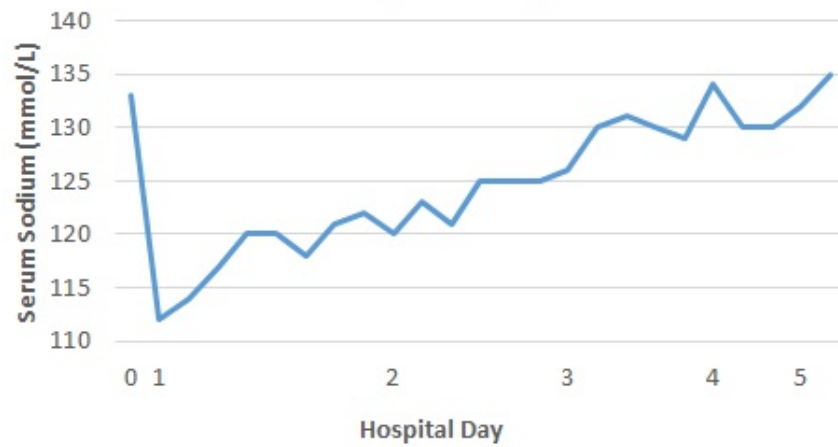


### 1 Hour Post Delivery



**ABG** 7.43/25.6/116/ 17/-7.1    **Lactate** 3.7  
**Urine Sodium** 37 mmol/L  
**Urine Osmolality** 181 mOsm/kg  
**TSH** 1.55  
**Cortisol** 25.4

### Sodium Trend Throughout Hospital Admission





## Anesthetic Management of a Parturient with Nemaline Myopathy

**Presenting Author:** Allison Lee, MD, MS

**Presenting Author's Institution:** Columbia University

**Co-Author:** Anne-Sophie Janvier, MD; Stephanie Purisch, MD; Richard Smiley, MD, PhD

**Background:** Nemaline myopathies (NM) are a heterogeneous group of rare myopathies (2:100,000) associated with sporadic and dominant/recessively inherited mutations.[1]

Described in 1963, NM is characterized by rod-like nemaline bodies in muscle fibers.[1] Features include facial dysmorphism, hypotonia, respiratory failure, cardiomyopathy and dysrhythmias.[1] Management is supportive. We present the peripartum care of the 12th reported obstetric case.[2]

**Case Report:** A 34 y.o. G1P0, at 32 5/7 wks gestation, BMI 18 kg/m<sup>2</sup> with congenital NM required cesarean delivery (CD) for malpresentation, preeclampsia with severe features (blood pressure), gestational diabetes and fetal growth restriction. She had an uncuffed tracheostomy tube (5.5 mm) and had been ventilator dependent since infancy (on AC Pinsp 45cmH<sub>2</sub>O, RR 18 TV ~1200ml), had severe restrictive lung disease, dysphagia, dysarthria, severe myopathy, gastric tube, scoliosis (post-anterior and posterior spinal fusion), chronic pain, on enoxaparin 40mg QD for DVT prophylaxis.

Notwithstanding counselling regarding likely technical difficulty, she desired neuraxial anesthesia. After last enoxaparin dose >24hrs, combined spinal epidural anesthesia was attempted in the lateral decubitus position. Inadvertent dural puncture with a 17G Tuohy needle occurred at 4.5cm (L4/5), with no epidural space detected and a 19G multi-orifice intrathecal catheter with free aspiration of CSF was secured at 11cm skin depth. Despite fentanyl 15mcg, morphine 0.15mg and repeated 0.5-1ml boluses of hyperbaric 0.75% and plain 0.5% and 0.25% bupivacaine (total 41.5mg bupivacaine) and 3% 2-chloroprocaine (total 90mg) over 90 mins, the sensory level remained below T6 to pinprick. The decision was made to proceed to general anesthesia.

Otolaryngologists (ENT) on standby performed bronchoscopy via the uncuffed tracheostomy tube under sedation, to confirm patency of the tract, and exchanged it for a cuffed tube to facilitate controlled mechanical ventilation. The CD was conducted uneventfully with total intravenous anesthesia. Regional anesthesiologists consulted reported that abdominal fascial plane blocks were impossible due to no appreciable muscle planes on ultrasound.

She was transferred mechanically ventilated to the ICU postoperatively. ENTs reinserted the uncuffed tracheostomy tube 4hrs later. Post-cesarean pain was managed with oxycodone and acetaminophen via gastric tube, lidocaine and fentanyl patches, and additional 0.2mg intrathecal morphine before catheter removal after 24hrs. No postdural puncture headache developed. She was discharged home on postoperative day 6.

### Discussion

NM is associated with difficult IV, airway and neuraxial placement, postoperative respiratory failure and pulmonary aspiration. Successful outcome in this complex case required coordinated multidisciplinary planning and management, and flexibility to change plans when indicated.

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## **Parturient with Jarcho-Levin Syndrome Managed Successfully for a Full-term Delivery with Labor Neuraxial Analgesia**

**Presenting Author:** Erik Romanelli, MD, MPH

**Presenting Author's Institution:** Montefiore Medical Center

**Co-Author:** Sherif E. Elsayed Ali Ali, MD; Yelena Spitzer, MD; Shamantha Reddy, MD

**Abstract :** We present the first documented case of a patient with Jarcho-Levin Syndrome (JLS), spondylocostal dysostosis subtype, managed successfully for full-term delivery with labor neuraxial analgesia. Limited literature exists of obstetric anesthesia management in JLS patients, and case reports are limited to planned cesarean deliveries (all performed under general anesthesia following awake fiberoptic intubation, with the exception of one utilizing spinal anesthesia). The clinical management for our patient for whom a trial of labor was ultimately permitted became largely tailored to the inherent potential difficulties in the provision of either neuraxial and/or general anesthesia for JLS patients, and an increased emphasis was placed upon multidisciplinary collaboration throughout the patients' peripartum course.

Our patient is a 21-year old G1P0 presenting in latent labor at 37-weeks gestation, with genetic testing confirmatory of spondylocostal dysostosis. She was born with no shoulder blade, and six missing ribs on the left side. She had cervical spine fusion at age 1 and kyphoscoliosis correction with surgical rods at age 13. She reported lifetime recurrent pulmonary infections, with most recent pneumonia hospitalization at 7-weeks gestation. She had baseline oxygen saturation of 94% on room air, left lung hypoplasia noted on chest X-Ray and baseline spirometry consistent with severely restricted lung disease. Echocardiogram was normal. A cervical spine MRI confirmed vertebral body fusion from C7-T6 and noted multilevel degenerative changes. MRI lumbar spine was largely unremarkable, confirming presence of surgical rods extending to L2 and appropriate level terminations of the conus medullaris and thecal sac. The patient was essentially at her baseline functional status upon admission, and it was deemed she could attempt a trial of labor. Difficult airway equipment including fiberoptic scope was placed in a dedicated operating room. The plan for labor analgesia was to attempt an early dural puncture epidural, and if difficulty was encountered to consider use of neuraxial ultrasound assistance and/or intentional intrathecal catheter placement.

After a difficult placement however, the Anesthesiologist decided to thread the catheter following two "dry taps" with the Gertie-Marx needle, and carefully assess analgesia with a slow catheter load of 10ml of 0.25% bupivacaine. Bilateral analgesic block and insensation to ice up to a T9 level was noted within twenty minutes. Fortunately, the patient progressed to full dilation within two hours without need for pitocin augmentation, and had uneventful vaginal delivery after twenty minutes pushing unassisted. The patient had an uneventful postpartum hospital course and was discharged postpartum day 2.

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**Pre-eclampsia associated bilateral serous retinal detachments diagnosed on bedside ultrasound**

**Presenting Author:** Jessica Sheeran, MD

**Presenting Author's Institution:** University of Virginia Department of Anesthesiology

**Co-Author:** Emmarie Myers, MD; Mohamed Tiourine, M.D.

**Abstract :** Pre-eclampsia affects 3-5% of pregnancies and is associated with many different types of maternal organ system dysfunction. Visual symptoms, usually presenting as blurry vision, may be seen in up to 25% of pre-eclamptic patients, but serous retinal detachments (SRD) are a rare complication of pre-eclampsia with severe features occurring less than 1% of the time [1]. The generalized endothelial dysfunction and vasospasm in pre-eclamptic patients affects the choroidal vasculature similarly resulting in fibrinoid necrosis of choroidal vessels and choriocapillaris occlusion. This compromises fluid transport by retinal pigment epithelium leading to serous RD [2]. Pre-eclampsia associated SRD usually has spontaneous resolution with good visual recovery within weeks, but necessitates ophthalmic management for detailed management. Studies have shown a high sensitivity and specificity for ocular ultrasound in the diagnosis of SRD in the emergency department [3]. We present a case of using bedside ocular ultrasound to diagnose SRD in a patient with pre-eclampsia with severe features and disseminated intravascular coagulation (DIC) complaining of blurry vision.

A 19-year-old G3P0020 female at 33w3d with history of gestational hypertension and anemia presented with severe abdominal pain and an intrauterine fetal demise due to presumed placental abruption. She began an induction of labor with misoprostol, but after three hours went into DIC diagnosed by significant anemia, thrombocytopenia, and hypofibrinogenemia confirmed with ROTEM. She was transferred to the ICU for further management of her DIC and to continue her induction with IV oxytocin. There, she began to complain of increased blurry vision. Bedside ocular ultrasound was consistent with bilateral SRD diagnosed with normal gain settings and the appearance of a thick cord that is attached to the back wall of the eye and moves with eye movement. In total, she received 4 units packed red blood cells, 2 units of cryoprecipitate, 2 units of platelets, 1 g concentrated fibrinogen, and tranexamic acid infusion with a 2.5 liter blood loss during vaginal delivery. Her blurry vision began to improve on postpartum day #2 and she was able to be discharged to home by postpartum day #3.

This illustrates a complex case of a pre-eclamptic parturient in DIC with blurry vision found to have bilateral SRD on ocular ultrasound after presenting with an intrauterine fetal demise due to placental abruption. This case demonstrates that bedside ocular ultrasound can very quickly diagnose this rare complication of SRD and help expedite ophthalmic involvement when needed.

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## **Persistent Vegetative State and 24 Weeks Pregnant: A Clinical and Ethical Dilemma**

**Presenting Author:** Kathleen A. Smith, MD

**Presenting Author's Institution:** University of North Carolina

**Co-Author:** Bryna Capshew, MD

**Abstract :** We present the tragic ongoing case of a 24-year-old G3P1103 who presented to our tertiary care center following motor vehicle collision with a semi-trailer truck. The patient's boyfriend drove the car underneath the semi, resulting in severe brain injury of the patient. Upon arrival, she was hemodynamically stable with a GCS of 4. An intrauterine pregnancy was discovered during initial FAST exam. OB was called and the fetus was determined to be 13-16 weeks' gestation. A non-operable depressed skull fracture was diagnosed and the patient was taken to the SICU.

The patient's history is significant for smoking and polysubstance abuse (cocaine, heroin, marijuana) since age 16, for which she had been previously incarcerated. She was living with her boyfriend, but did not have custody of her 5-year-old or 4-year-old twins.

On hospital day (HD) 2, she was underwent emergent decompressive bifrontal craniectomy and external ventricular drain (EVD) placement secondary to increasing intracranial pressure. Tracheostomy and percutaneous endoscopic gastrostomy tube placement were performed on HD 15. The patient is currently 24 weeks pregnant and remains in a persistent vegetative state.

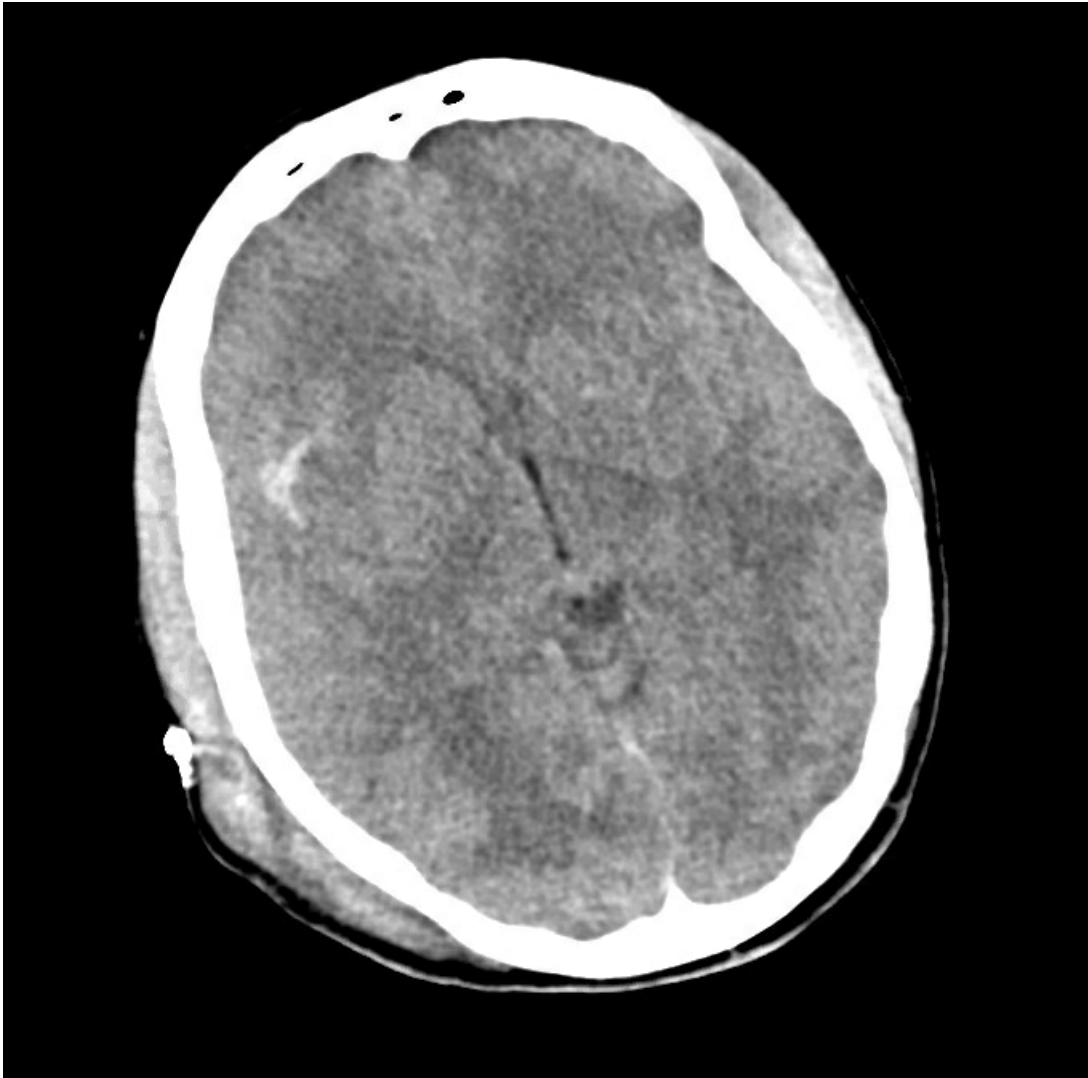
A multidisciplinary meeting (OB, Neuro, NSG, legal, ethics) concluded that focusing on maternal health is consistent with continued fetal well-being. The patient's father, estranged until recently due to incarceration for substance abuse, is the healthcare decision maker. Her family states this was a planned and desired pregnancy, and requests a trial of recovery for the patient as well as continued pregnancy. After extensive discussion, the family has chosen not to deliver in the event of fetal distress until 28 weeks gestation. Perimortem cesarean delivery would be performed in the event of maternal cardiac arrest.

The patient is having frequent episodic tachycardia (130's), HTN (160's/90's) and fever, concerning for paroxysmal sympathetic hyperactivity<sup>1</sup> versus other etiologies (occult infection). Rapid responses called during these events have resulted in numerous resources being deployed. Therefore, a detailed communication plan was developed to disseminate information on patient condition to avoid this in the future.

This case report will contain a description of paroxysmal sympathetic hyperactivity, as well as in-depth discussion of clinical and ethical dilemmas when caring for a parturient in a persistent vegetative state, including timing and mode of delivery, anesthetic type, pain management, interpretation of these hypertensive events during delivery and neonatal disposition.

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## **Patient-Centered Management of a COVID+ Pregnant Pediatric Patient with Fetal Congenital High Airway Obstruction Syndrome**

**Presenting Author:** Caitlin D. Sutton, MD

**Presenting Author's Institution:** Baylor College of Medicine

**Co-Author:** Alice King, MD; Roopali Donepudi, MD; David Mann, MD, DBe; Michael Belfort, MBBCH, MD, PhD

**Abstract :** Congenital high airway obstruction syndrome (CHAOS) is an extremely rare congenital anomaly that is fatal without fetal or perinatal intervention (1,2). CHAOS can result from a spectrum of tracheal or laryngeal anomalies such as atresia, stenosis, webs, or cysts (3). Historically, management of prenatally diagnosed CHAOS has uniformly included ex-utero intrapartum treatment (EXIT) to fetal airway (1,3). We present the case of a pregnant pediatric patient with a fetal diagnosis of CHAOS, further complicated by a maternal diagnosis of COVID-19. Multidisciplinary planning focused on novel, individualized surgical and anesthetic management in order to minimize morbidity and mortality for both mother and baby.

A 16-year-old G1P0 woman was referred to our hospital at 31 weeks' gestation with fetal CHAOS and symptomatic polyhydramnios. Through surveillance testing, she was found to have COVID-19 but had no symptoms at presentation.

Multidisciplinary planning included the maternal-fetal intervention, maternal-fetal anesthesia, pediatric surgery, pediatric otolaryngology, pediatric interventional cardiology, and pediatric radiology teams. A multi-stage intervention was planned with the goals of 1) avoiding an EXIT procedure for this primigravida, 2) avoiding a general anesthetic for a patient with COVID-19, and 3) optimizing neonatal outcome.

At 32 weeks, fetoscopy with tracheal dilation was planned. Anesthetic management involved moderate sedation and combined spinal-epidural. Nitroglycerin was available for emergent conversion to EXIT without general anesthesia or airway instrumentation. Fetoscopic evaluation revealed laryngeal atresia, which was treated with balloon dilation and tracheal stent placement.

The patient developed symptomatic contractions on post-operative day 7, which prompted the need for delivery. Neuraxial anesthesia facilitated external cephalic version as well as the repeat fetoscopy to confirm a patent fetal airway. Brief uterine relaxation using nitroglycerin was required for the procedure. The baby was then delivered via cesarean under neuraxial anesthesia without the need for EXIT.

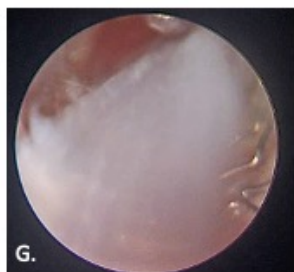
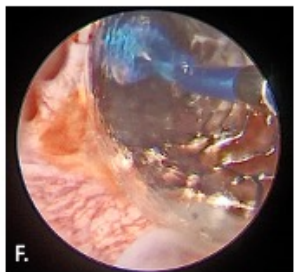
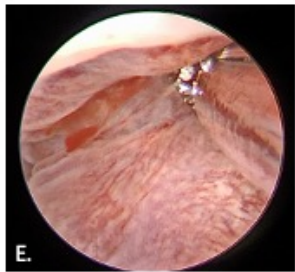
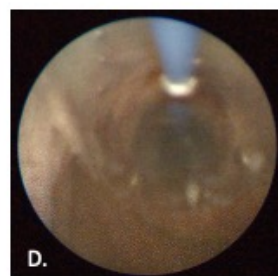
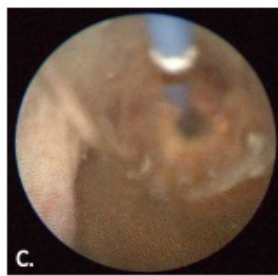
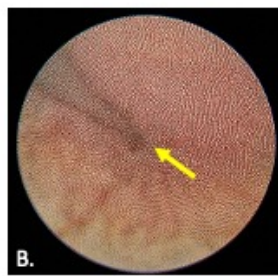
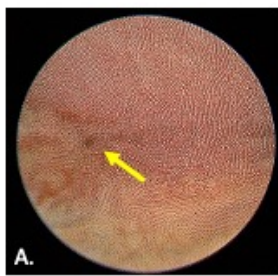
In the adjacent pediatric operating room, a neonatal airway was established with rigid bronchoscopy. Laryngeal atresia was confirmed and a small tracheoesophageal fistula was noted immediately inferior to the laryngeal atresia. A tracheostomy was then performed. The procedures were well tolerated by both mom and baby. The baby demonstrated spontaneous healing of the tracheoesophageal fistula by day of life 7.

Neuraxial anesthesia with nitroglycerin for uterine relaxation facilitated safe and nimble anesthetic management in this complex case. Use of fetoscopy in order to relieve fetal upper airway obstruction offered the potential to minimize neonatal hypoxia, while concurrently decreasing maternal morbidity by avoiding an EXIT procedure.

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## **Successful Cesarean Delivery of a Coronavirus Positive Patient with Hypoplastic Right Ventricle and Pulmonary Atresia at 27 Weeks' Gestation**

**Presenting Author:** William J. Trudo, M.D.

**Presenting Author's Institution:** Emory University

**Co-Author:** Ben Shatil, DO, MPH; Grant C. Lynde, MD MBA

**Abstract :** 30yo G3P0020 obese (BMI 37) parturient at 27 3/7 weeks with history of tricuspid atresia, hypoplastic right ventricle and pulmonary atresia s/p Glenn and Fontan Procedures presented with one week's history of symptomatic COVID-19. She presented with shortness of breath, hypoxia (SpO2 92% on 3L NC), and congestive heart failure. Remdesivir and dexamethasone were started on hospital day (HD) 1. The patient was also placed on a heparin drip for thromboembolism prophylaxis.

The patient's oxygenation declined and the patient required heated high flow nasal cannula (HHFNC) and epoprostenol to maintain oxygen saturation 90% on HD 2. Prone position and diuresis were attempted without improvement.

A cesarean delivery (CD) was performed on HD 5 due to worsening course. The following patient- and disease-specific considerations were performed:

- Location: Because the patient was unable to be transported safely to the operating room while on HHFNC, the decision was made to perform the CD in the ICU.
- ECMO Standby: 4 Fr single lumen catheters were placed in the femoral artery and vein in the event of cardiovascular collapse requiring ECMO.
- Perioperative Monitoring: The patient had standard ASA monitors, an arterial line, and central venous pressures measured via a midline catheter.
- Venous Access: The patient had a multi-lumen midline catheter, two 18-gauge peripheral IV catheters. All venous catheters utilized air filters.

On the morning of the CD, the patient's blood pressure was 130/80, CVP 33, 92% on 60L HHFNC. A combined spinal epidural placed at L2/3. No fluid preload was given. Into the CSF, 15 mcg fentanyl and 200 mcg preservative morphine were administered. The epidural was serially dosed with increasing concentrations of bupivacaine with 10-minute pauses between doses to ensure HD stability. The patient achieved a T4 block.

CD proceeded uneventfully. Total time from skin incision to delivery was 7 minutes. Total surgical time was 30 minutes. EBL was 300 cc and total IV fluid administered was 50 ml. The patient remained HD stable and required no vasopressor or fluid boluses except for a 15-minute period following the administration of 3 units of Pitocin IV following delivery of the placenta.

A 1.09 Kg male fetus was delivered and immediately taken to an adjacent ICU room with Apgar score of 6 and 8. The fetus was intubated and has had an improving course.

The mother's oxygen demands immediately improved and her overall clinical course improved. Aggressive diuresis was instituted, the ECMO access catheters were discontinued, and the patient was weaned to 6 L NC on HD 7 and to room air on HD 10.

### **Discussion:**

We describe the successful management of a 30 yo at 30 6/7 weeks who presented with significant congenital heart defects with superimposed COVID-19 symptoms using a CSE.



## Massive Transfusion Protocol for Uterine Rupture in a Preterm Obstetric Patient with Suspected Cornual Pregnancy

**Presenting Author:** Amy Walker, BS

**Presenting Author's Institution:** The Ohio State University College of Medicine

**Co-Author:** Rose McGahan, MD; Benjamin Rausch, DO; Plato Lysandrou, MD; Blair H. Hayes, MD

**Case:** A 38-year-old G3P0120 with a PMH of myomectomy and bicornuate uterus with suspected cornual pregnancy presented at 20w6d to OSH for evaluation of flank and abdominal pain. With acute onset of anemia (Hgb 7), hypotension, and leukocytosis, she was transferred to a tertiary care center for suspected urosepsis. On arrival, she was in hypovolemic shock despite receiving 2 units of PRBCs pre-transfer. FAST scan showed peritoneal free fluid, a heterogeneous placenta, and absent fetal heart tones. Transvaginal US was consistent with uterine rupture and intrauterine fetal demise. Massive transfusion protocol (MTP) was initiated and she was taken emergently to the OR for exlap. Intraoperatively, the etiology of hypovolemic shock was confirmed to be severe uterine rupture complicated by placental abruption. Due to the extent of uterine damage, supracervical hysterectomy and bilateral salpingectomy was performed with estimated blood loss of 2.5L. Arterial access was placed to resuscitate and guide management. Serial arterial blood gases and coagulation studies were obtained. In total, the patient received 11 units of PRBCs and 4 units of FFP. Postoperative course was uncomplicated following admission to ICU.

**Discussion:** Uterine rupture is rare, occurring in 1:25K to 1:50K deliveries, usually within the 3rd trimester or during labor. Second trimester uterine rupture is uncommon (1). Most ruptures occur at the site of previous cesarean scars, but additional risk factors include a history of uterine surgeries, induction of labor, advanced maternal age, and placental and/or uterine abnormalities (2).

Cornual pregnancies occur in a rudimentary horn or in one horn of a septate or bicornuate uterus. Pregnancy in the bicornuate uterus reduces the successful term delivery rate to 40% (3). Due to the risk of uterine rupture and massive hemorrhage, early diagnosis is the most important factor in the successful management of cornual pregnancies and the avoidance of rupture (2,3).

When the window for early diagnosis and treatment has closed, hemodynamic management of any high-risk pregnancy must include a high suspicion for conversion to uterine rupture. Massive hemorrhage requires massive transfusion to maintain adequate circulation and hemostasis. Obstetric patients in particular are susceptible to coagulopathy (4). Our case highlights the critical importance of having an established transfusion protocol in the management of obstetric hemorrhage.

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## **Takotsubo's Cardiomyopathy and Spontaneous Coronary Artery Dissection in a 40-year-old Postpartum Patient with Cardiogenic Shock**

**Presenting Author:** Gabriel Washington, MD

**Presenting Author's Institution:** Massachusetts General Hospital

**Co-Author:** Shiliang A. Cao, MD; Arjun Tara, DO; Lisa Leffert, MD

**Introduction:** Spontaneous coronary artery dissection (SCAD) is a rare event known to occur in the peripartum period, and there have been reports that suggest SCAD and Takotsubo's Cardiomyopathy (TTC) have similar risk factors and may even cooccur. Maintaining SCAD and TTC on the differential in peripartum patients is important, even in the absence of typical symptoms.

**Case Description:** A healthy 40-year-old G4P0 woman presented at term for vaginal delivery. Her delivery was briefly complicated by shoulder dystocia and a second-degree perineal laceration. A few hours postpartum, she reported feeling weak. Her vital signs were stable; however, she lost a total of 1L of blood, and was diagnosed with postpartum hemorrhage (PPH) secondary to retained products of conception and uterine atony. Oxytocin and misoprostol were initiated.

She continued to report generalized weakness and her blood pressure dropped to 80/40. She underwent manual evacuation for concern of ongoing hemorrhage, but minimal bleeding was noted. Carboprost, tranexamic acid and a pRBC transfusion were initiated with improvement in hemodynamics.

One hour later, she became hypotensive to 60/40 with oxygen saturation in the 80s and intermittent bradycardia to the 40s. She was given supplemental oxygen, high dose phenylephrine infusion and 500mcg of epinephrine, and transferred to ICU. Chest x-ray showed pulmonary edema. Cardiac workup revealed EKG with sinus rhythm, troponin of 129 ng/L and BNP of 3539 pg/mL. TTE showed LV dysfunction with EF of 29%. Coronary CT angiography the following day revealed SCAD of a small distal D1 branch with associated hypokinesis of the mid inferolateral wall. Cardiology diagnosed the patient with both TTC and SCAD.

Patient was diuresed with rapid improvement of cardiac function. She made a brisk recovery and was discharged 2 days later.

**Discussion:** Coexistence of SCAD and TTC has been reported in relatively few cases. Risk factors for SCAD include connective tissue disorders, pregnancy, multiparity and precipitating stressful events. Our patient's risk factors included pregnancy and labor, a stress event. High levels of estrogen and progesterone in the peripartum period may alter normal arterial wall structure, increasing susceptibility to dissections. In addition, increased cardiac output, total blood volume, and strain during labor and immediately following delivery may result in increased cardiovascular stress. This case illustrates the importance of considering both SCAD and TTC in the differential diagnosis of peripartum patients with cardiogenic shock, even in the absence of traditional symptoms like chest pain.

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## Labor Epidural Analgesia for a Patient with Brugada Syndrome

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**Co-Author:** Erin Martin, M.D.; Wendy Abramson, M.D.

**Abstract :** The patient is a 27-year-old woman presenting for induction at 38 weeks gestation. Her history is significant for an accident following a sudden onset of shortness of breath and loss of consciousness. She was admitted with a stable C-5 fracture and workup was performed to evaluate the loss of consciousness. EKG demonstrated right bundle branch block with down-sloping ST segments and a negative T waves in V1 and V2, consistent with Brugada Syndrome. Echocardiogram was normal. Genetic testing confirmed the patient had a mutation of the SCN5A-encoded sodium channel and was diagnosed with Type-1 Brugada Syndrome. She was fitted with a LifeVest and will receive an AICD following delivery.

Brugada Syndrome is a rare disease caused by a variety of ion-channel mutations in the cardiac conduction system. Patients may be asymptomatic, but are at increased risk of developing life-threatening arrhythmias such as ventricular tachycardia or ventricular fibrillation. Diagnosis is via EKG and can be categorized with genetic testing. Circumstances and drugs may trigger arrhythmias and treatment for Brugada Syndrome is avoidance of precipitating factors. These include fever, stress, high vagal tone, and alcohol. Many drugs, including local anesthetics, antidepressants, and antiarrhythmics may also precipitate EKG changes. This is relevant to obstetric anesthesia, as bupivacaine is listed as a medication to avoid given its strong binding to sodium channels. There are also reports of arrhythmia after large doses of paravertebral ropivacaine, though ropivacaine has been used without incident for labor epidurals in the setting of Brugada Syndrome. In the event of arrhythmia, medical treatment can be attempted with isoproterenol or quinidine. Unstable rhythms should be cardioverted or defibrillated.

The patient was placed on EKG monitoring and defibrillation pads were applied prior to induction of labor. Telemetry was continuously monitored by a qualified nurse. When she reached cervical dilation of 4 cm, the patient requested an epidural. A lumbar epidural was placed and the catheter slowly loaded with 8 cc ropivacaine 0.2%. Maintenance was ropivacaine 0.2% at 8 cc/hour with no PCEA. The patient delivered uneventfully 3.5 hours later and no arrhythmias were noted on EKG.

This case describes the management for a patient with the rare and potentially dangerous cardiac abnormality Brugada Syndrome. Labor epidural analgesia was safely provided and we were able to avoid using bupivacaine, our institution's primary epidural local anesthetic. Care was taken to dose the epidural slowly, with constant attention to potential EKG changes and signs of IV injection. The case demonstrates the importance of a coordinated interdisciplinary approach when caring for women with complex comorbidities.

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## Case report of a parturient with coronary artery fistula: a multidisciplinary approach

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**Co-Author:** Meghan Cook, MD; Kasey Fiorini, MD; Goran Ristev, MD

**Introduction:** Congenital coronary artery fistulas are rare and occur where there is an abnormal connection between the coronaries and the lumen of the cardiac chambers or great vessels (1). A multidisciplinary approach to the care of these obstetric patients is paramount to ensure good maternofetal outcomes.

**Case Report:** A 32 y.o. G2P1001 with PMH of coronary cameral aneurysm fistula (left main to right atrium) s/p Amplatzer vascular plug. Imaging post fistula plug showed residual minimal leak along with Qp:Qs of 1.09. Recent ECHO demonstrated large coronary fistula exiting left coronary cusp measuring 1.3cm and dilated to 1.9cm near RA with RA enlargement. She was on ASA and clopidogrel and was switched to enoxaparin 40mg BID 7 days before delivery. She had a history of shoulder dystocia and 4th degree laceration in G1, and gestational DM so a Cesarean delivery was planned at 38 wk. Prior to surgery, patient was asymptomatic outside of her usual PVCs. Cesarean delivery was completed under CSE without complication. NIBP and telemetry were monitored throughout. She had an uneventful postpartum course, and was transitioned from enoxaparin to clopidogrel prior to D/C on PPD 2.

**Discussion:** Cameral aneurysm fistulas are rare usually congenital anomalous communication between a coronary vessel and a cardiac chamber. The outcome of the connection differs based on the connection site and the pressure gradient between them (1). In this patient, a LM to RA connected created a L-R shunt, leading to her original presenting symptom: arrhythmia. Treatment is controversial, centering on surgical closure vs medical management depending on the communication, size, and symptoms. Class 1 AHA guidelines suggest large fistulas should be closed, in line with our patient's vascular plug (2). There is no consensus for anticoagulation in these patients, but the risk of thrombosis is high (3). In this patient, some residual minimal leak helped prevent total stasis and subsequent thrombosis formation leading to ischemia. As such her provider placed her on DAPT. OB anesthetic concerns for this patient include possible coronary dissection during labor, as well as potential for drop in SVR with spinal anesthesia due to sympathectomy-induced hypotension with both arterial and venous vasodilation. In this case, a low dose CSE allowed for close hemodynamic control. The Qp:Qs ratio, which describes the magnitude of CV shunt, is also an important consideration when evaluating congenital heart disease. Since this patient's fistula was closed, her post-plug Qp:Qs of 1.09 (normal of 1) suggests a relatively small shunt. Overall, this case shows the importance of a multidisciplinary approach towards management of complex congenital cardiac disorders including OB, Cardiology, and Anesthesia to ensure patient safety.

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## Which continuous monitor should we use for accurate detection of postoperative apnea events?

**Presenting Author:** Mohamed Elgamal, MBChB

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The SOAP and the ASA recommend hourly or continuous monitoring for high-risk patients.<sup>1</sup> Pulse oximetry (SpO<sub>2</sub>) and capnography are the most commonly used monitors to detect respiratory depression (RD) in hospitals. However, SpO<sub>2</sub> does not reflect ventilation, and EtCO<sub>2</sub> measurements via the capnography nasal cannula can be difficult in mouth breathers and non-compliant patients.<sup>2</sup> On the other hand, respiratory volume monitoring (RVM) provides direct measures of ventilation by detecting changes in electrical conductance of the chest obtained with surface electrodes to estimate respiratory rate (RR), minute ventilation (MV), tidal volume (TV), and apnea events. Our study aims to compare these 3 devices' ability to detect RD after neuraxial morphine administration in a high-risk post-cesarean delivery (CD) cohort.

77 high-risk parturients who received neuraxial morphine for scheduled CD were monitored with RVM, SpO<sub>2</sub>, and Capnography for 24 hours postoperatively. Inclusion criteria were BMI  $\geq 35$  kg/m<sup>2</sup>, with any of the following risk factors: pre-eclampsia, gestational hypertension, diabetes, or obstructive sleep apnea. MV, TV, RR were measured by the RVM (ExSpiron1Xi, Respiratory Motion Inc, Watertown, MA). MV was presented as a % of predicted MV (MVPRED) based on body surface area. RVM true alarm was defined as MV < 40% MVPRED for  $\geq 2$ min. Low MV resulted in an audible alarm as an indication of RD. SpO<sub>2</sub> was measured continuously (LifeSense, Nonin Medical Inc) with defined true alarm threshold SpO<sub>2</sub> < 90% for  $\geq 2$  minutes and capnography true alarms as RR < 8 or > 30 for  $\geq 30$ s and as EtCO<sub>2</sub> < 15 or > 45 mmHg for  $\geq 2$  min. Alarm rates were calculated by the number of alarms divided by monitored hours for each technology and alarm type (total, true, and false alarm rates). We used generalized estimating equation models to estimate the devices' rates.

Patient compliance was higher for RVM > SpO<sub>2</sub> > Capnography as demonstrated by monitored hours. The true alarm rate/hr for RVM, SpO<sub>2</sub> and Capnography were  $0.144 \pm 0.0376$  (CI 0.087-0.237),  $0.047 \pm 0.0196$  (CI 0.02-0.106) and  $0.039 \pm 0.0212$  (C.I 0.014-0.113), respectively. The comparison of true alarm rates between devices showed statistical difference. The true alarm rate for SpO<sub>2</sub> was approximately one-third that of RVM (RR=0.32, 95%CI= [0.12, 0.86, p = 0.024]), while the true alarm rate for Capnography was approximately one-fourth of RVM (RR=0.27, 95%CI= [0.09, 0.81, p-val = 0.019]). RVM showed a rate of 0.004 false alarms/hr, which is significantly lower than SpO<sub>2</sub> 4.804 false alarms/hr or Capno 23.44 false alarms/hr (Fig1 and 2).

In summary, our study demonstrates that RVM had fewer false alarms than SpO<sub>2</sub> and capnography. When the RVM alarmed, it was 3 and 4 times more likely to be a true alarm when compared to SpO<sub>2</sub> and Capnograph, respectively. These findings reflect that RVM aids with early detection of RD with less alarm burden to the clinical staff.

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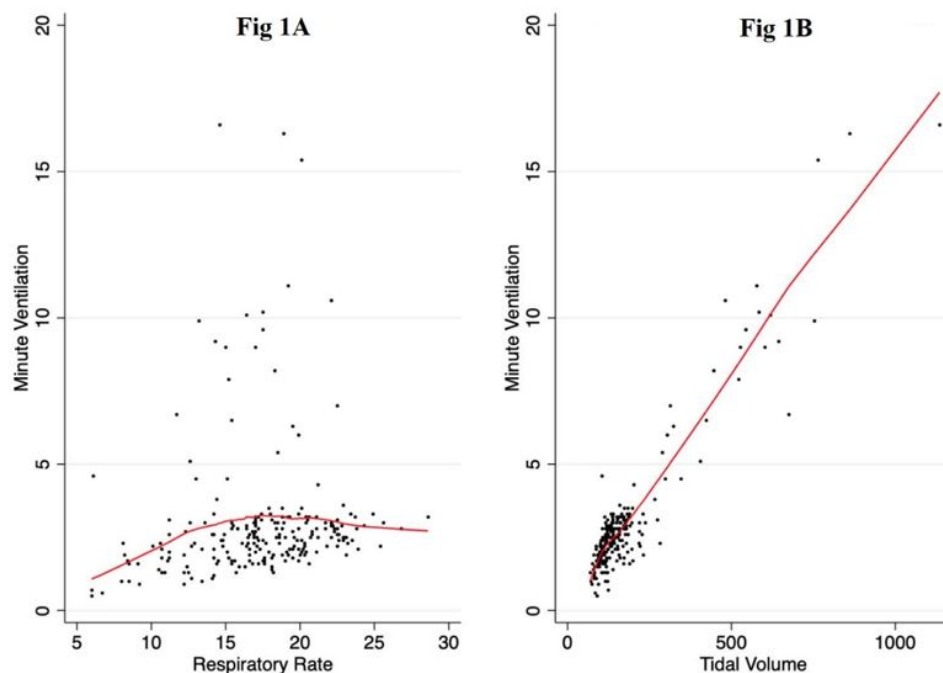


Fig 1A: Scatter plot showing the association between MV and RR.

Fig 1B: Scatter plot showing the association between MV and TV.

Factor	No alarm	Alarmed	p-value
N	48	29	
Age (years), mean (SD)	31.9 (5.6)	31.3 (5.5)	0.68
Body Mass Index, mean (SD)	44.8 (7.0)	46.4 (8.6)	0.39
Weight (kg), mean (SD)	117.6 (19.4)	124.8 (22.5)	0.16
Diabetes	15 (31%)	10 (34%)	0.77
High BP	18 (38%)	7 (24%)	0.23
Sleep apnea	10 (21%)	6 (21%)	0.99
Stopped breathing	12 (25%)	3 (10%)	0.12
Sternomental distance, mean (SD)	13.8 (1.9)	13.8 (2.1)	1
Thyromental distance, mean (SD)	7.9 (1.0)	8.0 (1.1)	0.9
Chest circumference, mean (SD)	124.9 (12.4)	126.6 (10.2)	0.53
Abdominal girth, mean (SD)	144.3 (10.5)	145.9 (16.5)	0.65
Neck circumference, mean (SD)	42.3 (4.4)	41.9 (3.4)	0.62

Table 1: Collected patient's history and morphologic features for prediction of respiratory depression events



## Comparing the use of Quantra vs. Rotational Thromboelastometry for Point of Care Viscoelastic Testing

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**Co-Author:** Antonio Gonzalez-Fiol, MD; Kristen Fardelmann, M.D; David Yanez, PhD, MS; Sonya Abdel-Razeq, MD; Aymen Alian, M.D.

Fibrinogen is a predictor of hemorrhage and a product that should be promptly replaced during postpartum hemorrhage.<sup>1</sup> Clauss fibrinogen level could take close to one hour to result, prompting the use of Point of Care Viscoelastic testing (POCVT) for goal-directed resuscitation. In this study, we compared two different POCVT devices: rotational thromboelastometry® (ROTEM) and Quantra®, an innovative device that uses Sonic Estimation of Elasticity via Resonance to measure clot stiffness.<sup>2</sup>

Three blood samples were obtained from healthy pregnant patients for ROTEM®, Quantra®, and a coagulation profile (i.e., PT/PTT, INR, platelets, and fibrinogen). Our primary outcome was to compare run times (in minutes). ROTEM® variables include the Amplitude at 10 minutes (A10) for the Extrinsic thromboelastometry (EXTEM) and FIBrinogen thromboelastometry (FIBTEM) assays. The EXTEM A10-FIBTEM A10 was used to estimate platelet contribution. The Quantra analogous variables are clotting time (CT), clot stiffness (CS), platelets (PCS), and fibrinogen (FCS). ROTEM A10 run time (A10-RT) was defined as the time needed for mixing reagents and blood until reported A10. Total ROTEM A10 time was defined as A10-RT plus the 15 minutes the reagents need to be warmed at room temperature. The Quantra run time (Q-RT) was defined as the time the sample was inserted in the cartridge until the result. Secondary outcomes include the relations between the FIBTEM A10 and FCS to Fibrinogen and PCS and EXTEM A10-FIBTEM A10 to platelets. We compared the mean times of the monitors using paired t-tests. Pearson correlation coefficients were utilized to estimate the linear associations between these variables. All hypothesis tests and confidence intervals are two-sided.

30 samples were analyzed for this comparison. The mean (standard deviation) for the A10-RT, Total ROTEM A10 time, and Q-RT were 14.5 (6.40), 33.1 (6.48), and 12.2 (0.58), respectively. The difference between A10-RT and Q-RT was not statically different, whereas that of the Total ROTEM A10 and Q-RT was 20.9 min [95%CI 18.4-23.4],  $p < 0.0001$ . For the secondary outcomes a high linear correlation was noted between fibrinogen and FIBTEM A10 ( $R = 0.84$ ,  $p < 0.0001$ ) and fibrinogen and FCS ( $R = 0.723$ ,  $p = 0.0001$ ). A linear correlation was noted between platelets and PCS ( $R = 0.659$ ,  $p = 0.0001$ ) and platelets and EXTEM A10 – FIBTEM A10 ( $R = 0.45$ ,  $p = 0.0133$ ). (See Figure 1)

In summary, both ROTEM and Quantra offer quick and reliable fibrinogen estimates to aid in goal directed transfusion during a hemorrhage. The Quantra produces results 21 min faster and with less operator variability than ROTEM. Both the FIBTEM A10 and the FCS show high linear correlations with Clauss fibrinogen levels. There is a modest, but statistically significant correlation between EXTEM A10-FIBTEM A10 and platelets. Quantra offers a better linear correlation between the PCS and platelet contribution.

### References:

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Groves et al. Anesth Analg 2020



## **Peripartum magnesium sulfate in preeclampsia: effect on postpartum endothelial function and blood pressure in early versus late onset preeclampsia**

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**Presenting Author's Institution:** Columbia University

**Co-Author:** Ruthi Landau, MD; Beatriz Raposo Corradini, B.S.; Whitney Booker, M.D.; Andrea Miltiades, M.D. MS

**Introduction:** Women with a history of preeclampsia have an increased risk of cardiovascular disease (CVD) years following delivery.<sup>1</sup> Endothelial dysfunction (ED), involved in preeclampsia and CVD, seems to persist beyond the postpartum period in early onset (< 34 weeks) preeclampsia (EOPE) which may explain the greater risk for CVD in later life in these women.<sup>1,2</sup>

It has been suggested that endothelial function testing within 72h of delivery may serve as an early diagnostic and prognostic assessment in women with preeclampsia. However, the effect of magnesium sulfate (MgSO<sub>4</sub>) infusion, given to prevent eclampsia, on the interpretation of vascular testing measures is unclear.<sup>3</sup>

We decided to examine the effect of MgSO<sub>4</sub> therapy on postpartum vascular reactivity characteristics, hypothesizing that women tested within 24h of receiving MgSO<sub>4</sub> would show less evidence of ED compared to those who received MgSO<sub>4</sub> >24h prior to the assessments. Since women with EOPE seem to have ED beyond the postpartum period, we also hypothesized that women with EOPE may show more ED and arterial stiffness (AS) within 72h of delivery, compared to women with late onset preeclampsia (LOPE).

**Methods:** Within 72h of delivery, vascular reactivity characteristics such as reactive hyperemia index (RHI), augmentation index (AI@75) using EndoPAT™, and overall change in blood pressure before and after MgSO<sub>4</sub> treatment were assessed in women with EOPE (N=17) and LOPE (N=19). We further performed a subgroup analysis comparing RHI results in cases in which either less or more than 24 hours had elapsed between MgSO<sub>4</sub> infusion cessation and EndoPAT™ testing.

**Results:** There was no difference in incidence of ED and AS between groups (Table 1). In subgroup analysis, endothelial function testing within 24h of MgSO<sub>4</sub> was associated with normal readings in EOPE but not LOPE group (Figure 1). There was a negative correlation between time since MgSO<sub>4</sub> infusion and endothelial function in EOPE (F=4.95, p= 0.045), but not LOPE (Figure 2). There was a significantly greater decrease in SBP after MgSO<sub>4</sub> in LOPE (27.7±4.7mmHg) compared to EOPE (12.3±3.9mmHg, t=2.48, p=0.018) (Table 1).

**Discussion:** We found a time dependent association between MgSO<sub>4</sub> therapy and improved vascular function scores among women with early but not late onset preeclampsia. The clinical significance of these findings remains to be determined but suggests caution with interpretation of vascular function measurements in the immediate postpartum period in women receiving MgSO<sub>4</sub>, as it may result in improvements that could be temporary. Women with late onset were found to display greater SPB change with MgSO<sub>4</sub> than women with early onset preeclampsia.

These two findings taken together further support the idea that early vs late onset preeclampsia are distinct clinical entities with separate implications for pregnancy and delivery.

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**Association of obstructive sleep apnea with body fluid distribution in pregnant women with obesity – A prospective observational pilot study**

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**Abstract :** Introduction: Obstructive Sleep Apnea (OSA) is common in women with obesity<sup>1</sup> and has been linked to multiple maternal and fetal morbidities<sup>2</sup>. Changes in Total Body Water (TBW) and segmental body water shift are clinically relevant markers of OSA in the non -pregnant population<sup>3</sup>. The objective of this feasibility study was to determine the association of body fluid measurements with the severity of OSA in women with obesity.

**Methods:** This was a prospective, observational feasibility study of women in the third trimester of pregnancy ( $\geq 24$  weeks gestation) with class III obesity (body mass index  $\geq 40$  kg/m<sup>2</sup>). Bioelectrical Impedance Analysis (BIA) was used to measure TBW and segmental neck fluid volume, and neck circumference was measured using a measuring tape. The difference in neck fluid volume and circumference between sitting and Trendelenburg positions ( $\Delta$ ) was calculated. OSA diagnosis and classification was made using overnight polysomnography. The primary outcome was OSA (measured by apnea-hypopnea index (AHI)). Secondary outcomes included association of OSA with rostral shift of fluid to neck and change in neck circumference with change in body position. Pearson correlation coefficient (CC) with 95% confidence interval (CI) was calculated to estimate the strength of each association.

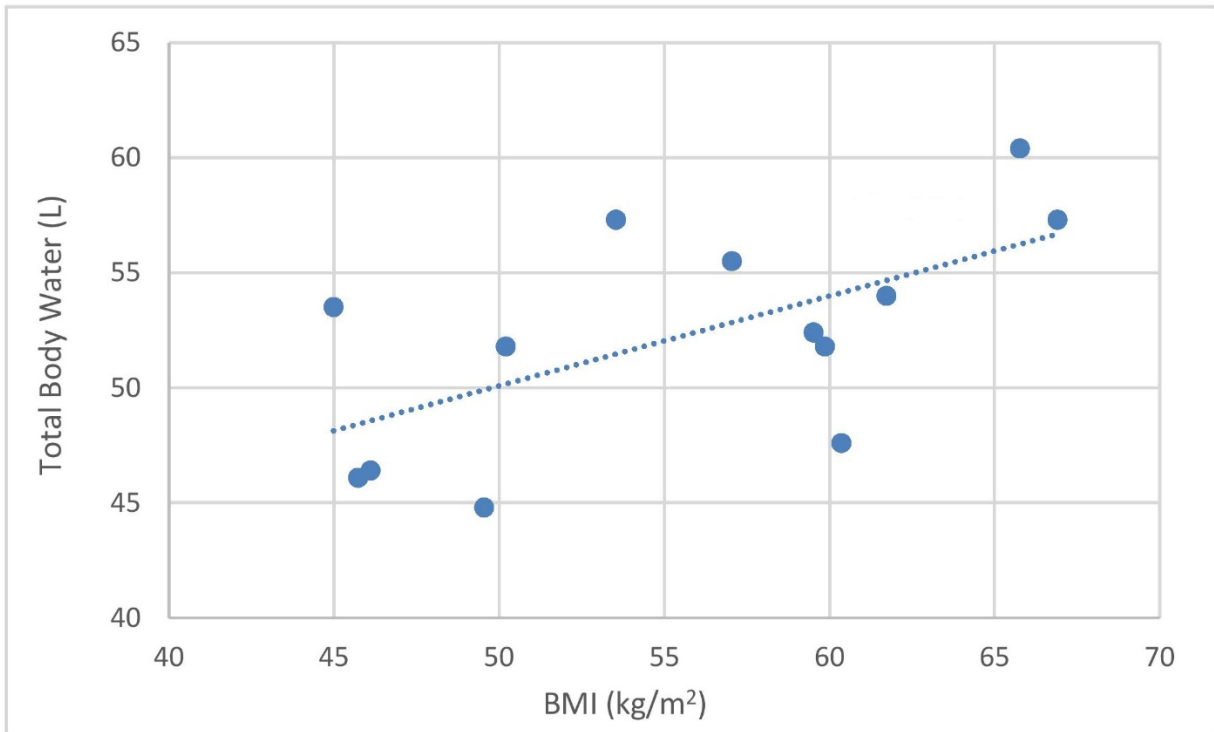
**Results:** Fifty-eight patients were assessed for eligibility of which 28 completed the BIA testing and 13 completed both the BIA and sleep study. The mean (standard deviation) BMI was 56 (8) kg/m<sup>2</sup>. Seventy-seven percent of patients investigated were diagnosed with OSA (AHI $\geq 5$ ). There was a significant association between BMI and TBW 0.613 (0.094, 0.870),  $p=0.024$ . There was a trend towards positive but not statistically significant association of AHI with TBW (Pearson CC 0.203, 95% CI -0.392, 0.678,  $p=0.515$ ),  $\Delta$  neck volume (Pearson CC 0.344, 95% CI -0.415, 0.821,  $p=0.380$ ),  $\Delta$  neck circumference (Pearson CC 0.284, 95% CI -0.346, 0.738,  $p=0.381$ ), and BMI (Pearson CC 0.172, -0.446, 0.679,  $p=0.602$ ).

**Conclusions:** This study demonstrated the feasibility of body water assessment using BIA in women with class III obesity in the third trimester of pregnancy. We found that TBW increases with increasing BMI, and there is likely a positive association of the severity of OSA with TBW and rostral fluid shift in neck. However, these results should be interpreted with caution considering our wide confidence intervals, possibly due to a small sample size. Further research is required to confirm these findings.

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## Anesthesia work force capacity and maternal mortality in low and middle-income countries

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**Presenting Author's Institution:** University of Michigan

**Co-Author:** Kathryn Flaharty, n/a; Lindsay Rosenthal, n/a; Hana Murphy, n/a; Bela Parekh, n/a; Ruthi Landau, MD

**Background:** In Africa, maternal mortality after cesarean delivery is 50 times higher than that of high-income countries and is driven by peripartum hemorrhage and anesthesia complications, and CDs represent one third of all surgeries.[1] Based on a recent workforce survey, the World Federation of Societies of Anesthesiologists (WFSA) recommended a minimum density of physician anesthesia providers (PAP) of 5 per 100,000 population.[2] It has also been suggested that a PAP density of 4 will achieve a reasonable standard of healthcare based on median maternal mortality ratio (MMR), as currently seen in Mauritius (MMR 61).[3] We decided to assess the relationship between the anesthesia work force capacity and MMR in Africa, Southeast Asia (SEA) and Eastern Mediterranean (EM), hypothesizing regional variation in the relationship between PAP density and MMR.

**Methods:** Using data from the WFSA and the World Bank, we conducted a correlation analysis between PAP density and MMR in Africa (data available for 37 countries), SEA (9 countries), and EM (15 countries). Information from SEA and EM was combined into one region (SEA/EM) for comparison with Africa. Fisher's transformations were applied to correlation strengths and compared by paired analysis.

**Results:** Overall, the highest MMR was in South Sudan (1150) with a PAP density of 0.02, and the lowest MMR was in UAE (3) with a PAP density of 10.92. South Africa had the highest PAP density (16.18) and MMR of 119, while the Central African Republic had the lowest PAP density (0.00) and MMR of 829. Serving as reference, the MMR in the U.S. is 19 with PAP density of 20.82 (in green; Figure), the MMR in Norway (lowest worldwide) is 2 with PAP density of 25.50 (in turquoise; Figure) and the MMR in Mauritius is 61 with PAP density of 4.32 (in brown; Figure). PAP density was inversely correlated with MMR in both Africa ( $\rho = -0.59$ ,  $p = 1.0 \times 10^{-4}$ ) and SEA/EM ( $\rho = -0.89$ ,  $p = 4.9 \times 10^{-9}$ ). Paired analysis of Fisher transformed correlation coefficients revealed distinct trends between Africa and SEA/EM ( $Z=2.5$ ,  $p = 0.01$ ).

**Conclusion:** We confirmed the correlation between physician anesthesia work force capacity and maternal mortality ratio. However, the correlation was stronger in South East Asia and Eastern Mediterranean compared to that in Africa, suggesting additional factors drive maternal mortality ratios in Africa. Limitations to our analysis are that we did not examine the interaction between cesarean delivery rates - known to be extremely low in some regions - PAP density and MMR, nor did we examine the contribution of non-physician anesthesia providers in countries reporting few or no physician anesthesiologists. Additional investigation into parallel drivers of maternal outcomes could guide local and international aid programs aiming to improve maternal care with a global health emphasis.

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## The clinical tolerability and pharmacokinetics of intraperitoneal chloroprocaine administered to peripartum women

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**Presenting Author's Institution:** Oregon Health & Science University

**Co-Author:** Yalda Zarnegarnia, PhD, MS; Dennis Koop, PhD; David Yanez, PhD, MS; Miriam Treggiari, MD, PhD, MPH;

**Background:** We previously published a case series of 32 parturients with inadequate neuraxial anesthesia during cesarean delivery who were able to avoid general anesthesia after receiving intraperitoneal 2-chloroprocaine (mean dose 11.8 mg/kg).<sup>1</sup> The aim of this study was to characterize the pharmacokinetic profile of chloroprocaine administered intraperitoneally to women undergoing cesarean delivery, and to assess for clinical signs of toxicity.

**Methods:** We designed a single center, prospective, cohort, multiple dose escalation study with intraperitoneal chloroprocaine. Fifteen women were administered 40 mL of chloroprocaine solution after delivery of the baby prior to the completion of uterine closure: 5 subjects received 1% chloroprocaine, 5 subjects received 2% chloroprocaine, and 5 subjects received 3% chloroprocaine. Maternal blood samples were obtained prior to administration, and 1, 5, 10, 20, and 30 minutes after dosing. The research coordinator questioned the patient for local anesthetic toxicity 5, 10, 15, 30, 60 minutes after dosing, at PACU arrival, and at PACU discharge. Institutional Review Board approval was obtained on January 4, 2019 and the trial was registered on clinicaltrials.gov (NCT03760718) on November 30, 2018.

**Results:** The pharmacokinetic profile of 1%, 2%, and 3% chloroprocaine were analyzed. The concentration-time profiles for intraperitoneal chloroprocaine are shown in the figure. The peak concentration was 64.8, 28.7, and 799.2 ng/mL for 1%, 2%, and 3% chloroprocaine, respectively. Conservatively, using Vricella's 100 mL/kg estimate for parturient plasma volume,<sup>2</sup> this corresponds to a 79.92 mcg/kg peak concentration in the 3% group. No parturients had seizures, tinnitus, agitation, muscle twitching, sedation, respiratory depression, desaturation, vision changes, perioral numbness, or an arrhythmia. One parturient reported metallic taste, one reported dizziness, and two reported nausea.

**Conclusion:** Our data support the safety of intraperitoneal chloroprocaine use during cesarean delivery after separation of the fetus from the mother. The 79.92 mcg/kg peak plasma concentration is considerably below the median lethal dose in mice (97 mg/kg)<sup>3</sup> and the lowest concentration reported to causes systemic toxicity in humans with normal pseudocholinesterase activity (2.8 mg/kg)<sup>4</sup>. Interestingly, peak chloroprocaine plasma concentrations were disproportionately higher in the 3% group, compared to the 1% and 2% groups.

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## **A Randomized, Double-Blind, Placebo-Controlled Trial of Outpatient Gabapentin to Reduce Persistent Pain and Opioid Use in Women Suffering from Severe Pain after Cesarean Delivery**

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**Presenting Author's Institution:** Stanford

**Co-Author:** Amy Willet, M.D; Jessica R. Ansari, M.D.; Nan Guo, PhD; Brendan Carvalho, MBBCh, FRCA, MDCH; Pamela Flood, M.D.

**Abstract:** Introduction: Women experiencing severe acute pain with high opioid requirements after surgery, are at increase their risk for persistent opioid use and ongoing pain (1,2). No studies have examined whether outpatient treatment with gabapentin will facilitate opioid cessation and prevent persistent pain in women with severe pain and high opioid requirements after delivery. The primary aim of the study was to determine if gabapentin would decrease the time to opioids cessation in a cohort of women identified to be at risk for prolonged opioid usage after cesarean delivery.

**Methods:** Prospective, randomized, double-blinded, placebo-controlled trial (NCT03472521). Following IRB approval, consecutive in-hospital patients who fulfilled the study inclusion criteria (cesarean within 5 previous days and severe pain (NRS >6) despite standardized multimodal analgesia (scheduled acetaminophen and ibuprofen and rescue opioids) were approached. Women were randomly assigned to augment their analgesic management with study drug (gabapentin 300 mg PO TID) or placebo. Women were advised to use scheduled study drug (and their prescribed acetaminophen and ibuprofen) while reserving their prescribed oxycodone only as-needed and to titrate off the opioid first. Study drug stopped next when pain permitted. Women were followed for 12 weeks or until they indicated that they had recovered to their previous level of function. The primary outcome was time to opioid cessation. Key secondary outcomes include time to pain resolution (pain score = 0) and time to pain cessation (pain score < 4).

**Results:** 78 women were enrolled (n=41 received gabapentin and n=37 received placebo). There was no difference between groups in the time to opioid cessation (p=0.7). In the gabapentin group, participants stopped taking their opioid at 2 [1-4] and the placebo group stopped at 2 [1-3] weeks (Fig 1A). Time to pain resolution (p=0.4) and time to pain cessation (p=0.4, Fig 1B) were similar between groups.

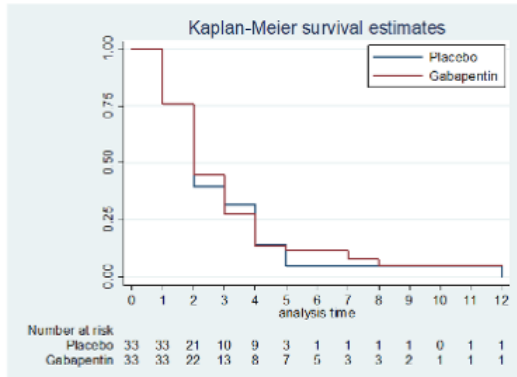
**Conclusion:** Gabapentin for outpatient treatment of an enriched cohort of women with severe pain and at high risk for prolonged opioid usage did not affect time to opioid cessation or pain resolution. While gabapentin is commonly prescribed for post-surgical patients with difficulty managing pain with the usual multimodal regimen (3), we found limited evidence of its efficacy in the post-cesarean delivery population. Future research is needed to evaluate different pharmacological or non-pharmacological approaches in this vulnerable population.

### **References:**

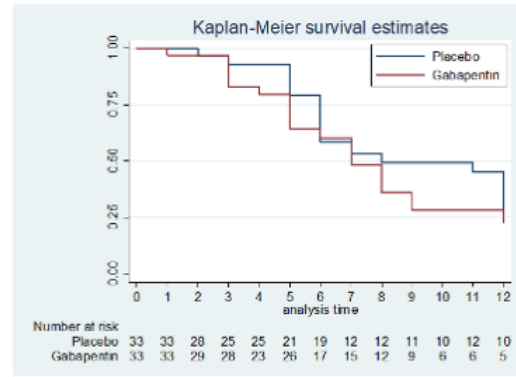
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- Hah et al. JAMA Surg 2018;153:303-11



**Figure 1A:** Kaplan Meier survival estimates of time to opioid cessation in the study cohorts



**Figure 1B:** Kaplan Meier survival estimates of time to pain resolution in the study cohorts





## **Treatment of Shivering After Cesarean Delivery Under Epidural Anesthesia During Labor : Dexmedetomidine vs Meperidine**

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**Introduction :** Shivering is common following delivery with cesarean section. Meperidine is a standard treatment for shivering, but is associated with side effects such as nausea, vomiting, sedation and respiratory depression. Dexmedetomidine is a centrally-acting  $\alpha_2$ -agonist with demonstrated efficacy against shivering during cesarean section compared to placebo<sup>1</sup>. The aim of this study was to compare onset time, efficacy and side effects of dexmedetomidine and meperidine in this setting.

**Methods :** In this double-blinded single-center randomized controlled trial, we recruited patients with an American Society of Anesthesiologists Physical Status (ASA PS) of I or II who presented grade 3 or 4 shivering on the Crossley and Mahajan scale at least 5 minutes after a cesarean delivery under epidural anesthesia during labor. Patients were randomized to receive either 0.35 mcg/kg of dexmedetomidine (DEX) or 0.35 mg/kg of meperidine (MEP) over 2 minutes. The primary outcome was time to cessation of grade 3 or 4 shivering. Secondary outcomes included efficacy within 15 minutes, patient satisfaction, and incidence of side effects such as hypotension, bradycardia, nausea, vomiting and sedation. Data is presented as n (%), mean (SD) or median (IQR). We used chi-square, Fischer's exact tests, Wilcoxon rank sum tests, t-tests and mixed models with repeated results in our statistical analysis, and a p-value of < 0.05 was considered statistically significant. This study is registered on ClinicalTrials.gov (NCT03115047).

**Results :** 80 patients were recruited between May 2017 and August 2020. All patients were included in statistical analysis. Demographic data was similar between groups. There was no statistically significant difference between groups for time to cessation of grade 3 or 4 shivering (median 204.5 sec (IQR 163.5-286.0) in DEX group vs 196.5 sec (IQR 169.0-276.5) in MEP group;  $p=0.866$ ), efficacy at 15 minutes (90% in DEX group vs 85% in MEP group;  $p=0.737$ ), patient satisfaction (92.5% in both groups), shivering grade over time (see figure 1;  $p=0.616$ ) or incidence of side effects. Nausea and vomiting was higher in MEP group without reaching statistical significance ( $n=12$  (30%) in DEX group vs  $n=18$  (45%) in MEP group;  $p=0.1659$ ). No major adverse effects were recorded with either drug.

**Conclusions :** Dexmedetomidine and meperidine have a similar onset time, efficacy and patient satisfaction for treatment of shivering following cesarean delivery under epidural anesthesia during labor. Although meperidine could cause more nausea and vomiting, this study lacked power to demonstrate this finding. Dexmedetomidine is a safe and well tolerated alternative to meperidine for treatment of shivering.

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- Lamontagne C, Lesage S, Villeneuve E, Lidzborski E, Derstenfeld A, Crochetière C. Intravenous dexmedetomidine for the treatment of shivering during Cesarean delivery under neuraxial anesthesia: a randomized-controlled trial. *Can J Anesth.* 2019;66(7):762-771.



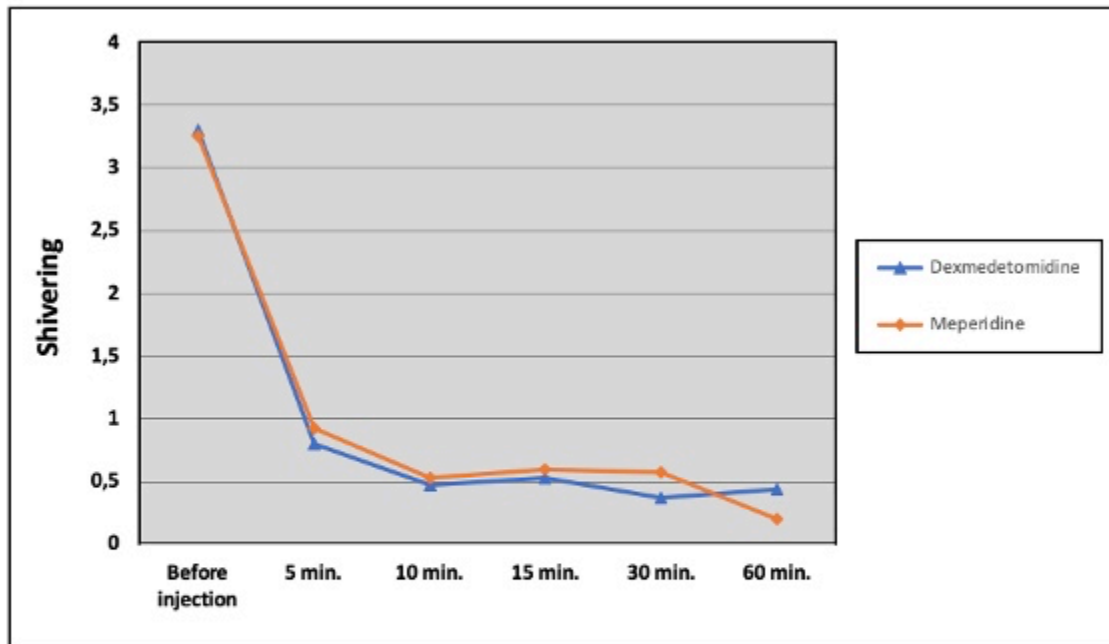


Figure 1 – Mean shivering grade on the Crossley and Mahajan scale in each treatment group before and after injection of study drug. There was no significant difference between groups for shivering grade over time ( $p=0.6158$  using a mixed model with repeated measures).



## **A Randomized Controlled Trial of Dural Puncture Epidural versus Standard Labor Epidural Technique in Parturients with Obesity**

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**Presenting Author's Institution:** Duke University Medical Center

**Co-Author:** Hon Sen Tan, MD; Sydney Reed, MD; Jennifer Mehdiratta, MD; Daniel Weikel, MS; Ashraf S. Habib, MBBCh, MSc, MHSc, FRCA

**Background:** The dural puncture epidural (DPE) technique was reported to produce a more rapid onset with improved quality of labor analgesia compared to a standard epidural technique (EPL). This has been attributed to the confirmation of midline placement with return of CSF and the provision of a conduit allowing translocation of medications administered in the epidural space into the intrathecal space. Those benefits would be especially advantageous in parturients with obesity, in whom neuraxial placement could be challenging and the presence of a well-functioning epidural catheter is crucial to avoid the need for general anesthesia and its associated risks in the event of cesarean delivery. Therefore, we performed this study to compare the quality of labor analgesia between the two techniques in obese parturients.

**Methods:** After IRB approval, term parturients with cervical dilation of 2-7cm, BMI  $\geq 35$  kg/m<sup>2</sup>, pain score  $> 4$ , requesting labor epidural analgesia were enrolled in this prospective double-blinded, randomized trial. Randomization was stratified by class of obesity and parity. The neuraxial technique was placed in the sitting position at L3/4 or L4/5 interspace using loss of resistance to saline. In the DPE group, a 25-g Whitacre needle was used to puncture the dura. Initiation and maintenance of labor analgesia was standardized and identical in both groups. Data were collected by a blinded investigator for the first 30 minutes of epidural catheter placement then every 2 hours until delivery. Breakthrough pain was managed by a standardized protocol. The primary outcome was block quality defined by a composite of five components: (1) asymmetric block after 30 minutes of initiation, (2) top-up interventions, (3) catheter adjustments, (4) catheter replacement, and (5) need for general anesthesia or catheter replacement in case of cesarean delivery. Secondary outcomes included time to pain score  $\leq 1$ , motor block, and sensory levels 30 minutes after block placement, adverse events (hypotension, nausea, pruritus, fetal bradycardia, postdural puncture headache), motor block, pain scores, duration of second stage of labor, total anesthetic dose, patient-controlled epidural analgesia use, mode of delivery, and overall satisfaction with analgesia.

**Results:** One hundred thirty-two patients were included in the analysis. Patient demographics, pain scores and cervical dilatation at initiation of analgesia, and duration of analgesia were comparable between the two groups. There were no significant differences between the two groups in the primary composite outcome of quality of analgesia or of its individual components. There were also no significant differences between the groups in any of the secondary outcomes

**Conclusion:** The DPE technique was not superior to standard EPL technique in providing labor analgesia among obese pregnant women in this study.



## Magnesium sulfate bioavailability and clearance after intramuscular dosing in women with preeclampsia

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**Co-Author:** Hadiza Galadanci, MBBS, MSc; Lihong Du, PhD; Olufemi Oladapo, MBBS, MPH; Han Witjes, PhD; Brendan Carvalho, MBBCh, FRCA, MDCH

**Introduction:** Intramuscular (IM) dosing of magnesium for pre-eclampsia is frequently utilized in low and middle-income countries (LMICs), however pharmacokinetic (PK) behavior of magnesium after IM dosing is poorly understood. (1,2) The study aimed to construct a PK model of magnesium sulfate using a commonly prescribed IM regimen (Pritchard), determine key PK variables (absorption rate constant (KA), bioavailability (F), clearance (Cl)) and simulate drug concentrations attained.

**Methods:** Women at a tertiary hospital in Nigeria with severe pre-eclampsia receiving standard Pritchard regimen for seizure prophylaxis were approached for participation between October–December 2019. The administered Pritchard regimen consisted of: magnesium sulfate 4g IV over 20 minutes and 10g IM loading dose, followed by 5g IM every 4 hours for 24 hours. Serum magnesium levels were obtained at various time points: baseline, 30 minutes, 1.5, 3.5, 11.5, 13, 21 and 24 hours after magnesium sulfate administration. Samples were obtained from two groups of women (n=10/group) to limit blood draws. The PK model was adjusted for maternal age, gestational age, creatinine, weight, and antepartum/postpartum status. The model was compared to that previously published PK model of intravenous magnesium Zuspan regimen. (1,2)

**Results:** 80 magnesium levels from 20 women were collected. PK profiles and change from baseline magnesium level are shown in Figure 1. At 11.5 hours after magnesium sulfate administration, 63% of women reached therapeutic serum magnesium levels of  $\geq 2.0$  mmol/L. Serum magnesium concentration was described by a 2-compartment PK model. The PK variables were:  $KA=0.86$  h<sup>-1</sup>,  $F=0.91$  and  $Cl= 3.52$  L/h. A PK model simulation of attained serum levels is shown in Figure 2.

**Conclusion:** The study results show achievement of therapeutic serum magnesium levels and support the use of the Pritchard IM regimen in low and middle-income countries (LMICs). The data provides valuable PK data and supports previously attained and proposed Ka and F values that can be used to simulate serum magnesium levels associated with different IM regimens and simulation of eclampsia response when alternate regimens are utilized.

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1. Du L, Wenning LA, Carvalho B, Duley L, Brookfield KF, Witjes H, de Greef R, Lumbiganon P, Titapant V, Kongwattanakul K, Long Q, Sangkomkarnhang US, Gülmezoglu AM, Oladapo OT. Alternate magnesium sulfate dosing regimens for women with preeclampsia: a population pharmacokinetic exposure-response modeling and simulation study. *J Clin Pharmacol.* 2019;59(11):1519-1526.
2. Du L, Wenning L, Migoya E, Xu Y, Carvalho B, Brookfield K, Witjes H, de Greef R, Lumbiganon P, Sangkomkarnhang U, Titapant V, Duley L, Long Q, Oladapo OT. Population Pharmacokinetic Modeling to Evaluate Standard Magnesium Sulfate Treatments and Alternative Dosing Regimens for Women With Preeclampsia. *J Clin*



Figure 1. Individual change from baseline (CFB) magnesium concentration-time profiles in preeclamptic Nigerian women. Red line = excluded subject for sampling error.

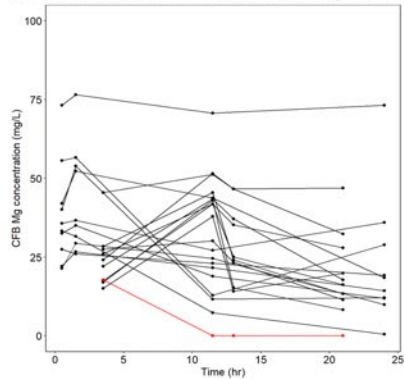
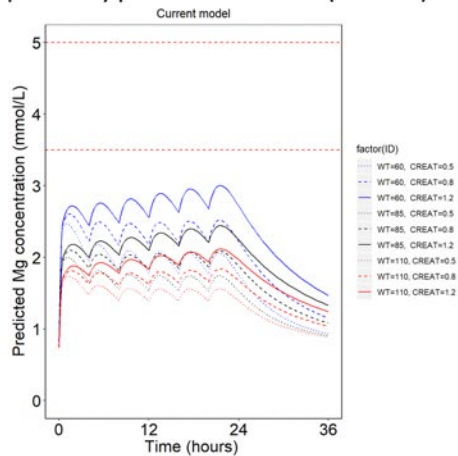


Figure 2. PK modelling simulation of drug concentration attainment using data from this study combined with previously published PK model (Du 2019).



Pharmacol. 2019;59(3):374-385.



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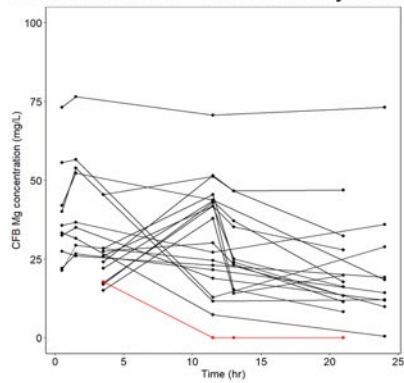
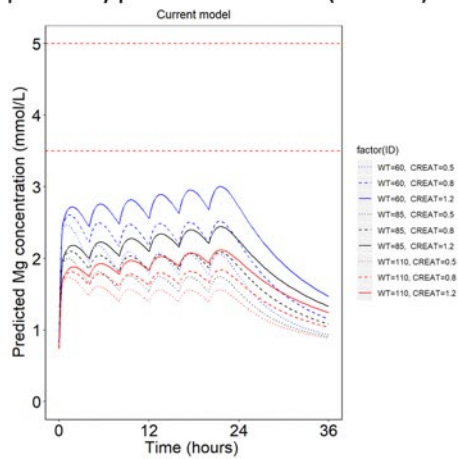


Figure 2. PK modelling simulation of drug concentration attainment using data from this study combined with previously published PK model (Du 2019).





## **Appetite regulation in pregnancy: peripheral and central leptin and melanocortin neuropeptides**

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**Presenting Author's Institution:** Columbia University Department of Obstetrics and Gynecology

**Co-Author:** Sunil Panigrahi, PhD; Giselle Jaconia, MD; Cynthia Gyamfi-Bannerman, MD; Richard Smiley, MD, PhD; Gabrielle Page-Wilson, MD

**Introduction:** Pregnancy is associated with changes in the regulation of appetite favoring caloric consumption, despite a placentally-mediated rise in circulating leptin levels. Leptin normally inhibits caloric intake by modulating the activity of hypothalamic proopiomelanocortin (POMC) and agouti-related protein (AgRP) neurons, but pregnancy appears to be a leptin-resistant state at term.<sup>1</sup> The mechanisms underlying appetite changes earlier in pregnancy have not been studied. Therefore, we evaluated leptin and melanocortin physiology in pregnancy by examining differences in CSF and plasma leptin, and AgRP and POMC, in early (2nd trimester) and term gestation.

**Methods:** Plasma and CSF samples were collected from 72 women; 24 at 2nd trimester cerclage placement, 24 at term elective cesarean delivery, and 24 regularly cycling non-pregnant controls the morning after an overnight fast, matched for age and BMI. Plasma levels of leptin, soluble leptin receptor (Ob-Re), and AgRP, and CSF levels of leptin, POMC, and AgRP were assayed by ELISA. Data were analyzed by two-tailed Student t test or one-way ANOVA.

**Results:** Plasma leptin levels were 1.5 times higher in pregnant women, in pregnancy and at term, compared to non-pregnant controls (48.8 ± 3.6 vs. 30.1 ± 5.0 ng/ml;  $P=0.01$  and 46.0 ± 7.1 vs. 30.1 ± 5.0 ng/ml;  $P=0.01$ ). Despite hyperleptinemia of pregnancy, CSF leptin levels did not differ among the three groups (329.8 ± 27.6 vs. 328.5 ± 20.2 vs. 309.7 ± 26.9 pg/ml;  $P=0.8$ ), supporting a decrease in leptin transport into CSF during mid and late pregnancy. CSF/plasma leptin percentage was significantly lower both in early (0.8 ± 0.1;  $P<0.0001$ ) and term pregnancy (0.9 ± 0.1;  $P<0.0001$ ) compared to controls (1.7 ± 0.2). While CSF AgRP in early pregnancy did not differ from controls, CSF POMC concentrations were 25% lower in early-pregnancy than among non-pregnant controls (161.1 ± 12.3 vs. 207.0 ± 10.10 fmol/ml;  $P=0.006$ ). CSF POMC levels were also lower early vs. at term (161.1 ± 12.3 vs. 206.5 ± 14.0;  $P<0.005$ ). However, the CSF AgRP/POMC ratio was almost 1.5 times higher in both early ( $p=0.002$ ) and term pregnancy ( $p=0.0004$ ) vs. non-pregnant controls, reflecting a decrease in melanocortin tone throughout pregnancy that favors food intake. Plasma AgRP, a peripheral biomarker of hypothalamic AgRP, was also significantly higher in early pregnancy (95.0 ± 7.8;  $P=0.005$ ) and at term (100.0 ± 7.4  $P=0.0009$ ) compared to non-pregnant subjects (67.5 ± 5.3).

**Conclusions:** These data show that pregnancy-specific adaptations in the central regulation of energy balance occur early in human gestation and suggest decreased leptin transport into brain and resistance to the effects of leptin on target melanocortin neuropeptides. This may maintain caloric intake despite rising leptin plasma levels. Studies examining these relationships in women with gestational diabetes, obesity and other metabolic alterations would be of interest.

**References:** 1 J Clin Endo Metab 2013;98:264-71



**Association between labor neuraxial analgesia and reduced odds of severe maternal morbidity among women who delivered vaginally in New York State hospitals, 2010-2016.**

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**Presenting Author's Institution:** Columbia University Vagelos College of Physicians and Surgeons

**Co-Author:** Ruthi Landau, MD; Guohua Li, MD, DrPH; ; ;

**Abstract :** Background: Severe maternal morbidity (SMM) is a growing public health burden in the US, with postpartum hemorrhage (PPH) as the first cause of preventable SMM. SMM incidence has tripled during the last 2 decades, affecting now 1 in 75 non-Hispanic White women and 1 in 50 racial/ethnic minority women (Ref. 1). Labor neuraxial analgesia (LNA) is suggested to be associated with reduced odds of PPH among women who delivered vaginally (Ref. 2). A possible explanation linking LNA to reduced odds of PPH is that presence of an epidural catheter at the time of delivery reduces delays in managing PPH because obstetrical procedures needed to stop the bleeding require anesthesia. However, LNA is still underutilized in racial/ethnic minority women (Ref. 3). We hypothesized that LNA is associated with reduced odds of SMM among women who delivered vaginally, and that this protective effect is mediated by decreased odds of PPH.

**Methods:** Data for this retrospective study came from the New York State Inpatient Database 2010-2016, a census of hospital discharge records. Women who delivered vaginally with (exposed) or without (unexposed) LNA were analyzed. SMM was identified using the CDC algorithm for administrative data, and PPH using the ICD codes 666 and O72. Adjusted odds ratios (aOR) and 95% confidence intervals (CI) for SMM associated with LNA were estimated using propensity score matching and stratified according to: 1) race/ethnicity (non-Hispanic White vs. racial/ethnic minority women), and 2) the comorbidity index for obstetric patients (CMI-OB = 0 or low-risk vs. CMI-OB  $\geq 1$  or high-risk). The proportion of the effect of LNA on the odds of SMM mediated through PPH was estimated using non-causal mediation analysis.

**Results:** During the study period, 532,781 vaginal delivery cases were analyzed. Of them, 7142 (1.34%) recorded SMM. PPH was recorded in 3501 (49.0%) of the SMM cases. Before matching, the incidence of SMM among women who received LNA was 1.27% and among women who did not 1.40% (risk difference -0.13%; 95%CI: -0.18,-0.08). After matching, LNA was associated with 10% reduced odds of SMM (aOR 0.90; 95%CI: 0.85,0.96) (Table). Reduced odds of SMM associated with LNA was similar between racial/ethnic minority women (aOR 0.90; 95%CI: 0.83,0.97) and non-Hispanic White women (aOR 0.91; 95%CI: 0.82,1.01), and between low-risk women (aOR 0.88; 95%CI: 0.81, 0.96) and high-risk women (aOR 0.88; 95%CI: 0.80, 0.96). The overwhelming majority (89%) of the protective effect of LNA on the occurrence of SMM was mediated through reduced odds of PPH.

**Conclusions:** LNA is associated with 10% reduced odds of SMM among women who delivered vaginally, due to reduced odds of PPH. Increasing access to and utilization of LNA, especially for racial/ethnic minority women, might be an actionable intervention to improve maternal health and reduce disparities.

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3. Sem Perinatol 2017;41:293-8



## **The association between patient satisfaction and inadequate regional anesthesia for cesarean delivery: a prospective observational study**

**Presenting Author:** Emma Frank, M.D.

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**Co-Author:** Grace Kohn, B.A.; Belinda Kohl-Thomas, M.D.; Courtney Shaver, M.S.; Michael Hofkamp, M.D.

**Introduction:** Patient satisfaction for cesarean deliveries performed under inadequate regional anesthesia that requires the use of systemic anesthetic adjunct medication is unknown. Our hypothesis was that subjects who had cesarean deliveries under regional anesthesia that required supplementation with systemic anesthetic adjunct administration would have lower patient satisfaction compared to subjects who did not require supplementation.

**Methods:** A previously validated survey designed to measure patient satisfaction for cesarean deliveries performed under regional anesthesia<sup>1</sup> was administered to subjects who gave informed consent and met inclusion criteria. Detailed demographic and clinical data for subjects who completed the survey were extracted from the medical record by the principal investigator, an anesthesiologist. Informed consent was waived by our institutional review board to obtain less detailed data for all other subjects who had cesarean deliveries during the study period. The study began July 1, 2019 and was terminated on March 9, 2020 due to the COVID-19 pandemic.

**Results:** 591 subjects had cesarean deliveries during the study period and 239 of these subjects completed the survey. 37 (6.3%), 25 (4.2%), and 10 (1.7%) subjects had cesarean deliveries under general anesthesia for the indications of perceived lack of time to initiate regional anesthesia, failure of regional anesthesia, and maternal co-morbidities, respectively. 113 (19.1%) subjects had regional anesthesia with administration of one or more systemic anesthetic adjunct medications. Demographic, clinical, and survey data for the 239 subjects who completed the survey are included in Table 1. Systemic anesthetic adjunct medications administered to subjects who completed the survey were intravenous fentanyl (45), morphine (3), midazolam (3), ketamine (7), propofol (5), and inhaled nitrous oxide (20).

**Discussion:** Subjects who received one or more systemic anesthetic adjunct medication(s) reported clinically and statistically significant lower satisfaction with pain control, dry lips or mouth, and being able to hold and nurse the baby after delivery compared to subjects who did not. Limitations of this study were that subjects who received systemic anesthetic adjunct medication were more likely to have a preoperative diagnosis of depression, had a longer time from skin incision to wound closure, and had a longer length of stay compared to subjects who did not. Subjects from the two groups also differed in regional anesthetic technique, urgency of cesarean delivery indication, and time of day that the cesarean delivery occurred. Future studies are needed to compare patient satisfaction between subjects who receive general anesthesia for cesarean delivery due to failure of regional anesthesia and subjects who have inadequate regional anesthesia.

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## Effect of implementation of perineal tear pain management program on pain scores

**Presenting Author:** Karunakaran Ramaswamy, FRCA, MBA

**Presenting Author's Institution:** Sidra Medicine

**Co-Author:** Zofia Kotyra, FRCA MBA; Nicolas Hooker, FRCA; Saravanan Dhanashekar, FRCA; Sam Soltanifar, FRCA; Monzer Sadek, MD, FANZCA

**Background:** Perineal tear (PT) occurs in more than 85% of women undergoing vaginal birth and up to 11% of these can be third and fourth-degree tears. The majority of the women with PT suffer from pain<sup>4</sup>, preventing them from mobilizing and looking after the infant, difficulty in micturition, incontinence, constipation, decreased mobilization, and psychological impact in the short term<sup>5</sup>. Long-term implications include chronic pain, stress and urge incontinence, flatus, fecal incontinence, chronic pelvic pain<sup>6</sup>, and dyspareunia<sup>7,8</sup>. The institution introduced a perineal tear pain management program (PPP) as part of a quality improvement program from January 1st, 2020. This paper is a retrospective analysis of the effect of this implementation on pain scores and patient satisfaction.

**Methods:** De-identified data were retrieved from electronic medical records of 100 consecutive women who had PT from January 1st, 2019 to March 31st, 2019 (Pre-PPP), and 96 women who had PT from April 1st, 2020 to July 31st, 2020. Our sample size calculation was based on institutional data on pain scores following PT at rest, 12 hours post-repair which was  $4.6 \pm 1.6$  (Mean $\pm$ SD). A 33% reduction in pain score would be a clinically significant difference. A minimum sample size of 48 patients was calculated (24 per group) using a two-tailed t-test, an alpha error of 0.05, and a power of 90%. The primary outcome was pain scores at rest 12 and 24 hours post repair. We also analyzed satisfaction score rating from 0 (worst possible) to 10 (best care) before discharge. The treatment effect was assessed using t-tests. A P-value  $\leq 0.05$  was considered statistically significant for the outcome. Values are presented as ( Mean $\pm$ SD, [difference of means], 95%CI).

**Results:** Data from (n=100 before; n= 96 after) women who had a second, third, and fourth-degree PT were reviewed. The incidence of 2nd, 3rd, or 4th-degree tear in our institution is 16%. 4% of these were third-degree tears. There were no 4th-degree tears. There was no difference in the degree of tear type in the two groups and there was an equal number of 3rd-degree tears in both groups. There was no significant difference in the demographics between the two groups. Significant differences in pain scores at 12 hours ( Mean $\pm$ SD, [difference of means], 95%CI) ( $2.17 \pm 1.11$  vs  $4.5 \pm 1.65$ , [2.33], 1.93 to 2.73, t (194)= 11.54, P < 0.0001) and 24 hours ( $2.17 \pm 1.11$  vs  $4.32 \pm 1.44$ , [2.15], 1.79 to 2.52, t (194)=11.67, P< 0.0001) were found after the introduction of the PPP. Patient satisfaction scores were improved after the program (  $8.13 \pm 1.35$  vs  $5.11 \pm 1.72$ , t(194)=13.6, P< 0.0001).

**Conclusion:** Implementation of a pain program for PT was associated with improvements in pain scores and patient satisfaction. Further prospective evaluations and work to confirm this finding in other institutions would be useful.

**References:** The Management of Third-and Fourth-Degree Perineal Tears Green-top Guideline No. 29. 2015.



## Acute pain intensity and opioid dose requirement after cesarean delivery in parturients with pre-existing chronic pain

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**Presenting Author's Institution:** University of Washington

**Co-Author:** William Harbour, MD; Kenneth Ruth, MD; Taylor Ziga, MD; Hani El-Omrani, MB, BCh; Emily Dinges, MD

**Background:** Pre-existing chronic pain has been reported to be a consistent risk factor for severe acute pain after surgery.<sup>1</sup> However, each specific chronic pain condition has unique pathophysiology, and it is possible that the effect of each condition on postoperative pain is different. We performed a retrospective cohort study to compare opioid consumption and pain intensity after cesarean delivery between patients who had different types of chronic pain conditions.

**Methods:** This is a retrospective cohort study of pregnant women with age 18 years or older with pre-existing chronic pain conditions (i.e. migraine, chronic back pain, and combination of migraine + chronic back pain), who underwent cesarean delivery at our institution. Patients who required postoperative mechanical ventilation, and those who required postoperative epidural analgesia containing opioids were excluded. The primary outcome was time-weighted average pain score (0 to 10 scale), and the secondary outcome was opioid dose requirement in morphine milligram equivalents (MME) during 48 postoperative hours. The effects of the three chronic pain conditions on time-weighted average pain score were compared using Tukey's HSD test with ordinary least squares analysis of covariance (ANCOVA), while their effects on the opioid dose requirement outcome were compared using Z tests based on the estimated covariance matrix from the ANCOVA model using rank-based estimation, both controlling for demographic, obstetric, and surgical covariates.

**Results:** No chronic pain condition was associated with significantly different time-weighted average pain score than any other. Chronic back pain was associated with significantly greater opioid dose requirement than migraine (12.92 MME, 95% CI 0.41 to 25.43,  $p = 0.0405$ ) (Table 1). The effects of preoperative opioid use (unadjusted  $p = 9.825e-07$ ), receipt intraoperative dexamethasone (unadjusted  $p = 0.0010$ ) and postoperative acetaminophen dose (unadjusted  $p = 0.001285$ ) on pain were significant after controlling for multiple comparisons, with preoperative opioid use, higher postoperative acetaminophen dose, and receipt of intraoperative dexamethasone associated with greater time-weighted average pain score. The effects of preoperative opioid use (unadjusted  $p < 1e-10$ ), postoperative ibuprofen dose (unadjusted  $p = 0.0001$ ), smoking status (unadjusted  $p = 0.0003$ ) and postoperative acetaminophen dose (unadjusted  $p = 0.0010$ ) on opioid dose requirement were significant, with preoperative opioid use, smoking, higher postoperative acetaminophen dose and lower postoperative ibuprofen dose associated with greater opioid dose requirement.

**Conclusion:** Women with pre-existing chronic back pain required 13 MME greater opioid dose than those with migraine during 48 hours after cesarean delivery, but the pain intensity during this period was not different between different pre-existing chronic pain conditions.

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## **Informed Consent in Obstetric Anesthesiology: Resident Practices and Education to Improve Quality of Consent**

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**Co-Author:**

**Background:** Bioethical principles of autonomy, justice, beneficence, and nonmaleficence underlie modern medicine. Informed consent is the process by which clinicians provide patients with the knowledge requisite to exercise autonomy. Consent is a cornerstone of the physician-patient relationship, and the current medicolegal climate demands clinicians to be thorough in this process. A survey of anesthesiology residents revealed an absence of formal clinical instruction on obtaining consent. Rather, elements are gleaned from self-directed reading, casual observation, or prompted by the electronic medical record. Specialty and patient specific nuances influencing consent require accumulation of clinical experience which junior trainees lack. Obstetric anesthesiology presents unique clinical considerations influencing consent: situations evolve rapidly requiring time-limited decision making, patients may be in extremis due to pain, of minor age with variable parental involvement, or maternal/fetal comorbidities may indicate interventions to which a patient is not amenable. Social factors and distrust towards physicians may limit robust consent discussions.

**Objectives:** Evaluate anesthesiology resident practices in obtaining informed consent in the obstetric setting. Identify deficiencies and provide education to enhance quality of consent.

**Methods:** Anesthesiology residents were observed consenting patients admitted for labor. Residents did not know the reason for observation. Discussions were assessed using a detailed written metric identifying required elements of consent. Verbal feedback and current literature were provided to address individual growth areas, with demonstration of a model consent discussion. Trainees were observed after intervention using the same metric.

**Results:** Recurrent themes included failure to describe the offered procedure of a labor epidural, its elective nature or alternative therapies, omission of material risks of neuraxial blockade, and failure to provide a recommendation when one was clearly indicated. Situations arose in which questionable patient capacity was overlooked or in which highly educated patients were presumed to possess the requisite information despite complete omission of a consent discussion. Trainees excessively prioritized written consent above the process of consent. Educational intervention yielded robust consent discussions that routinely met all required elements.

**Conclusions:** Clinical instruction improves accuracy and breadth of consent discussions by anesthesiology trainees in an obstetric setting, satisfying legal requirements of consent and ethical obligations to the patient. Future work expands this educational model to implement program wide clinical instruction in informed consent.

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## Evaluating racial/ethnic inequities in the utilization of liposomal bupivacaine truncal blocks following cesarean delivery

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**Co-Author:** Fei Chen, PhD., MEd; Lacey Straube, MD; Jasmine Johnson, M.D.; Alison Stuebe, M.D.; Benjamin Cobb, MD

**Introduction:** Women of color have been shown to report higher pain scores and receive less analgesic medication compared to non-Hispanic white women following cesarean delivery (CD). Truncal blocks with liposomal bupivacaine (LB) may offer an opioid sparing benefit post CD. Our study aimed to evaluate racial/ethnic inequities in the utilization of truncal blocks for post-cesarean analgesia.

**Methods:** We performed a retrospective cohort study of CD patients from January 1, 2020 to December 31, 2020 at a tertiary care center. Medical records were queried for number of pain assessments, pain scores, non-opioid analgesics, opioid consumption (converted to oxycodone mg equivalents (OME)), and LB administration with truncal analgesia. CD patients were divided into two groups: 1) all pain scores less than 7 and 2) at least one pain score of 7 or greater. Outcome measures were evaluated only for the patients with at least one pain score equal or greater than 7. Outcomes were stratified by race/ethnicity: Hispanic, non-Hispanic (NH) Black, NH White, Asian, and other. CD patients are managed with a standardized orderset including scheduled non-steroidal anti-inflammatory drugs, scheduled acetaminophen and as-needed oral opioid analgesics. Truncal blocks, most commonly the transversus abdominis plane (TAP) block, are offered on a case-by-case, non-standardized basis. Group differences in the proportion of women receiving TAP blocks were analyzed using Fisher's exact test. Continuous outcomes were analyzed using Kruskal-Wallis tests.

**Results:** There were 1140 CD patients included in the analysis. 591 patients reported at least one pain score of 7 or higher. Table 1 shows outcomes measures for this group of patients. Among these women, there were a total of 21 truncal blocks with LB performed. The racial/ethnic distribution of the truncal blocks performed was 57.1% (n=12) NH White, 14.3% (n=3) NH Black, 14.3% (n=3) Hispanic, 4.8% (n=1) Asian, and 9.5% (n=2) other. For the 549 patients with all pain scores less than 7, median 48-h opioid consumption was 0 [0,5] OME and 4 (0.73%) truncal blocks with LP were performed.

**Discussion:** Overall utilization of truncal blocks with LB was low. In women reporting pain scores of 7 or greater, no statistically significant difference was observed between NH White and NH Black women receiving truncal blocks with LB, although there was a trend towards more truncal blocks in NH White women. There is an opportunity for increasing our utilization of truncal blocks with liposomal bupivacaine. Leveraging the electronic medical record to alert the anesthesia provider when patients report severe pain may increase the administration of truncal blocks in women with severe pain post CD. Future studies with more women receiving truncal blocks with LB may offer additional insights into ethnic/racial inequities in treating severe post-cesarean pain.

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	Non-Hispanic White (n=223)	Non-Hispanic Black (n=175)	Hispanic (n=126)	Asian (n=14)	Other (n=53)	P value
Pain assessments (n)	13 [10, 17]	12 [10, 16]	11 [9, 15]	14 [10, 15]	14 [11, 17]	0.0078*
48h opioid consumption (oxycodone mg equivalents)	29.2 [15, 45]	20 [10, 35]	15 [10, 25]	17.5 [10, 30]	30 [15, 38.3]	<0.0001 <sup>†</sup>
Proportion of pain scores $\geq 7$	0.18 [0.11, 0.33]	0.25 [0.17, 0.38]	0.20 [0.11, 0.29]	0.24 [0.11, 0.33]	0.17 [0.10, 0.33]	0.0056 <sup>^</sup>
Number of truncal blocks performed (n (%))	12 (5.38%)	3 (1.71%)	3 (2.38%)	1 (7.14%)	2 (3.77%)	0.2051

Reported in median [IQR]; Pairwise comparisons revealed significant between individual groups: \*Hispanic compared to NH-White; <sup>†</sup>NH-White compared to NH-Black and Hispanic and Hispanic compared to Asian; <sup>^</sup>NH-White compared to NH-Black and NH-Black compared to Hispanic.



## Comparative Effectiveness of First-Dose Oral Versus Intravenous Acetaminophen for Cesarean Delivery Analgesia: A Prospective Interrupted Time Series Trial

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**Co-Author:** Anne Wanaselja, MD; Brendan Carvalho, MBBCh, FRCA, MDCH; Grace Lim, MD, MSc; ;

**Abstract :** Introduction: Scheduled postpartum acetaminophen (APAP) as part of multimodal analgesia is known to reduce pain and opioid consumption after cesarean delivery [1]. However, data comparing analgesic effectiveness of intravenous (IV) and oral (PO) APAP in the peripartum setting is lacking. Obstetric patients often experience nausea and vomiting, so IV formulations may be pharmacokinetically advantageous [2]. However, clinical trials comparing PO and IV may not reflect real-world practice as patients experiencing nausea/vomiting could be excluded from analyses. We compared perioperative pain and opioid use outcomes between first-dose oral (PO) vs. IV APAP using a real-world comparative effectiveness design.

**Methods:** In this prospective interrupted time series trial, women undergoing scheduled cesarean deliveries were assigned to no APAP, 1000mg PO APAP, or 1000mg IV APAP based on date of surgery. The PO APAP was given at the time of departure from the preoperative area to the operating room (allowing 20-60-minute time to peak plasma concentration) [3]. IV APAP was administered at fascial closure to approximate similar peak plasma concentrations anticipated with PO APAP. Post anesthesia care unit time and total hospital pain scores, intraoperative and postoperative nausea/vomiting, time to first opioid dose, and total opioid consumption were recorded. Segmented regression was used to compare pain and opioid use outcomes between the time epochs. One-way ANOVA compared opioid dose and pain scores between groups.

**Results:** 144 subjects were included in the final analysis. Demographic, operative, and nausea/vomiting characteristics were similar between groups (Table). Segmented regression results showed significant differences between epochs for in-hospital average pain scores (Intercept  $\beta_0=0.02$ ,  $P=0.48$ ; level change after PO APAP  $\beta_1=0.07$ ,  $P<0.001$ ; level change after IV APAP  $\beta_2=-0.07$   $P<0.001$ ) (Figure). There was no significant difference between groups for total opioid dose. However, in-hospital average (no APAP=4.8 vs. PO=4.0 vs. IV=3.9,  $P=0.04$ ) and maximum pain scores (no APAP=6.6 vs. PO=5.6 vs. IV=5.4,  $P=0.02$ ) were higher in the no APAP group, while PO and IV APAP groups performed similarly for average and maximum postoperative pain scores.

**Conclusion:** For postoperative pain and opioid consumption, IV APAP is not superior to PO APAP. Pre-operative PO APAP may be a preferable first-dose route in scheduled cesarean deliveries compared to IV APAP, based on cost differences. However, further studies are needed to identify if IV APAP is advantageous in women prone to intraoperative nausea or vomiting.

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**A Retrospective study to evaluate the effect of anaesthesia technique on foeto maternal safety among women with cord prolapse undergoing category one cesarean section**

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**Introduction:** The overall incidence of cord prolapse ranges from 0.1-0.6%.Cord prolapse is one of the few instances of obstetric emergencies which call upon the efficiency of the obstetrician and anaesthesiologist as a team.

**Methodology:** we retrospectively performed the study on 73 parturients who delivered between 2012 to 2019 by category one cesarean section for cord prolapse.The exclusion criteria included antepartum haemorrhage, suspected uterine rupture, failed instrumental delivery and multiple gestations, gestational age< then 34 weeks, foetus with morphological or chromosomal abnormality.Outcomes were compared for neonates born following category 1 cesarean section under general anaesthesia(GA)with neonates born under spinal(SA) and epidural anaesthesia(EA) for the following:The decision to delivery(DDI) and anaesthesia to delivery interval, Apgar scores at 1 and 5 minutes, umbilical cord ph, NICU admissions.For normally distributed quantitative parameters the mean values were compared using independent sample t test( 2 groups) or ANOVA( >2 groups).Categorical outcomes were compared using chi square test/ Fischer exact test.A subgroup analysis for FHR less than 100 was also done to study the influence of FHR on type of anaesthesia administered.P value of < 0.05 was considered statistically significant.

**Results:** The mean maternal age and BMI were comparable in 3 groups. The median Apgar score in 5th minute were 6 in GA, 8 in SA, 8 in EA. Mean arterial cord ph in group GA was  $7.1 \pm 0.09$ ,  $7.18 \pm 0.1$  in SA,  $7.13 \pm 0.09$  in EA with P value 0.004. 8 out of 35 neonates needed NICU admissions and only 2 in SA.The mean DDI was  $10.4 \pm 2.64$  minutes in GA group,  $12.69 \pm 3.88$  minutes in SA,  $7.17 \pm 1.6$  minutes in EA with p value 0.001.The anaesthesia to delivery time was  $5.66 \pm 2.48$  in GA,  $6.81 \pm 2.57$  in SA group,  $4.67 \pm 1.21$  in EA group with p value of 0.06.The odds of FHR < 100 was 2.889 times more in GA group when compared to EA anaesthesia (95%CI 0.492 to 16.97) but p >0.05.This concludes that GA in our study was not specifically chosen because the foetal heart rate was < 100.

**Discussion:** A retrospective cohort study was performed by Beckmann et al<sup>1</sup> on 533 neonates born by emergency cesarean section.They have observed that arterial cord ph was significantly higher in regional anaesthesia group, Apgar score less than 7 in GA group, more admissions in NICU in GA group. DDI was 8 times faster in GA group.In our study the DDI is as fast for a top of epidural catheter as for GA.

**Conclusion:** To conclude in a parturient with high risk of cord prolapse like multiparity, breech presentation, unstable or transverse lie, polyhydramnios or while doing artificial rupture of membranes with high presenting part, should have a functioning epidural catheter inserted early in labour in anticipation of possible emergency cesarean section.

**References:** 1.Beckmann M,Calderbank S.Mode of anaesthetic for category 1 cesarean section and neonatal outcomes.Aust N Z J Obstet Gynaecol 2012;52:316-20



Parameter	General anesthesia (N=35)	Spinal anesthesia (N=32)	Epidural anesthesia (N=6)	P value
Age(yrs)	27.66 ± 5.13	30.34 ± 5.23	29.83 ± 3.76	0.097
BMI	26.65 ± 5.66	28.48 ± 5.19	27.12 ± 5.54	0.387
Cord pH (Arterial)	7.1 ± 0.09	7.18 ± 0.1	7.13 ± 0.09	0.004
Anesthesia to Delivery interval (min)	5.66 ± 2.48	6.81 ± 2.57	4.67 ± 1.21	0.060
Decision to delivery interval(min)	10.4 ± 2.64	12.69 ± 3.88	7.17 ± 1.6	<0.001
Apgar( 5 Min)	6	8	8	
NICU admissions	8 (22.86%)	2 (6.25%)	0 (0%)	



## Impact of Post Anesthesia Position on Post Spinal Hemodynamic Variables in Elective Cesarean Sections

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**Presenting Author's Institution:** UTMB, Galveston

**Co-Author:** Govindaraj Ranganathan, MD; Amir Jafari, DO; Partha Krishnamurthy, PhD, MBA; Rakesh Vadhera, MD; Rovnat Babazade, MD

**Background:** Patients in elective Cesarean section(CS) are given hyperbaric local anesthetic and will then lie in supine position(REF). It is common to have disturbances to hemodynamic(HD) after spinal. We propose this is because drug is in dependent area in supine position, both sides of sympathetic system is likely affected. We hypothesize if patient lie in right or left lateral position after spinal, drop in HD will be less as effect of spinal will be limited to one side. We hypothesize supine(SU) position will have highest disturbances to HD.

**Method:** With approval of University of Texas Medical Branch Institutional Review Board (IRB # 16-0119), forty patients for elective CS were included in randomized trial where the post spinal position was varied as SU,RL,LL. We monitored five HD parameters, cardiac output(CO), stroke volume(SV), systolic and diastolic blood pressure(SBP&DBP) and systemic vascular resistance (SVR). HD variables were assessed continuously. To assess impact of position, we measured values of HD for three time periods 1) admission on OR to time of spinal(Spinal), 2) time of spinal to 120 seconds post spinal(Spinal120) and 3) time of spinal to 300 seconds post spinal(Spinal300). Analytic Framework: Effect of position on HD was assessed using 3Position(SU, RL, LL) x 3Time (Spinal, Spinal120, Spinal300). The effect of interest was effect with each position from Spinal to Spinal300.

**Results:** The results are presented in Table 1. The simple main effects for the contrast between Spinal and Spinal300 are presented in Table 2. Figures 1 through 5 represent the mean for CO, SV, SBP, DBP and SVR.

Cardiac Output: We found significant effect of time on CO,  $p=0.0139$ ; the mean values for spinal, spinal 120, and spinal300 were 6.08, 6.325, and 6.689. The simple main contrast between Spinal and Spinal300 suggested that increase in CO was most pronounced in RL position ( $p<0.0001$ , see Table 2 and Figure 1)

Stroke Volume: We found a significant effect of time on SV,  $p=0.0064$ ; the mean values for spinal, spinal 120, and spinal300 were 66.9326, 69.2575, and 72.6399. We observed a marginally significant time  $\times$  position interaction,  $p=0.0529$ . The simple main contrast between Spinal and Spinal300 suggested that the increase in SV was most pronounced in RL ( $p<0.0002$ , see Table 2 and Figure 2).

Blood Pressure: No significant effect of either time or position or time  $\times$  position was seen for BP (see Figures 3 and 4).

Systemic Vascular Resistance: We observed significant effect of time for SVR,  $p=0.0114$ ; the pattern of means suggested SVR decreased over time from spinal to spinal120 to spinal300, 1305.37, 1280.91, 1137.00. Although we did not observe a significant time  $\times$  position effect, the decrease in SVR was most pronounced in the RL ( $p<0.0072$ , see Table 2 and Figure 5).

**Discussion:** In this study sample, RL position appears to increase both CO, SV and SVR, but did not confer any advantages in DBP, SBP or HR. The small sample size is chief limitation in the study.



## Validation of a Portuguese version of the Obstetric Quality of Recovery-10 (ObsQoR-10) instrument

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**Background:** ObsQoR-10 is an obstetric quality of recovery scoring tool, which was developed and validated in the UK and US populations.<sup>1-2</sup> We aimed to evaluate the validity, reliability and feasibility of a Portuguese version of this scoring tool, ObsQoR-10 (Port), following elective cesarean delivery (CD).

**Methods:** The English version of ObsQoR-10 was translated (2 native bilingual Portuguese speakers) and back-translated (2 native bilingual English speakers). Following IRB approval, ObsQoR-10 (Port) was completed by postpartum women, 24 h after elective CD in a large Brazilian (>10, 000 deliveries per annum) tertiary center. Validity was assessed by: Convergent validity (spearman correlation of ObsQoR-10 (Port) with the EQ5D global health VAS (GHVAS; 0-100) score and EQ5D total score) and discriminant validity (correlation with good vs. poor recovery (VAS of  $\geq 70$  vs.  $< 70$  mm, respectively). Reliability was assessed by: Cronbach's alpha, inter-item correlation, split-half reliability, test-retest correlation and floor and ceiling effects. Feasibility was tested by completion and recruitment rate.

**Results:** One hundred thirteen women completed ObsQoR-10 (Port) at 24 h and 29 repeated the survey at 25 h. ObsQoR-10 (Port) correlated moderately with GHVAS ( $r = 0.568$  [95% CI 0.421 to 0.689],  $P < 0.001$ ) and EQ5D ( $r = -0.587$  [95% CI -0.705 to -0.453],  $p < 0.001$ ); discriminated well between good (VAS  $\geq 70$ ) vs. poor (VAS  $< 70$ ) recovery (84.1 (95% CI 81.8-86.4) vs. 69.9 (95% CI 64.6-75.1); difference 14.2 (95% CI 8.3-20.1,  $p < 0.001$ ). There was a weak correlation with ObsQoR-10 (Port) score and increasing gestational age ( $r = 0.191$ ,  $p = 0.043$ ). Cronbach's alpha was 0.819 and inter-item correlation was 0.311 indicating good internal consistency. Split half reliability using Spearman-Brown Prophecy Reliability Estimate was 0.804 (very good). Floor or ceiling effects were demonstrable in 1.8%. ObsQoR-10 (Port) was repeated and completed in 24.8% of women. Test re-test reliability and repeatability was excellent with intra-class correlation coefficient of 0.87 (95% CI 0.71-0.94). No women declined to respond.

**Conclusions:** ObsQoR-10 (Port) performed well in measures of validity, reliability and feasibility. ObsQoR-10 (Port) appears to be a tool that can assess quality of recovery following CD in the Brazilian, Portuguese speaking population. Further work is needed to determine minimal important change values, differences in ObsQoR-10 scores between countries and its impact on outpatient recovery outcomes.

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## Effect of Prophylactic Phenylephrine versus Noradrenaline Infusions on Funic Gases in Healthy Women for Elective Low Risk Caesarean Delivery: A Randomized, Double-Blind Trial

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**Co-Author:** Nitika Goel, MBBS, MD; Kajal Jain, MBBS, MD; Aashima Arora, n/a; Praveen Kumar

**Background:** Phenylephrine (PE) has been recognized as the vasopressor of choice to manage maternal spinal hypotension as it is associated with good maternal (no nausea, vomiting) and neonatal outcomes (higher umbilical arterial (UA) pH). However, due to its potential to cause bradycardia, and a consequential fall in cardiac output, current data has proven superiority of noradrenaline (NA) as alternative vasopressor, in obstetric setting. Nonetheless, the effect of NA on funic gases and neonatal outcome merits further research in healthy women undergoing low-risk elective caesarean delivery (CD).

**Methodology:** After obtaining ethical clearance and approval from Clinical Trials Registry - India, 100 healthy, term pregnant females scheduled for elective caesarean delivery were randomized to receive prophylactic infusions of either PE 100 mcg/min or NA 4.2 mcg/min. Rescue boluses of PE 50 mcg/ml and NA 5 mcg/ml, respectively, were given as required, to maintain baseline blood pressure.

Primary outcome: UA base deficit

Secondary outcomes: UA pH, PaO<sub>2</sub>, PaCO<sub>2</sub>, Apgar scores, maternal hemodynamic parameters, and intraoperative nausea and vomiting

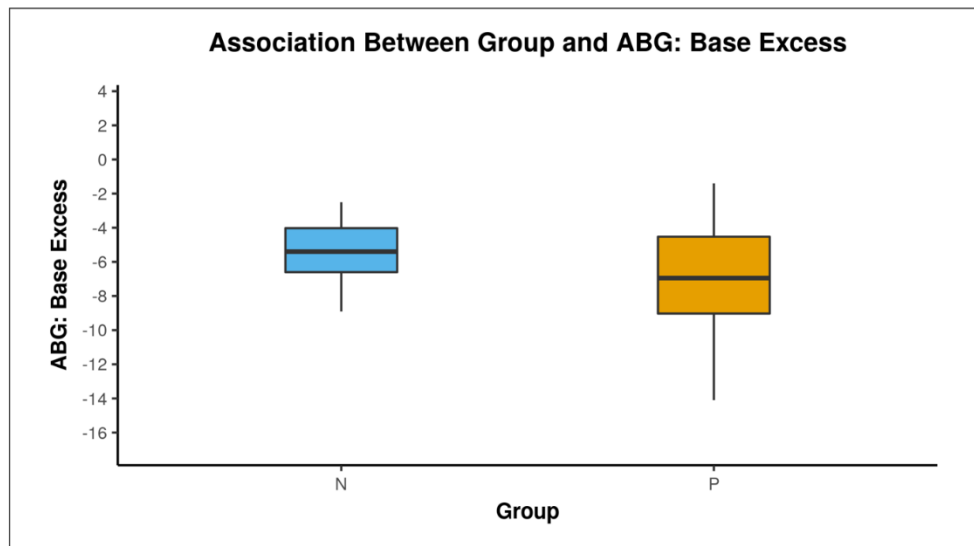
**Results:** Median UA base deficit was significantly lower in NA group, as compared to PE group (5.4 (4.03 - 6.6) vs. 6.95 (4.53 - 9.02),  $p = 0.014$ ). Other UA blood gas parameters and Apgar scores were comparable. Minimum heart rate was significantly lower in PE group ( $58.88 \pm 6.93$  vs.  $72.90 \pm 10.77$ ,  $p < 0.001$ ). The proportion of participants requiring rescue boluses was similar in both groups. Incidence of reactive hypertension requiring dose reduction was higher in PE group (22% vs. 2%,  $p = 0.008$ ). The total number of physician interventions required to manage episodes of bradycardia, hypotension and reactive hypertension were significantly higher in PE group than in NA group (52% vs. 30%,  $p = 0.025$ ). There was no difference in the incidence of intraoperative nausea and vomiting between the two groups.

**Conclusion:** The study suggests that both PE and NA are equally effective in maintaining maternal blood pressure in low-risk CD. However, NA infusion is associated with a superior control and maintains better fetal funic gases.

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**Fig 1. Box-and-Whisker plot depicting the distribution of umbilical cord blood base excess in both the groups.**



## **Reducing Cesarean Section Surgical Site Infections: Multidisciplinary Implementation of a Novel Bundle within an Integrated Health Care System**

**Presenting Author:** Eric Hunt, MD, PhD

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**Co-Author::** Neeru Gupta, MD; Frederick Cabasa, n/a; Franklin Keathley, RN, MBA

**Abstract :** Surgical site infection (SSI) is the most common complication of surgery in the US, and of the surgeries in women, cesarean delivery is the most performed operation. Preventing these infections is critical in reducing maternal morbidity, associated costs, and enhancing patient care experience. In 2018, a multidisciplinary leadership team launched an evidence-based patient care bundle directed at decreasing Cesarean Delivery SSIs across 15 hospitals within an integrated health system to address rising SSI rates. Development of resources, agreements in practice changes, supporting order sets, and implementation required multidisciplinary collaboration. We developed a toolkit, including educational materials, implementation guides, and a data site to monitor bundle implementation using a Tableau dashboard. SSI teams were established at each hospital to partner with the leadership team and lead local facilities to adopt the bundle.

In 2019, the SSI bundle was implemented across all Cesarean deliveries, excluding only emergency surgeries. The bundle elements included: reinforcing sterile technique, skin preparation with CHG wipes and chlorhexidine prep, weight-based antibiotic administration and redosing, hyperglycemic control in diabetics, as well as new practices including vaginal preparation, maintaining normothermia, and azithromycin administration. The composite of all (Superficial, Deep and Organ Space) Cesarean Delivery SSI Standardized Infection Ratio (SIR) of our 15 hospitals was reduced from an average of 2.32 during Jan 2017 to Oct 2018 to 1.045 ( $p < 0.0001$ ) in the same time frame of 2019-2020. Similarly, the Complex SIR was also reduced, from 3.098 to 1.030 ( $p < 0.0001$ ) during these times. Since implementation, medical centers continue to see a reduction in their Cesarean delivery SIR. This data supports the conclusion that this SSI bundle reduces surgical site infections in cesarean deliveries. The strategic process used is a model that can be translated to other performance improvement projects.

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## **Association Between Unscheduled Procedure and Poor Postpartum Recovery in Cesarean Delivery Patients: A prospective observational cohort study**

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**Introduction:** Measuring patient-oriented outcomes and satisfaction is important to guide meaningful changes in obstetric anesthesia care. Starting in June 2020, we implemented the obstetric-specific quality of recovery survey at 24 hours after cesarean delivery (24h OBsQoR-11).<sup>1</sup> The survey was administered in conjunction with our regular postpartum follow-up visits to understand factors affecting quality of recovery. We hypothesized that unscheduled procedures would be associated with lower QoR-11 scores.

**Methods:** Institutional ethical approval was waived for this quality improvement study. All women who underwent cesarean deliveries between June 1, 2020, and July 31, 2020 were prospectively followed up, and completed the 24h OBsQoR-11 survey. As part of our standard postpartum follow-up visit, we recorded information on the urgency of the procedure, mode of anesthetic and the number of anesthesia-related adverse events encountered during the patient's hospital stay. Adverse events were defined a priori and classified under one of 8 major categories (i.e. ICU admission, blood transfusion, failed neuraxial block, conversion to general anesthesia, accidental dural puncture, postdural puncture headache, neurologic complications, other anesthetic complications). The primary outcome of poor quality of recovery was defined by a 24h OBsQoR-11 score  $\leq 64$ .<sup>2</sup> The association between urgency of procedure and poor quality of recovery was examined in a multivariable logistic regression model adjusting for Global Health Status score,<sup>1</sup> and number of anesthesia-related adverse events. Mean OBsQoR-11 scores were compared using Welch's t test.

**Results:** A total of 300 patients completed the survey (n=96 scheduled, and n=204 unscheduled). The mean 24h OBsQoR-11 score was significantly lower in patients who had unscheduled surgeries (87.0 vs. 76.7,  $p < 0.0001$ ). Having an unscheduled procedure was significantly associated with higher odds of poor quality of recovery (aOR 4.3, 95%CI 1.9,11.1,  $p=0.0011$ ) with 53/204 (25.9%) unscheduled, and 0/96 (0%) scheduled patients having 24h OBsQoR-11 score  $\leq 64$ . (Fig 1)

**Discussion:** Having an unscheduled cesarean delivery significantly increased the odds of having poor quality of recovery postpartum. Since one in four patients having an unscheduled cesarean experienced poor recovery at 24 hours, further investigations are needed to identify factors influencing this relationship. Our findings suggest greater resources and attention need to be allocated to patients undergoing unscheduled cesarean deliveries, possibly with an Enhanced Recovery After Surgery protocol designed specifically for this patient population.

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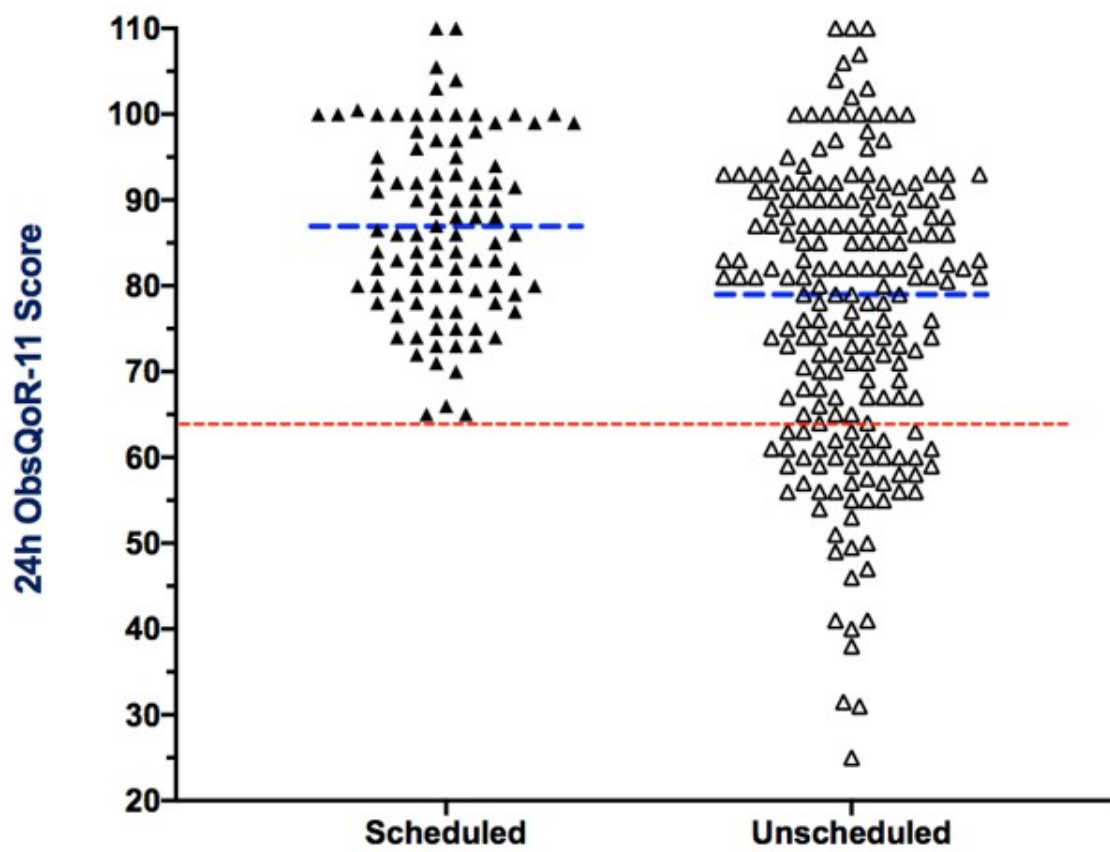


Fig 1. Distribution of 24h OBsQoR-11 scores between scheduled vs. unscheduled cases. Blue dotted lines represent mean, red dotted line represents primary outcome threshold (OBsQoR-11 Score  $\leq 64$ ).



## **Quality Improvement Survey Study of Obstetric Anesthesia Personnel with STAT C-Section Kit and Its Use in Preventing Inappropriate Practices When Preparing Medications**

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**Background:** When obstetric emergencies occur, they require fast action by the obstetric anesthesiologists and trainees. Particularly for emergency STAT cesarean sections, one major concern is the quick preparation and availability of common medications as delays can have negative consequences on both the mother's and fetal health. The necessity for speed has led to the practice of drawing up commonly used medications ahead of time, which has the potential to create unnecessary medication waste. Additionally, it can put patients at harm for infection by increasing the likelihood of administering expired medication. For this reason, a multidisciplinary team of obstetric anesthesiologists and pharmacists devised a STAT c-section kit, a sealed box that contains the most commonly used medications for c-sections (including lidocaine 2%, chloroprocaine 3%, ephedrine, phenylephrine syringes, and propofol succinylcholine needles and syringes), to be opened upon notification of a STAT c-section. The goal of this quality improvement project was to assess the attitudes and practices of anesthesia providers on the preparation and readiness of common medications used during emergency c-sections. The study also assessed their knowledge and views on the STAT c-section kit.

**Methods:** Obstetric anesthesiologists, anesthetic fellows, and resident trainees in the anesthesiology department took questionnaire surveys on their practices when preparing medications for STAT c-sections, and their knowledge on the expiration period of medications and contents/location of the STAT c-section kit in the labor ward theater supply area. They were asked whether they found the kit useful, if they would change their current practices, and if it would benefit patient care.

**Results:** Of 37 responses, 63% stated they prepare medications before emergencies are known and 22% said they prepare medications at the beginning of their shifts. Only 46% correctly identified the expiration time of medication once drawn up - 1 hour as recommended by the Joint Commission. 86% were correctly able to identify all medications/supplies in the STAT c-section kit. 89% found the STAT c-section kit beneficial and 86% believed its use could directly benefit patient care in the OB areas.

**Conclusion:** The survey indicates that STAT c-section kits, when implemented on an institutional level, have the potential benefit of changing provider practices when drawing up and preparing emergency medication. Additionally, it has the potential to save medication waste costs and encourage safer practices to prevent infections when administering iv and intrathecal medications.







## Obstetric Anesthesia Workload and Facility Utilization of SOAP Centers of Excellence Designated Institutions

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**Introduction:** SOAP Centers of Excellence (COE) for Obstetric Anesthesia Care is a designation recognizing institutions that demonstrate excellence in all obstetric anesthesia (OBA) care domains. We surveyed facility and staffing models at United States COEs to evaluate OBA workload and facility use, and to compare OBA staffing ratios in academic (AC) and non-academic (NA) centers.

**Methods:** An online survey instrument (RedCap) was sent by email (1 initial and 2 reminders) to 53 SOAP COE OBA leaders. Survey data included number of deliveries, cesarean delivery (CD) rate, neuraxial labor analgesia rate, number of labor and operating rooms (ORs), and number of in-house and backup providers. OBA activity was estimated using a time-based workload ratio during weekday, weeknight, and weekend shifts (1,2). To calculate the time-based work ratio, the number of cesarean deliveries and neuraxial labor analgesia were multiplied by the time associated with the procedures. Staffing ratios were compared between AC and NA centers. OR and labor room utilization rates were also calculated.

**Results:** There were 51 of 53 surveys returned (96% response rate). Data from 33 AC and 14 NA institutions were analyzed; 4 non-United States COE were excluded in this study. The time-based workload ratio per hour of provider coverage is outlined in Table 1. Attending-only workload ratios were similar between AC and NA centers, but these ratios were significantly lower when staffing included trainees and CRNAs. Workload ratios did not differ between the centers reporting adequate and inadequate staffing coverage. Although operating and labor room utilization correlated with annual number of CDs and vaginal deliveries ( $R^2 = 0.24$  and  $0.48$ , respectively; Fig 1), there was significant variability in space resources across delivery volumes.

**Discussion:** The results outline staffing, workload ratios and facility utilization at SOAP COEs in the United States. Staffing, physical space, and workload are correlated, but resources are highly variable across institutions. These data can be used to help institutions determine staffing needs for both AC and NA OBA practices. Further analyses are required to determine optimal workload ratios, attending and trainee staffing numbers, and OR and labor room requirements.

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## **Obstetric and anesthetic management of deliveries in women with a Fontan circulation: single centre experience and trends in practice over the past 21 years**

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**Abstract :** The Fontan procedure is undertaken in children with a single functional ventricle. In a staged fashion over childhood the systemic venous return is routed to the pulmonary arteries without the interposition of a ventricle(1). Currently the estimated 20-year survival of these patients is 61% to 85%(2). Improvements in care means that survival rates are predicted to further improve. Obstetric anesthesiologists will increasingly be involved in the management of these women. The limitations of the Fontan circulation means that the physiological burdens of pregnancy can pose a significant health risk to these women. We sought to examine the anesthetic management and complications suffered by these women during delivery.

**Methods:** Following REB approval, we reviewed the medical records of women with Fontan circulation who delivered at our institution, from 2000 to 2020. We extracted data related to co-morbidities, underlying cardiac functional status, anesthetic management, mode of delivery and peripartum complications.

**Results:** Over 21 years there were a total of 28 deliveries to 20 women; 20 of these deliveries occurred since 2010. There were no deaths. One woman had three deliveries over 15 years and there was one twin delivery. The functional status of these women pre-pregnancy was good. The average maternal age at delivery was 27.7 years. The average gestational age at delivery was 34 weeks. 19 deliveries were vaginal and 9 were cesarean deliveries. 16 of the vaginal deliveries had epidural analgesia. Of the 9 deliveries by cesarean delivery 6 had epidural anesthesia, 1 spinal anesthesia, 1 combined spinal-epidural and 1 continuous spinal anesthesia. Central line insertion for delivery was not performed after 2004. After 2012, 75% of eligible vaginal deliveries did not have arterial lines. Postpartum care on the obstetric floor as opposed to CCU also became more common (74%) after 2006. Complications were frequent, particularly arrhythmias (18%), with just 10 of 28 deliveries having no recorded complications.

**Discussion:** This is the largest published case series describing the anesthetic management of women with Fontan circulation. It is noteworthy that 20 of these deliveries occurred since 2010. Reassuringly there were no deaths in our series. Increasing familiarity in managing these complex patients is reflected in the trend of reduced invasive hemodynamic monitoring use and postpartum care on the obstetric floor. However we should not be complacent as complications were frequent, particularly arrhythmias. Multi-disciplinary care is the hidden narrative underpinning the care provided to these women.

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## Association between Diastolic Function Parameters and Obstructive Sleep Apnea in Morbidly Obese Pregnant Women

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**Background:** Obesity and obstructive sleep apnea (OSA) are independent risk factors for maternal morbidity and mortality, including long-term cardiovascular morbidity.<sup>1,2</sup> While a few small studies have evaluated prevalence of left ventricular diastolic dysfunction (DD) in morbidly obese pregnant women,<sup>2,3</sup> data regarding the impact of OSA on diastolic function in morbidly obese pregnant women are lacking. The clinical assessment of DD is uncommon in this setting, and its clinical significance remains unclear. We hypothesized that presence of OSA in pregnant women with morbid obesity is not associated with worse left ventricular diastolic function parameters.

**Methods:** After IRB approval, we conducted a retrospective matched case-control study of diastolic function in pregnancy. Fifteen women with morbid obesity and OSA with TTEs performed during pregnancy were identified; each was matched to a healthy pregnant control with morbid obesity but without OSA, matched on age  $\pm$  7yrs, BMI  $\pm$  7kg/m<sup>2</sup>, race, ethnicity, and gestational age at time of TTE  $\pm$  5 weeks. TTEs were read by two blinded investigators (OID, SJ). Inter-rater and intra-rater variability were verified by examining intra-class correlation coefficients for each parameter based on 16% of the TTE measurements made by each reader. All diastolic parameters were reviewed; primary end points were lateral/septal/average  $e'$  and  $E/e'$ . Each diastolic parameter was summarized as median and interquartile range (IQR) and compared between matched groups using a Wilcoxon rank sum test. A p-value less than 0.05 was considered statistically significant and no adjustment was made for multiple comparisons.

**Results:** Diastolic function in morbidly obese pregnant women with OSA was not significantly reduced compared to matched controls. There was no significant difference in any diastolic function parameter between OSA cases and non-OSA controls: lateral tissue Doppler index  $E/e'$  (7.4 v. 8.0,  $p=0.7$ ), septal tissue Doppler index  $E/e'$  (8.6 v. 8.7,  $p=0.8$ ), average tissue Doppler index  $E/e'$  (8.4 v. 8.5,  $p=0.6$ ) (Figure 1). Similarly, there was no significant between-group difference in lateral  $e'$  (11.3 v. 10.6 cm·second<sup>-1</sup>,  $p=0.9$ ), septal  $e'$  (9.0 v. 9.2 cm·second<sup>-1</sup>,  $p=0.8$ ), and average  $e'$  (9.8 v. 9.7 cm·second<sup>-1</sup>,  $p=0.1$ ). Mitral valve E/A ratio was 1.34 v. 1.37 ( $p=0.6$ ) and deceleration time 160 v. 180 msec ( $p=0.17$ ).

**Conclusion:** Presence of OSA in morbidly obese pregnant women was not associated with parameters of DD. As prevalence of both morbid obesity and OSA among women in the US is on the rise, and each entity alone has been found to be associated with maternal cardiac morbidities, further studies are needed to establish the impact of OSA on cardiovascular health of pregnant women.

Additional authors: Svati Shah, Madhav Swaminathan

### References:

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- Buddeberg BS, et al. Ultrasound Obstet Gynecol 2019;54:344-9.



## **Association of Medicaid Expansion with the Provision of Neuraxial Labor Analgesia: A Retrospective Cross-sectional Analysis**

**Presenting Author:** Maggie Z. Xiao, BSc

**Presenting Author's Institution:** Faculty of Medicine, University of Alberta

**Co-Author:** Dylan Whitney, BASc; Nan Guo, PhD; Eric C. Sun, MD, PhD; Cynthia Wong, MD; Alexander J. Butwick, MBBS, FRCA, MS

**Objective:** The Affordable Care Act (ACA) has been associated with increased Medicaid coverage for childbirth [1] among low-income U.S. women. We sought to determine the association of the ACA Medicaid expansion with the use of labor neuraxial analgesia.

**Design, Setting, and Participants:** Cross-sectional analysis of U.S. women who underwent vaginal delivery or intrapartum cesarean delivery, identified from birth certificate data between January 1, 2009, through December 31, 2017. The analysis was limited to 11,207,497 singleton live births in 25 U.S. states that adopted the 2003 Revised U.S. Birth Certificate (which has data on payment source). We performed a complete case analysis, excluding women who had an out-of-hospital delivery, cesarean delivery without prior trial of labor, or missing data for preselected confounders. The highest percent for missingness among all covariates was 1.3% for race.

**Main Outcomes and Measures:** We used difference-in-difference linear probability models to compare changes in the prevalence of neuraxial labor analgesia in 15 expansion and 10 non-expansion states before (2009-13) and after (2015-17) Medicaid expansion. Models were adjusted for potential maternal and obstetric confounders, with standard errors clustered at the state level. Secondary analyses were performed in women with no history of prior live birth and women with no more than a high school education.

**Results:** The study sample included 5,703,371 births from 15 expansion states and 5,504,126 from 10 non-expansion states. In the pre-ACA period, the overall rate of neuraxial analgesia in expansion and non-expansion states was (73.24% vs 76.52%). Compared with the pre-ACA period, the rate of neuraxial analgesia increased in the post-ACA period by 1.8% in expansion states and 0.9% in non-expansion states. In the adjusted analysis, the rate of neuraxial analgesia increased by 0.7% [95% CI: -0.5 - 1.8],  $P=0.23$ ) in expansion versus non-expansion states. Findings were similar in the subgroup of women with no more than a high school education (+0.9% [95% CI: -0.4 - 2.2],  $P=0.17$ ). However, there was a small but significant 1.6% increase in the rate of neuraxial labor analgesia among nulliparous women in expansion states compared with non-expansion states (95% CI: 0.3 - 3.0,  $P=0.02$ ).

**Conclusion:** ACA expansion was associated with a very small and statistically insignificant increase in the rate of neuraxial labor analgesia in expansion states. Increasing Medicaid eligibility alone may be insufficient to increase the rate of neuraxial labor analgesia.

**References:** (1) Clapp, MA. Obstet Gynecol 2019; 134: 1066-74.



## Anesthetic Management of Parturients with Vascular Malformations

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**Co-Author:** Sharon C. Reale, MD; Jean M. Carabuena, M.D.; Michaela K. Farber, MD, MS

**Background:** Vascular malformations (VMs) in the parturient present unique challenges to the anesthesiologist. To date, there is a paucity of reported obstetric or anesthetic outcomes in women with known VMs or VM-associated syndromes.<sup>1-4</sup> The safety of neuraxial anesthesia in parturients with VMs is uncertain and there is no consensus on anesthetic management. We report the anesthetic management and obstetric outcomes of parturients with VMs at a large tertiary center.

**Methods:** A retrospective analysis was performed of women evaluated in our high-risk obstetric anesthesia clinic for known VMs or known syndromes associated with VMs between 2007 and 2020. Patient demographics, obstetric history, vascular anomaly history, cerebrospinal imaging, radiologic studies, anesthetic management, maternal outcomes, and complications were recorded.

**Results:** 27 deliveries among 18 women with intracranial (IC) VMs or VM-associated syndromes (Blue rubber bleb nevus, Klippel-Trenaunay, Hereditary hemorrhagic telangiectasia, Glomuvenous, and Kasabach-Merritt) were identified (Table). Neuraxial lesions, pregnancy related-VM enlargement, VM associated bleeding, and peripartum complications are described. Pre-delivery imaging was performed in 83.3% of patients. The Cesarean delivery rate was 78% (42.9% of these for VM-related concerns withValsalva in labor). Labor was avoided in patients with elevated intracranial pressure or a history of intracranial bleeding from a VM. Conversely, labor was permitted in asymptomatic patients with small intracranial lesions from 2019 onward. Expansion of a labial VM precluded vaginal delivery in one patient. Neuraxial techniques were performed in 89% of deliveries. General anesthesia was utilized in 3 deliveries, twice for 1 patient with no available imaging and once for a patient with a known lumbar epidural VM. There were no anesthesia-related complications. The postpartum hemorrhage incidence was 11.1% and one patient had peripartum seizures.

**Conclusion:** To our knowledge, this is the largest case series describing the anesthetic management of parturients with VMs. Consideration of neuraxial VMs, coagulation status, and associated morbidity from elevated IC pressure or seizure disorders were predominant priorities for safe anesthetic management. Airway and gynecologic VMs also influenced anticipatory anesthesia and delivery planning. Consultation with neurology, neurosurgery, hematology, and pediatric VM experts in conjunction with imaging helped stratify risk for neuraxial techniques. With physiologic plasma volume expansion in pregnancy, growth of VMs in gestation must be considered as it can greatly impact anesthetic plans and mode of delivery. With appropriate planning and communication, anesthetic options can be safely maximized, and positive obstetric and anesthetic outcomes can be achieved.

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- 4Ochiai Case Rep Obstet Gynecol 2013



## **Uterine Exteriorization Versus In Situ Repair of Hysterotomy During Cesarean Delivery: A Systematic Review, Equivalence Meta-Analysis, and Trial Sequential Analysis**

**Presenting Author:** Adithya Bhat, MD

**Presenting Author's Institution:** Washington University in St. Louis School of Medicine

**Co-Author:** Danish Jaffer, MD; Paige Keasler, DO; Kiran Kamath, MD; Preet M. Singh, MD;

**Background:** Both exteriorized and in situ repair of uterine hysterotomy during cesarean delivery are widely practiced. Since 1978, 19 randomized controlled trials have been published in attempts to determine which technique results in decreased maternal morbidity. A 2015 meta-analysis<sup>1</sup> including 19,439 patients reported a statistically significant difference in blood loss after excluding an outlier study, but did not find significant differences in other primary outcomes. Since then, three more randomized control trials enrolling an additional 1,300 patients have been published. This meta-analysis and trial sequential analysis attempts to ascertain if statistical equivalence exists between the two techniques for relevant perioperative outcomes using the available body of evidence.

**Methods:** We searched ClinicalTrials.gov, MEDLINE, Embase, and the Cochrane Central Register of Controlled Trials for randomized control trials comparing the two surgical techniques. Primary outcomes were blood loss and surgical duration. Secondary outcomes were incidences of vomiting and hypotension.

**Results:** Nineteen studies including 20,751 patients were included in the final analysis; 10,386 patients were randomized to exteriorization, and 10,365 were randomized to in situ repair. There were no statistically significant differences in surgical duration (mean difference [MD], 1.12 minutes; 95% confidence interval [CI], -1.82 to 4.05), blood loss (MD, -27.34 ml; 95% CI, -81.31 to 26.63), intraoperative hypotension (odds ratio [OR], 1.42; 95% CI, .90 to 2.22) or vomiting (OR, 1.94; 95% CI, .69 to 1.28). Random effects modeling was used given significant heterogeneity for both primary outcomes ( $I^2 = 99.8\%$  for surgical duration and  $97.5\%$  for blood loss). Publication bias was unlikely (Egger's Test, X-intercept = 1.39,  $P = .79$ ). Trial sequential analysis confirmed statistical equivalence of the two techniques for surgical duration (information size 19,706; required > 7688) and futility of further studies for this outcome ( $\alpha = 5\%$ ,  $\beta = 15\%$ ,  $\delta = 5$  minutes).

**Conclusion:** No statistically significant differences were found between the techniques when analyzed for surgical duration, blood loss, vomiting and hypotension. Exteriorized uterine repair is equivalent to in situ repair when analyzed for surgical duration, and further studies are unlikely to demonstrate statistically significant differences between the techniques for this outcome.

### **References:**

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## Preventing Postpartum Hemorrhage After Cesarean Delivery: A Network Meta-Analysis of Available Pharmacologic Agents

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**Co-Author:** David Monks, MBChB; Preet M. Singh, MD; Adam Aslam, n/a; Arvind Palanisamy, MD FRCA;

**Background:** Postpartum hemorrhage (PPH) causes a quarter of global maternal deaths. The WHO recommends oxytocin as the first line agent to prevent PPH in cesarean deliveries (CD). (1) However, some randomized controlled trials (RCTs) suggest alternative agents to be superior. A previous network metanalysis (NMA) addressed this question but did not distinguish between surgical context (elective vs. intrapartum) or assess estimated blood loss (EBL) at CD. (2) We conducted an updated NMA comparing the effectiveness of available pharmacological agents in reducing blood loss and minimizing need for additional uterotonics at CD.

**Methods:** Our systematic review included RCTs that compared oxytocin, carbetocin, misoprostol, ergometrine, carboprost or combinations of these. Our primary outcomes were EBL and need for additional uterotonics. Secondary outcomes included PPH >500ml, PPH >1000ml, and nausea. We performed sensitivity analyses to explore the influence of surgical context and oxytocin administration strategy on comparative ranking of agents.

**Results:** A total of 99 studies (17978 participants) contributed data to our NMA. 22 trials (7 agents and 3865 participants) formed the EBL network, and the best ranking agent was "oxytocin + carbetocin" combined therapy. The probability rank order (and associated "surface under the accumulative ranking" [SUCRA] value) was oxytocin + carbetocin (0.79), carbetocin (0.69), misoprostol (0.59), oxytocin + ergometrine (0.53), oxytocin (0.33), ergometrine (0.32), and oxytocin + misoprostol (0.25). 38 trials (9 agents and 6393 participants) formed the "additional uterotonic" network and the probability rank order (SUCRA value) was oxytocin + carbetocin (1.00), carbetocin (0.84), oxytocin + misoprostol (0.64), oxytocin (0.54), oxytocin + ergometrine (0.53), misoprostol (0.42), carboprost (0.28) ergometrine (0.15), and placebo (0.11). A paucity of good quality data limited the ability to assess the influence of surgical context on EBL, although it had a minimal effect on the comparative need for additional uterotonics. For both primary outcomes, oxytocin administration strategies performed better if they were initiated with a bolus.

**Conclusion:** Carbetocin, alone or in combination with oxytocin, is the most effective agent in reducing blood loss and the need for additional uterotonics. When administered alone, oxytocin compared poorly with other agents with regards to these outcomes but is more effective when initiated with a slow bolus. Misoprostol, alone or combined with oxytocin, compared favorably given its relatively low cost and convenient storage and is an important therapeutic option in poorly resourced healthcare settings.

### References:

- 1) WHO recommendations: uterotonics for the prevention of postpartum haemorrhage. Geneva: World Health Organization; 2018.
- 2) Cochrane Database of Systematic Reviews 2018, Issue 12.



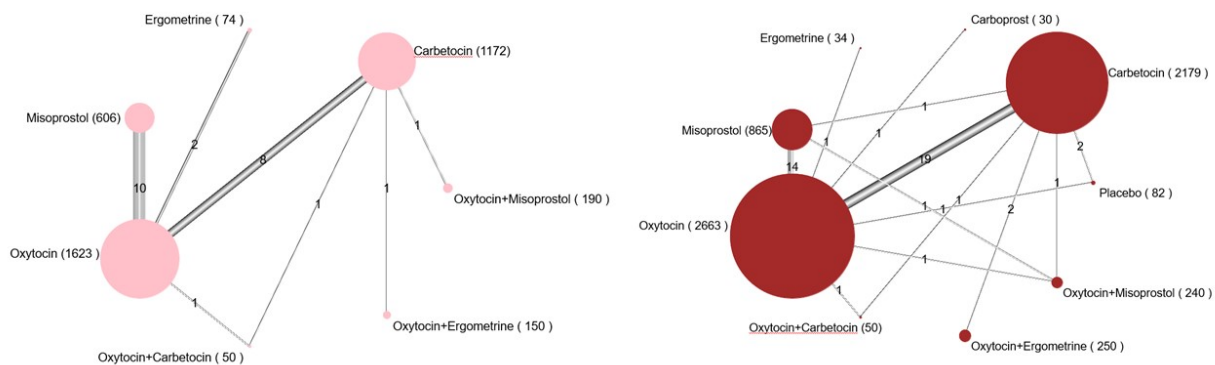


Figure 1: Network plots showing the network geometry for EBL (left) and need for additional uterotonics (right). Size of nodes corresponds to sample size of treatment group (reported in parenthesis). Lines connecting nodes show the number of trials comparing the nodes and is proportional to their thickness.



## The rate of maternal fever does not differ between women receiving continuous spinal versus continuous epidural labor analgesia

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**Presenting Author's Institution:** University of Chicago

**Co-Author:** David E. Arnolds, MD, PhD; Barbara Scavone, MD

**Background:** Labor epidural analgesia is associated with non-infectious maternal fever.<sup>1</sup> The mechanism is unknown, but potential etiologies include altered thermoregulation, lacking antipyretic effect of opioids, and inflammation.<sup>2</sup> Bupivacaine may have immunomodulatory effects or cause cell injury, and an inflammatory response that produces fever.<sup>3</sup> A continuous spinal provides effective analgesia with reduced local anesthetic dosage. If a dose-dependent inflammatory effect of bupivacaine mediates maternal fever, the rate of fever between women with epidural and spinal labor analgesia may differ. We compared rates of maternal fever between women with spinal versus epidural labor analgesia.

**Methods:** We retrospectively identified women who received continuous spinal labor analgesia between June 2012 and March 2020 using an obstetric anesthesia quality database. Patients receiving continuous spinal analgesia were matched to 2 patients with the nearest anesthesia start time and nulliparous status with epidural analgesia. We excluded those with no temperatures between anesthetic start and delivery, those with multiple catheter type, and cases of IUFD. The primary outcome was the incidence of maternal fever (temperature > 38C). We also collected data on gestational age, BMI, GBS status, labor induction, delivery mode, number of cervical exams in labor, diagnosis of chorioamnionitis, magnesium administration, antibiotics for chorioamnionitis or GBS, misoprostol or dinoprostone for induction, admission and rupture of membranes (ROM) to delivery time, analgesic duration, and local anesthetic dose (excluding patient controlled boluses).

**Results:** We identified 81 women who received continuous spinal analgesia with a temperature recorded between anesthetic start and delivery from August 2012 to March 2020. These were matched to 162 women with epidural labor analgesia. Demographic, obstetric, and analgesic information is described in the Table. Maternal fever was observed in 8/81 (9.9%; 95% CI: 5.1%-18.3%) women receiving continuous spinal analgesia and 18/162 (11.1%; 95% CI: 7.1%-16.9%) of women receiving epidural analgesia (p=0.83; Fisher's exact test).

**Discussion:** The incidence of maternal fever did not differ between groups despite different local anesthetic doses. While the route of administration and dose of bupivacaine differs between epidural and spinal labor analgesia, they are titrated to produce similar levels of neuraxial blockade. Our results are consistent with a model in which epidural related fever is due to altered thermoregulation and argue against a direct effect of bupivacaine, although we cannot rule out a concentration-independent effect of bupivacaine or an inflammatory effect of the catheter itself. These retrospective results highlight the importance of prospective and mechanistic study of neuraxial analgesia related maternal fever.

### References:

- 1: Morton: BJA 2021;122:500
- 2: Arendt: Clin Perinatol 2013;40:385
- 3: Sultan: Anesth Analg 2016;122:1546



	Spinal Analgesia	Epidural Analgesia
n	81	162
Nulliparous	35 (43%)	70 (43%)
Gestational age (completed weeks)	39 (37.5-40)	39 (38-40)
Preterm (<36 weeks)	10 (12%)	11 (6.8%)
BMI (kg/m <sup>2</sup> )	33 (28.25-42.5)	32 (27-36)*
GBS Status		
Negative	36 (44%)	84 (52%)
Positive	26 (32%)	43 (26.5%)
Unknown	19 (23.5%)	35 (21.6%)
Labor Induced	41 (51%)	66 (41%)
Mode of Delivery		
NSVD	60 (74%)	126 (78%)
OVD	4 (5%)	6 (4%)
Cesarean	17 (21%)	30 (19%)
Number of cervical exams	5 (3.25-7)	6 (4-7)
Chorioamnionitis	10 (12%)	16 (10%)
Mg <sup>++</sup> in labor	7 (8.6%)	14 (8.6%)
Antibiotics for GBS	28 (35%)	54 (33%)
Antibiotics for chorioamnionitis	10 (12%)	16 (10%)
Misoprostol or dinoprostone for induction	10 (12%)	11 (7%)
Admission-Delivery (hours)	16 (9-23)	16 (10-24)
ROM-Delivery (hours)	8.2 (3.1-15)	6.7 (3.2-13)
Anesthesia Start-Delivery (hours)	8 (5-13)	8 (5-14)
Bupivacaine (mg)*	57 (29-99)	9.75 (5.7-20.6)**

Data are presented as n(%) or median (IQR)

\* indicates p<0.05, Kruskal-Wallis test

\*\* indicates p<0.001, Kruskal-Wallis test

\* Bupivacaine exclusive of patient delivered boluses



## Racial and ethnic disparities in obstetric anesthesia: a review of the literature (2004-2021)

**Presenting Author:** Ruthi Landau, MD

**Presenting Author's Institution:** Columbia University Vagelos College of Physicians and Surgeons

**Co-Author:** Chloe E. Kern, B.S.

**Background:** Racial and ethnic disparities in the U.S. have become a healthcare emergency, with alarming differences in maternal mortality rates based on race reported by the CDC.[1] Evidence regarding racial/ethnic minority disparities specific to obstetric anesthesia care is emerging,[2] although actionable factors are yet to be identified.

We decided to review the literature reporting on racial/ethnic minority disparities in the setting of labor and delivery in the U.S., focusing on obstetric anesthesia-related practice. Our goal is to identify gaps in knowledge and raise awareness for future initiatives and projects.

**Methods:** We performed a PubMed search using the terms "racial/ethnic minorities", "healthcare disparities", "labor & delivery", "pregnancy", "epidural", "anesthesia", "general anesthesia", "labor analgesia", "cesarean delivery". We limited the review to publications on 'racial/ethnic disparities' related to neuraxial labor analgesia use or cesarean delivery anesthesia, and did not include articles reporting on maternal mortality, perinatal outcomes or postpartum issues. The search was repeated 3 times (last 2/1/2021).

**Results:** Our search yielded 20 papers reporting on obstetric anesthesia practice published between 2004-2021; there were 16 original papers and 4 review articles/editorials. Main findings from original research (Table 1) and reviews/editorials are reported (Table 2).

**Discussion:** This review allowed to identify the volume and content of obstetric anesthesia papers related to ethnic/racial disparities; we identified some trends in the publication agenda:

- (1) numerous papers on disparities in neuraxial labor analgesia use and failures (11 papers between 2004 and 2019)
- (2) recent papers on general anesthesia use for cesarean deliveries (3 papers between 2015 and 2020)
- (3) most recently, on postpartum pain and opioid prescriptions (2 papers in 2019)

That African American and Hispanic women have consistently lower anticipated and actual neuraxial labor analgesia use compared to non-Hispanic White women, and that African American women have 1.5-2-fold increased odds for general anesthesia for cesarean delivery is striking.

Implementing shared-decision making might help narrow the inequities in women's use of neuraxial labor analgesia and will contribute to reduce the odds of avoidable general anesthesia for cesarean delivery.[3] This includes using language-concordant, educational programs regarding labor analgesia and culturally tailored decision aids, in addition to routine prenatal education, to help reduce misconceptions about labor neuraxial utilization.

Evidence of such disparities in obstetric anesthesia adds to the well-documented and pervasive pattern of racial disparities in women's health care. Directions for future research should include exploring provider-mediated barriers to racially-conscious care.

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## Labor Epidural with Dural Puncture Reduces Catheter Replacement Rates when Compared to Epidural without Dural Puncture

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**Presenting Author's Institution:** Beth Israel Deaconess Medical Center

**Co-Author:** John J. Kowalczyk, M.D.; Yunping Li, M.D.; Philip E. Hess, MD

**Introduction:** A lumbar epidural catheter for labor analgesia can be placed with one of three techniques: directly (LEA), or as part of a combined spinal-epidural (CSE) or dural-puncture epidural (DPE). When used in clinical practice, studies suggest an epidural catheter may be more effective when placed using a CSE over LEA technique,<sup>1,2</sup> but robust evidence on the effect of DPE on replacement remains limited. We hypothesize that DPE is superior to LEA for successful labor epidural analgesia.

**Methods:** This retrospective study retrieved data from women who gave birth at a single center tertiary hospital between Jan 2018 and Dec 2020. We identified women who received labor analgesia using an epidural catheter. We excluded those who had a cesarean delivery without labor or had missing key data. We compared epidural catheter replacement rates among the three insertion techniques. Wilcoxon t-test, Chi-square, ANOVA and Cochran-Mantel-Haenszel tests were used. We performed a generalized linear model binomial regression to identify independent factors for catheter replacement.

**Results:** 11,582 women met inclusion criteria, including CSE=9,936 (85.8%), LEA= 1,157 (9.99%) and DPE=489 (4.22%). The DPE group had significantly more obese ( $p < 0.001$ ), nulliparous women ( $p=0.014$ ), and multiple gestations ( $p < 0.001$ ). Age, Height, and Gestational Age were not significantly different. Catheter replacement occurred in 8.6% LEA, 4.4% CSE, and 5.9% DPE techniques (see Table 1;  $p < 0.001$ ). Early replacement rates (replaced within 60 min) were similar between techniques, the higher late replacement rate occurred in catheters that were likely initially functional. Obesity (OR 1.7, 95%CI 1.4-2.0) and Nulliparity (OR 2.1, 95%CI 1.7-2.45) were significantly associated with catheter replacement. Replacement was also associated with cesarean, independent of obesity and nulliparity (OR 3.4, 95%CI 2.8-4.1). After controlling for obesity and nulliparity, replacement after DPE was less likely than after LEA (OR 0.63, 95%CI 0.4-0.97,  $p=0.04$ ). Multivariate regression identified BMI and Parity ( $p < 0.001$  for both) as significant risk factors for replacement. Compared with LEA, both CSE ( $p < 0.001$ ) and DPE ( $P=0.02$ ) were protective against replacement.

**Discussion:** We examined the impact of epidural catheter placement technique in a clinical practice and found that catheters placed using a CSE or DPE technique were less likely to be replaced when compared with LEA. Prior studies have attributed this to confirmation of midline through return of CSF after dural puncture. As we found no difference in early replacement rates, the lower late replacement may also represent medication translocation through the dural puncture, or likely a combination of both. In our cohort, one in 38 women would avoid a replacement procedure if all LEAs were performed as DPE or CSE.

### References:

- 1 Anesth Analg 2001;93:414-8
- 2 Int J Obstet Anesth 2004;13:227-33



## The Interaction of Programmed Intermittent Epidural Bolus Flow Rate and Time Interval on Labor Analgesia Quality: A Prospective, Randomized, Double-Blind Study of Three Pump Settings

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**Introduction:** During the initial implementation of a programmed intermittent epidural bolus (PIEB) at our institution, we used a flow rate of 500 mL/h and a bolus time interval of 60 min. There is evidence suggesting that the optimal PIEB interval of 45 min would lead to lower physician-administered supplemental bolus (PASB) for inadequate analgesia.[2] We hypothesized that a higher PIEB flow rate coupled with a shorter time interval would result in a greater incidence of high sensory blocks and a lower rate of PASB.

**Methods:** Upon patient consent, 360 healthy, term parturients in early labor (Cx  $\geq$  5 cm) were randomized to one of 3 PIEB flow rate/interval combinations: Groups A (500mL/hr, 60 min), B (500mL/h, 45min), or C (250 mL/h, 45min). Standardized epidural technique, loading dose (2 mL 2% lidocaine + 14 mL 0.1% bupivacaine + 35 mcg fentanyl), and maintenance solution (0.08% bupivacaine + 2 mcg/mL fentanyl) were used. Protocols were instituted for inadequate analgesia and high sensory blocks. Patients and providers were blinded to group allocations. The primary outcome was hourly rate of PASB adjusted for duration of epidural infusion analyzed using a negative binomial regression. Secondary outcomes included incidence of high sensory block ( $\geq$ T4), motor block ( $\geq$  Bromage 4), mean hourly bupivacaine consumption, the number of patient-controlled epidural analgesia (PCEA) bolus requests, and time to first physician intervention. All p-values were adjusted for multiple comparisons.

**Results:** The hourly rate of PASB was highest for group A and lowest for Group C but there was no significant difference between groups ( $p=0.12$ ). The rate of PASB per hour for group A = 0.17 (95%CI = 0.12, to 0.25), for group B = 0.11 (95%CI = 0.07, to 0.17), and for group C = 0.09 (95%CI = 0.05, to 0.14). The incident rate ratio (IRR) for group B compared to group A = 0.61 (95%CI = 0.26 to 1.41), while the IRR for group C compared to group A = 0.41 (95%CI = 0.17 to 0.97). There was no significant difference in any of the secondary outcomes.

**Discussion:** Using a shorter programmed intermittent epidural bolus (PIEB) time interval of 45 min did not result in significantly greater incidence of high sensory blocks compared to 60 min. Consistent with a prior study comparing PIEB flow rate of 300 mL/h vs. 100 mL/h [2], the use of a higher PIEB flow rate of 500 mL/h compared to 250 mL/h did not confer significant improvement on PASB or other markers of labor analgesia quality.

### References:

- Carvalho et al A&A 2016
- Lange et al Anesthesiology 2018



## Anesthetic Outcomes of the Dural Puncture Epidural Technique: A Retrospective Cohort Study

**Presenting Author:** Ayumi Maeda, MD

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**Introduction:** The dural puncture epidural (DPE) technique has been increasingly utilized to provide effective neuraxial labor analgesia.<sup>1</sup> To date, studies comparing the anesthetic outcomes of the DPE, combined spinal epidural CSE, and standard EPL techniques have been limited. We hypothesized that in large, high-risk cohort, the DPE technique would be associated with a decreased incidence of epidural catheter failure (ECF), when compared to the CSE or EPL techniques.

**Methods:** A retrospective analysis of all parturients receiving neuraxial labor analgesia at a large, urban teaching hospital between January 2015 to December 2020 was performed. Electronic medical records were abstracted for patient demographics, anesthetic, and obstetric outcomes. ECF was defined as a catheter requiring intrapartum replacement or an airway intervention during cesarean delivery. Logistic regression analysis was used to evaluate the association between each neuraxial technique and the odds of ECF, adjusting for potential confounders (age, BMI, parity, gestational age, multiple gestation, delivery year, back pathology, time from neuraxial placement to delivery and oxytocin augmentation).

**Results:** A total of 21,410 parturients received neuraxial labor analgesia: DPE 3,867 (18.1%), CSE 1,106 (5.2%), and EPL 16,437 (76.8%). The DPE group had higher BMI (median DPE 30, CSE 29, and EPL 28), greater back pathology prevalence (DPE 12.7%, CSE 9%, and EPL 7.4%), and longer skin-to-epidural-space distance (median 5.5cm vs 5cm in CSE/EPL). The DPE group was more likely to require 3 or more placement attempts (DPE 9.5%, CSE 0%, EPL 4.9%). The incidence and odds of ECF, inadvertent dural puncture (IDP) and PDPH requiring epidural blood patch (EBP) with each technique are shown in Table 1. The CSE group had the lowest incidence of ECF, IDP and duration from placement to delivery (DPE 6.9, CSE 3.7, and EPL 7 hrs). The incidence of PDPH requiring EBP was similar among the groups.

**Conclusion:** In our large cohort, the DPE technique was selected more frequently in parturients with higher BMI, greater back pathology, and longer skin-to-epidural-space distance; these features likely contributed to the DPE technique requiring more placement attempts than the other techniques. While the CSE technique was associated with the lowest epidural catheter failure rate, the duration from placement to delivery was significantly shorter, perhaps indicating more frequent use in parturients with advanced labor. Some differences in the epidural catheter failure rate, IDP, or PDPH requiring an epidural blood patch were observed between techniques. Whether the selection of the ideal neuraxial technique is dependent on patient, anesthetic or obstetric factors warrants more focused questions in large, prospective epidemiologic trials.

### References:

- Chau Anesth Analg 2017



## **Labour epidural made safe**

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**Presenting Author's Institution:** NHS Greater Glasgow and Clyde

**Co-Author:**

**Background:** During epidural placement, accidental dural puncture (ADP) occurs at a rate of 1.5%.<sup>1</sup> Inexperienced operator is risk factor for ADP. This study tests an assembled epidural device that can offer novice trainee hands-on learning of loss of resistance (LOR) technique while under direct senior supervision.

**Methods:** Two LOR syringes are connected in series to a single epidural needle. The injectate flows in one-way direction from each or both syringes to the tip of the needle via 3-way taps and non-return valves (see picture below). Thirty-eight midwives were recruited to test this device; they were first taught how to perform epidural insertion using intermittent and continuous LOR (to water) techniques on an epidural manikin then, they were asked to perform the procedure on the same manikin under supervision using the assembled device described above. Standing on the side of the manikin, the supervising anesthesiologist was able to continuously observe LOR technique by using the second LOR syringe and intervenes as necessary. Each participant was given real-time feedback on failure, false and successful detection of LOR. These attempts were recorded. Participants were asked to grade the degree of LOR technique supervision (1-continuous supervisor-needle contact, 2-intermittent, 3-occasional and, 4-no supervisor-needle contact).

**Results:** For intermittent LOR technique: 39.5% (15) detected LOR, 28.9% (11) detected false LOR and 31.6% (12) failed to detect LOR. For continuous LOR technique: 26.3% (10) detected LOR, 34.2% (13) detected false LOR and 39.5% (15) failed to detect LOR. For grading the degree of LOR technique supervision: 76.3% (29) graded as 4 and 23.7% (9) as 3.

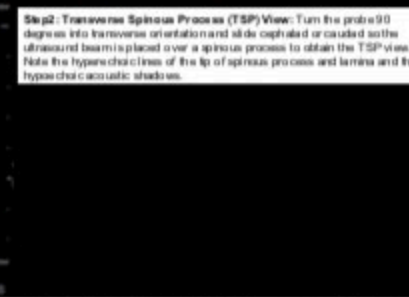
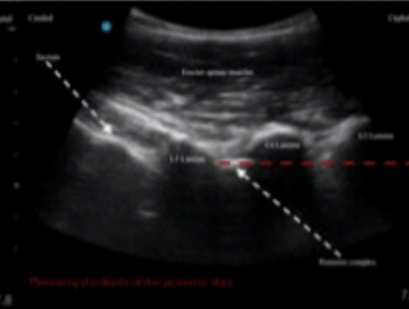
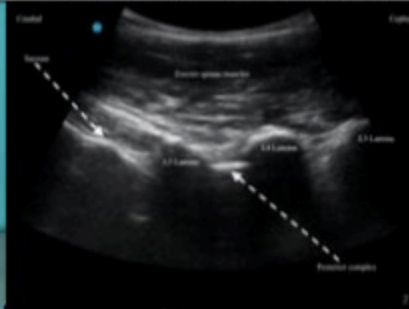
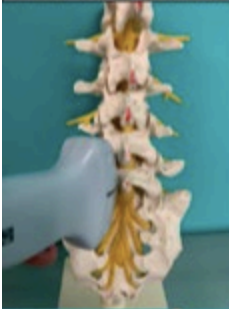
**Conclusions:** This device assembly could help novice trainees to practice LOR technique under direct supervision but with minimal or no supervisor-needle contact. Using the second LOR syringe to detect missed or false LOR by the supervisor could help to prevent ADP.

**References:** 1. Kwak K-H. Postdural puncture headache. Korean Journal of Anesthesiology 2017; 70: 136-139.



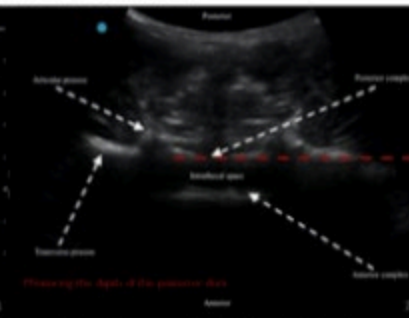
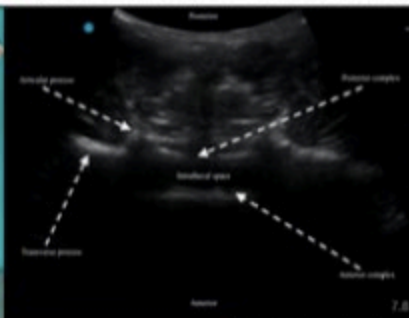
## Lumbar Neuraxial Ultrasound Made Easy

**Step 1: Parasagittal Oblique (PSO) View:** The transducer is placed 1-2cm lateral to the spinous process with slight medial tilt to direct the ultrasound beam into the vertebral canal. Look at the anechoic-like acoustic shadows of the laminae. Slide the probe caudad until the sacrum is identified as long horizontal hyperechoic line. The gap between the hyperechoic line of the sacrum and the 'backstop' of the adjacent L5 lamina represents L5-S1 interspace. Slide the probe cephalad to locate L4-5 and L3-4 interspaces. Measure the depth of the posterior dura before moving to step 2.



**Step 2: Transverse Spinous Process (TSP) View:** Turn the probe 90 degrees into transverse orientation and slide cephalad or caudad so the ultrasound beam is placed over a spinous process to obtain the TSP view. Note the hyperechoic lines of the tip of spinous process and lamina and their hypoechoic acoustic shadows.

**Step 3: Transverse Interapophyseal (TIS) View:** From the TSP view, slide the probe cephalad or caudad so the US beam enters the acoustic window between the spinous processes to obtain the TIS view. The hypoechoic interapophyseal space is bounded anteriorly and posteriorly by hyperechoic lines of the anterior complex (anterior dura and posterior longitudinal ligament) and posterior complex (posterior dura and ligamentum flavum). Note the probe angle and measure depth of the posterior dura (it should be the same depth as in step 1) before moving to step 4.



**Step 4: Identify and mark needle insertion for a midline approach using TIS view:** Position probe perpendicular to skin and centre the neuraxial midline on the screen. If probe angulation is required, then use the same angle for needle insertion.

- Make skin marks at the: (i) midpoint of the probe's short edge by using surgical skin marker (ii) midpoint of the probe's long edge by denting the skin with a needle cap in order to avoid contamination of insertion point with ink from surgical skin marker.
- Needle insertion point is represented by either: (i) the intersection between the above two marks or, (ii) 50-100 mm caudad to the inferior edge of the skin dent described above.



## Association Between Documentation Accuracy and Number of Neuraxial Placement Attempts and Redirections: A Prospective Observational Study

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**Introduction:** Accurate documentation of neuraxial placements is essential for interprofessional communication and has significant medicolegal implications when complications occur.[1] However, when a placement requires more than a single forward pass of the needle, attention can become increasingly task-focused therefore making it harder to keep count of attempts and redirections taken. We hypothesized that low documentation accuracy is associated with high total number of neuraxial placement attempts and redirections.

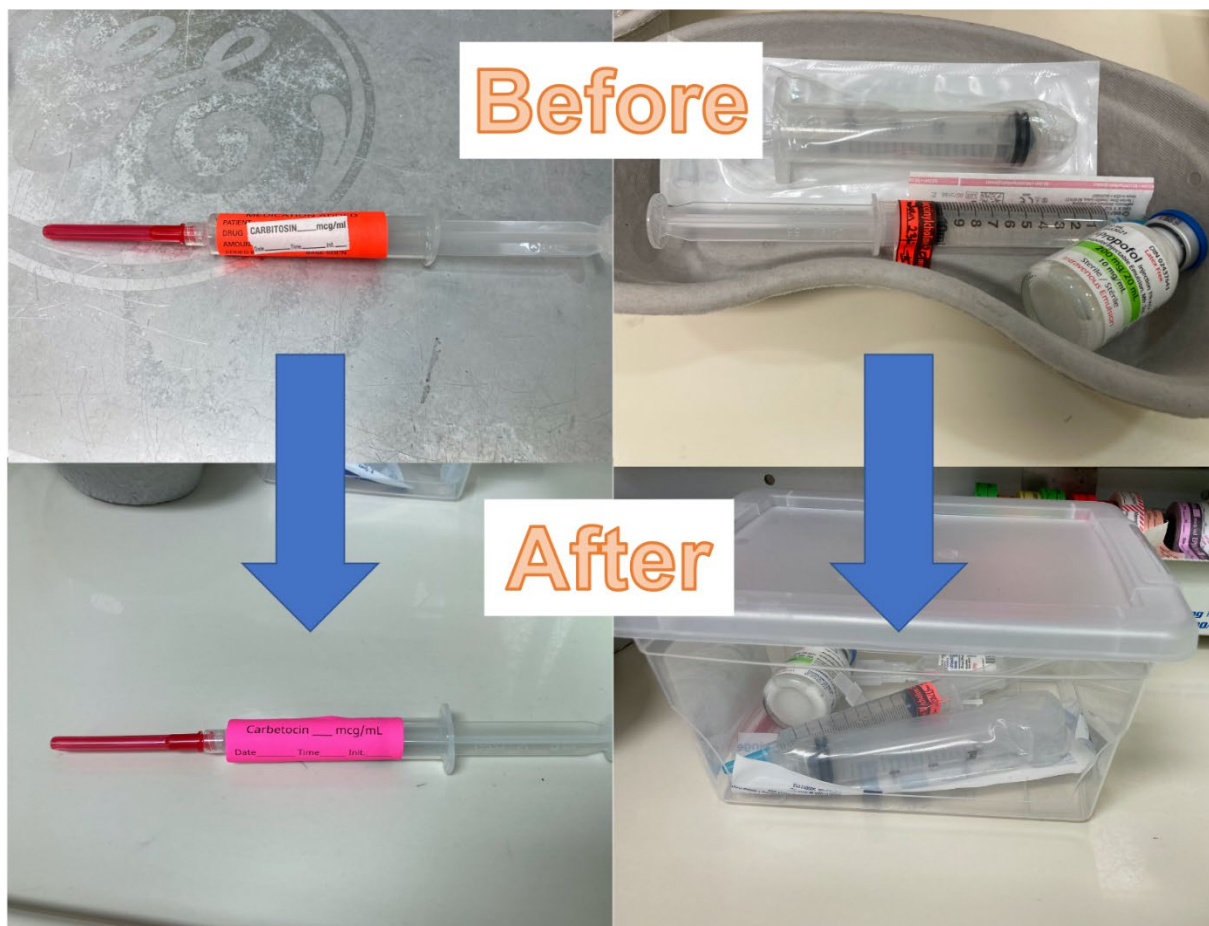
**Methods:** Ethics committee approval was sought and informed consent was waived. Women receiving a neuraxial placement were eligible and verbal consent was obtained prior to observation of each procedure. Operators were anesthesia providers who performed the neuraxial placements and were blinded to the study protocol to avoid bias from the Hawthorne effect. A trained observer recorded the number of attempts (skin punctures) and redirections (a backward followed by a forward movement of the needle without skin puncture). Documentation was retrieved from the anesthesia record the following day. The primary outcome was documentation accuracy, defined as the documented total divided by the observed total number of attempts and redirections. A multivariable linear regression was used to assess the relationship between documentation accuracy and the number of attempts and redirections controlling for neuraxial technique and operator's experience. Secondary outcomes were elements associated with inadequate documentation (which we defined as < 80% charting completion) by neuraxial technique.

**Results:** To date, data for 70 procedures have been analyzed. Documentation accuracy was significantly associated with total number of observed redirections, estimated to decrease by 4.5% (95%CI 2.6-6.4%,  $p < 0.0001$ ) per every one increase in redirection. The number of attempts and provider experience did not predict documentation accuracy. Documentation accuracy dramatically decreased when the total number of attempts and redirections exceeded two. The elements associated with frequent inadequate documentation included whether ultrasound was used, loss of resistance medium, and absence of paresthesia, blood, and cerebrospinal fluids.

**Discussion:** A high number of needle redirections was significantly associated with low documentation accuracy. This may stem from a lack of consensus on what defines a single attempt and whether a needle redirection should be counted as an attempt and charted. Additionally, pertinent negatives, an important element of medical documentation, were found to be commonly missing in the epidural and spinal procedural records. Obstetric anesthesia is an area of significant malpractice liability and these findings indicate that an improvement in our current chart format is needed to encourage accurate documentation of neuraxial placements and adequate recording of pertinent negative details.

**References:** 1. Kovacheva V et al. Anesth Analg 2019







## Implementation of an electronic alert notification platform for a maternal early warning system

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**Introduction:** A significant proportion of maternal morbidity and mortality are preventable and early warning systems have been proposed to facilitate timely recognition, diagnosis, and treatment for patients developing critical illness.(1) Standard adult warning tools are suboptimal for obstetric patients as they do not consider normal physiologic changes of pregnancy on vital signs, so Maternal Early Warning Systems (MEWS) have been developed.(2) However, integration of MEWS and associated alert notification platforms into electronic medical programs have lagged. We describe development and introduction of a maternal vital sign alert notification platform into our institution's electronic medical record (EMR).

**Methods:** The Maternal Early Warning Criteria (MEWC) was chosen as the designated MEWS for our obstetric unit, which is a tertiary referral center with 4500 deliveries/year, of which 70% are high-risk.(1) In 2019, the Clinical Informatics Team (CIT) at our institution was tasked with building a platform to enable integration of MEWS and an associated alert notification platform into our Epic EMR for L&D and maternity units. As part of the development phase prior to implementation, audits of the alert notification platform were performed by the CIT to detect system errors and realize the number of potential alerts the system would generate.

**Results:** Figure 1 outlines the phases of development and audit results. The standard MEWC resulted in too frequent alert notifications with many viewed as unnecessary or inconsequential. Subsequent adjustments were made to the MEWC and alert system. The MEWC were modified by excluding urine output (due to reporting inconsistencies) and including temperature (as maternal sepsis is a leading cause of maternal morbidity and mortality).(3) The impact of MEWS and threshold triggers adjustments on alert notification frequency are shown in Figure 1.

After implementation, analysis of data from 2020 found 2643 alert notifications (mean 7.2 per day, range 5.6-8.5): 52% (1368) 'MD aware, ongoing monitoring'; 28% (751) 'Will notify MD'; 16% (425) 'Treatment provided, ongoing monitoring'; 3% (86) 'Not providing direct care'; < 1% (13) alert not acknowledged.

**Discussion:** Implementation of MEWS into clinical practice and a standard EMR should be combined with an accurate and efficient alert notification platform. We found that a standard MEWS may lead to too frequent and unnecessary alerts, and our experience outlines potential adjustments to reduce these along with potential alarm fatigue. We found implementation of the MEWS alert notification platform increased the nurse to physician care team communication. Future studies are required to evaluate patient outcomes with appropriate modifications of MEWS's criteria to determine the optimal balance between maternal outcomes and alert fatigue.

### References:

- Obstet Gynecol. 2014;124:782-6
- PLoS One. 2019;14:e0217864
- [www.cdc.gov/reproductivehealth/maternal-mortality/index.html](http://www.cdc.gov/reproductivehealth/maternal-mortality/index.html)



## **A cost-savings comparison between disposable and reusable pulse oximetry sensors in labor and delivery operating rooms**

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**Presenting Author's Institution:** Stanford Health Care

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Brendan Carvalho, MBBCh, FRCA, MDCH; ;

**Introduction:** Operating room (OR) expenditures and waste generation are a key priority, with several professional societies recommending the use of reprocessed or reusable equipment where feasible (1,2). The aim of this analysis was to compare disposable pulse oximetry stickers (DS) vs. reusable pulse oximetry sensor clips (RC) in terms of annual cost savings and waste generation in labor and delivery (L&D) ORs nationally.

**Methods:** An economic model was used to compare the relative costs and waste of DS vs. RC. Pricing data for DS (\$17.93) and RC (\$201.15) was derived from the average of 4 secondary merchants on the open market. Assumptions were made that at baseline, each cesarean delivery (CD) requires 1 new DS per patient. A transition to reusable sensors would substitute the DS for 1 RC per L&D OR, to be reused for each CD; plus an additional 33% reserve of RC in the event of loss or breakage. The number of annual CDs nationally was estimated to be 1,198,446 (3). The number of L&D ORs nationally was estimated to be 15,075 based on publicly available data from institutions across the United States (US), SOAP Centers of Excellence data, and the American Hospital Association 2015 Database Survey. To determine workload burden, two independent operators were timed cleaning the RC with the same sanitization wipe used to clean the sensor cable, and this was compared to the time to retrieve a DS and apply it to the cable (after cleaning). Waste production was based on the raw weight of the DS (0.0181kg) and the RC (0.0510kg) that would be disposed of over the course of the year, without recycling interventions.

**Results:** The national net annual savings of transitioning from DS to RC in L&D ORs was \$16,311,620. This estimate accounts for an additional expense of \$1,215,091 in cleaning the RC: added time to clean RC vs. replace DS was 1.7 seconds, at a cost of \$36.50 per OR minute (4). Capital costs were estimated assuming an interest rate of 1%, and adjusted for a higher upfront purchase of RC, compared to purchase of DS that could be distributed throughout the year. The annual waste that could be diverted from landfill by transitioning from DS to RC in all L&D ORs in the US was found to be 22.8 tons. The model assumed that the interchangeable nature of DS and RC from the selected vendor would require minimal capital expenditure in making the transition. If institutions need to purchase new vendor monitors or cables, that may increase the one-time capital outlay prior to a transition to RC.

**Discussion:** A conversion from DS to RC in all L&D ORs nationally can have a modest but tangible impact on healthcare expenditures (\$16,311,620) and waste production (22.8 tons) annually. As both DS and RC are equally accurate and reliable, this cost and waste savings could be instituted without compromise to clinical care.

### **References:**

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## Which tracks MV better, TV or RR for assessment of ventilatory function in postoperative patients?

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**Presenting Author's Institution:** Yale Medical School

**Co-Author:** Antonio Gonzalez-Fiol, MD; Nayema K. Salimi, MD; Kristen Fardelmann, M.D; David Yanez, PhD, MS; Aymen Alian, M.D.

**Abstract :** Current monitoring recommendations for prevention and detection of respiratory depression (RD) after neuraxial morphine encourages clinical assessments every 1-2 h.<sup>1</sup> Unfortunately, standard monitors and intermittent respiratory rate (RR) assessments can fail to detect RD.<sup>2</sup> Respiratory Volume Monitoring (RVM) measures ventilation by detecting changes in electrical conductance obtained with chest surface electrodes to estimate RR, minute ventilation (MV), and tidal volume (TV). The study's primary aim is to evaluate the association between RR and TV changes in patients with alarms for low MV after low dose neuraxial morphine for post-cesarean delivery (CD) analgesia. A secondary outcome is to assess medical history and morphologic features as predictors of RD.

77 high risk parturients that received intrathecal morphine for scheduled CD were monitored with RVM (ExSpiron1Xi, Respiratory Motion Inc, Watertown, MA) postoperatively. Inclusion criteria were BMI  $\geq 35$  kg/m<sup>2</sup>, with any of the following risk factors: pre-eclampsia, gestational hypertension, diabetes & obstructive sleep apnea. We monitored and measured respiratory parameters; MV, TV and RR at baseline and postoperatively for 24 h. MV, TV, and RR were collected at each alarm episode of hypopnea. Baseline parameters were defined as the respective values 5 min after the start of data collection. MV was presented as a percent of predicted MV (MVPRED) based on body surface area. True alarms were defined as MV < 40% MVPRED for  $\geq 2$ min. We investigated how well TV and RR tracked MV by evaluating the strength of association in separate linear regression models. The associations between MV and TV or MV and RR are presented as mean differences in MV for one standard deviation (SD) in RR or TV. We used GEE and robust SE's to account for repeated measures correlation. All hypothesis tests and confidence intervals are two-sided.

The device reported a total of 196 episodes of hypopnea for 2 mins in 29 (40%) patients. The average number of measurements per patient was between 7 and 8. Using TV to predict MV, there was a highly significant difference in MV of 2.2 L/min for a 1 SD difference in TV (95% CI[2.0, 2.5], p-value < 0.0001). For RR, the association with MV was marginal. The mean difference in MV was 0.26 L/min (95% CI[-0.03, 0.56], p-value = 0.083). The degrees of the association are reflected graphically in Figure 1 below. The left panel shows little association between MV and RR, while the right panel shows a clear association between MV and TV. None of the studied morphologic variables helped to predict apnea events. (Table 1)

Obstetric anesthesia services monitor RD via pulse oximetry and/or RR, both indirect and late predictors of RD. RR may be altered by pain level, medications, and disease. TV measurements may provide a more direct association to MV, hence RD. TV changes are more likely to reflect RD compared to changes in RR.

**References:** Bauchat et al. *Anesth Analg* 2019  
Voscopoulos et al. *J Clin Med Res* 2014



## Central cortisol regulation in pregnancy

**Presenting Author:** Richard Smiley, MD, PhD

**Presenting Author's Institution:** Columbia University Department of Obstetrics and Gynecology

**Co-Author:** Sunil Panigrahi, PhD; Giselle Jaconia, MD; Gabrielle Page-Wilson, MD; Maria Andrikopoulou, MD

**Objective:** Pregnancy is characterized by changes in the regulation of the maternal hypothalamic-pituitary-adrenal (HPA) axis. Aberrations in this pathway could have implications for metabolic and mood disorders during pregnancy. Cortisol activity is regulated at the tissue level by the enzyme 11 $\beta$ -hydroxysteroid dehydrogenase (11 $\beta$ -HSD) that functions in the bidirectional interconversion of active cortisol to inactive cortisone<sup>1</sup>, but the effects of cortisol and its interconversion to cortisone in the human brain are poorly understood. We aimed to enhance our understanding of central adaptations in cortisol metabolism in healthy pregnant women at term gestation.

**Study Design:** Plasma and CSF cortisol and cortisone were collected in 24 women at term gestation prior to scheduled cesarean delivery (CD) and in 24 regularly cycling non-pregnant controls matched for age and BMI. In the CD patients, 2 ml of CSF was collected via a 25G or 27G Whitacre needle during spinal or combined spinal-epidural anesthesia. In the non-pregnant volunteers, 10-12 ml CSF was collected via lumbar puncture with a 25G Whitacre needle. Subjects were healthy, with no history of smoking, alcoholism, psychiatric or neurological disorders. Cortisol and cortisone were assayed by ELISA. Data were analyzed by two-tailed Student t test.

**Results:** Plasma cortisol levels were 54% higher ( $248.5 \pm 15.9$  vs  $161.7 \pm 10.7$  ng/ml,  $p < 0.001$ ) and plasma cortisone levels were 88% higher ( $110.9 \pm 7.7$  vs  $59.1 \pm 6.1$  ng/ml,  $p < 0.001$ ) in pregnant vs non-pregnant women, as expected (Fig A). In CSF, cortisol ( $7.7 \pm 0.5$  vs  $6.1 \pm 0.3$  ng/mL,  $p = 0.01$ ) and cortisone ( $8.2 \pm 0.9$  vs  $2.7 \pm 0.2$  ng/mL,  $p < 0.001$ ) were also significantly higher in pregnant vs non-pregnant subjects (Fig B). However, in pregnant subjects the relative increase in CSF cortisol was only about half (26% v 54%) that observed in plasma, while the relative increase in CSF cortisone was 2.3 times greater than in plasma. Accordingly, the CSF cortisol/cortisone ratio was significantly lower in pregnancy ( $1.30 \pm 0.3$  vs  $2.4 \pm 0.2$ ,  $p = 0.003$ ), reflecting to the increased concentration of the inactive metabolite cortisone (Fig C).

**Conclusion:** To our knowledge, this is the first study to measure CSF cortisol and cortisone concentrations in pregnancy. These data demonstrate a pregnancy-specific shift in central cortisol metabolism that favors cortisone. This adaptation may protect the maternal brain from high cortisol levels, and aberrations in this pathway could have implications for mood disorders, appetite and metabolism during pregnancy and post-partum.

**References:** 1 PNAS USA 2014; 111:E2482-2491



## A Peripheral Immune Signature of Acute Labor

**Presenting Author:** Kazuo Ando, MD, PhD

**Presenting Author's Institution:** Stanford University School of Medicine

**Co-Author:** Ina Stelzer, PhD; Julien Hedou, n/a; Yair Blumenfeld, MD; Brendan Carvalho, MBBCh, FRCA, MDCH; Brice Gaudilliere, MD, PhD

**Introduction:** The dynamic biology underlying the onset of labor and labor progression remains incompletely understood.

Single-cell technologies, such as high-dimensional mass cytometry (CyTOF), have previously shown trajectories of finely-tuned immunologic adaptations in maternal blood over the course of pregnancy that predict gestational duration. (1) The aim of this study was to determine the peripheral blood immune profile associated with induction of labor. We hypothesized that we could identify an immune response signature in the systemic circulation that follows induction and the onset of labor.

**Material and Methods:** Fifteen participants with healthy, singleton pregnancies, who required or elected an induction of labor were included.

Whole venous blood was obtained at 5 time points during labor: (1) immediately prior to induction (baseline), (2) 1 hour after induction, (3) at first cervical change, (4) at the start of regular uterine contractions (less than every 3 minutes), and (5) at the start of active labor (defined as cervical length > 6 cm with regular uterine contractions; primary outcome) (Fig. 1A). Using CyTOF, the frequencies of 46 immune cell subsets representing all major innate and adaptive populations, endogenous intracellular activities of 11 signaling proteins, and capacities of each cell subset to respond to lipopolysaccharides (LPS) were analyzed (Fig. 1B).

**Results:** A total of 1,059 single-cell immune features were extracted from each sample. We observed strong correlations of the features with the continuous outcome of the minutes since the induction of labor. The interconnectedness of the immune features, observed in correlation networks, motivated a multivariate approach to identify biologically relevant components of the maternal single-cell proteome predictive of the progression of labor induction until onset of active labor (Fig. 1C). A linear regression model (LASSO) was built from all immunological features and predicted the minutes since the induction of labor with high accuracy ( $R = 0.86$ ,  $p\text{-value} = 6.7\text{e-}15$ ,  $\text{RMSE} = 277$  min), using a leave-one-patient-out cross-validation procedure. Prominent among the immune features that were most informative for the model were pro-inflammatory STAT3 responses in adaptive and innate immune cell subsets.

**Conclusion:** Our assessment of maternal circulating factors in the peripheral blood provides an immune profile associated with induction of labor and a prediction model for the onset of active labor. Understanding the immune signature of labor induction contributes fundamental insights for future therapeutic interventions to potentially increase the success and speed of labor inductions to optimize maternal and fetal outcomes.

**References:** 1) Aghaeepour N et al. An immune clock of human pregnancy. *Sci Immunol.* 2017;2(15)



## Intrathecal Bupivacaine Dosing for Transvaginal Cervical Cerclage: A Retrospective Analysis

**Presenting Author:** Sierra Camille Mims, MS

**Presenting Author's Institution:** Duke University School of Medicine

**Co-Author:** Matthew Fuller, MS; Ashraf S. Habib, MBBCh, MSc, MHSc, FRCA

**Background:** Cervical cerclage placement is commonly performed under spinal anesthesia. At our institution bupivacaine has been used as the standard of care, but intrathecal dosing is not standardized. There are limited data evaluating the optimum dose of bupivacaine that achieves adequate spinal anesthesia for cervical cerclage placement without delaying the time to hospital discharge. We therefore performed this retrospective study comparing commonly used bupivacaine doses in our practice with the aim of identifying the optimal dose to be used for this procedure.

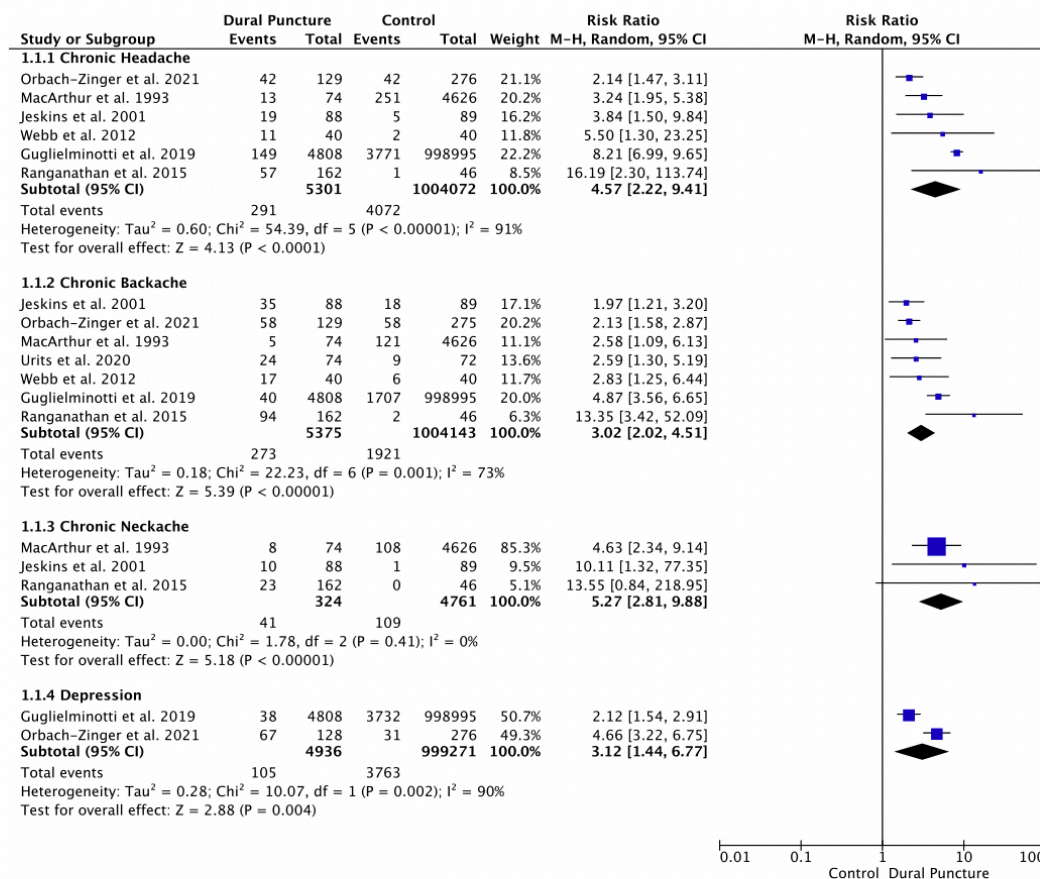
**Methods:** We performed a retrospective analysis of patients who underwent transvaginal cervical cerclage under neuraxial anesthesia with bupivacaine from 1/01/2015 and 10/31/2020. Based on the intrathecal bupivacaine dose administered, patients were categorized into two groups, 7.5 mg and > 7.5 mg. The primary outcome was inadequate blocks. An inadequate block was defined as a failed block or a block requiring IV analgesic supplementation with ketamine, propofol, midazolam >2mg, fentanyl >50 mcg or epidural supplementation (if a CSE technique was used). A failed block was defined as a block requiring a repeat block or conversion to general anesthesia. Secondary outcomes included the time to hospital discharge, need for vasopressors or anticholinergics, and postoperative pain scores in the first 2 hours after surgery. Continuous outcomes were assessed using linear regression and categorical outcomes using logistic regression. Adjustment was included for use of intrathecal fentanyl.

**Results:** 235 patients were included in this analysis (n = 118 and 117 in groups 7.5 mg and > 7.5 mg respectively). The most common doses used in the >7.5 mg group were 9 mg (56.4%) and 10.5 mg (30.8%). There were no significant differences in patient demographics, anesthetic or procedure details between the two groups except for more common use of intrathecal fentanyl in the 7.5 mg group (84.7% vs. 72.6%, P=0.02). There were significantly fewer inadequate blocks with bupivacaine doses > 7.5 mg compared to 7.5 mg (16.1 vs. 8.5%, p=0.050). Blocks were repeated in 6 patients (5.1%) in the 7.5 mg group and in 5 patients (4.3%) in the >7.5 mg group. There were no significant differences between the groups in any of the secondary outcomes including time to discharge, duration of PACU stay, postoperative pain scores, or need for vasopressors or anticholinergics (Table 1).

**Conclusion:** Bupivacaine doses greater than 7.5 mg were associated with a lower risk of inadequate blocks for transvaginal cervical cerclage placement compared to a 7.5 mg dose, without prolonging the time to discharge.



**Figure 1. Dural Puncture and Long-Term Symptoms**





## Intrathecal Bupivacaine versus Chloroprocaine for Transvaginal Cervical Cerclage: A Retrospective Analysis

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**Co-Author:** Matthew Fuller, MS; Ashraf S. Habib, MBBCh, MSc, MHSc, FRCA

**Background:** Bupivacaine is commonly utilized for spinal anesthesia for cervical cerclage placement, but its long duration of action can delay hospital discharge. Chloroprocaine has a short duration of action and has reemerged as an agent for outpatient neuraxial anesthesia. At our institution, cervical cerclage is typically performed under spinal anesthesia with bupivacaine, but recently chloroprocaine has been increasingly used for this procedure. There are limited data comparing the two agents when used for spinal anesthesia for cerclage placement. We performed this retrospective study to compare these agents with regards to time to hospital discharge and success of spinal anesthesia.

**Methods:** We performed a retrospective analysis of patients who underwent transvaginal cerclage placement under neuraxial anesthesia from 1/01/2015 and 10/31/2020. The primary outcome was time to hospital discharge. Secondary outcomes included inadequate blocks, need for vasopressors or anticholinergics, postoperative pain scores and the number of cases with reported postoperative neurologic symptoms. An inadequate block was defined as a failed block or a block requiring IV supplementation with ketamine, propofol, midazolam >2mg, fentanyl >50 mcg or epidural supplementation (if a CSE technique was used). A failed block was defined as a block requiring a repeat block or conversion to general anesthesia. Neurologic symptoms included postoperative paresthesia or radicular symptoms. Linear regression and logistic regression were used for analysis with adjustment for anesthetic technique and use of intrathecal fentanyl.

**Results:** 360 patients were included in this analysis (n=236 and 124 in groups, "Bupivacaine" and "Chloroprocaine," respectively). There were no significant differences in baseline characteristics or operative details between the groups. The median (IQR) intrathecal dose was 7.5 (7.5, 9) mg and 45 (45, 50) mg in the bupivacaine and chloroprocaine groups respectively. Spinal anesthesia was used in 97% of cases in the bupivacaine group and 64.5% of cases in the chloroprocaine group ( $P < .001$ ), with the remainder being performed with a combined spinal epidural (CSE) technique. Intrathecal fentanyl was used more commonly in the bupivacaine group (78.8% vs. 59.7%,  $P < .001$ ). Adjusted outcomes are summarized in the table. Time from spinal anesthesia to hospital discharge was significantly shorter in the chloroprocaine group compared to the bupivacaine group. There were no significant differences between the groups in inadequate blocks, need for anticholinergics or pain scores after surgery, but there was more vasopressor use in the chloroprocaine group (Table 1). Neither group had cases reporting neurologic symptoms.

**Conclusion:** When utilized for spinal anesthesia in transvaginal cervical cerclage placement, chloroprocaine may reduce the time to discharge while providing comparable anesthesia to that provided by bupivacaine.



## Introduction of a pre-procedural checklist to enhance compliance with anesthesia medication safety in the labor and delivery room

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**Presenting Author's Institution:** Brigham and Women's Hospital

**Co-Author:** Michaela K. Farber, MD, MS; Mihaela Podovei, MD

**Introduction:** Having immediate-use pharmacologic agents for patients in labor is an important safety initiative. Epidural labor analgesia can be associated with hypotension requiring urgent treatment. Separately, rapid conversion of a labor epidural for cesarean delivery can be indicated. Therefore, it is standard practice at our institution to store vasopressor medication and fast-acting local anesthetics in a locked cabinet at the patient's bedside for immediate use. It is the responsibility of the obstetric anesthesia team to ensure the presence and proper disposal of these medications. However, instances of missing or contaminated medications have been reported. This quality improvement project sought to determine the frequency of appropriate anesthesia medication storage at the bedside of patients receiving epidural labor analgesia and to improve the rate of compliance.

**Methods:** This quality improvement project was conducted on our Labor and Delivery unit from October 2020 to January 2021. For baseline compliance assessment, obstetric anesthesia fellows conducted periodic surveys of the medication content in the bedside cabinet of each patient utilizing epidural pain relief. During the interim period, a flowchart summarizing the workflow for stocking and disposal of anesthesia medications was created to identify possible intervention points. Subsequently, a comprehensive preprocedural checklist to be performed immediately prior to epidural placement was created by expert consensus. A laminated checklist was placed in every labor room, and education about the checklist was provided to all anesthesia providers at shift change. For the post-intervention period, compliance was re-measured. Using data from our pre-intervention period, we calculated 83 patients needed per group to detect a 20% improvement in compliance with 80% power and alpha 0.05 using Chi square analysis.

**Results:** The pre-intervention period was 22 days and the post-intervention period was 14 days, with 87 and 85 labor room medication cabinets evaluated, respectively. Compliance for appropriate medication storage was 59% pre-intervention and 87% post-intervention, yielding a relative risk (95% CI) of compliance post- versus pre-intervention of 1.47 (1.21 -1.79,  $p < 0.001$ ). The pre-procedural checklist was easy to implement and well received.

**Discussion:** This initiative demonstrates that implementation of a preprocedural checklist can successfully improve the compliance rate for proper storage and disposal of immediate-use labor epidural medications. Evaluating the storage of anesthesia medication in labor rooms is an important and possibly overlooked patient safety initiative. Sustainability of compliance is an important future priority in our unit. Incorporating the preprocedural checklist into the electronic medical record may promote sustainable change.



## USE OF INTRATHECAL DEXMEDETOMIDINE IN CARING FOR PREGNANT WOMEN WHO HAVE OPIOID USE DISORDER UNDERGOING FOR CESAREAN DELIVERY

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**Co-Author:** Lior Levy, MD; JoAnn Jordan, MS, Health Care Quality; Yunping Li, M.D.; Philip E. Hess, MD

**Introduction:** Despite multimodal analgesia strategies, patients with opioid use disorder (OUD) frequently report poor pain control after cesarean delivery (CD). Analgesia may be challenging because of opioid-induced hyperalgesia and tolerance.<sup>1,2</sup> Lack of evidence-based guidelines hamper optimization of the management of pain in patients with OUD. We report on the use of intrathecal dexmedetomidine in conjunction with a multimodal strategy for the postoperative analgesia after CD in patients with OUD.

**Methods:** We queried the electronic anesthesia record and medical records at a single, tertiary care center for parturients with OUD who underwent elective or intrapartum CD. Prescribed opioids included methadone, buprenorphine, buprenorphine/naloxone, oxycodone and hydromorphone. Our practice was patients on lower doses (methadone  $\leq$  80 mg/day or buprenorphine  $\leq$  8 mg/day) would receive intrathecal (IT) morphine, otherwise, they would receive intravenous and oral postoperative opioids. All patients received neuraxial anesthesia for CD with spinal Bupivacaine 11.25 mg and Fentanyl 25 mcg. Patients were divided into 3 groups: PCA-spinal Bup/Fent and postoperative PCA; ITM- Intrathecal morphine 0.25 mg and spinal Bup/Fent and postoperative opioid at request; SpinalDex - Intrathecal dexmedetomidine 10 mcg and spinal Bup/Fent and postoperative PCA. Primary outcomes were visual pain scores (VPS) and hydromorphone equivalent dose (HED) in 36 hours after cesarean. Postoperative use of opioids other than intravenous hydromorphone were converted to HED.<sup>3</sup> All patients were also on scheduled NSAIDs and acetaminophen.

**Results:** Of 6402 cesarean deliveries in a 4-year period (2017-2020), 44 cases were included. The prevalence of opioid use in pregnancy doubled (0.46% in 2017 to 0.92% in 2020). Demographics, gestational age, BMI, numbers of prior CD, length of surgery were similar between the groups. More patients in the PCA group received a truncal block than the ITM group, the SpinalDex group had the fewest. SpinalDex had the lowest VPS in the PACU with no difference afterward (Table 1). The median time to the first rescue opioid request were significantly longer in SpinalDex and ITM cohorts compared to PCA group. The HED were lowest in the ITM group compared to the other groups, with no difference between SpinalDex and PCA. IT dexmedetomidine did not increase the risk of postoperative hypothermia and sedation compared to both PCA and ITM groups.

**Discussion:** Despite multimodal analgesia and frequent use of truncal blocks, we found that patients with OUD had high pain scores and opioid requirements after cesarean. Patients who received spinal morphine had moderate-severity pain scores but avoided additional opioids. Spinal dexmedetomidine had a profound, but short-lived analgesic effect. Future work should examine how to prolong the effect of dexmedetomidine.

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**Effect of Neuraxial Clonidine on Post-Cesarean Opioid Consumption and Pain Scores in Parturients on Chronic Buprenorphine Therapy: a Retrospective Cohort Study**

**Presenting Author:** Michael G. Taylor, MD

**Presenting Author's Institution:** Vanderbilt University Medical Center

**Co-Author:** Jeanette Bauchat, MD MS; Jonathan Wanderer, MD; Xiaoke Feng, MS; Matthew Shotwell, PhD; Holly Ende, MD

Achieving adequate post-cesarean delivery (CD) analgesia in women receiving buprenorphine for opioid use disorder can be challenging due to the medication's high opioid receptor binding affinity and long half-life. Neuraxial clonidine may be especially helpful in women receiving buprenorphine; however, the benefits in this population have not been established. We hypothesized that neuraxial clonidine would be associated with lower post-CD opioid consumption 0-6 hours postoperatively in women receiving buprenorphine.



## **Cognitive Aid for Maternal Cardiovascular Life Support in Corona Virus Disease-19 Infection: A Simulation-Based Development of New Clinical Pathway.**

**Presenting Author:** Linda Korz, FRCPC

**Presenting Author's Institution:** McMaster University

**Co-Author:** Vandana Vaishnav, FRCPC; Annemaria De Tina, FRCPC; Suzan Ergun, FRCPC; Rui Hu, MD; Kara Gibson, FRCPC; Daniel Cordovani.

**Introduction:** Cardiac arrest in a parturient is a rare and challenging clinical scenario, requiring multi-disciplinary involvement and coordination. The American Heart Association (AHA) guidelines suggest immediate perimortem caesarean delivery (PMCD) to facilitate maternal resuscitation if there is no revival by 5 minutes<sup>1</sup>. The COVID-19 pandemic has added another layer of complexity with the need for protected code blue and safe airway management, which delays the intervention. The aim of this quality improvement (QI) study is to incorporate critical tasks from the protected code blue and COVID-19 airway management protocols to design a new cognitive aid for safe & efficient management.

**Methods:** A checklist was drafted through a brainstorming session with anesthesiologists, obstetric clinical educators and maternal intensive care unit (WHICU) physician to compile elements from the AHA maternal cardiac arrest algorithm<sup>1</sup>, the institutional protected code blue algorithm & the department recommendations for COVID-19 safe airway management. We performed a pilot simulation to assess the practicality of the checklist for PMCD. Next, an in-situ high-fidelity simulation in the WHICU involving multidisciplinary members of the code blue team was conducted to assess the workflow and modify the checklist based on participants' feedback. The updated checklist was circulated to 6 anesthesiologists and 2 obstetric clinical educators to rate each item between 0-4 (0 is not important and 4 is very important to patient management). A novel cognitive aid was prepared after two rounds of modified Delphi process of consensus generation (figure 1). This was finally tested during unannounced in situ simulation at WHICU.

**Results:** The time to PMCD was recorded as 13 min during first in situ simulation which was later improved to 7 min during final in situ simulation. The checklist ratings indicated a consensus among raters (100%) regarding the priority to call for help from the anesthesiologist, obstetrician & neonatal team and the need for essential equipment such as video-laryngoscope & PMCD set, early in the scenario. Full PPE & high-quality CPR were also highlighted by 100% of raters as being critical checklist components. Items rated by the majority as less than 3 were removed from the algorithm to improve efficiency. For example, clamping of endotracheal tube was not considered as important step by 75% of participants.

**Discussion:** The cognitive aid developed for maternal cardiovascular life support in a COVID-19 parturient, promotes safety of emergency responders. It facilitates early call for help, prompt resuscitation and safe intubation using airborne precautions but the time to PMCD is longer than the recommendations from AHA. The tool has utility in simulation-based training to prepare teams for such high-acuity, low frequency event.

### **References:**

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## Dexmedetomidine as an Adjunct to Neuraxial Anesthesia in Cesarean Delivery: A Retrospective Chart Review

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**Presenting Author's Institution:** Mayo Clinic

**Co-Author:** Hans Sviggum, MD; Emily Sharpe, MD

**Background:** Dexmedetomidine is a selective  $\alpha$ -2 agonist commonly used for sedation that has been used in obstetric anesthesia for multimodal labor analgesia, post cesarean delivery analgesia, and perioperative shivering. This study evaluated the role of dexmedetomidine to provide rescue analgesia and/or sedation during cesarean delivery under neuraxial anesthesia.

**Methods:** We conducted a single-center, retrospective cohort study of all parturients undergoing cesarean delivery under neuraxial anesthesia between 12/1/2018 and 11/30/2019 who required supplemental analgesia during the procedure. Patients were divided into two groups: patients who received intravenous dexmedetomidine (Dexmed group), and patients who received other adjunct medications such as fentanyl, midazolam, ketamine, and nitrous oxide without dexmedetomidine (Standard group). Our primary outcome was the incidence of conversion to general anesthesia. Secondary outcomes included incidence and duration of hypotension, bradycardia, and oxygen desaturation, inotropic/vasopressor use, antiemetic use, and characterization of dexmedetomidine usage patterns.

**Results:** During the study period, 107 patients received adjunct medications. There were 62 patients in the Dexmed group and 45 in the Standard group. There was no difference in conversion to general anesthesia between the Dexmed group and Standard group (6% [4/62] vs. 9% [4/45];  $p=0.72$ ). In the Dexmed group, the mean dexmedetomidine dose received was 37  $\mu$ g (range 10 to 140  $\mu$ g). While the use of inotropic/vasopressor medications was common and similar in both groups, there was an increase in incidence of bradycardia (Dexmed 15% vs. Standard 2%;  $p=0.042$ ) but not hypotension (24% vs 24%;  $p=1.00$ ) or desaturation (2% vs 0%) in the Dexmed group. However, the duration of bradycardia was similar in the Dexmed group compared to the Standard group (2 vs 1 min;  $p=0.35$ ), but episodes of hypotension were longer (6 vs 3 min;  $p=0.013$ ). Antiemetic use was similar between groups, with most patients receiving either ondansetron (Dexmed 94% vs Standard group 96%;  $p=1.00$ ), dexamethasone (69% vs 62%;  $p=0.54$ ), or droperidol (16% vs 4%;  $p=0.069$ ).

**Conclusion:** In patients who required supplemental analgesia for cesarean delivery, dexmedetomidine is a viable option for intraoperative rescue analgesia. Patients who received dexmedetomidine versus other medications had a similar rate of conversion to general anesthesia. We found a statistically significant increase incidence of bradycardia and increased duration of hypotension, but no effect on incidence of hypotension, desaturation events, vasopressor use, antiemetic use, and no major complications.



## **Predictive performance of 3 risk-assessment tools for postpartum hemorrhage after vaginal delivery: A nested case-control study using quantitative blood loss**

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**Presenting Author's Institution:** Brigham and Women's Hospital

**Co-Author:** Mario I. Lumbreras-Marquez, MBBS, MMSc; Kara G. Fields, MS; Brian T. Bateman, MD, MSc; Michaela K. Farber, MD, MS;

**Introduction:** Quantitative blood loss (QBL) has been recommended by obstetric organizations for better identification of postpartum hemorrhage (PPH). Visually estimated blood loss (EBL) is inaccurate, and QBL correlates better with blood loss calculated by hematocrit change.<sup>1</sup> To better predict PPH, various hemorrhage risk assessment tools have been established, but validation has been difficult due to the inaccuracy of visual EBL. Furthermore, modeling that stratifies risk factors based on QBL as an objective, measurable outcome has not been achieved. The aim of this study is to estimate preliminary models for PPH risk using QBL after vaginal delivery for 3 established risk-assessment tools: obstetric comorbidity index (OB-CMI), California Maternal Quality Care Collaborative (CMQCC) hemorrhage risk assessment tool, and ACOG Safe Motherhood Initiative obstetric hemorrhage instrument.

**Methods:** A case-control review of vaginal deliveries from January through July 2020 was performed. Cases were defined by the primary outcome of QBL >500 mL. Controls were vaginal deliveries randomly selected during the same timeframe with QBL < 500 mL. Chart review was performed to evaluate for each of the PPH or morbidity risk factors in the OB-CMI, CMQCC, and ACOG tools. Multivariable logistic regression with a minimum of 10 events per model coefficient to minimize bias and achieve adequate precision in coefficient estimates was planned. Regression analysis was used to estimate intercepts and predictor coefficients for each of the tools. For each model, cases and controls were reweighted by the inverse sampling fraction from the entire cohort. The apparent and internally validated performance of each model was assessed with respect to discrimination (area under the receiver operating characteristic curve [AUC]).

**Results:** 250 cases and 250 controls were identified. The goal of at least 10 events per coefficient was not met for each risk factor as some had very low or zero prevalence (Table). The odds ratios for each risk factor with at least 10 events is shown in the Table. The preliminary performance assessment for each tool as represented by the AUC is: OB-CMI 0.568, CMQCC 0.640, ACOG 0.617.

**Conclusion:** To our knowledge, this is the first study to evaluate 3 established PPH or morbidity risk-assessment tools utilizing QBL after vaginal delivery as an objective outcome measure. From the preliminary analysis of fitting reduced versions of these 3 PPH prediction tools, the CMQCC tool has the highest performance. Our results revealed low to zero prevalence of risk factors that impeded model convergence. This reflects an intrinsic limitation of existing tools to predict PPH risk under non-operative conditions (vaginal delivery). Further analysis is warranted.

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## Labor & Delivery Operating Room Staffing and Operating Efficiency Using Queueing Theory

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**Intro:** Operating efficiency in non-operating room locations have been described [1]. However, emergencies and competing dynamic priorities in a birth unit can make it challenging to set optimal staffing/operation benchmarks. Queueing theory analysis (QTA) is a mathematical concept used in the study of congestion and delays from waiting in lines. It can help healthcare stakeholders make informed decisions on creating safe, efficient, and cost-effective workflow systems, including mass casualty events [2,3]. This study used QTA to identify optimal birth center staffing and operating room (OR) resources, using real-world data from a busy center.

**Methods:** Data from a Level 4 Maternity Center (9,500 births/year, cesarean delivery (CD) rate 30%) were abstracted for all OR activity (e.g., CD, cerclage, tubal ligation, post-delivery bleeding, laceration repairs, twin deliveries) from July 2019 - June 2020. QTA has two variables: Mean Arrival Rate, calculated as patients (PT) per hour  $\lambda$  = number of patients per 1 year / number of hours; and Mean Service Rate  $\mu$  = average length of cases in hours per PT / hour. QTA formulas computed probabilities:  $P_0 = 1 - (\lambda / \mu)$  and  $P_n = P_0 (\lambda / \mu)^n$  where  $n$  = number of PTs.  $P_0 \dots n$  is the probability there are zero PTs in OR queue at a given time, and the probability that  $\geq 2$  PTs require ORs simultaneously. All probabilities add up to 1 ( $P_0 + P_1 + P_2 \dots P_n = 1$ ). Multiphase multichannel analysis was used to gain insights on optimal staff and space utilization assuming a priori safety parameters (i.e., 30 min decision to incision in unscheduled CD;  $\leq 5$  min for emergent CD; no greater than 8 hours for nil per os time). To achieve these safety targets a  $< 0.5\%$  probability that a PT would need to wait was assumed. Target utilization  $\rho$  was set at  $\geq 0.15$ .

**Results:** There were 3,092 CD in the study period (Figure 1). 1,976 (63.9%) occurred between peak hours (07:00-19:00). 63.8% of the time, 2 or more ORs were simultaneously running for up to 30 minutes. Arrival rate  $\lambda$  was 0.34 (patients per hour); service rate per server ( $\mu$ ) was 0.87 (patients per hour); number of servers ( $s$ ) dedicated to OR activity was 3. Over a 24-hour period, the probability of no patients in the system is  $P_0 = 0.61$ , while  $P_1 = 0.23$ , and  $P \geq 2 = 0.05$  ( $P_3 = 0.006$ ). However, between peak hours 07:00-19:00,  $\lambda = 0.45$ ,  $\mu = 0.87$ ,  $s = 3$ ,  $P_0 = 0.48$ , while  $P_1 = 0.25$ , and  $P \geq 2 = 0.07$  ( $P_3 = 0.01$ ,  $P_4 = 0.002$ ,  $P_5 = 0.0003$ ) and utilization  $\rho = 0.17$ .

**Conclusion:** QTA is a useful tool to benchmark birth center OR efficiency while upholding safety standards, and factoring peaks and troughs of daily activity. QTA can be used for birth centers of all sizes. For a Level 4 Maternity Center (birth rate 9,500/year, CD rate 30%) with standard wait time tolerance, optimal dedicated staff to OR activity was 3 and number of dedicated ORs was 5. These data can inform hospital-level decisions on essential staffing/space requirements for safe and efficient operations.

**References:** 1 Youn AM 2015; 68: 323

2 Maartje M 2010; 13: 256

3 Lin CC 2019; 27: 41



## Standardizing the Approach to Epidural Placement to Reduce Time to Epidural Completion: A Quality Improvement Project

**Presenting Author:** Kaitlyn Brennan, DO MPH

**Presenting Author's Institution:** Vanderbilt University Medical Center

**Co-Author:** Holly Ende, MD; Jeanette Bauchat, MD MS; Susan Dumas, MD

**Introduction:** Delay in providing epidural analgesia is associated with maternal dissatisfaction with overall anesthetic care.<sup>1</sup> Shortening the amount of time from maternal request for epidural to successful catheter placement may have positive effects on satisfaction. We hypothesized that standardizing the steps of epidural preparation, setup, and performance may improve efficiency of anesthesia providers. As a quality improvement initiative, our group standardized epidural placement steps for new learners in an attempt to decrease the time to epidural completion.

**Methods:** We designed an ideal process, depicted as a deployment flow diagram, for epidural preparation and placement (Figure 1). This was designed with input from all obstetric anesthesiologists and was used to orient new learners (residents, student nurse anesthetists) to the procedures of epidural placement. Baseline data was collected prior to implementation of the new educational material. Our first plan-do-study-act (PDSA) cycle involved showing the learners the flow diagram, simulating use with an epidural kit, and observing subsequent epidural placements. Average time from patient request for epidural to provider entering room, time from kit opening to skin localization, and time from skin localization to test dose administration were compared before and after utilization of the deployment flow diagram utilizing a two-sided t-test. Additional collected data for each neuraxial placement included: anesthesia provider type, whether the procedure was completed by the initial proceduralist, patient pain score at time of placement, cervical dilation at time of placement, and patient estimate of arrival and epidural completion time.

**Results:** Baseline data was collected on 27 epidural placements by junior trainees prior to process implementation, and 7 placements were observed after implementation. There were no differences in mean time to room entry (Pre  $8 \pm 3$  min vs. Post  $7 \pm 1$  min;  $p=0.48$ ), time from kit opening to skin localization (Pre  $6 \pm 3$  min vs. Post  $5 \pm 2$  min;  $p=0.73$ ), or time from skin localization to test dose administration (Pre  $8 \pm 3$  min vs. Post  $8 \pm 6$  min;  $p=0.82$ ).

**Conclusion:** A deployment flow diagram exists in both time and space, which can help to break a complex process into smaller steps for improved reliability and standardization of care.<sup>2</sup> Our first PDSA cycle revealed persistently long epidural preparation and setup times as well as learners deviating from the flow diagram. Additional observations will be necessary in order to demonstrate any potential benefit to the new process, if it exists. Future steps include surveys of anesthesia trainers and trainees, train-the-trainer sessions, and structured repeated simulations for learners.

### References:

- PMID: 31264207
- PMID: 8252125



## Questionnaire on Management of Unwitnessed Disconnected Labor Epidurals

**Presenting Author:** Rustin L. Roberts, MD

**Presenting Author's Institution:** Ochsner Medical Center

**Co-Author:** Liane Germond, MD; Adrienne Ray, MD

**Purpose:** Unwitnessed disconnects of labor epidurals are one of the multiple complications that must be managed. While no national guidelines presently cover this topic, current practice advisories from the ASA task force recommend that accidental unwitnessed disconnected epidurals be replaced immediately<sup>1</sup>. This is based on insufficient literature resulting in ambiguous practice management between providers<sup>1</sup>. An anonymous questionnaire was developed to determine how OB anesthesiologists address this problem in their daily practice.

**Methods:** We constructed an anonymous ten question survey using the website SurveyMonkey; the questionnaire was emailed to 123 OB anesthesiologists whose contact information was acquired from the SOAP registrar. The brief survey focused on how providers manage the issue of an unwitnessed disconnect.

**Results:** The survey was sent to 123 OB anesthesiologists; 44 individuals responded. The response rate was 36%. Most of the physicians (78%) have been in practice for greater than 5 years and 41 out of 44 (93%) who responded work in academics. Interestingly, roughly 84% do not have a protocol at their institution. The immediate replacement of an unwitnessed disconnect was split with 48% immediately replacing and 52% not replacing. If not immediately replacing the epidural, the majority 68% cleaned, cut, and replaced a new clamp. The most common reasons to keep the original disconnected epidural for those who would have otherwise replaced include: timing (< 10mins since disconnect), difficulty of placement, and whether it was witnessed. Practitioners' primary reason for replacing an unwitnessed disconnect is due to risk of infection; however, 100% have never experienced complications from not replacing an unwitnessed disconnected epidural.

**Conclusion:** The feared complication of neuraxial infection is shared by all obstetric anesthesia practitioners. Epidural abscess and meningitis were identified as the most common cause of neuraxial injury reported in the ASA closed-claims project database from 1980-1999<sup>2</sup>. Fortunately, these complications are rare: 0.479/100,000 cases for epidural abscess and 1/39,000 cases for meningitis<sup>3</sup>. Our survey findings support the development of a standardized guideline addressing the management of unwitnessed disconnected epidurals.

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## Nutritional preferences of women during labor: a survey study

**Presenting Author:** Geoffrey Liang, BSc

**Presenting Author's Institution:** Faculty of Medicine, University of British Columbia

**Co-Author:** Cyrus Bhiladvala, BSc; Roanne Preston, MD, FRCPC

**Background:** Anesthesiologists have been advising women to restrict their oral intake during labour since the 1950s, based on a study that demonstrated a risk of aspiration associated with general anesthesia.<sup>1</sup> Current evidence suggests that this restrictive policy may be outdated.<sup>2,3</sup>

**Objective:** To explore solid and fluid nutritional preferences of women in labour with a prospective survey study.

**Methods:** All women who were admitted and laboured for any duration of time were eligible for inclusion in this single center study. We offered surveys to women at two time points (unpaired responses): one intrapartum and one postpartum. Both surveys asked women to rank various solids (milk products, meats, grain products, fruits and vegetables, processed food, and other) from 1 (best) to 6 (worst) and fluids (water, milk and smoothies, juice, carbonated drinks, sports drinks, energy drinks, coffee, tea, and other) from 1 (best) to 9 (worst). The postpartum survey also asked about nausea, vomiting, and pain medication used during labour.

**Results:** The survey was offered to all labouring patients at a large academic hospital over a 9-month period in 2020. A total of 315 survey responses were collected (165 intrapartum and 150 postpartum). In the intrapartum group, 74% reported a desire to eat during labour, while only 53% of the postpartum participants reported the same ( $\chi^2$ ,  $p < 0.001$ ). The highest ranked solids were fruit/vegetables (intrapartum: median 1, IQR 1-2; postpartum: median 2, IQR 1-2) and grain products (intrapartum: median 2, IQR 1.5-3; postpartum: median 2, IQR 1-3), while the highest ranked fluids were water (intrapartum: median 1, IQR 1-1) and juice (intrapartum: median 2, IQR 2-3). The proportion of women who experienced nausea, vomiting, or had morphine, fentanyl, or nitrous oxide during labour that reported the desire to eat was statistically similar to their counterparts who did not have these variables ( $\chi^2$ ,  $p > 0.14$  for all). Women who had an epidural were more likely to report a desire to eat during labour if given the option ( $\chi^2$ ,  $p < 0.0001$ ).

**Conclusion:** More than half of the participants had a desire to eat during labour, especially those who had an epidural. The most highly ranked solids were fruits, vegetables, and grain products, and the most highly ranked fluids were water and juice. This data can be used to help guide future research in the safety of different types of solids and fluids in labour and help hospitals in their transition from an NPO policy.

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## **High Dependency Unit on the Labor and Delivery Floor**

**Presenting Author:** Rustin L. Roberts, MD

**Presenting Author's Institution:** Ochsner Medical Center

**Co-Author:** Allison Clark, M.D; Jane Martin, MD

**Introduction:** High Dependency Units (HDU) allow for care of parturients at an increased risk of morbidity to continue on the labor unit, avoiding costly intensive care unit (ICU) admission and disruption of the family unit during hospitalization. This retrospective project aimed to quantify the potential for HDU utilization at a Level IV maternal care center.

**Methods:** All maternal ICU admissions for a three year period were reviewed by obstetric anesthesia and maternal fetal medicine. Maternal demographic data, ICU and hospital length of stay (LOS), ASA classification, admitting and secondary diagnoses, invasive monitoring, and ventilatory requirements were recorded. Cases were then classified as HDU vs. ICU appropriate by both teams based on need for mechanical ventilation, multiorgan failure, or complex condition requiring ICU care.

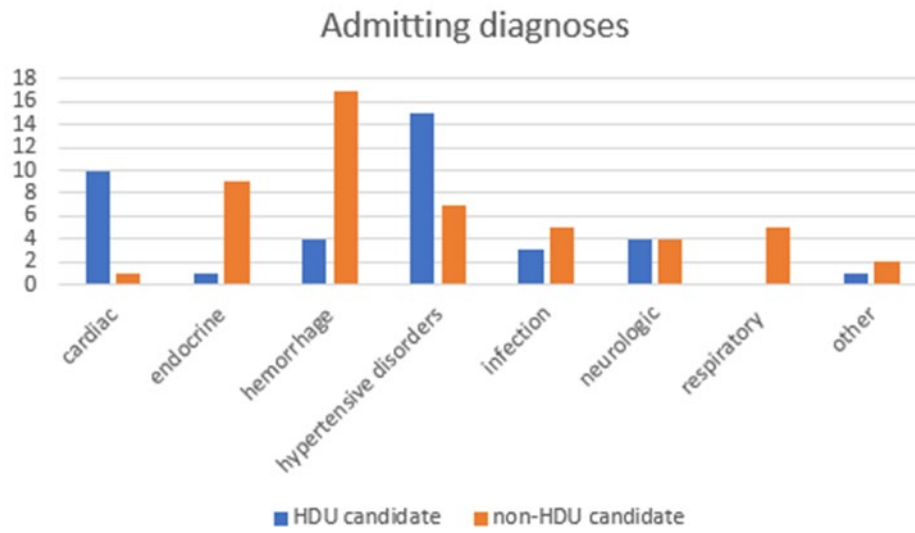
**Results:** Ochsner Baptist is a level IV tertiary referral center for the Gulf Coast and state of Louisiana. A total of 88 parturients were admitted to the ICU over this 3 year period (January 2016-December 2018) representing < 1% of all deliveries at our facility. 34 (38.6%) of these cases met HDU admission criteria. Demographic data (parity, ethnicity, age, or body mass index), ASA classifications, and comorbidities did not differ between groups. HDU candidates were more likely to be admitted for endocrine disorders and hemorrhage, while non-HDU candidates were more likely to be admitted for cardiac and hypertensive disorders ( $p < 0.01$ ). HDU candidates were less likely to require invasive monitoring (34% vs. 56%,  $p < 0.01$ ), less likely to suffer complications during hospitalization ( $p < 0.01$ ), had shorter ICU (1.4 vs. 3.5 days,  $p < 0.01$ ) & hospital LOS (6 vs 9 days,  $p=0.04$ ).

**Discussion:** HDU care is an underutilized method of providing a higher level of maternal care at our institution, and had the potential to decrease maternal ICU admission by 38.6% over a 3 year period. This model should be considered for a multitude of reasons, most importantly keeping these patients in close proximity to their obstetric providers and obstetric anesthesia colleagues, reducing hospital costs, increasing maternal comfort, and reducing disruption of the family unit by allowing rooming in with the neonate and family. On our unit we will use this data to encourage the use of newly built HDU rooms when admission criteria are met.

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## Using verbal and physical cues to identify temporary co-leaders during an obstetrical critical event in the operating room

**Presenting Author:** Grace Shih, M.D.

**Presenting Author's Institution:** Kansas University Health System

**Co-Author:** Mae Winchester, MD; Kelli Krase, MD; Shariska Petersen, MD; Steve Tarver, MD; Julie Broski, PhD

**Introduction:** Critical events in the operating room may expose failures in communication and teamwork processes. We conducted an observational study to understand participants' response to using a visual cue to identify team leaders during a simulated critical event in the operating room.

**Methods:** One-hundred-seventy-two participants of a single tertiary care center, including anesthesiology and obstetric and gynecology faculty, residents, CRNAs, surgical technicians, and nurses, participated in simulation training for maternal cardiac arrest and massive postpartum hemorrhage. During the simulated critical event, participants were instructed to transfer team leadership from the traditional surgeon-lead model to a shared co-leadership model between an anesthesiologist and nurse not involved in direct patient care. Anesthesia and nursing co-leads used a verbal declaration and red surgical bouffant to identify their role. A multi-disciplinary team analyzed debriefing transcripts after the institutional review board deemed the study quality improvement research.

**Results:** Transcript analysis revealed the following key themes: few learners were aware of the verbal declaration of leadership, learners perceived that use of the red hat facilitated task delegation, reduced surgeon distraction, and improved communication. Participants reported that using a red hat to identify leadership in the operating room would improve real-life critical events.

Numerous participants indicated that the red hat helped with task delegation, "it's really a great idea to have somebody that's like an obvious designated lead you go up to, 'What do you need me to grab? What do you need me to do? Who do you need me to call?'"

Another learner described that red hats "adds that instant organization of, 'Oh, this is whom I should go to to get a job.' Instead of just asking everyone in the room, one by one, 'What can I do?'"

Another participant reported that red hats "created an opportunity for delegation and everyone knowing their roles."

A surgeon indicated that the red hat facilitated her communication; she described that it is challenging being in the center of the room, trying to delegate and not know who is available, "if you have that nurse that you know is in the red hat, that's who I'm talking to because you know who in the room is going to be available."

Several surgeons indicated that the red hat enhanced efficiency, "we're not waiting, there's no gap. It makes for a smoother transition."

### **Conclusion/Implications:**

Using a red hat to implement anesthesia and nurse shared co-leadership may enhance managing teams' response to critical events in the operating room.



## **Anesthesia and Nursing Leadership During an Obstetrical Critical Event Enhances Communication, Performance, and Teamwork**

**Presenting Author:** Grace Shih, M.D.

**Presenting Author's Institution:** Kansas University Health System

**Co-Author:** Mae Winchester, MD; Kelli Krase, MD; Steve Tarver, MD; Amy Wolverton, RN; Julie Broski, PhD

**Introduction:** Responding to a critical event in the operating room, such as massive hemorrhage, requires multiple subspecialists to coordinate their actions during a dynamic situation. Traditionally, the operating surgeon leads this effort. However, unanticipated critical events often require surgeons or anesthesiologists to focus on immediate tasks, compromising situational awareness and maintaining a shared mental model among the team. Shared co-leadership between an anesthesiologist and nurse may be a better alternative during a critical event. With shared co-leadership, an anesthesiologist and a nurse do not have direct patient care duties, which allows them to focus on the overall situation. An observational study was conducted to understand participants' perceptions of using shared co-leadership to manage an obstetrical critical event in an operating room simulation.

**Methods:** One-hundred-seventy-two participants of a single tertiary care center, including anesthesiology and obstetrics and gynecology staff, including faculty, resident, CRNAs, and nurses, participated in 15 simulation-based training sessions for massive postpartum hemorrhage and cardiac arrest. Participants practiced transferring leadership from surgeon-as-leader to a shared anesthesia and nursing co-leadership. Co-leaders declared leadership verbally and donned a red surgical bouffant to designate leadership. A multi-disciplinary team analyzed debriefing transcripts.

**Results:** Transcript analysis revealed that shared co-leadership facilitated communication, surgeon focus, task delegation, and performance.

An anesthesiologist indicated it was "helpful that there was, someone...more familiar with the nursing staff, so I have a partner that I could help disseminate tasks to."

A nurse described the importance of partnering with anesthesia, "we often focus on what the surgeon needs, but we...forget what anesthesia needs."

A surgeon reflected that shared co-leadership was a "relief." She described that during a critical event, she is trying to lead and "trying to focus on the patient, and she's bleeding...it's really hard to do both."

An anesthesiologist described that practicing shared co-leadership prompted him to question his assumptions about leadership during a critical event, "I guess I'd always thought when there's a critical event, it's usually the surgeons and the anesthesia team working to solve it. That's probably been incorrect. The surgeons are doing what they can [and their] view of the patient is about a two by two foot area... I don't know that I'd appreciated... my partner is the nursing leader in the room."

### **Conclusion/Implications:**

Anesthesiology and nursing shared co-leadership may facilitate communication, performance, and teamwork during critical obstetrical events in the operating room, which may be associated with improved patient safety and outcomes.



**Mitochondrial dysfunction accompanies placental aging and promotes labor onset**

**Presenting Author:** Erin J. Ciampa, MD, PhD

**Presenting Author's Institution:** Beth Israel Deaconess Medical Center

**Co-Author:** Padraic Flahardy, n/a; Harini Srinivasan, n/a; Linus Tsai, MD, PhD; Samir Parikh, MD

**Abstract :** One in ten babies in the United States is born preterm<sup>1</sup>, and prematurity subjects these infants to an array of short- and long-term health problems<sup>2</sup>. The majority of preterm births have no known cause<sup>3</sup>.

The placenta has been noted to exhibit hallmarks of cellular aging in final weeks of even healthy pregnancies<sup>4,5</sup>. It has been speculated that the molecular signals responsible for the onset of labor could originate in part from the aging placenta, but particular mechanisms have not been proven.

We analyzed a previously published microarray dataset<sup>6</sup> representing global mouse placental RNA expression across advancing gestational ages, and found that a gene signature emerges reflecting enhanced mitochondrial dysfunction and cellular senescence as the pregnancy nears its natural end. These changes mirror effects we observed in a model of aging trophoblasts we have created in vitro. Further, we have demonstrated that induction of placental mitochondrial dysfunction in a mouse model is sufficient to shorten gestational length and are exploring interventions aimed at restoring mitochondrial health that may be able to prolong pregnancy in this model.

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## **A Cellular Model of Placental Aging**

**Presenting Author:** Padraich Flahardy, n/a

**Presenting Author's Institution:** Beth Israel Deaconess Medical Center

**Co-Author:** Erin J. Ciampa, MD, PhD; Harini Srinivasan, n/a; Linus Tsai, MD, PhD; Samir Parikh, MD;

**Abstract :** Pre-term labor burdens many pregnancies, and no underlying cause is understood for most cases [1]. While placental aging has been proposed as a contributing factor in the onset of labor, specific mechanisms have not been elucidated [2]. Labor is characterized as a state of sterile inflammation in the gestational tissues, and many in vivo models demonstrate that exogenously derived local or systemic inflammation is sufficient to induce labor onset in mice and other species [3]. We hypothesize that dysfunctional mitochondria in aging placental trophoblasts could be an endogenous source of these inflammatory mediators at the end of pregnancy. To test this hypothesis, we developed an in vitro model of mitochondrial dysfunction and aging in trophoblasts using the HIF1a stabilizing compound cobalt chloride (CoCl<sub>2</sub>). CoCl<sub>2</sub> drives JAR cells to senescence as noted by increased expression of senescence associated  $\beta$ -galactosidase, permanent growth arrest, and induction of a senescent-associated secretory phenotype. We also demonstrate mitochondrial dysfunction upon CoCl<sub>2</sub> administration, in the form of decreased mitochondrial abundance, increased mitochondrial reactive oxygen species, and mitochondrial membrane depolarization. RNA Sequencing following CoCl<sub>2</sub> treatment confirmed upregulation of pro-inflammatory pathways such as interferon signaling, and downregulation of pathways associated with mitochondrial biogenesis and oxidative phosphorylation. We found that pre-treatment of the cells with a Sirtuin1 (SIRT1) activator (sodium hydrogen sulfide or resveratrol) attenuated the appearance of senescence upon CoCl<sub>2</sub> administration, suggesting that targets of SIRT1 may be important in protecting these cells against aging. Our in vitro model of placental aging provides a valuable tool for future experiments in which we can probe candidate pathways that may delay the onset of placental aging and generation of inflammatory mediators in vivo.

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## Combined Spinal-Epidural and Fetal Heart Rate Monitoring: Time to Reevaluate the Use of Intrathecal Fentanyl

**Presenting Author:** Javier Jose Polania Gutierrez, MD

**Presenting Author's Institution:** Augusta University

**Co-Author:** Efrain Riveros-Perez, MD; Miguel Plaza Lloret, MD; Klifford Alexander Rocuts Martinez, MD; ;

**Intro:** Combined Spinal Epidural (CSE) techniques are popular. Although the literature is controversial, CSE has been associated with fetal heart rate abnormalities(1).Mardirosoff et al.found an association between intrathecal opioids and fetal bradycardia. The frequency of these adverse outcomes after a neuraxial technique may vary according to the technique and pharmacological agents administered. We conducted a retrospective comparative analysis evaluating the use of CSE versus epidural techniques with and without opioids during labor analgesia.

**Methods:** After IRB approval, 2500 charts of women admitted to the L&D unit from Nov. 2017 to Aug. 2020 were identified. Charts were screened for parturients at term (>37 weeks) receiving a neuraxial technique for labor analgesia. Patients with preeclampsia, eclampsia, uncontrolled diabetes mellitus, gestational diabetes, gestational hypertension, substance abuse, or those requiring psychotropic drugs during labor were excluded. Primary analysis compared CSE and epidural techniques;Subsequently a subgroup analysis and a logistic regression were conducted.

**Results:** 1078 medical records were used for statistical analysis. Tachysystole (>5 uterine contractions in 10 minutes)was twice as likely with CSE (OR: 2.28 [1.40-3.70]). Likewise, the likelihood of having late decelerations was 1.6 times higher using CSE for labor analgesia(OR: 1.65 [1.19-2.27]). Hypotension as the root cause of late decelerations was ruled out. The presence of late decelerations after neuraxial technique increased the odds of emergency cesarean delivery by 14 times (OR: 14.6 (7.49 - 28.4). Subgroup analysis found a statistically significant association between CSE with intrathecal fentanyl and tachysystole ( $p=0.05$ ). Similarly, the association between CSE with intrathecal fentanyl and late decelerations frequency was significant ( $p=0.00$ ). The logistic regression identifies the use of epidural technique, patients with normal weight, no vasopressor use after neuraxial technique, and early analgesia during the latent phase of labor as protective factors against the development of late decelerations. Increased number of uterine contractions and combined spinal-epidural technique with increased uterine contractions were risk factors for the development of late decelerations.

**Discussion:** Intrathecal fentanyl reproduces the pathophysiological effects described by Mardirosoff et al.Late decelerations represent uteroplacental insufficiency, fetal hypoxemia, and fetal acidemia that contribute to fetal bradycardia and intrauterine demise. CSE remains a powerful tool for pain management during labor; however, the risk-benefit of using intrathecal opioids should be reevaluated. Prospective studies comparing equipotent alternatives, such as local anesthetics in the intrathecal space, are needed to unveil the best labor analgesia strategy. Providing early analgesia during labor may help patients avoid painful contractions and decrease late decelerations.



## Effect of enhanced recovery after surgery for elective cesarean deliveries on neonatal outcomes

**Presenting Author:** Khadija Razzaq, B.S.

**Presenting Author's Institution:** University of Virginia

**Co-Author:** Sunny Chiao, M.D.; Jessica Sheeran, MD; Mohamed Tiourine, M.D.

**Objectives:** Enhanced recovery after surgery (ERAS) protocols for elective cesarean deliveries are patient-centered, evidence-based perioperative pathways designed to improve maternal outcomes, reduce opioid consumption and post-surgical pain, and hasten return of normal organ function with decreased hospital lengths of stay [1]. Data is lacking about the impact of ERAS on neonatal outcomes. Given there are higher rates of neonatal adverse events in neonates delivered via elective cesarean delivery, investigation into neonatal outcomes after elective cesarean delivery with ERAS protocol is necessary [2]. We hypothesized ERAS would not result in change in rates of neonatal adverse events, neonatal length of stay, or breastfeeding incidence.

**Methods:** A retrospective electronic chart review was conducted to analyze neonatal and maternal data from elective cesarean delivery at  $\geq 39$  weeks gestational age between September 2014 and August 2018 at a single institution before and after implementation of an ERAS protocol. The primary outcome for this study was neonatal adverse events with a secondary outcome of breastfeeding rates. Neonatal adverse events were defined as: neonatal length of stay exceeding maternal length of stay, hypoglycemia, jaundice, NICU admission, and thirty-day readmission. Univariate analyses were conducted in order to detect differences in outcomes before and after ERAS implementation.

**Results:** Compared to pre-ERAS (n=135), the post-ERAS group (n=227) experienced fewer neonatal adverse events (33.0% vs. 47.4%,  $p = 0.009$ ) and greater breastfeeding rates (80.2% vs. 67.4%,  $p = 0.009$ ; Table 1). Specifically, the post-ERAS group experienced decreased incidence of hypoglycemia (4.8% vs. 12.6%,  $p = 0.014$ ) and jaundice (20.7% vs. 31.1%,  $p = 0.036$ ). There was no significant difference in incidence of neonatal length of stay exceeding maternal length of stay (10.6% vs. 10.4%,  $p=1.000$ ). Neonatal adverse events were associated with infants with greater birth weight ( $3.59 \pm 0.52$  vs.  $3.47 \pm 0.41$  kg,  $p = 0.021$ ), but no other demographic predictors. **Conclusions:** Implementation of an ERAS protocol for elective cesarean delivery was associated with a significant reduction in neonatal adverse events and increased breastfeeding rates. Importantly, implementation of ERAS protocol was not associated with increased neonatal length of stay. Limitations to our study include using an exclusion criteria of gestational age less than 39 weeks. ERAS protocol for cesarean delivery does not negatively impact neonates and may provide some neonatal benefits. Future research should focus on mechanism of reduction in hypoglycemia and jaundice rates.

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## Correlating Prenatal and Delivery Platelet Count Values in Obstetric Patients: Clinical Utility of Reflexive Admission Laboratory Assessments

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**Presenting Author's Institution:** University of Pittsburgh Medical Center, University of Pittsburgh School of Medicine, Pittsburgh, PA

**Co-Author:** Anna Binstock, MD; Jacob Larkin, MD; Grace Lim, MD, MSc

**Intro:** Current practice guidelines state that admission platelet count is not necessary in healthy pregnant patients prior to neuraxial procedures [1], whereas admission blood counts are often ordered to identify risk for postpartum hemorrhage [2]. However, these recommendations are based on expert opinion and Level B2-4 evidence: non-comparative observational studies and case reports. The purpose of this study is to provide high-quality, comparative evidence to evaluate the recommendations on intrapartum lab testing in healthy pregnant patients. We hypothesized that in uncomplicated pregnant patients, no difference exists between 3rd trimester prenatal and admission intrapartum platelet count values.

**Methods:** Data from a single large volume tertiary care center were abstracted from medical records from January 2018 to October 2019. Complete blood counts are reflexively ordered and resulted on all women admitted for childbirth for the primary purpose of hemorrhage risk stratification. An uncomplicated medical history was defined as the absence of the following: chorioamnionitis, hypertensive disorder, abruption or acute bleeding of any nature, placenta accreta spectrum, placenta previa, obesity (BMI >35), grand multiparity, and prior cesarean delivery or uterine scar. Linear and logistic regression assessed relationship between prenatal and delivery platelet counts and risk for thrombocytopenia at delivery (defined as platelet count < 70k) after adjusting for abnormal medical history.

**Results:** 8,803 deliveries occurred in the study period and had both prenatal (3rd trimester) and delivery platelet counts recorded. 5,143 had complete labor and delivery medical history data; 1,385 (26.9%) met criteria for an uncomplicated history and 3,758 (73.1%) did not. Prenatal platelet count was predictive of delivery platelet count ( $R^2 = 0.67$ ,  $\beta = 0.79$ , 95%CI 0.78 to 0.80,  $P < 0.001$ ) (Figure). After adjusting for abnormal history, prenatal thrombocytopenia was significantly more likely to have delivery thrombocytopenia (aOR 1714.7, 95% CI 456.6-6439.2,  $P < 0.001$ ). 2 complicated patients (0.04%) had normal 3rd trimester platelet counts and developed thrombocytopenia (27k and 45k) on admission; both presented with HELLP syndrome and justified admission labs. No patients with normal 3rd trimester platelet counts and an uncomplicated history and labor course developed admission thrombocytopenia (Figure).

**Conclusion:** Prenatal platelet count is predictive of delivery platelet count values. These data provide additional evidence to support published recommendations that delivery platelet counts are not required prior to neuraxial, provided that third trimester labs, patient history, and delivery circumstances are uncomplicated. Further analyses can reveal the potential utility of admission hemoglobin for anemia detection, to inform obstetric hemorrhage/transfusion risk stratification.

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**The association between umbilical cord, maternal and neonatal sodium concentration: using cord gas analysis to expedite a diagnosis of peripartum hyponatraemia.**

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**Co-Author:** Arani Pillai, MBBS FRCA

**Introduction:** Hyponatraemia is potentially life threatening and treatable, yet often overlooked in the intrapartum period. Non-specific early symptoms can result in a delayed diagnosis. Umbilical artery and venous serum sodium is noted to be correlated to maternal plasma sodium.<sup>1</sup> Published hyponatraemia guidelines neglect to use cord blood to aid diagnosis of maternal or neonatal hyponatraemia. We aim to assess the links between umbilical artery sodium and maternal and neonatal sodium in symptomatic and non-symptomatic hyponatraemia.

**Method:** During 2017-2019 we reviewed the cases of all severe intrapartum hyponatraemia within our hospital trust (approximately 8500 births/year across 2 hospital sites). Severe hyponatraemia was defined as serum sodium < 125mmol/L.

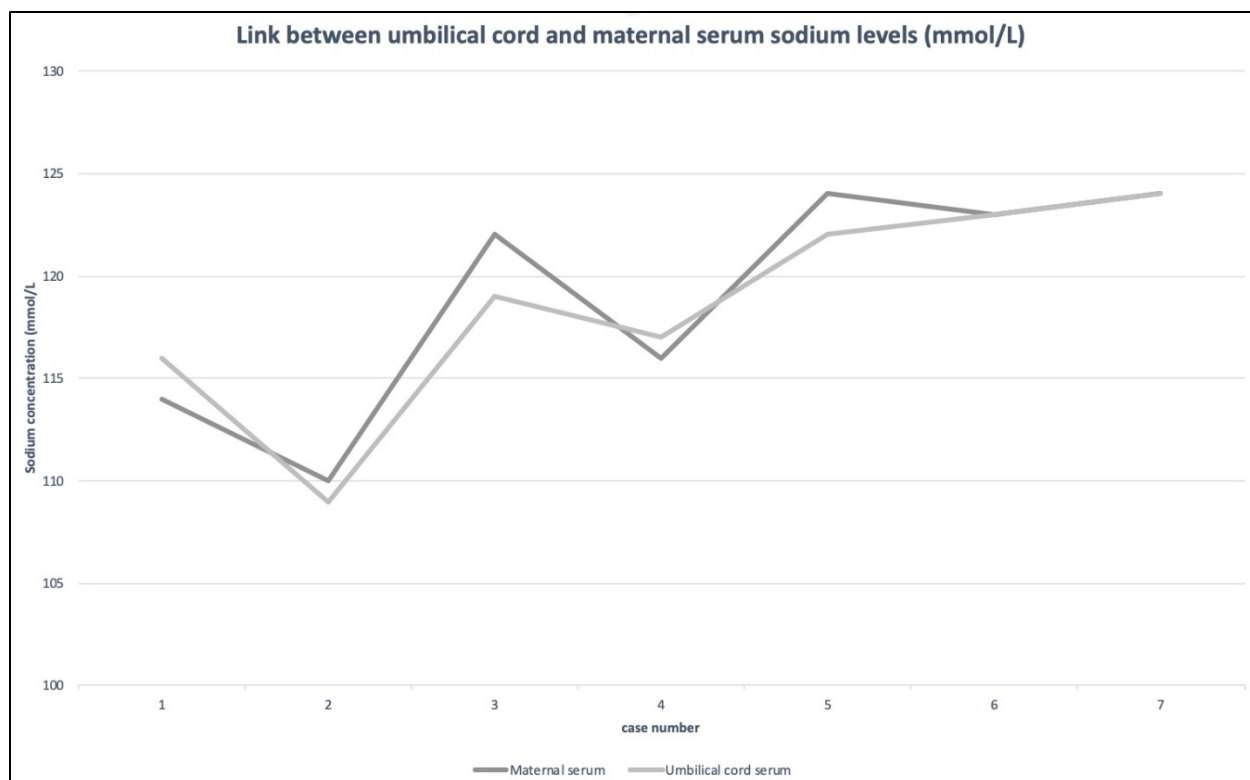
**Results:** 6 cases were identified as having symptomatic severe hyponatraemia and of these the mean maternal serum sodium level was 116.5 mmol/L (110-120 mmol/L). 3 of the cases had cord gas samples taken and 5 cases had neonatal serum sodium levels taken. Comparison between the maternal serum and cord gas sodium levels showed a maximum of 3mmol/L difference between the 2 values. All neonatal serum sodium levels taken also showed hyponatraemia with a mean time of testing 11.9 hours post-delivery (range 7.5-15.5 hours). All of the women and 3 of the neonates received treatment to correct hyponatraemia after diagnosis. A further 4 cases were identified as asymptomatic severe maternal hyponatraemia where cord gas analysis occurred at delivery. Of these the mean maternal sodium level was 121.75mmol/L (116-124 mmol/L). Comparison of these results with the corresponding umbilical cord gas sodium concentrations showed a maximum of 2mmol/L difference between the 2 values.

**Discussion:** Review of these cases shows that in women who are asymptomatic or exhibit non-specific symptoms in labour, rapid point of care measurement of a cord sodium level at delivery could expedite further investigations of both the mother and neonate to reduce the delay in diagnosis and management of their hyponatraemia.

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## Maternal Pain Management for Fetal Myelomeningocele Repairs: From Fetal Surgery to Delivery

**Presenting Author:** Claire Naus, MD

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**Co-Author:** Ruthi Landau, MD; Laurence E. Ring, MD

**Introduction:** Fetal myelomeningocele (MMC) repair is now commonly performed via a minimally-invasive fetoscopic approach. For both open and fetoscopic repairs, maintenance of uterine relaxation during and after the surgery is paramount.<sup>1,2</sup> The fetoscopic approach avoids a hysterotomy, reducing maternal morbidity and making it possible to have a vaginal delivery; however, positioning and accessing the fetus for the repair is a significant challenge of that approach. We report here on the challenges with maternal pain management for the fetoscopic procedure itself, as well as the delivery, typically weeks to months later, in the first 4 fetoscopic MMC repairs at our institution over 15 months.

### Case Series

The 4 fetal MMC repairs presented here were all fetoscopic procedures; the first case was via a closed laparoscopic approach with ports made at the skin and on the uterus, and the subsequent 3 cases were via an open laparoscopic approach with a low transverse skin incision and ports on the uterus. Given the importance of uterine relaxation, all patients received multimodal tocolysis (preoperative indomethacin and every 6h for 72h, MgSO<sub>4</sub> intraoperative dose (6g) followed by an infusion (2g/h) and continued for 48h).

Details from each case, including gestational age at the time of the repair, interval between repair and delivery, mode of delivery, and anesthetic for the delivery, are presented (Table). We found that women with an open laparoscopic approach experienced significant postoperative pain, and a multimodal approach combining neuraxial medication, adjuvants, significant doses of oral oxycodone, and TAP blocks was necessary.

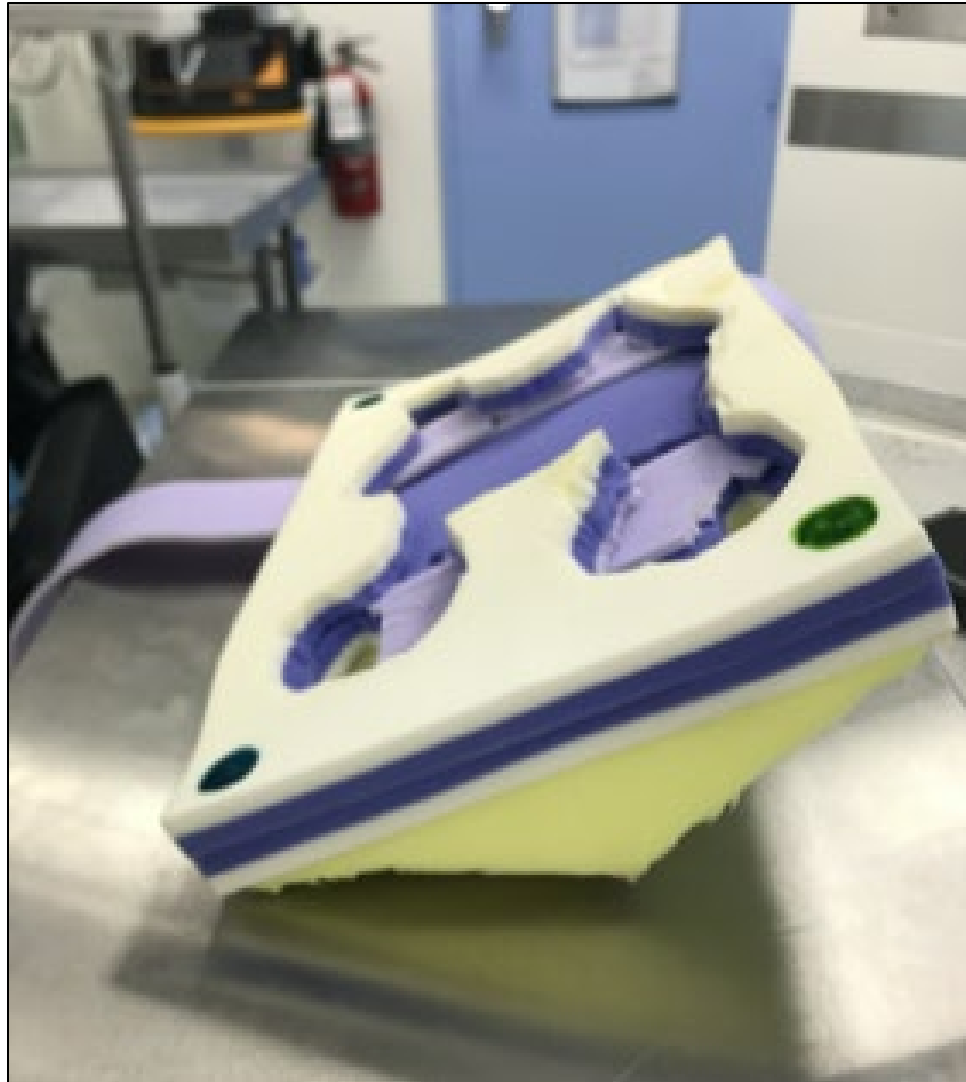
Our strategy for postoperative analgesia continues to evolve (Table). A CSE is placed prior to induction of general anesthesia for the repair, and spinal PF morphine 300mcg is administered. Women are kept on MgSO<sub>4</sub> infusion for 48h following the repair, and since they are mostly bed-bound, pain is managed via a PCEA/PIEB (typically 0.1% bupivacaine/fentanyl 2mcg/cc) until POD2. PF morphine 3mg is administered through the epidural catheter on POD1&2, with oral acetaminophen 975mg every 6 hours for an opioid-sparing effect. For case 4, we performed bilateral TAP blocks on POD2 after stopping the PIEB/PCEA. After the removal of the epidural catheter, analgesia was provided with oxycodone as needed in addition to scheduled acetaminophen.

This series outlines a multimodal approach to postoperative analgesia following fetoscopic MMC repairs. Although pain after the fetal repair was impressive for the 3 open laparoscopic cases, these patients did not require substantially more pain medication after their deliveries (one delivered vaginally), suggesting that the fetal MMC repair itself, despite being minimally-invasive and with a similar low transverse skin incision used for a CD, is a significantly painful procedure.

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## Review of anesthetic management of minimally invasive fetal interventions for complex monochorionic pregnancies

**Presenting Author:** Meryl William, D.O.

**Presenting Author's Institution:** Children's Hospital of Philadelphia, Anesthesiology and Critical Care Medicine

**Co-Author:** Allan Simpao, M.D.; Lezhou Wu, Ph.D.; Brittany Wohler, BSE; Nahla Khalek, M.D.; Olivia Nelson, M.D.

**Introduction:** Vascular anastomoses in monochorionic placentation place these pregnancies at risk for twin-twin transfusion syndrome (TTTS) or selective fetal growth restriction (sFGR).<sup>1</sup> These complications can be treated with second trimester minimally invasive interventions such as fetoscopic selective laser photocoagulation (FSLPC) and selective cord occlusion (SCO) via radiofrequency ablation (RFA).<sup>2,3</sup> In FSLPC, photocoagulation of vascular anastomoses redistributes and normalizes blood flow to both fetuses. SCO utilizes RFA of the umbilical cord to the pre-morbid fetus with the goal of optimizing the co-fetus's survival probability.<sup>4</sup>

General anesthesia, neuraxial anesthesia, and sedation have been used for FSLPC and RFA. At the Children's Hospital of Philadelphia (CHOP) Center for Fetal Diagnosis and Treatment (CFDT), sedation based on clinician preference is used almost exclusively for both procedures, resulting in a heterogeneous mix of approaches. Outcomes related to sedation strategy have not been assessed. We reviewed the anesthetic management of FSLPC and SCO via RFA and the conversion rate from sedation to general anesthesia. This review is the first step towards the creation of a standardized sedation protocol for second trimester minimally invasive fetal interventions at our institution.

**Methods:** This was a single center retrospective cohort review of patients who underwent FSLPC or SCO via RFA at the CFDT at CHOP from January 2015 to December 2019. Exclusion criteria included patients whose initial anesthetic plan was general or neuraxial anesthesia. Patient demographic and perioperative data were extracted from the electronic health record system into a REDCap database. Manual review of the data and descriptive statistics were performed (MW, BW, ON, LW).

**Results:** 345 patients met the inclusion criteria. The study cohort was 73.5% non-Hispanic White, and 96% were ASA Physical Status I or II. A total of 206 FSLPC and 145 SCO via RFA procedures were performed. TTTS was the primary diagnosis in 92.7% of the FSLPC group. The reasons for SCO via RFA included sFGR (53%), TTTS (15.9%) and twin-reverse arterial perfusion sequence (9.0%).

Anesthetic medications included a benzodiazepine in 82.9%, dexmedetomidine in 79.2%, an opioid in 72.1% and propofol in 25.9% of all cases. Four patients (1.9%) undergoing FSLPC were converted to general anesthesia compared to none of the SCO via RFA patients.

**Conclusions:** For patients receiving sedation for FSLPC or SCO via RFA, benzodiazepines, dexmedetomidine and opioids were the most commonly used medications. Conversion to general anesthesia was infrequent and occurred only in patients undergoing FSLPC.

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## Ultrasound-assisted versus landmark-based spinal block performance in emergency caesarean delivery in obese patients at a central hospital – a randomised controlled trial

**Presenting Author:** Bojan Korda, MBBCh (Wits), DA (SA), DipPEC (SA)

**Presenting Author's Institution:** University of the Witwatersrand

**Co-Author:** Dorinka Nel, MBBCh (Wits), FCA (SA), DA (SA); Juan Scribante, PhD; Helen Perrie, MSc; ;

**Background:** An ultrasound-assisted spinal block technique for obstetric anaesthesia has not been studied in an African population or during emergency caesarean delivery. The aim of the study was to assess the effect of preprocedural neuraxial ultrasound on the performance of spinal blockade in obese parturients undergoing spinal block for emergency caesarean delivery in a central hospital in South Africa.

**Methods:** Adult women booked for emergency caesarean delivery under spinal block had preprocedural ultrasound performed during the preoperative period. They were randomised to either a landmark-based group (LMG) or an ultrasound-assisted group (USG). The USG had identified landmarks marked to assist the anaesthetist. The primary end-points were first-pass success rate, difficult spinal block rate, procedure time, number of needle punctures and needle passes. Secondary end-points include the intervertebral spaces attempted, the predicted ultrasound distance and actual needle depth.

**Results:** Thirty-six participants were recruited between January and February 2020. The USG was associated with a shorter procedure time (48s versus 97s,  $p=0.049$ ) and fewer needle passes (3 versus 5.5,  $p=0.026$ ). The LMG had a higher rate of blocks performed at high risk intervertebral spaces (L1/2 or L2/3) compared to the USG (66.7% versus 11.1%,  $p=0.002$ ). The predicted ultrasound distance correlated well with the actual needle depth ( $r = 0.86$ , 95% CI 0.65 -0.95) with a mean difference of 10 mm (range 0 -25 mm).

**Conclusion:** Preprocedural ultrasound improved the technical performance and safety profile of spinal block during emergency caesarean delivery in an African population.





## Importance of Forward Leaning in Optimizing Sitting Position for Administration of Labor Neuraxial Analgesia in Term Parturients: An Ultrasonographical Study

**Presenting Author:** Yan Lin, MD

**Presenting Author's Institution:** BWH

**Co-Author:** Minxian Liang, MD; Xiaonan Liu, MD; Fanjie Zhou, MD; Ken W. Lee, MD; Jie Zhou, MD

**Background:** There is controversy on the optimal sitting position for women in labor undergoing epidural or spinal placement in relation to the interspinous space. In this prospective observational study, we investigated the five sitting positions in order to identify the optimal position that provides the widest lumbar interspinous space (LIS) for neuraxial needle insertion in laboring parturients using ultrasonographic measurements.

**Methods:** We performed ultrasonographic measurements on 38 volunteers at three lumbar levels (L2-L3, L3-L4 and L4-L5) in five different sitting positions: fetal sitting position (FS), traditional sitting position (TS), crossed legs sitting position (CLS), hamstring stretch sitting position (HSS) and modified hugging sitting position (MHS). These five positions were subdivided into two groups based on whether the torso was leaned forward: Hip Flexed Only (HFO) group and Hip Flexed and Leaning forward (HFL) group. The primary outcome was the LIS distances between two adjacent lumbar vertebrae as measured by ultrasonography. The comfort level of each position was also rated by participants.

**Results:** In the HFO group, the widest LIS was at L2-L3 (FS:  $\Delta$  L2-L3 vs. L3-L4 = 2.20 mm,  $\Delta$  L2-L3 vs. L4-L5 = 1.90 mm, TS:  $\Delta$  L2-L3 vs. L3-L4 = 2.90 mm,  $\Delta$  L2-L3 vs. L4-L5 = 1.90 mm, CLS:  $\Delta$  L2-L3 vs. L3-L4 = 2.60 mm). At the L3-L4 level, the HFL group generated wider LIS than the HFO group. Compared with positions in the HFO group, MHS showed a significantly increased LIS by 8.74% ( $\Delta$  MHS vs. FS=2.5mm, 95%CI: 0.1-3.9mm), 9.93% ( $\Delta$  MHS vs. TS=2.9mm, 95%CI: 1.4-4.3mm), and 7.05% ( $\Delta$  MHS vs. CLS=2.1mm, 95%CI: 0.1-3.3mm). HSS showed a significantly increased LIS by 8.56% ( $\Delta$  HSS vs. TS=2.5mm, 95%CI: 1.2-3.8mm) and 7.12% ( $\Delta$  HSS vs. CLS=2.1mm, 95%CI: 0.5-3.6mm). At L2-L3 and L4-L5, there was no statistically significant difference between five sitting positions at each lumbar level. MHS had the highest comfort level and was preferred by 47.37% of subjects.









































**Discussion:** In term parturients, the width of the interspinous space was maximally increased in HFL positions with forward lean compared to HFO positions without forward lean at L3-L4. This implies that the forward leaning process could be crucial for successful neuraxial administration. The modified hugging sitting position was found to be more comfortable than the hamstring-stretch sitting position. For HFO parturients, whose forward leaning mobility is limited, the L2-L3 level showed the widest LIS for neuraxial access.

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**Table 1. Pairwise Comparisons of the L2-L5 Lumbar Vertebral Level in Different Sitting Positions**

Vertebral level	Comparison						The mean difference (mm)	95% CI (mm)	Difference%	P-value	Adjusted P-value
L2-L3	MHS	vs	FS		vs		0.3	-0.1, 1.6	0.95	0.634	1.000
	MHS	vs	TS		vs		0.6	-1.1, 2.3	1.88	0.474	1.000
	MHS	vs	CLS		vs		-1.1	-3.0, 0.1	3.40	0.282	1.000
	MHS	vs	HSS		vs		-1.2	-2.9, 0.4	3.68	0.136	1.000
	HSS	vs	FS		vs		0.9	-0.2, 2.1	2.84	0.122	1.000
	HSS	vs	TS		vs		0.6	-1.1, 2.4	1.88	0.472	1.000
	HSS	vs	CLS		vs		0.2	-1.1, 1.5	0.62	0.792	0.792
	CLS	vs	TS		vs		0.4	-1.2, 2.1	1.25	0.596	1.000
	CLS	vs	FS		vs		0.7	-0.6, 2.2	2.21	0.298	1.000
	FS	vs	TS		vs		0.3	-1.2, 1.8	0.95	0.689	1.000
L3-L4	MHS	vs	FS		vs		2.5	0.1, 3.9	8.47	0.001	0.01
	MHS	vs	TS		vs		2.9	1.4, 4.3	9.93	<0.001	0.01
	MHS	vs	CLS		vs		2.1	0.1, 3.3	7.05	0.001	0.01
	MHS	vs	HSS		vs		0.4	-1.1, 1.7	1.27	0.928	1.000
	HSS	vs	FS		vs		2.1	0.5, 3.6	7.12	0.007	0.049
	HSS	vs	TS		vs		2.5	1.2, 3.8	8.56	<0.001	0.01
	HSS	vs	CLS		vs		1.7	0.3, 3.2	5.70	0.019	0.114
	CLS	vs	TS		vs		0.7	-0.6, 2.2	2.40	0.299	1.000
	CLS	vs	FS		vs		0.3	-1.0, 1.6	1.02	0.635	1.000
	FS	vs	TS		vs		0.4	-0.9, 1.7	1.36	0.522	1.000
L4-L5	MHS	vs	FS		vs		0.9	-0.7, 2.7	3.02	0.256	1.000
	MHS	vs	TS		vs		1.0	-0.4, 2.4	3.32	0.159	1.000
	MHS	vs	CLS		vs		0.5	-1.0, 2.1	1.64	0.469	1.000
	MHS	vs	HSS		vs		-0.4	-2.2, 1.4	1.27	0.636	0.636
	HSS	vs	FS		vs		1.7	0.2, 3.2	5.70	0.021	0.210
	HSS	vs	TS		vs		1.3	-0.1, 2.7	4.32	0.073	1.000
	HSS	vs	CLS		vs		0.4	-1.0, 1.8	1.31	0.565	0.792
	CLS	vs	TS		vs		1.4	0.8, 2.7	4.65	0.037	0.333
	CLS	vs	FS		vs		0.7	-0.8, 2.3	2.35	0.362	1.000
	FS	vs	TS		vs		0.3	-0.1, 1.6	1.01	0.617	1.000

**Table 2. Pairwise Comparisons of the L2-L5 Lumbar Interspinous Space in Different Sitting Positions**

Position	Comparison	The mean difference (mm)	95% CI (mm)	Difference %	P-value	Adjusted P-value
	L2-L3 vs L3-L4	2.20	0.9, 3.3	7.46	0.0006	0.0018
	L2-L3 vs L3-L5	1.90	0.7, 3.1	6.38	0.0025	0.005
FS	L4-L5 vs L3-L4	0.20	-1.0, 1.5	0.68	0.685	0.685
	L2-L3 vs L3-L4	2.90	1.4, 4.3	9.93	0.0003	0.0009
	L2-L3 vs L3-L5	1.90	0.3, 3.4	6.31	0.017	0.034
TS	L4-L5 vs L3-L4	1.00	-0.3, 2.3	3.42	0.133	0.133
	L2-L3 vs L3-L4	2.60	0.7, 4.5	8.72	0.007	0.021
	L2-L3 vs L3-L5	1.90	-0.7, 3.9	6.23	0.058	0.116
CLS	L4-L5 vs L3-L4	0.60	-0.7, 2.1	2.01	0.342	0.342
	L2-L3 vs L3-L4	1.00	-0.3, 2.4	3.16	0.153	0.306
	L2-L3 vs L3-L5	1.10	-0.3, 2.4	3.49	0.107	0.321
HSS	L3-L4 vs L4-L5	1.10	-1.4, 1.6	3.49	0.889	0.889
	L3-L5 vs L2-L3	0.60	-1.0, 2.2	1.91	0.462	1.000
	L2-L3 vs L4-L5	0.30	-1.3, 1.9	0.96	0.699	0.699
MHS	L3-L4 vs L4-L5	0.60	-1.3, 2.5	1.93	0.524	1.000

FS: Fetal Sitting position, TS: Traditional Sitting position, CLS: Crossed Legs Sitting position, HSS: Hamstring Stretch Sitting position, MHS: Modified Hugging Sitting position



## **A multicenter interdisciplinary national survey of practices and perceptions regarding oral intake during labor**

**Presenting Author:** Elisheva Fiszer

**Presenting Author's Institution:** Tel Aviv Sourasky Medical Center, Israel

**Co-Author:** Mindy Ebrahimoff; Michal Axelrod; Alexander Ioscovich; Carolyn F. Weiniger, Md

**Background:** The ACOG/ASA guidelines discourage oral intake during labor, however the WHO recommends “non-interference”. Our goal was to assess practices and opinions in labor and delivery (L&D) wards in Israel, specifically comparing different disciplines: anesthesiologists, obstetricians and midwives (nurses).

**Methods:** A survey was sent for anonymous completion to anesthesiologists, obstetricians and midwives in 27 L&D wards in Israel via key coordinators in each medical center. Hospitals were categorized according to L&D annual delivery volume, small (< 5000), medium (5000-10000), or large (>10000). Data collected via Google Forms and descriptive statistics presented.

**Results:** Responses were collected from all 27 L&D wards contacted, total 501 respondents: 161 anesthesiologists, 102 obstetricians, 238 midwives, 48% stated there were no institutional guidelines for oral intake. Responses regarding permitted oral intake: 11% any solid food, 60% light food only, 23% clear liquids and 1% nil per os. No midwives consistently forbid solid food, vs. 1% of obstetricians and 4% of anesthesiologists ( $P < 0.00001$ ). Midwives were significantly more likely than anesthesiologists and obstetricians to believe that both low risk ( $P < 0.00001$ ) and high risk ( $P = 0.001$ ) laboring women should eat (Fig 1). There were no statistically significant differences between disciplines regarding oral intake recommendations for women with or without epidural analgesia. The most prevalent reasons for restricting oral intake included obstetric bleeding (65%), problematic anesthetic history (62%), pre-eclampsia (54%), protracted labor (54%), multiple gestation (50%), trial of labor after cesarean delivery (46%), BMI  $> 40 \text{ kg m}^{-2}$  (33%), suspected fetal weight  $> 4 \text{ kg}$  (33%) and severe gastro-esophageal reflux (21%) (Fig 2). 62% of our cohort correctly identified aspiration as the potential main risk associated with eating during labor, however 19% of midwives stated there were no risks associated with eating, compared to 4% of both obstetricians and anesthesiologists ( $P < 0.00001$ ). Staff opinions did not significantly differ when comparing L&D wards according to annual delivery volume.

**Conclusions:** Midwives were significantly more likely to encourage permissive food policies vs. both anesthesiologists and obstetricians. Placement of labor epidural analgesia did not impact opinions about whether women can eat during labor. Despite Israel Society of Anesthesiologists guidelines recommending limited oral intake during labor, even women at high risk for cesarean delivery were not uniformly advised to avoid food. Standardized achievable guidelines regarding oral intake for low and high risk laboring women are required. Permissive eating practices identified in this survey should be addressed in order to find the ideal, safe middle ground between restrictive and permissive policies, and minimize the aspiration risk for high risk women.



## Ultrasound Image Quality Comparison between an Inexpensive Handheld Ultrasound Machine and a Large Mobile Ultrasound

**Presenting Author:** Nayema K. Salimi, MD

**Presenting Author's Institution:** Yale New Haven Hospital

**Co-Author:** Peter Mancini, M.D; Antonio Gonzalez-Fiol, MD; Kristen Fardelmann, M.D; David Yanez, PhD, MS; Aymen Alian, M.D.

**Abstract :** A handheld/portable ultrasound device is crucial for assessing fetal heart rate, placental position, and for procedural guidance. Given that anesthesiologists and obstetricians routinely use ultrasound, we designed a comparison study utilizing shared resources. This cross-sectional, blinded, and randomized observational study compares the images acquired by a handheld ultrasound machine (Butterfly iQ- BU) and our current mobile ultrasound system, the Sonosite M-turbo US (SU).

Pairs of ultrasound images, one with the BU and one with the SU, were obtained by an experienced sonographer for spine (Sp), transverse abdominis plane (TAP) and diagnostic obstetrics (OB) purposes. The images were cropped, masked to leave only gray-scale images, and presented paired, side by side in a randomized fashion for grading. Three experienced sonologists from each specialty reviewed a total of 74 image pairs: 29 for the Sp, 15 for the TAP, and 30 for OB, for a total of 148 images. Each reviewer rated every pair of images for its resolution (RES), detail (DET), and image quality (IQ). RES was defined as the sharpness and crispness of the image and a lack of haziness/blurriness. DET was defined as clarity of bone/tissue outlines and ease with which boundaries of structures are seen. IQ was an overall assessment encompassing contrast of solid and fluid-filled structures and the absence of noise. Each of these three qualities was rated using a ten-point Likert scale. We estimated mean rating scores for RES, DET, and IQ in separate models; we tested for a difference in the mean rating scores between the device types using Wald statistics. Hypothesis tests, p-values, and confidence intervals are two-sided.

BU spine imaging was favored with mean differences of -0.6 [(95% CI -1.1, -0.1),  $p = 0.017$ ], -0.8 [(95% CI -1.2, -0.3),  $p = 0.001$ ] and -0.9 [95% CI -1.3, -0.4,  $p = 0.001$ ] for RES, DET and IQ, respectively, when compared to SU. For the TAP, the BU image DET was favored with mean difference of -0.8 [(95% CI -1.2, -0.5),  $p < 0.001$ ] when compared to SU. No statistical difference was noted when comparing for RES and IQ. When evaluating the OB images, the SU was favored over the BU with RES, DET and IQ with mean differences of 1.7 [(95% CI 1.2, 2.1),  $p < 0.001$ ], 1.6 [(95% CI 1.2, 2.0],  $p < 0.001$ ] and 1.1 [(95% CI 0.7, 1.5)],  $p < 0.001$ ], respectively. See table 1.

The image characteristics of the BU are comparable to the SU for the spine and TAP. BU may be considered as a potential low-cost alternative to a more expensive ultrasound machine (SU) for anesthetic purposes. We can only speculate that obstetricians are more akin to detect IQ differences given their exposure to images from high-resolution consoles. All reviewers agreed that both devices are appropriate (albeit IQ differences) to obtain basic OB images, neuraxial guidance, and TAP block performance.

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## Echocardiography During Active Labor - Initial Observations and Protocol Implementation

**Presenting Author:** Pirianthini Suntharalingam, MD

**Presenting Author's Institution:** Internal Medicine

**Co-Author:** Leigh Hickerson, MD

**Abstract :** Acquired cardiovascular disease remains the leading cause of death among parturients in the United States. Current prenatal screening missed 25% of severe disease resulting in death.<sup>1-2</sup> The physiologic stress of labor is an opportunity for detecting subclinical cardiovascular disease.

However, echocardiography during labor can be challenging. Examinations must account for altered cardiac position during labor, unique patient positioning, modified views, fundal motion during contractions, and timing with labor breathing.

A protocol was developed to facilitate intrapartum transthoracic echocardiography and it has been performed on 52 parturients in active labor.

**Methods:** Following IRB approval, 52 voluntary term parturients were consented and underwent echocardiograms during active labor (6-10 cm dilation) as an intrinsic stress test. Term pregnancy was defined as  $\geq 37$  weeks gestational age and active labor as  $\geq 6$ cm cervical dilation. Adaptations to conventional echocardiography technique and probe orientation were made to facilitate obtaining standard views in the parturient, as outlined in figure 1.

### Results:

Table 1. Demographics of recruited parturients

Age (years)		29.73 $\pm$ 5.57	
BMI (kg/m <sup>2</sup> )		34.66 $\pm$ 9.72	
Parity		1.38 $\pm$ 0.5	
Race	White	46	88.5%



	American Indian/Alaska Native	0	0.0%
	Asian	2	3.8%
	Native Hawaiian or Other Pacific Islander	0	0.0%
	Black or African American	2	3.8%
Medical Comorbidity	Obesity ( >35 BMI)	16	30.8%
	Chronic HTN	2	3.8%
	Gestational HTN	10	19.2%
	Preeclampsia	2	3.8%
	Asthma	11	21.2%



	Diabetes	10	19.2%
	Tobacco use	1	1.9%
	No medical comorbidities	10	19.2%

**Observations:**

- Obesity did not impact image quality.
- Windows may be affected by uterine contraction in addition to labor breathing patterns.
- Frequent shadowing of the right ventricular free wall can limit assessment regardless of BMI.
- Inferior vena cava assessment was hindered by frequent misidentification of liver cysts and amniotic fluid.

Discussion: Intrapartum echocardiography is a tool for clinical decision making in obstetric anesthesia. However, normal values are not well established. Providers may forego transthoracic echocardiography in high BMI parturients out of perceived difficulty. This pilot data contains a large proportion of patients with BMIs >35. This did not impact image quality. This is likely due to the altered cardiac orientation intrapartum. Obesity should not be a limiting factor in performing echocardiography assessment in the parturient.

Limitations of this study include low racial diversity and high proportion of patients with advanced maternal age among recruited participants. Additional recruitment will allow for additional data in more diverse subgroups.

Figure 1. Altered cardiac position intrapartum affects ultrasound probe orientation.

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# SAVE THE DATE

## **54th Annual Meeting**

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



## **55th Annual Meeting**

Sheraton New Orleans Hotel  
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