SOAP
Society for Obstetric
Anesthesia and Perinatology

49th Annual Meeting

Beyond the Obstetric Suite

SYLLABUS

May 10–14, 2017

Hyatt Regency Bellevue
Bellevue, Washington

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

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SOAP 49th Annual Meeting: Beyond the Obstetric Suite

Welcome Letter

Welcome to the 2017 SOAP Annual Meeting at the Hyatt Regency in Bellevue, Washington!

On behalf of the SOAP Board of Directors and the SOAP 2017 Annual Meeting Program Committee, we would like to invite you to the 49th Annual Meeting of SOAP in Bellevue, Washington May 10-14th, 2017. The theme of this year's meeting is "Beyond the Obstetric Suite" and we are confident that the meeting will appeal to both academic and private practice anesthesiologists. Invited speakers at the SOAP 2017 Annual Meeting are renowned within the fields of obstetric anesthesia, obstetrics and maternal health. In addition, international speakers will add some global perspective to our program.

The Gertie Marx/FAER Lecture will be given by Ansgar M. Brambrink, Professor and Chair at Columbia University who will cover aspects of fetal neurotoxicity relevant to obstetric anesthesiologists. We will have a plenary lecture given by Jerker Liljestrand from the Bill and Melinda Gates Foundation. His lecture "Is Birth Becoming Safer in the World - and What Can We Do?" promises to be both enlightening and thought provoking. This year's Gerard W. Ostheimer Lecture: What's New in Obstetric Anesthesia? will be given by Brian Bateman, Associate Professor at Harvard Medical School. Cynthia Wong, Professor and Chair at University of Iowa will be giving this year's prestigious Fred Hehre Lecture. We are also delighted to be hosting the first ever SOAP Chinese Symposium on Obstetric Anesthesia on May 10th 2017, the day prior to the start of the meeting.

Talks and panels will highlight cutting-edge topics including point-of-care ultrasound techniques, obstetric hemorrhage management, enhanced recovery after cesarean delivery protocols, and programmed-intermittent labor epidural analgesia. For abstract presentations, we have decided to present a hybrid model where both paper posters will be displayed, and electronic posters presented. The research hour will consist of a panel of experts that will discuss the pharmacokinetics and pharmacodynamics of drugs in pregnancy, and aspects of drug transfer to the fetus and breastfeeding neonates. Experts in social media (Larry Chu, Professor, and Edward Mariano, Professor, Stanford University School of Medicine and Ronald George, Associate Professor, Dalhousie University) have been invited to help attendees use social media to improve care for and better educate pregnant women. We will be providing Mandarin real-time translations of key talks during the main program. Please also consider attending our excellent pre-meeting workshops: Patient Safety Workshop: Leading Systems Change, The Use of Ultrasound in Obstetric Anesthesia: Vascular Access, Neuraxial Anesthesia, TAP Block and Gastric Assessment Workshop, Focused Cardiac Ultrasound in the Management of the High Risk Parturient Workshop and Becoming a Successful Obstetric Anesthesiology Leader Workshop.

The meeting takes place at a superb venue, the Hyatt Regency Bellevue. Bellevue is only 10 miles from downtown Seattle, and a shuttle service will provide easy access for those wanting to explore. We will also provide a fun-filled social program with events for all to enjoy. We really look forward to seeing you in Bellevue, Washington May 10-14th, 2017, for a meeting that promises to deliver the highest quality educational and scientific material for both clinicians and researchers.

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Program Information

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

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

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

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

The American Society of Anesthesiologists designates this live activity for a maximum of 30.75 *AMA PRA Category 1 Credit ™**. Physicians should claim only the credit commensurate with the extent of their participation in the activity.

*This amount includes the optional workshops.

Target Audience
The SOAP 49th Annual Meeting is intended for anesthesiologists, obstetricians, neonatologists, obstetric medicine specialists, maternal-fetal medicine specialists, residents, fellows and medical students. The Society supports the attendance by associate members in the educational sessions of the annual meeting. The program is generated from member requests and an assessment of need by the Program Committee. Attendance at this meeting does not guarantee competency or proficiency in the performance of any procedures which may be discussed or taught during the course.

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

Participation in the SOAP 49th Annual Meeting
Attendance shall be open to all health practitioners, provided that they have registered for the meeting. CME credit will only be offered to M.D.s, D.O.s or equivalent.

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

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

1. Describe innovative neuraxial, gastric and focused cardiac ultrasound techniques to enhance the peripartum care of obstetric patients.
2. Identify how physiologic changes associated with pregnancy impact the pharmacokinetics and pharmacodynamics of drugs commonly used in obstetric practice.
3. Decide whether programmed intermittent epidural bolus techniques should be routinely offered as the optimal means for maintaining epidural labor analgesia.
4. Identify, discuss, and critically evaluate recent peer-reviewed research related to obstetric anesthesia, obstetrics, perinatology, and allied medical disciplines
5. Review how to properly use social media and other online platforms for marketing your anesthetic practice and educating pregnant women.
6. Discuss fetal anesthetic neurotoxicity and the potential impact to the fetus and neonate of maternal exposure to analgesic and anesthetic drugs.
7. Identify updates on enhanced recovery protocols after cesarean delivery to better manage perioperative pain and prevent hypothermia, nausea and vomiting.
8. Review controversies about blood management for obstetric hemorrhage.
9. Describe and discuss real-life ethical dilemmas that obstetric anesthesiologists face on the labor and delivery unit.
10. List about the latest medical advances in global health that can be used to reduce rates of maternal death and severe maternal morbidity.

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

Sonosite: Ultrasound Systems

Blue Phantom CAE Healthcare: Manikins

Special Needs Statement
The American Society of Anesthesiologists and the Society for Obstetric Anesthesia and Perinatology are committed to making its activities accessible to all individuals and fully comply with the legal requirements of the Americans with Disabilities Act and the rules and regulations thereof. If you are in need of an accommodation, please do not hesitate to call the SOAP office at (414) 389-8611 and/or submit a description of your needs in writing to info@soap.org.

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.

Program Schedule

Wednesday, May 10, 2017

7:30 a.m. - 6:00 p.m.
Registration Hours
Evergreen Ballroom Foyer

8:00 a.m. - 12:00 p.m.
Patient Safety Workshop: Leading Systems Change
Course Directors: *Unyime Ituk, M.B., B.S.; Jennifer Banayan, M.D.*
Evergreen Ballroom C

8:00 a.m. - 12:00 p.m.
The Use of Ultrasound in Obstetric Anesthesia: Vascular Access, Neuraxial Anesthesia, TAP Block and Gastric Assessment Workshop
Course Director: *Jose C.A. Carvalho, M.D., Ph.D., FANZCA, FRCPC*
Evergreen Ballroom AB

1:00 p.m. - 5:00 p.m.
Applications of Focused Cardiac Ultrasound in the Management of the High Risk Parturient Workshop
Course Director: *Laurie A. Chalifoux, M.D.*
Evergreen Ballroom AB

1:00 p.m. - 5:00 p.m.
Becoming a Successful Obstetric Anesthesiology Leader Workshop
Course Director: *Grant C. Lynde, M.D., M.B.A.*
Evergreen Ballroom C

1:00 p.m. - 5:00 p.m.
Chinese Symposium on Obstetric Anesthesia
Presenters: *Jun Ma, M.D.; Xiaofeng Shen, M.D.; Cynthia A. Wong, M.D.; Mingjun Xu, M.D.; Haiya Yan, M.D.; Shanglong Yao, MD*
Evergreen Ballroom HI

6:00 p.m. - 8:00 p.m.
Welcome Reception
Suite Restaurant/Lounge - Lobby Level of Hyatt

Thursday, May 11, 2017

6:30 a.m. - 3:30 p.m.
Registration Hours
Evergreen Ballroom Foyer

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

View Posters
Evergreen Ballroom EFGH

7:45 a.m. - 8:00 a.m.
Welcome to the 49th Annual Meeting
Brendan Carvalho, M.B.B.Ch., F.R.C.A., M.D.C.H.; Alexander Butwick, M.B.B.S., M.S., F.R.C.A.; Laurent A. Bollag, M.D.; John T. Sullivan, M.D., M.B.A.
Grand Ballroom

8:00 a.m. - 9:30 a.m.
Gertie Marx Research Competition
Moderator: *Richard M. Smiley, M.D., Ph.D.*
Grand Ballroom

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

Poster Viewing
Evergreen Ballroom EFGH

10:00 a.m. - 11:00 a.m.
Gertie Marx/FAER Education Lecture: Anesthetic Neurotoxicity - An Update
Introduction: *Arvind Palanisamy, M.B., B.S., M.D., F.R.C.A.*
Speaker: *Ansgar M. Brambrink, M.D., Ph.D.*
Grand Ballroom

11:00 a.m. - 12:00 p.m.
Poster Session 1
Moderators: *Benjamin G. Cobb, M.D.; Robert A. Dyer, FCA (SA), Ph.D.; Michaela K. Farber, M.D., M.S.; Yehuda Ginosar, B.Sc., M.B., B.S.; Stephen H. Halpern, M.D., M.Sc., FRCPC; Nicole Higgins, M.D.; Mark D. Rollins, M.D., Ph.D.; Philip A. Rubin, M.D.; Andrea J. Traynor, M.D.*
Evergreen Ballroom EFGH

12:00 p.m. - 1:00 p.m.
Lunch On Your Own

1:00 p.m. – 2:15 p.m.
Research Hour: Why Some Drugs Don't Seem to Work and Others Cause More Frequent Side Effects During Pregnancy - A Look at Changes in Drug Exposure During Pregnancy
Moderator: *Pamela Flood, M.D.*
Speakers: *Mary F. Hebert, PharmD, FCCP; Steven Shafer, M.D.*
Grand Ballroom

2:15 p.m. - 3:15 p.m.
Pro-Con Debate: Programmed Intermittent Epidural Bolus
Moderator: *Jeanette R. Bauchat, M.D.*
Speakers: *Roshan Fernando, M.B., Ch.B.; Kenneth E. Nelson, M.D.*
Grand Ballroom

3:15 p.m.
Open Afternoon & Poster Viewing
Evergreen Ballroom EFGH

6:00 p.m. - 8:00 p.m.
Fellows' Reception
(By Invitation)
Evergreen Ballroom I

Friday, May 12, 2017

6:30 a.m. - 5:00 p.m.
Registration Hours
Evergreen Ballroom Foyer

6:30 a.m. - 8:00 a.m.
Continental Breakfast & Exhibits Open
Grand Ballroom Foyer

View Posters
Evergreen Ballroom EFGH

6:45 a.m. - 7:45 a.m.
5K Fun Run/Walk
Hyatt Regency Lobby

7:40 a.m. - 7:45 a.m.
Opening Remarks
Brendan Carvalho, M.B.B.Ch., F.R.C.A., M.D.C.H.
Grand Ballroom

7:45 a.m. - 9:15 a.m
Best Paper Session
Moderator: *David H. Chestnut, M.D.*
Grand Ballroom

9:15 a.m. - 9:30 a.m.
Distinguished Service Award
Recipient: *Robert D'Angelo, M.D.*
Presenter: *Kenneth E. Nelson, M.D.*
Grand Ballroom

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

Poster Viewing
Evergreen Ballroom EFGH

10:00 a.m. - 11:00 a.m.
Fred Hehre Lecture: Two Steps Forward and One Step Forward
Introduction: *Lawrence C. Tsen, M.D.*
Speaker: *Cynthia A. Wong, M.D.*
Grand Ballroom

11:00 a.m. - 12:00 p.m.
Poster Session 2
Moderators: *Yaakov Beilin, M.D.; Maria C. Gutierrez, M.D.; McCallum R. Hoyt, M.D., M.B.A.; Allison J. Lee, M.D., M.B., B.S.; Kenneth E. Nelson, M.D.; Michael J. Paech, M.B., B.S., FANZCA, F.R.C.A., D.M.; May C.M. Pian-Smith, M.D., M.S.; Stephen Pratt, M.D.; Katherine M. Seligman, M.D.; Carolyn Weiniger, M.B., Ch.B.*
Evergreen Ballroom EFGH

Program Schedule *continued on next page*

Program Schedule *continued*

12:00 p.m. - 1:30 p.m.
SOAP Business Meeting & Elections
Boxed lunch will be provided.
Grand Ballroom

1:30 p.m. - 3:00 p.m.
Getting Social
Moderator: *Heather C. Nixon, M.D.*
Speakers: *Lawrence Chu, M.D., M.S.; Ronald B. George, M.D.; Edward R. Mariano, M.D., M.A.S.*
Grand Ballroom

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

Poster Viewing
Evergreen Ballroom EFGH

3:30 p.m. - 5:00 p.m.
Ultrasound for the Obstetric Anesthesiologist
Moderator: *Carolyn Weiniger, M.B., Ch.B.*
Speakers: *Cristian Arzola, M.D., M.Sc.; Jose C.A. Carvalho, M.D., Ph.D., FANZCA, FRCPC; Robert A. Dyer, FCA (SA), Ph.D.*
Grand Ballroom

6:00 p.m. - 10:00 p.m.
SOAP Banquet
Bellevue Arts Museum
510 Bellevue Way NE
Bellevue, WA 98004

Saturday, May 13, 2017

7:00 a.m. - 5:00 p.m.
Registration Hours
Evergreen Ballroom Foyer

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

View Posters
Evergreen Ballroom EFGH

7:40 a.m. - 7:45 a.m.
Opening Remarks
Brendan Carvalho, M.B.B.Ch., F.R.C.A., M.D.C.H.
Grand Ballroom

7:45 a.m. - 9:15 a.m.
Oral Presentations
Moderator: *Philip E. Hess, M.D.*
Grand Ballroom

9:15 a.m. - 9:30 a.m.
Awards Presentations
Grand Ballroom

9:30 a.m. - 10:00 a.m.
Coffee Break
Grand Ballroom Foyer

Poster Viewing
Evergreen Ballroom EFGH

10:00 a.m. - 11:00 a.m.
Is Birth Becoming Safer in the World - and What Can We Do?
Introduction: *Edward T. Riley, M.D.*
Speaker: *Jerker Liljestrand, M.D., Ph.D.*
Grand Ballroom

11:00 a.m. - 12:00 p.m.
Gerard W. Ostheimer Lecture
What's New in Obstetric Anesthesia?
Introduction: *Philip E. Hess, M.D.*
Speaker: *Brian T. Bateman, M.D., M.Sc.*
Grand Ballroom

12:00 p.m. - 1:00 p.m.
Lunch On Your Own & Poster Viewing

1:00 p.m. - 2:00 p.m.
Controversies of Obstetric Hemorrhage Management
Moderator: *Alexander Butwick, M.B.B.S., M.S., F.R.C.A.*
Speakers: *John T. Sullivan, M.D., M.B.A.; Jonathan H. Waters, M.D.*
Grand Ballroom

2:00 p.m. - 3:00 p.m.
Poster Session 3
Moderators: *Mrinalini Balki, M.B., B.S., M.D.; William R. Camann, M.D.; Rebecca D. Minehart, M.D., M.S.H.P.Ed.; Arvind Palanisamy, M.B., B.S., M.D., F.R.C.A.; Edward T. Riley, M.D.; Richard M. Smiley, M.D., Ph.D.; Hans P. Sviggum, M.D.; Lawrence C. Tsen, M.D.; Manuel C. Vallejo, Jr., M.D., D.M.D.; Richard N. Wissler, M.D., Ph.D.*
Evergreen Ballroom EFGH

3:00 p.m. - 3:30 p.m.
Coffee Break & Poster Viewing
Evergreen Ballroom

3:30 p.m. - 5:00 p.m.
Enhanced Recovery After Cesarean Delivery
Moderator: *Mohamed Tiouririne, M.D.*
Speakers: *Ashraf S. Habib, M.B., B.Ch., M.H.Sc., F.R.C.A.; Eric J. Hunt, M.D., Ph.D.; Ruth Landau, M.D.; Pervez Sultan, M.B., B.S., F.R.C.A.*
Grand Ballroom

6:00 p.m. - 10:00 p.m.
Queen Anne Beerhall Social Outing

Sunday, May 14, 2017

6:30 a.m. - 11:30 a.m.
Registration Hours
Evergreen Ballroom Foyer

6:30 a.m. - 8:00 a.m.
Continental Breakfast
Grand Ballroom Foyer

View Posters
Evergreen Ballroom EFGH

7:40 a.m. - 7:45 a.m.
Opening Remarks
Brendan Carvalho, M.B.B.Ch., F.R.C.A., M.D.C.H.
Grand Ballroom

7:45 a.m. - 9:15 a.m.
Best Case Report Panel - Case Report Review with the Experts
Moderator: *Katherine W. Arendt, M.D.*
Panelists: *Lisa R. Leffert, M.D.; Barbara M. Scavone, M.D.; Lawrence C. Tsen, M.D.*
Grand Ballroom

9:15 a.m. - 10:15 a.m.
Ethical Dilemmas in Obstetric Anesthesia
Moderator: *Laurent A. Bollag, M.D.*
Speakers: *Robert R. Gaiser, M.D. Caitlin D. Sutton, M.D.; Paloma Toledo, M.D., M.P.H.*
Grand Ballroom

10:15 a.m. - 10:30 a.m.
Final Awards Presentations and Closing Remarks
Brendan Carvalho, M.B.B.Ch., F.R.C.A., M.D.C.H.
Grand Ballroom

10:30 a.m. - 11:30 a.m.
Poster Session 4
Moderators: *Terrence K. Allen, M.B., B.S.; Brenda A. Bucklin, M.D.; Robert D'Angelo, M.D.; Michael A. Froelich, M.D., M.S.; Lisa R. Leffert, M.D.; Robert S. McKay, M.D.; Christine P. McKenzie, M.D.; Jill M. Mhyre, M.D.; Stephen Pratt, M.D.; Mark I. Zakowski, M.D.*
Evergreen Ballroom EFGH

11:30 a.m.
Adjournment

Thursday, May 11, 2017

Gertie Marx Research Competition
Moderator: Richard M. Smiley, M.D., Ph.D.

Gertie Marx/FAER Education Lecture: Anesthetic Neurotoxicity - An Update
Speaker: Ansgar Brambrink, M.D., Ph.D.

Research Hour: Why Some Drugs Don't Seem to Work and Others Cause More Frequent Side Effects During Pregnancy – A Look at Changes in Drug Exposure During Pregnancy
Moderator: Pamela Flood, M.D.; Speakers: Mary F. Hebert, PharmD, FCCP; Steven Shafer, M.D.

Pro-Con Debate: Programmed Intermittent Epidural Bolus
Moderator: Jeanette R. Bauchat, M.D.; Speakers: Roshan Fernando, M.B., Ch.B.; Kenneth E. Nelson, M.D.

Abstract #:GM-01

Oxytocin in the obese parturient: pharmacokinetics of oxytocin during induction and/or augmentation of labor

Presenting Author: Jeremy Juang M.D., Ph.D.
Presenting Author's Institution: Harvard Medical School, Brigham and Women's Hospital - Boston, MA
Co-Author: Annemaria De Tina M.D., FRCPC - Harvard Medical School, Brigham and Women's Hospital - Boston, MA
Chuan-Chin Huang M.S., Sc.D. - Harvard Medical School, Brigham and Women's Hospital - Boston, MA
Thomas Frederick McElrath MD,PhD - Brigham and Women's Hospital, Boston, MA - Boston, MA
Arvind Palanisamy MD, MBBS, FRCA - Washington University in St. Louis School of Medicine at Barnes-Jewish Hospital - St. Louis, MO

In the US, over one third of pregnant women are obese (pre-pregnancy body mass index [BMI] ≥ 30 kg/m2) with increased risk for cesarean delivery (~35%) compared to women with normal BMI ≤ 24.9 kg/m2 (~20%), mostly due to failure of progress of labor. Whether this diagnosis is due to a difference in oxytocin (OT) pharmacokinetics is unclear. To investigate this hypothesis, we compared the basal plasma levels of OT in parturients with BMIs ≤ 24.9 kg/m2 (Group N) and ≥ 30 kg/m2 (Group O) scheduled for induction of labor, and subsequently determined the plasma OT level either at maximal oxytocin augmentation (20 mIU/min) or when labor was deemed optimal enough that no further OT augmentation was likely.

Methods: Patients >18 years of age, and scheduled for elective induction of labor were recruited between Dec 2015 and Nov 2016. 10 mL of blood was drawn at the time of iv placement prior to initiation of oxytocin infusion (T1), and another sample was obtained by a separate needle stick in the non-iv arm at least 20 min after maximal OT augmentation or optimal clinical response (T2). The samples were collected in an EDTA-containing Vacutainer®, cooled immediately on ice, centrifuged at 1600xg for 15min at 4°C, and the resultant plasma stored at –80°C. Plasma samples were subsequently thawed, C-18 extracted, and assayed in duplicate using a commercially available OT ELISA kit (Phoenix Pharmaceuticals, Inc.). Data were analyzed with either student's t-test or Mann Whitney test as appropriate and expressed either as mean±SD or median (I.Q.R); $P<0.05$ was accorded statistical significance.

Results: We collected samples from 51 patients (N=26, O=25), of which 30 had paired samples (N=18, O=12). The mean BMIs of group N and O were 22.1 ± 1.6 and 36.2 ± 5.1, respectively. No differences were observed in the mean duration of OT infusion (397±159 vs. 370± 186 min; P=0.66), total cumulative dose of OT (3396±1602 vs. 3107±1416 mIU; P=0.61), OT levels at T1 (260 [56,770] vs. 140 [14,530] pg/mL; P=0.40) and at T2 (460 [15, 790] vs. 320 [12,930] pg/mL; P=0.95). In paired samples, we found evidence that was interesting and contrary to expectation; plasma OT levels either decreased or showed no change after OT augmentation compared to baseline values, regardless of BMI (group N [83%] vs. group O [92%]).

Conclusion: In summary, we provide preliminary evidence that the pharmacokinetics of OT may not be different between obese and non-obese women during labor. In addition, we show for the first time that plasma OT levels are actually lower after OT augmentation in a majority of patients regardless of BMI, suggesting either increased metabolism via oxytocinase or suppression of endogenous release. Our study challenges the arbitrary administration of OT and confirms the poor correlation between plasma OT levels and uterine activity. We are currently assaying oxytocinase levels to better understand the metabolism of oxytocin in vivo.

Abstract #:GM-02

The protein content of cerebrospinal fluid is altered in preeclampsia

Presenting Author: Erin J Ciampa MD, PhD
Presenting Author's Institution: Beth Israel Deaconess Medical Center - Boston, MA
Co-Author: Towia Libermann PhD - Beth Israel Deaconess Medical Center - Boston, MA
Laura Sorabella MD - Beth Israel Deaconess Medical Center - Boston, MA
Yunping Li MD - Beth Israel Deaconess Medical Center - Boston, MA
S. Ananth Karumanchi MD - Beth Israel Deaconess Medical Center - Boston, MA
Philip Hess MD - Beth Israel Deaconess Medical Center - Boston, MA

Introduction: Some of the clinical manifestations of preeclampsia (hypertension, proteinuria, fetal growth restriction) can now be explained with specific molecular pathways that implicate endothelial dysfunction as a central pathogenic process [1, 2]. No such molecular-level understanding exists for its central nervous system manifestations, which include headache, hyperexcitability, visual disturbances, and seizures. We hypothesized that the protein content of the cerebrospinal fluid (CSF) may reflect metabolic disturbances, inflammatory states, or other pathologic factors encountered by the brain in preeclampsia that may contribute to its neurologic manifestations.

Methods: We enrolled 14 patients with preeclampsia and 14 control patients, each presenting in spontaneous labor or for induction of labor or Cesarean section for any indication. CSF was collected at the time of administration of spinal anesthesia. Samples were applied to a SOMAscan assay, a proteomics platform that uses single-stranded DNA aptamer technology to capture > 1,300 proteins for quantitiative analysis at a wide range of concentrations (SOMALogic Inc, Boulder, CO). Mean protein concentrations and SEM were calculated for preeclamptic and control groups; unpaired student t-test was applied to determine the statistical significance of the difference among groups for each protein.

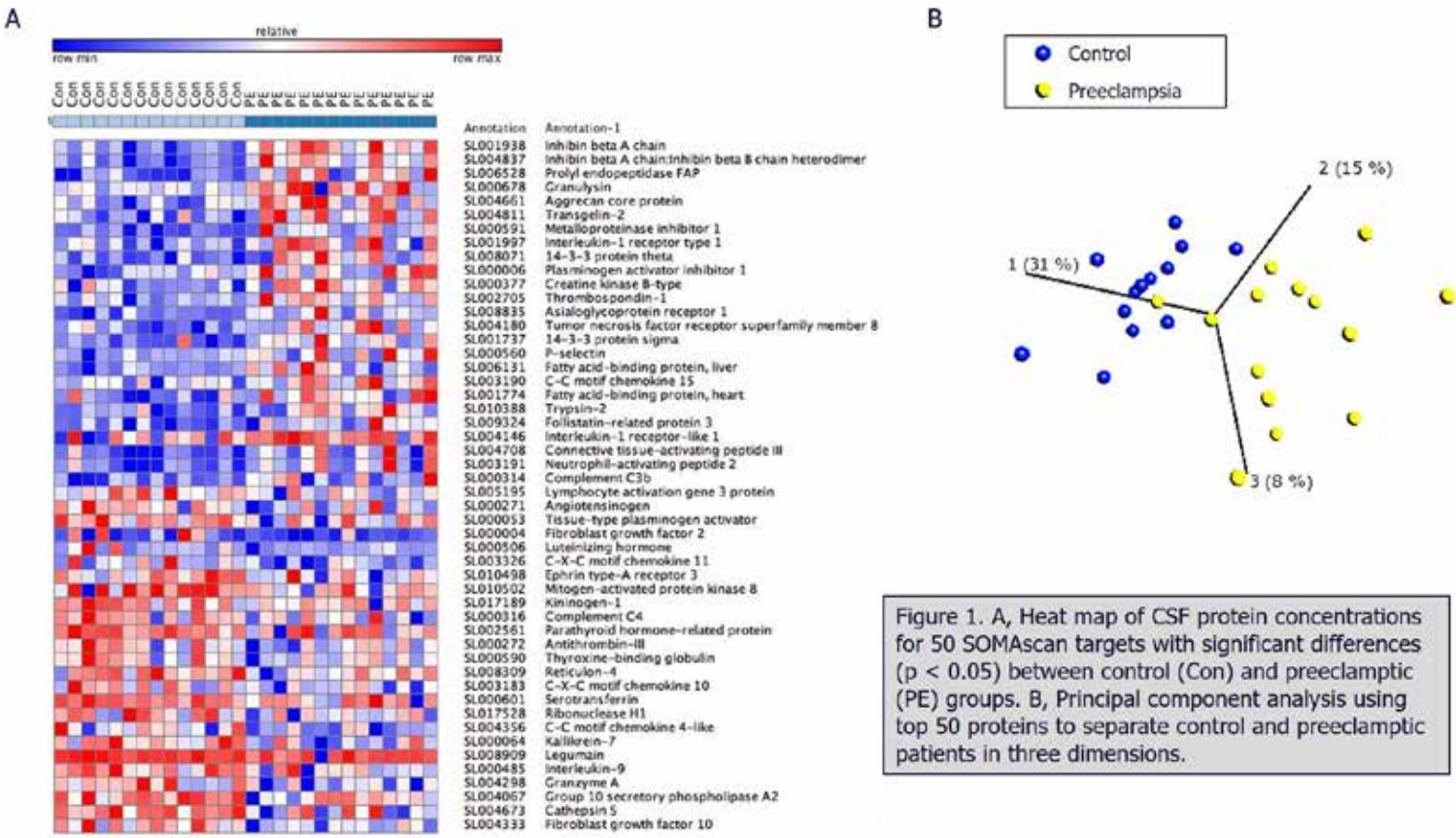


Figure 1. A, Heat map of CSF protein concentrations for 50 SOMAscan targets with significant differences ($p < 0.05$) between control (Con) and preeclamptic (PE) groups. B, Principal component analysis using top 50 proteins to separate control and preeclamptic patients in three dimensions.

Results: SOMAscan analysis revealed more than 50 proteins whose expression levels were significantly different ($p < 0.05$) in CSF from preeclamptic patients versus controls (Figure 1A). Principal component analysis reveals that separation of the preeclamptic group from the control group can be achieved in three dimensions (Figure 1B), with the first principal component accounting for 31% of the variance.

Conclusions: CSF protein content is altered in preeclampsia. Physiologic functions represented among the proteins up- or down-regulated include: neuronal growth, signaling, and electrophysiology, metabolism, inflammation, coagulation, and vasoactive factors. Several of the hits are well represented in prior studies of preeclampsia, including: INHBA, INHBB, FLRG, sRAGE, and IGFBP1, though the functional significance of these proteins in preeclampsia is unknown.

References:

1. Nat Med, 2006. 12(6): p. 642-9.
2. J Clin Invest, 2016. 126(7): p. 2561-74.

Abstract #:GM-03

Pulse pressure and the risk of post-epidural fetal heart rate (FHR) abnormalities: a randomized controlled trial

Presenting Author: Justin R Lappen MD
Presenting Author's Institution: MetroHealth Medical Center, Case Western Reserve University School of Medicine - Cleveland, OH
Co-Author: Stephen A Myers DO - MetroHealth Medical Center, Case Western Reserve University School of Medicine - Cleveland, OH
Normal Bolden MD - MetroHealth Medical Center, Case Western Reserve University School of Medicine - Cleveland, OH
Brian M Mercer MD - MetroHealth Medical Center, Case Western Reserve University School of Medicine - Cleveland, OH
Edward KS Chien MD, MBA - MetroHealth Medical Center, Case Western Reserve University School of Medicine - Cleveland, OH

Objective: FHR abnormalities and maternal hypotension occur commonly after the initiation of neuraxial analgesia. Narrow pulse pressure (PP), a marker of low central volume status, may predict these post-epidural complications. We tested the hypothesis that increasing the IV fluid bolus in women with narrow PP would reduce post-epidural FHR abnormalities and hypotension.

Study Design: We performed a single-center randomized controlled trial. Eligible participants were normotensive with singleton gestations ≥ 35 weeks and a narrow PP (<45 mmHg) on admission. Enrolled patients remained eligible for randomization at epidural request if they were ≤ 6 hours from admission and FHR remained category 1. Patients were randomized to 500mL (institutional standard) or 1500mL of IV fluid prior to epidural placement. A reference arm with admission PP>50 mmHg matched for BMI was also evaluated. The primary outcome was the incidence of new-onset category 2 or 3 FHR patterns in the 60 minutes following epidural placement. Primary outcome events were determined by a member of the research team blinded to study group. Secondary outcomes included hypotension, interventions (to correct FHR abnormalities or hypotension) or adverse events. We estimated needing 138 women per group to show a 50% reduction in the primary outcome from a baseline of 27% with 80% power and 2-tailed alpha of 0.05.

Results: 276 women with narrow PP were randomized to 500 mL (n=139) or 1500 mL (n=137). 138 women enrolled in the reference arm. Demographic, obstetric and labor management characteristics were similar among groups. A significant reduction in the incidence of new-onset FHR abnormalities was observed with 1500mL IV fluid (51.8% vs 38.0%, p=0.02). Hypotension and post-epidural interventions were also reduced in the 1500mL group. However, the risk of new-onset FHR abnormalities and hypotension remained significantly lower in the reference group (Table).

Conclusion: Increasing IV fluid preload in women with a narrow PP decreases the risk of post-epidural FHR abnormalities (NNT=7). Additionally, increasing IV fluid preload decreases the risk of post-epidural hypotension and interventions. While the risk of post-epidural complications was reduced with increased IV fluid administration, they were only attenuated when compared to a reference group with normal PP. Admission PP reflects maternal central volume status and may direct the individualization of intrapartum fluid management.

Table: Primary and secondary study outcomes

	Reference Group (PP > 50 mmHg)	Randomized Groups (PP < 45 mmHg)			
	500 mL Bolus N = 138	500 mL Bolus N= 139	1500 mL Bolus N=137	p^1	p^2
Primary Outcome					
Category 2/3 FHT		72 (51.8)	52 (38.0)	0.02	
Secondary Outcomes					
Category 2/3 FHT	24 (17.4)	72 (51.8)	52 (38.0)		0.0004
Intervention for hypotension or FHR abnormality	21 (15.2)	61 (44.2)	25 (18.3)	< 0.001	0.55
Intentional position change	11 (8.0)	41 (29.5)	20 (14.6)	0.003	0.14
Supplemental oxygen	8 (5.8)	26 (18.7)	16 (11.7)	0.10	0.13
Additional IVF bolus	15 (10.9)	38 (27.3)	10 (7.3)	< 0.001	0.42
Vasopressor	14 (10.1)	22 (15.8)	12 (8.8)	0.07	0.72
Transfer to OR	1 (0.7)	1 (0.7)	2 (1.5)	0.55	0.53
Emergent delivery	0	0	1 (0.7)	0.31	0.22
Systolic hypotension*	34 (24.6)	48 (34.5)	14 (10.2)	< 0.001	0.005
Diastolic hypotension*	47 (34.1)	101 (72.7)	76 (55.5)	0.003	0.0003
Any hypotension*	56 (40.6)	105 (75.5)	76 (55.5)	< 0.001	0.01
Adverse events§	0	0	0	n/a	n/a

Data presented as n (%)

* Hypotension defined a priori as > 20% decrease in systolic or diastolic blood pressure

§ Adverse events: pulmonary edema or diuretic requirement

1 = Pairwise comparison between randomized groups (chi-squared)

2 = Three group comparison (Kruskal-Wallis)

Abstract #:GM-04

Recovery after Nulliparous Birth: Detailed Analysis and Predictions of Pain Analgesia and Recovery of Function

Presenting Author: Ryu Komatsu MD
Presenting Author's Institution: Stanford University School of Medicine - Stanford, California
Co-Author: Brendan Carvalho MBBCh, FRCA - Stanford University School of Medicine - Stanford, California
Pamela Flood MD, MA - Stanford University School of Medicine - Stanford, California

Background: There is limited information on postpartum pain, analgesic requirement and functional recovery after childbirth beyond the hospital stay. Factors predicting poor recovery have not been identified. The aim of this study was to describe and evaluate factors associated with worse pain, longer opioid use and delayed recovery after delivery.

Methods: Two hundred and thirteen nulliparous women were enrolled and assessed daily until they completed the following endpoints: pain resolution, opioid cessation, complete analgesic cessation, self-assessed functional recovery and composite outcome (pain and opioid-free functional recovery) from vaginal (VD) and cesarean delivery (CD). Pain burden was assessed by area under the curve (AUC) derived by multiplying daily pain scores by days required to attain pain resolution. Times to attain endpoints after CD and VD were evaluated using Kaplan-Meier survival analysis. The study subjects were divided into two categories (worst 20th percentile vs the rest of the study cohort) for multivariate logistic regressions to predict poorly preforming individuals for pain, analgesic and recovery outcomes. Candidate predictors in the model included demographic, obstetric, breastfeeding and psychological (PROMIS anxiety and depression scales, civilian version PTSD check list, and SF-36) characteristics.

Results: Pain and opioid-free functional recovery, opioid cessation, complete analgesic cessation, pain resolution, and functional recovery (median [Q1, Q3]) occurred at 20 [11, 26], 0.5 [0.5, 2], 11[6, 17], 15 [8, 24], 20 [11, 24] days after VD, and 27 [19, 40], 8[4, 11], 17 [11, 24], 21 [14, 27], 27 [19, 40] days after CD, with all attained earlier after VD than CD (Log-rank P<0.05). Pain-burden-AUC was 1.7 times larger after CD than VD. Predictors left in final multivariate models for being in worst 20th percent for outcomes are shown in the table. Labor induction (vs. spontaneous or augmented labor) and higher postpartum day 1 pain numeric rating scale were predictive of increased postpartum pain and prolonged functional recovery.

Conclusions: Recovery to pre-delivery function was marginally longer after CD than VD, but opioids use was more apparent after CD. Labor induction was a robust predictor of prolonged recovery after correction for delivery type, CD only predicted opioid use postpartum. Data for this study can be used to set maternal expectation and predict recovery after childbirth.

Table. Multivariate prediction of outcomes

Predictors	Outcomes					
	Time to pain and opioid free functional recovery	Time to pain resolution	Time to Opioid cessation	Time to functional recovery	Time to all analgesic cessation	Pain burden- AUC
	Odds ratio (CI), P-value	Odds ratio (CI), P-value	Odds ratio (CI), P-value	Odds ratio (CI), P-value	Odds ratio (CI), P-value	Odds ratio (CI), P-value
Labor type (vs Not induced)						
Induced	3.90 (1.40-10.84), 0.009		3.29 (1.13-9.58), 0.029	5.07 (1.69-15.21), 0.004	5.06 (1.72-14.83), 0.003	5.57 (1.67-18.61), 0.005
Delivery type (vs VD)						
CD			23.51 (7.21-76.70), <0.001			
PROMIS Anxiety-8a T-score[¶]			1.18 (1.06-1.31), 0.003			
PROMIS Depression-8a T-score[♂]			0.89 (0.79-0.99), 0.029			
Day 1 pain-NRS (0 to 10)[Ω]				1.33 (1.02-1.73), 0.037		1.82 (1.31-2.53), <0.001
Day 1 breast feeding success (vs less than half)[θ]						
More than half			0.17 (0.03-0.86), 0.032			

Odds ratios with 95% confidence intervals (CI), and P-values of multivariate logistic regression model for each outcome variable are shown. Predictive variables not left in any of multivariate models are not shown in the table.No predictors are left in the final model for time to pain resolution outcome. AUC: Area under the curve. VD: Vaginal delivery. CD: Cesarean delivery. [¶]: Patient-Reported Outcomes Measurement Information System (PROMIS) Anxiety Scale 8a short form. T-score was calculated by transformation of sum score into t values suggested by the scoring manual. [♂]: Patient-Reported Outcomes Measurement Information System (PROMIS) Depression Scale 8a short form. T-score is transformation of sum score into t values suggested by the scoring manual. [Ω]: Postpartum day 1 pain level numeric rating scale. [θ]: Postpartum day 1 breast feeding success was assessed by proportion of breast milk in relation to total daily nutrition of the neonate.

Abstract #:GM-05

Accuracy of Blood Loss Measurement During Cesarean Deliveries

Presenting Author: Sahar V Doctorvaladan MD
Presenting Author's Institution: Santa Clara Valley Medical Center - San Jose, California
Co-Author: Andrea T Jelks MD - Santa Clara Valley Medical Center - San Jose, California
Eric W Hsieh BS - Gauss Surgical - Los Altos, California
Robert L Thurer MD - Gauss Surgical - Los Altos, California
Mark I Zakowski MD - Cedars-Sinai Medical Center - Los Angeles, California
David C Lagrew MD - St. Joseph Hoag Health - Irvine, California

Background: Postpartum hemorrhage (PPH) is a major cause of maternal morbidity and mortality. Standardized approaches to the recognition and treatment of PPH based on an accurate estimation of blood loss are recommended.(1) Of the currently available methods used to determine intraoperative blood loss during cesarean deliveries, visual estimation is inaccurate, underestimating blood loss by up to 41% (2) and the often recommended quantitative gravimetric method is also inaccurate, time consuming and difficult to implement.(3) A novel colorimetric method (Triton System™, Gauss Surgical, Los Altos, CA) uses image processing algorithms to measure blood loss by photographing surgical sponges and suction canisters and calculating their hemoglobin content independent of contamination with amniotic or other fluids.

Objective: To compare the accuracy of a visual, quantitative gravimetric and the novel colorimetric method in determining blood loss during cesarean deliveries.

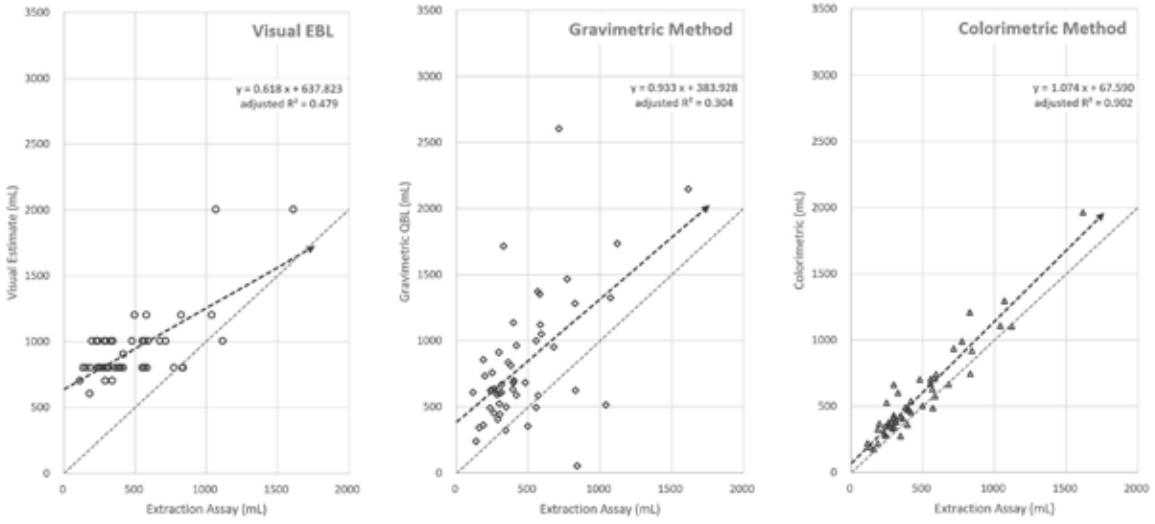
Study Design: Fifty patients having cesarean deliveries had blood loss determined by obstetricians' visual estimates, a quantitative gravimetric method, the colorimetric system and by assay of hemoglobin content from surgical sponges and in suction canisters. Agreement between the hemoglobin extraction assay (reference standard) and other measures was evaluated using the Bland-Altman method.

Results: Compared to the blood loss measured by the assay (470±296 ml), the colorimetric system (572±334 ml) was more accurate than either visual estimation (928±261 ml) or gravimetric measurement (822±489 ml). The correlation between the hemoglobin assay method and the colorimetric system was more predictive (standardized coefficient = 0.951, adjusted R2 = 0.902) than either visual estimation (standardized coefficient = 0.700, adjusted R2 = 0.479) or the gravimetric determination (standardized coefficient = 0.564, adjusted R2 = 0.304) (Figure).

Conclusion: Measuring blood loss using colorimetric image analysis during cesarean delivery is more accurate than both visual estimation and gravimetric methods. Implementation of the colorimetric system may facilitate the accurate recognition of blood loss potentially improving patient safety and clinical outcomes. Further studies of this method and the associated outcomes are needed.

References:

1. Anesth Analg 2015;121:142-148
2. Anesth Analg. 2007;105:1736-40
3. J Gynecol Surg 1993;9:151



Abstract #:GM-06

A shared decision-making intervention for opioid prescribing after cesarean delivery: a single-arm trial

Presenting Author: Malavika Prabhu MD
Presenting Author's Institution: Massachusetts General Hospital - Boston, Ma
Co-Author: Emily McQuaid-Hanson MD - Massachusetts General Hospital - Boston, Ma
Stephanie Hopp MHS MS - Massachusetts General Hospital - Boston, Ma
Lisa R Leffert MD - Massachusetts General Hospital - Boston, Ma
Anjali J Kaimal MD MAS - Massachusetts General Hospital - Boston, Ma
Brian T Bateman MD MSc - Massachusetts General Hospital - Boston, Ma

Background: There is a need to define strategies that align the amount of prescription opioids dispensed with what patients will require and thereby reduce the number of leftover prescription opioid tablets available for diversion or misuse. The aim of this study was to assess the impact of a shared decision-making model to guide opioid prescribing practices after cesarean delivery (CD).

Methods: Following IRB approval, 50 patients consented to participate in this single-arm trial in which patients self-selected the number of tablets of oxycodone prescribed following CD. An interactive, iPad-based decision aid formed the basis of the shared decision-making session, which occurred on the day prior to discharge. Through this decision aid, patients were presented information on typical trajectories of pain resolution and normative opioid consumption following CD, risks, benefits, and alternatives to opioids, and instructions on safe disposal of unused opioids. At the end of the session, patients chose the number of oxycodone 5mg tablets to be prescribed upon discharge, up to a total of 40 tablets. Telephone follow-up was performed 2 weeks after discharge. Summary statistics were used to describe study participants and a one-sided, one-sample t-test was performed to compare the mean number of oxycodone tablets chosen to the institutional standard of 40 tablets. The sample size of 50 women was based on 90% power to show a reduction in the mean oxycodone prescription from 40 to 35, assuming a standard deviation (SD) of 12 and alpha=0.05. Data were analyzed with Stata 14 (College Station, TX).

Results: The mean (SD) number of oxycodone 5mg tablets chosen by the patients was 20.6 (10.6), which was significantly less than the historically prescribed standard of 40 tablets ($p<0.001$) (Table). The mean (SD) number of leftover tablets was 6.4 (7.7). Among the 32 patients with unused oxycodone tablets who did not receive refills, 66% had a safe plan for disposal. At 2-week follow-up, 90% of patients reported being satisfied or very satisfied with their outpatient pain control. 4 patients (8%) required medication refills; 3 of these patients had infectious complications leading to greater than usual postoperative pain. No differences were seen in the amount of oxycodone chosen or used based on type (primary vs. repeat) or timing (scheduled vs. unscheduled) of CD.

Conclusions: The shared decision-making approach to opioid prescribing following CD reduced the number of opioids prescribed after CD at our institution by approximately half, while maintaining very high levels of patient satisfaction with the treatment of their pain. This novel approach is a promising strategy to reduce the amount of leftover opioid medication following CD, the most commonly performed surgical operation in the US.

Why some drugs don't seem to work and others cause more frequent side effects during pregnancy
A look at changes in drug exposure

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UNIVERSITY of WASHINGTON

Objective

- Describe the mechanisms by which medication exposures change during pregnancy
- Discuss the effects of pregnancy on medication exposure
- Discuss the clinical implications of drug exposure changes during pregnancy

Off Label Discussion

- Indication not approved
  - –Metoprolol for A-fib and flutter
  - –Glyburide and metformin for GDM
  - –Digoxin for SVT
- Dosage in pregnancy
  - –glyburide, metformin, digoxin, phenytoin, indinavir, tacrolimus, amoxicillin, dacarbazine, clonidine

Medication Use During Pregnancy (n=578)

	Percent of Women Reporting Use		
Number	Prescription	OTC	Herbal
0	4.2	7.4	54.8
1	26.6	18.5	25.8
2	31.7	23.2	12.5
3	19.4	18.7	6.9
≥4	18.2	32.2	

AJOG 2003;188:1039.

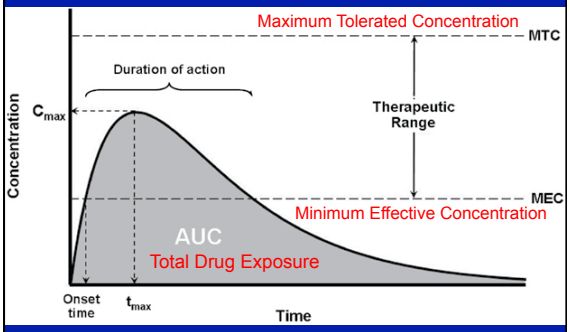
FDA Pregnancy and Lactation Labeling Final Rule

- Assists in assessing benefit versus risk
- Assists in counseling of pregnant and lactating women
- Removes pregnancy letter categories
  - –A, B, C, D and X.
- Requires the label to be updated when information becomes outdated.

http://www.fda.gov/Drugs/DevelopmentApprovalProcess/DevelopmentResources/Labeling/ucm093307.htm

Always Weigh Risks

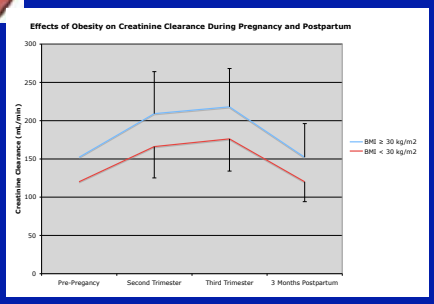
Pharmacokinetics



Adapted from Int J Impot Res. 2006;18:1-12

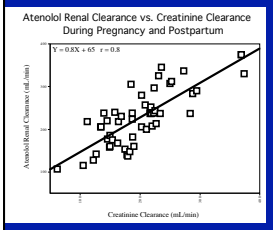
Renal Filtration

35% of medications are eliminated by the kidneys.

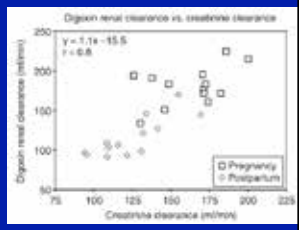


Buchanan & Hebert, ACCP Poster #366

Relationship Between CrCl and Renal Clearance of Drugs



Hebert et al. J Clin Pharmacol 2005;45:25-33.



Hebert et al. Clin Pharmacol Ther. 2008 Aug;84(2):248-53.

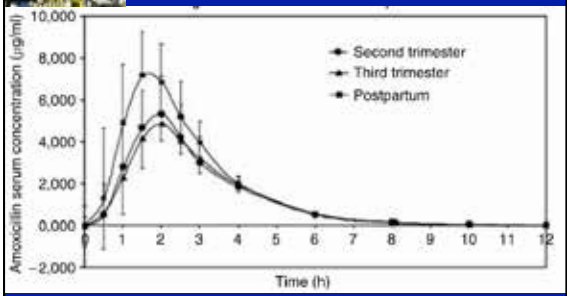
Effects of Pregnancy on Renal Transport

Probe	Transporters	Renal Secretion		
		Pregnancy (mL/min)	Postpartum (mL/min)	P Value
Digoxin	P-gp OATP	T3: 73 ± 22	37 ± 14	< 0.001
Amoxicillin	OAT hPepT1 hPepT2	T2: 280 ± 105 T3: 259 ± 54	167 ± 47	T2: < 0.002 T3: < 0.001
Metformin	OCT2	T2: 480 ± 190 T3: 419 ± 78	313 ± 98	T2: < 0.01 T3: < 0.01

P-gp: P-glycoprotein (secretion, apical)
OATP: organic anion transporter polypeptides (secretion, basolateral)
OAT: organic anionic transporters (secretion)
hPepT: oligopeptide transporters (reabsorption)
OCT2: organic cation transporter 2 (secretion)

Andrew et al. Clin Pharmacol Ther 2007;81:547-56.
Hebert et al. Clin Pharmacol Ther. 2008;84: 248-53.
Eyal et al. Drug Metab Dispos 2010;38:833-40.

Average Amoxicillin Concentrations



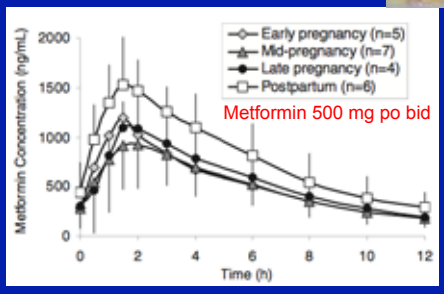
Andrew et al. Clin Pharmacol Ther. 2007;81(4):547-56.

Simulated Amoxicillin Concentrations Target trough >0.12 µg/mL

Dosing Scenario		500 mg q 8 hr	500 mg q 6 hr	500 mg q 4 hr	250 mg q 4 hr	750 mg q 6 hr	1000 mg q 6 hr
Min Trough	2nd Trimester	0.00	0.01	0.20	0.10	0.02	0.02
	3rd Trimester	0.00	0.04	0.36	0.18	0.06	0.08
	Postpartum	0.00	0.01	0.15	0.08	0.01	0.02

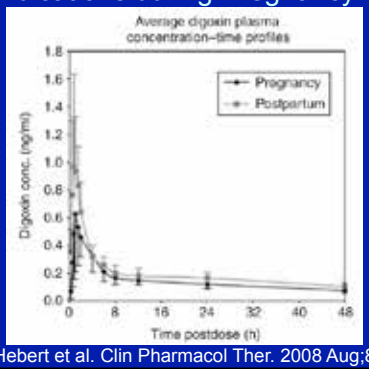
Andrew et al. Clin Pharmacol Ther. 2007;81(4):547-56.

Average Metformin Concentration-Time Profiles



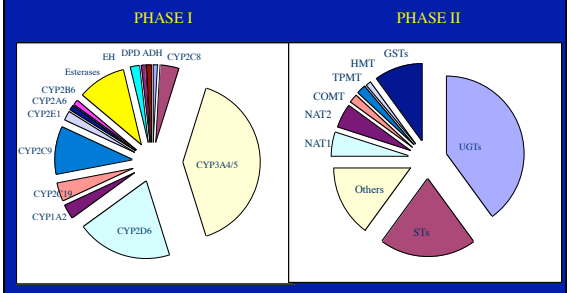
Eyal S et al. Drug Metab Dispos. 2010 May;38(5):833-40.

Digoxin - Maternal and Fetal Indications during Pregnancy



Hebert et al. Clin Pharmacol Ther. 2008 Aug;84(2):248-53.

Enzymes Involved in Drug Metabolism

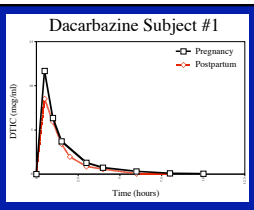


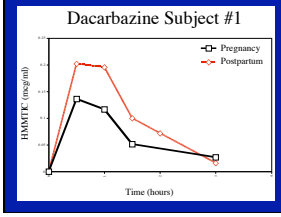
Adapted from W. Evans, St. Jude

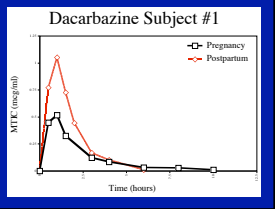
CYP1A2 Activity in Pregnancy

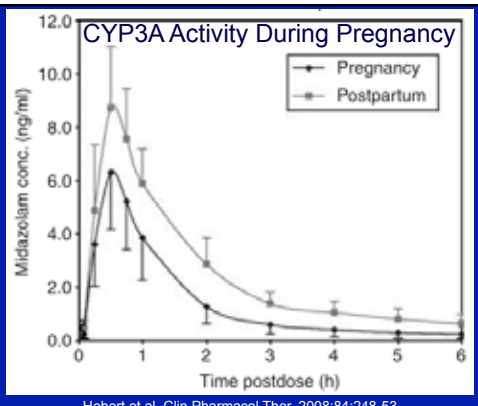
	14-18 Weeks Gestation	24-28 Weeks Gestation	36-40 Weeks Gestation
Decrease in CYP1A2 Activity	33%	48%	65%
P Value	< 0.001	< 0.001	< 0.001

Tracy et al. Am J Obstet Gynecol. 2005;192:633-9.
Caffeine used as probe (n=25).
6-8 weeks postpartum served as control.









Hebert et al. Clin Pharmacol Ther. 2008;84:248-53.

Midazolam Pharmacokinetics

Parameter	Pregnancy	Postpartum	Percent difference	P value
AUC_{0-inf} (ng·h/ml)	9.5 ± 4.3	17.9 ± 6.0	−46 ± 26	<0.002
CL/F (l/min)	4.2 ± 1.8	2.0 ± 0.6	108 ± 62	0.002
$CL/F_{unbound}$ (l/min)	593 ± 237	343 ± 103	86 ± 79	0.007
1'OH-mid $CL_{formation}$ (l/min)	3.0 ± 1.1	1.4 ± 0.4	124 ± 63	<0.002
1'OH-mid $CL_{formation, unbound}$ (l/min)	418 ± 150	228 ± 67	99 ± 86	<0.005
f_u (%)	0.71 ± 0.11	0.61 ± 0.16	21 ± 26	<0.05
C_{max} (ng/ml)	6.4 ± 2.6	9.3 ± 2.0	−28 ± 32	0.01
T_{max} (h)	0.56 ± 0.15	0.54 ± 0.14	7 ± 31	0.8
Half-life (h)	2.4 ± 0.7	2.5 ± 1.3	2 ± 26	0.6

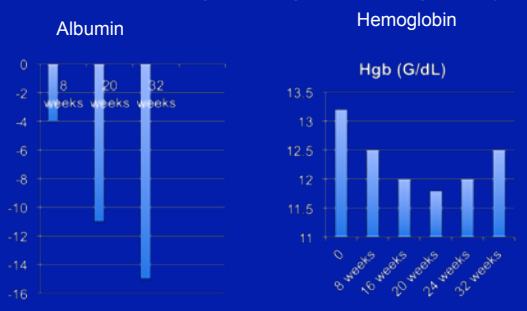
Hebert et al. Clin Pharmacol Ther. 2008;84:248-53.

Indinavir Pharmacokinetics in Pregnancy and Postpartum

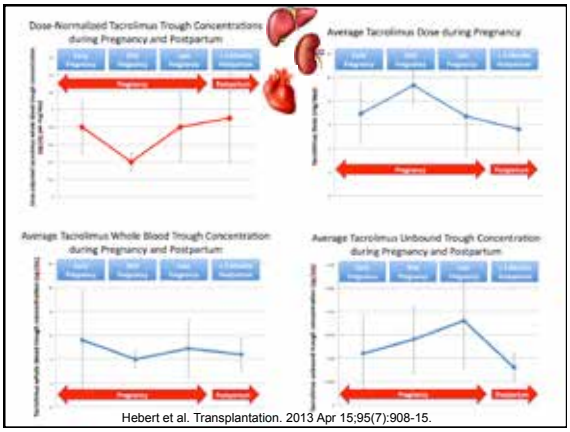
	Pregnancy 31 ± 2 wks (n=16)	Postpartum 6 - 10 wks (n=16)	P Value
$AUC_{0\Rightarrow8}$ (µg•min/mL)	459 ± 322	1429 ± 707	0.0004
CL/F (mL/min)	3558 ± 3796	697 ± 369	0.03
CL/F (mL/min/kg)	42 ± 40	9 ± 4	0.02

Unadkat et al. Antimicrob Agents and Chemother 2007;51:783-6.

Protein Binding Changes in Pregnancy

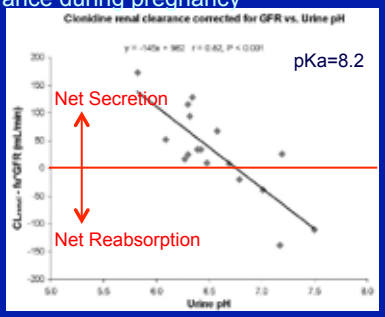


Institute of Medicine. Nutrition during pregnancy. Washington DC: National Academy Press;1990.



Hebert et al. Transplantation. 2013 Apr 15;95(7):908-15.

Clonidine: Primarily renally eliminated in the non-pregnant population, but no change in renal clearance during pregnancy



Buchanan et al. Drug Metab Dispos. 2009 Apr;37(4):702-5.

Clonidine

- Pregnancy
  - –Switch in primary pathway of elimination
    - Renal -> Metabolism
  - –CYP2D6 substrate
  - –Apparent oral clearance increased 80%

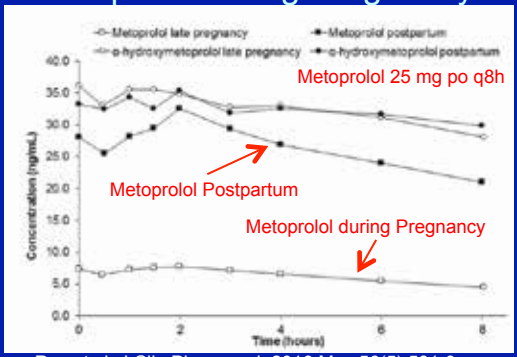
Buchanan et al. Drug Metab Dispos. 2009;37:702-5.
Claessen et al. Drug Metab Dispos. 2010;38:1393-6.

CYP2D6 Activity in Pregnancy

	14-18 Weeks Gestation	24-28 Weeks Gestation	36-40 Weeks Gestation
Increase in CYP2D6 Activity	25%	35%	50%
P Value	< 0.001	< 0.001	< 0.001

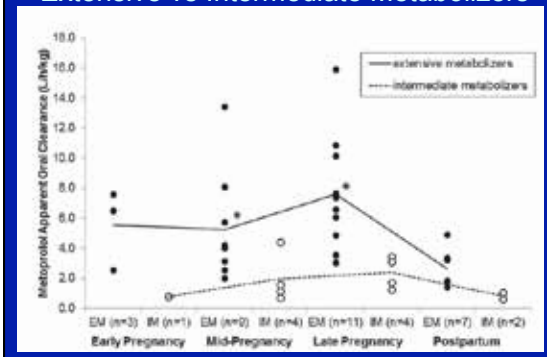
Tracy et al. Am J Obstet Gynecol. 2005;192:633-9.
Dextromethorphan used as probe (n=25).
6-8 weeks postpartum served as control.

Metoprolol during Pregnancy



Ryu et al. J Clin Pharmacol. 2016 May;56(5):581-9.

Extensive vs Intermediate Metabolizers



Ryu et al. J Clin Pharmacol. 2016 May;56(5):581-9.

30 year old female
Hypertrophic Cardiomyopathy, Atrial fibrillation and flutter
Automatic Implantable Cardioverter Defibrillator (AICD)

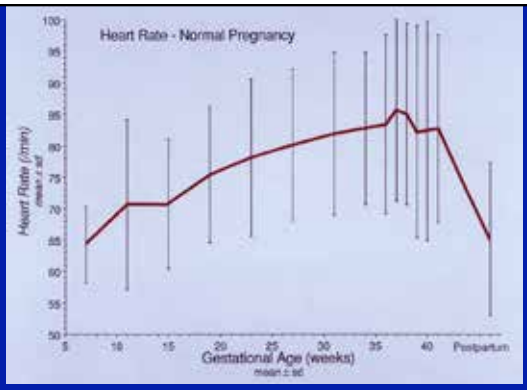
Time	Progression
Pre-pregnancy	Metoprolol 25 mg daily
GA: 11 weeks	Metoprolol XL 50 mg bid Episode AICD firing Increased metoprolol XL to 50 mg tid Added metoprolol 20 mg prn
GA: 11.5 weeks	2 episodes AICD firing 911 called -> ER Metoprolol IV X2 plus PO X2 Metoprolol XL increased to 75 mg tid Disopyramide added
GA: 12 weeks	3 episodes AICD firing (set at HR>200) Metoprolol IV X4, Metoprolol XL 50 mg X1 Admitted Metoprolol XL increased to 150 mg tid
GA: 13 weeks	Metoprolol XL 200 mg tid Multiple episodes of AICD firing Ablation, Replacement of AICD Metoprolol XL increased to 250 mg tid Digoxin added
GA: 15 and 27 weeks	Good rate control, Medications stable
Postpartum	Metoprolol dose titrated down

Atenolol Pharmacokinetics

	Creatinine Clearance (mL/min)			Atenolol Renal Clearance (CLR; L/hr)		
Subject	Second Trimester	Third Trimester	Postpartum	Second Trimester	Third Trimester	Postpartum
Mean	212	224	155	14.7	14.6	11.1
SD	59	55	46	3.6	3.5	3.5
P value	<0.001	<0.001		<0.001	<0.001	

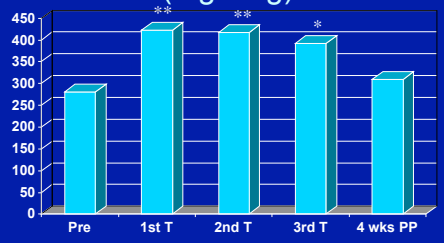
	Apparent Oral Atenolol Clearance (CL/F; L/hr)			Half-Life (t1/2; hours)		
Subject	Second Trimester	Third Trimester	Postpartum	Second Trimester	Third Trimester	Postpartum
Mean	31.1	32.7	29.2	4.8	4.9	5.7
SD	8.5	9.6	13.2	0.6	1.3	1.2
P value	0.4	0.2		0.009	0.03	

Hebert et al. J Clin Pharmacol. 2005 Jan;45(1):25-33.

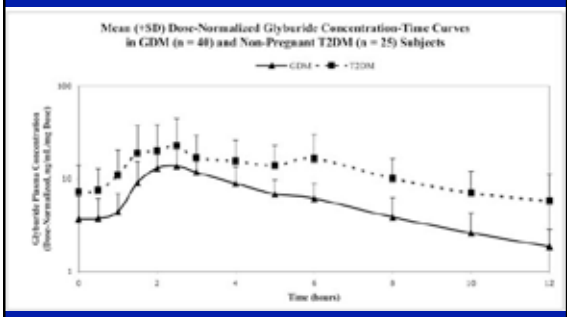


Courtesy of Thomas Easterling, MD

CYP2C9 Activity During Pregnancy Free Phenytoin Clearance (mg/h/kg)



N=14, ** $p \leq 0.025$, * $p \leq 0.05$;
Yerby et al. Epilepsy Res 1990;5:223-8.



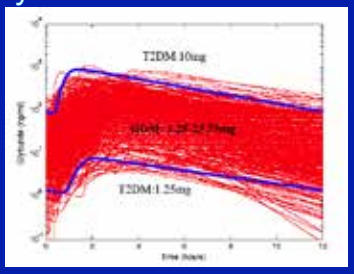
Hebert et al. Clin Pharmacol Ther. 2009;85:607-14.

Glyburide Pharmacokinetics

Design	Unbound CL /F (L/h)	Percent Unbound (%)	CL_{form} 4 Trans OH-gly (L/h)	4 Trans OH-gly % of dose recovered in urine
Our study - gestational diabetic subjects (n=40)	1103 ± 749	1.6 ± 0.1	4.7 ± 2.6	30 ± 15
Our study - type 2 diabetic control subjects (n=26)	537 ± 313	1.5 ± 0.1	2.0 ± 1.0	27 ± 12
	P < 0.0001	P = 0.2	P < 0.0001	P = 0.4

Hebert et al. Clin Pharmacol Ther. 2009;85:607-14.

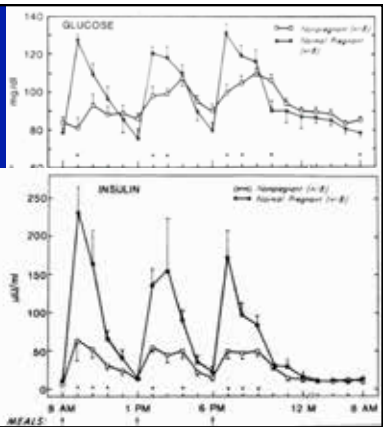
Monte Carlo Simulations Glyburide Concentrations



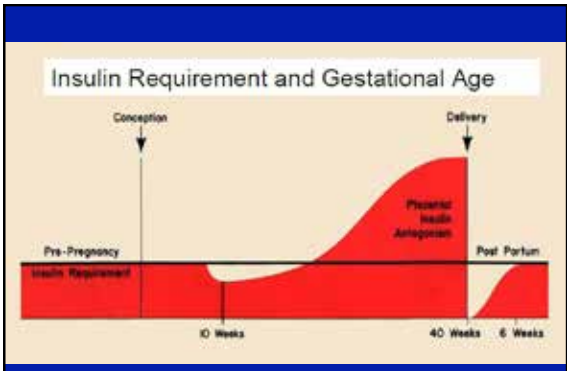
Blue lines: Type 2 diabetic subjects 99% CI, Dose 1.25 to 10 mg
Red lines: 100 simulated GDM subjects at each dose, Dose 1.25 to 23.75 mg
Hebert et al. Clin Pharmacol Ther. 2009;85:607-14.

Glucose

Insulin



Phelps et al. Am J Obstet Gynecol 1981;140:730.



Courtesy of Zane Brown, MD


Healthy Mothers, Healthy Babies

Society for Obstetric Anesthesia and Perinatology
Section Editor: **Cynthia A. Wong**
REVIEW ARTICLE

CME

Pharmacokinetics and Pharmacodynamics of Drugs Commonly Used in Pregnancy and Parturition

Jessica Ansari, MD, Brendan Carvalho, MBBCh, FRCA, MDCH, Steven L. Shafer, MD, and Pamela Flood, MD, MA

The majority of pregnant women will be treated with a medication other than a vitamin supplement during their pregnancy. Almost half of these medications will be category C or D according to the former US Food and Drug Administration classification system, indicating a lack of human studies with animal studies suggesting adverse fetal effects (category C) or evidence of risk in humans (category D). Changes in maternal physiology alter drug bioavailability, distribution, clearance, and thus the drug half-life in often unpredictable ways. For many drugs, good pharmacokinetic and pharmacodynamic data in pregnancy and parturition are lacking. For other drugs, recent studies demonstrate major pharmacokinetic or pharmacodynamic changes that require dose adjustment in pregnancy, but current dosing guidelines do not reflect these data. In this review, we address the principles that underlie changes in pharmacology and physiology in pregnancy and provide information on drugs that anesthesiologists commonly encounter in treating pregnant patients. (Anesth Analg 2016;122:786–804)

Pregnant women frequently require pharmacologic treatment for conditions both related and unrelated to their pregnancies. There are few studies of pharmacokinetics in women during pregnancy and lactation and even fewer linking pharmacokinetics to pharmacodynamic changes in pregnancy. One important reason is economic; sponsors consider economic return when planning clinical trials. The limited duration of pregnancy limits the potential economic return for pregnancy-specific dosing guidelines. Furthermore, a sponsor will necessarily consider the possibility that any adverse outcome for the newborn child will be blamed on the study drug, regardless of whether such an association is causative. With modest economic incentive and the risk of huge liability for any adverse outcome, it is not surprising that the pharmaceutical industry infrequently performs pharmacokinetic and pharmacodynamic studies in pregnant women and parturients.

Lacking pharmacokinetic and pharmacodynamic studies in parturients or pregnant women, clinicians may administer drugs based on the studies in healthy nonpregnant women. Here, the economics are better for the sponsor, because women account for half of the potential users of most drugs. Historically, even women who were not pregnant were excluded from research, partly because of concern by sponsors that any adverse outcome in a subsequent pregnancy might be blamed on the study drug.[1] In the past, virtually all clinical drug studies specifically excluded pregnant women and women of childbearing potential. In 2003, the National Institute of Child Health and Human Development formed the Obstetric Pharmacology Research Units Network. The network served as a proof-of-concept demonstration that clinical investigations could be performed in pregnant women.[2] Current regulations require pharmacokinetic and pharmacodynamic studies in women including women of childbearing potential. Thus, new drugs coming into the market will have dosing guidelines for women as part of the package insert.

In one retrospective study of 8 health maintenance organizations, 64% of pregnant women received at least 1 prescription medication during pregnancy, with an average of 2 prescriptions other than vitamin supplements or mineral nutrients per patient overall in the United States.[3] In Europe, there is wide variability in prescription practices during pregnancy (Fig. 1).[4] The studies did not include medications used during delivery. Despite the frequency of these prescriptions, few medications have been studied in the setting of pregnancy. Most drugs administered to pregnant patients are used off-label.[5] Currently, almost half of all pregnant patients receive drugs in former Food and Drug Administration (FDA) categories C and D, indicating complete lack of data or evidence for harm.[3]

The US FDA put the Pregnancy and Lactation Labeling Rule into effect on June 30, 2015, replacing previous labeling that designated drugs as category A to D and X for use in pregnancy. These categories have been eliminated because most drugs were category C, indicating a lack of data in humans. The designation of category C as opposed to B was highly idiosyncratic for historical reasons. Because this is a recent change, the categories are maintained in the tables for reference. Category A indicated that adequate and well-controlled studies had failed to demonstrate risk to the fetus in the first trimester. Category B indicated that human studies were not available but animal studies had failed to demonstrate a risk to the fetus. Category C indicated that animal studies had shown adverse effects to the

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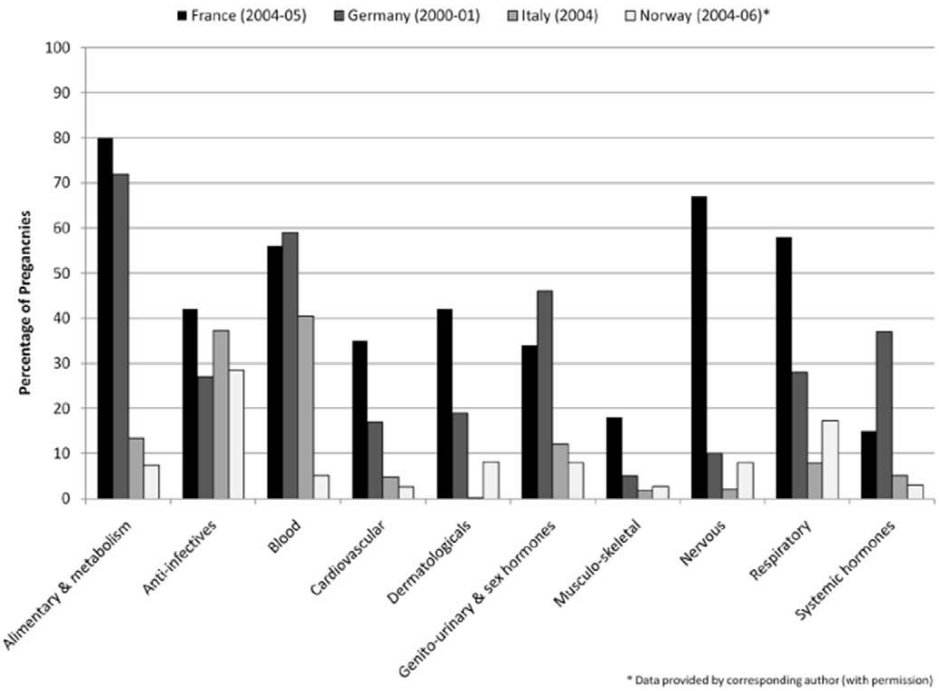

Figure 1. Percentage of pregnancies in which a prescription drug was used by drug class. Data do not include prescriptions for vitamin and mineral supplements. Reprinted with permission from Daw et al.[4]

fetus and there are no adequate human studies. Category D indicated that there was evidence of human risk based on the data from investigational or postmarketing experience in humans, but potential benefits might outweigh the risk. Category X indicated that human or animals studies had shown that fetal abnormalities and the risks of use in pregnancy clearly outweigh the benefits. Under the new labeling rule, a pregnancy exposure registry has been created, and updating is required as more data become available.

Pregnancy induces well-known physiologic changes that may alter drug pharmacokinetics. In addition, hormonal perturbations and placental physiology may affect drug pharmacodynamics. Currently, there are inadequate data for physicians and patients to make informed decisions as to the proper selection and appropriate dosing of many drugs used during pregnancy and lactation.[5] Many package inserts state that the indicated population excludes pregnant, peripartum, or lactating women because of the absence of data. One option would be to avoid these older drugs out of concern for potential maternal or fetal harm. However, they are often preferred given their longer history of use and track record of safety. Unfortunately, the recommended doses and dosing intervals for these drugs may be inaccurate because they are based on the pharmacokinetics usually determined in healthy male volunteers. The data referenced in the following sections represent information garnered mostly from small academic research studies because formal drug development programs that include pregnant women are not required by the FDA or other international governing bodies.

This review outlines known alterations in drug pharmacokinetics and pharmacodynamics that occur during pregnancy, as well as the impact of acute changes in physiology at the time of childbirth. We will highlight known differences induced by pregnancy for drugs commonly administered to pregnant women and parturients. We will specifically note several instances where current clinical guidelines do not reflect the recent findings from pharmacokinetic and pharmacodynamic studies conducted in pregnancy. Finally, we will point out areas where pharmacokinetic and pharmacodynamic studies in pregnant women are most urgently needed.

PHARMACOKINETIC CHANGES IN PREGNANCY

Pregnancy results in extensive anatomical and physiologic changes. Physiologic changes affecting the cardiovascular, respiratory, renal, gastrointestinal, and hematologic systems can significantly alter the pharmacokinetic and/or pharmacodynamic profile of drugs used in pregnancy. Specifically, physiologic changes during pregnancy can alter the bioavailability, distribution, and clearance of many drugs.

BIOAVAILABILITY

Multiple gastrointestinal changes in pregnancy may affect the bioavailability of oral medications. Gastric emptying is not changed during pregnancy before the onset of labor, and, thus, absorption time should not be changed after oral administration.[6,7] During labor, decreased gastric emptying caused by pain, anxiety, or the administration of opioids (including neuraxial opioids) may delay intestinal absorption of drugs.

The changes in liver enzyme activity can alter both activation of prodrugs (and therefore the time course of drug onset), as well as absorption, metabolism, and offset of drugs. For example, codeine is a prodrug. It is converted to morphine by CYP2D6 in the liver. In addition to significant

polymorphisms and multiple gene copies that result in variable CYP2D6 activity, the activity of CYP2D6 is induced in pregnancy. Ultrarapid metabolizers of codeine produce particularly high plasma morphine peaks in pregnancy.[8] In this setting, women would be expected to have rapid pain relief from codeine but may also have increased opioid toxicity. This is a particular problem during breastfeeding, because morphine is passed to the infant through breast milk. Because of these sources of variability, codeine is a poor choice of opioid for breastfeeding women.

In contrast, if a drug is subjected to significant first-pass metabolism, then an up-regulation in enzymatic activity will reduce bioavailability. For example, induction of CYP2D6 in pregnancy increases the rate of metoprolol metabolism, causing 12% to 55% reduction in peak plasma levels compared with the peak in nonpregnant women (Table 1).[9–13]

DISTRIBUTION

Pregnancy obviously increases the size of women. Larger people need larger doses of drugs, because they have larger volumes of distribution and greater clearance. It follows that, as a general rule, pregnant women will need a larger dose of drug than the nonpregnant woman, simply because the pregnant woman is larger.

Maternal intravascular fluid volume begins to increase in the first trimester of pregnancy as a result of increased production of renin–angiotensin–aldosterone, which promotes sodium absorption and water retention. With increasing plasma volume, there is an associated reduction in maternal plasma protein concentration. By term gestation, the plasma volume has increased approximately 50%. Increased plasma volume increases the volume of distribution for water-soluble drugs, and, therefore, pregnancy may be associated with lower peak and steady-state drug concentrations if the dosing is unchanged.[31]

Albumin concentration decreases during the second trimester and declines further throughout pregnancy. Plasma protein levels and therefore drug-binding ability is 70% to 80% of normal prepregnancy values at the time of delivery.[32] This is particularly relevant for drugs that are water soluble and highly protein bound. Reduction in plasma protein increases the free fraction of highly protein-bound drugs such as midazolam, digoxin, phenytoin, and valproic acid.

CLEARANCE

Drug metabolism and excretion rely on the liver and kidney blood flow and function. The enhanced cardiac output beginning in the first trimester increases renal blood flow in healthy pregnancy. Renal blood flow and the glomerular filtration rate are increased 50% by the second trimester and remain increased until 3 months postpartum. Alteration in renal function can significantly increase the clearance of renally excreted drugs such as heparin (Table 2). Because of more rapid clearance, guidelines for dosing based on the data in nonpregnant adults may result in tissue concentrations that are too low in pregnant women.

Although the proportion of cardiac output flowing to the liver does not change during pregnancy, markers of liver function including aspartate aminotransferase, alanine aminotransferase, and bilirubin increase to the upper limits of

Table 1. Antihypertensive Drugs

Drug	Dose adjustment	F/M ratio	Breast milk/maternal plasma ratio	Former FDA category	PK/PD alteration	References
Atenolol	No change in dose required	0.94	1.6–6.8	D	Increased oral absorption compensates for increased renal clearance Unchanged $t_{1/2}$ 100% renally cleared	14–17
Clonidine	Increased dose/shorter dosing interval may be needed	1.0	1.5	C	Renal clearance increased 2× $t_{1/2}$ significantly decreased	14, 18, 19
Diltiazem	Unknown	Unknown	1	C	Unknown	20, 21
Furosemide	No change in dose required	~1	Excreted in breast milk	C	Clearance unchanged in third trimester	22, 23
Hydralazine	Unknown	0.72	Small amount of active compound in breast milk	C	Unknown	14, 24
Labetalol	Increased dose or more frequent dosing	0.4–0.8	0.8–2.6	C	Oral labetalol, clearance increased with advancing pregnancy (1.4× at 12 wk, 1.6× at term) Due to increased activity of hepatic blood flow and induction of UGT1A1	14, 25
Methyldopa	Unknown	1.2	0.19–0.34	B	Unknown	14, 26
Metoprolol	Increased dose or more frequent dosing	1	3	C	Oral clearance 4×greater in third trimester Peak serum concentrations 12%–55% Mechanism increased hepatic blood flow and CYP2D6 induction More effective at lower plasma concentrations in pregnancy	11, 13, 14
Nifedipine	Increased dose/shorter dosing interval	Unknown	<0.05	C	Oral clearance 4× higher $t_{1/2}$ decreased by 50% Mechanism increased hepatic blood flow and CYP3A4 induction	27–29
Sotalol	Unknown	1.1	>1	B	Unknown	14, 18, 30

FDA = Food and Drug Administration; F/M = fetal/maternal ratio; PK/PD = pharmacokinetic/pharmacodynamic.

Table 2. Anticoagulants and Antiplatelet Drugs

Drug	Dose adjustment	F/M ratio	Breast milk/maternal plasma ratio	Former FDA category	PK/PD alteration	References
Acetylsalicylic acid	Unknown, possibly increased dose requirement based on PK	1 for salicylic acid, lower for acetylsalicylic acid due to placental esterases	Peak levels 9–12 h after dose	N	Slower uptake, lower peak plasma concentration after single dose	33–35
Argatroban	Unknown	Unknown, low molecular weight, moderate protein binding Likely crosses placenta	Unknown, low molecular weight, moderate protein binding Likely crosses into breast milk	B	Unknown	36
Clopidogrel	Unknown	Unknown likely crosses placenta, low molecular weight	Unknown likely crosses into breast milk, low molecular weight	B	Unknown	37
Dabigatran	Unknown	0.33	Unknown	C	Unknown	36, 38
Enoxaparin	Must titrate to Xa levels given wide swings in pharmacokinetics through pregnancy. Once daily dosing is likely insufficient given higher clearance	Does not readily cross placenta due to large molecular weight	Very little excreted into breast milk due to high molecular weight. Milk/plasma ratio of <0.025–0.224. Also not absorbed orally.		Increased clearance, larger volume of distribution with major increase in last 2 mo of pregnancy Progressive reduction in anti-Xa activity during pregnancy	39, 40
Fondaparinux	Unknown	0.1 large molecular weight	Unknown	B	Potentially unchanged, case report data	41
Heparin	Higher doses and/or more frequent intervals aPTT is not valid in pregnancy, measure Xa levels	Does not cross placenta due to large molecular weight	Not excreted into breast milk due to high molecular weight	C	Peak plasma concentration 50% that of nonpregnant controls Reduced efficacy in pregnancy ACCP recommends 10,000 U every 12h or monitoring anti-Xa levels	42–44
Rivaroxaban	Unknown	Unknown	Manufacturer reports rivaroxaban is excreted in breast milk	C	Unknown	36
Warfarin	Highly variable	0.15—not metabolized readily by fetal liver leading to higher INR in fetus	Not excreted into breast milk	X (D if mechanical heart valve)	PK unknown, postpartum patients require more drug than nonpregnant women to achieve therapeutic anticoagulation	44–46

ACCP = American College of Chest Physicians; aPTT = activated partial thromboplastin time; FDA = Food and Drug Administration; F/M = fetal/maternal ratio; INR = international normalized ratio; PK/PD = pharmacokinetic/pharmacodynamic.

normal. Some metabolic liver enzymes are induced in pregnancy such as CYP2D6 in the example of codeine mentioned earlier (Table 3). CYP3A4, CYP2B6, CYP2C9, and uridine 5′-diphosphate glucuronosyltransferase are also induced in pregnancy. Other metabolic enzymes are unchanged in pregnancy. A few metabolic enzymes have reduced activity, such as CYP1A2, which is the primary enzyme for caffeine metabolism. As a result of the reduction of CYP1A2 activity, caffeine plasma concentration is doubled during the third trimester compared with the concentrations after a typical dose (e.g., a cup of coffee) in nonpregnant women.[47]

HALF-LIFE

Half-life is a function of the ratio of volume to clearance. The interaction of volume and clearance can be envisioned as a tank full of drug (volume) and a pump that removes the drug from the tank (clearance). Increasing the size of the tank while maintaining the same pump removing drug results in increasing the time needed for the pump to drain the tank. Using a bigger pump with the same tank drains it faster. Similarly, if volume increases more than clearance, then half-life increases. If clearance increases more than volume, then half-life decreases.

Because both volume and clearance increase during pregnancy, changes in half-life are not predictable. Half-life may increase, decrease, or stay the same. Each drug must be studied individually to determine whether the half-life changes in pregnancy. The volume of distribution primarily determines the concentration from the first dose of a drug (e.g., propofol for induction of anesthesia). The clearance of drug primarily determines the concentration with steady-state dosing (e.g., metoprolol for hypertension in the last

trimester). The half-life determines the dosing interval at steady state, how often the drug must be given to maintain adequate drug levels. In the absence of specific guidance based on the pharmacokinetic studies in pregnancy, the safest assumption is that the half-life is unchanged in pregnancy, and, therefore, drugs should be dosed with the same frequency in pregnant and nonpregnant women. However, we will provide examples of pharmacokinetic studies in pregnant women that suggest important changes in dosing interval.

PLACENTA DRUG TRANSFER AND FETAL METABOLISM

Pregnancy is unique in that it is associated with the formation and the subsequent sloughing of a metabolically active organ. The placenta is a semipermeable barrier to drug passage much like the blood–brain barrier. For drugs that can pass through the placenta, or are metabolized by the placenta, uptake, distribution, and metabolism by the placenta and fetus will contribute to the changes in drug pharmacokinetics associated with pregnancy.

Passive placental transfer is determined by lipid solubility, charge, molecular weight, and concentration difference across membranes. Some drugs are actively restricted, whereas others are readily taken up by the placenta and fetus. As a general rule, drugs that cross the blood–brain barrier will cross the placenta. Changes in the acid–base status of the mother or fetus can alter placental drug transfer. An example is the relatively acidotic fetus that can trap high concentrations of weak bases such as lidocaine administered to the mother, potentially causing fetal toxicity.

The placenta is also capable of drug metabolism. Although less metabolically active than the liver, the placenta expresses both phase 1 enzymes (oxidation, reduction, and hydrolysis) and phase 2 enzymes (conjugation). Phase 1 enzymes expressed by the placenta include CYP1A1, CYP2E1, CYP3A4, CYP3A5, CYP3A7, CYP4B1, and CYP19 (aromatase). Drugs that undergo significant placental metabolism in pregnancy include dexamethasone and prednisone.[74] Remifentanil is metabolized by esterases highly expressed in the placenta, resulting in fetal remifentanil concentrations an order of magnitude less than maternal concentrations during remifentanil administration for labor analgesia and cesarean delivery (Table 3).[72]

Terminology regarding the ratio of maternal drug concentrations to that in the fetus is often confusing because several ratios are described with variable language. Maternal arterial blood from the uterine artery feeds the placenta. The abbreviation MA (maternal artery) refers to this concentration even though it may be measured from an arm vein, assuming that the arterial and venous concentrations in the mother's arm are at steady state. The umbilical vein (UV) takes the blood from the placenta to the fetus. The umbilical artery (UA) takes blood from the fetus back to the placenta. Drug measured in the UA represents the concentration measured after fetal metabolism and mixing and approximately represents the concentration of drug delivered to the fetal brain. If there is no fetal metabolism, then UA and UV are identical at steady state. The ratios UV/MA and UA/MA are often termed the fetal-maternal or fetal/maternal (F/M) ratio for simplicity. In this text, F/M will be used as the equivalent of UV/MA or UA/MA, as used, for example, in "Placental Transfer of Drugs and Perinatal Pharmacology" in the most recent version of *Shnider and Levinson's Anesthesia for Obstetrics*.[14] The term cord:maternal is also used for UA/MA in some texts including *Drugs in Pregnancy and Lactation: A Reference Guide to Fetal and Neonatal Risk*.[37] Many of the ratios quoted in this text are collated from these textbooks, which serve as excellent references.

Neonates have significantly reduced glomerular filtration rate, decreased hepatic drug metabolism, and increased extracellular fluid (and therefore increased volume of distribution).[75,76] As a result, drugs that are metabolized in the liver or excreted by the kidneys (most drugs) would be expected to have significantly longer half-life and duration of activity in neonates relative to adults. In addition, decreased plasma protein binding can result in increased free-drug fraction and drug toxicity in the neonate. Doses well tolerated by adults may be relatively toxic to the fetus. For example, maternally administered amiodarone for refractory arrhythmia can result in iodine accumulation in the fetus, leading to hypothyroidism and even goiter that may require treatment at birth.[77] There are also physiologic effects specific to the fetus such as premature closure of the ductus arteriosus by nonsteroidal anti-inflammatory drugs (NSAIDs) that require consideration. The neonatologist and pediatric anesthesiologist must consider the potential consequences to the fetus of drugs given to the mother during pregnancy and parturition.

PHYSIOLOGIC CHANGES OF PREGNANCY AND PHARMACOKINETICS OF SPECIFIC DRUG CLASSES

Analgesics

Acetaminophen is commonly used in pregnancy for analgesia and the treatment of fever. Maternal absorption, metabolism, and clearance of oral acetaminophen is not changed in pregnancy.[78] Maternal clearance of a 2 g dose of IV acetaminophen was more rapid during cesarean delivery for preterm (<37 weeks) than term delivery, potentially suggesting differences in blood loss or fluid shifts.[79] A recent epidemiologic study suggested an association of acetaminophen with neurodevelopmental and behavioral problems in the offspring including a higher risk for attention deficit hyperactivity disorder and an increased risk of asthma-like syndromes.[80] This study considered repeated maternal dosing in pregnancy, and the findings likely do not apply to a single dose during delivery. Newborn infants are frequently given acetaminophen without observed negative consequences. However, the study does raise questions about an old drug that has long been considered safe in pregnancy.

NSAIDs may be prescribed in pregnancy both for chronic conditions such as inflammatory bowel disease and for obstetric indications such as tocolysis (indomethacin) and antiphospholipid antibody syndrome (aspirin). Pregnant women may also take these familiar over-the-counter medications that are part of many combination products without consulting their obstetric providers.[81] However, NSAIDs were classically categorized as categories C or D by the

Table 3. Opioids

Drug	Dose adjustment	F/M ratio	Breast milk/maternal plasma ratio	Former FDA category	PK/PD alteration	References
Alfentanil	No major dosing changes anticipated	0.3	Excreted into breast milk at low concentrations	C	No change in volume of distribution or clearance	14, 37, 48, 49
Buprenorphine	Dose increase in third trimester. Decreased risk of neonatal withdrawal compared with methadone (adjusted odds ratio, 2.55)	Minimal data. Estimated F/M ratio was 6.3 in 1 patient	More data needed. Known to cross into breast milk. Values not reported. Poor oral bioavailability makes absorption during breastfeeding low	C	Increased metabolism to inactive metabolites via induction of CYP3A4	50–53
Codeine	Should not be used because of variable metabolism and excretion into breast milk	See morphine	See morphine	C	Prodrug metabolized by CYP2D6 that is induced in pregnancy and has extensive genetic variability	8, 54, 55
Fentanyl	Unknown	0.5–0.9	1.4–3. Low oral bioavailability in neonate	C	Peak maternal concentration 0.5 ng/mL with epidural dosing	14, 56–58
Hydrocodone	Unknown, more research needed	Unknown	Fully breastfed neonates received 1.6%–3.7% (range, 0.2%–9%) of the maternal weight-adjusted hydrocodone dose	C	Increased activity of hepatic CYP2D6 enzyme increases conversion to the more potent opiate, hydromorphone, can result in higher and more rapid peak effect	59–61
Hydromorphone	Unknown	Unknown	2.6. Estimated infant dose was 0.67% of the mother's weight-adjusted dose	C	Metabolized by CYP2D6	55, 59, 60
Meperidine	No change, caution with repeat dosing in breastfeeding	0.35–1.6	0.8–1.6. Long $t_{1/2}$ of meperidine and normeperidine in infants—no >1 dose is recommended in breastfeeding women	C	Increased metabolism (inactivation) is expected via induction of CYP3A4 in pregnancy. Likely counterbalanced by decreased clearance. No change in $t_{1/2}$	14, 48, 49, 51, 62
Methadone	Higher dose and shorter dosing interval required. Mean increased dose of 24 mg in methadone maintenance by third trimester, and many authors recommend splitting total daily dose into twice a day. Dose returns to normal by 6 wk postpartum	0.2. Withdrawal symptoms occur in 60%–90% of the infants exposed in utero to methadone	Average = 0.8, wide range of 0.05–1.2. Concentration in breast milk can help with symptoms neonatal abstinence syndrome	C	Increased clearance, largely due to induction of CYP3A4 and CYP2B6. Placental aromatase CYP19 also metabolizes methadone. Reduced elimination half-life of 8–20 h compared with the 24-h half-life in a nonpregnant patient	63–67
Morphine	May require increased dose and/or increased dosing interval	0.61–1. Undetectable in most infants 1–2 h after a single IV maternal dose	<1. Low oral bioavailability (26%) in infant. Receives 8%–12% maternal dose	C	Volume of distribution unchanged, clearance >70%, decreased half-life, glucuronide conjugation by UGT	14, 68–70
Oxycodone	May require a shorter dosing interval due to faster elimination half time	Maternal plasma: umbilical plasma ratio of 1	3.2	B	Increased clearance via increased GFR as well as induction of CYP3A4 and CYP2D6. May achieve a faster peak in active metabolite oxymorphone due to CYP2D6 induction. Shorter elimination half-time in laboring women (decreased from 3.8 to 2.6 h)	55, 71
Remifentanil	May require higher dose to achieve the same plasma concentration due to increased clearance	0.29–0.88. Extensive fetal and placental metabolism occurs, as evidenced by a large decrease from the UV:MA ratio of 0.88	Unknown. Low molecular weight and high lipid solubility suggest that it will be excreted into breast milk	C	Clearance more than doubles, likely due to larger blood plasma volume, increased cardiac output, and increased renal blood flow	14, 72, 73

FDA = Food and Drug Administration; F/M = fetal/maternal ratio; GFR = glomerular filtration rate; MA = maternal artery; PK/PD = pharmacokinetic/pharmacodynamic; UV = umbilical vein.

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FDA because of concerns regarding increased risk of miscarriage and fetal teratogenicity in the first trimester and concerns for premature closure of the fetal ductus arteriosus in the third trimester.[82,83] Therefore, pharmacokinetic and pharmacodynamic studies of this drug class in pregnancy are largely lacking, but the existing data were recently reviewed.[81] Placental transfer of NSAIDs including aspirin, indomethacin, and naproxen has been demonstrated by studies of placental and fetal tissues of women who terminated pregnancy.

The use of prescription opioids during pregnancy has increased with significant regional variation in the United States.[84,85] Opioids are used for analgesia during pregnancy to prevent opioid withdrawal in chronic users and for labor analgesia. With the exception of remifentanil, all opioids are metabolized to inactive and occasionally active derivative compounds by the liver. Many opioids are metabolized by liver enzymes that have altered activity in pregnancy (Table 3). For the most part, opioids are dosed to effect. However, induction of metabolic enzymes in pregnancy can cause unexpected changes in drug duration and efficacy. Increased metabolism of a prodrug (codeine) may increase peak drug levels. Increased metabolism of the parent drug to inactive metabolites, as is the case for morphine, oxycodone, hydrocodone, hydromorphone, methadone, and buprenorphine, can result in unexpectedly low drug levels. This becomes particularly important in managing methadone and buprenorphine treatment during pregnancy. Methadone and buprenorphine, both metabolized by CYP3A4 and CYP2B6, respectively, are used to prevent opioid withdrawal syndrome. In patients who are not pregnant, methadone takes nearly a week to reach steady state with repeat dosing. During pregnancy, CYP2B6 is induced by increased estrogens leading to increased drug clearance.[86] Induction of CYP3A4 also results in reduced concentrations during pregnancy.[87] Because of these considerations, altered dosing regimens required in pregnancy are best managed by experts in their use.[50,63,64]

Systemic opioids as a drug class only offer marginal pain relief in labor, and their use is complicated by maternal, fetal, and neonatal side effects.[88] Remifentanil is unique among opioids in that it is metabolized by plasma and tissue esterases. Ultrarapid metabolism of remifentanil in the mother and extensive metabolism by the placenta and the fetus significantly reduce the possibility of respiratory depression and impaired transition in the neonate. This increased neonatal safety margin permits substantially higher doses to be used for labor analgesia compared with other systemic opioids.[72,89–92]

Sedative Hypnotics

For many years, thiopental was the primary drug used to induce general anesthesia in pregnant women. The pharmacokinetics of thiopental have been studied in detail in pregnancy.[93] Pregnant women have more rapid thiopental clearance because of increased liver blood flow, which decreases the elimination half-life.[94] All sedative hypnotic drugs cross the placenta (Table 4). The characteristics that allow them to cross the blood–brain barrier to induce hypnosis also favor placental transfer to the fetus.

Thiopental is no longer available in the United States and has been largely replaced by propofol for the induction of general anesthesia in healthy patients. Pharmacokinetic and pharmacodynamic changes of propofol in pregnancy have not been well studied, despite its nearly ubiquitous use for induction of general anesthesia. A few early studies evaluated the use of propofol for cesarean delivery but did not compare propofol in parturients with propofol in nonpregnant controls.[106,107,114] Studies of propofol transfer in perfused human placental cotyledons suggested that maternal concentration is highly dependent on albumin concentration.[115] As a result, free propofol concentration would be expected to be increased in pregnancy. Consistent with these expected pharmacokinetics, a case series using a target-controlled infusion of propofol and remifentanil for cesarean delivery under general anesthesia found that neonatal depression occurred in 6 of 10 babies delivered from women anesthetized with this technique.[114] Another study showed no change in the total propofol required for maternal hypnosis in patients early in pregnancy; however, free propofol concentration was not measured.[108] Other sedative hypnotic drugs have increased pharmacodynamic activity during pregnancy, possibly because of the neuronal effects of progesterone. No dosing changes are recommended based on the clinical experience,

Table 4. Sedative Hypnotic Drugs

Drug	Dose adjustment	F/M ratio	Breast milk/maternal plasma ratio	Former FDA category	PK/PD alteration	References
Diazepam	Not recommended	1	0.2–2	D	No change in clearance	14, 95–98
Etomidate	Unknown	0.5–0.86	1.2, undetectable in 4 h	C	Unknown	14, 99, 100
Ketamine	Unknown	1.26	Unknown	NA	No human data; unchanged in pregnant ewe	14, 101
Midazolam	Not recommended during first trimester, may require dose increase for intended effect at term	0.15–0.66	0.15, cleared in 4 h	D	Peak plasma concentration is reduced, half-life unchanged CYP3A-induced hepatic metabolism increased	14, 102–105
Propofol	2 mg/kg resulted in less neonatal depression	0.7–1.3	Negligible	B	C_{50} for loss of consciousness unchanged first trimester	14, 106–111
Thiopental	No dose change	0.4–1.1	<1	NA	Volume of distribution and clearance increased resulting in lower plasma concentrations but more efficacious in pregnancy	14, 112, 113

FDA = Food and Drug Administration; F/M = fetal/maternal ratio; NA = not applicable; PK/PD = pharmacokinetic/pharmacodynamic.

but this is an area where more detailed pharmacokinetic and pharmacodynamic information is needed.

Two of the authors (PDF and SLS) attempted to address this shortcoming in propofol clinical pharmacology about 5 years ago by requesting an Investigational New Drug (IND) Application from the FDA to study propofol's pharmacokinetics in parturients who required cesarean delivery under general anesthesia because of placental invasion. The proposed study was simple: administer propofol when general anesthesia was indicated and obtain arterial blood samples to characterize the pharmacokinetics. The FDA imposed onerous requirements on the study before granting an investigator-initiated new drug application, including an analysis of propofol in breast milk that would require development of a completely new assay. Because of the demands placed by the FDA to grant an investigator IND, this study was never undertaken. This is an example of the barriers that academic investigators may encounter in attempting to better understand the pharmacokinetics of commonly used drugs in pregnancy.

The use of benzodiazepines in early pregnancy is limited by conflicting data concerning a potential increase in oral clefting when benzodiazepines are used during the first trimester.[116] Benzodiazepines are used for mild sedation and anxiolysis during cesarean delivery and other near-term procedures. Midazolam has been extensively studied as a typical drug metabolized by CYP3A4, a liver enzyme that is induced in pregnancy. Physiologically based pharmacokinetic models have been constructed based on known changes with the intention of predicting exposure changes induced by pregnancy for other compounds that are metabolized by CYP3A4 or renally excreted.[102] The peak concentration of midazolam is reduced after both oral and parenteral administration in pregnancy, but the half-life is unchanged. Prolonged use of benzodiazepines near term is contraindicated because of neonatal toxicity and withdrawal symptoms. The fetal–maternal ratio for most benzodiazepines with the exception of midazolam is close to 1 (Table 4), making midazolam the preferred drug when short-term use is required near term pregnancy.

Neuromuscular-Blocking Drugs

Succinylcholine and mivacurium are metabolized by plasma cholinesterase (pseudocholinesterase or butyrylcholinesterase). Maternal plasma cholinesterase activity is decreased about 30% from the 10th week of gestation until up to 6 weeks postpartum. However, decreased cholinesterase activity is not associated with clinically relevant prolongation of the neuromuscular blockade from succinylcholine or mivacurium in patients with normal baseline levels (Table 5). The larger volume of distribution of succinylcholine in pregnancy likely offsets any decreased cholinesterase activity, and normal nonpregnant doses are recommended for pregnant women and parturients. Very little succinylcholine crosses the placenta, and there is no pharmacodynamic effect in a fetus with normal pseudocholinesterase activity. However, even the small amount transferred can produce flaccidity in the setting where both the mother and the fetus produce atypical pseudocholinesterase.[117]

Nondepolarizing muscle relaxants are largely ionized at physiologic pH, so there is little transfer of nondepolarizing muscle relaxants across the placenta or into breast milk. When fetal muscle relaxation is desired for fetal surgery, muscle relaxants must be injected directly into the UV or fetal muscle.

Local Anesthetics

Local anesthetics are commonly used to provide labor or surgical analgesia during pregnancy. Local anesthetics may be administered for single-dose or continuous wound infiltration, perioperative IV infusions, peripheral nerve blocks, transverse abdominis plane blocks, or neuraxial blocks. Pregnancy does not increase the absorption or peak concentration of bupivacaine.[125] However, physiologic changes during pregnancy, in particular, decreased plasma protein binding, can increase the risk of local anesthetic toxicity when large doses of local anesthetics are administered to pregnant women (Table 6). Local anesthetics are highly protein bound, and the reduction in plasma protein that occurs in pregnancy will increase the free fraction

Table 5. Muscle Relaxants

Drug	Dose adjustment	F/M ratio	Breast milk/maternal plasma ratio	Former FDA category	PK/PD alteration	References
Atracurium	Unchanged	0.12	Unknown, not orally absorbed by infant	C	VD, Vss, and Vc unchanged, clinical duration unchanged	14, 118, 119
Pancuronium	Unchanged	0.2–0.5	Unknown, not orally absorbed by infant	C	Faster clearance no change in VD	14, 120–122
Rocuronium	No change in initial dose, some studies suggest prolonged duration and therefore decreased redosing	0.1–0.6	Unknown, not orally absorbed by infant	C	PK unknown, onset unchanged, possible increased clinical duration of action	14, 123, 124
Succinylcholine	No change except avoid in women with atypical cholinesterase	Not detectable	Unknown, not orally absorbed by infant	C	Slightly prolonged recovery time postpartum Reduced cholinesterase not significant with 1 mg/kg dose, prolonged blockade may occur with larger doses	14, 119
Vecuronium	May require more frequent monitoring	0.1–0.5	Unknown, not orally absorbed by infant	C	VD, Vss, and Vc unchanged, terminal half-life reduced but clinical duration is prolonged	14, 121, 122

FDA = Food and Drug Administration; F/M = fetal/maternal ratio; PK/PD = pharmacokinetic/pharmacodynamic; Vc = central volume; VD = volume of distribution; Vss = steady-state volume.

Table 6. Local Anesthetic Drugs

Drug	Dose adjustment	F/M ratio	Breast milk/maternal plasma ratio	Former FDA category	PK/PD alteration	References
2-Chloroprocaine	N/A, titrated to effect	Rapidly hydrolyzed by esterases, and only traces of this compound reach the fetus, even after overdose, suggesting safety for the fetus	Unknown	C	Unknown	14, 131
Bupivacaine	N/A, titrated to effect	0.3–0.7, 90% binding to maternal α1-acid glycoprotein that exceeds fetal protein binding (50%). Fetal acidosis will cause increased fetal accumulation and possible toxicity	0.3	C	No change in absorption or peak concentration. Some changes in metabolism—less 4′ hydroxylation, enhanced *N*-dealkylation	14, 125, 131–133
Lidocaine	N/A, titrated to effect	0.5–0.9, acidosis increases transfer to fetus	1	B	Unknown	14, 131–133
Mepivacaine	N/A, titrated to effect	0.5–0.7	Unknown	C	Unknown	14, 131
Prilocaine	N/A, titrated to effect	1	Unknown	B	Unknown	131
Ropivacaine	N/A, titrated to effect	0.3–0.7	0.25	B	Unknown	14, 134, 135

FDA = Food and Drug Administration; F/M = fetal/maternal ratio; NA = not applicable; PK/PD = pharmacokinetic/pharmacodynamic.

of local anesthetics. This effect is particularly important for hydrophilic drugs if the concentrations approach the upper limit of the therapeutic window. Transverse abdominis plane blocks, in particular, are associated with high local anesthetic absorption.[126] Case reports of maternal seizures have been reported after placement of transversus abdominal plane blocks for analgesia after cesarean delivery.[127–130]

Amide local anesthetics are primarily hepatically metabolized, and their metabolites are renally excreted. Toxic plasma concentrations may result from drug accumulation with large or repeated doses. Ester local anesthetics undergo hydrolysis by pseudocholinesterase present in plasma. Although ester local anesthetics have limited potential to accumulate, they may have higher than expected initial blood levels because of relative deficiency of pseudocholinesterase associated with pregnancy. Therefore, recommended "safe doses" outlined in drug package inserts for all local anesthetics may cause side effects in pregnant women.[126]

A study that measured ropivacaine blood concentrations after ultrasound-guided transverse abdominis plane blocks (2.5 mg/kg ropivacaine in 20 mL per side) in 30 women undergoing cesarean delivery found that concentrations of ropivacaine exceeded the potentially toxic threshold of 2.2 μg/mL in 12 patients and that 3 women described symptoms attributable to mild local anesthetic neurotoxicity (perioral tingling, slurred speech, tongue paresthesia).[126] There is also a suggestion of increased sensitivity to neuraxial local anesthetic doses in pregnancy, but it is not clear whether the changes are because of increased sensitivity of the nerves to local anesthetic blockade or changes in distribution because of engorgement of epidural vasculature.[136–139] It is not known whether the case reports of toxicity with doses at the top of the recommended range reflect a pharmacokinetic effect (increased drug concentration) only and/or reflect a pharmacodynamic effect (increased sensitivity to the same concentration). Thus, it is prudent in pregnancy to avoid the upper range of local anesthetic doses considered safe in other settings.

Fetal acidosis will increase the ionization of local anesthetics because they are all weak bases. As previously mentioned, local anesthetic drugs have the capacity to accumulate in an acidotic fetus.[140] Because of the potential for enhanced toxicity, lipid emulsion to treat local anesthetic overdose should be available whenever local anesthetics are administered to parturients.[141,142] Lipid emulsion should be administered to the mother at the first sign of local anesthetic toxicity. It is not known whether it crosses a human placenta; however, it does not cross the rabbit placenta intact.[143] It may need to be dosed to a rapidly delivered neonate separately if there are signs of local anesthetic-induced depression.

Antibiotics

Knowledge of pharmacokinetic and pharmacodynamic changes for antibiotics in pregnancy is particularly important because there is normally no clinical response to guide dose titration. Administration of prophylactic antibiotics, most commonly cefazolin, before skin incision reduces the incidence of surgical site infection, endometritis, and total surgical infectious morbidity.[144] Only free drug is assumed to have antibacterial activity. For antimicrobial agents to be effective, it is critical that the free drug concentration remains above the minimum inhibitory concentrations (MICs).[145] Changes in antibiotic pharmacokinetics during pregnancy include increased volume of distribution, increased renal clearance, and reduced protein binding. The reduction in protein binding is not sufficient to offset the decrease in free drug concentration because of a larger volume of distribution and increased clearance. The result is reduced free plasma concentration and antimicrobial efficacy of many antibiotics administered to pregnant women. When surgical antibiotic prophylaxis fails, the only measureable outcome is the incidence of surgical site infection or endometritis. These are potentially highly consequential, because maternal sepsis is a leading cause of maternal morbidity and mortality.[146]

Cefazolin, the most commonly used IV antibiotic in pregnancy, has been well studied (Table 7).[147–152]

Table 7. Antibiotic Drugs

Drug	Dose adjustment	F/M ratio	Breast milk/maternal plasma ratio	Former FDA category	PK/PD alteration	References
Amoxicillin	Higher more frequent dosing	0.18 after 3 min	0.014, 0.013, and 0.043 at 1, 2, and 3 h	B	Increased clearance	154–156
Ampicillin	Higher more frequent dosing	0.3–0.7 at 1 h after dose, 1.1–10 2 at 6 h after dosing	0.2	B	Increased clearance in pregnancy	157, 158
Azithromycin	500 mg before cesarean delivery leads to sustained concentrations greater than MIC for *Ureaplasma*	0.2–0.4	Accumulates reaches steady state in 3 d	B	Clearance by hepatobiliary excretion may be reduced in pregnancy	159–162
Cefazolin	Higher dose to reliably keep plasma concentration above MIC	0.35–0.69	0.02	B	Clearance and volume of distribution are increased	149, 151, 152, 163
Cefepime	Higher dose or increased frequency may be required	0.23	Low concentration	B	Clearance and volume of distribution are increased	164
Cefoxitin	Higher dose or increased frequency may be required More studies needed	0.1–0.9	Minimal secretion	B	Clearance and volume of distribution are increased	157, 165
Ceftriaxone	More studies needed	Unknown	0.03–0.06	B	? Longer half-life in pregnancy	166
Ciprofloxacin	Unknown	Unmeasured but crosses placenta and concentrates in amniotic fluid	4.71	C	Unknown	167
Clindamycin	Increased dosing may be required depending on degree of protein binding More research needed	0.5	0.08–3.1	B	Decreased AUC/MIC ratio	167, 168
Ertapenem	Unknown	Low molecular weight, may pass	0.13–0.38	B	Unknown	37
Gentamicin	Increased frequency of dosing, may require measurement of plasma levels	0.34–0.44 were at 1–2 h	0.1 at 1 h and 0.4 at 7 h	D	Increased volume of distribution and increased clearance result in low peak concentrations	166, 169, 170
Meropenem	Unknown	Unknown	0.18	B	Unknown	171
Metronidazole	No dose adjustment required	1	1	B	Unchanged	167, 172
Moxifloxacin	Requires increased dosing	0.78	Unknown	C	Peak serum concentrations decreased, clearance increased, AUC 0.2 × nonpregnant values	173, 174
Piperacillin and tazobactam	Increased frequency of dosing	0.17–0.27	Unknown	B	Increased clearance and volume of distribution Concentration less than MIC at 4 h	175, 176
Sulfonamides	Likely reduced concentration due to dilution but not described	0.5 sulfasalazine 0.06 sulfisoxazole	Competes with bilirubin for albumin binding at birth	Sulfasalazine-B Sulfamethoxazole/trimethoprim-D Sulfamethoxazole-C	Unknown	37
Tetracyclines	Not tested Teratogenicity	Crosses and leads to dental discoloration	Crosses and leads to dental discoloration	D	Unknown	167, 177
Vancomycin	20 mg/kg q8h measurement of maternal plasma levels for sustained treatment	1 with steady state reached at 1–2 h	1	C	Increased volume of distribution, and clearance, unknown changes in half-life	178–180

AUC = area under the curve; FDA = Food and Drug Administration; F/M = fetal/maternal ratio; MIC = minimum inhibitory concentration; PK/PD = pharmacokinetic/pharmacodynamic.

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Pregnancy increases the clearance of cefazolin likely because of increased renal excretion.[147,151,152] The increased volume of distribution for cefazolin in pregnancy in conjunction with increased clearance results in a requirement for both a larger initial dose and more frequent dosing to keep plasma concentrations above MIC during surgery.[152] Figure 2 (adapted from Elkomy et al.[152]) shows the probability of maintaining the plasma-free cefazolin concentration above 8 μg/mL (MIC) as a function of dose (1, 1.5, or 2 g) and time of administration in the mother (A) and the fetus (B).[152] A 2-g dose of cefazolin given 15 minutes before surgery should maintain adequate concentrations for a 1-hour procedure in approximately 100% of patients. However, a delay of 1 hour between the administration cefazolin and the surgery will not maintain adequate concentrations in >20% of patients. This is consistent with a recommendation for a 2-g dose of cefazolin for all pregnant patients regardless of weight. In addition, because of the more rapid clearance, the dosing interval for cefazolin should be 3 to 6 hours, not 8 hours.[151] Obesity decreases the tissue concentrations of cefazolin. Based on the adipose cefazolin concentrations reported by Pevzner et al.,[150] 3 g would be an appropriate cefazolin dose for parturients with a body mass index of 30 to 40 kg/m^2, and 4 g would be an appropriate cefazolin dose for parturients with body mass index >40 kg/m^2. Published guidelines have not kept up with advances in our understanding of pharmacokinetics. Despite good studies that recommend administration of 2 g cefazolin 15 minutes before skin incision, the American Congress of Obstetricians and Gynecologists currently recommends 1 g cefazolin be administered within 60 minutes at the start of the operation.[153]

Other cephalosporins are variable with respect to pharmacokinetic changes in pregnancy. Only about one-third of the dose of ceftriaxone is excreted unchanged in the urine and two-thirds by hepatic metabolism.[181] As a result of the reduced dependence on renal elimination, the pharmacokinetics of ceftriaxone are not significantly altered during pregnancy.[182]

Gentamicin, commonly used when enhanced Gram-negative coverage is required at cesarean delivery, has more rapid clearance in pregnant patients compared with nonpregnant control.[183] Larger doses are required to obtain adequate antibiotic concentrations, and the typical dosing interval should be 6 hours, not 8 hours.[183] A dose of 5 mg/kg given every 24 hours may provide better antibiotic coverage for chorioamnionitis with a sustained "postantibiotic effect" and no increase in maternal or fetal complications compared with multiple daily doses.[184]

Sulfonamides used immediately after delivery compete with bilirubin for albumin binding and can lead to kernicterus of the newborn. Although the potential for kernicterus should be considered, they should not be completely avoided peripartum.[37] Sulfonamides have important uses during the peripartum period for specific indications including ulcerative colitis, Crohn disease, and prophylaxis in the setting of human immunodeficiency virus infection. Most studies have demonstrated no adverse effects when used during gestation remote from delivery except for a single retrospective study that found an increase in congenital malformations in neonates of mothers who used sulfonamides during pregnancy.[37]

Antibiotics may be administered to the mother for the purpose of transfer to the fetus to decrease the incidence of neonatal sepsis. UV (blood from the placenta to the fetus reflecting blood concentration in the baby) to MA (reflecting blood concentration in the mother) concentration ratios are important to determine for drugs requiring transplacental efficacy. In our text and tables, this is referred to as the F/M ratio. Figure 2B (adapted from Elkomy et al.)[152] shows the probability of maintaining the fetal concentrations of cefazolin ≥8 μg/mL from a maternal dose of 1, 1.5, or 2 g of cefazolin as a function of the time before surgery. If the intent is to provide antibiotic coverage to the fetus, onset takes a significant amount of time. Even a dose of 2 g given 1.5 hours before surgery has only a 60% chance of providing

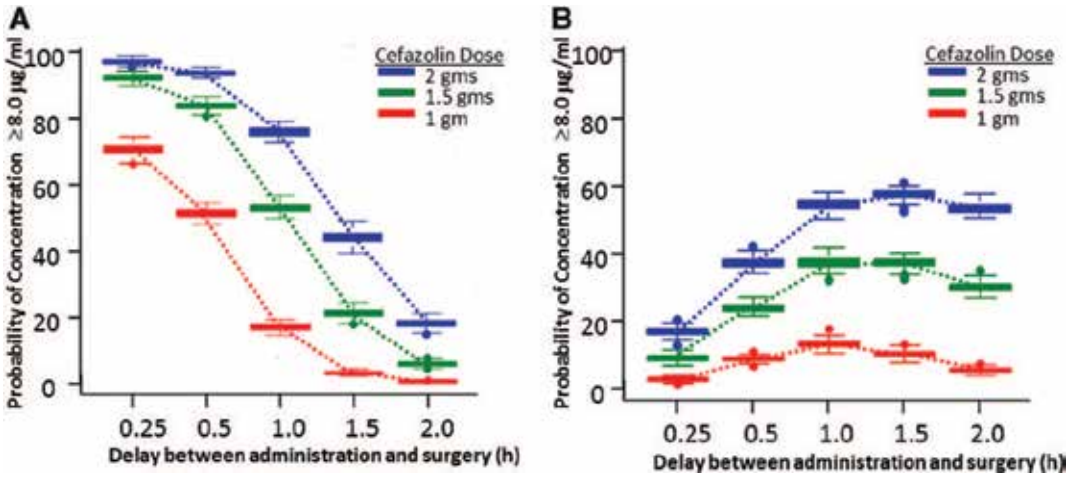

Figure 2. Probability of maintaining plasma concentration above minimum inhibitory concentration during surgery according to time delay between administration and surgery for 3 doses of cefazolin. A, Maternal concentrations. B, Fetal concentrations from uterine vein. Adapted from Elkomy et al.[152]

adequate coverage for the fetus at delivery. Higher doses will be required if fetal antimicrobrial coverage is a priority. Fetuses and neonates have significantly reduced metabolic capacity for many drugs, including antibiotics, which would be expected to extend the duration of antimicrobial coverage in the newborn.

Antihypertensive Drugs

The pharmacokinetics of antihypertensive drugs in pregnant women were reviewed in 2009.[20] By the end of the first trimester, maternal cardiac output increases approximately 35% above prepregnancy values and continues to increase to 50% above nonpregnant values by the end of the second trimester. Material cardiac output remains stable throughout the third trimester. At delivery, cardiac output can yet again double. Coincident with the increases in cardiac output and plasma volume, systemic blood pressure normally decreases secondary to a 20% reduction in systemic vascular resistance at term. Arterial blood pressure decreases approximately 20% by 20 weeks gestational age and then increases toward nonpregnant values because of further increases in plasma volume as the pregnancy reaches completion. Although blood pressure is reduced in normal pregnancy, antihypertensive drugs are commonly required to manage either underlying hypertension or hypertensive diseases associated with pregnancy including preeclampsia (Table 1).

β-Blockers are the mainstay of treatment of hypertensive diseases of pregnancy. The most commonly used β-blockers in pregnancy are labetalol, metoprolol, and atenolol. Increased volume of distribution and hepatic blood flow reduce peak concentrations and decrease appropriate dosing intervals for labetalol and metoprolol.

Labetalol is a mixed α- and β-adrenergic antagonist. The American College of Obstetricians and Gynecologists recommends labetalol as the first-line antihypertensive drug to treat blood pressure in the setting of preeclampsia.[185] The half-life of IV labetalol is 1.7 hours in the setting of pregnancy-induced hypertension at term, as opposed to 6 to 8 hours in nonpregnant women.[186] As such, IV labetalol may be an appropriate drug to treat acute hypertension in pregnancy but would have to be dosed too frequently to be effective for ongoing treatment. Larger bolus doses of labetalol are also required to treat hypertension in pregnant women compared with nonpregnant women.[185] The clearance of oral labetalol is increased 1.6-fold at term. Therefore, the dosing interval outlined should be shorter than recommended in the published guidelines.[20]

The effect of pregnancy on metabolism is not conserved among all β-blocking drugs. Similar to labetalol, increased clearance of metoprolol in pregnancy results in lower plasma concentrations in pregnant women compared with the same women postpartum.[9] In contrast to the reduced peak concentrations of labetalol and metoprolol in pregnancy, there is no difference in atenolol concentrations in pregnancy. Atenolol clearance is completely renal with no dependence on hepatic metabolism. Increased renal clearance is compensated for by increased oral absorption. Based on the absence of pharmacokinetic alteration, atenolol might be considered the preferred β-blocker for use in pregnancy. However, there are reports of intrauterine growth restriction when atenolol is used early in pregnancy, although separating drug treatment effect from severity of disease makes assessment of causation difficult.[187]

Magnesium sulfate is used commonly in preeclampsia/eclampsia for seizure prophylaxis and in preterm delivery for fetal neuroprotection. Minimum plasma magnesium sulfate concentrations of 4 mEq/L are suggested for seizure prophylaxis. Magnesium sulfate is commonly dosed IV but can be dosed IM in resource-poor settings. The 2 regimens are considered to have equivalent clinical efficacy.[139] Plasma concentrations peak at 15 minutes and are reliably maintained above 4 mEq/L at steady state after either a 4-g IV loading dose followed by 1 g/h or an IV push of 4 g over 20 minutes followed by 20 g by deep intramuscular injection.[188] However, there are a number of different treatment regimens that are used clinically, and there is uncertainty as to the optimal protocols for seizure prophylaxis, tocolysis, and fetal neuroprotection. Detailed pharmacokinetic and pharmacodynamic studies for magnesium sulfate are lacking. There are no comparison trials between pregnant and nonpregnant women, because magnesium at higher doses is typically only indicated in pregnant women.

Drugs Administered to the Mother for Fetal Treatment

Drugs with β-adrenergic blocking activity have been administered to the mother to treat fetal arrhythmias. Sotalol is a class III antiarrhythmic drug that acts largely through inhibition of potassium channels. Sotalol also has nonselective β-adrenergic blocking activity and prolongs both the PR and the QT interval. Sotalol has been used as first-line treatment of fetal tachycardia similar to digoxin and flecainide.[189,190] Proarrhythmic activity is a concern for the mother, and interaction with other drugs that prolong the QT interval requires surveillance. Sotalol is transferred effectively to the fetus with the mean F/M ratio of 1.[30] Betamethasone is administered to the mother to facilitate fetal lung maturation (see corticosteroids section).

Anticoagulants and Antiplatelet Drugs

Obtaining therapeutic anticoagulation in pregnancy can be challenging. Despite mild thrombocytopenia, pregnancy is a hypercoagulable state with increased fibrinogen and factor VII.[191] Factor XI, factor XIII, and antithrombin III are decreased, whereas factors II and V typically remain unchanged. These changes result in an approximately 20% decrease in prothrombin time and partial thromboplastin time in normal pregnancy. Hypercoagulability in pregnancy is a common cause of miscarriage, thrombophlebitis, and pulmonary embolism.

Treatment with anticoagulants is complex in the setting of pregnancy-associated hypercoagulability, increased liver blood flow caused by intravascular volume expansion, induction of liver enzymes, and increased renal clearance. Furthermore, it is imperative to normalize coagulation in the parturient to be able to offer neuraxial labor analgesia and avoid hemorrhage at delivery.

Warfarin is a highly effective anticoagulant that is being used in late pregnancy more frequently than in the past.[192]

However, as an uncharged, low-molecular-weight drug, warfarin readily crosses the placenta (Table 2). The use of warfarin between the 6th and 12th week of gestation is associated with a characteristic embryopathy associated with skeletal malformation and miscarriage. The skeletal malformations are because of defects in vitamin K-dependent osteocalcin carboxylation that is necessary for bone formation.[193] Previously, warfarin was considered absolutely contraindicated throughout pregnancy. Warfarin is now prescribed after the period of embryogenesis (after the first trimester), when consistent anticoagulation is necessary for the mother's well-being, such as in a pregnant woman with a mechanical heart valve.[194] Warfarin's pharmacokinetics have not been well studied in pregnancy because of its previous category X designation. With increased use in later pregnancy, more information would be valuable.

Heparin is a charged, high-molecular-weight molecule. As such, heparin does not readily cross the placenta and is not excreted into breast milk. The peak maternal plasma concentration of heparin is only 50% of concentrations in women who are not pregnant.[42] Although higher and more frequent doses of heparin are commonly used in pregnancy, the resulting reduction in factor Xa and activated partial thromboplastin time is highly variable, and therapeutic monitoring is often necessary.[43] Because activated partial thromboplastin time is prolonged in pregnancy, it is not entirely clear what target value is appropriate in pregnancy. Unfractionated heparin is often used as a short-acting, reversible bridge near term pregnancy to allow for discontinuation of longer-acting anticoagulants when delivery is anticipated to prevent intrapartum or postpartum hemorrhage.

Many new anticoagulatants have recently come to market including idrabiotaparinux, fondaparinux, otamixaban, RB006, dabigatran, AZD0837, rivaroxaban, apixaban, and edoxaban.[195] Other than enoxaparin, which is used commonly in pregnancy for thrombotic prophylaxis, these drugs have not been studied in parturients or pregnant women. Their package inserts uniformly state that they have not been studied in pregnancy, and they should only be used if the benefit outweighs the risk. Given the lack of data, it is surprising that some of these, including fondaparinux and apixaban, were considered category B under the old classification system for risk in pregnancy. Although enoxaparin has been studied for recurrent pregnancy loss, no large dose-finding studies have been performed in pregnancy. A variety of doses are used for prophylaxis and therapy of thrombosis. Given the importance of reliable thromboprophylaxis and its reversal in pregnancy, pharmacokinetic and pharmacodynamic studies of these drugs in pregnancy are needed.

Antinausea Drugs

Nausea and vomiting are common problems in pregnancy and during labor and delivery. Thalidomide remains one of the most extreme examples of the importance of evaluating drugs in human pregnancy. In the late 1950s, the treatment of morning sickness with thalidomide was responsible for malformed limbs in about 10,000 children. Animal models do not always predict human toxicity. The thalidomide experience demonstrates the risks when adequate human studies are not conducted, and doctors are not given proper guidance about the safety of drugs in pregnancy.

Table 8 shows the drugs commonly used to treat nausea and vomiting. Ondansetron is among the most effective and commonly used antiemetics. Ondansetron's pharmacokinetics are not affected by pregnancy, and plasma concentrations are not changed in pregnancy.[196] Ondansetron readily crosses the placenta with a F/M ratio of 0.41 at steady state.[197] Ondansetron has a significantly longer half-life in neonates compared with adults.[196] The use of ondansetron in the first trimester has been associated with a small increase in the risk for cleft lip and palate. More studies are needed to evaluate the risk versus benefit of ondansetron in pregnancy.[198]

Table 8. Drugs Commonly Used to Treat Nausea and Vomiting

Drug	Dose adjustment	F/M ratio	Breast milk/maternal plasma ratio	Former FDA category	PK/PD alteration	References
Betamethasone	Increased dose required for lung maturity in multiple gestations. 3 doses at 18-h intervals rather than 2 doses at 24-h intervals	0.3–0.5, more studies required	Unknown	C—concern for risk of cleft palate in T1	Increased volume of distribution, increased clearance, no change in half-life in singleton pregnancy Increased clearance proportional to number of gestations	199–201
Dexamethasone	Multiple gestation requires increased dose due to extensive placental metabolism	0.45	Unknown	C—concern for risk of cleft palate in first trimester	Clearance doubled in single gestation	199, 202
Doxylamine/ pyridoxine	No change first trimester of pregnancy	Unknown	Unknown	A	Clearance unchanged	203
Metoclopramide	Unknown	0.57–0.84	Highly variable	B	Unknown	204, 205
Ondansetron	Limited data, likely no change, more study needed	0.41	Unknown, low molecular weight likely excreted	B	No change in steady-state concentrations in first trimester	197
Scopolamine	Unknown	1	Excreted into breast milk, likely safe	C	Unknown	206, 207

FDA = Food and Drug Administration; F/M = fetal/maternal ratio; PK/PD = pharmacokinetic/pharmacodynamic.

Corticosteroids

Corticosteroids are commonly used to prevent nausea and vomiting and to enhance fetal lung maturity. The pharmacokinetics of steroids in pregnancy are unusual in that they are extensively metabolized by the placenta. The dose requirement is increased in the presence of multiple gestations. Because of increased placental metabolism, mothers carrying twins need greater steroid dosages than singletons and mothers carrying triplets more than mothers carrying twins.[199] This consideration is particularly important for dosing of betamethasone for lung maturity in multiple gestations. However, after delivery of the placenta, it is expected that the maternal dose requirements for steroids would abruptly decrease. Stress steroid prophylaxis may require an increased dose during vaginal delivery but no change during cesarean delivery because the placenta(s) will be quickly removed.

CONCLUSIONS

Pregnancy is associated with diverse physiologic changes that result in alterations of uptake, distribution, metabolism, and excretion of drugs.[208] Concern for adverse fetal outcomes has hampered clinical research on drugs administered in pregnancy. Despite an FDA mandate for the study of drugs in pregnancy, the pharmaceutical industry has not been willing to undertake these studies. Most of the high-quality studies in the literature were performed with academic funding. As shown in our example of propofol, even academicians attempting to study drugs in pregnancy may face unexpected regulatory obstacles.

Clinical choices about dosing and administration of drugs are mostly based on the experience and comfort of practitioners rather than on actual data.[5] Even when there are good pharmacologic data, for example, on reduced dosing interval for β-blockers in pregnancy and the higher dose requirements of cefazolin to attain effective antimicrobial levels, these findings have not made their way into clinical guidelines. Because β-blockers are a mainstay in the treatment of pregnancy-induced hypertension and preeclampsia, patients may be undertreated and their disease considered intractable when they are simply underdosed. Similarly, routine underdosing of cefazolin may contribute to the frequent incidence of peripartum infection.

All drugs commonly used in pregnancy should be subjected to rigorous pharmacokinetic study. When drugs have not been studied, there is little guidance for the clinician to determine whether the benefit outweighs the risk. When clinicians choose to administer drugs that have not been well studied in pregnancy (previous category B and C), significant consideration should be given to obtaining informed consent, recording patient characteristics, documenting drug dose and interval, measuring plasma drug levels, and publishing the experience as a case report. A few such case reports could become the basis of at least an initial effort to characterize the pharmacokinetics of unstudied drugs. These reports should be coalesced in new or existing clinical registries.[209] With better dosing guidelines for pregnant women, clinicians can improve treatment efficacy by avoiding underdosing and limiting overdosing with the associated side effects. Most critically, clinicians could provide better pharmacotherapy for optimal maternal and fetal well-being and outcomes.

DISCLOSURES

Name: Jessica Ansari, MD.
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RECUSE NOTE

Dr. Steven Shafer is Editor-in-Chief of *Anesthesia & Analgesia*, and Dr. Pamela Flood is married to Dr. Shafer. This manuscript was handled by Dr. James Bovill, Guest Editor-in-Chief, and Dr. Shafer was not involved in any way with the editorial process or decision.

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PIEB for Labor Analgesia

CON

Disclosures

none.

Ob PCEA Studies:*

- Studies: 33
- Patients PCEA/Total: 2,048/3,205
- Techniques Compared:
  - PCEA to IB, CI, IV PCA: 20
  - PCEA Variations: 13
    - Include Basal Rate: 18
    - Basal Rate: 0-12 ml/hr
    - Bolus Dose: 2-12 ml/hr
    - Lockout: 5-40 min
    - Hourly Limit: 12-24 ml

*PubMed Search: www.ncbi.nlm.nih.gov/PubMed

Ob PCEA:

Outcome	# of Studies*
↓ Drug Use	11
↓ Motor Block	4
↓ Pain Scores	4
↑ Patient Satisfaction	7
↓ Workload	11
No Sig. Differences	8
Disadvantages	0

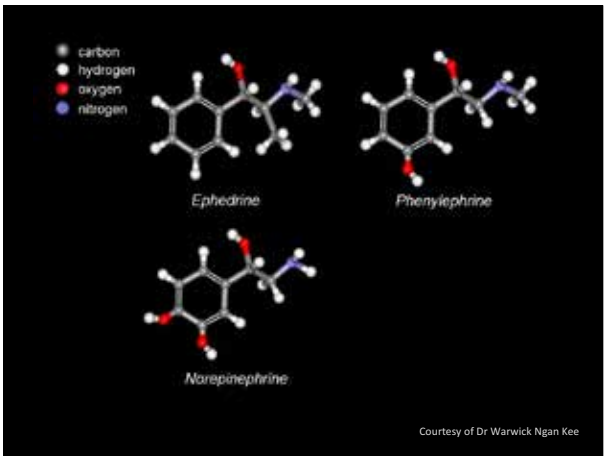
* Multiple Benefits Noted in Some Studies

"Better is the enemy of good"

Voltaire

Better is the Enemy of Good

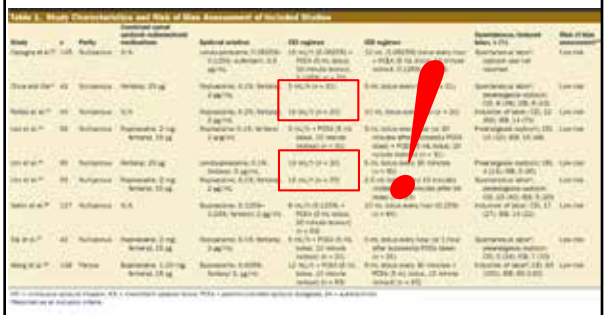
"An engineering solution to a problem that never existed"



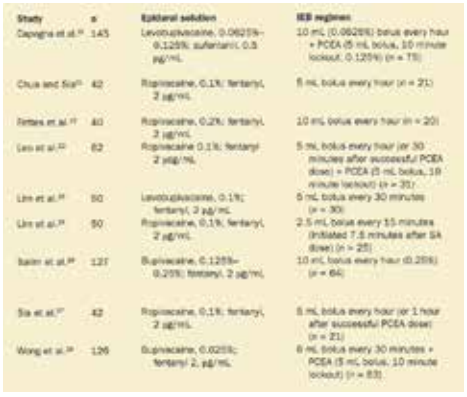
EDITORIAL

More perfect?

Smiley RM. Int J Obstet Anesth. 2017 [Epub ahead of print]



George RB, Allen TK, Habib AS. Anesth Analg. 2013;116:133-44



Study	n	Epidural solution	IED regimen
Capogna et al.[24]	145	Levobupivacaine, 0.0625%–0.125%; sufentanil, 0.5 μg/mL	10 mL (0.0625%) bolus every hour + PCEA (5 mL bolus, 10 minute lockout; 0.125%) (n = 75)
Chua and Sia[25]	42	Ropivacaine, 0.1%; fentanyl, 2 μg/mL	5 mL bolus every hour (n = 21)
Fettes et al.[26]	40	Ropivacaine, 0.2%; fentanyl, 2 μg/mL	10 mL bolus every hour (n = 20)
Leo et al.[27]	62	Ropivacaine 0.1%; fentanyl 2 μg/mL	5 mL bolus every hour (or 30 minutes after successful PCEA dose) + PCEA (5 mL bolus, 10 minute lockout) (n = 31)
Lim et al.[28]	60	Levobupivacaine, 0.1%; fentanyl, 2 μg/mL	5 mL bolus every 30 minutes (n = 30)
Lim et al.[28]	60	Ropivacaine, 0.1%; fentanyl, 2 μg/mL	2.5 mL bolus every 15 minutes (initiated 7.5 minutes after SA dose) (n = 25)
Sabin et al.[29]	127	Bupivacaine, 0.125%–0.25%; fentanyl, 2 μg/mL	10 mL bolus every hour (0.25%) (n = 64)
Sia et al.[30]	42	Ropivacaine, 0.1%; fentanyl, 2 μg/mL	5 mL bolus every hour (or 1 hour after successful PCEA dose) (n = 21)
Wong et al.[31]	126	Bupivacaine, 0.025%; fentanyl, 2 μg/mL	6 mL bolus every 30 minutes + PCEA (5 mL bolus, 10 minute lockout) (n = 83)

George RB, Allen TK, Habib AS. Anesth Analg. 2013;116:133-44

Implementation

- A lot of work has been done but best regimen still unknown
  - Dose
  - Interval
  - Drug concentration

Implementation

- High pressure alarms
- Patient and L&D RN confusion

Carvalho B, et. al. Anesth Analg. 2016;123:965-71

Limited pump options

- 60 ml Syringe?!?

Limited pump options

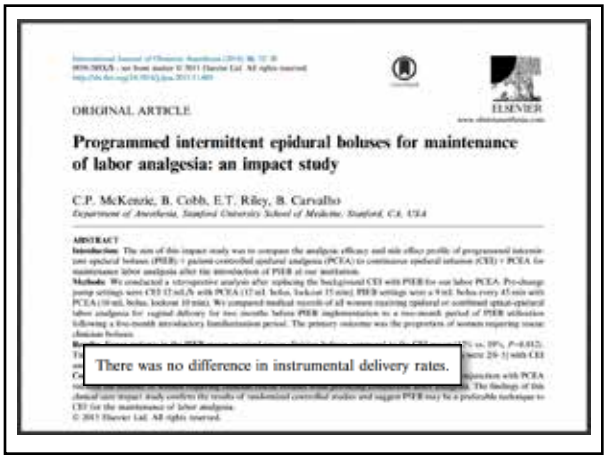
Limited pump options

All of these pumps are really cheap, so don't worry about that

…and have no battery issues, and communicate with your EMR, etc.

Less instrumented delivery?!?

George RB, Allen TK, Habib AS. Anesth Analg. 2013;116:133-44



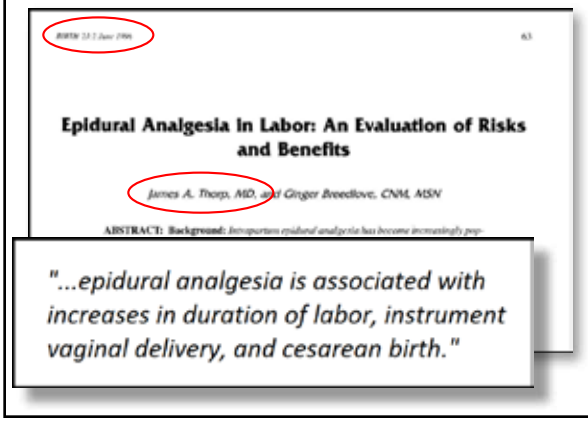
ORIGINAL ARTICLE

Programmed intermittent epidural boluses for maintenance of labor analgesia: an impact study

C.P. McKenzie, B. Cobb, E.T. Riley, B. Carvalho

Department of Anesthesia, Stanford University School of Medicine, Stanford, CA, USA

There was no difference in instrumental delivery rates.



Epidural Analgesia in Labor: An Evaluation of Risks and Benefits

James A. Thorp, MD, and Ginger Breedlove, CNM, MSN

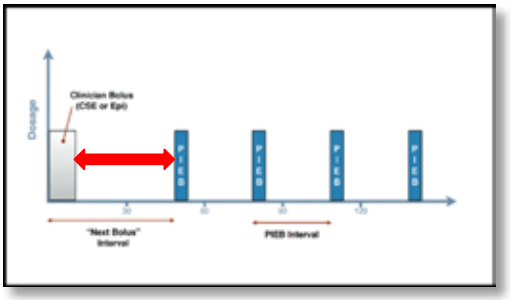
ABSTRACT: Background: *Intrapartum epidural analgesia has become increasingly pop-*

"...epidural analgesia is associated with increases in duration of labor, instrument vaginal delivery, and cesarean birth."

Less Local Anesthetic?!?

Of course! It is simply an artifact of study design!

Less Local Anesthetic?!?



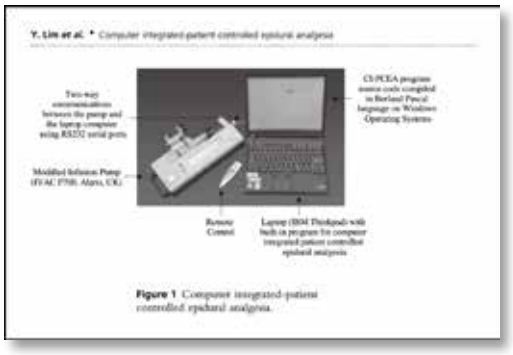
Carvalho B, et. al. Anesth Analg. 2016;123:965-71

On Balance

The advantages (if they even exist) are miniscule

The Evolution of Labor Analgesia

Single shot	Intermittent bolusing	Continuous infusion	PCEA PIEB



Lim Y, Sia AT, Ocampo CE. Anaesthesia. 2006;61(4):339-44

Case Report

- 34 year old G3P2 requesting epidural
- Several attempts by resident
- Eventually successful CSE
- SA test negative (neg asp and 40mg lidocaine)
- Placed on PCEA
  - 10 ml/hr basal
  - 5 ml bolus
  - 10 minute lockout

Case Report

- 2 hours later
- Patient complains of SOB
- Complete motor block bilateral LEs
- +CSF asp from catheter


Clinical Investigations in Education

Serious Complications Related to Obstetric Anesthesia

The Serious Complication Repository Project of the Society for Obstetric Anesthesia and Perinatology

Robert D'Angelo, M.D., Richard M. Smiley, M.D., Ph.D., Edward T. Riley, M.D., Scott Segal, M.D., M.H.C.M.

CME

This article has been selected for the ... CME Program. Learning objectives and disclosure and ordering information can be found in the CME section at the front of this issue.

ABSTRACT

Background: Because of the lack of large obstetric anesthesia databases, the incidences of serious complications related to obstetric anesthesia remain unknown. The Society for Obstetric Anesthesia and Perinatology developed the Serious Complication Repository Project to establish the incidence of serious complications related to obstetric anesthesia and to identify risk factors associated with each.

Methods: Serious complications were defined by the Society for Obstetric Anesthesia and Perinatology Research Committee which also coordinated the study. Thirty institutions participated in the approximately 3-yr study period. Data were collected as part of institutional quality assurance and sent to the central project coordinator quarterly.

Results: Data were captured on more than 257,000 anesthetics, including 5,000 general anesthetics for cesarean delivery. There were 157 total serious complications reported, 85 of which were anesthesia related. High neuraxial block, respiratory arrest in labor and delivery, and unrecognized spinal catheter were the most frequent complications encountered. A serious complication occurs in approximately 1:5,000 (1:3,445 to 1:7,782) obstetric anesthetics.

Abstract #:T-01

Resident and Faculty Unprofessionalism in Obstetrics and Anesthesiology

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Scott Cottrell PhD - West Virginia University - Morgantown, WV
Norman D. Ferrari MD - West Virginia University - Morgantown, WV

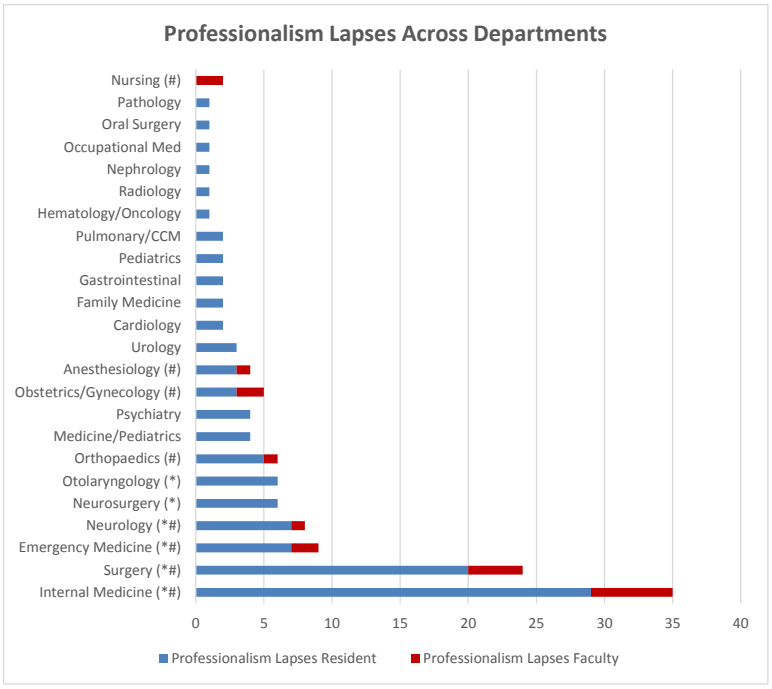
Introduction: Unprofessional resident behavior predicts poor performance, increases patient complaints and litigation, and is associated with later adverse actions by state licensing boards. The Liaison Committee on Medical Education, the ACGME, and the American Board of Medical Specialties, all require formal training and assessment of resident professionalism. We aimed to determine the frequency and underlying themes of resident and faculty unprofessionalism in obstetrics and anesthesiology compared to other clinical services at an academic teaching institution.

Methods: After local IRB approval, "Professionalism Button" activations conveniently located on our institutional GME website from July 2013 (inception of the button) through September 2016 were analyzed among 24 clinical services. "Professionalism Button" activations could be for either professionalism lapses or exemplary professional behavior. Professionalism lapses were identified among the following identified themes: "unethical and unprofessional behavior," "poor patient treatment," "unprofessional language," "unprofessional attire," and "patient endangerment." Exemplary professional behavior themes identified included: "job well done," "excellent patient care," "excellent team player," and "excellent interpersonal skills." Frequency data greater than the third interquartile was considered significant.

Results: There were 211 button activations, 143 (67.8%) for professionalism lapses, and 68 (32.2%) for exemplary professional behavior. "Unethical and unprofessional behavior" (49.5%) and "poor patient treatment" (25.9%) were the most common reasons for lapses in professionalism. "A job well done" (30.3%) was the most common reason for exemplary resident professional behavior. Resident professionalism lapses across the 24 clinical services with the highest frequency (>3rd IQR) were Internal Medicine (25.7%), Surgery (17.7%), Emergency Medicine (6.2%), Neurology (6.2%), Neurosurgery (5.3%), and Otolaryngology (5.3%), (Fig). Faculty professionalism lapses across the 24 clinical services with the highest frequency (>3rd IQR) were Internal Medicine (31.6%), Surgery (21.1%), Emergency Medicine (10.5%), Obstetrics and Gynecology (10.5%), Nursing (10.5%), Neurology (5.3%), Orthopaedics (5.3%), and Anesthesiology (5.3%), (Fig).

Conclusions: Clinical services with high inpatient contact had the highest frequency for "Professionalism Button" activations. Faculty (rather than resident) unprofessionalism in the specialties of Obstetrics and Anesthesiology occurred at a higher frequency compared to other specialties.

Figure. Resident and Faculty Professionalism Lapses across Departments



Legend: * ≥ 3rd interquartile for resident professionalism lapses, # ≥ 3rd interquartile for faculty professionalism lapses

Abstract #:T-02

Retrospective Study to Investigate the Effect of Fixed Ratio Management of Packed Red Blood Cell to Fresh Frozen Plasma on Transfusion Requirements in Postpartum Hemorrhage

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Alexander Ioscovich MD - Shaare Zedek medical Center - Jerusalem, None
Sharon Einav MD - Shaare Zedek medical Center - Jerusalem, None

Background: Postpartum hemorrhage (PPH) is a major cause of maternal morbidity, and often necessitates blood product transfusion. Outcome and survival is improved among trauma victims using a transfusion protocol of 1:1 fixed ratio for packed red blood cells (PRBC) to fresh frozen plasma (FFP), and 1:1 fixed ratio has been recommended for PPH despite poor evidence.(1) Our primary aim was to study transfusion requirements among women with PPH managed with a 1:1 fixed ratio PRBC:FFP versus nonfixed ratio.

Methods: Retrospective IRB approved study in 2 neighboring tertiary centers that cover 80% of labors in the metropolitan area. We identified PPH cases, ≥3PRBC within 24hr of delivery, from blood bank records. We focused on the active bleeding period (blood products transfused continuously until a 4hr break without blood product administration was identified). Massive transfusion protocol (MTP) affirming 1:1 fixed ratio PRBC:FFP was introduced in 2010 in both centers. Demographic, obstetric, and blood management data were retrieved. We compared estimated blood loss (EBL), blood product administration, and hematologic variables for PPH managed by 1:1 fixed ratio PRBC:FFP versus nonfixed ratio, using descriptive statistics.

Results: We identified 273 women (2004-2014) with PPH ≥3PRBC within 24hr of delivery. 1:1 fixed ratio PRBC:FFP management was used for 41/161 (26%) women since 2010 vs. 23/112 (21%) prior to 2010, p=0.34. EBL among women managed with 1:1 fixed ratio was 2.3±0.7L vs. 2.9±1.9L with nonfixed ratio, p=0.04. PPH managed with 1:1 fixed ratio received less PRBC units, median(IQR) 5(4-6) vs. 6(4-10) with nonfixed ratio, p=0.013, Table 1. Nadir fibrinogen levels for 1:1 fixed ratio were significantly higher, 324.0±131.3mg/dl vs. 264.6±113.5mg/dl with nonfixed ratio, p=0.003, despite similar baseline values. PPH management with nonfixed ratio PRBC:FFP was associated with a higher likelihood of receiving massive transfusion (≥8PC units), Odds Ratio 2.88 95%CI 1.37-6.06.

Conclusion: Introduction of the MTP did not increase use of 1:1 fixed ratio PRBC:FFP for PPH management. Management of PPH using a 1:1 fixed ratio PRBC:FFP strategy was associated with significantly lower EBL and less PRBC and platelets, lower likelihood of massive transfusion and higher nadir fibrinogen levels. Our study findings support using 1:1 fixed ratio PRBC:FFP administration for PPH management.(1,2)

Table 1: Blood transfusion management for 1:1 fixed ratio PRBC:FFP versus nonfixed ratio among women with postpartum hemorrhage

	Fixed ratio PRBC:FFP 1:1 (n=64)	Nonfixed ratio PRBC:FFP 1≠1 (n=209)	p-value
Total estimated blood loss (L)[1]	2.26±0.74	2.91±1.93	0.04*
Blood products transfused during active bleeding period[2]			
PRBC (no.)	5 (4-6)	6 (4-10)	0.013*
FFP (no.)	5 (4-6)	6 (3-9)	0.44
PLT (no.)	0 (0-1)	1 (0-2)	0.016*
CRYO (no.)	10 (0-10)	10 (0-20)	0.40
Total blood products[2]			
PRBC (no.)	5.5 (4-7)	7 (4-11)	0.004*
FFP (no.)	4 (4-6)	6 (3-9)	0.09
PLT (no.)	0 (0-6)	10 (0-20)	0.007*
CRYO (no.)	10 (0-10)	5 (0-12)	0.29

Key: PRBC=Packed red blood cells, FFP=Fresh frozen plasma, CRYO=Cryoprecipitate, PLT=Platelets; no.=number of units; [1]Mean ± SD, [2]Median (IQR); *=p<0.05, significant difference

Table 2: Hematologic values for 1:1 fixed ratio PRBC:FFP versus nonfixed ratio among women with postpartum hemorrhage

	Fixed ratio PRBC:FFP 1:1 (n=64)	Nonfixed ratio PRBC:FFP 1≠1 (n=209)	p-value
Fibrinogen (mg/dl)[1]			
Baseline	498.5 ± 180.7	481.5 ± 154.7	0.75
First during active bleeding period	360.1 ± 134.6	311.7 ± 131.2	0.050
Nadir	324.0 ± 131.3	264.6 ± 113.5	0.003*
Hemoglobin (g/dl)[1]			
Baseline	11.5 ± 1.4	11.6 ± 1.4	0.59
First during active bleeding period	9.1 ± 1.8	9.2 ± 1.7	0.67
Nadir	7.8 ± 1.5	7.4 ± 1.5	0.07
Hematocrit (%)[1]			
Baseline	34.1 ± 3.9	34.7 ± 3.8	0.32
First during active bleeding period	27.1 ± 5.3	27.2 ± 5.1	0.84
Nadir	23.1 ± 4.6	21.9 ± 4.3	0.06

Key: PRBC=Packed red blood cells, FFP=Fresh frozen plasma; [1]Mean ± SD; *=p<0.05, significant difference

References

1. Shaylor. Anesth Analg 2017;124:216.
2. Pasquier. Anesth Analg 2013;16:155

Abstract #:T-03

Retrospective Cohort Study to Investigate the Impact of Timing of Term Elective Cesarean Delivery on Maternal and Neonatal Morbidity

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Background: Early term cesarean delivery (CD) increases neonatal respiratory morbidity, (1,2) while delaying CD (≥39 complete wks gestational age) may generate urgent CD due to spontaneous onset of labor. We aimed to assess maternal and neonatal morbidity for planned early (37/38 wks) versus later (39/40 wks) CD.

Materials and methods: A retrospective cohort study (IRB approval), identified women who planned to deliver by CD in a single tertiary medical center. A priori sample size calculated 296 women/group for neonatal respiratory morbidity 5.1% early vs. 2.1% later term CD (80%power, 0.05 significance). We worked backwards through medical records (2012-2015) to identify early (37/38 wks) vs. later (39/40 wks) term CD; excluding unplanned CD, trial of labor, multiple gestation/fetal anomaly. Maternal morbidity (uterine rupture, anesthesia mode and complications, packed cells transfused, bleeding, surgical complications, ICU) and neonatal respiratory morbidity were compared: early vs. later term CD, and secondary analysis was elective vs. urgent CD.

Results: Among 4044 CD, we identified 370=early and 300=later term CD meeting inclusion criteria. Women who underwent early term CD were older 33.9(5.4) vs. 32.8(5.8)yrs, multiparous(52%vs.36%), with more prior CD 1.4(1.3) vs. 0.8(0.9). Frequency of spontaneous onset of labor/rupture of membranes, out-of-hours delivery and urgent CD were significantly higher for later term CD, however maternal morbidities were similar for early vs. later term CD (Table 1). Neonatal respiratory morbidity was higher for early 2.7% vs. later 0.3% term CD, p=0.03. Comparing elective, 484/670(72.2%) vs. urgent CD, 186/670(27.8%), we found no significant difference in maternal morbidities (Table 2) or neonatal respiratory morbidity, 1.9% vs. 1.1%, p=0.74.

Conclusion: Early term CD was associated with increased neonatal respiratory morbidity, as expected.(1) Planning later term CD significantly increased the risk of onset of labor prior to the booking date, out-of-hours and urgent CD. However we did not observe an increased rate of general anesthesia, hemorrhage and other maternal morbidity measures when later term CD was planned, even when CD became urgent. The staffing and administrative impact of increased out-of-hours and urgent CD that result from planning elective CD ≥39 complete wks gestational age should be investigated.

References:

1. Hansen AK. BMJ 2008; 336:857.
2. Chiossi G. Obstet Gynecol 2013; 121:5619

Table 1: Maternal outcomes according to early versus later term cesarean delivery

	Early term CD N=370	Later term CD N=300	P value
Spontaneous onset of labor (contractions and/or ROM** (n%) p	67 (18.1%)	85 (28.3%)	0.002
Urgent CD (n%) p	85 (23.0%)	101 (33.7%)	0.002
Out of hours CD* (n%) p	64 (17.3%)	101 (33.7%)	<0.001
Uterine rupture (n%) ƒ	2	0	0.54
General anesthesia (n%) p	24 (6.5%)	19 (6.3%)	0.94
Anesthesia complications (n%) ƒ	1 (0.3%)	3 (1.0%)	0.24
Excessive bleeding (n%) p	16 (4.3%)	11 (3.7%)	0.67
Packed cells transfused (number) ŧ	0[0][0-1]	0[0][0-1]	0.71
Surgical complications (n%) ƒ	2 (0.5%)	4 (1.3%)	0.25
Intensive care admission (n%) ƒ	0	2 (0.7%)	0.20

Key: ƒ= Fisher's exact chi square test; p = Pearson chi square test; ŧ =median[interquartile range][total range]; CD = cesarean delivery; *Out-of-hours surgery = before 08:00 AM or after 16:00; **ROM = rupture of membranes; excessive bleeding = composite of >1000cc estimated blood loss, packed cell transfusion, surgical bleeding control including iliac vessel ligation, B-lynch suture

Table 2: Maternal outcomes according to elective versus urgent cesarean delivery

	Elective CD N= 484	Urgent CD N =186	P value
Out of hours CD** (n%) p	47 (9.7%)	118 (63.4%)	<0.001
Contractions and/or ROM*** (n%) p	7 (1.4%)	145 (78.0%)	<0.001
Early term (37/38 weeks) gestational age (n%) p	285 (58.9%)	85 (45.7%)	<0.001
Later term (39/40 weeks) gestational age	199 (41.1%)	101(54.3%)	
Uterine rupture (n%) p	1 (0.2%)	1 (0.5%)	0.48
General anesthesia (n%) p	28 (5.8%)	15 (8.0%)	0.28
Anesthesia complications (n%) ƒ	3 (0.6%)	1 (0.5%)	1.00
Excessive bleeding (n%) p	18 (3.7%)	9 (4.8%)	0.51
Packed cells transfused (number) ŧ	0[0][0-1]	0[0][0-1]	0.29
Surgical complications (n%) ƒ	2 (0.4%)	4 (2.2%)	0.053
Intensive care admission (n%) ƒ	2 (0.4%)	0	1.00

Key: ƒ= Fisher's exact chi square test; p = Pearson chi square test; ŧ =median (interquartile range)[total range]; CD= cesarean delivery; *Out-of-hours surgery = before 08:00 AM or after 16:00; **ROM = rupture of membranes; excessive bleeding = composite of >1000cc estimated blood loss, packed cell transfusion, surgical bleeding control including iliac vessel ligation, B-lynch suture

Abstract #:T-04

Prospective Observational Study of the Relationship Between Body Habitus Features and Neuraxial Block Depth and Assessed Difficulty

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Background: Body mass index (BMI) is a recognized predictor of neuraxial block (NB) difficulty, (1) and greater epidural depth, (2) however the importance of fat distribution has not been previously reported. We investigated the relationship between fat distribution, BMI, and body shape with NB difficulty and epidural depth.

Methods: A prospective IRB approved observational study of term pregnant women enrolled in a tertiary center, prior to NB request. We evaluated self-reported and actual BMI, height, weight, mid-arm and subscapular fatpads (digital caliper, mm), cervical-sacral spine distance (cm), epidural depth (ultrasound, cm) and NB difficulty (operator report and/or ≥2 needle passes). 4 experts assessed photographs (Likert scale 1-5) taken in lateral and sitting positions for NB difficulty and body-shapes (apple-A, pear-P, banana-B, hourglass-H).

Results: We recruited 133 women with self-reported mean±SD BMI of 29±5 kg/m2. Bland Altman analysis showed a mean difference between self-reported and actual BMI of -0.8 kg/m2 (95% CI -3.8 to 2.2). There was a significant correlation between actual BMI, mid-arm and subscapular fatpads, and the epidural depth (R-square=0.755, 0.674, and 0.661, respectively; all p<0.0001). There was agreement between expert assessments of NB difficulty (Cronbach's Alpha=0.76 in lateral, and 0.71 sitting), but less agreement with expert assessments of body-shapes (Cronbach's Alpha=0.54). Relationship between body-shapes and fat distribution, with assessments of epidural depth and of NB difficulty are shown in Table 1. Actual NB placement was difficult in 29 (22%) of the women. Expert assessments of NB difficulty in lateral and in sitting position, and longer cervical-sacral spine were associated with greater likelihood of actual difficult NB placement (OR 1.81, 95% CI 1.04-3.15; OR 1.96, 95% CI 1.09-3.45; and OR 1.10 95% CI 1.01-1.20 respectively), but BMI was not significantly associated.

Conclusions: Study findings suggest that fat distribution and body shape assessments do not predict epidural depth better than BMI measurement. However actual BMI should be measured as women underestimate when reporting their BMI. Visual expert assessment of NB difficulty appears to predict actual difficult NB placement. Predicting difficult NB is important as alternative strategies such as close supervision and ultrasound-guided insertion may be required.

Table 1: Relationship between body-shapes and body habitus measures, depth to epidural space and expert assessment of neuraxial block difficulty.

	Body Shapes				
	Apple	Pear	Banana	Hourglass	P-value
Self-reported BMI (kg/m^2) ǂ	31.1± 7.4	30.2± 4.7	28.1± 4.1	30.3± 4.7	0.12
Actual BMI (kg/m^2) ǂ	32.1±8.3	31.4±4.7	29.0±4.5	31.1± 4.6	0.14
Subscapular fatpad (mm) ǂ	25.7±11.9	21.7±10.2	21.1± 8.4	26.5± 9.4	0.06
Midarm fatpad (mm) ǂ	26.6±10.7	24.1±6.9	20.7±6.5	25.4 ±8.0	0.016*
C7S1 length (cm) ǂ	50.6± 2.8	50.8± 3.7	50.7±7.0	51.9± 6.2	0.77
Depth to epidural space, ultrasound (cm) ǂ	51.8±14.2	48.4±9.6	45.6±8.6	48.1±6.9	0.10
Actual epidural space depth (cm) ǂ	66.0±18.5	61.0±15.2	51.1±10.9	57.0± 9.4	0.09
Expert block difficulty assessment§ - Sitting	5(4-6) [4-10]	7.5(5-9) [5-11]	6(5-7) [4-14]	5(5-8) [4-13]	0.04¶
Expert block difficulty assessment§ - Lateral	7(6-7) [6-11]	8(6.3-9.8) [6-15]	7(6-8) [5-15]	7(6-9) [5-13]	0.37

Key: BMI = body mass index; C7S1= cervical (C7) spinous process to sacrum (S1) distance; Analysis of variance (ANOVA test) mean±standard deviation; §Kruskal-Wallis test median (interquartile range) [total range]; n,%=number(percentage); Experts block difficulty assessed using Likert scale (1=easy, 5=difficult) and total scores (4 experts) are presented, thus score range is from 4 to20; *Post-hoc test showed the difference was between banana versus apple and banana versus hourglass shapes; ¶Post-hoc test showed the difference was between apple versus pear shapes

References:

1. Bamgbade et al. IJOA 2009;18:221
2. Narang et al. BJA 1988;60:402

Abstract #:T-05

Predictors of Individual Labor Progress in a Cohort of Israeli Nulliparous Laboring Women

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Background: Individual patient characteristics may contribute to the progress and pain of labor, and previous models have been used to study the effect of characteristics on labor pain and progress.

Methods: The local IRB approved a prospective study of nulliparous laboring women who all received labor epidural analgesia (LEA). We evaluated cervical dilation at placement of epidural analgesia 60, 120 cm, pain intensity (numerical pain rating scale, NPRS) at LEA placement, 60, 120 and 2nd stage, and duration of 2nd stage. We created a population labor progress model using a biexponential function that identifies latent and active phases of labor, and the cervical dilation at which transition occurs. Labor pain was modeled as a sigmoid function of cervical dilation using previously validated models.(1,2) Association between inter-individual variability and maternal weight, age, fetal weight, duration of 2nd stage, maternal ethnicity and country of origin was assessed. Variables with association at P<0.05 were considered for inclusion into a final predictive model.

Results: We present data for 105 nulliparas with mean age31±4yrs; gestational age 40±1wks; BMI 22±3kg/m2. 71% were born in Israel and multiple ethnicities were reported, majority Ashkenazi, 41%. The following factors were significantly associated with labor progress: maternal age on latent labor (P=0.047), maternal weight on latent labor (P=0.002), fetal weight on the transition point between latent and active labor (P=0.0003), duration of 2nd stage and rate of latent labor (P=0.002), birth country (Israel vs other) on the transition point between active and latent labor (P=0.003). Ethnicity did not influence labor progress. In the corrected model, only birth country and fetal weight significantly affected the cervical dilation at which transition between latent and active labor occurs (P=0.0002).

Conclusions: As previously demonstrated fetal weight is an important factor in labor progress. Israel is a melting pot and many women had mixed ethnicities. Being born in Israel was associated with transition to active labor at a smaller cervical dilation, while there was no effect of ethnicity. Asian ethnicity has previously been associated with slower transition, however there is little representation of nulliparas of Asian descent in this cohort.

References:

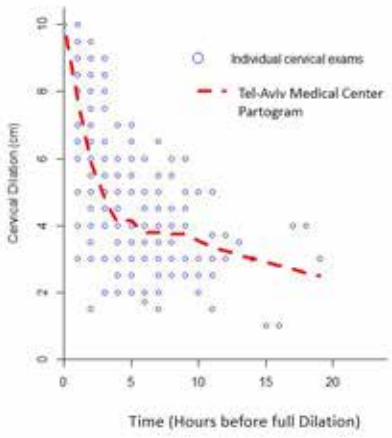
1. Quincy Am J Perinatol 2014;31:745.
2. Debiec Anesthesiology 2009;111:1093

Table 1. Maternal and labor and labor pain characteristics for the cohort of Israeli nulliparous laboring women

Variable	Data for total cohort, N=105
Maternal age (years)	30.9±4.1
Gestational age (weeks)‡	39.9±1.2
Current weight (kg)	73.7±10.7
Body mass index kg/m²	22.2±3.2
Fetal birth weight (kg)	3.27±0.40
Cervical dilatation when LEA placed (cm)	3.7±1.2
Rupture of membranes prior to LEA placed n%	52(49.5%)
Augmented labor (oxytocin) n%	25(23.8%)
NPRS prior to LEA placed	9(8-10)
NPRS 60min after LEA placed	1(0-2)
NPRS 120min after LEA placed	1(0-3)
Cervical dilatation 60min after LEA placed	4.9±2.1
Cervical dilatation 120min after LEA placed	6.0±2.6
NPRS at 2nd stage	6(1-9)
Duration of 2nd stage (min)	112.0±69.8
Ethnicity¶ n%	
Israeli	36(34.3%)
Ashkenazi	41(39.0%)
Sephardi	22(21.0%)
Philippines	2(1.9%)
Unknown (born in France)	2(1.9%)
Birth country n%	
Israel	75(71.4%)
Former Soviet Union	14(13.3%)
Mid-Asia	2(1.9%)
South Africa	1(1.0%)
Europe	4(3.8%)
Far-east Asia	2(1.9%)
North America	3(2.9%)
North Africa	1(1.0%)
South America	1(1.0%)
Unknown	2(1.9%)

Key: ¶ Israeli ethnicity comprised many ethnicities eg. Mother Polish/Ashkenazi and Father Indian; or Grandparents from many countries and mixed Ashkenazi/Sephardi ethnicity; LEA=labor epidural analgesia. Data presented as mean±standard deviation, number(percentage)

Figure 1. This figure represents the partogram for laboring nulliparas in our cohort. Transition occurred at 4cm dilation.



Abstract #:T-06

Arrow Flextip Plus TM Wire Reinforced Epidural Catheters Decrease Complications in Chinese Obstetric Patients

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Backgroud: Transient paraesthesia and inadvertent epidural vein injury are most common complications during epidural catheter placement. The Arrow Flextip PlusTM is an soft-tipped, flexible catheters, which designed for possible reduction of these complications. To date, there still few published Chinese studies comparing traditional multiport catheters (BD DurasafeTM epidural catheters) and the novel wire reinforced epidural catheters □Arrow Flextip PlusTM □in terms of analgesic efficacy or the incidence of complications in obstetric patients.

Methods: This prospective, randomized, unblinded clinical trial (n=182) was to compare the incidence of inadvertent epidural vein injury, transient paraesthesia and accidental intrathecal catheter placement in pregnant women scheduled for selective caesarean section receiving combined spinal-epidural anesthesia (CSEA) with either the Arrow Flextip PlusTM or the BD DurasafeTM epidural catheters.

Results: In the novel wire reinforced epidural catheters group (Arrow Flextip PlusTM), the incidence of both paraesthesia and epidural vein injury were 0%, significantly lower than that of traditional multiport catheters group (BD DurasafeTM epidural catheters), it was 11.7% and 15.9% respectively (p = 0.000); the resistance of epidural catheter insertion was similar in both groups (p = 0.623).

Conclusion: This novel wire reinforced epidural catheters did reduce the incidence of both transient paraesthesia and inadvertent epidural vein injury to 0%, and provided high success epidural catheter placement, improved Chinese parturients' comfort during epidural puncture procedure and perioperative safety.

Table 3 Complications at Catheter Placement

Characteristic	BD Durasafe™ group	Arrow Flextip Plus™ group	*P*-value
Paraesthesia, n (%)			
Needle induced	6/94(6.4%)	2/88(2.3%)	0.0178
Catheter induced	11/94(11.7%)	0/88(0%)	0.001
Vein injury, n (%)			0.000
Grade 0	79/94(84.0%)	88/88(100%)	
Grade I	5/94(5.3%)	0/88(0%)	
Grade II	10/94(10.6%)	0/88(0%)	
Resistance of insertion, n (%)			0.623
Grade 0	78/94(83.0%)	75/88(85.2%)	
Grade I	12/94(12.8%)	12/88(13.6%)	
Grade II	4/94(4.3%)	1/88(1.1%)	
Subarachnoid misplacement, n (%)	0/94(0%)	0/88(0%)	1.0
Difficulty of withdraw, n (%)	0/94(0%)	0/88(0%)	1.0
Catheter kinking, n (%)	0/94(0%)	0/88(0%)	1.0
Epidural hematoma, n (%)	0/94(0%)	0/88(0%)	1.0

Needle induced: means paraesthesia induced by threading the spinal needle into the subarachnoid space.
Catheter induced: means paraesthesia induced by placement of epidural catheter into the epidural space.
Grade 0: no withdrawing bleeding or no resistance.
Grade I: non-continuous withdrawing bleeding or a little resistance.
Grade II: continuous withdrawing bleeding or obvious resistance, hard to advance.

Abstract #:T-07

Development and validation of a postoperative obstetric 'Quality of Recovery' scoring tool (ObsQoR)

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Introduction: Few robust scoring systems exist assessing postoperative recovery following cesarean delivery (CD). Quality of Recovery-15 (QoR-15) is a validated general postoperative recovery scoring tool. We present an interim analysis for the development and validation of an obstetric QoR (ObsQoR) for elective CD.

Methods: Items were generated from QoR-40 and the literature. 50 stakeholders were surveyed (13 parturients, 4 partners, 13 anesthesiologists, 11 midwives and 9 obstetricians), with items endorsed by fewer than 66% deleted. Shortlisted items became ObsQoR, each with an 11-point numerical Likert scale (0 = strongly negative; 10= strongly positive). This was tested on 57 women at 3 time points: pre-CD (55/57 respondents), 24 hours (36/57) and at 25 hours (4/57) post-CD. Primary outcome was validity, by correlation analysis of items to 100-mm visual analogue scale (VAS) of general health status. Secondary outcomes included reliability, responsiveness and feasibility. Statistical analysis (Spearman r, Mann-Whitney, Cohen effect size and standardized response mean) was performed using GraphPad Prism (7.0, USA).

Results: 31 items were identified from six dimensions: pain, physical comfort, physical independence, psychological support, emotional state and care of the neonate. Stakeholder survey revealed 23 of these items to include in ObsQoR, and analysis of parturient ObsQoR survey determined ObsQoR-15. Items were analysed against VAS and ObsQoR-15 (Table 1). There was good discriminant validity: VAS of ≥70 or <70 correlated to ObsQoR-15; internal consistency: inter-item and test-re-test correlation; and responsiveness: pre and post-CD scores were 135±12 and 112±18 (mean ± SD), respectively ($p<0.0001$). Cohen effect size was good at 1.48; standardized response mean 0.99. It is feasible: accepted by 100% of women approached, with a mean ± SD time for completion of 2.16 ± 0.68 minutes.

ObsQoR Item	ObsQoR-15 correlation (Spearman r)	Global-VAS correlation (Spearman r)	95% confidence interval	P value (two-tailed)
Moderate pain	0.68	0.51	0.34 to 0.66	<0.0001
Severe pain	0.64	0.46	0.27 to 0.62	<0.0001
Nausea or vomiting	0.47	0.44	0.25 to 0.60	<0.0001
Able to feed baby	0.55	0.42	0.16 to 0.63	0.0019
Feeling in control	0.48	0.40	0.12 to 0.62	0.0045
Pruritus/feeling itchy	0.63	0.35	0.15 to 0.53	0.0008
Feeling comfortable	0.42	0.34	0.13 to 0.52	0.0013
Can mobilise independently	0.60	0.34	0.13 to 0.52	0.0016
Able to hold baby	0.54	0.33	0.12 to 0.51	0.0023
Can communicate with staff	0.45	0.33	0.12 to 0.51	0.0024
Feeling dizzy	0.61	0.32	0.11 to 0.50	0.0027
Able to do personal hygiene	0.64	0.30	0.09 to 0.49	0.0051
Shivering	0.65	0.29	0.08 to 0.48	0.0057
Can understand instructions	0.31	0.23	0.01 to 0.42	0.0374
Feeling depressed	0.36	0.22	0.00 to 0.42	0.045

Table 1. Best 15 of 23 ObsQoR items with correlation to global-VAS (n=87), to form ObsQoR-15. Convergent validity (Spearman r) of ObsQoR-15 to global-VAS = 0.64 (P<0.0001)

Discussion: In order to complete ObsQoR-15 validation, we will recruit 100 more women. Interim analysis however shows that ObsQoR-15 appears to be a valid tool to assess elective post-CD recovery, and provides more detailed information than a simple VAS in a reliable and reproducible manner.

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Abstract #:T-08

Enhanced recovery in obstetric surgery: an executive shadowing programme perspective

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Introduction: Enhanced recovery in obstetric surgery (EROS) for elective cesarean delivery (CD) has gained in popularity, with next day discharge in keeping UK national guidelines. Benefits include improved maternal satisfaction and reduced length of hospital stay, which has great economic advantages. Based at a busy tertiary referral center with >6,800 deliveries and >1,400 elective CD per year, optimizing quality, efficiency and productivity (QEP) of this service is important for future sustainability. Executive shadowing is popular in the corporate world to gain managerial and leadership skills. Our institution runs such an executive shadowing programme (ESP) for residents/junior doctors, which includes undertaking a quality improvement project (QIP). We present our experience of introducing EROS, the challenges faced, and potential benefits of ESP to facilitate improvement in obstetric services.

Methods: Elective CD were audited Oct-Dec 2014 (n=50) on EROS principles including patient education, fasting times, pain relief, urinary catheter removal, mobilization, satisfaction and length of hospital stay. Action plans were communicated to midwifery and obstetrics. Re-audit occurred Oct-Dec 2016 (n=57). An ESP was attended by all fellows involved for training in QI methods and hospital board executive shadowing.

Results: The 2016 re-audit did not demonstrate improvement (Table 1). Inadequate pain control was the leading cause of delay to hospital discharge (30% of all delays).

Discussion: Relatively simple changes in clinical practice can have a big impact on QEP, but failure can be high due to poor communication and engagement. We identified barriers including poor awareness of EROS principles by patients and midwives and lack of engagement by senior clinical staff. A structured EROS programme has been planned: guidelines prepared for protocol driven care, an EROS patient companion diary, communications via meetings and presentations, liaison with senior clinical staff, and allocation of clinical 'champions'. ESP may benefit this process through knowledge of healthcare transformation, mentorship, training in improvement science, stakeholder engagement and process mapping, and 'collective leadership'. ESP's facilitate communication between clinicians and management, gaining credibility and momentum for a large-scale QIP. Residents/junior doctors are able to share their unique input.

References:

1. NICE: Clinical guideline on caesarean section/http://publications.nice.org.uk/caesarean-section-cg132/guidancecare-of-the-woman-after-cs
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EROS Principle	2014	2016	Action 2017
Snack within 2h recovery (%)	78	42	EROS information booklet and patient companion diary
Pain severe on mobilizing (%)	46	41	Midwife education
Wait too long for opioids (%)	46	57	Dedicated EROS bay, one-check oral morphine, education
Catheter removal (hours)	19	19	Guideline: Urogynaecology
Mobilization on ward (hours)	18	20	Guideline: 6-hour midwife assessment
Maternal satisfaction (%)	85	79	EROS package
Next-day discharge (%)	37	37	EROS package

Table 1. Audit cycle and EROS action plan

Abstract #:T-09

Comparing Low-Dose bupivacaine with Epidural Volume Extension to Standard Bupivacaine Dosing for Short Obstetric Procedures: A Prospective, Randomized Study

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Introduction: Neuraxial anesthesia is standard of care for parturients undergoing short obstetric procedures such as postpartum tubal ligation (PPTL), cerclage, and dilation & curettage. Bupivacaine is routinely used due to concerns for transient neurologic symptoms with lidocaine; however, the duration of bupivacaine greatly outlasts the procedure, and patients often spend prolonged periods of time in the post-anesthesia care unit (PACU). This prolonged PACU stay can increase healthcare costs and lead to maternal dissatisfaction. The aim of this study was to take a well-known technique – low dose intrathecal (IT) bupivacaine combined with a saline epidural volume extension (EVE) – and see if we could reduce the recovery time. A secondary aim was to determine the effectiveness of the block as low-dose bupivacaine without EVE has been shown to provide inadequate coverage for PPTL. We hypothesize that the low dose bupivacaine with EVE would provide adequate analgesia and decrease time to recovery.

Methods: 32 patients were randomized into two groups. Each group received IT bupivacaine via combined spinal-epidural. The control group (C) received our standard dose of 10 mg 0.5% isobaric bupivacaine with 12.5 mcg of fentanyl. The volume extension group (EVE) received 5 mg 0.5% isobaric bupivacaine with 12.5 mcg of fentanyl followed by 10 cc of sterile saline through the Tuohy needle. The epidural catheter was threaded in both groups. Measurements recorded included basic patient demographics, time from spinal to PACU discharge, PACU time, and spinal failure. We compared the groups using a paired t-test assuming unequal variances.

Results: The two groups did not differ with respect to BMI and age ($p > 0.05$). There was no difference in surgery time (C 18.9 ±5.8 min, EVE 21.3±4.4, $p=0.203$) but both the time from spinal anesthesia injection to discharge (C 183.9 ±59.9 min, EVE 97.3±15.9, $p<0.001$) and PACU time (C 138.8 ±59.2 min, EVE 52.0±12.2, $p<0.001$) differed significantly. There was no anesthetic failure in either group.

Conclusion: We demonstrated a significant decrease in recovery time in the EVE group. We also showed that the low dose IT bupivacaine provided adequate anesthetic coverage when combined with an EVE. Given both the significant decrease in recovery time and adequate coverage, we recommend this technique for short obstetric procedures.

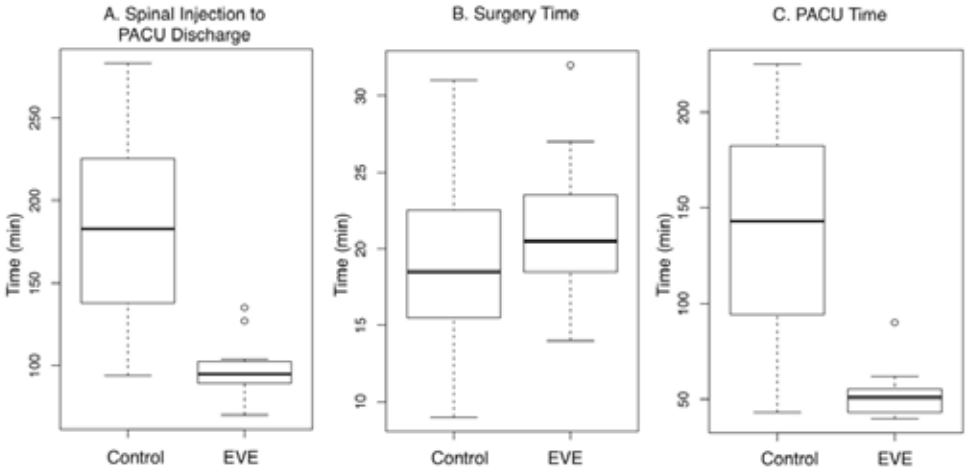

Figure 1. (Comparisons of Time Intervals by Study Groups) A. Time from Spinal Anesthesia Injection to Discharge from Recovery Room B. Surgery Time C. PACU Time Abbreviations: PACU...Post Anesethsia Care Unit, EVE...Extradural Volume Extension

Abstract #:T-10

Comparing the epidural surgical anesthesia and spinal anesthesia following epidural labor analgesia for intrapartum cesarean section: a prospective randomized, controlled trial

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Background: The conversion of epidural labor analgesia (ELA) to epidural surgical anesthesia (ESA) for intrapartum cesarean section (CS) often fails, resulting in intraoperative pain. Spinal anesthesia (SA) can provide a denser sensory block than can ESA. The purpose of this prospective, non-blinded, parallel-arm, randomized trial was to compare the rate of pain-free surgery between ESA and SA following ELA for intrapartum CS.

Methods: Both groups received continuous epidural infusions for labor pain at a rate of 10 ml/h. In ESA group (n = 163), ESA was performed with 2% lidocaine 17 ml mixed with 100 μg fentanyl, 1 : 200,000 epinephrine, and 2 mEq bicarbonate. In SA group (n = 160), SA was induced with 10 mg of 0.5% hyperbaric bupivacaine and 15 μg fentanyl. We investigated the failure rate of achieving pain-free surgery and the incidence of complications between the two groups.

Results: The failure rate of to achieving pain-free surgery was higher in ESA group than in SA group (15.3% vs. 2.5%, $P < 0.001$). There was no statistical difference between two groups with regard to the rate of conversion to general anesthesia; however, the rate of analgesic requirements was higher in ESA group than in SA group (12.9% vs. 1.3%, $P < 0.001$). The incidences of high block, nausea, vomiting, hypotension, shivering, and Apgar scores were comparable between the two groups.

Conclusions: SA after ELA is associated with a lower rate of pain-free surgery during intrapartum CS compared to that of ESA after ELA.

Abstract #:T-11

Patient Education Using Multi-Modal Digital Media in Obstetric Anaesthesia

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Introduction: Optimising the sharing of information using both direct doctor-patient dialogue and with multimedia resources has been shown to improve patient satisfaction and decrease anxiety in patients undergoing surgery (1).

In our hospital, there is no standardisation of the information given to women regarding anaesthetic services provided. Sharing information is further challenged by the non-English speakers in our multi-cultural catchment area.

Method: We built an information pack in an audiovisual format, in the form of multiple videos narrated in English, Arabic, Urdu and Polish. They cover in details the parturient journey through the elective caesarian section, emergency caesarian section and epidural analgesia during labour (2). Additionally, a 360-degree virtual tour through the obstetric unit, obstetric theatre and community obstetric unit provides a real connection to the place and introduce the staff and their roles (2).

The parturient and her partner are introduced to the videos during the open day visit, the preoperative assessment visit or during labour either using group education or individual consultations. That is combined with the opportunity to have one to one consultation with an anaesthetist to respond to any questions or queries. The videos and the virtual tour is available on the obstetric unit web page, giving the parturient the option to watch it again at any time.

A survey comparing between the method already in use (verbal information provided by the individual anaesthetist) and the new method using the videos was completed. Results show that the all the parturients (N=15) reported the videos were more informative and gave a better insight of what was going to happen on the day of surgery when compared to the current method and all recommend using it in the future. Also, the feedback from the open day showed a high degree of satisfaction, especially when the information was tailored to the parturients' needs.

Discussion and Conclusion: Tailoring information to parturients' needs and using different approaches and methods for patient education increases satisfaction and help to decrease anxiety. Also, it increases patients' compliance allowing more patient-centered care (3).

Take-home Message

Investing in an imaginative interactive multimedia patient information platform enhances the patients' experience.

References

1. Tompsett E, Afifi R, Tawfeek S.Can video aids increase the validity of patient consent?. Journal of Obstetric and Gynaecology. 2012 Oct;32(7):680-2.
2. http://www.simeducation.co.uk/queens-maternity-unit/
3. Farrell EH, Whistance RN, Phillips K et al. Systematic review and meta-analysis of audio-visual information aids for informed consent for invasive healthcare procedures in clinical practice. Patient Education Counselling. 2014 Jan;94(1):20-32.

Abstract #:T-12

A Comparison of Meperidine PCEA With and WIthout Basal Rate for Post-Cesarean Analgesia

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Background: Continuous infusion of epidural meperidine has provided safe and effective post-cesarean section (CS) analgesia at our hospital for over 30 years. Patient-controlled techniques can provide better pain relief, patient satisfaction, and reduced side effects compared with continuous techniques so we wanted to add that to our practice. We hypothesized that adding a basal rate to patient-controlled epidural analgesia (PCEA) would not improve analgesia based on the results of a prior study.(1)

Methods: 273 patients undergoing scheduled CS at Mercy Hospital St. Louis were randomly assigned to one of two groups: meperidine PCEA (NB) with 20 mg demand bolus with 30 minute lockout or PCEA with basal rate of 20 mg/hr with same bolus settings (B). Epidural meperidine was initiated after delivery and continued up to the second post-operative morning unless patient request or dressing or IV failure resulted in early discontinuation. Patients, nurses, and research personnel were blinded to the treatment groups. Data obtained included verbal pain scores (VPS 0-10) as recorded by the nurses, basic demographic data (age, BMI, primary vs repeat CS), administration of nalbuphine or diphenhydramine for pruritis, ondansetron for nausea, and patient satisfaction using the Revised American Pain Society Patient Outcome Questionnaire (2). Data were analyzed using Fisher's Exact tests and unpaired t tests where appropriate.

Results: 256 of 273 patients completed the study with 127 in the NB and 129 in the B groups. Satisfaction data was available for 240 patients (122 in NB and 118 in B). There was no difference with respect to age, primary vs repeat CS, use of ordered non-steroidal anti-inflammatory drugs, or length of epidural post-op use. There was a statistically significant difference in BMI with an average of 34.03 in the NB group and 32.18 in the B group (p=0.03). Analysis of the primary outcome variable of mean VPS with movement showed significantly more pain in the NB group (1.92 NB vs 1.50 B p=0.03 95% CI 0.32, 1.51). When administration of medications to treat side effects was analyzed, all were found to be statistically similar with the exception of nalbuphine given for itching (14 in NB vs 4 in B, p=0.01). Survey data for the 24 hours following surgery showed significant differences for the following questions: worst pain experienced (5.79 NB vs 5.10 B p=0.01 95% CI 0.16, 1.21), pain interfering with activities in bed (4.04 NB vs 3.13 B p=0.003 95% CI 0.32, 1.51), reported drowsiness (2.26 NB vs 2.91 B p=0.04 95% CI -1.26, -0.03), and overall satisfaction (8.76 NB vs 9.41 B p=0.003 95% CI 0.32, 1.51). The other responses were not statistically significantly different between the two groups.

Conclusions: Addition of a basal rate to meperidine PCEA resulted in less itching and improved analgesia and patient satisfaction. It did result in more drowsiness.

References:

1. Ngan Kee et al Can J Anaesthesia 1997
2. D Gordan et al J Pain 2011

Abstract #:T-13

Analysis of anaesthetic times for category 1 caesarean delivery: A, 5-year review of outcomes.

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Introduction: The Royal College of Obstetricians and Gynaecologists introduced a classification system for caesarean delivery (CD) in 2010. Category 1 CD describes immediate threat to life of the mother or fetus. Recommended times have been reported, but there is little data on anaesthetic times (defined here as minutes from arrival to the operating theatre and surgery commencing) and neonatal outcomes for category 1 CD. We explored the relationship between level of anaesthetist, time of day and neonatal outcomes for category 1 CD performed over 5 years at our teaching hospital.

Methods: We performed a retrospective analysis of 3 prospectively collected databases (anaesthetic, operating room and obstetric) between 2009-2014. The primary outcome for the study was anaesthetic time for category 1 CD and level of anaesthetist (consultant vs. trainee). Secondary outcomes were the relationship between anaesthetic time, time of day ('day' defined as 8am-8pm, with consultant presence; 'night' 8pm-8am with trainee on duty) and neonatal admissions to the neonatal unit (NNU). Statistical analysis was performed using R (Version0.99.896:RStudio.Inc). Time-to-event analysis was performed using Cox's proportional hazards regression model.

Results: The databases contained 59,333 independent data entries. For the primary and secondary outcomes 508 data entries were available. The breakdown of the type of anaesthetic provided for category 1 CD was 26% (n=133) general anaesthesia, 25% (n=131) spinal, 50% (n=255) epidural top-up. There was no difference in anaesthetic times between consultant anaesthetists and trainees (HR 0.788;95% confidence interval (CI) 0.612-1.017;p=0.0669). There was no variation in the number of category 1 CD depending on time of day. Category 1 CDs were performed faster at night (HR 1.259, 95% CI 1.107-1.431;p=0.0004). Anaesthetic times of category 1 CDs performed by trainees only did not however differ with time of day (HR 1.149, 95% CI 0.962-1.373;p = 0.123). Controlling for NNU admission, there was no difference in anaesthetic timings, regardless of time of day. The breakdown of anaesthetic technique chosen by consultant vs. trainee was: Top-up:27 (39%) vs. 228 (45%); CSE:15 (22%) vs 29 (6%), Spinal:11 (16%) vs. 120 (24%); Epidural:1 (1%) vs. 7 (1%); GA:15 (22%) vs. 118 (23%), other:0 (0%) vs. 4 (1%), respectively.

Discussion: There was no difference in anaesthetic time for Category 1 CD when the anaesthetic was delivered by consultant anaesthetist compared to those delivered by trainees. Category 1 CDs occurred evenly throughout a 24-hour period. Despite a faster anaesthetic time at night, admissions to the NNU were similar. All the CDs in this study were defined as category 1. There are situations when the obstetrician may deem some category 1 CDs more urgent than others. Whilst we saw no impact of anaesthetic timings on neonatal outcome, this broad classification may obscure cases where changes in anaesthetic timings may have an impac

Abstract #:T-14

Treatment of Intrathecal Morphine Induced Pruritus in Women Post Cesarean Delivery : A Systematic Review

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Kamal Kumar MBBS, MD - Western University - London, Ontario
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Background: Pruritus after intrathecal morphine has a high incidence of 60-100% in patients undergoing cesarean delivery (CD) and commonly leads to maternal dissatisfaction as it can be severe.(1) It is often refractory to conventional antipruritic treatment due to its multifactorial etiology. A variety of medications have been used to treat pruritus, with varying success rates.(2,3) We therefore performed this systematic review to evaluate the efficacy of different drugs used for the treatment of intrathecal morphine-induced pruritus in women undergoing CD.

Methods: This systematic review was planned in accordance with the PRISMA guidelines. The protocol was defined a priori. An expert literature search of multiple electronic databases was conducted. We included RCTs that compared drugs used for treatment of pruritus in women undergoing cesarean delivery under spinal anesthesia with intrathecal morphine. Relevant trials had to report on the treatment success for all the drugs. Quality of the studies was assessed using modified oxford scoring system. Percentage statistics was used to calculate the success rate of the drugs used for the treatment of pruritus.

Results: Seven studies (727 parturients) met inclusion criteria.(Table 1). Only 2 studies included a control group and hence a meta-analysis could not be done. Methodological validity scores determined by modified oxford score ranged from 4 to 7 indicating a low risk of bias. Four studies assessed ondansetron for the treatment of pruritus with a success rate of 76.49%. There was a recurrence of pruritus within 12 hours after successful treatment in 20.54%. Pentazocine was evaluated in one study, with a success rate of 96.15%. Nalbuphine was evaluated in 3 studies, with an overall success rate of 89.75%. Two studies examined IV diphenhydramine with a success rate of 68.83%. Propofol was successful in treating pruritus in only 53.27% of patients.

Conclusion: This systematic review comprehensively reports all the drugs used in the literature for the treatment of pruritus. Pentazocine and nalbuphine have a high overall success rate. Our findings are limited by the small number of studies. Further studies are needed to evaluate the most effective drug for the treatment of intrathecal morphine induced pruritus without recurrences.

Table 1: Treatment of intrathecal morphine induced pruritus in patients undergoing cesarean section:

Study Type Study ID Year	Groups Treatment(T) Drug Dosage (route of Administration)	Results
RCT Alhashemi et al.1997	(T) Nalbuphine 5-10-10mg (IV) (T) Diphenhydramine 25-50-50mg (IV)	**Group N^T (40) vs. Group D^T (40)** Incidence(n): 24 vs. 21 Success rate: VAP Score 0: 83% vs. 43% (P<0.01) 24h: VAP score: 4±2 vs. 2±2 (P<0.003) Treatment Failure: 4% vs. 29% (P<0.04)
RCT Beilin et al.1998	(T) Propofol 10mg (IV) (T) Control (IV)	**Group P^T (17) vs. Control (12)** Success rate: 11.8% vs. 8.3% Treated with Naloxone
RCT Charuluxananan S et al.1999	(T) Nalbuphine 2mg (IV) (T) Nalbuphine 3mg (IV) (T) Nalbuphine 4mg (IV)	**Group N^{2T} (30) vs. Group N^{3T} (30) vs. Group N^{4T} (30)** Success rate: 86.7 vs. 96.7 vs. 100 (P=0.004) Failure rate: 13.34% vs. 3.34% vs. 0%
RCT Charuluxananan S et al.2000	(T) Ondansetron 4mg (IV) (T) Control (IV)	**Group O^T (41) vs. Control (39)** Success rate: 80% vs. 36% (P<0.001) Recurrence rate: 12% vs. 70% (P<0.001)
RCT Charuluxananan S et al.2001	(T) Nalbuphine 3mg (IV) (T) Propofol 20mg (IV)	**Group N^T (40) vs. Group D^T (40)** Success rate: 83% vs. 61% (P<0.001) Recurrence rate: 9% vs. 7% (P=0.76)
RCT Tamdee et al.2009	(T)Pentazocine 15mg (IV) (T) Ondansetron 4mg (IV)	**Group P^T (104) vs. Group O^T (104)** Severity after treatment • Absent: 84.6% vs 51.0% • Mild: 11.5% vs. 29.8% • Moderate: 1.9% vs. 6.7% • Severe: 1.9% vs. 12.5% Success rate: 96.1% vs. 80.8% (95% CI Difference: 7% - 23.8%; P=0.001) Recurrence rate: 12% vs. 32.1% (P=0.001)
RCT Saddik-Sayyid et al.2010	(T) Ondansetron 4mg (IV) (T) Diphenhydramine 25mg (IV)	**Group O^T (57) vs. Group D^T (56)** Success rate: 70% vs. 70% (P=0.79) Recurrence rate: 28% vs. 35% (P=0.52)

References:

1. J Clin Anesth 2003;15:234–9.
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Abstract #:T-15

Medications for the Prevention of Pruritus in Women Post Cesarean Delivery with Intrathecal Morphine: A Systematic Review and Meta-analysis

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Kamal Kumar MBBS, MD - Western University - London, Ontario
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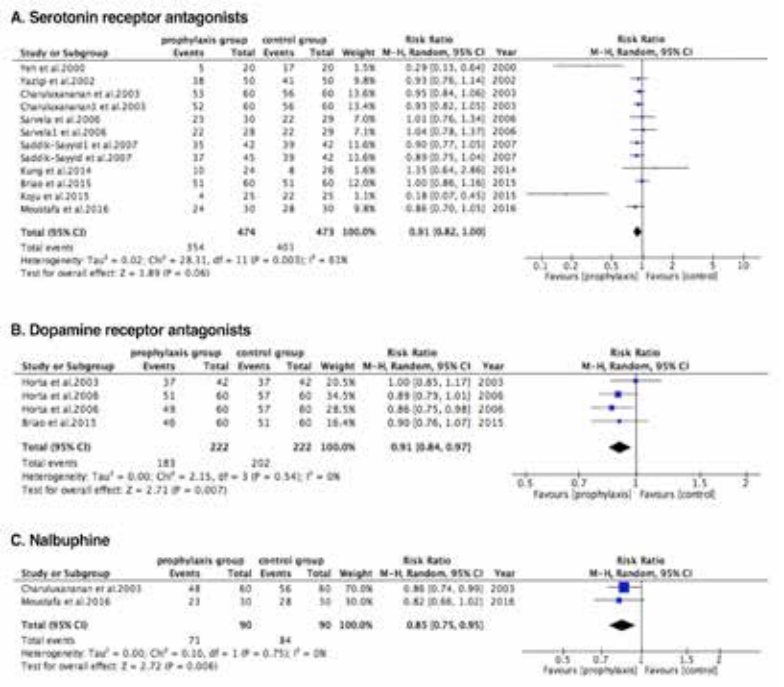
Background: Intrathecal morphine provides excellent analgesia after cesarean delivery (CD), but can be associated with troublesome pruritus in 60-100% of patients.(1) It is often difficult to treat and is refractory to conventional antipruritic treatment. A variety of medications have been used for pruritus prophylaxis with varying success. We performed this meta-analysis to evaluate the efficacy of medications in preventing this pruritus.

Methods: This review complies with the PRISMA guidelines. A literature search of multiple electronic databases was conducted. We included randomized controlled trials (RCTs) that compared drugs used for prophylaxis of pruritus with a control group in women undergoing CD under spinal anesthesia with intrathecal morphine. Quality of the studies was assessed using modified oxford scoring system. Dichotomous data were extracted and summarized using relative risks (RR) with 95% confidence intervals (CIs). Statistical analysis was conducted using Cochrane Review Manager 5.3.

Results: Nineteen RCTs with 2435 patients (prophylaxis vs. control: 1219 vs. 1216) were included. 474 patients received serotonin antagonists(ondansetron, granisetron, tropisetron); 222 received dopamine antagonists (alizapride, droperidol); 179 received opioid agonist-antagonists (nalbuphine, butorphanol); 145 received opioid antagonists (naltrexone, nalmefene, naloxone); 80 received histamine antagonists (diphenhydramine, promethazine); 89 received propofol and 30 received celecoxib. The incidence of pruritus was not reduced with serotonin antagonist prophylaxis compared with control group (RR:0.91; 95%CI:0.82-1.0; p=0.06) (Figure 1). However, their use significantly reduced the severity and need for treatment of pruritus. There was a significant reduction in the incidence (RR:0.91; 95%CI:0.84-0.97; p=0.008) and severity of pruritus (RR:0.39; 95%CI:0.17-0.91; p=0.03) with dopamine antagonist prophylaxis. Nalbuphine decreased the incidence (RR:0.85; 95% CI:0.75-0.95; p=0.006), severity and need for treatment of pruritus [27.77% vs. 75.55%; RR (95% CI) = 0.37 (0.26 –0.52); P=0.00001](Figure 1). There was no difference in the incidence, severity and need for treatment of pruritus with opioid and histamine antagonists, propofol and celecoxib.

Figure 1: Incidence of pruritus in prophylaxis vs. control group



Conclusion: This is a comprehensive analysis of medications used in pruritus prophylaxis after CD. Serotonin antagonists reduced the severity and need for treatment, while dopamine antagonists and nalbuphine significantly reduced the overall incidence of intrathecal morphine-induced pruritus in women post CD.

References:

1. J Clin Anesth 2003;15:234–9.

Abstract #:T-16

Prospective Observational Study of the Relationship Between Labor Epidural Analgesia Onset Time and Subsequent Analgesic Requirements in Laboring Women

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Background: The relationship between labor epidural analgesia (LEA) onset time and subsequent pain intensity during labor has not been reported. We aimed to investigate the relationship between LEA onset time and subsequent pain intensity and analgesic requirements in nulliparas.

Methods: Observational prospective cohort, term nulliparas in a large tertiary center, who had signed IRB on admission, and had cervical dilatation ≤5cm at request for LEA. After LEA was performed, initial bolus was 5cc bupivacaine 0.1%+fentanyl 1.67mcg/cc, followed by 10cc. Patient controlled epidural analgesia (PCEA): bupivacaine 0.083%+fentanyl 1.67mcg/cc, bolus 5cc, infusion 6cc/hr, lock-out time 10min. Our primary measured variable was LEA onset time, defined as time to numerical pain rating score (NPRS=0-10) ≤3, asked after each contraction, and measured from the time of initial 5cc bolus. We report NPRS at 60 and 120min and at pushing in the second stage, and analgesic requirements (PCEA attempts and bupivacaine consumption) during 1st stage using Spearman's rank correlation.

Results: We completed assessments for 105 nulliparas; age31±4yrs; BMI 22±3kg/m2. Half the nulliparas achieved NPRS≤3 by 14mins (IQR)[total range](10-19)[4-55]. There was a significant correlation between LEA onset time and NPRS at 60min, R2=0.286, p=0.003; and between NPRS at 60 and 120min, R2=0.469, p<0.0001, Table 1. The strongest correlations were between number of PCEA attempts at 120min and: LEA onset time, R2=0.321, p=0.001; NPRS at 60min, R2=0.588, p<0.001; and NPRS at 120min, R2=0.539, p<0.001. Weaker but signifcant correlations existed between number of PCEA attempts at 60min and: LEA onset time; NPRS at 60min; and NPRS at 120min. Total bupivacaine consumption/hour was significantly correlated with NPRS at 60min, R2=0.403, p<0.0001 and NPRS at 120min, R2=0.433, p<0.0001. There were significant correlations between cervical dilatation at 60min and NPRS at both 60min and at 120min. There were signifcant correlations between cervical dilatation at 120min and LEA onset time; NPRS at 60; and NPRS at 120min.

Conclusion: Our data suggest a relationship between analgesic requirements and LEA onset time and subsequent pain intensity in nulliparous laboring women. This may be explained by faster labor progression. Evaluation of NPRS at 60 and 120min may faciliate active management of LEA,(1) by identifying nulliparas who have greater analgesic requirements.

Reference:

1. Bauer.etal.A&A2016;123:1074

Table 1. Relationship between labor epidural analgesia onset time and subsequent pain intensity and analgesic requirements in nulliparous women with labor epidural analgesia

	All cohort N=105	Time to LEA onset (NPRS≤3)◊		Pain intensity 60 min after LEA onset ◊ (NPRS)		Pain intensity 120 min after LEA onset ◊ (NPRS)	
		R-square	P-value	R-square	P-value	R-square	P-value
Time to LEA onset, NPRS≤3 ∫ (min)	14(10-19)[4-55]	N/A	N/A	0.286	0.003*	0.030	0.76
Pain intensity at contraction prior to LEA onset ∫ (NPRS)	9(8-10)[6-10]	0.107	0.28	0.142	0.15	0.087	0.39
Pain intensity during local anesthetic injection prior to LEA ∫ (NPRS)	4(2-6)[0-10]	-0.09	0.37	-0.025	0.80	0.166	0.10
Pain intensity 60 min after LEA onset ∫ (NPRS)	1(0-2)[0-8]	0.286	0.003*	N/A	N/A	0.47	<0.001*
Pain intensity 120 min after LEA onset ∫ (NPRS)	1(0-3)[0-10]	0.030	0.76	0.469	<0.001*	N/A	N/A
No. PCEA attempts 60 min after LEA onset ∫	0(0-1)[0-3]	0.361	<0.0001*	0.361	<0.001*	0.224	0.023*
No. PCEA attempts 120 min after LEA onset ∫	1(0-3)[0-5]	0.321	0.001*	0.588	<0.001*	0.539	<0.001*
Total bupivacaine consumption/hour 1st stage ‡(mg/hr)	10.9±4.4	0.194	0.08	0.403	<0.001*	0.433	<0.001*
Cervical dilatation prior to LEA onset ‡ (cm)	3.7±1.1	0.095	0.33	0.066	0.51	0.083	0.40
Cervical dilatation at 60 min ‡ (cm)	4.9±2.2	0.178	0.07	0.259	0.008*	0.126	0.204
Cervical dilatation at 120 min ‡ (cm)	6.0±2.6	0.219	0.026*	0.329	0.001*	0.243	0.013*
Pain intensity at pushing in second stage∫ (NPRS)	6(1-9)[2-10]	-0.028	0.80	0.062	0.56	0.190	0.07
Maternal satisfaction with LEA ∫ (NPRS)	10(9-10)[0-10]	0.01	0.92	-0.036	0.73	-0.196	0.05

Key: NPRS=numerical rating score (0-10); No.=number; LEA = labor epidural analgesia; PCEA = patient controlled epidural analgesia; bupivacaine consumption= infusion rate/hr of PCEA + PCEA boluses administered + physician top-ups; ∫ median(interquartile range)[range]; ‡ mean(standard deviation); ◊Spearman's rank correlation; N/A=not applicable correlation; *=significant correlation

Abstract #:T-17

The influence of preoperative epidural labor analgesia on postoperative pain in parturients undergoing emergent Cesarean section: a retrospective analysis

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Background: Preemptive analgesia attenuates pain–induced sensitization. Parturients who undergo emergent Cesarean section after experiencing labor pain are likely to develop pain–induced sensitization. We compared postoperative pain after Cesarean section among those parturients with or without preoperative epidural labor analgesia.

Methods: Medical database from February 2015 to September 2016 was searched, and 364 parturients, who had emergent Cesarean section under spinal anesthesia, were initially selected. After reviewing their medical records, parturients who underwent a trial of labor before emergent Cesarean section were finally enrolled in this study. Of those, parturients whose labor pain was managed with epidural analgesia were allocated to the ED group (n = 71) and parturients without epidural analgesia were assigned to the NED group (n = 43). Numeric rating scale (NRS) for postoperative pain, cumulative consumption of intravenous patient–controlled analgesia (PCA), and the number of rescue analgesic administration were compared between the two groups.

Results: The characteristics of patients, operation, and anesthesia were not different between the two groups. NRS for postoperative pain and cumulative consumption of intravenous PCA were comparable between two groups. However, significantly less patients of the ED group required rescue analgesics than those of the NED group (21% vs. 44% P = 0.047). Specifically, this different proportion was mainly observed on postoperative 6–24 h (7% vs. 33%, P = 0.011), whereas there were no differences on postoperative 0-6 h and on postoperative 24–48 h. The proportion of multiple rescue analgesic requirement (≥2 during admission period) was also significantly lower in the ED group than in the NED group (3% vs 26%, P = 0.022).

Conclusion: Although the pain score and PCA consumption were comparable between the two groups, rescue analgesics were significant less required in the ED group compared to the NED group. Epidural analgesia before Cesarean section seems to act as a preemptive analgesia for postoperative pain after Cesarean section.

Abstract #:T-18

Accuracy of a Handheld Ultrasound Device and a Traditional Ultrasound for Neuraxial Depth and Landmark Assessment in Cohort Receiving Labor Epidurals

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Introduction: Ultrasound guidance for neuraxial blocks is gaining in popularity, however lack of clinician expertise and availability of equipment has limited widespread adoption.(1) We investigated a novel handheld ultrasound (HU) device with pattern recognition software that recognizes lumbar spine bony landmarks and calculates depth to epidural space. We compared the accuracy of HU measurements to Touhy needle depth (at loss of resistance during epidural insertion), and to traditional ultrasound (TU) measurements.

Methods: A prospective, IRB-approved study of women requesting labor epidural analgesia. The L2/3, L3/4, L4/5 interspaces and respective depths to epidural space were identified, marked and measured using HU (Accuro, Rivanna Medical) and TU (GE Logiq S8). The epiduralist, blinded to measured ultrasound depths, used the HU-identified L3/4 interspace insertion point without palpation for the first epidural placement attempt. We used Bland Altman analysis to compare the epidural depths measured by HU, TU and Touhy needle. We also recorded the number of Touhy needle passes, re-directs, the interspaces attempted.

Results: We analyzed data from 47 women; age 32.3 ± 5.6 yrs, BMI 28.8 ± 4.7; 32% had BMI ≥ 30 kg/m2. The mean difference between HU and Touhy needle depth was -0.61 cm; 95%CI -1.75 to 0.52 (Figure 1a). The mean difference between HU and TU depth was -0.29 cm; 95%CI -1.08 to 0.50 (Figure 1b). Using the HU-identified insertion point resulted in successful epidural placement at first attempt in 87% of patients, 78% of these required no re-directs, and the HU accurately identified L3/4 interspace in 94% of patients.

Conclusion: The HU accurately predicted Touhy needle depth to epidural space and provided similar accuracy comparable to TU. The HU-identified epidural insertion was associated with high first pass success and minimal needle redirections. This handheld ultrasound device appears to be a useful to guide epidural insertion in our non-obese laboring population, and future investigation is needed to examine its utility in an obese population.

Reference:

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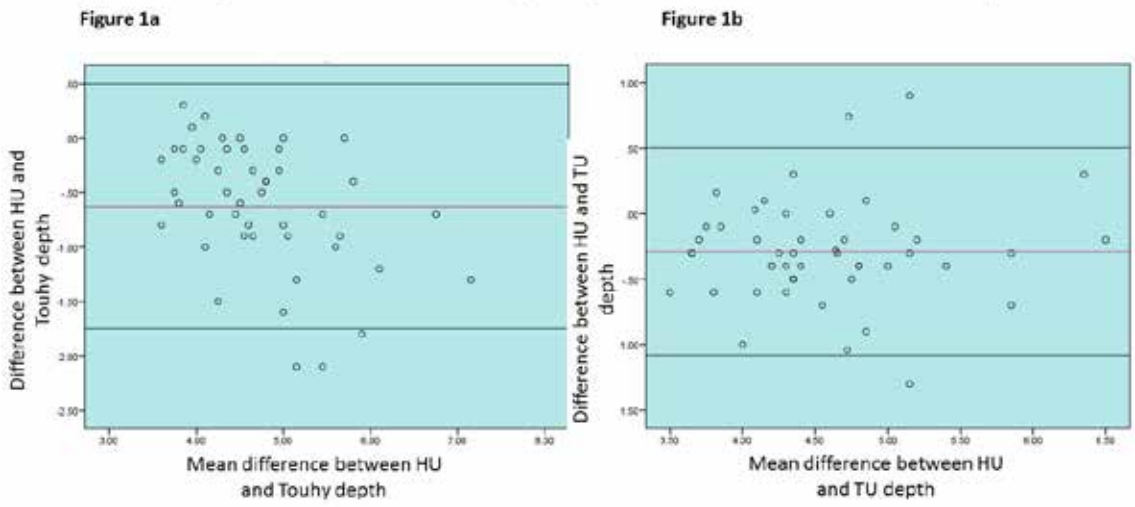
Figure 1: Bland Altman plots. **Figure 1a** shows the differences between measurements for the handheld ultrasound (HU) and the clinical depth represented by the Touhy needle. **Figure 1b** shows the differences between measurements for HU and traditional ultrasound (TU). On both figures the x-axis represents the mean difference and the y-axis represents the difference between these measured depths.



Abstract #:T-19

Tiny Pinch and Burn: Effect of Removing Negatively-Loaded Words During Epidural Placement

Presenting Author: Benjamin F Redmon MD
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Co-Author: Stephanie Woodward MD - University of North Carolina - Chapel Hill, NC

Multiple studies have explored the relationship between the use of negatively loaded words (NLWs) and perceived pain during procedures.2,4 Health care providers often use NLWs, such as "poke, burn, and sting," during procedures to express sympathy and compassion to patients.4 However, these words have been associated with increased distress during procedural discomfort.4 The effect on pain and anxiety scores associated with removal of NLWs during epidural placement has not been studied in the obstetric population. The aim of this pilot study is to determine if removing NLWs during epidural placement for OB patients will decrease perceived pain and anxiety as reported by post-procedural survey assessment.

Methods: A previously validated visual analog pain scale (BS-11)3 was used to determine baseline pain scores and maximal pain scores during epidural placement on a scale of 0-10. This same concept was used to evaluate anxiety1, with 0 = no anxiety and 10 = feeling terrified. Patients were asked which aspect of the procedure was the most painful and which caused the most anxiety. Thirty-five patients were surveyed over a 3-week period. Patients were surveyed after receiving an epidural or CSE prior to vaginal delivery or caesarian section. For our control group, 20 patients were surveyed prior to attempts to reduce NLWs during epidural placement. Staff and providers were then sent an educational email and verbally reminded daily about reducing NLWs during procedures, including words like "poke, burn, and worst part." Fifteen patients were sureyed after this intervention. A two-tailed T-test was used to analyze the data.

Results: Both groups reported similar levels of baseline pain scores (2.5 vs 2.4, p=0.89). There was no statistically significant decrease in perceived pain (2.2 vs 3.2, p=0.62) after the intervention. There was a statistically significant decrease in anxiety scores (3.0 vs 2.1, p=0.01). Patients reported the most painful parts of epidural placement both pre and post intervention were contractions (8/20 vs 7/15) and skin local anesthesia placement (8/20 vs 7/15). Patients experienced the most anxiety with epidural needle movement prior to provider education (7/20), and with contractions during epidural placement (6/15) after provider education.

Conclusion: Reducing the use of NLWs may decrease the anxiety patients experience during epidural placement in the obstetric population, but do not appear to affect pain scores. Larger studies are needed to evaluate the effectiveness of removing NLWs during procedural discomfort on both pain and anxiety.

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2. Chooi CS. The effects of positive or negative words… Anaesth Intensive Care. 2011 Jan;39(1):101-6.
3. Jensen MP. The subjective experience of acute pain... Clin J Pain. 1989 Jun;5(2):153-9.
4. Lang EV. Can words hurt... Pain. 2005 Mar;114(1-2):303-9.

Abstract #:T-20

Resident Wellness on OB Anesthesia

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Introduction: The prevalence of depression, drug abuse, and suicidal ideation in physician residents is rising, and this is associated with increased job turnovers, reduced patient satisfaction, and decreased quality of care (1). Amongst physicians, anesthesiologists are at an even higher risk for burnout, depression, and drug abuse secondary to a special subset of acute stressors and high intensity situations (2). We created an anesthesia wellness battery to not only document the demand for a wellness program in anesthesia residency but also to determine if there is a difference across anesthesia subspecialties.

Methods: We created a wellness survey and electronically distributed it to all residents (n=81) at Columbia University Medical Center in April 2016. The survey focused on resident satisfaction on OB Anesthesia and on Maslach and Leiter's six main factors of work stress: workload, fairness, control, balance between effort and reward, community, and values. Qualitative and quantitative analyses of the weighted survey responses will be performed using the Mann-Whitney-U test.

Results: 37 of 81 residents completed the survey (46%). The number of CA1, CA2, and CA3 residents that completed the survey was 13 (37.1%), 12 (34.3%), and 10 (28.6%), respectively. OB Anesthesia received a mean score of 4.79 +/- 1.75 based on a resident satisfaction scale (1 being the least happy and 8 being the happiest). Of the workload and stressors on OB Anesthesia, the factor most contributive to stress was general financial stress (Table 1). Despite 29 of the 34 (85.3%) residents stating that workload was manageable on OB Anesthesia (Table 1), 34 out of 36 (94.4%) respondents felt the need for a well-being curriculum. Annual departmental retreat was the most desired intervention to improve well-being (mean score 5.61 +/- 0.68 with 6 being most desired).

Conclusion: Results from our anonymous physician wellness survey administered to anesthesia residents demonstrated both a necessity and desire of improving resident well-being. Of Maslach and Leiter's six main factors of work and stress, community programming was the most desired intervention by the residents. Discovering the factors that contribute most and least to resident physician well-being is important to make effective improvements on OB anesthesia and to begin a wellness curriculum in residency.

References:

1. JAMA 2015;314(22):2373-2383.
2. J Health Hum Serv Adm.1999;21(4):472-89.

Table 1. FACTORS THAT AFFECT WORKLOAD AND STRESSORS ON OB ANESTHESIA

	Weighted Average*
I am not burdened by financial stress or level of indebtedness.	3.44
I feel the stress of work provides an opportunity for me to elevate myself.	3.78
I exhibit good control of my reactions when experiencing stress at work.	4.53
I feel well-respected by my attendings, nurses, and OB team.	4.61
I feel that the workload is manageable on OB anesthesia	5

*Weighted average based on a scale of 1-6. 1 = strongly disagree and 6 = strongly agree

Abstract #:T-21

Clonidine versus fentanyl as the adjuvant for epidural top-up for breakthrough labor pain

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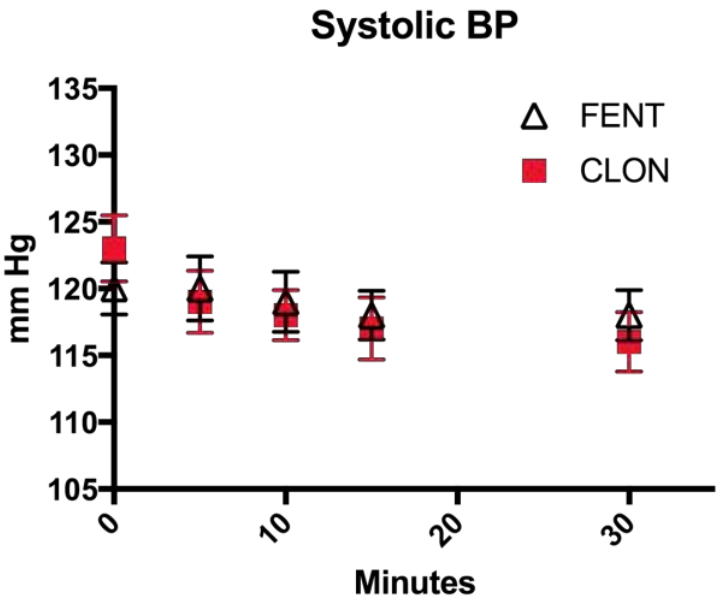
Introduction: Epidural clonidine produces analgesia via α2-receptor agonism in the dorsal horn of the spinal cord. In conjunction with local anesthetics, it improves the quality and duration of labor epidural analgesia.1,2 Use in parturients is not widespread due to concerns for maternal hypotension, bradycardia, sedation, and fetal heart rate (FHR) abnormalities which may result with high doses (>120mcg).2 Management of breakthrough pain during labor with patient-controlled epidural analgesia (PCEA) is often provided with a top-up dose of local anesthetic and fentanyl, however, some patients experience opioid-induced side-effects. Clonidine has not been studied as an adjuvant with local anesthetic for epidural top-up to treat breakthrough labor pain. We aimed to compare analgesia and side-effects of epidural clonidine vs. fentanyl, added to bupivacaine, for breakthrough labor pain, hypothesizing equal effect.

Methods: Women with PCEA for labor (bupivacaine 0.0625% & fentanyl 2mcg/ml, infusion 12ml/hour, bolus dose 5ml, lockout 6min), requesting a top-up for breakthrough pain (VAS ≥ 5/10; 0=no pain, 10= worst pain) were randomized to Group C (n=50): 10ml bupivacaine 0.125% & clonidine 100mcg vs. Group F (n=51) 10ml bupivacaine 0.125% & fentanyl 100mcg. Pain VAS was evaluated every 5min for 15min. 'Success' was defined at 15min as at least a 4-point reduction in VAS. With failure of the study drug to provide adequate pain relief, the alternate study drug was given, again with 10mL 0.125% bupivacaine. With further failure at 15min, epidural lidocaine 2% 5ml was given to exclude epidural catheter failure. Maternal blood pressure (BP), heart rate (HR), degree of sedation, and FHR were recorded for 15min after each intervention; BP, HR and FHR were recorded for 2hrs after the last intervention.

Results: Success rate was similar in both groups (Group F 38/51 vs. Group C 31/47; p = 0.38). No difference in BP (Figure) or sedation was observed; 2/51 in Group F and 1/47 in Group C received phenylephrine IV for BP sys<90 mmHg. Mild sedation occurred in 2/51 Group F vs. 7/47 Group C, and severe sedation in 1 Group F case (p=0.32) at 15 mins.

Conclusion: When administered with 0.125% bupivacaine 10ml, clonidine 100mcg is as effective as fentanyl 100mcg for treatment of breakthrough pain in labor. Epidural clonidine was not associated with greater hypotension, sedation or FHR abnormalities.

Figure 1: Mean (SEM) maternal systolic blood pressure by group over 30 min post-injection of study drug. FENT = fentanyl, CLON= clonidine.



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2. Anesth Analg 2002;95:728-734.

Abstract #:T-22

Anesthetic Management of a Patient with Pruritic Papules in Third Trimester: Neuraxial vs. General Anesthesia?

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Co-Author: Connie Chang MD, PhD - Columbia University - New York, NY
Stephanie Goodman MD - Columbia University - New York, NY

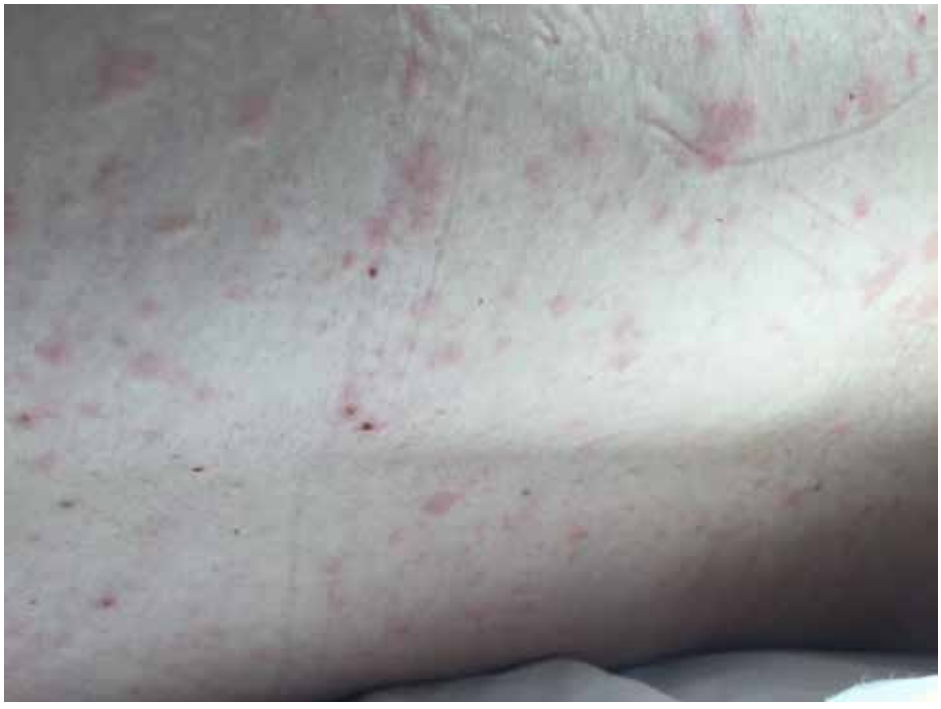
Introduction: Parturients with a rash present a unique challenge to the anesthesiologist with regard to the safety of neuraxial analgesia/anesthesia. There is a risk of introducing infection from the skin into the central nervous system (CNS) with needle placement, which can result in meningitis and encephalitis.

Case: 33 year old G4P2012 presents to the emergency department at 37 weeks gestation for evaluation of diffuse pruritic papules. She was in her normal state of health up until three days prior when she noticed a rash that almost entirely covered her extremities, abdomen, chest, and back. On skin exam, there were numerous 1-2mm pink papules/pseudovesicles. Dermatology consult performed a punch biopsy. The patient was afebrile and had a normal white blood cell count. The obstetricians decided to induce labor for a 4/8 biophysical profile. A non-reassuring fetal heart rate developed so a cesarean delivery was planned. Despite no signs of acute infection, we decided to perform general anesthesia since dermatology was unable to diagnose the rash (the biopsy results were pending and the patient did not have an area of her back unaffected by the rash). The anesthetic and delivery were uneventful. The biopsy results showed likely spongiotic eczematous process consistent with prurigo gestationis.

Discussion: One contraindication to neuraxial techniques is thought to be infection at the site of needle insertion. Pruritic urticarial papules and plaques of pregnancy (PUPPP), also known as polymorphic eruption of pregnancy (PEP), is the most common cause of rash in pregnancy.(1) While it is safe to perform neuraxial techniques in patients with PEP if affected skin in avoid (due to risk of bacteria at the site of excoriations), there is a risk of epidural abscess.(2) While it seemed prudent at the time to avoid neuraxial anesthesia in this patient, prurigo gestationis is a benign atopic dermatitis. When neuraxial techniques are employed in patients with rashes, it seems best to avoid needle placement at the site of skin lesions due to the risk of introducing bacteria or virus into the central nervous system.

References:

1. J Reprod Med 2005; 50: 61-3.
2. Can J Anesth 2006; 54: 1010-14.



Abstract #:T-23

Evaluation of a Novel Method of Surgical Blood Loss Determination During Cesarean Delivery in Predicting Postoperative Hemoglobin – A Prospective Observational Study

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Introduction: Visual estimation and gravimetric methods are commonly used to quantify the volume of blood loss (BL) during cesarean delivery (CD). A new device, Triton™ (Gauss Surgical Inc., Los Altos, CA) measures BL using "Feature Extraction Technology" from iPad-derived images of surgical material contaminated with blood. The aim of the study was to evaluate the association between BL, evaluated by a gravimetric approach (gBL), visual estimation and Triton System™ (tBL), and post-CD hemoglobin (Hb).

Methods: After obtaining IRB approval, we performed a prospective study of 61 women undergoing CD to assess the relations between post-CD Hb and BL measured using 4 modalities: gBL, visual estimations by a blinded obstetrician (oBL) and anesthesiologist (aBL), and tBL. Hb was measured preoperatively and at 15 min post-CD. gBL was quantified from blood volume in a suction canister plus the weight of blood-soaked sponges. To obtain aBL and oBL, the anesthesiologist and obstetrician were each asked to estimate the total BL at the end of surgery. tBL was measured with the Triton System™ by photographing blood-soaked sponges and suction canister contents. To assess the relation between each BL measurement with post-CD Hb, we performed uni- and multivariable linear regression adjusting for baseline Hb, patient BMI, and oxytocin dose.

Results: Mean preoperative Hb was 12 g/dL and post-CD Hb was 11.3 g/dL. Only 1 patient had a post-CD Hb<9 g/dl. Median [IQR] qBL, oBL, aBL, and tBL values were 672 ml [266-970], 700 ml [600-800], 750 ml [600-1000], and 496 ml [374-729], respectively. Univariable analyses revealed statistically significant associations between qBL, aBL, tBL with post-CD Hb, respectively (Table). However, after additional adjustment, only aBL was independently associated with post-CD Hb (P<0.05) (Table). Similar associations, albeit non-significant, were found between oBL and tBL with post-CD Hb.

Conclusion: Although only BL estimated by the anesthesiologist was independently associated with post-CD Hb, the magnitude and direction of change was similar for the associations between aBL, oBL, and tBL with post-CD Hb. As the majority of women did not experience large amounts of intraoperative blood loss and were not severely anemic post-CD, larger studies are needed to determine which BL measuring technique best predicts severe postoperative anemia.

Table. Univariable and Multivariable Linear Regression Analyses

	qBL		oBL		aBL		tBL	
Outcome	**Beta coefficient (se)**		**Beta coefficient (se)**		**Beta coefficient (se)**		**Beta coefficient (se)**	
	Unadjusted	**Adjusted**	**Unadjusted**	**Adjusted**	**Unadjusted**	**Adjusted**	**Unadjusted**	**Adjusted**
Post-CD Hb	-0.04	-0.03	-0.08	-0.05	-0.07	-0.07	-0.1	-0.07
(g/dl)	(0.02)*	(0.02)	(0.04)	(0.02)	(0.03)*	(0.02)*	(0.04)*	(0.04)

qBL = gravimetric measurement of blood loss; oBL = visual estimate of blood loss by obstetrician; aBL = visual estimate of blood loss by anesthesiologist; tBL = blood loss measured using Triton System™ device. CD = cesarean delivery; Hb = hemoglobin; se= standard error;

The beta coefficient correspond to the incremental change in postoperative Hb (in g/dl) for every 100 ml of measured or estimated blood loss.

The adjusted models included: maternal body mass index, preoperative hemoglobin, volume of intravenous crystalloid and total dose of intravenous oxytocin given during the intraoperative period.

* P<0.05

Abstract #:T-24

Virtual Reality Analgesia in Labor: The VRAIL pilot study

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Intro: Virtual reality (VR) distraction has been studied since 2000 in a wide variety of clinical settings to manage pain and distress. Until recently, the high cost of VR systems remained inhibitory to its use outside of research studies; however, with the current proliferation of high-definition mobile phone screens, VR systems are now readily available to consumers. This is the first study to investigate the effects of immersive VR distraction on the pain of childbirth in laboring women.

Methods: An immersive VR experience was developed for this study using all consumer-ready, off-the-shelf components and software. In a randomized, controlled, within-subjects (crossover) study, we examine the effects of immersive VR on subjective pain during the first stage of labor in 30 women. Participants spend equivalent time in both the virtual environment and control condition (natural childbirth without medications or systematic distraction). Numeric rating scale (NRS) scores assessing the sensory, affective, and cognitive components of pain, as well as nausea and anxiety scores are obtained for each treatment condition. Secondary outcomes measure patient perceptions of the VR experience.

Results: Preliminary descriptive results on the first 18 patients show considerable decreases (23-41%) in the three pain ratings during VR compared to control, with half of patients reporting a decrease of 3 or more in "time spent thinking about pain" on a 10-point NRS. Of those reporting anxiety in the control condition, VR decreased anxiety scores by 45%. The incidence and magnitude of nausea were lower in the VR condition than in control. The reported depth of immersion in the VR experience was not associated with feeling absent from the birth experience while using VR. 82.4% of subjects preferred the VR treatment over no VR. Greater than 75% would use VR again and be interested in new VR content development specifically for use during labor.

Conclusion: These preliminary results suggest that (1) immersive VR distraction may be an effective nonpharmacologic analgesic and anxiolytic during child birth, and (2) it is possible to create VR experiences that are well tolerated during labor without causing nausea using low-cost consumer-ready components.

Abstract #:T-25

IMPACT OF COMPANION PRESENCE DURING PLACEMENT OF NEURAXIAL ANALGESIA

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Background: The practice of companion presence during the placement of labor epidural catheters may impact a paturient's satisfaction and level of anxiety during the procedure.(1) However, the effect of companion presence has not been studied during neuraxial catheter placement for labor analgesia in the United States. In addition, no study has examined the impact of this practice on the parturient or provider anxiety and satisfaction in a teaching institution when trainees are being instructed during the procedure. The purpose of this study was to evaluate the impact of companion presence on maternal and provider anxiety and satisfaction during combined spinal-epidural procedure for labor analgesia at a USA teaching institution.

Methods: Women admitted for labor between December 2016 and April 2017 are considered for enrollment in this study. Inclusion criteria include: nulliparity, spontaneous labor or induction of labor, ASA class < 3, desire for neuraxial labor analgesia. Subjects initially complete four validated questionnaires: State-Trait Anxiety Inventory (STAI), Newest Vital Sign, Pain Catastrophizing Scale, an assessment of knowledge of the procedure. Subjects are randomized to companion present vs. companion absent for the procedure. Following the procedure when the women are comfortable, they repeat the STAI, as well as a post-procedural assessment of satisfaction. The anesthesia provider is also questioned regarding difficulty and anxiety during the procedure. In a pre-study survey the majority of parturients surveyed, 29 of 34, stated that they would choose to have a companion present. Using a two-sided Mann-Whitney-Wilcoxon Test simulation, we determined that a total of 150 patients, 75 per group, would be sufficient to achieve an 81% power to show a difference in means.

Results: Over half of the total patients required have been recruited. We are expecting to have data collection completed by the end of March, and analysis completed by the end of April. The primary outcome of the study will be maternal satisfaction reported at the end of the neuraxial procedure. Secondary outcomes include the level of anxiety when comparing spontaneous and induced women, the effect of maternal preference regarding companion presence on level of anxiety, the effect of health literacy on level of anxiety, the degree of pain catastrophizing on level of anxiety, the effect of ethnicity on level of anxiety, the effect of the relation of the companion to the parturient on level of anxiety, the perceived difficulty for the provider based on the presence of a companion.

Discussion: The dynamic relationships between the Anesthesiologist and the trainee, as well as between the Anesthesiologist and the parturient must be balanced to provide the highest quality of patient care. This study will illustrate the role of companion presence during neuraxial labor analgesia on these relationships.

References:

1. Orbach-Zinger, S. et al. Anesth Analg 2012; 114: 654-60.

Abstract #:T-26

Acceptability and Preferences for Labor Analgesia in Dominican Women

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Introduction: Barriers to labor analgesia programs in low resource settings include lack of financial resources, equipment or personnel; government or hospital policies; and patient education or cultural beliefs.1 In the US, Hispanic women are as likely to use labor analgesia as other ethnicities.2 Perceptions of labor analgesia may differ in women from the Dominican Republic (DR). We used a structured interview to evaluate women's perceptions of labor analgesia in one DR institution currently without a labor analgesia program.

Methods: Ethics board approval was obtained. Verbal consent was obtained. An anonymous structured, multiple choice and qualitative questionnaire was developed and interpreted in Spanish in collaboration with local physicians. The survey was self-administered with an interviewer available to clarify questions. All women 1-2 days postpartum were interviewed. A convenience sample of 2 weeks was used in an attempt to reach thematic saturation. Demographic data including age, gestation, parity and education level were obtained.

Results: We present preliminary data (1wk) from 24 women. 26 women were approached. 24 women completed the survey. The median age of women was 23 y (IQR 20-27). 12 women were nulliparous and 12 women were multiparous. The median maximum pain score was NRS 10 (IQR 9-10). The survey and results are presented in the Table. Most women desired labor analgesia that reduced but did not eliminate pain. Relaxation techniques were most preferred. The primary reason for not wanting analgesia was not believing in pain control during labor.

Discussion: The most common reasons US Latina women decline labor analgesia are acceptance of pain during labor, fear of back pain, and advice from family and friends.3 Our study population would accept labor analgesia, and although a procedure was not their preferred method for pain control, they would accept a procedure to lower their pain. The epidural labor analgesia services billed by the hospital is 4500 pesos, of which 15% is the out-of-pocket cost charged to publicly-insured patients. Of those who would be willing to pay for pain control, the cost of a labor epidural was within most women's stated budgets. Epidural labor analgesia would be an acceptable and affordable option for the DR women surveyed.

References:

1. Kodali BS et al. Int J Obstet Anesth. 2014;23:267-73
2. Toledo P et al. Anesth Analg. 2012;114:172-8
3. Orejuela FJ et al. J Immigr Minor Health. 2012;14:287-91

Abstract #:T-26

Table Patient Questionnaire during Labor. Number of patients choosing each response is listed next to the answer choice with percentage of patients choosing each response in parentheses

Question	Multiple Choices	Patient response (N=24)
1. What is your highest level of education achieved?	a. Finished college b. Completed part of college c. Finished high school d. Completed part of high school e. Did not attend high school	a. 3 (12.5%) b. 6 (25%) c. 6 (25%) d. 6 (25%) e. 3 (12.5%)
2. On a scale of 0-10, what was your worst pain during labor?	NRS 1-10	10 (IQR 9-10)
3. If we could make your pain better during labor, would you want it?	a. Yes b. No	a. 21 (87.5%) b. 3 (12.5%)
3a. If no, why not?	a. It costs too much b. I do not believe in pain control during labor c. I am not having significant pain d. My family member does not want me to have pain control e. Other:_____	a. 2 (8.3%) b. 6 (25%) c. 0 (0%) d. 0 (0%) e. 0 (0%)
4. What type of pain control would be acceptable to you? (Choose as many as apply)	a. No medications, only relaxation techniques b. Medications c. Superficial injection d. Medical procedure (ex: spinal or epidural block)	a. 15 (62.5%) b. 9 (37.5%) c. 1 (4.2%) d. 1 (4.2%)
5. If we could improve your labor pain from a 10/10 to a 0/10, would you want it?	a. Yes b. No	a. 16 (66.7%) b. 7 (29.2%)
6. If we could improve your labor pain from a 10/10 to a 5/10, would you want it?	a. Yes b. No	a. 21 (87.5%) b. 3 (12.5%)
7. If we could improve your labor pain from a 10/10 to a 0/10, what is the most you would pay for this service?*	a. $0 b. $1-100 c. $100-499 d. $500-999 e. $1000-1500 f. >$1500	a. 9 (37.5%) b. 4 (16.7%) c. 3 (12.5%) d. 4 (16.7%) e. 1 (4.2%) f. 2 (8.3%)
8. If we could improve your pain from a 10/10 to a 5/10, what is the most you would pay for this service?*	a. $0 b. $1-100 c. $100-499 d. $500-999 e. $1000-1500 f. >$1500	a. 7 (29.2%) b. 2 (8.3%) c. 7 (29.2%) d. 3 (12.5%) e. 1 (4.2%) f. 2 (8.3%)
9. Would you accept a medical procedure if it improved the labor pain from a 10/10 to a 0/10?	a. Yes b. No	a. 20 (83.3%) b. 4 (16.7%)
10. Would you accept a medical procedure if it improved the labor pain from a 10/10 to a 5/10?	a. Yes b. No	a. 19 (79.2%) b. 5 (20.8%)

Data presented as median(IQR) or n(%).
Percentiles do not add up to 100% as questions were occasionally left blank.
* DR pesos

Abstract #:T-27

EFFICACY OF TRANSVERSE ABDOMINIS PLANE BLOCK WITH LIPOSOMAL BUPIVACAINE FOR POST C-SECTION ANALGESIA

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Introduction: The purpose of our study was to show the benefit of extended pain relief with liposomal bupivacaine with TAP block in patients with neuraxial anesthesia that receive intrathecal morphine. Liposomal Bupivacaine suspension is currently indicated for single-dose infiltration into the surgical site for postsurgical analgesia. This formulation combines bupivacaine with DepoFoam®, a proven product delivery technology that delivers medication over a extended time period. A single dose of Liposomal Bupivacaine is shown to provide significant reductions in cumulative pain scores with a decrease in opioid consumption.

Methods: Twelve patients were selected who were scheduled for elective C-Section under spinal anesthesia. Intrathecal preservative free morphine for postoperative analgesia. Bilateral TAP Blocks were performed,at the end of the surgery, under ultrasound guidance. 20ml of liposomal bupivacaine mixture(liposomal bupivacaine mixed with 0.25% bupivacaine) was injected on each side. A standard order for intravenous acetaminophen and ketorolac was placed for breakthrough pain. Patients were evaluated at 6, 12, 24, 48, and 72 hours. Data was collected regarding pain relief using VAS score, and amount of opioids consumed. We performed a chart review on 20 patients who did not receive TAP block but received intrathecal morphine and data was collected on pain scores and amount of opioid consumption.

Results: Patients who received bilateral TAP blocks with liposomal bupivacaine had pains scores (mean±SD) of 1.0±1.4, 1.4±2.1, 1.7±1.9, 1.9±3.3 and 1.9±2.3 at 6, 12, 24, 48 and 72 hours respectively. Only 3 out of 12 patients used oxycodone with the mean total dose of 18±10 mg of Oxycodone. One of the 3 patients only requested pain medication on postoperative day 3 and received 5 mg of oxycodone 3 times that day. The mean pain score at the first request for pain medication was 1.3±2.3 on a scale of 0-10. The mean pain score recorded at all request for pain medication was 0.8±1.8. 12 out of 20 patients without TAP block used 24±17 mg of oxycodone. Pain scores were recorded only at the time when the patient was requesting pain medication and only 11 out of 12 patients had recorded pain scores. The mean pain score at the first request for pain medication was 6±2.3. The mean pain score recorded at all request for pain medication was 5.6±1.9.

Conclusion: TAP Blocks have been extensively used in the obstetrics, have been show to reduce analgesic requirements and pain scores after C-Section and can be used as an effective adjuvant for breakthrough pain. Previous studies reported rest pain to be reduced at 6, 12, 24 but not 48 hours and dynamic pain was reduced at 6 and 12 but not 24 hours. Although there is a large difference in both pain scores and opioid use between the two groups in our study, we need to review another 40 charts of patients who received intrathecal morphine without a TAP block to properly power the study.

Abstract #:T-29

Effect of Preemptive Epidural Labor Analgesia on Patients with Preeclampsia undergoing Vaginal Delivery

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Abstract

Objective: To observe the effect of pre-emptive epidural analgesia onpatients with preeclampsiaundergoing vaginal delivery.Methods:Eighty nulliparous parturientswith preeclampsia were enrolled from January2015 to December2016. Enrolled subjects with a singleton fetus and presented by the head, willing to accept the labor analgesia, were divided into two groups (Group A:labor analgesia in active phase; Group B:labor analgesia with pre-emptive epidural analgesia). For group A, labor analgesia with epidural catheterization was performed in active phase when cervix was up to 3cm. For group B,epidural analgesia was performed at the start of active labor and pumped analgesics through epidural catheter if the maternal women required. The vital signs, time of labor process,pain occurrence, delivery outcomes and perinatal fetus outcomes were recorded in different time points in the two groups.Maternal venous blood wererespectively got at the start of labor(T0),completed cervical dilatation(T1) and fetal delivery(T2) to detect the concentration of plasma cortisol and ACTH.Results: Compared with group A, the time of the first and the second stage of labor in group B showed a significant decrease($P<0.05$). The VAS score in group B decreased at all time points within the first 60mins of cervical dilation($P<0.05$). The mean arterial pressure of group B was lower than group A after labor analgesia, the difference had statistical significance ($P<0.05$).Thematernal and neonatal outcomes of group B were superior to group A ($P<0.05$).Compared with T0, the concentration of plasma Cor and ACTH showed a significant increase at T1 and T2 in both groups($P<0.05$), and it was significantely decreased in group Bcompared to group A ($P<0.05$).Conclusion:Pre-emptive epidural labor analgesia forvaginal delivery in patients with preeclampsia could alleviate the pain as soon as possible.It may control the blood pressure and prevent the eclampsia attack via decreasing the stress responseand improve both maternal and neonatal outcomes.

Abstract #:T-30

Analysis of Maternal Complications during Labor and Delivery Using Cost-based Criticality.

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Background: The incidence of severe maternal morbidity during childbirth has more than doubled in the last 2 decades in the United States.(1) Ranking complications based on criticality may help prioritize interventions and reduce severe maternal morbidity.(2) Criticality is the product of the incidence and severity of a complication. Severity can be estimated with the adjusted excess cost attributed to this complication.(3) The aim of this study was to calculate and rank the cost-based criticality of maternal complications during labor and delivery in a national representative sample.

Methods: Discharge records indicating labor and delivery, and 17 maternal complications were identified with ICD-9-CM codes in the National Inpatient Sample (NIS) 2012, a 20% representative sample of discharges records from community hospitals in the United States. The adjusted excess cost was calculated as the difference between the mean adjusted costs of discharges with and without the examined complication.(3) Costs were calculated as the product of hospital charges and a cost-to-charge ratio provided by the NIS, and adjusted with a linear regression model. Confidence intervals (CI) were exact CI or bootstrap CI.

Results: The study sample included 734,865 delivery-related discharges corresponding to 19 % of the live births reported in the United States in 2012. Maternal death was recorded in 29 discharges (0.39 per 10,000; 95% CI: 0.26-0.57) and at least 1 complication in 80,865 (11.0 per 100; 95% CI: 10.9-11.1). The 4 most critical complications were: preeclampsia and eclampsia (criticality: $93.3), postpartum hemorrhage ($47.2), isolated hypertension of pregnancy ($34.2), and anesthesia-related complications ($5.8) (Table 1).

Conclusions: Using a cost-based approach, we identify anesthesia-related complications as a significant maternal safety concern, ranking 4th in criticality among the 17 complications examined. Further investigation is warranted to develop effective interventions to reduce obstetric anesthesia-related complications. Our results also validate the choice of 2 out of the 3 Patient Safety Bundles launched by the National Partnership for Maternal Safety, obstetric hemorrhage and severe hypertension in pregnancy.(4)

References:

1. Obstet Gynecol 2012;120:1029-36
2. Joint Commission Resources 2010
3. Anesth Analg 2016;122: 2007-16
4. Obstet Gynecol 2014;123: 973-7

Table 1: Ranking of Maternal Complications According to Cost-Based Criticality in the 734,865 Delivery-Related Discharges of the NIS 2012.

Rank	Complication	Criticality ($) (95% CI)	Excess cost ($) (95% CI)	Incidence (per 10,000)
1	Preeclampsia and eclampsia	93.3 (91.8-94.8)	2104 (2071-2136)	443.5 (438.8-448.3)
2	Postpartum hemorrhage	47.2 (45.9-48.6)	1574 (1530-1618)	300.2 (296.3-304.1)
3	Isolated hypertension of pregnancy **(a)**	34.2 (33.2-35.2)	988 (959-1017)	346.4 (342.2-350.6)
4	Anesthesia-related complications **(b)**	5.8 (5.4-6.2)	1340 (1244-1434)	43.1 (41.6-44.6)
5	Diabetes mellitus **(c)**	1.5 (1.3-1.7)	1977 (1733-2260)	7.6 (6.9-8.2)
6	Venous thromboembolic disease	1.3 (1.1-1.5)	2333 (1945-2719)	5.5 (5.0-6.1)
7	Severe sepsis and septic shock	0.7 (0.5-0.8)	7312 (5693-8897)	0.9 (0.7-1.2)
8	Stroke	0.5 (0.4-0.6)	3019 (2265-3888)	1.6 (1.3-1.9)
9	Injuries	0.3 (0.2-0.4)	3928 (3039-4918)	0.9 (0.7-1.1)
10	Status asthmaticus	0.2 (0.1-0.3)	2841 (1659-4211)	0.6 (0.4-0.8)
11	Amniotic fluid embolism	0.2 (0.1-0.3)	5293 (3878-6850)	0.4 (0.2-0.5)
13	Aortic aneurysm and dissection	0.10 (0.05-0.16)	3476 (1707-5510)	0.3 (0.2-0.4)
14	Obstetrical air embolism	0.03 (0.02-0.05)	2817 (1463-4315)	- (d) (0.0-0.2)
15	Status epilepticus	0.03 (0.01-0.05)	3111 (1452-4824)	- (d) (0.0-0.2)
16	Diabetic coma	0.01 (0.01-0.03)	1738 (1147-2160)	- (d) (0.0-0.2)
17	Obstetrical pyemic and septic embolism	0.02 (0.01-0.03)	4491 (3815-5832)	- (d) (0.0-0.1)

Criticality is the product of the adjusted excess cost and incidence of the complication.
The excess cost is the difference between the mean adjusted cost of discharges with and without the complication.
(a) excluding pre-existing hypertension and preeclampsia/eclampsia
(b) 63 ARCs (2%) were severe (i.e. associated with maternal death, cardiac arrest, or severe morbidity)
(c) excluding preexisting diabetes mellitus
(d) because of HCUP data use agreement restrictions on small cell size, exact proportions are not presented

Abstract #:T-31

Cost-based Criticality of Chronic Maternal Comorbidities

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Background: The increased prevalence of chronic comorbidities in pregnant women is a major driver for the increase in severe maternal morbidity observed in the United States during the last 2 decades.(1) Early interventions may help reduce severe maternal morbidity but require identifying modifiable risk factors. Criticality, defined as the product of the incidence and severity of a medical condition, is a novel tool that could be used to prioritize chronic comorbidities requiring interventions.(2) Severity can be estimated with the adjusted excess cost attributed to a given condition.(3) The purpose of this study was to assess and rank the cost-based criticality of chronic maternal comorbidities during labor and delivery in a nationally representative sample.

Methods: Hospital discharge records indicating labor and delivery, and 15 most commonly listed chronic maternal comorbidities were identified with ICD-9-CM codes in the National Inpatient Sample (NIS) 2012, a 20% representative sample of hospitalizations from community hospitals in the United States. The adjusted excess cost was calculated as the difference between the mean adjusted costs of discharges with and without the examined comorbidity.(3) Costs were calculated as the product of hospital charges and a cost-to-charge ratio provided by the NIS, and adjusted with a linear regression model. Confidence intervals (CI) were exact CI or bootstrap CI.

Results: The study sample included 734,865 delivery-related discharges, or 19% of the live births reported in the United States in 2012. There was at least 1 chronic comorbidity recorded in 112,171 of the discharges (15.3%; 95% CI: 15.2-15.4). Obesity (criticality: $56.8) was the most highly ranked chronic comorbidity, followed by asthma ($24.2), psychiatric disorders ($17.0), and pre-existing diabetes mellitus ($13.5) (Table 1).

Conclusions: Obesity, asthma, psychiatric disorders, and pre-existing diabetes mellitus are the chronic comorbidities most critical to maternal outcomes. Effective interventions targeting these comorbidities should be incorporated into reproductive health programs and merit high priorities to improve maternal health.

References:

1. Obstet Gynecol 2012;120:1029-36
2. Joint Commission Resources 2010
3. Anesth Analg 2016;122: 2007-16

Table 1: Ranking of Chronic Maternal Comorbidities Based on Cost-Based Criticality in the 734,865 Delivery-Related Discharges of the National Inpatient Sample 2012.

Rank	Comorbidity	Criticality ($) (95% CI)	Excess cost ($) (95% CI)	Incidence (per 10,000)
1	Obesity	56.8 (55.5-58.1)	1096 (1071-1120)	518.5 (513.4-523.6)
2	Asthma	24.2 (23.3-25.3)	680 (654-709)	356.4 (352.2-360.7)
3	Psychiatric disorders	17.0 (16.1-17.9)	599 (565-631)	284.5 (280.7-288.4)
	- Depression	*11.8 (11.1-12.6)*	*575 (540-614)*	*205.9 (202.6-209.1)*
	- Bipolar disorders	*4.6 (4.1-5.1)*	*624 (555-689)*	*73.9 (72.0-75.9)*
	- Schizophrenia	*0.6 (0.4-0.7)*	*817 (587-1043)*	*7.2 (6.6-7.8)*
	- Mental retardation	*0.2 (0.1-0.3)*	*756 (418-1112)*	*2.6 (2.3-3.0)*
4	Pre-existing diabetes mellitus (a)	13.5 (12.9-14.1)	1422 (1361-1486)	95.1 (92.9-97.4)
5	Pre-existing hypertension (b)	11.8 (11.1-12.5)	732 (689-776)	160.7 (157.8-163.6)
6	Drugs and alcohol use	11.6 (10.8-12.3)	694 (651-739)	166.7 (163.8-169.5)
7	Smoking	7.2 (6.6-7.9)	412 (375-452)	175.3 (172.3-178.3)
8	Chronic kidney disease	3.6 (3.2-4.0)	1336 (1190-1495)	26.9 (25.8-28.1)
9	Sickle cell disease	2.8 (2.5-3.1)	1584 (1429-1757)	17.6 (16.7-18.6)
10	Cardiac valve disease	1.9 (1.7-2.2)	897 (783-1013)	21.5 (20.5-22.6)
11	Lupus	1.6 (1.3-1.8)	1337 (1147-1537)	11.7 (11.0-12.5)
12	HIV	1.6 (1.4-1.9)	1650 (1438-1881)	9.9 (9.2-10.6)
13	Congenital heart disease	1.2 (1.0-1.4)	1683 (1422-1987)	6.9 (6.3-7.5)
14	Pulmonary hypertension	0.6 (0.5-0.7)	3152 (2503-3856)	1.9 (1.6-2.2)
15	Chronic ischemic heart disease	0.2 (0.1-0.3)	1215 (766-1727)	1.9 (1.6-2.2)

Footnote: The excess cost is the difference between the mean cost of discharges with and without the comorbidity of interest. Criticality is the product of the excess cost of the comorbidity and its incidence.

(a) excluding diabetes mellitus of pregnancy

(b) excluding gestational hypertension and preeclampsia/eclampsia

Abbreviations: CI: confidence interval; $: 2012 US dollars

Abstract #:T-32

Fibrinogen retention and hemostatic quality of pathogen reduced cryoprecipitate stored at room temperature, 5-days post thaw

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BACKGROUND: Postpartum hemorrhage (PPH) continues to be a significant cause of morbidity and mortality worldwide accounting for almost 25% of maternal deaths.1 Fibrinogen (FB) levels are a marker of PPH severity3 which has led to studies looking at Fb therapy as a means to control hemorrhage. Cryoprecipitate (cryo) is an enriched source of fibrinogen (FB), Factor XIII, Factor VIII and von Willebrand Factor (vWF). Today's pooled cryo poses risk of transfusion transmitted infection from bacteria, known and unknown pathogens. Because of the risk of bacterial growth, cryo's post-thaw shelf life is 4-6 hours. We assessed hemostatic quality and retention of coagulation factors in pathogen reduced (PR) cryo.

METHODS: Six units of whole blood derived (WBD) FFP were produced by pooling type-matched FFP from 3 different donors and dividing each pool into a Test Jumbo FFP (625 ± 25 mL) and an untreated Control (230 mL). Six replicates of apheresis (Aph) plasma were each produced by pooling 2 Aph collections and dividing each pool as described above. All Test units were PR using UVA light and psoralen treatment. Cryo was manufactured according to blood center SOPs and frozen at -30°C with residual supernatant (60 mL for Test and 20 mL for Control). Cryo was thawed at 37°C and sampled (Day 0) then stored at 22˚C and sampled aseptically again at 1 and 5 days post-thaw. FVIII and FB activity were measured using an automated coagulation analyzer. Antigen levels were measured by ELISA for Factor XIII and vWF. Samples were evaluated using ROTEM's INTEM and EXTEM assays and thrombin generation (TG).

RESULTS: FB and FXIII levels in PR cryo remained constant up to 5 days post-thaw when stored at 22˚C, regardless of plasma source (Table 1). FVIII activity declined over storage for both PR derived and control cryo in both WBD and Aph source plasma. Approximately, 95% ± 3 of FB was retained in PR Aph cryo stored for 5 days and 104% ± 6 retained in WBD PR cryo. Similar values were seen for FXIII and vWF. Hemostatic function of PR cryo, using ROTEM and TG analysis also showed equivalence with Control at days 1 and 5.

CONCLUSION: Cryo prepared from PR plasma showed consistent FB and FXIII yields up to 5 days post-thaw, compared to untreated cryo. Preparation of cryo from PR plasma could potentially extend thawed storage, thereby reducing product wastage and increasing FB availability for urgent use, with the added advantage of a reduced risk of transfusion-transmitted infection.

Table 1.
% Retention of Coagulation Factors, ROTEM and Thrombin Generation of PR-Cryo at Day 5 Post-Thaw

Aph-Derived Cryo

In Vitro Stability of INTERCEPT Cryo Prepared from T0 Apheresis FFP and Paired T120 Apheresis FFP	Post Thaw (T = 0)	Post Thaw (T = 120 HR)	Retention (%)
Coagulation Factors			
Fibrinogen (f) mg/container	1483 ± 172	1565 ± 270	95 ± 3
Fibrinogen (a) mg/container	635 ± 84	709 ± 130	112 ± 17
Factor VIII (f) IU/container	317 ± 75	278 ± 59	80 ± 13
Factor VIII (a) IU/container	325 ± 66	346 ± 116	104 ± 16
Factor XIII (a) mg/container	2,330 ± 377	2,409 ± 113	106 ± 17
vWF (a) IU/container	1,178 ± 179	1,218 ± 157	106 ± 24
Fibrin Clot Formation (ROTEM)			
CT (s) EXTEM	58 ± 7	89 ± 14	156 ± 32
CT (s) INTEM	192 ± 13	249 ± 21	130 ± 11
MCF (mm) EXTEM	75 ± 6	78 ± 6	104 ± 3
MCF (mm) INTEM	74 ± 5	78 ± 6	104 ± 3
Alpha angle (°) EXTEM	86 ± 1	85 ± 2	98 ± 2
Alpha angle (°) INTEM	87 ± 0	85 ± 1	98 ± 1
A 10 (mm) EXTEM	71 ± 4	75 ± 6	105 ± 3
A 10 (mm) INTEM	71 ± 4	74 ± 6	105 ± 3
Thrombin Generation (CAT)			
Lag time (min)	2.6 ± 0.1	3.0 ± 0.3	118 ± 6
Peak (nM)	232 ± 17	236 ± 9	104 ± 3
ETP (nM)	2,238 ± 175	2,267 ± 89	104 ± 4
Time to peak (min)	4.7 ± 0.1	5.2 ± 0.4	110 ± 6

WBD-Derived Cryo

In Vitro Stability of INTERCEPT Cryo Prepared from WBFFP and Paired Untreated Cryo Prepared From WBFFP	Post Thaw (T = 0)	Post Thaw (T = 120 HR)	Retention (%)
Coagulation Factors			
Fibrinogen (f) mg/container	1199 ± 222	1246 ± 192	104 ± 6
Fibrinogen (a) mg/container	202.6±35.6	238.6±71.1	118.2 ± 28.5
Factor VIII (f) IU/container	380± 55	270± 77	70 ± 10
Factor VIII (a) IU/container	Not completed		
Factor XIII (a) mg/container	3,528.±614.5	3,753.6±755.	108.5 ± 24.4
vWF (a) IU/container	786.1±111.4	821.4±262.8	104 ± 28
Fibrin Clot Formation (ROTEM)			
CT (s) EXTEM	70.2±7.8	80.2±5.5	116.6 ± 15.4
CT (s) INTEM	219.4±8.6	249.7±11.8	112.8 ± 6.4
MCF (mm) EXTEM	65.6±2.7	69.8±6.8	107 ± 11.8
MCF (mm) INTEM	67.8±7.1	70.8±6.5	109.5 ± 11.5
Alpha angle (°) EXTEM	84.7±1.4	84.7±1.2	100.3 ± 2.5
Alpha angle (°) INTEM	84.7±1.3	84.9±0.8	100.9 ± 1 .2
A 10 (mm) EXTEM	62.9±3.9	68.3±5.9	110.3± 14
A 10 (mm) INTEM	65.1±6.1	68.8±5.9	110.7 ± 11.2
Thrombin Generation (CAT)			
Lag time (min)	2.2±0.2	2.6±0.2	116 ± 10.5
Peak (nM)	218.0±21.4	222.6±24.2	102 ± 5.6
ETP (nM)	2,432.5±201.3	2,448.7±231.5	99.7 ± 6.1
Time to peak (min)	4.4±0.3	4.8±0.2	109 ± 8.4

f= function activity (clotting assay)
a= antigen level (ELISA)

Retention(%)=Post Thaw T120/Post Thaw T0

Abstract #:T-33

Effectiveness of Different Dosages of Programmed Epidural Boluses for Labor Analgesia. A Randomized Single-Blind Study in Parturient Women

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BACKGROUND: Current standards of labor epidural analgesia consist of local anesthetic in combination with opioids delivered via parturient-controlled epidural analgesia with basal infusion. In this prospective randomized single-blind controlled study, we compared the effectiveness of different dosages of preset scheduled epidural boluses to standard continuous epidural infusion evaluating clinical outcome, patient comfort and satisfaction, the need for manual anesthesia interventions, other analgesic outcomes, labor progression, and mode of delivery in healthy laboring women.

We hypothesized that epidural local anesthetic consumption would be lower with increased patient satisfaction if programmed intermittent boluses were used instead of basal infusion.

METHODS: Nulliparous, term women in spontaneous labor and cervical dilation 4cm were consented. Epidural analgesia was then initiated and maintained with Bupivacaine-0.125% with fentanyl 2mcg/ml. After an initial loading dose of 5mL of epidural solution, patients were randomized to one of three groups receiving either programmed intermittent epidural bolus 5ml every 30 minutes (Group 1), 10mL every hour beginning 60 minutes (Group 2), or continuous epidural infusion 10 mL/h (Group 3). Breakthrough pain was treated with manual boluses with Bupivacaine-0.125% with fentanyl 2mcg/ml or Lidocaine-2% if necessary.

The degree of motor block was assessed in lower extremities using modified Bromage score; total local anesthetic requirement, total analgesic solution consumption, and maternal satisfaction as primary outcomes. Secondary outcomes such as, sensory anesthesia to cold sensation using the ice glove test at regular intervals throughout labor, verbal pain scores, incidence of side effects, and outcome of labor also compared among groups.

RESULTS: We studied 126 patients. Patient demographics, labor characteristics, and side effects were similar in each group. We found a reduction in verbal pain scores during labor in Group 1, but not significantly. There were no differences in pain scores in Group 2 and Group 3. However, Group 1 was significantly more likely to receive a bolus dose for breakthrough pain than Group 2. Group 3 was more likely to receive a bolus than Group 2, and less likely than Group 1, but was not significantly different from either of them. There was no difference between the groups in the likelihood of a patient having a block T9 or higher.

CONCLUSIONS: The results of this study suggest that the use of programmed intermittent epidural anesthetic bolus technique slightly reduces local anesthetic usage, total analgesic consumption and improves maternal comfort and satisfaction. More studies are required to conceptualize the ideal intermittent epidural anesthetic bolus technique and further investigate its effect on labor analgesia and obstetric outcomes.

Abstract #:T-34

Mitigating the risk associated with Zika virus transfusion-transmission in pregnant women using licensed pathogen-reduced blood components

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BACKGROUND: Pregnant women may require platelet and plasma transfusion. Concerns over the safety of transfusions in pregnant women and fetuses increased after Zika virus (ZIKV) emergence. ZIKV, which was confirmed responsible for congenital syndromes after maternal ZIKV infection, was demonstrated transmissible through platelet transfusion. The high prevalence of viremic donors in active transmission areas, several cases of ZIKV transfusion-transmission, and thousands of travel associated infections were evidence that mitigation strategies should be deployed to reduce the risk of ZIKV transmission. This precipitated the Food and Drug Administration (FDA) to mandate that blood collections be tested using ZIKV nucleic acid testing or be treated using FDA approved pathogen reduction (PR) technologies. The psoralen (amotosalen) and ultraviolet A (UVA) light treatment system for platelets and plasma was developed to improve blood transfusion safety by reducing the risk of transfusion transmitted infections and transfusion-associated graft versus host disease. The FDA approved system for plasma and platelets uses amotosalen and UVA to inactivate bacteria, viruses, parasites and white blood cells, the PR technology for RBCs uses amustaline and glutathione and is currently in clinical development. Inactivation of ZIKV using these systems was previously demonstrated to be >6.57 log10 ZIKV in plasma (Aubry et al.) and >5.99 log10 in RBCs (Laughhunn et al.). The current study evaluated the efficacy of the psoralen/UVA treatment to inactivate ZIKV in platelet components (PCs).

METHODS: PCs were spiked with ZIKV. ZIKV infectious titers and RNA loads were measured in spiked platelets before and after photochemical treatment using psoralen/UVA, utilizing different methodologies of quantification and post-treatment passages on Vero cell cultures.

RESULTS: The mean ZIKV infectivity titers and RNA loads in platelets before inactivation were respectively 4.4 log10 TCID50/mL and 7.5 log10 genome equivalents (GEq)/mL. No infectivity was detected either immediately after psoralen/UVA treatment or after multiple passages on Vero cells; ZIKV RNA was not detectable from the first passage post-inactivation. Additional studies demonstrated efficient inactivation to the limit of detection regardless of whether platelets were manufactured in platelet additive solution or plasma.

CONCLUSION: As previously demonstrated for plasma and RBCs, robust levels of ZIKV inactivation were achieved in PCs. With inactivation of higher levels of ZIKV than those reported in asymptomatic viremic blood donors, the psoralen/UVA treatment may be used to reduce the risk of ZIKV transmission through plasma and platelet transfusion.

The INTERCEPT Blood System for Red Bloods Cells is not approved for use.

The data in this study have not been reviewed by the FDA.

Abstract #:T-37

Does magnetic resonance imaging of epidural cerebrospinal fluid spread correlate with severity of headache following accidental dural puncture: a-proof-of-concept observational multi centre study

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Currently the decision for performing an epidural blood patch (EBP) to treat post dural puncture headache (PDPH) relies mainly on subjective clinical judgement as there is no validated pathway to guide treatment. An evidence base protocol may be of value in identifying those women most likely to develop a severe PDPH necessitating EBP. The use of magnetic resonance imaging (MRI) in characterising cerebrospinal fluid (CSF) spread in the epidural space and its association with severity of PDPH has been proposed. Our study aimed to investigate a potential link between CSF spread after accidental dural puncture (ADP), using a MRI score, and the development/severity of PDPH in obstetric patients.

The MRiADP group, a collaboration of 10 National Health Service hospitals was formed to recruit patients for this study. Parturients who had an ADP complicating a labour epidural underwent a T1 & T2 weighted sagittal MRI scan of the lumbar spine and brain within 48 hours following ADP. All women were followed up for the development of PDPH for one week. Each patient had a daily PDPH score calculated using a 4 point visual analogue scale (none, mild, moderate and severe), with additional points given for visual, auditory, nausea/vomiting. All MRI scans were reported by a blinded neuroradiologist using a predefined scoring system (one point for every vertebral level covered vertically by CSF and one point for circumferential spread). Data are presented as count (%) and median (range). Kendall τ and Spearman rs correlations were used to assess the relationships between PDPH symptom severity and MRI findings. Significance was defined at ($P<0.05$ two -sided).

Twenty two patients were recruited. The majority developed a PDPH (n=19, 86%) after ADP. The onset time of PDPH was 24 (4-126) hours. An EBP was performed on 47% (n=9) of patients, which resolved the PDPH in 88% (n=8). Eight participants had a spinal catheter inserted for PDPH prophylaxis following ADP, of which 75% (n=6) developed a PDPH, but only 25% (n=2) needed an EBP which resolved the PDPH. The PDPH and MRI scores were 10 (0-21) and 2.5 (0-10) respectively. Kendall τ and rs correlations for PDPH and MRI scores were 0.35 (95%CI: 0.06-0.59, P=0.038) and 0.46 (95%CI: 0.04-0.74, P=0.017) respectively.

Our preliminary results confirm previous findings that characteristics of CSF spread in the epidural space correlates with PDPH severity, although, statistically the correlation remains weak to moderate. Patterns of CSF leak are not understood. Further research should be directed at developing a validated MRI scoring system that could predict severity of PDPH to guide clinical management.

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Abstract #:T-38

Estimating Obstetric Anesthesiology Workload: Number of Deliveries versus Workload Hours per Hour.

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Introduction: Knowledge of the number of deliveries is utilized to estimate obstetric anesthesiologist workload on labor and delivery (1, 2). However, this number may not reflect true workload for ideal staff planning. The goal of this analysis was to assess if including estimates of procedure-related time commitments would better predict clinical workloads.

Methods: We queried the electronic medical record data at our academic center for 12 consecutive months of maternal deliveries. Data extracted included delivery type, anesthetic/analgesic procedure and whether delivery occurred during weekday (Mon-Fri 7a-5p), weeknight (Mon-Fri 5p-7a) or weekend (Sat 7a-Sun 7a) shifts. To calculate anesthesiology workload hours, delivery type was multiplied by an estimated total dedicated time associated with the anesthetic/analgesic procedure. We estimated 2 hours for cesarean delivery anesthetic and 30 minutes for labor epidural analgesia. To generate an hour to hour comparison of shifts of varying duration, workload hours was divided by the number of hours in each shift.

Results: A total of 4598 deliveries occurred in the 12 month study period, including 1707 during weekdays and 2891 during the weeknights and weekends. The cesarean delivery rate was 31.7% and labor epidural rate was 85%. 1564 anesthetic/analgesic procedures occurred during weekdays and 2557 anesthetic/analgesic procedures occurred during the weeknights and weekends (Fig 1a) including 773 cesarean deliveries during weekdays and 684 during weeknights and weekends. The number of anesthetic/analgesic procedures/hour was 0.60 during weekdays compared to 0.42 during weeknights and weekends. After accounting for the duration of each procedure, weekdays utilized 0.75 workload hours/hour versus 0.38 workload hours/hour on weeknights and weekends (Fig 1b).

Fig 1a: Deliveries during shifts.

Fig 1b: Workload Hours per Hour during shifts.

Conclusion: Basing relative workload on delivery numbers alone suggests 59% less workload during the weekday compared to weeknight and weekend shifts, whereas accounting for anesthetic/analgesic procedures per hour shows a 42% greater workload during the weekday shifts. Factoring in time of anesthetic/analgesic procedures resulted in a 99% greater workload on weekday shifts. Data from this study shows the importance of considering anesthetic/analgesic procedures and their relative duration to better plan optimal staffing for different shifts on labor and delivery.

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Abstract #:T-39

Intravenous Fluid Flow Rates with the Addition of a Fluid Warming Insert: An In Vitro Study.

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Introduction: Intravenous fluid coloading decreases hypotension after spinal anesthesia (1). Fluid warming is recommended to reduce hypothermia during cesarean delivery (2). The increase in tubing length and resistance associated with in-line warming devices used to prevent perioperative hypothermia may reduce the speed of intravenous fluid administration, and therefore the efficacy of coloading. The aim of the study was to investigate the effect of a fluid warming system on flow rates.

Methods: We conducted a randomized in vitro study. The experimental groups included an unheated and heated 3M Ranger insert added to a standard intravenous set. These were compared to a control group consisting of the same intravenous set without warming insert. All sets were pressurized to 250 mmHg and connected to an 18 gauge intravenous catheter. The time (seconds) taken for 800 ml (10 ml/kg x 80 kg standard patient weight) of lactated ringers to collect into a graduated cylinder was measured. The experiment was repeated for a total of 16 times per group.

Results: The mean flow rates of the experimental and control groups are shown in Table 1. An 800 ml fluid bolus took 11 sec longer (95% CI 10 - 16, p=0.0003) to administer when a heated in-line warming device was added to a standard intravenous set (281 sec in the Heated Ranger versus 271 sec in the control group). The Heated Ranger decreased infusion time compared to the Unheated Ranger (Table 1).

Conclusions: The modest decrease in flow rates with an in-line fluid warming insert is unlikely to impact the ability to provide effective coloading or rapid fluid resuscitation. In-line warming devices may be used in cases with moderate volume fluid administration or high chance of blood administration to maintain normothermia without concern for decreased fluid flow rates.

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Table 1: Time and Flow Rates for Intravenous Fluid Administration

Groups	Time (sec)	Flow Rate (ml/min)	Mean difference (ml/min) (95% CI)	P-value
Control	271	178	-----	-----
Heated Ranger	281	171	-7 (-4 - -10)	0.0002
Unheated Ranger	292	165	-13 (-10 - -16)	<0.0001

Abstract #:T-40

Hypodysfibrinogenemia in a Pregnant Patient: Peripartum Management and Thromboelastogram Results.

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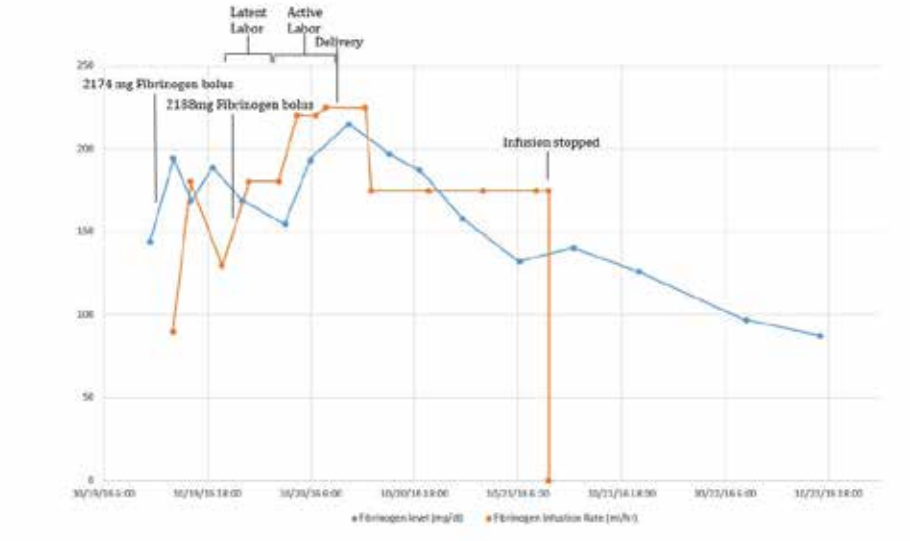
Introduction: Hypodysfibinogenemia is typically an autosomal dominant disorder characterized by both quantitative and qualitative fibrinogen deficiency with variable degrees of penetrance (1). Adverse outcomes include spontaneous abortion (typically at 8-10 weeks gestation), preterm abruption, postpartum hemorrhage and thrombosis (2). Fibrinogen concentrate is often utilized to prevent these complications throughout pregnancy and labor (3). We report the obstetric anesthetic management and the first reported use of a labor epidural for a patient with hypodysfibrinogenemia.

Case Report: A 30 year old G1P0 at 36 weeks and 0 days with a history hypodysfibrinogenemia presented with absent fetal heart tones. Her pre-pregnancy baseline fibrinogen levels varied between 20 and 60 mg/dl and she had history of abnormal bleeding after a loop electrosurgical excision procedure. During the antenatal period, she received fibrinogen concentrate to maintain her fibrinogen nadir above 50, 100 and 150 mg/dl during 1st, 2nd and 3rd trimester, respectively. Based on multidisciplinary consensus for her labor admission, an arterial line was placed for frequent laboratory draws, including fibrinogen and thromboelastogram. She received an initial fibrinogen concentrate bolus of 2174mg, followed by an infusion 90 mg/hr titrated to maintain a fibrinogen level of approximately 200 mg/dl throughout labor. Fibrinogen levels during labor and fibrinogen infusion rate are shown in Fig 1. A labor epidural was performed when her fibrinogen concentration was greater than 150 mg/dl. She underwent an uncomplicated vaginal delivery with no abnormal bleeding. Fibrinogen concentrate infusion was continued for 24 hours after delivery before being discontinued and allowing to drift to baseline.

Discussion: A threshold fibrinogen level for safe neuraxial block placement is unknown. For this case, we elected to use a threshold of greater than 150 mg/dl. Individualized care for patients with hypodysfibrinogenemia requires early multidisciplinary input from obstetricians, anesthesiologists and hematologists. In order to lessen the potential risk of postpartum hemorrhage and neuraxial hematoma, these patients require fibrinogen supplementation during the peripartum period.

Fig 1: Fibrinogen levels during labor and fibrinogen infusion rate.



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Abstract #:T-41

Comparison of arm and calf blood pressures in parturients after epidural anesthesia

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Introduction: Measurement of maternal blood pressure (BP) during labor allows early identification of iatrogenic maternal hypotension, which can lead to fetal distress via changes in uteroplacental blood flow (UBF). Many patient factors, among them intravenous placement and prior mastectomy, can prevent upper extremity BP measurement. This prospective, non-interventional study compared BP measured in the upper arm v calf in parturients undergoing vaginal delivery, including predictive implications for non-reassuring fetal heart rate changes (NRFHR).

Methods: Following Institutional Review Board approval and informed consent, patients with at least one arm and one calf available for BP measurement had appropriately-sized cuffs fit to each limb. Following epidural bolus injection of lidocaine, bupivacaine, or ropivacaine, and left uterine displacement positioning, we obtained paired measures of BP and heart rate at 2, 4, 6, 8, 10, 15, 20, then every 15 mins until epidural cessation. We pre-defined hypotension as >20% reduction from baseline (2 min) systolic BP or <90 mmHg. Patient received fluids and vasopressors per usual clinical practice. The primary outcome was the decrease in BP at 10 mins compared to 2 mins following epidural bolus injection. Paired Student's t-test compared arm to calf BP. Logistic regression sought association of BP decreases with NRFHR outcome, with P<0.15 needed to enter the model and P<0.05 for significance.

Results: 290 of 374 patients enrolled had both BPs recorded at both 2 and 10 minutes and NRFHR data. Both systolic and diastolic BPs were higher in the calf v the arm (table); the spread narrowed at 10 min (20.8/5.2 mmHg) v at 2 min (34.0/12.4). Hypotension 10 min after epidural injection occurred in 8.9% using arm and 26.7% using calf BP (P=0.009, Fisher exact test), the latter always based on >20% decrease, the former in all but 4 (1.4%) patients. No BP decrease (arm systolic, arm diastolic, calf systolic, calf diastolic) predicted NRFHR.

We expected increased systolic and decreased diastolic BP in the calf v arm, and found both increased. When using calf BP following epidural injection, clinicians should expect numerically higher values and >20% decreases more often. Neither arm nor calf BP decreases 10 min following injection predict NHFHR.

Systolic BP	Arm 10min; 2min	Calf 10min; 2min	Difference 10min; 2min	Δ Difference
Overall N=292	117±15; 124±15	138±20; 158±21	20.8±16.9*; 34.0±20.9*	13.4±22.5*
NRFHR (-) N=262	118±16; 123±16	139±21; 159±21	21.2±17.1*; 35.1±21.0*	13.9±22.7*
NRFHR (+) N=30	117±16; 123±17	134±21; 149±17	17.3±15.4*; 26.1±18.6*	8.6±19.5#
Diastolic BP				
Overall N=290	61±10; 69±11	66± 9; 81±15	5.2±9.6*; 12.4±16.2*	7.2±17.1*
NRFHR (-) N=260	61± 9; 69±11	66± 9; 82±15	5.3±9.9*; 12.9±16.5*	7.6±17.6*
NRFHR (+) N=30	61±11; 67±10	65±10; 75±13	4.3±6.5[&]; 7.8±12.8#	3.5±12.1 NS

*P<0.0001; &P<0.001; #P<0.05, NS=not significant by paired t-test

Abstract #:T-42

Retrospective analysis of the safety and efficacy of epidural fentanyl bolus immediately prior to cesarean delivery

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Background: A well-functioning labor epidural is often used to deliver surgical anesthesia for a cesarean delivery. In addition to a concentrated local anesthetic, many providers also administer a bolus dose of fentanyl through the epidural to improve the quality of pain relief for cesarean delivery. This may decrease the need for intraoperative supplementation or conversion to general anesthesia. There is concern, however, that larger boluses of epidural fentanyl administered just prior to delivery lead to adverse neonatal outcomes. The limited data that currently exists shows no difference in neonatal Apgar scores with a bolus dose of 100 mcg epidural fentanyl administered prior to cesarean delivery (Hong et al., J Kor Med Sci, 2010 Feb;25(2):287-92). However, more sensitive measures of potential opioid effect including the need for supplemental oxygen, positive pressure ventilation (PPV), intubation, or umbilical cord gas results have not been investigated. The aim of this retrospective chart review is to examine the effect of epidural fentanyl on maternal and neonatal outcomes when administered to a pre-existing labor epidural for cesarean delivery anesthesia.

Methods: A retrospective chart review from June 2012 to December 2016 yielded 770 patients who had a labor epidural dosed to provide surgical anesthesia for cesarean delivery. Primary maternal outcomes included the need for supplemental IV sedation/analgesia and conversion to general anesthesia. Primary neonatal outcomes included Apgar scores, umbilical artery cord gases, and need for intraoperative support or resuscitation (supplemental oxygen, PPV, intubation, chest compressions). Data were compared for those who received an epidural fentanyl bolus before delivery to those who did not.

Results: In the group who received an epidural fentanyl bolus, there was a lower rate of propofol sedation (0% vs 2.1%, p=0.04). There was no difference in any other maternal outcome between the two groups including conversion to general anesthesia before delivery and need for additional analgesia.

In the group who did not receive an epidural fentanyl bolus, there was a higher rate of neonatal intubation (5.2% vs 1.9%, p=0.047) and a greater base deficit via uterine artery blood gas (-3.7 vs -3.1, p=0.04). However, there was no difference in the need for blow-by oxygen, PPV, or other resuscitative measures.

Conclusion: Based on the retrospective data presented, administration of an epidural fentanyl bolus prior to cesarean delivery is not associated with adverse maternal or neonatal outcomes. Moreover, the need for intraoperative sedation with propofol may be decreased. One potential limitation of the study is that urgency of cesarean delivery is not accounted for. This may explain the increased rate of intubation and worse base deficit in the group who did not receive an epidural fentanyl bolus prior to delivery due to time limitations.

Abstract #:T-43

An Analysis of Labor Room Usage and Cesarean Section Rates on High Volume, High Acuity Obstetric Unit: Does Layout Matter?

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Introduction: The physical environment of a hospital can influence patient care (1-4). We hypothesized that proximity to operating room (OR) or nursing station is associated with labor and delivery room (LDR) utilization and intrapartum cesarean delivery rates at our high acuity, tertiary center with 10 LDRs and 3 ORs; [Figure 1A].

Methods: Electronic medical record data were reviewed for all women over 2.5 years. Cesarean delivery (CD) rates, vaginal delivery (VD) rates, and room utilization rates were calculated. Contingency table analysis was performed to determine differences in CD vs. VD rates amongst LDRs. Charge nurse interviews were conducted to determine room assignment preferences.

Results: Of 8,727 patients, 17.2% required intrapartum CD and 82.8% had VD. LDR utilization varied significantly ($P < 0.001$), with 36.1% of deliveries occurring in or from LDRs 5-7. Only 6.4% of all deliveries occurred in or from LDR 4. CD rates varied by LDR, with the highest rates occurring after labor in LDR's 4, 9 and 10 (23.4%, 20.5% and 20.7%, respectively; [Fig 1B]).

Charge nurses preferred to admit women at higher risk of CD to LDRs 9 and 10 because of close proximity to OR and 4 because of negative air flow. LDRs 5-8 were preferably filled first given close proximity to nursing station. LDRs 1-3 were preferred for low risk women given furthest distance from monitoring station. These rooming preferences based on perceived risk correlated with significant differences in CD rate (Low risk rooms: 14.8%, normal risk: 16.5%, high risk: 21.5%).

Discussion: We found asymmetry in LDR use, CD rate, and rooming preferences. These results demonstrate 1) physical factors may be associated with resource utilization, and 2) charge nurses can stratify patient risk based on initial assessment. A rational future approach would incorporate these considerations and design a unit for stratification based on parturient risk.

This project was supported by grant P30HS023506 from the Agency for Healthcare Research & Quality. The content is solely the responsibility of the authors and does not necessarily represent official views of the AHRQ.

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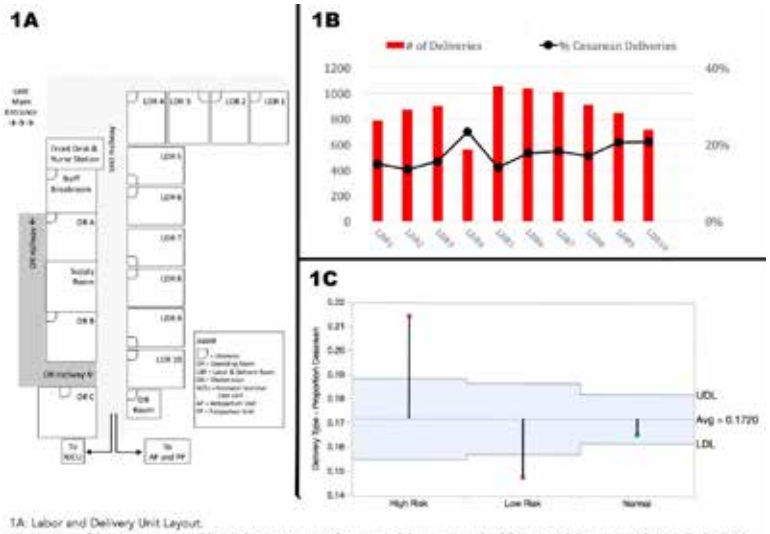

1A: Labor and Delivery Unit Layout.
1B: Number of deliveries in each LDR and the percentage of cesarean deliveries in each LDR over a a 2.5 year period at Lucille Packard Children's Hospital.
1C: The percentage of cesarean deliveries in each room type. Contingency table analysis with analysis of the mean proportions. High risk and low risk rooms significantly outside the group means.

Abstract #:T-44

Combination of low dose L type Calcium channel blockade with calcium-activated chloride channel anoctamin 1 (ANO1) antagonism potentiates relaxation of pre-contracted murine uterine smooth muscle (mUSM).

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Objective: Current tocolytic agents have no major impact on pre-term labor beyond 48 hours.Lack of clinical utility with current tocolytics is exacerbated by maternal side effects that preclude maintaining effective steady-state drug concentrations (ex. hypotension).One strategy to mitigate drug side effects is to combine two drugs with distinct mechanisms of action at lower than typical doses required to achieve a functional effect. We previously described ANO1 blockade mediates potent relaxation of pre-contracted human and murine USM,and questioned if the combination of sub-therapeutic nifedipine and benzbromarone (ANO1 blocker) would potentiate relaxation.

Methods: With IACUC approval, ex vivo organ bath experiments were performed:

(A) Initial Single drug Dose Response Studies: Strips of non-pregnant mUSM (n=5 mice) were pre-contracted with TEA (10 mM), equilibrated for 20 minutes, and treated with sequentially increasing doses (10^{-10}M-10^{-3}M) of benzbromarone (BB), nifedipine (NIF) or vehicle control (0.1% DMSO final) to determine IC_{50}, I_{max}, and sub-therapeutic drug concentrations.

(B) Combination Drug Potentiation Studies: Strips of non-pregnant mUSM (n=7 mice) were contracted (TEA 10 mM) and allowed to equilibrate at an increased contractility for 60 minutes.We then tested the capacity of sub-therapeutic low dose treatments (derived in A above) by assessing subsequent relaxation following treatment with either vehicle (0.1% DMSO final), BB (1 μM), NIF (0.01 μM), or the combination of BB (1 μM) and NIF (0.01 μM).

Changes in force was measured over time and processed as a percent reduction in integral force (g*sec) from baseline TEA-induced contractility.Results were compiled and reported as mean + SEM.Data was analyzed by One way ANOVA with Bonferroni's Multiple Comparison Test,and p<0.05 was taken as significant.

Results: The IC_{50} of BB or NIF on TEA-induced contractility of mUSM (controlled for time decay) are 10 μM or 47 nM respectively.We observed statistically non-significant reductions in percent integral force following by NIF at 0.01 μM and by BB at 1 μM.Using these low dose– sub-therapeutic doses in combination, we demonstrate statistically significant potentiation of relaxation compared to the BB alone or NIF alone groups (***p <0.001).

Conclusions: Combination therapy of low dose L-type calcium channel blockade and ANO1 blockade potentiates relaxation of TEA-induced contractility in mUSM.

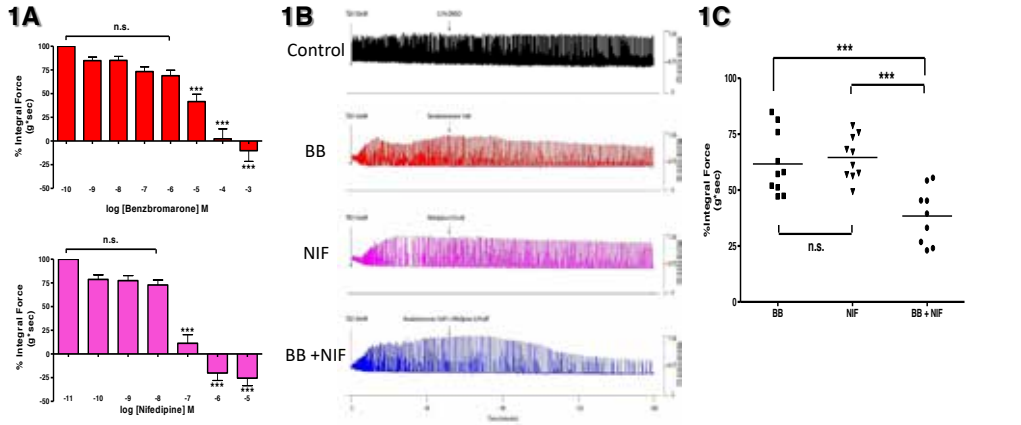

Figure 1. Potentiation of L type Calcium channel antagonism with Calcium-activated chloride channel anoctamin 1 antagonism in murine uterine smooth muscle (mUSM) contractility.
1A. Initial dose-response experiments performed to assess significant reductions in contractility mediated by nifedipine and benzbromarone demonstrated non-statistical reductions in force at 0.01 uM and 1 uM respectively. These sub-threshold drug doses were then used in subsequent organ bath experiments utilizing mUSM (n=7 different mice) to assess for potentiation of relaxation when combining the ANO1 antagonist benzbromarone with nifedipine.
1B-C. Combination of low dose L-type voltage gated calcium channel blockade with ANO-1 blockade enhances relaxation of pre-contracted mUSM.
Following contractile stimulation with TEA (10 mM), strips were allowed to equilibrate at an increased baseline of contractility for 60 minutes, after which each bath was treated with one dose of vehicle (0.1% DMSO final), benzbromarone (1 μM), nifedipine (0.01 μM), or the combination of both benzbromarone (1 μM) and nifedipine (0.01 μM).
B. Representative force tracings showing the enhanced potency of combining low dose nifedipine and benzbromarone (blue tracing) on both frequency and force of TEA-induced contractions compared to single low dose treatments (pink and red tracings) or vehicle control (black tracing). *BB=benzbromarone, NIF=nifedipine.
C. Compiled data illustrates percentage of reduction in integral force (g*sec) from baseline TEA-induced contractility between treatment groups. Results were normalized to the control and reported as mean ± SEM. One way ANOVA and Bonferroni's Multiple Comparison Test was used to analyze statistical differences. We observed statistically significant potentiation of relaxation with low dose nifedipine + benzbromarone versus the benzbromarone alone or nifedipine alone groups (***p* <0.001).

Abstract #:T-45

Labor epidurals: a mixed method analysis of communication and themes on #SocialMedia

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Background: Labor epidurals are the gold standard for pain management during labor and delivery. The internet and social media are being increasingly used by the general population, including pregnant women and their families, as a health information resource and a forum to share their opinions and experiences.(1) The objective of our study is to characterize the communication that occurs on social media, specifically within Twitter news and social media platform, on the topic of labor epidurals. This study examines the frequency with which labor epidurals are discussed, which topics and themes dominate the discussion, what type of information is being shared, and what type of users are sharing the information.

Methods: This was a cross-sectional and prospective analysis of publicly available micro-posts or "tweets" from the Twitter social media platform on the topic of labor epidurals. Our mixed-method analysis uses both quantitative and qualitative analysis. "Epidural" in the English language was the search term after preliminary pilot searches, as it allowed for an adequate number of search results specific to the topic. We used the social media analytical software Netlytic© to collect the search result data. This software was programmed to retrieve the last 1000 results, starting on September 1, 2016, and then prospectively collect results every fifteen minutes for the next week. Results were manually screened, only those with specific reference to labor epidurals were further analyzed. Netlytic© analyzed and organized tweets into categories based on the keywords contained within them and to determine which users were the most common posters on the topic . We also determined how many posts contained an enhancement (link to article/website, or multimedia). Lastly, we determined whether the post was being re-shared or a "retweet", i.e. Twitter knowledge dissemination.

Results: We retrieved 2,224 total micro-posts on Twitter. After screening, 1,608 tweets reference labor epidurals. The number of unique users who tweeted on the topic of labor epidurals was 1,375. The dataset included 435 tweets that were disseminated. The most commonly retweeted post was shared 170 times. The dataset contained 338 tweets that contained publicly accessible enhancements. The most commonly used keywords determined through Netlytic© Software were song (n=173), pain (n=147), back (n=143), birth (n=127) and labor (n=117). The most common categories of tweets were tweets describing bad feelings (129 tweets), tweets describing good feelings (95 tweets), and tweets with a reference to time (52 tweets).

Conclusion: Social media and Twitter have served as platforms for communication on the topic of labor epidurals and this study has provided insight into the characteristics of this communication. Knowing what communication occurs on social media around the topic will help to tailor our patient education efforts.

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Abstract #:T-46

Neuraxial anesthesia for cesarean delivery in a parturient with vascular Ehlers-Danlos syndrome and Goodpasture syndrome

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Background: Patients with vascular Ehlers-Danlos syndrome (EDS) are high risk during pregnancy, labor and delivery, with mortality rates around 11.5%.(1) Considerations include fragile tissues, excessive bleeding, spontaneous pneumothoraces, valvular prolapse, and dissections or rupture of major vessels. They are high risk for premature labor, uterine prolapse and rupture and severe postpartum hemorrhage. Labor and vaginal delivery have risk for uterine rupture, hemodynamic volatility and vascular strain. Instrumental delivery and cesarean delivery have added risk. Neuraxial anesthesia may be unreliable, especially with dural ectasia, and may increase the risk for epidural hematoma. Neuraxial anesthesia may be preferable for hemodynamic control and to reduce the risk of pneumothorax with positive pressure ventilation. Goodpasture syndrome is an autoimmune disorder leading to glomerulonephritis with or without diffuse pulmonary hemorrhage.

Case features: The patient was a 32 year-old G1P0 diagnosed with vascular EDS by genetic testing. She had a past history of multiple spontaneous pneumothoraces and a C1-C2 neck fusion for instability. She had no known large vascular or cardiac manifestations, or issues with tissue healing. Her Goodpasture syndrome was diagnosed during an episode of hemoptysis but with minimal renal involvement. This was treated and considered to be in remission. Recent testing indicated moderate to severe bullous restrictive disease. Serial echos and cardiac MRIs done during pregnancy showed normal cardiac structures, function and vessel diameters. MRI showed dural ectasia in the lumbar region.

Elective cesarean delivery in cardiac OR with primed cardiac bypass pump at 35 wks was chosen to reduce risks associated with spontaneous labor. Despite the dural ectasia, epidural anesthesia was decided on to facilitate hemodynamic stability, to avoid positive pressure ventilation, to facilitate early maternal newborn bonding and to vocalize any abnormal symptoms. Large bore IVs and a left radial arterial line were placed. An epidural catheter was placed at the L3/4 interspace without complication. Epidural lidocaine 2% with epinephrine and bicarbonate was slowly titrated to a surgical block. Epidural fentanyl and morphine were given. Surgeons performed an uncomplicated low transverse C-section. Blood loss was 500cc. After delivery, the patient was admitted to the cardiac care ICU for 24 hrs of observation. The neuraxial block resolved in a normal fashion with no neurological concerns. She was discharged home without any complications 72 hrs postpartum and continued an uneventful course.

Conclusion: This case illustrates safe and uneventful delivery for a parturient medically complicated by vascular EDS with history of Goodpasture syndrome using epidural anesthesia for elective cesarean delivery at 35 wks GA in a controlled, multi-disciplinary setting.

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Abstract #:T-47

Qualitative Analysis of the Anesthesiology Residents Perceptions and Reflections of the Impact and Relevance of a Simulation-based Empathy Curriculum

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Introduction: Patient-centered care, including empathetic care, improves patient satisfaction and health outcomes.1 Non-technical skills such as empathy are presumed to be innate or learned via role-modeling, even though physician empathy declines throughout medical training and role-modeling is lacking.2 There are no studies on empathetic communication skills training in anesthesiology residencies or trainee perceptions of the value and relevance of it in their practice. This qualitative study explores themes from debriefings after a simulation-based empathy curriculum.

Methods: The empathetic communication curriculum was a simulated scenario where residents, in the role of a patient, undergo an emergent c-section. Scenario includes: rushing to the OR, undergoing consent, medical history, physical exam and monitor application, responding to commands by the OR team and witnessing emergency team dynamics in a chaotic environment. The simulation was followed by a recorded debriefing session covering topics such as: their experiences in the scenario and how it may differ from patient perspectives, healthcare team dynamics in emergencies, and their experiences as providers and witnesses to communication in the clinical setting. Traditional approaches to coding were employed sequentially, using open, theoretical, and then constant comparative coding. Individual open coding results were refined through discussion for consensus, and the codes that emerged were used for further coding and to capture impressions as coding notes. Constant comparative method was used to refine and clarify meanings, allowing themes to emerge. A final discussion among the researchers (JRB, RDM) clarified the meanings of the final themes.

Results: Sixty residents participated in 12 debriefing sessions. Themes from the debriefing sessions included experiencing an emergent c-section through the patient's eyes, the concept and practice of empathy, and the impact of the team on patient experiences. During the scenario, the trainees appreciated the patient's experience of chaos, inability to speak-up for themselves and dissociation from the medical team. They realized the negative impact that team and individual communication and behaviors can have on the patients' perception of care.

Discussion: Resident trainees derived a comprehensive understanding of how and when empathy is or isn't valued in anesthesiology, medical education and the healthcare system. They explored systemic and individual barriers to providing empathetic care in daily practice, including the concept of 'ownership' of empathetic communication.

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2. Pederson, R. Med Teacher 2010; 32: 593–600

Abstract #:T-48

Ultrasound assessment of the gastric content of women undergoing cesarean delivery during labor: a prospective descriptive study

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Background: Pulmonary aspiration of the gastric content is one of the most feared complications in obstetric anesthesia. Bedside gastric ultrasonography (US) is a feasible imaging tool that can be reliably performed by anesthesiologists to assess gastric content in the perioperative period.1,2 The aim of this study was to provide a qualitative and quantitative description of the sonographic appearance of the gastric antrum of women undergoing cesarean delivery during labor.

Methods: We conducted this prospective observational study in women undergoing cesarean delivery during labor. The assessment was performed on the operating table, immediately preceding surgery. A standardized scanning protocol of the gastric antrum was carried out using a 5-2 MHz curvilinear array transducer in a sagittal to right parasagittal plane on the epigastric area by one of three anesthesiologists trained in gastric ultrasound. Subjects were on a 450 semi-recumbent position, initially supine and then in right lateral decubitus (RLD). We performed a qualitative assessment of the gastric content and classified the subjects according to a 4-point grading system (grade 0: empty; grade 1: fluid seen in RLD only; grade 2: fluid seen in both positions; grade 3: any solid content). We also performed a quantitative assessment by measuring the cross-sectional area of the antrum (CSA) in both study positions. Primary outcome: qualitative assessment of the antrum (empty, fluids, solid contents) and antrum classification (grade 0-3). Secondary outcome: quantitative assessment (CSA of the antrum).

Results: We have examined 18 out of 60 planned subjects. Women had stopped ingestion of solids and clear fluids for 10.9 (6.1) hr and 3.3 (2.8) hr, respectively (mean (SD)). Qualitative assessment showed (n/N, %): grade 0 (4/18, 22.2%), grade 1 (6/18, 33.3%), grade 2 (3/18, 16.7%), grade 3 (5/18, 27.8%). Quantitative assessment of clear fluids showed a CSA mean (SD) of 5.1 (2.5) cm2 in the supine and 6.4 (2.6) cm2 in the RLD position.

Conclusion: A significant percentage of women presenting for cesarean delivery during labor will exhibit a gastric antrum sonogram compatible with a stomach that is empty or contain baseline physiological fluid volumes. A systematic qualitative/ quantitative assessment of the gastric content may help anesthesiologists to better assess aspiration risk and guide anesthetic and airway management as part of the decision-making process in non-elective cesarean deliveries.

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1. Can J Anesth 2012;59:416
2. Can J Anesth 2015;62:1188

Abstract #:T-49

Abnormally Adherent Placentation: A Report of Cases from 2011-2016 at Froedtert Hospital in Milwaukee, WI

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Background: Parturients with abnormally adherent placentation are a population that necessitates a multidisciplinary plan to manage their care. At our institution, there has been desire from the obstetricians to perform these deliveries in the Labor and Delivery (L&D) operating rooms and to utilize neuraxial anesthesia as possible. Our goal was to examine our anesthetic management of these patients over the last five years, identify characteristics that may allow neuraxial anesthesia and assess a way to stratify cases to see which could be safely managed on L&D.

Results: A total of 14 patients were identified: 3 with placenta percreta, 3 had increta and 8 had accreta. 13/14 patients required a hysterectomy. 11 /14 patients had a general endotracheal anesthetic(GETA), 3 had continuous neuraxial anesthetics and 1 had a spinal that was converted to a GETA.

The average estimated blood loss(EBL) for all cases was 5.5 L(range 1.5 L-24 L) and the average RBC transfusion requirement was 7 units(range 0-24 units), with 2 patients receiving no blood products. A total of 5 patients required recovery in an ICU.

For the 6 patients in whom the pre-operative diagnosis is "possible" adherent placentas, all went on to have operative findings of accreta or increta, with EBL of 2 or more liters. Our data also show that even the operative findings of "merely" an accreta does not seem indicate a low blood loss surgery with average EBL 3.1 L(range 1.3-7.5L) with an average transfusion of 4.8 units of PRBCS(range 0-12 units).

Conclusions: We have performed a majority of these cases under GETA – therefore we were unable to assess outcomes/ risk factors surrounding this parameter. When attempting to stratify which cases could be performed in the L&D ORs, we did not find the predicted type of placental abnormality based on imaging to be a reliable clinical outcomes predictor.

Fortunately, the expert coordination of care allowed for none of the patients in our study to experience mortality or long term morbidity. Our next steps would be to further delineate whether a change of our practices away from GETA may be warranted, how other physicians risk stratify these parturients, and what factors can be optimized to allow for delivery of some of these patients on L&D. To this effect, we have created an online survey that was sent to the heads of the obstetric anesthesia departments of all ACGME accredited programs to learn more about how these patients are cared for nationwide.

References:

1. Kuczkowski, K. M. (2006). Anesthesia for the repeat cesarean section in the parturient with abnormal placentation: What does an obstetrician need to know?
2. Ioscovich, A., (2013). Anesthetic considerations for high order cesarean sections: A protective cohort study.
3. Lilker, S., (2011). Anesthetic Considerations for placenta accreta.

Abstract #:T-50

Intrathecal Hydromorphone for Post Cesarean Delivery Analgesia – Impact of Lowering the Dose on the Amount of Rescue Pain Medication

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Introduction: Cesarean section (C/S) is usually performed under spinal using bupivacaine and intrathecal morphine (ITM). With the critical shortage of ITM in 2012, we empirically used 200-mcg intrathecal hydromorphone (ITH) and undertook a dose finding study. We found the minimum concentration of ITH to be 60-mcg and the ED 80 to be 130-mcg (1). This study assesses the effect this lower dose has had on post-operative medication usage.

Methods: After IRB approval, a chart review was conducted to identify 120 matched patients who had primary or repeat C/S under spinal, 60 using 200-mcg ITH and 60 using 130-mcg ITH. The amount of post-operative oxycodone/acetaminophen (5-mg/325-mg), oxycodone, and morphine (via PCA) were converted to oral morphine mg equivalents and totaled for each patient's hospital stay (2). Ibuprofen and acetaminophen amounts were also tallied.

Statistical Analysis: 54 subjects per group were necessary for 80% power to detect a 15% difference in morphine mg equivalents. Statistical significance was determined using the Student t-test (age, LOS, BMI), Mann Whitney U (number C/S, MSO4 mg equivalents), Pearson Chi-Square (race).

Results: We found no difference in post-operative opioid use (p=0.877), age, length of stay, or number of C/S per patient; BMI was higher in the 130-mcg group.

Discussion: In light of our prior study's results (minimal dose, 60-mcg ITH, ED 80, 130-mcg), we have switched from 200-mcg ITH to 130-mcg. This study's goal was to validate the lower dose by comparing post-operative pain medication use before and after the change. We found no difference in opioid consumption and little variability in ibuprofen and acetaminophen use. This implies that a 130-mcg dose is clinically as effective as 200-mcg. Other literature suggests 130-mcg ITH may be too high and an additional dose finding study may be indicated (3, 4).

	200-mcg ITH	130-mcg ITH	
Age (years)	33 (26-40)	32.5 (22.5-42.5)	p>0.05
BMI (kg/m^2)	29.9 (23.3-36.5)	32.2 (20.4-44)	p=0.001
Length of Hospital Stay (days)	4 (3-8)	4 (3-7)	p>0.05
Number of C-Sections	1.5 (0-6)	1.5 (0-3)	p=0.784
CDC Morphine Equivalents (mg)	117.75 (3-232.5)	103.5 (3.75-203.25)	p=0.877

As with any chart review, we could have introduced selection bias; our sample may not be representative of, or generalizable to, our whole population. We hoped to lessen this using a relatively large sample size and group matching of patients. We acknowledge the difference in BMI, however long acting IT opioids are not routinely dosed based on patient weight.

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1. ASA Abstract A-3109,2015
2. Calculating Total Daily Dose of Opioids for Safer Usage. http://www.ced.gov/drugoverdose/pdf/calculating_total_daily_dose-a.pdf
3. Beatty NC, et al. JCA 2013;25:379-383
4. Sviggum HP, et al. A&A 2016;123:690-7

Abstract #:T-51

Evaluation of Epidural Trays for Microscopic Debris

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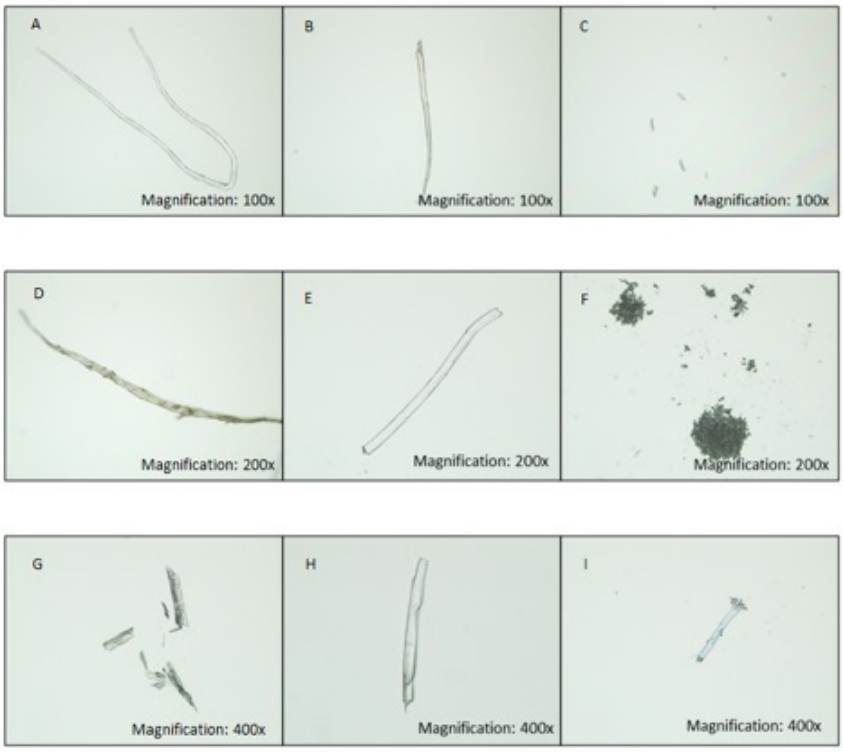
Introduction: The current practice of epidural placement employs the loss of resistance technique (LOR) with normal saline(NS) or air. To standardize the process, institutions purchase epidural kits which contain most of the needed components. The kits contain material such as a label set, prep sponges, needle block foam, gauze, drape, paper towel, and packaging. The epidural trays are certified sterile, but no ascertainment is made whether they are "dustless" or free of debris. We have observed clinicians utilizing the wells of the epidural trays as a reservoir for NS to be used for the LOR technique.

Although, needle tips, medication ampules have been evaluated for bacterial contamination, the epidural trays, specifically the wells, have not been evaluated for bacterial or other contamination (1,2).

Methods: Five epidural trays were randomly selected from the L & D and operating suite at our teaching institution. The selection contained two lot numbers. Each tray was opened under a laminar flow hood. Sterile water (SW) was placed in two wells per tray from which 3 samples per well were obtained via sterile pipets. The samples were placed on sterile slides and sealed in sterile petri dishes prior to transport to pathology for microscopic examination. The SW was obtained from single plastic vials to eliminate the known risk of glass particles when drawing solution from glass ampules. All samples were collected in adherence with sterile compounding standards issued by the US Pharmacopeia.

Results: The study included 30 samples, of which 30 were found to have evidence of microscopic debris. Figure A-I represents 9 out of 30 samples.

Conclusion: This is a pilot study with a small sample size, however, all of the epidural kits we tested contained debris. Utilizing wells as a reservoir may lead to inadvertent introduction of such debris, in vivo. While the clinical implication of the introduction of these contaminants is not known, further evaluation of epidural kits and placement techniques should be considered.



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1. C.J. Hemingway, S.M. Yentis. The effect of alcohol swabs and filter straws on reducing contamination of glass ampoules used for neuraxial injections. Journal of the association of anaesthetists of Great Britain and 2007; 62: 211-318
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Abstract #:T-52

Development of a checklist to aid handovers in an Obstetric Post- Anesthesia Care Unit

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Handing over patient care in the post anesthesia care unit (PACU) is an integral part of anesthesia practice. Handover practices have been shown to be haphazard and suboptimal (1) and concerns have been raised regarding potential patient harm (2). Inter-anesthesia handovers of obstetric patients in an obstetric ward have been assessed with inadequacies identified (3). There are no studies regarding handover between anesthesia providers and PACU nurses after obstetric anesthesia –chiefly after cesarean delivery. Evidence supports the implementation of standardized checklists to warrant accurate information delivery to PACU nurses (4). We decided to evaluate and improve our obstetric PACU handovers through a quality improvement (QI) process.

Methods: We commenced with a questionnaire-based survey of 20 Obstetric PACU nurses. The questionnaire explored their satisfaction using a standard 7-point satisfaction scale and asked for items commonly omitted by anesthesia providers during handovers. Five handovers were observed with respect to structure and content. A Comprehensive search of electronic data-base (PubMed) using keywords:cesarean delivery/section-handover-PACU-post anesthesia care-recovery-checklist-obstetric anesthesia was undertaken to identify improving handovers strategies, relevant inclusion items and methods of designing validated PACU handover checklists. Five handovers were then observed and screened with the draft checklist. To arrive at a consensus on the relevant checklist items, we used modified Delphi approach. 7 local expert Obstetric anesthetists were given a -yes/no- questionnaire of items deemed relevant to be included in the checklist over two rounds. These items were derived from the literature review and the nurse questionnaire.

Results: The nurse survey revealed 45 % slight dissatisfaction with handovers. The commonly missed items listed by nurses were: neuraxial morphine dose and timing, total and type of intravenous fluids, uterotonic drugs and patient allergies. The PACU nurses strongly supported a standardized process for handing over patient care. The observed handovers were highly variable in content and organization. Literature search did not reveal any prior studies in Obstetric anesthesia PACU. No additional items were identified on observing handovers using the draft checklist. Data obtained from all sources facilitated the development of a standardized checklist unique for Obstetric PACU (table 1). We observed handovers using this checklist and found it easily usable.

Obstetric PACU Handover Checklist

Preoperative	Name		YES		NO
	Age		YES		NO
	Allergies		YES	NO	ND
	Relevant medical/surgical history		YES	NO	ND
	Prescription medications		YES	NO	ND
Intraoperative	Anesthesia: General / Regional	• Airway issues	YES	NO	ND
		• NMB reversal	YES	NO	ND
		○ Opioid(s) added (type/dose)	YES	NO	ND
		○ Time of Epimorph	YES	NO	ND
		○ Adverse Events	YES	NO	ND
		○ Epidural catheter removal	YES	NO	ND
	Fluid management	Input (volume/type)	YES		NO
		EBL	YES		NO
		Urine output	YES		NO
	Medications	Antibiotics	YES	NO	ND
		Aspiration prophylaxis	YES	NO	ND
		Antiemetic	YES	NO	ND
		Analgesic	YES	NO	ND
		Sedatives	YES	NO	ND
		Cardiovascular medications	YES	NO	ND
		Uterotonic medications	YES	NO	ND
		Others(e.g.: hemostatic agents)	YES	NO	ND
	Vascular access	IV peripheral/central lines	YES		NO
		Arterial lines	YES	NO	ND
	Anesthetic complications/events		YES	NO	ND
	Surgical complications/events		YES	NO	ND
Postoperative orders	IV PCA		YES	NO	ND
	Antiemetic		YES	NO	ND
	Analgesics		YES	YO	ND
	Antipruritic		YES	NO	ND
	Destination		YES		NO

Please mark items as follows:

- YES→ Item has been verbally relayed by provider to nursing staff.
- NO→ Item is recorded /documented but was omitted by provider.
- ND→ Item is not recorded /documented.

Discussion: Nurse satisfaction survey and observed handovers suggested improvements could be made with potential benefits for patient safety. We are now evaluating handovers in our Obstetric PACU using this tool. Our handover tool may be of value to other obstetric centers.

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2. Ugeskr Laeger 2011; 173:1412–1416.
3. Anaesthesia 2015, 70(Suppl. 3), 11–101
4. Int J Qual Health Care 2013; 25: 176-181.

Abstract #:T-53

A retrospective cohort assessment of the impact of an anesthetic intervention during the second stage of labor

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Introduction: Adverse maternal and perinatal outcomes increase with prolonged duration of the second stage of labor.(1) An anesthetic intervention known as a "top-up" may be used to optimize labor analgesia, especially in the second stage of labor, to reduce the rate of cesarean deliveries, mid-pelvic procedures, and high degree perineal tears seen with sub-optimal pain control.(2) The first study objective was to define population characteristics of nulliparous patients who received a labor epidural and had a second stage longer than one hour. The second objective was to estimate the incidence of top-ups that occur and the final objective was to describe population characteristics of women who received a top-up compared to women who did not.

Methods: A population-based cohort analysis was performed using data derived from a provincial perinatal database from January 2013 to December 2014. With institutional ethics board approval, obstetrical and anesthetic databases identified women who met inclusion criteria. The provincial protocol for linking charts was followed to match patients who received a top-up with predetermined clinical outcomes. Outcomes between groups were evaluated using $\chi 2$ or Student's t-test, as appropriate. Logistic regression was used to address potential confounders between variables. Significance was set at $p<0.05$.

Results: There were 1462 women eligible for study inclusion. The mean maternal age in this nulliparous group was 29±5, and most women were Caucasian (79%), non-smokers (83%), and had post-secondary education (77%). Augmentation or induction of labor was required for 77%. Cesarean delivery and assisted vaginal delivery rates were 12% and 19%, respectively. Most women received a standard epidural (70%); while 30% had a combined spinal epidural. Seven percent (106/1462) of women required a top-up during the second stage of labor; these women were more likely to be Caucasian (90% vs 78%, p=0.02), non-smoking (90% vs 83%, p=0.08), to have augmentation or induction of labor (88% vs 76%, p<0.01), to have larger weight infants (3635g vs 3459g, p <0.001), to have a longer second stage of labor (301 min vs. 171 min, p<0.00), and to undergo assisted vaginal (41% vs 17%, p<0.001) or cesarean delivery (26% vs 11%, p<0.001), compared to women without a top-up. When controlling for potential covariates, top-ups and augmentation/induction were strongly associated with the risk of cesarean delivery (OR 4.3, 95% CI 2.5-7.5; OR 3.5, 95% CI 1.9-6.6, respectively).

Conclusion: Seven percent of women required a top-up in the second stage of labor. These women had a longer second stage of labor and were more likely to require a cesarean or assisted vaginal delivery. Women requiring top-ups were more likely to have predictors of difficult labor such as medical augmentation and larger weight infants but were still more likely to have spontaneous vaginal delivery overall.

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1. Obstet Gynecol 2009:113(6)1248-58
2. AJOG 2008:199(5)500e1-6

Abstract #:T-54

Sidestream dark field imaging of the sublingual microcirculation to assess microvascular dysfunction in the preeclamptic patient

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Background: Preeclampsia is a multi-system hypertensive disorder of pregnancy and a significant cause of maternal mortality worldwide. Efforts to develop models for prediction of preeclampsia only yielded modest results.(1) Anti-angiogenic signaling and vascular abnormalities manifest prior to the development of clinical signs, even as early as mid-gestation.(2,3) It was hypothesized that impaired indices of microcirculatory function could be detected using sidestream dark field (SDF) imaging. The objective of this study was to examine microvascular function in women at high risk for preeclampsia at mid-gestation using SDF imaging.

Methods: With REB approval, women presenting for a prenatal clinic visit between 16 and 22 weeks gestation of pregnancy were screened for eligibility. Patients at high risk for preeclampsia were recruited if they met at least one of the following criteria: previous preeclampsia, pre-existing renal disease or diabetes mellitus, antiphospholipid syndrome, BMI ≥ 35, pre-existing hypertension, or both age > 40 years and family history of preeclampsia in a first degree relative. Participants were excluded if they were smokers, consumed caffeine within 6 hours of imaging or were non-English speaking. Investigators performed analytical non-invasive SDF imaging of the 5 different visual fields of the sublingual microcirculation. Video images were analyzed blindly following randomization to determine the microcirculatory parameters (microvascular flow index (MFI), perfused vessel density (PVD), total vessel density (TVD), and proportion of perfused vessels (PPV)). After delivery, charts were reviewed to determine if they developed gestational hypertension, preeclampsia or severe preeclampsia. The primary outcome was the difference in MFI between the normal participants and participants with preeclampsia.

Results: Data from 66 patients were included in the final analysis. Twelve of the participants (18.2%) developed preeclampsia or severe preeclampsia during the course of their pregnancy. Obesity was a common risk factor for inclusion across all groups, representing over 50% of participants with no preeclampsia. MFI was not significantly different between participants with normal pregnancies and participants with preeclampsia or severe preeclampsia (2.75 ± 0.38 vs. 2.80 ± 0.34, respectively; p = 0.459). Similarly, there were no significant differences in TVD, PVD and PPV between the two groups.

Conclusion: We did not detect a functional difference in microcirculation between women who did develop preeclampsia and those who did not. SDF imaging of the sublingual microcirculation may remain an appropriate tool to identify women at risk for the disease, albeit later in pregnancy.

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2. N Engl J Med (2006) 355(10) 992-1005
3. Circulation (2010) 122(5) 478-87

Abstract #:T-55

Neuraxial and Narcotic Anakgesia for Labor; Effects of Administrative Mandates on Availability and Use in a Serbian Obstetric Hospital

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Introduction: In Serbia, the use of analgesia for labor has been low. In 2012 the Department of Anesthesia at Clinical Center Vojvodina (CCV), requested a multi-year Kybele Inc. collaboration to train physicians in the use of neuraxial analgesia for (NAL). During the first visit in 2012, the Kybele team members demonstrated the use of IV narcotic analgesia for labor (IVNA) as an alternative if NAL could not be performed. In the fall of 2015, the Health Ministry of Serbia mandated nationwide NAL availability at no patient cost. In August 2016, the CCV administration mandated an evening attending plus anesthesia resident shift for labor analgesia. We report 5 year results in use of NAL and IVNA and the effects of administrative changes on use.

Method: Since 2012, Kybele has conducted annual week long visits to CCV to provide didactic and clinical training, and collaborative process change. In 2016, Kybele conducted 2 visits. Training in the use of IVNA was not performed after the initial visit in 9/2012. In the fall of 2015, the Serbian Health Ministry and in August 2016, the CCV hospital leadership both mandated the process changes cited above. Chi square analysis with adjustments for multiple comparisons were used to compare year over year changes in NAL, IVNA use, 2012 - 2016.

Results Table 1: Yearly NAL use increased 330% from 2012- 2016) (year over year comparisons). Similar percentage increases in IVNA occurred. Overall, analgesia use increased 6 fold 2012 - 2016. During, 1-7/2016, NAL use decreased substantially compared to 2015 coinciding with Health Ministry mandates. Both NAL and IVNA increased substantially 8-12/2016 after staffing adjustments. No serious side effects of IVNA were noted

Discussion: The use of NAL increased nearly 3 ½ times, 2012 – 2016. IVNA increased similarly despite no further training in its use after 2012, perhaps reflecting patient choice (many patients fear NAL), provider perceived ease of administration of IVNA compared to NAL, or lack of training in NAL. IVNA may offer a safe alternative to NAL in settings where NAL use is not available1, 2; safe use requires adequate maternal/fetal monitoring for adverse effects.3 The nationwide mandate for no patient cost NAL without changes in staffing lead to a decrease in NAL use. CCV staffing changes improved overall analgesia availability.

References:

1. Isaacs RA et al. Int J Obstet Anesth. 2016;27:90-2.
2. Melber A et al. Int J Obstet Anesth. 2016;27:89-90.
3. VanDeVelde M IJOA 2016;25:66-74

Abstract #:T-56

Peripartum Analgesia for Parturients Maintained on Buprenorphine: A Retrospective Matched Cohort Study

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Background: Buprenorphine (BPNP) is an easily accessible optional for treatment for opioid dependence. However, its effects on peripartum pain management are controversial in previous reported studies. We designed this pilot study aiming to compare the pain management on parturients who were maintained on buprenorphine with those who were not on opioid before delivery.

Methods: From our institution's Research Patient Database Repository, we identified all the parturients who were on BPNP before delivery (group B) in the past 10 years from 2007 to 2016. A control group with parturients not being on BPNP (group C) was matched to the same age, weight and delivery mode. Patients' medical records were reviewed. Data points included: 1. Primary endpoint: daily postpartum opioid utilization (not including BPNP) in the first 3 postpartum days; 2. Second endpoints: postpartum pain scores, daily postpartum medication of NSAIDs in the first 3 postpartum days, and length of hospitalization. T-test and Wilcoxon Rank Sum test were used for statistical analysis according to the requirements of data.

Results: By the deadline of the abstract submission, we have collected data of totally 60 patients with 30 (vaginal n=13; cesarean n=17) in each group. All the women in group B continued medication of BPNP before delivery. Compared with group C, both pain score at postpartum 12-24h [3.5 (1.3, 4) vs 4.5 (3.5, 5.5), P =0.018] and daily postpartum opioid utilization (calculated with morphine equivalents, 2.1±6.7 vs 21.6±27.1 mg/day, P =0.026) following vaginal delivery (VD) were less in group C. Both pain scores at postpartum 0-12h [4.5 (3, 7) vs 0 (0, 2), P =0.000] and 24-72h [5.3 (4, 7.8) vs 4 (3.3, 5), P =0.019] following CD were larger in group B. Similar length of hospitalization were noted for both groups.

Discussion: Hoflich et al reported that less opioid analgesics but more NSAIDs were administered in BPNP maintained patients following CD. However, Meyer et al found that BPNP maintained women experienced more postpartum pain and required more other opioid analgesic following CD. In this study, we found that BPNP maintained women experienced significantly more post-CD pain without more opioid given. The providers might hesitate because of the strong binding and partial agonist effects of BPNP on mu-opioid receptors. Interestingly, group B women expressed much less postpartum pain and opioid utilization following VD, which may be resulting from the long-acting characteristics of BPNP. Our study indicates that although BPNP maintenance may be sufficient for pain control after VD, it may still pose challenge to parturients who failed labor progress. For elective CD, pain management may be benefit from withholding BPNP preoperatively, for which we are in the process of a prospective study.

References:

1. Jumah NA, et al. BMJ Open 2016; 6: e011774
2. Hoflich AS, et al. Eur J Pain 2012; 16: 574-584
3. Meyer M, et al. Eur J Pain 2010; 14: 939-943

Abstract #:T-57

Successful pulmonary embolectomy for massive pulmonary embolism during pregnancy: A case report

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Introduction: Pulmonary embolism (PE) is the leading cause of maternal mortality and is always a complication to keep in mind during pregnancy. Management of PE in pregnant women is not established. We herein report the case of woman who delivered under epidural analgesia after pulmonary embolectomy for severe pulmonary embolism that occurred during pregnancy.

Case Description: A 35-year old G1P0 nulliparous woman sought medical advice at 28 weeks of gestation due to exertional dyspnea. CT scan showed bilateral pulmonary artery thrombi. A transthoracic echocardiography showed a right ventricular thrombus. We planned an emergent thrombectomy because of the mobility of the right ventricular thrombus and risk of exacerbation of PE.

We placed an intracardiac echography probe intravenously via the right femoral vein to monitor umbilical artery pulse wave via Doppler. After induction of anesthesia, the patient's blood pressure could not be measured; hence, emergent cardio pulmonary bypass (CPB) was performed via median sternotomy followed by cardiac resuscitation. Approximately 10 minutes after the hemodynamic collapse, the intravenous umbilical artery monitor detected a decrease in fetal heart rate to about 80 bpm. Immediately after establishing the extracorporeal circulation, fetal heart rate recovered rapidly and remained stable during the procedure while keeping the CPB average perfusion pressure above 70 mmHg. Thrombectomy were successfully performed under cardiac arrest (Figure). At 32 weeks of gestation, she was discharged.

She was readmitted to hospital for labor at 38 weeks of gestation. Then, epidural anesthesia was administered to protect the thoracic wound site and to reduce cardiac load. Ropivacaine 0.1% with 2mcg/ml fentanyl were continuously administered through the epidural catheter by patient control epidural analgesia. During labor, epidural analgesia was adequate and no hemodynamic changes occurred. A healthy male infant was delivered by vacuum extraction. Both the child and his mother were discharged without complications.

Discussion: Intra cardiac echography is useful for fetal heart rate monitoring during emergent cardiac surgery during pregnancy. Careful CPB management is also important to maintain uteroplacental blood flow in these patients. Although there is no fixed delivery method of pregnant women after thoracotomy, epidural analgesia during labor was useful for reducing heart load and wound traction.

Abstract #:T-58

Severe hyponatremia secondary to water intoxication - an unintended consequence of encouraging oral hydration during labour

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Introduction: During pregnancy, sodium homeostasis is altered through increased salt appetite and thirst combined with activation of the renin-angiotensin system[1]. Oral hydration is encouraged during labor, and is often supplemented with intravenous fluid. However, excessive fluid intake may result in severe hyponatremia. which can lead to complications in both mother and neonate including seizures, coma and death.

Case: A 33 y/o healthy primigravida at 40+4 weeks presented in active labor and initially attempted a water birth with nitrous oxide for analgesia. During labor she became drowsy with periods of agitation; this was ascribed to labor pain and fatigue. After eight hours she consented to epidural analgesia, but remained agitated despite a bilateral T6 sensory block to ice. Two hours later, the decision was made to proceed to cesarean delivery in view of obstructed labor and non-reassuring fetal heart tracing.

At this point she was reassessed by the anesthesiologist, who found her alertness had deteriorated but she could still be briefly roused. On examination she was afebrile, with no focal neurological signs, pupils were equal and reactive, and blood sugar level was 106.2 mg/dl. Diagnostic tests were ordered, but it was decided that delivery should not be delayed for these investigations. Epidural top-up with 12ml 2% lidocaine with 1:200,000 epinephrine achieved bilateral T4 sensory block and surgery proceeded uneventfully; a vigorous baby was delivered with Apgar scores 9/9.

Post-operatively, laboratory results showed severe hyponatremia, sodium (Na) 116 mEq/L, low urinary Na 5 mEq/L and low urinary osmolality 40 mmol/Kg. Strict fluid restriction successfully restored her Na level and sensorium over the next 24 hours. Upon maternal diagnosis, her baby was also investigated and found to have a corresponding severe hyponatremia (Na 116 mEq/L); hypertonic saline was instituted and the neonate's serum Na was restored to normal over the next 12 hours.

Collateral history from the family and midwife revealed the patient had been drinking water obsessively based on internet advice to stay well hydrated during labor. A positive fluid balance of 9L was calculated over the preceding 20 hours; based on this, the underlying cause of her altered mental state was diagnosed as hyponatremic encephalopathy secondary to water intoxication.

Discussion: Hyponatremia is common and under-recognized in pregnancy[2], as early symptoms (nausea, lethargy and altered sensorium) can be misconstrued as symptoms from protracted labor. Once diagnosis is made, prompt neonatal workup should also be done as maternal hyponatremia can induce fetal hyponatremia via placental equilibration[3]. This case is a reminder of the need for fluid intake monitoring during labor, and that well-intentioned advice can sometimes lead to unintended consequences.

References:

1. Scaife, PJ. et al. Placenta 2017
2. Moen, V et al. Bjog 2009
3. Gude NM, et al. Thromb Res 2004

Abstract #:T-59

Rediscovering the Chinese pioneer of epidural labor analgesia, Dr. Guang-Bo Zhang (□□), and her unpublished manuscript completed more than a half-century ago

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In 2011, while composing a chapter of Chinese obstetric anesthesia history for "Your side of the story",[1] my (Hu LQ's) research let me add a brief piece on Dr. Guang-Bo Zhang. After having a phone conversation in Sept 2011 with Dr. Yuan Qu, the current chief obstetric anesthesiologist at Peking University First Hospital (PUFH), I was convinced by what she stated that Dr. Zhang was the first Chinese anesthesiologist to administer and study epidural labor analgesia in China. Unfortunately, Dr. Zhang's story was difficult to unearth. Only the following short statement was written: "Dr. Guang-Bo Zhang performed an epidural labor analgesia study with low concentration procaine in 1963 and presented her results in 1964 at the First National Conference of the Chinese Society of Anesthesiologists in Nanjing (aka Nanjing meeting)".[1] which informed and altered Chinese medical community's opinion of labor analgesia.

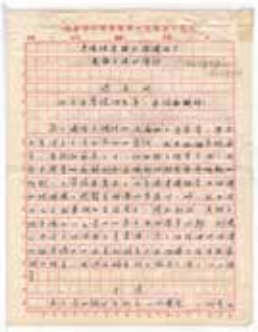
On Nov. 19, 2016, Dr. Zhen-Yu Cai, an obstetrician and Deputy Editor-in-Chief of the Journal of No Pain Labor & Delivery - Global Health Initiative, attended a conference at PUFH celebrating the 15th anniversary of their dedicated labor analgesia service. She serendipitously met Dr. Zhang there and texted me "Dr. Guang-Bo Zhang is here, and Dr. Zhang is a woman". I became elated: we found the Chinese "Gertie Marx"!

With joy, Dr. Cai introduced herself to Dr. Zhang and asked a few questions regarding her study. Incredibly, Dr. Cai was invited to visit Dr. Zhang's home. There, Dr. Zhang told the story of the first labor analgesia study. Her motivation and the underlying concept that compelled her to design and execute her study which started in Sept. 1963 and finished in March 1964.

Dr. Cai also saw the original manuscript written greater than 50 years ago (Fig.1). The documents were well preserved. Amazingly, they survived the Cultural Revolution. At that time, Dr. Zhang was suspected of spying for Japan due to her fluency in Japanese.

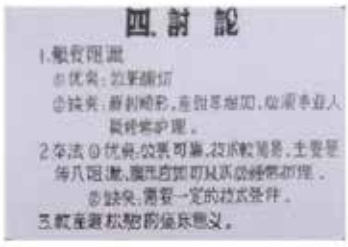
Although, by today's standards, the study is far from perfect. There is no doubt that the newly discovered, unpublished manuscript (currently being translated) is one of the most important historical documents of obstetric anesthesiology, not only for China but also for the rest of the world.

Fig 1. DOCUMENTS written by Dr. Guang-Bo Zhang in 1964

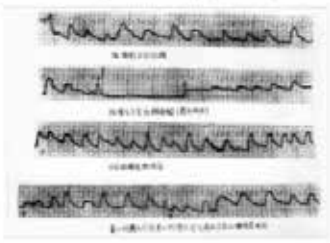


a) 15 pages of original, unpublished, handwritten MANUSCRIPT

b) One page typewritten ABSTRACT of the Proceedings of the Nanjing meeting



c) One of the original 19 SLIDES used by Dr. Zhang for her presentation



d) Original TRACES of uterine contractility before and after epidural labor analgesia applied on both the manuscript and the slides

Reference:

1. Hu LQ, Zhao PS, Zhang Q. Painless Childbirth: You Must Know Your Side of the Story. 1st ed. Shanghai: World Publishing Company, 2012

Abstract #:T-60

Dilation and Delivery: Management of Post-viable Parturients with Severe Subglottic Stenosis

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We present the cases of two pregnant, post-viable patients (hereafter referred to as Patients A and B) presenting with severe symptomatic subglottic tracheal stenosis of 4mm with audible stridor. They both underwent microdirect subglottoscopy, CO2 laser incision, tracheal dilation and steroid injection at approximately 31 weeks and 26 weeks gestation, respectively. Anesthesia management involved use of manual intermittent jet ventilation, and total intravenous anesthesia (TIVA) with propofol and remifentanil. Obstetric management involved continuous fetal monitoring and readiness for immediate emergent cesarean section, if needed. Both patients tolerated the laryngoscopy, dilation, jet ventilation, and anesthesia without issue and continuous fetal monitoring was uneventful.

Patient A was discharged home on the day of tracheal dilation. She returned in spontaneous labor at 39 weeks, 5 days gestation. The patient remained without stridor or other airway symptoms throughout her labor and tolerated normal spontaneous vaginal delivery with one dose of intravenous fentanyl as her only labor analgesic.

Patient B remained inpatient for the duration of her antepartum course after her tracheal dilation for monitoring of her fetus' concurrent intrauterine growth restriction. The obstetric operating rooms were equipped with multiple small size endotracheal tubes and airway exchange catheters with jet ventilation capabilities. The otolaryngology service was involved in her care over the subsequent 6 weeks and the patient had no recurrence of symptoms. At 31 weeks 3 days gestation a fetal ultrasound demonstrated reverse end-diastolic flow. At that time, initial plan was for induction of labor but the patient failed a contraction stress test and was subsequently taken to the operating room for primary cesarean section under single shot spinal anesthesia and her surgical delivery was without complication.

Reported cases of perioperative and peripartum management of parturients with tracheal stenosis, especially in those undergoing tracheal dilation using general TIVA and intermittent jet ventilation during viability, are extremely rare.[1] Successful management of these complex patients requires timely intervention, excellent multidisciplinary care coordination, and regular assessment of airway status.

References

1. Carness, J.M. and J.L. Berman, Awake microlaryngoscopy and serial balloon dilation in a third trimester multigravida with subglottic tracheal stenosis: anesthetic implications. A A Case Rep, 2014. 3(12): p. 166-8.

Abstract #:T-61

Management of a pregnant patient with MEN2A syndrome and recurrent pheochromocytoma

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Introduction: Pheochromocytomas are rare catecholamine-producing endocrine tumors that produce paroxysmal HTN, headache, sweating and palpitations (1). Pregnancy complicated by undiagnosed pheochromocytoma is associated with up to a 50% maternal and fetal mortality rate (2). Early detection and appropriate management of this condition can be life-saving.

Case: A 22 year old female G1P0 with MEN2A syndrome and pheochromocytoma presented at 39 weeks gestation for elective primary Cesearean delivery. The patient had a prior left adrenalectomy for pheochromocytoma and thyroidectomy for medullary thyroid cancer.

At 13 weeks gestation, a recurrent pheochromocytoma was diagnosed based on plasma free metanephrines in the upper range of normal and a right adrenal mass on MRI. The patient was admitted at 36 weeks gestation for initiation of alpha blockade and then underwent scheduled Cesarean delivery at 39 weeks.

Neuraxial anesthesia was utilized for the Cesarean delivery. Prior to epidural placement, an arterial line and a central line were placed. Neuraxial anesthesia was then titrated with 2% lidocaine to achieve a surgical block. Modifications in surgical technique included vacuum assistance for delivery without fundal pressure, in situ uterine closure, and avoidance of fundal massage. The patient was hemodynamically stable and did not require vasoactive medications. She was admitted to the ICU for invasive blood pressure monitoring. She was discharged on postpartum day 4.

Discussion: Due to their rarity, pheochromocytomas can be missed or misdiagnosed as gestational hypertension or pre-eclampsia (Table 1). Definitive therapy is surgical resection, but timing in pregnancy requires individualized treatment. In the first 24 weeks of gestation, the patient should be stabilized on medication, and resection can be considered. After 24 weeks, this condition is usually best managed medically. Cesarean delivery (with or without simultaneous tumor removal) is generally recommended, as vaginal delivery may cause mechanical irritation of the pheochromocytoma (3). Cesarean delivery can be safely performed under neuraxial or general anesthesia. A general anesthetic would be favored if there was a plan for simultaneous pheochromocytoma resection or if there was significant hemodynamic instability.

Table 1. Signs and symptoms of preeclampsia vs pheochromocytoma

	Pre-eclampsia	Pheochromocytoma
Presentation/onset	>=20 weeks gestation	Any time
HTN	Usually sustained	Paroxysmal
Headache	May be present	May be present
Sweating, palpitations, tachycardia	Absent	May be present
Orthostasis	Absent	May be present
Edema/weight gain	May be present	Absent
Stress cardiomyopathy	Absent	May be present
Elevated LFTs/ abdominal pain	May be present	Absent
Proteinuria	May be present	Absent
Catecholamine levels	Normal	Elevated

References:

1. Lenders J. Eur J Endocrinol 2012;166:143-150
2. Darr R, et al. Ther Adv Endocrinol Metab 2012;3(1):11–26
3. Oliva R, et al. Hypertension 2010;55:600-606

Abstract #:T--62

A parturient with Pulmonary Hypertension: Multi-disciplinary Team Approach

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Introduction: Pulmonary hypertension is defined as a syndrome with elevated pulmonary artery pressures by a mean pulmonary arterial pressure higher than 25 mmHg at rest, diagnosed by right heart catheterization(1). The increased blood pressure in the pulmonary vessels ultimately leads to hypertrophy and failure of the right ventricle (1,2). During pregnancy, physiologic cardiovascular and pulmonary changes worsen pulmonary hypertension and right ventricular dysfunction. Additional hemodynamic changes occur with labor, therefore, physiologic changes during pregnancy but also during delivery and postpartum period are critical for patients with severe pulmonary hypertension (3,4).

Case Presentation: 27 y.o. female, G1P0 at 31 weeks with past medical history of pulmonary hypertension (on CPAP/4L home oxygen – diagnosed 01/2015 post ECHO showing severely enlarged right ventricle with severely reduced global right ventricular systolic function and elevated systolic PA pressure of 74 mmHg), Chronic right-sided heart failure, diastolic CHF, Obesity, Hypertension and Asthma presented in October 2015 with shortness of breath and epigastric pain.

She was also found to be hypertensive with urine dipstick positive for 3+ protein and elevated liver enzymes. She received 2 doses of Betamethasone for fetal lung maturity and started on labetalol and MgSO4 for seizure prophylaxis severe preeclampsia. ABG showed evidence of respiratory acidosis, therefore intubated for hypercapneic respiratory failure. Aretiral Line and Mac Cordis with Swan were placed in preparation for preoperative optimization and for evaluation of pulmonary pressures monitoring. Cardiology was consulted and repeat ECHO and right heart cauterization were performed, which showed severely elevated RA, and moderately elevated RV and PA pressure with Pulmonary hypertension.

Given patient's significant morbidity, decision was made to proceed with delivery. A multidisciplinary meeting was held and elective Caesarean section was planned under general anesthesia. She received a TAP block prior to her incision for post-surgical pain management. Procedure was uncomplicated. Patient was transferred to the MICU postoperatively for continued monitoring.

Discussion: PPH complicating pregnancy remains a fatal condition with deaths reported to occur usually from right heart failure. Epidural and nitric oxide therapies may have a role in controlling PAP during labor but there is no evidence of improved survival (5). In addition, recent case reports describing good maternal and neonatal outcomes from advances in the multidisciplinary approach decreasing the high mortality rate previously reported (4). It is therefore important to provide counseling to patients with pulmonary hypertension before they become pregnant and also give new insights into cardiopulmonary, obstetric, and anesthetic management during pregnancy, delivery, and the postpartum period (1, 3, 4, 7).

References: will be provided

Abstract #:T-63

Management of Qualitative Plasminogen Activator Inhibitor-1 Deficiency in an Early Term Parturient

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Tanya M Keverian MD - Beth Israel Deaconess Medical Center - Boston, MA
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Introduction: Plasminogen Activator Inhibitor-1 (PAI-1) deficiency has been previously described in Amish, European, and Asian populations. An autosomal recessive bleeding disorder, PAI-1 deficiency in the setting of pregnancy has been observed to be variable in its presentation.(1) A frameshift mutation in exon 4 of the PAI-1 gene has been identified as a cause for the disease; another mutation has been identified in exon 2. Current activity assays include zero as being within the range of normal, and thus lack sensitivity in providing a reliable diagnosis of PAI-1 deficiency. We present the peripartum overview of a patient with a clinical diagnosis of PAI-1 deficiency.

Case: A 26 y/o G3P1011 was referred for anesthesia consultation at 26 weeks from the division of maternal fetal medicine. Her past medical history was significant for diagnosis of PAI-1 deficiency upon workup for menorrhagia as a teenager. Her obstetric history was significant for elective primary cesarean section under general endotracheal anesthesia. Postoperatively, she was placed on aminocaproic acid for 2 weeks. However, at 8 weeks, she encountered an episode of postpartum hemorrhage requiring further aminocaproic acid therapy.

Previous genetic analysis was negative for any known established mutations; PAI-1 activity levels were determined to be within the low-normal range during this current pregnancy. Antenatal thromboelastogram was significant for normal values during pregnancy. Given the patient's prior diagnosis and her presently inconclusive findings, the decision was made to perform a repeat cesarean under general anesthesia at 37 weeks. Immediately upon delivery, she received a dose of tranexamic acid. The patient tolerated the procedure well. She was subsequently discharged on an oral dose of tranexamic acid; there were no bleeding complications by the time of her 2 week postpartum visit.

Discussion: We present our experience in the management of a patient with a history consistent with bleeding diathesis due to suspected PAI-1 deficiency. PAI-1 levels were obtained during this current pregnancy that were in the low-normal range. It is notable that increases in PAI-1 levels are considered part of the normal hemostatic changes of pregnancy.(2) Also during pregnancy, PAI-2 is secreted by the placenta. Collectively this may have potentially contributed to our within-range results on TEG. Regarding her history of postpartum hemorrhage, we theorize this may have coincided with a resumption of her menses and a decline in PAI-2 levels. PAI-2 levels have been demonstrated to remain in circulation up to 8 weeks postpartum.(2) We suspect a follow-up TEG at this timepoint may potentially reflect changes in her coagulation profile.*

References:

1. Haemophilia. 2014, vol. 20, 407.
2. Semin Thromb Hemost. 2003, vol 29, 125.
3. *Patient is 3 weeks postpartum at time of abstract submission.

Abstract #:T-64

Spinal Anesthesia for Reduction of Incarcerated Gravid Uterus

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Introduction: Incarceration of the gravid uterus is a rare complication of pregnancy with an incidence of 1 in 3000. As a result of persistent retroversion by the end of the first trimester, the growing uterus remains positioned within the sacral promontory and pubic symphysis. Incarcerated uterus poses significant potential risk to both maternal and fetal morbidity and mortality. Early manual reduction is recommended as the first-line treatment in the management of incarcerated uterus. We present a case of incarcerated uterus in a patient at 20 weeks and 1 day managed with manual reduction under spinal anesthesia.

Case: A 37 year old G2P0 at 20+1 presented following three days of vaginal pain. The patient also noted several weeks of urinary frequency and occasional incontinence. Her past medical and obstetric history were otherwise noncontributory. Bimanual exam was significant for an absent cervix and a palpable fundus within the vagina. Ultrasound exam indicated an anterior cervix with a retroverted uterus, consistent with incarceration. Attempted manual reduction was unsuccessful. The decision was made to reattempt manual reduction under anesthesia. Hyperbaric bupivacaine 11.25 mg and fentanyl 25 mcg were delivered intrathecally through a 24G Sprotte spinal needle at the L3-L4 interspace. The patient was subsequently positioned in lithotomy before undergoing manual reduction with ultrasound guidance; the fundus was successfully repositioned anteriorly to a normal anatomic position. The patient tolerated the procedure well, and was discharged upon recovery from her spinal anesthetic.

Discussion: Management of incarcerated uterus is recommended before 20 weeks gestation.(1) After 20 weeks, attempts at manual reduction are less successful, and the risk of preterm labor increases. More invasive measures have been described ranging from insufflation via colonoscopy to surgical laparotomy. Previous case reports indicate successful manual reduction in later second trimester and third trimester individuals under general endotracheal anesthesia. We present a case in which spinal anesthesia was sufficient to allow for successful reduction of incarcerated uterus in a patient who presented beyond the recommended gestational age for manual intervention. Currently, no guidelines exist regarding anesthetic considerations in the management of this rare presentation. Spinal anesthesia has been previously shown to improve success rates for external cephalic version without any increased risk in maternal or fetal morbidity. We propose that the pelvic floor relaxation provided by a spinal anesthetic can potentially increase the rate of safe and successful manual reduction of incarcerated uterus. In turn, this could also extend the window of opportunity in which manual reduction can be considered while simultaneously avoiding a general anesthetic.

Reference:

1. Obstet Gynecol Surv. 2016, vol. 71, 613.

Abstract #:T-65

Anesthetic management of emergent craniotomy with cesarean section in a 36 week pregnant female with intraparenchymal hemorrhage and midline shift

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Co-Author: Priyanka Ghosh MD - Beth Israel Deaconess Medical Center - Boston, MA
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Philip E Hess MD - Beth Israel Deaconess Medical Center - Boston, MA

Introduction: Intracranial hemorrhage (ICH) requiring emergent craniotomy in a parturient is an uncommon situation that requires vigilant care. We present the first case of total intravenous anesthesia (TIVA) use for cesarean delivery followed by emergent craniotomy.

Case: 29 year old, 36 week lethargic patient presented with an ICH, intraventricular extension, and 8mm midline shift. Her medical history was unremarkable. Fetal well being was reassured by a reactive NST and preop ultrasound. We performed a multidisciplinary team huddle. A decision was made for delivery via c section (CS) prior to the craniotomy. Arterial line was placed. Trachea was intubated with a video laryngoscope. A healthy male was born 6 minutes after induction with APGARS of 9 and 9. Anesthesia was maintained with propofol and remifentanil. Mannitol, hyperventilation, dexamethasone, and furosemide were used during craniotomy. She received 3L of NS, EBL was 900ml, and UOP was 3L. She was taken to the ICU intubated. Both the newborn and mother were discharged a few days later.

Discussion:

- Challenges include aspiration risk, potentially difficult airway, uterine tone, hemodynamic stability, and high ICP.
- CS was performed first because of the advanced gestational age, and reassuring fetal health. Craniotomy can expose the fetus to prolonged anesthesia, hyperventilation, electrolyte abnormalities, mannitol, and furosemide. This may jeopardize uterine blood flow. FHR abnormalities during anesthesia are impossible to differentiate form true fetal distress, which can prompt emergent CS during a craniotomy. Uterine contractions, straining, and labor pain can raise ICP.
- Neuraxial technique in our patient may have been too risky. It can compromise cerebral blood flow. Patient's altered mental status made placement difficult. Accidental dural puncture with a large bore epidural can lower ICP, which risks expansion in intraventricular hemorrhage, new subdural hemorrhage, and brain herniation. Subarachnoid re-bleed in pregnancy carries a mortality rate of 50-70% .
- It was safest to proceed with video laryngoscopy on first attempt.
- Inhaled anesthetics, except for nitrous oxide (N2O), decrease uterine tone, increase the risk of blood loss, and increase ICP. N2O can increase ICP.
- We performed a TIVA anesthetic with remifentanil and propofol. This avoided the risk of increased ICP and decreased uterine tone. Remifentanil does not significantly cross the placenta (6). We could not use an EEG monitor during TIVA.
- Calcium channel blockers and beta-blockers were used for BP management. Oxytocin was the uterotonic. Carboprost tromethamine and methylergonovine can cause hypertension and increase ICP. We were prepared for fundal massage, tranexamic acid infusion, Bakari balloons, uterine artery ligation.

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Abstract #:T-66

Epidural anesthesia in a patient with history of Pott's Disease

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Abstract: Tuberculosis remains a global health concern. Despite this, little is known about the safety of neuraxial anesthesia in patients with a history of spinal tuberculosis (TB). We describe the management of a 33 year old in labor with known history of treated spinal TB with uncomplicated labor epidural anesthesia.

Introduction: According to WHO, tuberculosis was one of the top 10 causes of death worldwide. Though less common in the United States, it is highly prevalent in other countries.1 Spinal TB, also known as Pott's disease, is an infection of the vertebrae from TB.4 Despite its prevalence, there is scarce literature on the safety of neuraxial anesthesia in patients with a history of treated spinal TB.

Case Description: A 33 year old G1P0 at 37 weeks presented to Labor and Delivery with severe preeclampsia based on blood pressure. The patient reported a history of spinal TB in 2009, for which she had received successful medical treatment in Cape Verde. She denied any current neurological symptoms and had an unremarkable physical exam. She was subsequently induced and had a lumbar epidural catheter placed for labor analgesia that was removed shortly after successful vaginal delivery. Her postpartum course was uneventful and the patient was discharged 3 days later.

Discussion: Our patient never required surgery for her disease and had been symptom-free since receiving adequate medical treatment. Once on appropriate antimicrobial treatment, the response to therapy is monitored clinically based on improvement in pain, constitutional or neurological symptoms.3 Serial radiographs are not useful as findings may appear to worsen while on appropriate treatment.5 The majority of patients respond to medical treatment and recurrence rate of skeletal TB is only about 2%.2 Given that our patient had been symptom-free and had a benign physical exam, we felt confident to safely place an epidural catheter. To our knowledge, there are no prior case reports of uncomplicated neuraxial anesthesia performed on a patient with successfully treated spinal TB. Prior case reports written were in patients with untreated Pott's disease resulting in tragic consequences (i.e. paraplegia). The patient population in the United States now is more international and our case report supports the safe use of regional in patients with history of treated Pott's disease.

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Abstract #:T-67

Multidisciplinary Team Management of Vaginal Delivery with Severe Aplastic Anemia

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Background: Aplastic anemia (AA) is a rare hematologic condition characterized by pancytopenia from immune-mediated destruction of hematopoietic stem cells. Patients with AA require active supportive therapy, including aggressive broad-spectrum antibiotics for infections and frequent transfusions for severe anemia and bleeding episodes. When paired with pregnancy, these conditions pose serious challenges to the mother and fetus, especially at time of delivery. This case report discusses the successful multidisciplinary team management for a 2nd successful NSVD of a 25 year old (YO) with severe AA (sAA) complicated by immune thrombocytopenia (TCP) secondary to alloimmunization.

Case Description: A 25 YO G4P1112 with sAA presented at 18.4 weeks (wks) EGA to the MFM clinic after confirmation of a 4th pregnancy. The patient (pt) was well-known to the MFM group from a previous pregnancy, where she required 8 units (U) of platelets (PLTs) with dexamethasone intrapartum and was readmitted 3 wks postpartum for symptomatic anemia at HCT 20.2% and PLT 14 x 10*9/L. During the initial prenatal visit, she had a HCT 27.1% and PLT 25 x 10*9/L. Similar to her prior pregnancy, she required intermittent pRBC transfusions antepartum for fatigue and spontaneous epistaxis with marginal responses to transfusions. Specifically at 32 wks EGA, she had no response to transfusion for a PLT 9 x 10*9/L. Hematology recommended coordinating HLA-matched PLTs (requiring 96h notice to obtain from an outside blood bank) prior to her induction at 36 wks. They noted that the pt was refractory to transfusions due to alloimmunization with a panel-reactive antibody showing 98% reactivity. Anesthesia was involved to prepare for possible general anesthesia and massive intrapartum hemorrhage.

The patient was admitted to the L&D floor at 36.2 wks EGA with a starting PLT 13 x 10*9/mL in preparation for induction. She received an IVIG transfusions every 24h, tranexemic acid every 3 hours, and one-dose of romiplostim, an analog of thrombopoietin, starting on hospital day (HD) 2. On HD3, at 36.5 wks EGA, her induction commenced. She received 1U HLA-matched PLTs with a response from PLT 9 to 24 and a second U PLT with an increase to 42 x 10*9/L. Several hours after cytotec was given the patient had a NSVD with minimal blood loss and prophylactically received 2U PLTs. Her PLT improved to 69 and 103 x 10*9/L, respectively and HCT remained stable at 30%.

Conclusion: Historically, patients with AA have poor prognosis in the setting of pregnancy. However, one retrospective study reported successful pregnancy management with immunosuppressants or allogeneic bone marrow transplants for 36 periparturients. On rare occasions, these therapies are ineffective, AA relapses, or treatment options are not easily accessible. This case discusses sAA complicated by alloimmunization and successful multidisciplinary team management during the intrapartum period.

Abstract #:T-68

Obstetric Anesthesia App: Development of a Mobile App for Obstetrical Anesthesia Education

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Introduction: The obstetrical anesthesia rotation is a unique experience in anesthetic care. There are special considerations for complications, physiology, anatomy and pharmacological agents. Furthermore, anesthesiologists care for both the mother and fetus at once. Among residents, these considerations are commonly addressed by independent study, or by consulting senior providers and reference materials. Independent study is a staple in resident learning, however learners may have difficulty prioritizing learning topics prior to gaining experience first. Consulting more experienced clinicians provides useful and targeted information, but these providers are not always immediately available. References such as review books and notes may be difficult to organize and carry at all times. Mobile applications can hold virtually limitless capacity of clinically relevant information, without increasing bulk or otherwise being difficult to carry. We sought to develop a mobile application to serve as a reference for anesthesia trainees.

Methods: The application was developed with React Native, a framework with the tagline "learn once, write anywhere." The underlying logic and graphical implementation was written in JavaScript which runs in a background WebView. Distinct from platforms like Cordova and Ionic, native components are drawn on the screen, as opposed to drawing web components directly into a WebView. A separate program was developed for updating content based on the Electron framework. We created content for the application based on needs discussed in interviews with providers, our personal experience and the established educational topics at our institution. We store all application content on Google Firebase and distribute the application directly to mobile devices.

Results: We developed a cross-platform application for use by trainees. Clinicians may easily update the application using software we created for administration of the app. This allows changes without needing to know the details of the underlying implementation. Storing content on Google Firebase allows for immediate propagation of updates to all devices. This foregoes delays with acquiring app-store approval for future updates, as content is dynamically downloaded from highly-available servers without requiring upgrades. All content updates are reflected in the app in real-time.

Conclusion: Mobile applications can be viable teaching tools for residents. With realtime databases content can be changed quickly, keeping it up-to-date and allowing for quick correction of errata. With the ubiquity of mobile phones among residents, mobile applications are still underutilized and provide an oppurtunity to improve resident education.

Abstract #:T-69

Use of TEG to evaluate a term obstetric patient with presumed VWD type 2B presenting to labor and delivery

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Background: There are several types of von Willebrands Diesease (VWD), each with different presentation, work up, and treatment. While factor VIII levels, VWF:Ag, and VWF:RCo have been used as predictors for bleeding and response to treatment in type 1 VWD, there are no guidelines to accurately predict bleeding risk and response to treatment in pregnant patients with other types of VWD (1-3). Thromboelastogram (TEG) analysis was used in the management of a patient with a presumed diagnosis of type 2B VWD.

Case Report: The patient was a 24 year old G6P0151 female with a history of recurrent spontaneous abortions and bleeding after tonsillectomy, who presented in labor. Her sister had a history of VWD type 1, and she reported a history of VWD type 2B. There was no diagnostic labs to confirm the diagnosis. She received recombinant VWF prior to epidural placement and just following her spontaneous vaginal delivery at the request of the hematology service based on history. TEG analysis was performed prior to recombinant VWF, after recombinant VWF, and after delivery (Table 1).

Discussion: The patient's TEG results prior to delivery were hypercoagulable, unlike case reports of TEG evaluation during pregnancy which show a hypocoaguable TEG (1-3). This prompted further investigation into the patient's history. She had outside hospital labwork done at 21 weeks which was normal, and not consistent with VWD, including normal PTT, Factor VIII, ristocetin cofactor, platelet count, and VWD antigen. Therefore, she likely did not have VWD. In this case, TEG helped to disprove a diagnosis of VWD. Recombinant VWF was not warranted and potentially increased her risk of thrombotic complications. More data on TEG analysis during pregnancy is needed, but it may be used as a tool to determine if a patient requires recombinant VWF during labor and delivery when the initial diagnosis is unclear.

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	R time	Alpha angle	Maximum amplitude
Pre-treatment TEG	5.3	78.7	80.0
Post-treatment TEG	5.8	77.9	80.3
Post-delivery TEG	4.3	79.6	81.3

Table 1. These are the patient's TEG values before VWF administration, after VWF administration, and after delivery.

Abstract #:T-70

Successful utilization of the Decision Tree proposed by Leffert et al. to assess the neuraxial anesthesia risk in two symptomatic Arnold Chiari type 1 patients scheduled for Cesarean Delivery.

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Introduction: Arnold Chiari type 1 malformation (CM1) is a rare neurologic defect resulting in herniation of the cerebellar tonsils into the foramen magnum. Elevated intracranial pressure (ICP) has been associated with CM1 patients, potentially prohibiting neuraxial anesthesia (1). Reports of safely performed obstetric neuraxial anesthesia, including Combined-Spinal-Epidural (CSE), exist. A review of parturients with intracranial pathologies by Leffert et al. provided a decision tree to assess feasibility of neuraxial anesthesia (2).

Briefly, if no evidence of mass effect or obstructed CSF flow are present, intrathecal anesthesia is deemed minimal risk for herniation.

We report two primiparous with symptomatic CM1, presenting for primary Cesarean delivery (CD), where this decision tree was successfully applied do determine eligibility for a spinal anesthetic.

Case one: 27 year-old at 38+5 wks gestational age (ga) with history of mixed connective tissue disease, SLE complicated by symptomatic CM1. Surgical decompression was performed 3 years ago and she reported residual visual symptoms, positional headaches, and vomiting. A pre-admission MRI of brain and spinal cord due to worsening of symptoms during pregnancy was negative for midline shift or hydrocephalus.

After assessment in our high risk clinic, a routine Spinal anesthesia (SPA) was performed for her CD. The intra, - and post operative course was uneventful and she was discharged on POD2 with no new or worsening neurologic symptoms. At her 6 week post-partum check neurological symptoms were unchanged.

Case two: 30 year-old at 39 wks ga with obesity, status post gastric-bypass, sleep apnea, chronic low-back pain, multiple psychiatric comorbidieties, and symptomatic CM1 scheduled for decompression post-partum. Neurological symptoms included stable upper extremity radiculopathy, headaches, and balance issues. Her MRI showed significant tonsillar herniation 14mm below the foramen magnum with peg-like tonsils and a small syrinx from C6 to T1. There was no evidence of mass effect, hydrocephalus or midline shift. The patient strongly desired neuraxial anesthesia over GA for maternal-infant bonding.

A routine Combined-Spinal-Epidural (CSE) anesthesia, due to unknown surgical duration, was performed for her uneventful CD. The patient was discharged on POD2 with stable neurologic symptoms which remained unchanged at the 6 week post-partum check. Her neurosurgical decompression is pending.

Conclusion: Both CM1 patients presented with neurological symptoms but absent hydrocephalus or increased ICP, and were deemed amendable for a spinal anesthetic, the standard of care for CD.

The decision tree by Leffert and al. (2) helped with and structured the risk assessment for these neurologically complex parturients with symptomatic CM1, potentially avoiding an unwanted general anesthetic.

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Abstract #:T-71

The anesthetic management of an urgent cesarean section in a patient with Goldenhar syndrome: a case report

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Abstract: Goldenhar Syndrome (GS), also called oculoauriculovertebral spectrum or syndrome, is a relatively rare congenital condition (1). Exact etiology is not known but believed to be due to abnormal embryonic vascular supply to the first and second arch (2). Common characteristics include hemifacial microsomia, facial hypoplasia, lateral facial cleft, dental abnormalities, microtia, anotia and an unusually small mouth (3,4,5). Systemic manifestations may include heart, kidney, lung and spinal abnormalities (6,7). Fertility and longevity are not directly affected (8). Despite this, there are only two reported cases outlining the anesthetic management of pregnant patients with GS in the literature (9,10). We present a case outlining the anesthetic management of a 21-year-old pregnant women with GS presenting for an urgent cesarean section complicated by an intra-operative failed airway and a severe adverse reaction while managing postpartum hemorrhage. This case will not only add to the reported cases in the literature but will also outline the necessary steps required to safely manage patients with such a congenital disease. This is a unique patient population that should be managed at a tertiary care centre with high volume of high risk obstetrical patients with a standardized approach that include pre-operative multi-disciplinary planning and the involvement of multiple health care workers to ensure patient safety.

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Abstract #:T-72

Obstetric anesthetic management of a patient with surgically repaired dextro-Transposition of Great Arteries

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Case: A 19 year-old female, G1P0, BMI 29.3, with a history of surgically corrected situs solitus, d-ventricular loop dextro-Transposition of Great Arteries (d-TGA) presented for anesthetic management for vaginal delivery. The patient underwent an arterial switch, repair of ASD and VSD at age 2 months. At presentation she was WHO Class III maternal cardiovascular risk and had NYHA Class II symptoms. History was also significant for persistent left SVC, asthma, left bronchial compression by the pulmonary artery and repaired thoracolumbar scoliosis with Harrington rods. Pre-labor transthoracic echocardiogram(TTE) showed preserved LVEF (>60%), 3+ AR, 3+ TR and mild PAH. Initially, large bore IV access was obtained, and an arterial line was placed. Ultrasound of her thoracic and lumbar spine was performed to assess her hardware, and confirm normal anatomy at the planned level of epidural(Fig 1-1). An epidural was placed at L3/4 early in her labor to provide time for slow up-titration of analgesia and avoid dramatic hemodynamic shifts. One hour post epidural, the epidural concentration was up-titrated to obtain dense sensory blockade in the event that she required forceps or vacuum assisted delivery. Concentration was increased from 0.04% bupivicaine/1.7mcg/ml fentanyl(BF) to 0.0625%, 0.08%, 0.125% and 0.1875%/1.7mcg/ml BF at one hour intervals. All infusions were run at 15ml/hr. Prior to delivery, a TTE and pulmonary ultrasound was performed to assess the patient's cardiac and volume status. TTE was stable, with normal systolic function, 3+AR and no pericardial effusion.(Fig 1-2). The patient had intermittent discomfort which was relieved with small bolus dosing of 0.25% bupivicaine. After briefly pushing, without cardiovascular symptoms, the patient delivered a healthy male infant.

Discussion: TGA has an approximate incidence of 5/10,000 live births in the US and after surgical repair, neo-aortic valve regurgitation, dilation of the aortic root, pulmonary artery stenosis and coronary stenosis have been described[1]. Anesthetic management of these patients hinges on the maintenance of their normal baseline physiology, and requires individualized care. This case raises the possibility that valsalva and expulsive efforts may be safe in carefully selected patients with a history of congenital heart disease.

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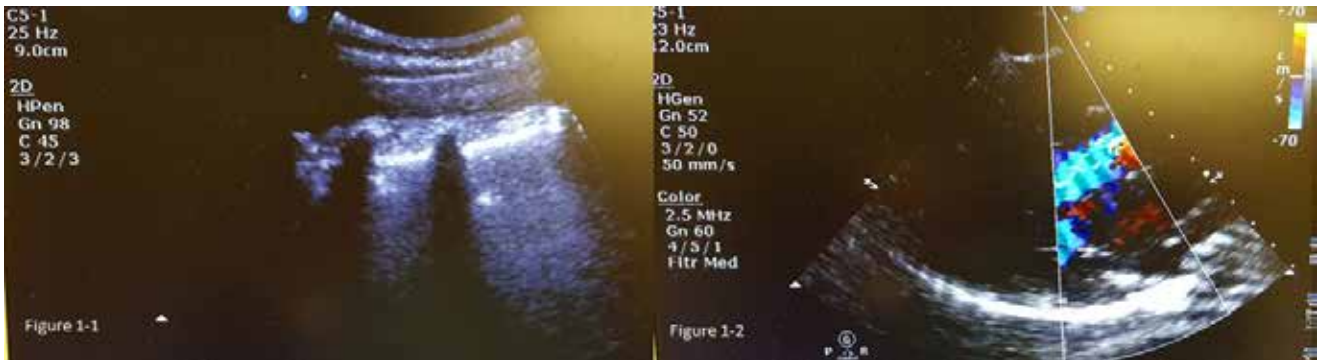

Abstract #:T-73

Emergent Peripartum Hysterectomy with Massive Transfusion and Coagulopathy

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In obstetric anesthesia few cases are as challenging as an emergent peripartum hysterectomy due to hemorrhage. At term the gravid uterus receives greater than 15% of cardiac output (~700ml/min) and exsanguination can occur in a matter of minutes if bleeding is not promptly controlled. While abnormal placentation and uterine atony are by far the most common causes of severe uterine hemorrhage, other less common causes include uterine rupture and laceration of uterine vessels. In these cases, peripartum hysterectomy is indicated when conservative measures fail to control the hemorrhage. While conservative measures may be able to avoid the sterilization due to hysterectomy, they have been shown to lead to greater transfusion requirements and higher maternal morbidity overall.

In our case, a G7P2042 @ 34 5/7 weeks presented for repeat cesarean delivery. Her past medical history was significant for two prior cesarean sections, two prior D&Cs, morbid obesity, smoking, hepatitis C, asthma, GERD, and gestational diabetes mellitus. Ultrasound on admission revealed placenta previa with suspicion for placenta accreta. While the incidence of placenta accreta is only 1:22,150 in the absence of placenta previa and without uterine scar, this incidence is >33% when placenta previa is present with a history of 2 or more prior cesarean sections as was the case for our patient. Preoperatively, 2 IVs were places and a type and crossmatch was completed in addition to preparation for invasive lines.

A spinal was performed which was converted to general anesthesia secondary to partial failure. Shortly after delivery the placenta did not appear adhered to the uterine wall and was removed without excessive force per the obstetric team. However, massive hemorrhage ensued immediately. The patient quickly became hemodynamically unstable and both arterial line and central venous access was established. Massive transfusion protocol was activated while conservative surgical measures to stop the hemorrhage including intrauterine balloon placement ultimately failed. Over the next five hours the patient was multi vasopressor dependent receiving in total 28 units PRBCs, 25 units of FFP, and 6 units of platelets in addition 9000mcg of Factor VIIa and 24mcg Desmopressin. EBL for the surgery was estimated at 8000 ml. Amazingly, the patient was extubated on POD1 and discharged home on POD5. She was noted to have only a foley catheter for ureteral injury and right femoral nerve injury likely secondary to retraction at discharge.

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Abstract #:T-74

Low-Dose Spinal with Epidural Volume Extension (EVE) for Management of Very Advanced Maternal Age Parturient with Significant Medical Comorbidities and Placenta Previa During Urgent Cesarean Delivery

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Introduction: In high income countries, pregnancy in women of advanced maternal age (AMA) is becoming increasingly common. There is a paucity of data describing women of very advanced maternal age (>45). They are more likely to suffer from pre-existing medical conditions (cardiovascular, respiratory, metabolic) and peripartum complications. In conjunction with hemorrhage risk factors, this accounts for important causes of potentially preventable maternal morbidity. Obstetric anesthesia delivery strategies for this patient cohort require multidisciplinary planning. Low dose spinal with epidural volume extension (EVE) is a technique that has been used in parturients with complex cardiac or respiratory disease for cesarean delivery in whom avoidance of general anesthesia is desirable. We report the successful use of low dose spinal with EVE to facilitate an urgent cesarean delivery of an obese parturient of very AMA with COPD, OSA, SVT, pulmonary edema, and placenta previa.

Case: Patient is a 49yo G4P1 at 32 weeks gestation who presented with placenta previa in the setting of obesity (BMI 44), COPD on chronic oxygen, OSA, and medically treated SVT. Because this was her second bleeding episode with concomitant pulmonary edema, a multidisciplinary meeting was formed to discuss the delivery plan. Anesthetic goals included avoidance of hemodynamic instability, limiting accumulation of extravascular fluid in the lungs, patient comfort, and placement of a reliable neuraxial anesthetic that would obviate the need for general anesthesia. A pre-neuraxial arterial line with cardiac output monitoring was placed, and 7.5 mg of hyperbaric bupivacaine was injected intrathecally as part of a CSE. After the patient was placed in Semi-Fowler's position (due to baseline orthopnea), a T5 level was achieved with EVE of 3mL 1.5% lidocaine. Delivery of the fetus was uneventful, and IV furosemide was administered. Surgical blood loss (1.7L) was treated with preferential colloid and PRBC transfusion. Due to the risk of postoperative apnea, neuraxial opioids were withheld, and an epidural infusion was maintained in the ICU for pain control. Discharged home on POD 3 after an uneventful postoperative course.

Discussion: Women of very AMA presenting for cesarean delivery may pose clinical challenges to the obstetric anesthesiologist due to their pre-existing medical and obstetrical complications. In addition to multidisciplinary planning, choosing an appropriate but safe anesthetic plan is paramount to achieving a safe outcome. Low dose spinal with EVE has been described in parturients with advanced cardiovascular or respiratory disease, but often not with multiple diseases in one patient. We describe a successful case of low dose spinal with EVE in a medically and obstetrically complex patient.

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Abstract #:T-75

Anesthetic Management of a Gravid Patient with Von Willebrand Disease

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Introduction: Patients with coagulopathies often present a challenge when pregnant; their labor and delivery anesthetic plan necessitates advanced planning. We present the case of a patient with HbC trait and Von Willebrand Disease (VWD), whose labor and delivery course went smoothly thanks to a thorough discussion and meticulous plan established between the obstetric and hematology teams.

Case report: A 17 year old, G1P0 patient with HbC trait, VWD (inherited from her father) was followed by the obstetric team during her pregnancy. PMHx also included obesity (BMI 32) and was significant for multiple episodes of prolonged epistaxis. Given her VWD, patient was referred to both the Maternal Fetal Medicine and Hematology. Further testing at 36 weeks revealed a Ristocetin cofactor activity of 20% (normal range 50-150%) and von Willebrand factor (vWF) antigen of 31%. These findings along with a normal Multimer report were suggestive of VWD Type I. Given the patient's inadequate vWF activity or antigen response to pregnancy, it was recommended she take vWF/Factor VIII concentrate 40 IU/kg (~3200 IU) as a loading dose during labor, followed by ~1600 IU every 12-24 hours for 3-5 days post-delivery. A daily vWF assessment was necessary to ensure that the vWF level did not dip below 50%.

When the patient presented to the L&D Floor at 40w1d, her vWF was measured at 22% and she was started on vWF/Factor VIII concentrate as planned. Given her increased risk of epidural hematoma, she was not a candidate for neuraxial anesthesia and was placed on a low dose IV Fentanyl PCA for analgesia. Her physical exam was significant for a MP class I airway and a thyromental distance > 3 cm. The patient was agreeable to a general anesthetic approach if necessary. To assess the patient's response to vWF/Factor VIII concentrate, a vWF panel was drawn daily (desired vWF activity level and factor VIII level is >50%). It was necessary to ensure the vWF was not decreased nor elevated since factor VIII levels above 100% increase the risk for thromboembolism. Finally, as vWF levels decline very quickly in the postpartum period, patient needed DDAVP for 3 weeks postpartum (typical range for bleeding is 10-23 days). Her inpatient course was complicated by fever, tachycardia and significant Hgb drop (10 à8.2) without clinical signs of bleeding. She received 2 uPRBC, and was started on oral tranexamic acid (650mg q12h). Patient subsequently remained stable, and infusions of DDAVP were continued as an outpatient, with monitoring of Factor VIII levels.

Conclusions: Gravid patients with VWD need to be evaluated carefully prior to delivery, and their care must be discussed in a multidisciplinary setting. Repletion of vWF and Factor VIII must be done cautiously, with frequent laboratory assessments to prevent both hemorrhage and thromboembolism.

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Abstract #:T-76

Labor Analgesia in a Parturient with Isaac's Syndrome

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Introduction: Isaac's syndrome also known, as Neuromyotonia is a rare neuromuscular disorder characterized by muscle cramping, stiffness, muscle twitching at rest, and delayed muscle relaxation. The symptoms are secondary to antibodies directed against voltage gates potassium channels (VGKC). There have only been approximately 200 cases of this syndrome that have been described and even fewer in gravid patients. The syndrome can be either inherited or acquired. With the number of described cases being so few there is minimal amount of information of the best way to proceed with labor analgesia.

Case Report: A 37-year-old white female G1P0 at 40 weeks gestation presented for induction of labor at term. Patient has a past medical history significant for Isaac's Syndrome that was diagnosed in 2011 after an extensive workup that included EMG changes consistent with Isaac's syndrome as well as antibodies against VGKC. At the time of presentation patient reported that her symptoms, which included back and upper extremity spasms, has been well controlled with Oxcarbazepine 600mg four times daily. Patient reported symptoms were worse after strenuous activity or in the days preceding her menstrual cycle. After history and physical examination patient was offered regional anesthesia (epidural) for labor analgesia, which she accepted. Epidural was placed without complication and patient delivered a 3.2 kg healthy infant and was discharged two days later.

Discussion: Isaac's syndrome is a rare neuromuscular disorder that is characterized by antibodies against the voltage gated potassium channels that results in peripheral nerve hyperexcitability. This hyperexcitability translates to muscle cramping, twitching, and delayed muscle relaxation that is often seen in these patients. These myokymic discharges have been shown to persist under general anesthesia as well as peripheral nerve blocks, which could add a layer of complexity to a caesarean section. There have been two forms described in the literature, an inherited type which follows an autosomal dominant inheritance pattern and a much more common acquired type. The mainstay of treatment has been anticonvulsants such as phenytoin and carbamazepine. There have also been cases that have been treated with botulinum toxin, plasma exchange, and corticosteroids. A multidisciplinary discussion is important in coming up with an appropriate treatment plan in the gravid patient as anticonvulsants that are first line therapy are known to be teratogens and have been implicated in neural tube defects, cardiac defects and cleft lip/palate.

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Abstract #:T-77

Labor analgesia in a coagulopathic parturient

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Presenting Author's Institution: New York - Presbyterian Hospital / Columbia University Medical Center - Manhattan, NY
Co-Author: Allison Lee M.D. - New York - Presbyterian Hospital / Columbia University Medical Center - Manhattan, NY

Background: Management of labor analgesia in parturients with disorders of coagulation is a challenge for anesthesiologists. Although thrombocytopenia is a relative contraindication for spinal/epidural analgesia/anesthesia, reports suggest neuraxial blockade is safe with platelet counts >70,000/microliter.(1) Alternative modalities, typically IV remifentanil, provide only modest analgesia and the latter is associated with tachyphylaxis as labor progresses.(2,3) We present a controversial approach to management of labor analgesia in a coagulopathic parturient.

Case Report: A 26-yr old P0 at 38 wks' gestation, BMI 41kg/m2 presented for induction of labor due to increasing dyspnea. Her medical history included obstructive sleep apnea (OSA) and cryptogenic hepatic cirrhosis, with esophageal varices. Laboratory studies revealed platelet count 48,000/microliter, fibrinogen 175 mg/dL, INR 1.5, and AST/ALT 119/48 units/L. Her Model for End-Stage Liver Disease score was 13. She had 2+ pitting edema in both legs and a Mallampati 2 airway score.

Twelve hours after induction of labor, the patient complained of severe pain with uterine contractions. She was offered a remifentanil IV infusion starting at 0.05mcg/kg/hr, due to concerns for development of epidural hematoma given thrombocytopenia and coagulopathy. Because of her history of OSA, and increasing somnolence at 0.1mcg/kg/hr, the staff was reluctant to titrate upward the remifentanil infusion. An interdisciplinary discussion between obstetric anesthesiologists, hepatologists, and maternal fetal medicine specialists was held to develop a plan for delivery and pain management, given inadequate analgesia, and high risk for cesarean delivery. The hepatologists advised platelet and cryopreciptate transfusion would effectively, though transiently, increase platelet count ≥ 70,000/microliter and coagulation factors to within the normal range. Pooled platelets 1unit and cryoprecipitate 1unit were transfused immediately prior to uneventful combined spinal epidural placement and patient controlled epidural analgesia. Satisfactory analgesia was achieved. Vacuum assisted vaginal delivery occurred 18hrs later. The epidural catheter was removed 2hrs postpartum, after repeat transfusion with platelets and cryoprecipitate. She was monitored for 24hrs postpartum in a high-risk unit, with hourly neurologic checks. Her sensation and motor strength returned to baseline within 12hrs.

Discussion: Transfusion of coagulation factors to facilitate neuraxial analgesia placement is controversial. After interdisciplinary consultation, we concluded that the benefits of superior labor analgesia and avoidance of respiratory depression with neuraxial blockade outweighed the limited risks associated with blood product transfusion, and poor maternal satisfaction from suboptimal analgesia with IV remifentanil.

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3. Anesth Analg. 1998;86:1307-11.

Abstract #:T-78

Peripartum management of a symptomatic airway vascular malformation

Presenting Author: Shannon Page MD
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Background: Airway vascular malformations present more commonly in the pediatric population, as many of these lesions are congenital and cause symptoms early in life. Such findings are uncommon in the adult population, and, to our knowledge, previously unreported in a pregnant patient.

Case: A 23 year-old gravida 1 para 0 woman presented at 34w4d gestation with shortness of breath. One and a half years prior to presentation she developed hoarseness, vocal fatigue, and a single episode of hemoptysis. She underwent MRI which showed a large venous malformation within the supraglottic larynx, parapharyngeal spaces, and prelaryngeal/ pretracheal with glottic, subglottic, and cervical tracheal involvement (Figure 1A). She was offered sclerotherapy at that time, but declined due to likely need for temporary tracheostomy. Three weeks prior to presentation, at 31w3d gestation, the patient transferred care to our institution for management of her increasingly symptomatic supraglottic laryngeal vascular malformation in the setting of pregnancy. The otolaryngology service performed flexible nasolaryngoscopy and found violaceous masses on the surface of the epiglottis, vallecula, false vocal cords, and bilateral arytenoids (Figure 1B). On the day of presentation, the patient described worsening dyspnea and orthopnea. Given the potential for airway collapse, a multidisciplinary team was organized to facilitate delivery planning. Oral/nasal intubation was thought to be contraindicated given the friable glottic vascular malformations. She was scheduled for a cesarean delivery given the patient's worsening clinical status and recommendation against pushing during the second stage of labor. She underwent uneventful cesarean delivery at 35w1d gestation under spinal anesthesia with the otolaryngology service present and equipped to perform emergent tracheostomy in the event of airway compromise. The patient had an uncomplicated post-partum course notable for substantial improvement of her dyspnea.

Discussion: Vascular airway malformations are rare in the adult population. Management requires a multidisciplinary approach with planning for the possibility of an airway emergency. Our patient noted worsening of her symptoms as her pregnancy progressed, which may be related to hormonal responsiveness of the lesion, anatomic changes secondary to a gravid uterus, or airway edema from increased circulating volume and cardiac output.

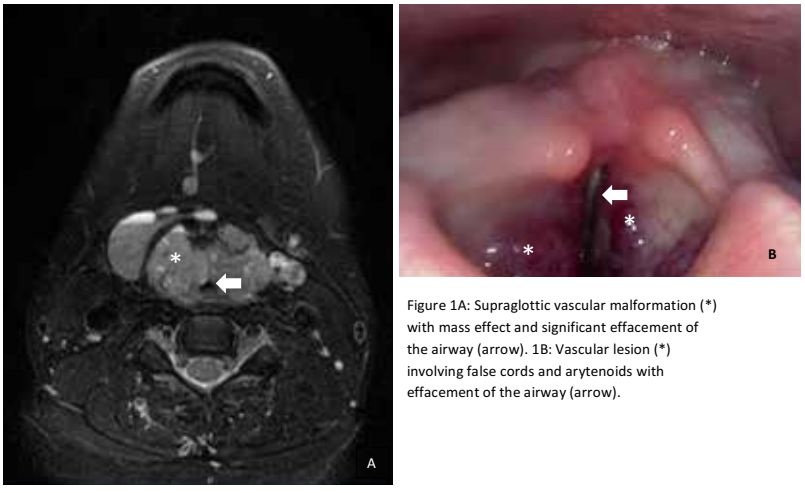

Figure 1A: Supraglottic vascular malformation (*) with mass effect and significant effacement of the airway (arrow). 1B: Vascular lesion (*) involving false cords and arytenoids with effacement of the airway (arrow).

Abstract #:T-79

Peri-operative management of Maple Syrup Urine Disease for emergency caesarean section

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Pervez Sultan MBBS, FRCA, MD - University College Hospital - London, London
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Introduction: Maple Syrup Urine Disease (MSUD) is a rare autosomal recessive metabolic disorder caused by an inability of the body to metabolise branched-chain amino acids (BCAA), resulting in an accumulation of BCAA and their toxic metabolites. This is the first report describing the peripartum management of a parturient undergoing cesarean delivery (CD) with MSUD.

Case report: A 31-year-old primagravida, with classic MSUD presented for a category III emergency CD at 38+1 weeks gestation. Pre-operative optimization included an emergency regime of MSUD energy drinks and an infusion of 10% intravenous Dextrose. Daily BCAA blood spots with 6 hourly blood sugars were taken. To prevent catabolism, 10% Dextrose was infused throughout surgery at a rate of 2mls/kg/hour. A combined spinal-epidural was inserted, facilitating the safe delivery of a healthy baby girl. Anti-emesis was administered to ensure prompt re-institution of oral intake. Surgery was uneventful and the patient's pre-operative oral regime was recommenced following surgery. She was monitored closely for signs of hypoglycemia, neurological deterioration and dehydration on the high dependency unit. She made a good recovery post-operatively and was discharged home after 5 days.

Discussion: The clinical manifestation of MSUD initially may be non-specific: muscle fatigue, anorexia, epigastric pain. Late neurological features are similar to Wernicke's encephalopathy.1 Many well-managed women with MSUD are now reaching child-bearing age, however very few deliveries have been reported. The risk of metabolic decompensation increases during the time of delivery, particularly with fasting requirement and stress response of surgery. General principles of maintaining a high calorie, low BCAA diet are recommended.2 Peri-operative management involved close liaison with her metabolic physician, obstetricians, dieticians, anaesthetic staff and of course the patient, who was extremely well informed regarding her condition. Fasting was kept to a minimum, particularly challenging in an unpredictable emergency setting. Normoglycaemia and normovolaemia prevented catabolism and dehydration related acidosis respectively. The added benefits of a neuraxial block included: improved neurological monitoring, decreased incidence of nausea and vomiting, reduced opioid usage and better pain relief. This optimized chances of the patient eating, drinking and recommencing supplementary drinks. Cautious fluid resuscitation was administered in view of the physiological fluid shifts post delivery and the risk of cerebral edema. Successful peri-operative CD management of parturients with MSUD requires a patient-centered approach with collaboration from a multidisciplinary team undertaken in a specialist center.

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Abstract #:T-80

Conservative Management of the Morbidly Adherent Placenta: a Case Series

Presenting Author: Laurie S. Daste MD
Presenting Author's Institution: Ochsner Clinic Foundation - New Orleans, Louisiana
Co-Author: Elaine Pages MD - Ochsner Clinic Foundation - New Orleans, Louisiana

Introduction: With the rising prevalence of morbidly adherent placentation (MAP), physicians are seeking alternative approaches to decrease morbidity and mortality as a result of hemorrhage-related complications. One conservative method involves leaving the placenta in situ, allowing for regression of vascular structures before a delayed hysterectomy. In this case series we present two patients with placenta percreta who were successfully managed with interval hysterectomies.

Case 1: A 26 y/o G4P1 with history of a c/s x1 presented with known placenta previa and percreta. At 32w5d, she underwent a scheduled c/s under general anesthesia in which the percreta was found to extend into the parametrium. Intraop EBL was 500cc and no blood products were transfused. The placenta and uterus were left in place with plans to undergo delayed hysterectomy 6-12 weeks later. She was followed with weekly U/S and CBC. She presented to the ED 8 weeks postop with vaginal bleeding and lower extremity ecchymosis. Fibrinogen was <70mg/dL, and she was immediately recognized to have disseminated intravascular coagulation. She underwent an emergency hysterectomy, under general anesthesia, resulting in 5L EBL. She was taken back to the OR that night for bleeding complications. She received a total of 16u PRBCs, 12u FFP, 4u cryo, and 2 packs of platelets during her hospitalization, and was discharged home on POD6.

Case 2: A 35 y/o G3P2 with history of c/s x2 presented with known placenta previa and percreta. She underwent a scheduled c/s, under general anesthesia, at 34w1d in which the percreta was noted to involve the right pelvic sidewall and bladder. Intraop EBL was 400cc and no blood products were transfused. The placenta and uterus were left in situ, with plans to undergo delayed hysterectomy at 8 weeks. She was followed with weekly U/S, CBC, and fibrinogen. Five weeks postop, she was admitted to the hospital after her fibrinogen was noted to be 107mg/dL. She was asymptomatic. The next morning her fibrinogen decreased to 76mg/dL, and she urgently underwent uterine artery embolization by IR followed by hysterectomy. Intraop EBL was 2400cc. She received a total of 4u cryo, 2u FFP, and 1u PRBC during her hospital course, and was discharged on POD3.

Discussion: In this case series we treated two placenta percreta pts with conservative management. Both presented earlier than their scheduled procedures and required urgent interventions due to developing DIC. While cesarean hysterectomy remains the most common approach for women with MAP, conservative management is becoming more prevalent due to reduced blood loss (1750 versus 3700 ml) and decreased rate of transfusions (57 vs 86%) (1,2). This approach, however, is not without risks and remains controversial as many patients require further surgery, often emergently, and may experience significant morbidity due to DIC, sepsis, and hemorrhage (3).

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Abstract #:T-81

A CASE REPORT OF A PARTURIENT WITH A TETHERED SPINAL CORD FOR DELIVERY-MANAGEMENT AND IMPLICATIONS FOR NEURAXIAL ANESTHESIA

Presenting Author: Sangeeta Kumaraswami MBBS,MD
Presenting Author's Institution: New York Medical College/Westchester Medical Center - Valhalla, NY
Co-Author: Lana Kuang MD - New York Medical College/Westchester Medical Center - Valhalla, NY

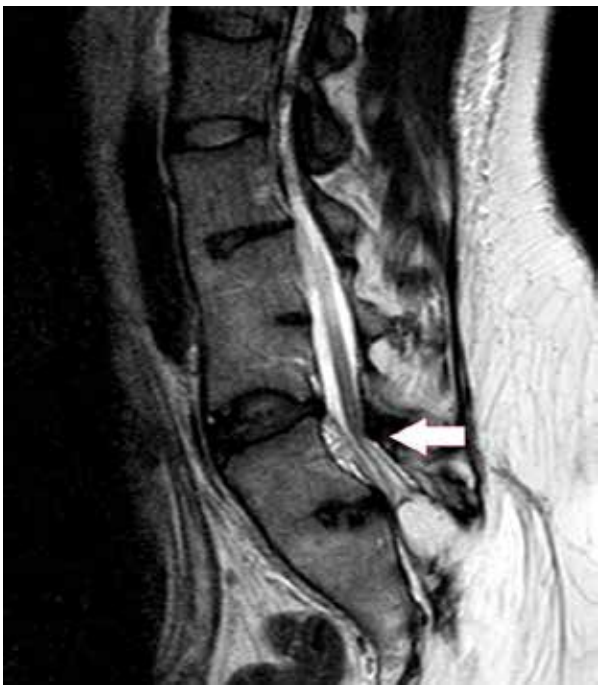
Introduction: A tethered spinal cord occurs when the spinal cord gets attached to tissue around the spine, most commonly at the base. Acquired causes include tumor, infection and scar tissue from previous surgery. The spinal cord is unable to move freely in the canal and becomes stretched with growth, causing damage. The progression of neurological signs and symptoms is highly variable, and includes sensory, motor, bowel and bladder control issues referred to as tethered cord syndrome.

Case: A 21year old patient G1P0 was admitted for pyelonephritis at 33 weeks gestation. An anesthesia consult was requested due to history of lipomyelomeningocele repair at birth. Her medical history was significant for neurogenic bladder needing intermittent catheterization since adolescence. She reported good exercise tolerance with no other neurological deficit. She had latex allergy, was 5'1" tall and weighed 76 kg. Airway exam was unremarkable.

An MRI lumbosacral spine done showed an anterior unsegmented bar from L2-L4 and a large spinal dysraphic defect from L5 to sacrum, with associated lipomyelomeningocele and tethered spinal cord. A discussion with neurosurgeons confirmed a high risk of spinal cord injury with neuraxial anesthesia. An elective cesarean section was scheduled at 39 weeks due to surgery for imperforate anus and rectovaginal fistula that she had in childhood. The patient received GA for her cesarean section without any complications.

Discussion: A lipomyelomeningocele is a spinal dysraphism that is inherently associated with a tethered spinal cord. Neurosurgical repair attempts to prevent further cord tethering, however re-tethering may occur,as perhaps in our patient. (1) Surgery for tethered cord release after the primary repair is a decision based on neurological function rather than radiological findings.(2)

A concern when performing neuraxial blockade is a possible low lying or tethered spinal cord. Permanent nerve injuries and spinal hematoma have been reported in such patients,who received spinal anesthesia.(3-5) Ultrasound is not sufficiently validated to detect low lying cords.MRI is recommended to clarify anatomical abnormalities, and exclude tethering before attempting neuraxial anesthesia.



MRI Lumbosacral spine of the parturient with arrow showing the tethered cord at L5 vertebral level

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Abstract #:T-82

NON FATAL VENOUS AIR EMBOLISM DURING A CESAREAN SECTION-A CASE REPORT AND REVIEW OF THE LITERATURE

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Nenna Nwazota MD - New York Medical College/Westchester Medical Center - Valhalla, New York

Introduction: Venous air embolism(VAE) is the entrainment of air commonly from the operative field into the venous system producing systemic effects. The risk of occurrence during a cesarean section(CS) is high with a reported incidence of up to 97%. Our case highlights the continued vigilance necessary to prevent morbidity and mortality from VAE.

Case: A 32 year old parturient G3P2002 with history of SLE was admitted to L&D at 33weeks gestation with preterm labor. She was scheduled for an urgent CS having had 2 prior CS for failed induction.She reported conversion to GA from spinal anesthesia in her previous delivery due to a patchy block, and requested GA for this procedure despite explanation of potential risks. She reported being NPO for about 12 hours.She was 5'2", weighed 120 lb with an unremarkable airway exam.

After application of standard ASA monitors in the OR, an uneventful RSI and intubation of patient was done in supine position. She was maintained on 100% O2 with volatile anesthetic, with stable vital signs. After the delivery of the baby oxytocin infusion was started, and the uterus exteriorized in preparation for repair. Immediately a fall in ETCO2 to 16 mm Hg was noted, with a drop in O2 saturation to 88% and a drop in BP to 72/46 mm Hg. Due to high index of suspicion for VAE, the surgeon was informed and additional help requested. The patient was given intravenous boluses of phenylephrine and a norepinephrine infusion started at 8mcg/min. A central venous catheter was placed in the right internal jugular vein and an attempt made to aspirate air which was negative. The hemodynamics gradually improved and the norepinephrine was weaned and stopped in 1 hour. An initial ABG done showed hypoxia (PO2 49mm Hg). The patient was kept intubated after the procedure and admitted to the ICU. She was extubated about 4 hours later with no sequelae. The rest of her postoperative course was uneventful and she was discharged home on the 4th postoperative day.

Discussion: The incidence of VAE during a CS is reported to be higher with GA than regional anesthesia. VAE can result in gas exchange abnormalities leading to lung edema. Decompensation of right followed by left ventricle and cardiac arrest may occur. Morbidity and mortality are directly related to volume and rate of air accumulation. Understanding factors that contribute to VAE are crucial. The traditional 15 degree left lateral tilt and Trendelenburg position as well as exteriorization of the uterus and hypovolemia increase risk. Positioning to reverse Trendelenburg seems not to reduce the risk. Avoidance of nitrous oxide is suggested as has the usage of precordial Doppler and expired nitrogen concentration as monitors. (1,2) Even though lethal VAE is rare in obstetrics, the risk of occurrence should be taken seriously. Knowledge of methods of prevention, recognition and prompt treatment are key.

References:

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2. Lew TWK et al Obstetric Anesthesia 1993

Abstract #:T-83

Posterior Uterine Rupture without Previous Cesarean Delivery or Myomectomy

Presenting Author: Richard C Robertson, Jr M.D.
Presenting Author's Institution: Ochsner Clinic Foundation - New Orleans, LA
Co-Author: Adrienne Ray MD - Ochsner Clinic Foundation - New Orleans, LA

Introduction: Uterine rupture is a known risk of pregnancy and can cause multiple serious complications including hemorrhage, shock, maternal or newborn mortality and potentially require hysterectomy for management. Risk factors include increased age, multiparity, malpresentation, excessive induction with oxytocin, low birth weight, uterine abnormalities, previous surgical manipulation, particularly myomectomy and cesarean delivery (CD). Uterine rupture, while rare, occurs in approximately 1:2500-1:5000 deliveries. We present a case of 32yo with pre-eclampsia with severe features who developed posterior uterine rupture without previous CD or myomectomy.

Case Report: 32 y.o. G4P2012 female with IUP at 35w1d wga with a history of endometriosis and Behcet's syndrome presented with contractions and pre-eclampsia with severe features. She was started on magnesium and given a betamethasone series for preterm induction. Low dose oxytocin was initiated for labor augmentation. Pt requested an epidural for labor analgesia. She had a unilateral block that required a second epidural. After several hours of labor with reassuring fetal tracing, cervical exam was performed and though previously normal, now revealed fetal head in posterior cul-de-sac of the pelvis with a very anterior cervix. Decision was made to proceed to the OR for CD. Lidocaine 2% with epi was administered via the epidural for surgical anesthesia. After standard pfannenstiel and fascial incisions, hemoperitoneum was noted and evacuated. A low transverse uterine incision was made and a vigorous baby was delivered. Upon exteriorization of the uterus, a large posterior uterine defect was discovered and remained attached only via the uterosacral ligaments and uterine vessels. Hysterectomy was performed, as safe reapproximation of the uterus was not possible. Arterial and central lines were placed and the patient remained with epidural anesthesia. She received 4units of RBCs and 2u of FFP. After an uneventful hospital course mother and baby were discharged POD 3.

Discussion: The classic presentation of uterine rupture involves fetal distress with profound fetal bradycardia in the setting of previous CD. Other risk factors and variable presentations have been documented. We present a case of posterior uterine rupture with reassuring fetal status in a patient whose only previous surgical history included resection of endometriosis. Prior operative note indicated endometriosis primarily on the posterior uterus. Resection was performed without complication. Typically CD and myomectomy history are the most concerning surgical risk factors for uterine rupture. This case should raise suspicion for uterine rupture in patients with previous endometrial procedures as well.

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1. Ofir, K. Uterine rupture: Risk factors and pregnancy outcome. Amer J of Ob & Gyn. 2003.
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Friday, May 12, 2017

Best Paper Session
Moderator: David H. Chestnut, M.D.

Fred Hehre Lecture: Two Steps Forward and One Step Forward
Speaker: Cynthia A. Wong, M.D.

Getting Social
Moderator: Heather C. Nixon, M.D.; Speakers: Lawrence Chu, M.D., M.S.; Ronald B. George, M.D.; Edward R. Mariano, M.D., M.A.S.

Ultrasound for the Obstetric Anesthesiologist
Moderator: Carolyn Weiniger, M.B., Ch.B.; Speakers: Cristian Arzola, M.D., M.Sc.; Jose C.A. Carvalho, M.D., Ph.D., FANZCA, FRCPC; Robert A. Dyer, FCA (SA), Ph.D.

Friday Abstracts

Abstract #:BP-01

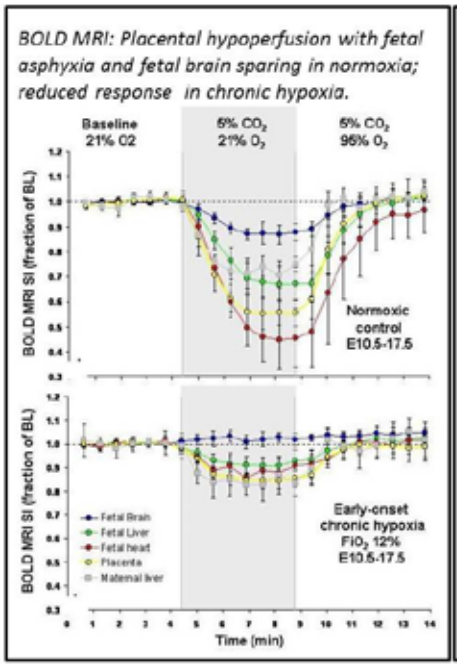
Demonstration of fetal brain sparing to both acute and chronic fetal asphyxia in mice: differential hypoxic inducible factor 1α expression and blood oxygen level dependent (BOLD) functional MRI.

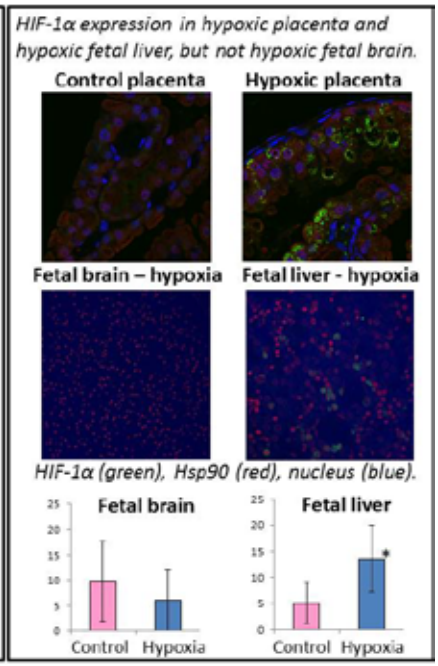
Presenting Author: Zohar Bromberg PhD
Presenting Author's Institution: Goldyne Savad Institute of Gene Therapy, Hadassah Hebrew - Jerusalem, Israel
Co-Author: Yehuda Gonosar PhD - Department of Anesthesiology and Critical Care, Hadassah Hebrew, and Department of Anesthesiology Washington University - St Louis, MO
Natalie Corchai-Nachmansson PhD - Goldyne Savad Institute of Gene Therapy, Hadassah Hebrew - Jerusalem, Israel
Rinat Abramovitch PhD - Goldyne Savad Institute of Gene Therapy, Hadassah Hebrew - Jerusalem, Israel

Introduction: Blood oxygen level dependent (BOLD) MRI has been used to follow acute changes in organ perfusion in pregnant mice. We demonstrated that normoxic hypercapnia and i.v. phenylephrine caused acute reduction in BOLD MRI signal intensity (SI) in the placenta, fetal liver and fetal heart with minimal change in fetal brain. These changes were accompanied by increased pulsatility index and absent-diastolic flow on Doppler ultrasound in the umbilical artery, and fetal bradycardia. All these changes were consistent with acute placental hypoperfusion with fetal asphyxia and fetal brain sparing. Here we expose pregnant mice to chronic hypoxia (12% FiO2 from E10.5-E17.5) to assess whether there were either MRI or molecular changes suggestive of fetal brain sparing in chronic asphyxia.

Methods: Pregnant female ICR mice (n=18) were either normoxic or were exposed to chronic hypoxia (12% FiO2) on gestational days E10.5-17.5. On E17.5, mice were anesthetized with pentobarbital and scanned in a 4.7-T Bruker Biospec spectrometer. Mice breathed in consecutive 4 min periods a) air, b) 5% CO2 :21%O2, and c) 5% CO2 :95%O2. Placenta and fetal organs (liver, heart and brain) were identified on True-FISP images, and change in SI was analyzed from T2*-weighted GE images (TR/TE=147/10 ms); percentage change in SI induced by hypercapnia (ΔSCO2) was calculated and presented by color maps and time curves. Images were repeated at 30 second intervals for dynamic studies in response to brief acute episodes of hypercapnia (5% CO2). After MRI, fetuses and placentas were evaluated histologically. HIF-1α was assessed by immunofluorescence (Novus); neuro-apoptosis was assessed by TUNEL assay stain.

Results: Brief hypercapnic challenge in normal pregnancy caused immediate reduction in SI of placenta, fetal liver and fetal heart but not fetal brain, suggesting preferential fetal brain sparing. BOLD-fMRI responses to hypercapnia were diminished in chronic fetal hypoxia. HIF-1α expression was demonstrated in fetal liver but not in fetal brain in hypoxic animals, suggestive of chronic fetal brain sparing. There was neuro-apoptosis in the fetal brain tissue in chronic hypoxic animals.





Discussion: We observed that acute maternal hypercapnia caused MRI changes suggestive of acute placental hypoperfusion with fetal asphyxia and fetal brain sparing. This may be related to the observation that chronic maternal asphyxia led to increased HIF-1α expression in fetal liver but not fetal brain.

Abstract #:BP-02

Cellular Mechanism of Inhibitory Effect of Propofol on Uterine Smooth Muscle and its Clinical Implication

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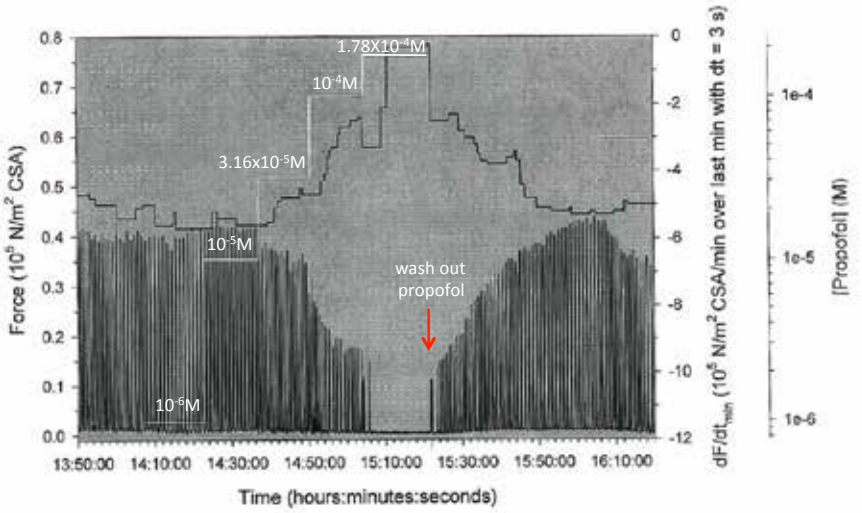
Presenting Author's Institution: Beth Israel Deaconess Medical Center - Boston, MA
Co-Author: Ruike Wang MD - Xiangya Hospital - Changsha, Hunan
Shiqin Xu MD, MPH - Nanjing Maternity and Child Health Care Hospital - Nanjing, Jiangsu
Thomas Huang MSc - Tufts Uiversity School of Medicine - Boston, MA
Philip E. Hess MD - Beth Israel Deaconess Medical Center - Boston, MA

Propofol-induced smooth muscle relaxation has been extensively studied in arteries and tracheal smooth muscle. The effect of propofol on uterine smooth muscle is poorly understood.

Methods: Term human uterine samples were collected during cesarean. Term pregnant rat uterine samples were collected for comparison. Isometric tension was measured to determine the effect of propofol on spontaneous (SMC) and oxytocin (1mU/ml) augmented muscle contraction (AMC) on strips of myometrium. Western immunoblotting was used to study cellular mechanisms.

Results: The effect of propofol on SMC and AMC was assessed in rat uterine muscle and a non-cumulative dose-response curve to propofol (10-6 to 3.16x10-4 M) was built. The sensitivities of SMC and AMC to propofol were similar with IC50's around 100uM (10-4M) (SMC: mean±SE 93.7±10.47uM, n=7; AMC: 87.9±5.23uM n=7). Inhibition by propofol was rapidly and fully reversible (5.5±1 min to reach 50% and 22.7 ± 2.9min to reach 90% of maximal force). In human uterine muscle, 10-5M propofol inhibited oxytocin AMC (10-9M to 10-6M; $p<0.05$). To explore the cellular mechanism of propofol-induced relaxation, we compared the effect of propofol on the thin-filament and thick-filament regulation. Oxytocin increased the phosphorylation of ERK1/2 (extracellular signal-regulated kinase) (2.79±0.25 vs. 1.04±0.03 in control group, n=5), but failed to activate p-CAD (phospho-Caldesmon) - the end target of thin-filament regulation (1.04±0.04 vs. 1.06±0.02 in control group). Propofol inhibited neither p-ERK1/2 (2.39±0.36 vs. 2.79±0.25 in oxytocin group) nor p-CAD (1.07±0.05 vs. 1.04±0.04 oxytocin group), indicating that thin-filament regulation plays no role either in oxytocin AMC or propofol inhibitory effect. We examined the end target of thick-filament regulation (calcium dependent pathway): oxytocin increased myosin light chain phosphorylation (p-MLC) (1.64±0.62 vs. 1.04± 0.13 in control group). And Propofol inhibited oxytocin-activated p-MLC (1.03±0.2 vs. 1.64±0.62 in oxytocin group).

Conclusion: Oxytocin contraction is mediated via calcium-dependent pathway and activation of MLC. Propofol inhibits oxytocin AMC and attenuates oxytocin-induced MLC phosphorylation. The extremely high IC50 of propofol (120x higher than concentration of propofol induction dose) and complete recovery suggests that clinical propofol use doesn't contribute to uterine atony, or increase the risk of postpartum hemorrhage.



A typical myogram showed inhibitory effect of propofol (10^{-6}M to $1.78x10^{-4}$M) on rat uterine smooth muscle contractions and complete recovery after wash out of propofol.

References:

1. Anaeth Intensive Care 1990;18:180-4.

Abstract #:BP-03

Maternal Obesity and The Risk of Postpartum Hemorrhage: A Cohort Study.

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Introduction: Postpartum hemorrhage (PPH) is the leading cause of maternal death globally. Identifying risk factors for PPH, such as maternal obesity, may improve risk-stratification, preparation, and resource allocation. Prior studies investigating the association between maternal obesity and PPH report inconsistent findings. Our aim was to examine the strength and direction of the association between maternal body mass index (BMI) with PPH in a large, population-based cohort, carefully attending to potential confounders in our study design.

Methods: We performed a retrospective, cohort study of women who delivered in California between 2008-2012. Linked patient discharge and birth certificate data were obtained from California OSPHD Data Center. PPH cases were identified using ICD-9 codes (666.x). For the main exposure of interest, pre-pregnancy BMI was categorized using the WHO criteria for adult underweight, overweight, and obesity class 1,2, and 3. We performed multilevel logistic regression to examine the association between BMI class with PPH, accounting for relevant maternal and obstetric confounders, with a random intercept for maternity units. Secondary analyses were performed, using ICD-9 codes, with atonic PPH and severe PPH (classified as PPH with transfusion) as outcome measures.

Results: There were 2,176,673 deliveries in our study cohort; PPH occurred in 60,704 (2.8%) of all deliveries. Rates of PPH according to BMI class were: underweight (2.4%), normal BMI (2.8%), overweight (2.9%), obese class I (2.8%), class II (2.6%), and class III (2.6%); P for trend=0.68. In the multilevel analysis, compared to women with a normal BMI, the adjusted odds of PPH were modestly increased for overweight women (aOR=1.06; 95% CI=1.04-1.08) and class 1 obese women (aOR=1.08; 95% CI=1.05-1.11) (Table). Of note, underweight women had a 8% reduced odds of PPH compared to those with normal BMI. Similar findings were observed in the model with atonic PPH (Table). In contrast, the odds of severe PPH was reduced for overweight women, and women with class 1, 2, and 3 obesity (Table).

Conclusion: Our findings demonstrate a small positive effect of maternal obesity on the risk of PPH and a stronger protective association between obesity and severe PPH. Because our analysis accounted for a broad set of confounders, residual confounding may explain why findings from prior studies were inconsistent.

Table: Odds Ratios of PPH, Atonic PPH, and PPH with Transfusion according to Body Mass Index

	PPH	Atonic PPH	PPH+Transfusion
BMI	**aOR[a] (95% CI)**	**aOR[a] (95% CI)**	**aOR[a] (95% CI)**
<18.5	0.92 (0.87-0.96)	0.89 (0.84-0.94)	1.05 (0.94-1.17)
18.5 – 24.9	Reference	Reference	Reference
25 – 29.9	1.06 (1.04-1.08)	1.07 (1.05-1.09)	0.94 (0.89-0.99)
30 – 34.9	1.08 (1.05-1.11)	1.11 (1.08-1.15)	0.85 (0.8-0.91)
35 – 39.9	1.01 (0.97-1.05)	1.04 (1.0-1.09)	0.78 (0.71-0.87)
≥ 40	1.01 (0.96-1.07)	1.03 (0.98-1.09)	0.85 (0.76-0.97)

BMI = body mass index; PPH = postpartum hemorrhage

[a] Model adjusted for maternal age, race/ethnicity, insurance type, maternal education, nulliparity/multiparity, chronic hypertension, prenatal care, gestational age at delivery, singleton/multiple pregnancy, prior cesarean, labor, prolonged labor, induction of labor, chorioamnionitis, placental abruption, polyhydramnios, placenta previa, fibroids, stillbirth, mode of delivery.

Abstract #:BP-04

Point of care ultrasound abnormalities in late onset severe preeclampsia: incidence and association with laboratory abnormalities and delivery outcome

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Background: Complications of preeclampsia, including pulmonary and cerebral edema, have been demonstrated by point-of-care ultrasound (POC-US)1,2. Also, novel acid-base (AB) markers have been identified3. Our primary goal was to study the incidence of cardiac dysfunction, interstitial pulmonary edema (iPE) and increased optic nerve sheath diameter (ONSD) in women with late onset severe preeclampsia. Secondary aims were to examine the association with AB abnormalities, BNP and delivery outcomes.

Methods: 95 women were enrolled in this prospective cohort study. At diagnosis, a POC-US examination of heart, lungs and ONSD was performed. Serum BNP and AB-status was analyzed applying the Stewart approach4. iPE was defined as a bilateral B-line pattern on lung-US, and diastolic dysfunction according to the guidelines of the European Society of Cardiology. ONSD > 5.8 mm was interpreted as raised intracranial pressure (ICP) (>20 cmH2O). The association of US-abnormalities with laboratory parameters and delivery outcomes was analyzed.

Results: iPE, diastolic-, systolic dysfunction, and raised LVEDP were present in 23 (24.2%,) 31 (32.6%), 9 (9.5%), and 18 (19.0%) of women respectively(Table 1). ONSD was increased in 27 (28.4%) women. Thirty-nine women (41.0%) had zero-, 34 (35.8%) had 1-, and 22 (23.2%) had ≥2 US abnormalities. Elevated BNP was associated with iPE, raised LVEDP, systolic- and diastolic dysfunction ($p<0.0001$). AB-analysis revealed hyperchloremic acidosis offset by hypoalbuminemic alkalosis, associated with increased LVEDP ($p=0.03$). On univariate analysis, iPE was associated with presence of diastolic dysfunction ($p=0.02$) and raised LVEDP ($p<0.0001$). On multivariate analysis, the development of an abnormal fetal CTG tracing within 48 hr following diagnosis was associated with having 2 or more US-abnormalities (RR 1.8, 95% CI 1.1 – 3.0, $p=0.03$), increased ONSD (RR 2.53, 95% CI 1.1-6.4, $p = 0.05$), and serum albumin level (RR 0.93, 95% CI 0.88-0.99, $p=0.02$).

Conclusion: iPE, diastolic dysfunction and raised ICP are common in severe preeclampsia. Hypoalbuminemic alkalosis and a higher serum BNP are associated with abnormal cardiac and lung-US findings. Many women have multiple US-abnormalities, and 2 or more US-abnormalities are associated with fetal distress. POC-US may be useful in the evaluation of patients with severe preeclampsia.

References:

2. Zielekiewicz L, Anesthesiology 2014
3. Dubost C, Anesthesiology 2012
4. Ortner C, BJA 2014
5. Story D, A&A 2015

Abstract #:BP-04

TABLE: Point of care ultrasound and acid-base abnormalities in late onset severe preeclampsia

I) Patient demographics and acid base analysis

Patient characteristics		Acid-base status based on simplified Stewart analysis	
Age (yrs)	26.6 ± 5.8	pH	7.40 ± 0.03
Gestation weeks	38.7 ± 2.5	pvCO2 (mmHg)	34.3 ± 3.9
Gravida	2 ± 1	HCO3 (mEq/L)	20.5 ± 2.0
Parity	1 ± 1	BE (mEq/L)	-2.9 ± 1.9
Weight (kg)	78 ± 18	BE[NaCl] (mEq/L)	-2.6 ± 2.2
Height (cm)	160 ± 6	BE[lactate] (mEq/L)	-0.37 ± 0.4
BMI (kg/m2)	31.2 ± 7.5	BE[albumin] (mEq/L)	2.4 ± 1.0
		BE[uma] (mEq/L)	-2.9 ± 2.5

Metabolic acid-base (AB) analysis was performed according to simplified Stewart methodology, based on the concept that net base excess (BE) is determined by effect of free water excess and changes in chloride (BE[NaCl]), serum Albumin (BE[albumin]), serum Lactate (BE[lactate]) and the accumulation of unmeasured anions (BE[uma]): BE = BE[NaCl] + BE[albumin] + BE[lactate) + BE[uma]

II) Point of care ultrasound findings

Systolic function parameters		Diastolic function parameters	
EDD (mm)	44 ± 9.4	E (cm/s)	92.4 ± 21.5
ESD (mm)	29.6 ± 4.7	A (cm/s)	75.5 ± 18.4
FS (%)	32 ± 7	mean E/A	1.4 ± 1.6
EDA (cm2)	19.1 ± 3.9	Deceleration time (dct) (ms)	170 ± 45
ESA (cm2)	9.3 ± 2.6	Septal E' (cm/s)	9.3 ± 2.2
FAC (%)	51 ± 9.6	Septal E/E'	10.3 ± 3.3
Systolic dysfunction n (%, 95% CI)	9 (9.5%, 4.4-17.2)	Lateral E' (cm/s)	11.0 ±2.8
EF (%)	56 ± 10	Lateral E/E'	8.9 ± 3.0
Increased LVEDP n (%, 95% CI)	18/80 (29%, 13.9-33.2)	Diastolic Dysfunction n (%, 95% CI)	31 (33 %, 23- 43)
Lung ultrasound parameters		Optic nerve ultrasound	
Mean B-line score	12 ± 8	Optic Nerve Sheath Diameter (mm)	53.9 ± 5.0
Interstitial Pulm. Edema n (%, 95% CI)	23 (24%, 16- 34)	ONSD > 58 mm n (%, 95% CI)	27 (28%, 20-39)
Individuals with 0 US-abnormality	39 (41%)		
Individuals with 1 US-abnormality	34 (36%)		
Individuals with ≥ 2 US-abnormalities	22 (23%)		

Data are presented as mean, standard deviation, proportion and 95% confidence intervals (95% CI)

EDD: left ventricular (LV) end-diastolic diameter
ESD: LV end-systolic diameter
FS: fractional shortening
EDA: LV end-diastolic area
ESA: LV end-systolic area
FAC: fractional area change
EF: LV eyeballing ejection fraction
E: mitral valve early inflow velocity
A: mitral valve atrial inflow velocity
septal E': tissue doppler velocity (TDI) of septal mitral annulus
lateral E': TDI of lateral mitral annulus
LVEDP: left ventricular end-diastolic pressure

Systolic dysfunction was defined as FS < 25%
Diastolic dysfunction was defined as Sept E' < 8 cm/s or Lat E'< 10 cm/s
Increased LVEDP was defined as Sept E/E'>15 or Lat E/E' > 12
Interstitial Pulmonary Edema was defined as more than 3 B-lines in more than 2 lung regions bilaterally
Raised ICP was defined as ONSD > 58 mm

Abstract #:BP-05

Association Between Bolus Rate and Duration of Adequate Labor Analgesia

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Introduction: Programmed intermittent boluses of local anesthetic have been shown to be superior to continuous infusions for maintenance of labor analgesia. One suggested mechanism is improved spread of the local anesthetic within the epidural space. An in vitro study found that higher programmed intermittent epidural infusion delivery speeds generate higher epidural pressures. The objective of this study was to determine if higher delivery speeds result in a longer duration of adequate analgesia than lower delivery speeds. We hypothesized that a higher-speed bolus would result in a longer duration of adequate analgesia.

Methods: Nulliparous women with a singleton pregnancy, admitted to labor and delivery for spontaneous or induced labor, and at a cervical dilation of ≤5cm at request for neuraxial analgesia, were eligible for this double-blind randomized controlled study. Combined spinal-epidural analgesia was initiated with an intrathecal dose of 25mcg fentanyl. The maintenance epidural solution was bupivacaine 0.625 mg/mL with fentanyl 1.95 mcg/mL. Programmed intermittent boluses of 10 mL administered every 60 minutes were given using a CADD-Solis pump, starting 30 minutes after intrathecal injection. Patients in the high-delivery speed group received the timed bolus at a rate of 300 mL/h. The bolus speed in the low-speed group was 100 mL/h. The primary outcome was time to first request for supplemental analgesia.

Results: Patient characteristics were similar in both groups (Table 1). Epidural analgesia was initiated at a similar cervical dilation in both groups. There was no difference in the number of patients that required supplemental analgesia, or in the time to first request for supplemental analgesia between the groups. Mode of delivery, motor block at delivery, and overall satisfaction with labor analgesia was also similar between the two groups.

Conclusions: While there was a trend towards longer duration of adequate analgesia in the higher delivery speed group, there was no difference between the groups. As clinical outcomes were similar between the groups, either bolus delivery speed should be acceptable for clinical care. Future work should determine the optimal bolus volume and timing interval when using programmed intermittent bolus analgesia.

	High-pressure group (n=103)	Low-pressure group (n=108)	P
Age (years)	32 (29-33)	31 (29-33)	0.81
BMI (kg/m^2)	29.4 (26.5 – 32.6)	29.3 (26.4 -32.7)	0.88
EGA	40.0 (38.6 – 40.6)	39.6 (39.0 – 40.5)	0.77
Spontaneous labor	74 (71.8%)	73 (67.6%)	0.50
Cervical dilation at request for labor analgesia (cm)	2.8 ± 0.1	2.9 ± 0.1	0.77
Requested supplemental analgesia	37 (35.9%)	43 (39.8%)	0.56
Time to request for supplemental analgesia (min)	357 (219-522)	291 (146-549)	0.51
Mode of delivery			0.73
Spontaneous	70 (68%)	71 (65.8%)	
Instrumental	9 (8.7%)	13 (12%)	
Cesarean	24 (23.3%)	24 (22.2%)	
Bromage score at delivery	2 (2-2)	2 (2-2)	0.71
Overall satisfaction with analgesia (0-100 mm)	98 (88-100)	98 (88-100)	0.58

Data presented as n (%), mean ± standard deviation, or median (interquartile range)

Abstract #:BP-06

Prospective observational investigation of postoperative respiratory monitoring in women undergoing cesarean delivery with intrathecal morphine administration

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Presenting Author's Institution: Hebrew University – Hadassah School of Medicine, Jerusalem, Israel - Jerusalem, None
Co-Author: Seden Akdagli MD - SUNY Downstate Medical Center - NYC, NY
Kazuo Ando MD - Stanford School of Medicine - Stanford, CA
Brendan Carvalho MD - Stanford School of Medicine - Stanford, CA

Background: Intrathecal morphine (ITM) for cesarean delivery (CD) provides effective analgesia, however oxygen desaturation and bradypnea have been reported.(1) We used capnography, Capnostream™20 (Medtronic Boulder,CO,USA), to assess respiratory variables and apnea alert events (AAEs) after CD.

Methods: A prospective, observational IRB-approved study. All CDs received ITM 150 mcg. Recruited subjects were requested to use capnography/pulse oximetry up to 24h after CD. Nasal CO2 sampling measured end-tidal CO2 (EtCO2, mmHg) and respiratory rate (RR, bpm); and pulse oximeter measured SpO2, %. Variables alerted when: EtCO2<10, RR<8 or SpO2<94. Capnography data was defined as valid when EtCO2>10, RR>5, SpO2>70; or "no breath" for 30-120 secs. AAE was defined as "no breath", 30-120s. The number of AAEs and variable alerts prior to, during and after AAE, and nurse RR assessments (hourly and blinded to monitors) are reported.

Results: We recruited 80 subjects, aged 34.5±5.1yrs, 47% had >90kg/BMI>30, 11% had suspected obstructive sleep apnea. Duration of valid capnography and SpO2 data was 8:28(7:51)[0:00-22:32]h:min and 15:08(6:42)[1:31-23:07]h:min respectively; 6 subjects did not use the device. There were 198 AAEs (duration 57±27s) experienced by 39/74(53%) subjects; 35/74(47%) had no AAEs, Fig. 1. The number of variable alerts/min, 5 min prior to, during, 5 min after the AAEs were: EtCO2 1.7(2.2), 4.6(1.8), 4.6(5.5); RR 2.1(2.2), 5.7(0.6), 6.2(5.5); SpO2 0.9(1.7), 0.9(1.8), 2.1(4.1). The hourly means for RR and SpO2 are presented in Fig. 2. Nursing RR observation was RR ≥14 bpm at all time-points, the Pearson Correlation Coefficient is r=0.051 (p =0.246) between capnography and nursing RR. Two subjects (had 0 and 7 AAEs) received oxygen. 81% of subjects complained of itchy nose/feeling sick/visitors/baby/other inconvenience with capnography.

Conclusion: We report 198 AAEs detected by capnography after CD with ITM, however nursing observations did not reveal any clinical respiratory depression. Absence of observer verification precludes distinction between real, albeit non-clinically significant alerts with capnography, versus false AAEs.(2) Continuous respiratory measurements by capnography might alert for apneas that intermittent hourly nursing observations may miss. However subject-expressed device discomfort, and frequent alerts may impact capnography application after CD.

References:

1. Pan. J Clin Anesth 1994;6:124
2. Bauchaut. Anesth Analg 2017prepub

Figure 1. Number of apneic alert events per hour. Mean time after post-operative anesthesia care unit to first apnea was 5:36 ± 5:48 hrs:mins.

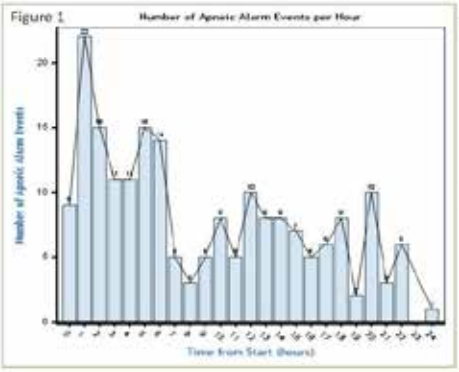
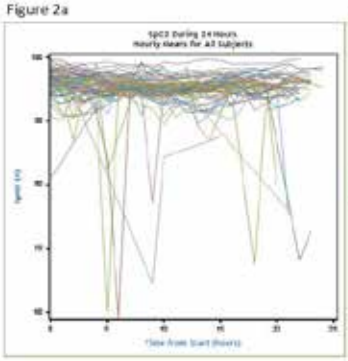
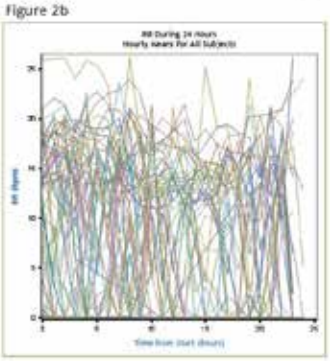


Figure 2a. Hourly means of pulse oximetry (SpO2), %, for all subjects.
Figure 2b. Hourly means for respiratory rate (RR), breaths per minute, for all subjects.
Absence of observer verification precludes a distinction between real variable alerts and artefacts.





Modernize Your CV and Develop Your Reputation

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Financial Disclosures

- Halyard Health, B Braun – Unrestricted educational program funding paid to my institution

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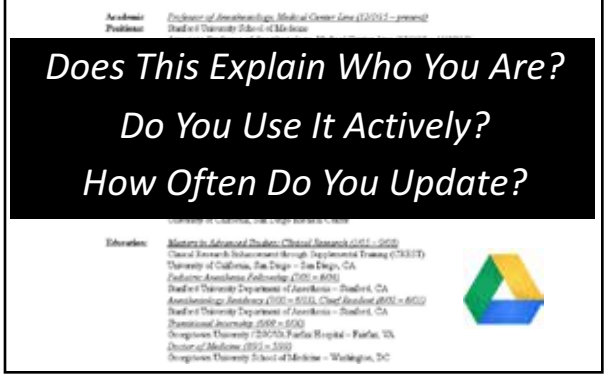
The CV: a Necessary Evil



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Do You Use It Actively?
How Often Do You Update?

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- Strive for accuracy
- When in doubt, pause
- Don't post anything that can identify a patient
- Ask for permission
- Assume beneficence
- Beware of "friending" patients
- Educate yourself

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http://www.kevinmd.com/blog/2013/05/10-simple-rules-doctors-social-media.html

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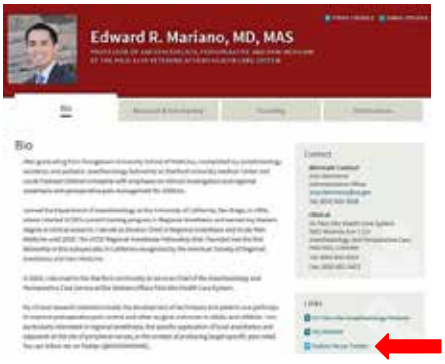

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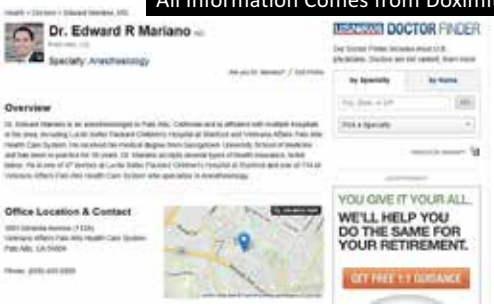

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How Do You Promote Research?

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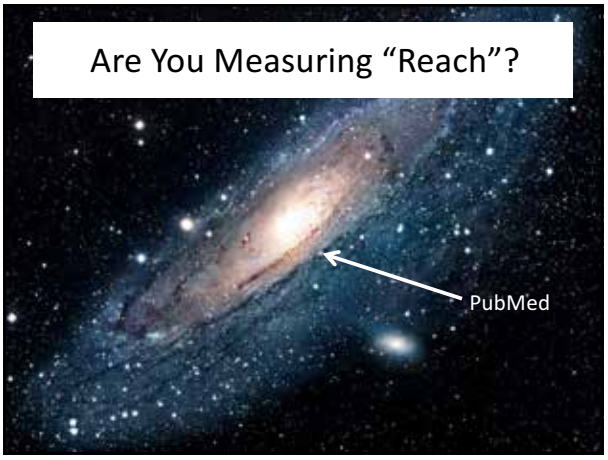
How Do You Promote Research?

By Rose Eveleth
SMITHSONIAN.COM
MARCH 25, 2014

There are a lot of scientific papers out there. One estimate puts the count at 1.8 million articles published each year, in about 28,000 journals. Who actually reads those papers? According to one 2007 study, not many people: half of academic papers are read only by their authors and journal editors, the study's authors write.

Are You Measuring "Reach"?



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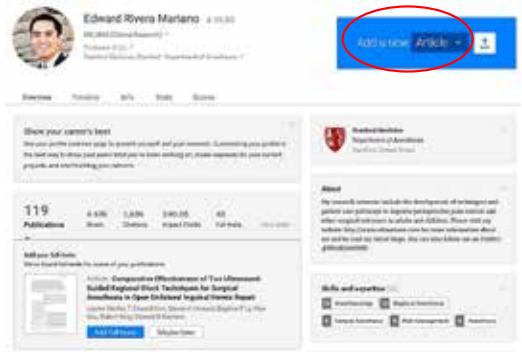

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Social Media Dissemination

- 170 Cochrane schizophrenia reviews were randomly assigned to dissemination via Twitter or control
- Primary outcome (# of page visits 7 days after intervention: 1162 (Twitter) vs. 449 (control)
- Users stayed on the page twice as long in the Twitter group vs. control

Adams CE, et al. BMJ Open 2016;6:e010509

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The "Twimpact Factor"

- "Tweetations" (cumulative Tweets within 7 days of publication) and citations show moderate correlation (Pearson r=0.57-0.89)
- Highly Tweeted articles are 11 times more likely to be cited

Eysenbach G. J Med Internet Res 2011;13(4);e123

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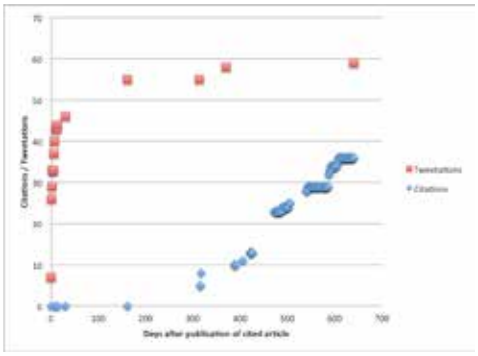

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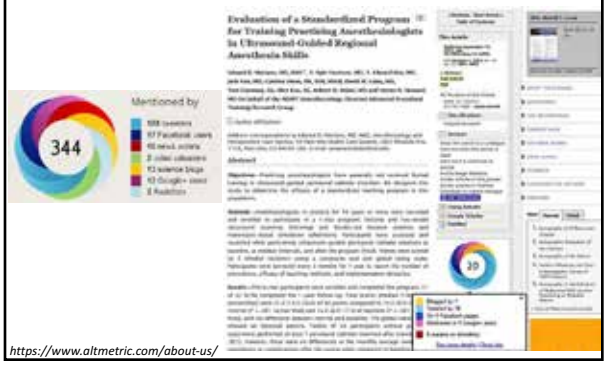

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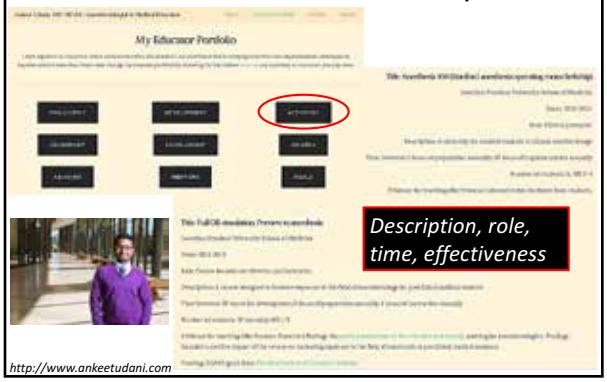

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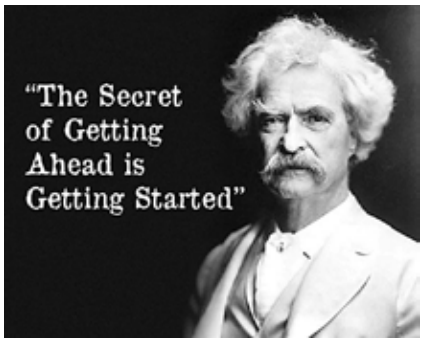

Ultrasound for the Obstetric Anesthesiologist - Gastric Ultrasound

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Pulmonary aspiration of gastric content is a serious anesthetic complication, which can have significant morbidity and mortality. The aspiration risk is usually estimated on fasting times. However, fasting guidelines do not always apply to urgent situations and to patients with certain conditions (obesity, pregnancy, co-morbidities). The use of gastric ultrasound for content and volume assessment is a new point-of-care ultrasound application that can help determine aspiration risk. The proper pattern recognition of the relevant sonoanatomy in the epigastric area allows a standard examination in the supine position and the right lateral decubitus, while adding a 45^0 semi-recumbent position helps increasing the detection and sensitivity in borderline and challenging situations. The evaluation provides a qualitative assessment of gastric content (solid, thick fluid, clear fluid or empty stomach). Additionally, a quantitative assessment in the presence of clear fluids can help, which is based on either a mathematical model by measuring the antral cross sectional area or the absolute measurement of antral cross-sectional area. The information from a systematic examination permits the integration with clinical characteristics for a more informed decision-making process.

Objectives:

1. Describe the relevant sonoanatomy for identification of the stomach in the epigastric area
2. Describe a systematic examination as part of aspiration risk assessment
3. Integrate the information obtained from the ultrasound examination to the perioperative decision-making.

References:

1. Educational website: “Gastric Ultrasound: A Point-of-care tool for aspiration risk assessment”. http://www.gastricultrasound.org.
2. Van de Putte P, Perlas A. Ultrasound assessment of gastric content and volume. Br J Anaesth 2014;113:12–22.
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8. Bataille A, Rousset J, Marret E, Bonnet F. Ultrasonographic evaluation of gastric content during labour under epidural analgesia: a prospective cohort study. Br J Anaesth 2014;112:703–7.
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Abstract #:F-01

Hetastarch administration during cesarean delivery in preeclampsia: is it associated with renal dysfunction?

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Background: Hydroxyethyl starch (HES) solutions such as hetastarch (6%) have been commonly used for the prevention or treatment of maternal hypotension in cesarean deliveries.(1) However, recent studies have associated HES with renal injury in critically ill nonpregnant patients (2) leading to an FDA black box warning.(3) Since preeclamptic patients may be at risk for mild renal impairment, we hypothesized that hetastarch use during cesarean delivery could exacerbate renal injury in this subpopulation of parturients.

Methods: We conducted a retrospective study of all cesarean deliveries with an ICD-9 code for preeclampsia (January 2011 to April 2015) who had preop and postop plasma creatinine measured. The grouping variable was whether any HES was administered (HES-Y vs HES-N). The primary endpoint was percentage change in plasma creatinine. Secondary endpoints were vasopressor dose, presence of postop pulmonary edema, use of blood/products and neonatal status (Apgar 1 and 5). Demographic data were age, BMI, parity, gestational age, type of anesthesia, diabetes and severity of preeclampsia. Paired creatinine data were assessed using a paired t-test. Primary and secondary endpoints were assessed using multivariate ANOVA, controlling for markers of severe maternal hemorrhage (EBL, change in hemoglobin, or any intraoperative blood administration). Demographic variables were assessed with 1-way ANOVA or $\chi 2$-test where appropriate.

Results: Paired creatinine values were available for 211/294 patients. Excluded patients were of more advanced gestation (36.1±3.4 weeks vs 33.6±4.5 weeks; p<0.0001) with lower preop creatinine (0.63±0.13mg/dL vs 0.77±0.46mg/dL; p= 0.006) and fewer cases of eclampsia (7/83 vs 27/211; p=0.001) and HELLP (1/83 vs 32/211; p=0.001). There were 84 patients in HES-Y and 127 in HES-N groups. Baseline and percentage change in creatinine were normally distributed. Plasma creatinine increased for both groups (HES-Y 13.1+/-21.5% rise; HES-N 14.3+/-21.3% rise), but there was no difference between groups before or after controlling for maternal hemorrhage. Hemoglobin fell more in the HES-Y group (mean difference 1.64±1.75g/dL vs 1.23±1.21g/dL; p=0.04). There was no difference in baseline creatinine, EBL or blood transfusion requirements between groups. Post hoc power analysis showed a 90% power to detect a 10% difference between groups.

Conclusions: This retrospective dataset indicates that even in preeclamptic parturients who may be more prone to renal dysfunction, hetastarch administration was not associated with evidence for additional renal dysfunction. The study was limited by the choice of effect measure, short duration of effect studied, lack of information about magnesium therapy and the retrospective design.

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Abstract #:F-02

Improving Patients' experience undergoing Spinal Anesthesia for cesarean delivery: A quality Improvement initiative

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Introduction: Cesarean delivery (CD) is one of the most common operations in North America and the incidence is increasing 1. It is most commonly carried out using spinal anesthesia (SA) 2 . The rate of CD at our tertiary care academic obstetric center is 22%. Therefore, an understanding of patients' experiences with SA is warranted. We conducted a quality improvement initiative to the patients' experience undergoing SA for CD, using the Plan-Do-Study-Act (PDSA) methodology.

Methods: REB approval and written informed consent was obtained from all participants in this study. Using a written, Likert scale questionnaire we surveyed thirty (n=30) healthy, pregnant patients at term gestation with single fetuses who had undergone elective CD with SA to ascertain the incidence of bothersome events (See Appendix 1) to determine our baseline data. Our questionnaire showed 40% of patients found shivering was the most bothersome event. Consequently, we conducted targeted interventions using the PDSA methodology to improve the rate of shivering. For PDSA cycle 1 we introduced forced air warming, PDSA cycle 2 we implemented intravenous fluid warming, and for PDSA cycle 3 we used to a circulating heat mattress. We used a convenient sample to survey patients after each PDSA cycle to see if our interventions demonstrated any improvement in shivering. We aim to survey 30 patients per PDSA cycle.

Results: To date, 94 patients have been surveyed and all patients received the intended intervention during the PDSA cycles. After implementing PDSA cycle 1, the incidence of bothersome shivering decreased from 40% at baseline to 32% . In PDSA cycle 2, shivering was reduced substantially to 13% . Results from our third intervention (PDSA cycle 3) are pending.

Discussion: This QI project highlighted an important aspect of the patients' experience following SA for CD, the bothersome event of shivering. We have used targeted interventions to successfully decrease this side effect. These interventions may make a meaningful impact and improvement in our patients' experience of SA for CD.

Patients' receiving spinal anesthesia for Cesarean Delivery Survey

Please Circle the number that represents how you feel about the anesthesia service you have received:

	Question	Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
1	The information provided to me about the spinal anesthetic was sufficient.	1	2	3	4	5
2	The time provided to me to give consent for the spinal was sufficient.	1	2	3	4	5
3	The teaching and discussion between anesthesia trainee and consultant bothered me.	1	2	3	4	5
4	I was comfortable during the placement of the spinal anesthetic.	1	2	3	4	5
5	I felt no pain during my surgery.	1	2	3	4	5
6	.The numbness in my body bothered me	1	2	3	4	5
7	The itching bothered me.	1	2	3	4	5
8	The nausea bothered me.	1	2	3	4	5
9	The shivering bothered me	1	2	3	4	5
10	Overall, my spinal worked well	1	2	3	4	5
11	I would want to receive a spinal again if I had another CS.	1	2	3	4	5
12	If I was asked to add something to improve the service I would suggest.....					

References:

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2. Anesthesiology 2005; 103:645-53
3. Br J Anaesth 2015; 115 (4): 500–10

Abstract #:F-03

A prospective observational study to evaluate efficacy of simple questions to predict labor pain and epidural analgesia use in parturients

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Introduction: Labor pain is a complex phenomenon made up of multiple physical and psychosocial factors.1 Epidural analgesia is commonly used to alleviate labor pain, but there is significant inter-patient variability in responses to labor pain and epidural analgesia .2,3 One-size-fits-all approach to labor analgesia is inappropriate and a disservice to patients. Pan et al. (2013) evaluated the efficacy of three simple questions about anxiety, expected pain, and expected analgesia requirements in predicting post-cesarean section pain in patients.4 The responses from each of these pre-operative questions were useful in predicting post-cesarean section pain. Our hypothesis is that these 3 questions will reliably predict the labor pain experience and epidural analgesic use for parturients having induction of labor.

Methods: Institutional REB approval was obtained. Written informed consent has been obtained from all patients participating in this study. A total of 50 pregnant women will be recruited. A 3-question survey has been given to full term pregnant women coming for induction of labor. Participants have been asked to mark, using a 0-10 cm visual analog scale (VAS) their level of anxiety and anticipated pain during labour and delivery. Using a categorical scale of 0-5, participants have been asked to rate their anticipated epidural analgesic need as compared to the average patient. Approximately 24 hours after delivery, a follow-up interview has been conducted to assess VAS scores during labor, patient comfort level during labor (using Likert scale of 0-5) and patient satisfaction with epidural analgesia. Review of the patient charts have been done to obtain the following data: time from onset of labor to epidural analgesia, cervical dilation at time of epidural request, duration of labor, number of epidural boluses, and mode of delivery.

Results: To date, we have recruited 30/50 obstetric patients. We are continuing to recruit. We had 0 rejection and no missing data.

Discussion: This study is feasible and we anticipate that we will be able to present our final results at the May 2017 SOAP annual meeting.

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2. Pan, P., Tonidandel, A., Aschenbrenner, C., Houle, T., Harris, L., Eisenach, J. Predicting acute pain after cesarean delivery using three simple questions. Anesthesiology 2013; 118: 1170-1179
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Abstract #:F-04

A comparison of the lumbar ultrasound acoustic window in parturients in the standard sitting and crossed leg positions

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Inroduction: Lumbar Spine Ultrasonography (LSUS) facilitates performance of neuraxial anesthesia in parturients.1. In ultrasonography (US), improved visualization of the Paravertebral Longitudinal Ligament (PLL) suggests an 'open acoustic window', or unobstructed path to the dura between the laminae of the lumbar spine 4. In addition, the effect of patient position on the visualized length of the PLL has been previously demonstrated 2,3. We hypothesized that the crossed legged position would increase the measured lengths of the PLL, Interlaminar Distance (ILD) and Ligamentum Flavum (LF) in the paramedian view during LSUS when compared to the standard sitting position.

Methods: Local REB approval was obtained. Thirty term pregnant, non-labouring women provided written informed consent . Two anesthesiologists independently scanned the L3-4 right paramedian space using a curvilinear ultrasound transducer (SonoSite M-Turbo, Bothell, WA, USA). Two positions were investigated for each patient: traditional sitting position (SP) with lumbar flexion; and cross legged position (CLP), where the patients sat on the bed with their legs crossed, neck and lower back flexed. The PLL, ILD and LF lengths were measured using the ultrasound calliper software and recorded, with the anesthesiologists blinded to the results and to each others' scans. Patients were asked to rate their comfort level in both positions using a Likert scale.

Results: We were able to obtain scans in both positions in all patients. There was a small but statistically significant increase in the measured lengths of the PLL, ILD and LF in the CLP position (Table 1). Comfort levels were not different between groups (Odds Ratio CLP/SP = 0.88 (95% CI 0.3 to 2.8; P > 0.999).

Discussion: This study demonstrates the feasibility of using LSUS to visualize PLL, LF, and ILD at L3-4 intervertebral space using paramedian view in term pregnant women in both CLP and SP. Measurements were found to be longer in CLP which suggests the possibility of easier lumbar neuraxial access in the CLP. . Future studies are needed to correlate these findings with ease of needle insertion in parturients.

	sitting	Crossed Legs	Difference (sitting – Crossed Legs) (95% CI)	P
PLL, cm (SD)	1.25 (0.23)	1.45 (0.35)	-0.19 (-0.32 to -0.06)	0.005
ILD	3.15 (0.41)	3.29 (0.47)	-0.14 (-0.24 to -0.03)	0.013
LF	1.13 (0.25)	1.25 (0.30)	-0.12 (-0.21 to -0.03)	0.009

P values from paired t test

References:

1. Grau T et al. J Clin Anaesth (2002): 14:169-175.
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3. Jones AR et al Anesthesia, 2013 Jan; 68(1):27-30.
4. Weed J et al. Anaesthesia, 2011, 66: 925–930

Abstract #:F-05

Hemorrhage Cart: How much time is saved in a critical scenario?

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Katherine St. Romain MD - University of North Carolina - Chapel Hill, NC

Background: Postpartum hemorrhage (PPH) is a leading cause of obstetric morbidity and mortality, affecting 2.9% of women giving birth in the U.S. in 2006 (1). Studies show that a protocol-based approach to PPH decreases morbidity (2). The national partnership for maternal safety developed protocol safety bundles with four domains: Readiness, Recognition and Prevention, Response, and Reporting and System Learning (3). One component of readiness is a cart with standard hemorrhage management supplies. On our L&D floor, supplies needed in a hemorrhage scenario are located in several places. Our aim was to create a hemorrhage cart as part of a developing PPH protocol.

Methods: We observed residents with OB anesthesia experience in a postpartum simulation scenario. We asked them to gather a list of supplies needed to manage a hemorrhage and to bring the supplies to the patient's room as quickly as possible. The residents were allowed to collect supplies from any area of the L&D floor. The end measures were time to completion of task (seconds) and percent completion (percent of supplies collected out of total supplies requested). A survey was completed by participants to gauge prior experience with hemorrhage cases on L&D, to determine why certain supplies were not found, and to assess if a cart would have been helpful. We then created a cart containing standard supplies commonly used for managing a hemorrhage. The same residents were asked to undergo the same simulation after a brief introduction to the hemorrhage cart, and a post intervention survey was conducted, this time asking if the hemorrhage cart had been helpful.

Results: We used paired t-test to evaluate time differences between the 2 cohorts. The average time to completion in the pre-intervention group was 295.7 seconds longer than the post-intervention group ($p<0.001$). The ability to find all of the supplies in the two groups was analyzed using a 2-proportion test. In the pre-intervention group 29% of residents found 100% of supplies vs 100% in the post-intervention group ($p<0.001$). Our pre-intervention survey showed that the most common cause of failure to find supplies was lack of knowledge of where supplies were located (several locations). 65% of residents reported experience with a stressful hemorrhage case and all agreed that a hemorrhage cart would be helpful. Our post-intervention data showed 100% success and 100% of residents stated the cart was helpful in managing the scenario.

Conclusion: While it is obvious that keeping supplies in one location would reduce time needed to gather supplies, the reduction in time in our simulated scenario was nearly 5 minutes. As part of a multi-step approach to PPH management, a cart can significantly improve efficient patient care in cases where early intervention can decrease morbidity and mortality.

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2. Shields. Am J Obstet Gynecol 2015;212:272-80.
3. Main. Anesth Analg 2015;121:142-8.

Abstract #:F-06

The Epidemiology of Placenta Previa in California, 2008-2012

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Introduction: Since the mid-1990s, the rate of cesarean delivery has increased > 50%. As a result, the incidence of placental pathologies, such as placenta previa, may have increased. The main study objectives were to determine contemporary trends and risk factors for previa in a large delivery cohort in California.

Methods: Linked California birth certificate and discharge data were used to identify women who delivered at ≥20 weeks' gestation in California between 2008-2012. Within this cohort, women with a previa diagnosis were identified with ICD-9 codes 641.x. Temporal trends and risk factors for previa were analyzed. Candidate variables considered as potential risk factors included: maternal age, race/ethnicity, insurance, history of smoking, prior cesarean, diabetes, chronic hypertension, history of abortion, cocaine use, single vs multiple gestation, hypertensive disorders of pregnancy and timing of prenatal care. We performed univariable and multivariable logistic regression to determine odds ratios and 95% CIs for determinants of previa.

Results: Our cohort comprised 2,176,673 women who delivered at ≥20 weeks' gestation, of whom 14,274 had a previa for a cumulative prevalence of 0.6%. Cases of previa increased slightly from 2872 (0.64%) in 2008 to 2819 (0.66%) in 2012. In our multivariable model, clinical factors independently associated with previa were: maternal age ≥35y (aOR=2.2; 95% CI=2.1-2.3), Asian (aOR=1.5; 95% CI=1.4-1.6), African-American (aOR=1.1; 95% CI=1.0-1.2), Other race (aOR=1.8; 95% CI=1.6-1.9), non/uninsured (aOR=1.1; 95% CI=1.0-1.2), history of abortion (aOR=2.0; 95% CI=1.8-2.3), cocaine use (aOR=2.0; 95% CI=1.1-3.2), smoking (aOR=1.2; 95% CI=1.1-1.4), prior cesarean (aOR=1.4; 95% CI=1.4-1.5), multiparity (aOR=1.05; 95% CI=1.0-1.1), and multiple gestation (aOR=1.7; 95% CI=1.5-1.9). Compared to starting prenatal care in the 1st trimester, prenatal care commenced in the 2nd or 3rd trimester had a 6% and 26% decreased odds of previa, respectively.

Conclusion: The prevalence of previa in California increased modestly from 2008 to 2012. Clinical risk factors for previa (advancing maternal age, prior CD, history of abortion, and cocaine use) are consistent with those reported in prior studies. Further research is needed to examine the complex interactions of biology and health services to explain how socioeconomic factors, such as insurance type, race/ethnicity, and timing of prenatal care influence the likelihood of incurring previa.

Adjusted Odds Ratios for Variables Associated with Placenta Previa among Women Delivering in Californian Hospitals between 2008 and 2012.

	aOR	95%CI
Maternal Age (y)		
<20	0.3	0.26 – 0.34
20 – 34	Reference	
≥ 35	2.18	2.1 – 2.26
Race / Ethnicity		
Non-Hispanic White	Reference	
Hispanic White	1.02	0.97 – 1.06
Non-Hispanic African-American	1.13	1.05 – 1.23
Non-Hispanic Asian	1.52	1.44 – 1.6
Non-Hispanic Other	1.77	1.64 – 1.89
Insurance		
Private Insurance	Reference	
Medi-Cal	0.83	0.80 – 0.87
Non-insured or uninsured	1.12	1.02 – 1.22
History of abortion	2.04	1.76 – 2.35
History of cocaine use	1.98	1.14 – 3.18
History of smoking	1.21	1.06 – 1.38
Pre-existing diabetes	1.01	0.86 – 1.18
Chronic hypertension	0.9	0.8 – 1.01
Trimester prenatal care commenced		
1st Trimester	Reference	
2nd Trimester	0.94	0.89 – 0.99
3rd Trimester	0.74	0.65 – 0.83
Prior Cesarean	1.44	1.38 – 1.5
Gestational hypertension	0.65	0.56 – 0.74
Pre-eclampsia	0.87	0.78 – 0.96
Multiparity	1.05	1.01 – 1.09
Multiple gestation	1.7	1.55 – 1.88

aOR = adjusted odds ratio; CI = confidence intervals.

Abstract #:F-07

Impact of consultant presence on regional anesthesia to general anesthesia conversion for category 1 cesarean sections

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Malachy Columb FRCA - University Hospital of South Manchester - Wythenshawe, Manchester

Introduction: In the UK a 4 grade classification system categorises the urgency of cesarean section (CS), category 1 denotes the most urgent, with a decision to delivery interval <30 minutes. The highest incidence of regional anesthesia (RA) failure, resulting in conversion to general anesthesia (GA), occurs in category 1 CS. The Royal College of Anaesthetists (RCOA) have suggested an auditable standard for the RA to GA conversion rate for category 1 CS, stating it should be <15%. They also highlighted that all cases where a regional analgesic technique was started for labor, are considered as having RA for CS, whether that regional block was extended for CS or not.1

Method: We collected data for all category 1 CS carried out between January 2011 and December 2015. Mode of anesthesia, time and day of the week, RA to GA conversion and consultant presence were documented. Consultant anesthesiologist presence on the labor ward was assumed between 0800-1700 Monday–Friday. Consultant obstetrician presence was assumed between 0800-2200 Monday-Friday, and 0800-2000 Saturday-Sunday. Results were analysed using proportions and differences in proportions with 95% confidence intervals, and exact 2-sided p values, with $p<0.05$ as significant.

Results: A total of 861 category 1 CS were performed, of which, 268 received a primary GA (no prior regional technique), and 593 received RA. 65 were converted from RA to GA, giving a RA to GA conversion rate of 11% (95% CI 8.6-13.8). Presence of both consultant anesthesiologist and consultant obstetrician on the labor ward were found to have a significant effect.

Discussion: The RA to GA conversion rate for category 1 CS was 11%, which was within the standard of <15%. Consultant anesthesiologist presence was found to be a significant factor, with absence of a consultant anesthesiologist more than doubling the RA to GA conversion rate. Absence of a consultant obstetrician had an even greater effect, resulting in a RA to GA conversion rate of 16%, exceeding the standard set by the RCOA. Our findings suggest, that junior staff, in the absence of direct consultant support, are more likely to convert a RA technique to GA. This could possibly be due to a lack of experience, or a perceived lack of time.

Conclusion: Consultant presence on the labor ward reduces the RA to GA conversion rate for category 1 CS.

Reference:

1. Royal College of Anaesthetists. Raising the Standard: a compendium of audit recipes. 3rd Edition 2012.

Consultant	Present	Absent	Difference %	*P*-value
Anesthesiologist	12/215 (5.6%)	52/442 (12%)	6.4 (1.7-10.6)	0.0083
Obstetrician	30/374 (8.0%)	35/219 (16%)	8.0 (2.7-13.9)	0.0028

Abstract #:F-08

Postpartum pain management: improving patient satisfaction

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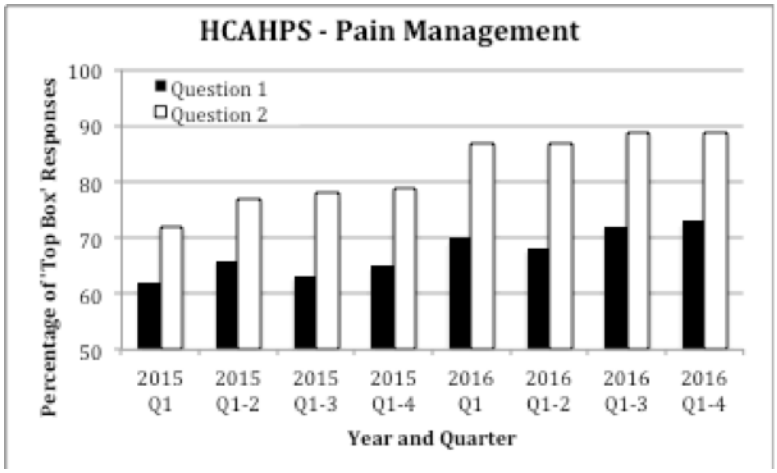
Objective: Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS) scores are standardized, publicly reported results that measure patients' perceptions of their hospital experience. This national survey allows for comparisons across hospitals and also has financial implications as scores are linked to reimbursement. In an effort to improve patient satisfaction and HCAHPS scores on our obstetric unit, particularly in pain management, we implemented a multimodal analgesic pathway with intent to maximize analgesia while minimizing opioid use.

Study Design: Prior to pathway implementation, cesarean patients received patient controlled epidural anesthesia (PCEA) for 12-18 hrs post-op. Upon stopping PCEA, oral analgesics were dispensed as needed (PRN) including acetaminophen 650 mg every 4-6 hrs, ibuprofen 600 mg every 6 hrs, and/or oxycodone 5-10 mg every 4-6 hrs. After vaginal delivery, neuraxial anesthesia was discontinued and the same analgesics PRN were started. The new pathway included a change in oral medications (dose, timing) for all patients. After cesarean, 2 hours before discontinuing PCEA, scheduled acetaminophen (1 g every 8 hrs) and ibuprofen (600 mg every 6 hrs) are administered. Breakthrough pain is treated with lidoderm patch and/or opioids PRN. Patients with mild/moderate pain are offered oxycodone 5-10 mg every 4 hrs; those with severe pain are offered hydromorphone 2 mg every 4 hrs. HCAHPS address pain management with 2 questions: Question 1: How often was your pain well controlled? Question 2: How often did the hospital staff do everything they could to help you with your pain?

Results: See Table. Scores for 2015 and 2016, divided into quarters (Q) (cumulatively), are presented as % of responses in the Top Box, the most positive response category. Top Box responses increased after the new pathway was implemented in Q1 of 2016, particularly Question 1. Total responses: 214 for 2015; 163 for 2016.

Conclusion: A multimodal analgesic regimen including the combination of scheduled acetaminophen and ibuprofen and PRN subcutaneous local anesthetics and opioids appears to improve pain management and overall satisfaction. No other systematic intervention occurred during this time frame to explain these positive changes. This is a relatively simple and inexpensive intervention to enhance patient satisfaction and may also reduce opioid use, which may have important implications.



Abstract #:F-09

Alkaline Battery vs. A/C Power for PIEB Infusion Epidural Pump

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Background: Alkaline battery powered epidural PIEB (programmed intermittent epidural bolus) pumps are common among the major training institutions in the country for obstetric anesthesia, and drain batteries much faster than non-PIEB pumps (88 hours vs 113 hours)1. The batteries represent a recurrent consumable product use that conveys little benefit to the patient, and could cause harm given the low battery alarm starts at 25% capacity. This could disrupt the labor experience and be a concern for the patient and family that something is going wrong. Additionally many partially-used batteries are disposed of, something that runs counter to our institution's commitment to environmental sustainability and the Greening the OR initiatives2,3. The use of alkaline batteries in the CADD®-Solis pump is likely very common since it is sold without an A/C adapter4. This makes sense for pumps used as PCAs and PCEAs for mobile non-laboring patients, but laboring patients with epidural catheters are generally non-ambulatory. In addition to the logistical and environmental considerations3, medicine is increasingly moving toward cost savings given declining reimbursements, making efficiency ever more important.

Methods: Our cost analysis took into account the major factors involved including alkaline battery acquisition cost ($0.64 per pack of 4 AA batteries with a CADD®-Solis PIEB pump requiring one pack), and cost of A/C adaptor per room ($145).

Results:

$0.64 per pack x 484 packs used per year = $310 yearly acquisition cost of batteries

$145 per A/C adaptor x 9 L&D rooms = $1305 one-time acquisition cost of adaptors

$1305 ÷ $310 = 4.2 years to recover initial investment cost

Discussion:

A/C power adapters for the CADD®-Solis pump while having a large initial cost, proved effective in decreasing variable costs and staff time in a high-risk low volume academic center providing approximately 1400 labor analgesics per year. The disposal of nearly 2000 AA batteries per year is prevented. An added and unquantifiable benefit of A/C power was the removal of the frequent stress-inducing low-battery alarm. The benefits and time to recoup the initial investment cost would be even faster in an L&D unit with higher bed utilization.

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Abstract #:F-10

Implementation of a Pharmacologic Prophylaxis Program to Prevent Obstetric Associated Venous Thromboembolism in an Urban Safety Net Hospital

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Introduction: In response to a series of venous thromboembolic (VTE) events, and in accordance with mounting medical evidence, we launched a collaborative project to implement a bundle of care for prophylaxis against pregnancy-associated VTE in our urban, safety-net population.

Methods: A multi-disciplinary team developed and implemented a comprehensive VTE prophylaxis care bundle. The bundle included: a risk assessment tool, a pharmacologic order set, extensive staff and patient education, and medical documentation improvements aimed at in-hospital VTE prophylaxis and post-discharge outpatient prophylaxis. The risk assessment tool, order set and staff "cheat sheet" were developed through series of rapid Plan Do Study Act cycles. The "cheat sheet" contains our risk assessment scoring system, pharmacologic prophyaxis drugs and doses and an algorithm for managing regional anesthesia and pharmacologic prophyaxis in the peri partum period. Laminated versions of the "cheat sheet" are widely distributed throughout our Labor and Delivery unit.

Results: We determined that 45% of our patients are high risk for VTE. In the most recent quarter since the launch of the pharmacologic order set, 98% of our high risk patients received inpatient pharmacologic VTE prophylaxis and were given a prescription for post-discharge medication. In the last quarter of measurement, 73% of patients contacted after discharge reported continuing the recommended chemoprophylaxis.

Conclusion: This project demonstrates that an urban safety-net institution can successfully implement a comprehensive bundle for VTE prophylaxis for hospitalized ante- and post-partum patients with a high rate post-discharge continuation in at risk patients. This care bundle was developed and implemented by a multi-disciplinary team using standard quality improvement tools.

Abstract #:F-10

VTE GUIDELINES for OB

VTE Treatment for Every Stage of Care

	Ambulation	Mechanical Prophylaxis (SCD)	Prophylactic Dose LMWH or UFH*	Treatment Dose LMWH or UFH*
Prenatal Assessment			▸ Prior VTE: • Idiopathic VTE • VTE with pregnancy or oral contraceptives • VTE with LR thrombophilia ▸ Family History of VTE with HR thrombophilia ▸ HR thrombophilia	▸ Multiple VTE Episodes ▸ VTE with HR thrombophilia ▸ VTE with acquired thrombophilia *Consult with MFM Team
Antepartum Hospitalization	Yes, if not on bed rest	Yes, if on bed rest	Patient Score is ≥ 2 (see score chart)	*Consult with MFM Team
Delivery Hospitalization*	Yes, if not on bed rest	Yes, any surgical procedure	Patient Score is ≥ 2 (see score chart)	*Consult with MFM Team
*** Important: Initiate Anticoagulation Post-Delivery**				
Discharge			If Patient Score is ≥ 2: 10 days prophylactic dose If Patient Score is ≥ 2 and patient has any of the following – Prior VTE (Idiopathic or Provoked VTE, VTE with pregnancy or oral contraceptives, VTE with LR thrombophilia), Family History of VTE with HR or LR thrombophilia, or HR thrombophilia: 6 weeks prophylactic dose	*Consult with MFM Team

A VTE Risk Assessment should be performed for every patient on admission, after delivery, after any surgical procedure and at discharge. To calculate the score, sum the total of all of your patient's risk factor score points (the 1 or 2 to the right of the risk factor). A score of ≥ 2 indicates high risk; a score of 0 or 1 indicates low risk.

Score System Key

- ▸ Already receiving prophylactic LMWH or UFH as outpatient (2)
- ▸ Any history of VTE (2)
- ▸ HR Thrombophilia (see definition below) (2)
- ▸ Thrombophilia and family history of VTE (2)
- ▸ LR Thrombophilia (see definition below) (1)
- ▸ Any Surgical Procedure (2)
- ▸ Bed Rest ≥ 3 days (2)
- ▸ Pre-pregnancy Morbid Obesity (BMI ≥ 40+) (2)
- ▸ Pre-Pregnancy Obesity (BMI ≥ 30-39) (1)
- ▸ Age >40 or <15 (1)
- ▸ ART (assisted reproductive technology) (1)
- ▸ General Anesthesia (1)
- ▸ Heart Disease (1)
- ▸ Postpartum OB hemmorhage >1000 ccs (if stable after 12-24 hours) (1)
- ▸ Hysterectomy (1)
- ▸ IUGR (intrauterine growth restriction) (1)
- ▸ Lupus (1)
- ▸ Major Infection: Chorioamnionitis, SIRS, Sepsis (1)
- ▸ Multiple Gestation (1)
- ▸ Preeclampsia (1)
- ▸ Renal Disease (1)
- ▸ Sickle Cell (1)

***Contraindications for LMWH or UFH**

- ▸ Hemophilia or other known bleeding disorder
- ▸ Antenatal Patients: Active or threatened bleeding (e.g. placenta previa, placental abruption) based on clinical judgment of balancing risks/benefits (consider holding LMWH/UFH 12-24 hours after bleeding stops)
- ▸ Thrombocytopenia (platelet count <75 x10^9)
- ▸ Recent stroke (hemorrhagic/ischemic)
- ▸ Severe renal disease (GFR <30ml/min)
- ▸ Severe liver disease (prolonged PT)
- ▸ Uncontrolled hypertension (BP >200mmHg systolic or >120mmHg diastolic)
- ▸ Unfractionated heparin should be used if there is a specific contraindication to LMWH
- ▸ **Admission for delivery**

Definitions:

High-risk thrombophilia (HR): Factor V Leiden or prothrombin gene mutation homozygous, Antithrombin III deficiency, Compound heterozygote disorders (FVL and prothrombin)

Low-risk thrombophilia (LR): Factor V Leiden or prothrombin gene mutation heterozygous, Protein C or S deficiency

Acquired thrombophilia: Antiphospholipid antibody syndrome

Provoked VTE: VTE event occurring in the setting of a temporary risk factor (ie. Orthopedic surgery, indwelling catheter, immobilization)

Unprovoked VTE: VTE event in the absence of a temporary risk factor

Protocols for Prophylaxis

Agent	LMWH Enoxaparin	UFH Unfractionated Heparin	
Dosed Based on Weight		**Dosed Based on Trimester**	
<50kg	20mg daily	First trimester	5000 units BID
50-90kg	40mg daily	Second trimester	7500 units BID
91-130kg	60mg daily	Third trimester	10000 units BID
131-170kg	40mg BID (80mg daily if patient declines BID dosing)	Postpartum	5000 units BID
>170kg	0.6mg/kg/day (Divided BID)		

Hospitalized antepartum patients may receive 5000 units UFH twice daily for prophylaxis to facilitate regional anesthesia

Adapted from ACOG Practice Bulletin 123, ACCP Recommendations , RCOG Green Top Guideline 37a

Abstract #:F-11

Neuraxial Anesthesia in Obstetric Patients Receiving Thromboprophylaxis with Unfractionated or Low Molecular Weight Heparin: a Systematic Review of Spinal Epidural Hematoma

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Background: Venous thromboembolism (VTE) is a major source of maternal morbidity and mortality, with an incidence of 29.8/100,000 vaginal delivery hospitalizations and a 2-fold increased VTE risk with cesarean delivery.(1)Revised national guidelines stipulate that mechanical or pharmacological prophylaxis be used for most women after cesarean and for those at risk for ante-or postpartum VTE. In light of these practice changes, examining the literature to determine the incidence of spinal epidural hematomas (SEH) among anticoagulated women after neuraxial block is timely and topical. Our primary aim was to identify SEH associated with neuraxial anesthesia in obstetric patients with unfractionated or low molecular weight heparin thromboprophylaxis. Our secondary aim was to identify SEH in obstetric patients with thromboprophylaxis and neuraxial anesthesia without the ASRA recommended time interval between dose and neuraxial procedure.

Methods: We conducted a systematic review of published English language studies (1952- 2016) and of the Anesthesia Closed Claims Project Database (1990-2013) to identify relevant cases. Ten of 736 publications met inclusion criteria and were combined with the 5 SEH cases within 546 obstetric anesthesia Closed Claims reviews.

Results: There was no report of SEH associated with neuraxial anesthesia and thromboprophylaxis in obstetric patients. We identified 2 cases of SEH in postpartum women with neuraxial anesthesia unrelated to their thromboprophylaxis (Table). In addition, of 296 obstetric cases reported in the 10 relevant publications, 80 parturients received their neuraxial procedure before the ASRA recommended time interval since last heparin dose and did not develop a SEH.

Discussion: It is encouraging that this broad systematic review did not identify a single case of SEH after neuraxial anesthesia among obstetric patients receiving thromboprophylaxis. Analysis of large scale registries with additional clinical and pharmacological data is needed to assess the impact of recent national VTE prophylaxis guidelines on SEH incidence in the obstetric population. In the interim, optimal care of obstetric patients will depend on multidisciplinary planning of anticoagulation dosing to facilitate neuraxial anesthesia, and thoughtful weighing of the relative risks and benefits of providing versus withholding neuraxial in favor of general anesthesia or non-neuraxial labor analgesic techniques.

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Abstract #:F-11

Table. Two Case Reports of Spinal Epidural Hematoma in Postpartum Women with Neuraxial Anesthesia Unrelated to Their Thromboprophylaxis

Study	Anesthetic and Mode of Delivery	Heparin	History	Signs/ symptoms	Outcome
Walters, *Int J Obstet Anesth,* **2012**	CSE (PCEA maintained for post-delivery pain management)	Enoxaparin 40 mg qPM after surgery	Otherwise healthy	Symptoms began *before* LMWH dose: Shortly post-op, new back pain with radiation down legs; progressive bilateral weakness and sensory changes *prior to* enoxaparin dose	Wheelchair bound due to persistent motor deficit; neuropathic pain.
Chiaghana *Reg Anesth Pain Med,* **2016**	Continuous Spinal Anesthesia	*Pre-op:* UFH 7500U SQ bid (held), ASA (continued) *Post-op:* **Day 1** Enoxaparin 1 mg/kg >12 hrs after catheter removal **Day 3** Enoxaparin 1 mg/kg bid for pulmonary embolus	Fontan, morbid obesity, superficial phlebitis	Symptoms did not occur until *after* therapeutic anticoagulation for pulmonary embolus: Back pain, perineal paresthesia, Lower extremity weakness and MRI-confirmed hematoma occurred 1 day after full dose anticoagulation.	Full recovery after 18 months.

[1]

[1] UFH= Unfractionated Heparin; ASA= aspirin; Bid= twice, daily; CD=cesarean delivery; Post-op=postoperatively; qPM= per night; CSE=combined spinal epidural; PCEA=patient-controlled epidural analgesia

Abstract #:F-12

The Obstetric Anesthesiology Match: Feelings Behind the Numbers

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Introduction: The obstetric anesthesiology fellowship joined the NRMP's Specialties Matching Service in 2015 and has matched two fellowship classes. Results are weaker than anticipated. We present a comparison of the first two years of match results in cardiothoracic anesthesia, pain medicine, and pediatric anesthesia fellowships with the obstetric anesthesia fellowship. An assessment of resident and fellow perceptions of the OB anesthesia fellowship is underway and will add context to the match data.

Results: The first obstetric anesthesia match included 25 applicants who applied for 48 available positions. Twenty-three applicants matched, leaving two applicants unmatched. The small applicant pool left unfilled positions at 61% of participating programs (2). The 2016 match included 29 applicants who applied for 43 positions. Twenty-six applicants matched, leaving three unmatched participants and unfilled positions at 58% of participating programs (1). We compared these results to the first two matching years in other anesthesiology specialty matches (See Chart 1). Cardiothoracic, pain and pediatric fellowships each enjoyed stronger initial matches demonstrated by larger applicant pools and a lower number of unfilled positions(1,3).

Discussion: The obstetric anesthesia fellowship match data demonstrates 0.5 and 0.7 applicants per position for the first and second match year respectively. The relatively limited applicant pool and high number of unfilled programs raises concerns about resident interest in obstetric anesthesiology. We aim to assess resident perceptions of the obstetric anesthesiology fellowship. An IRB exempt survey sent to all current U.S. anesthesiology residents and fellows seeks to assess barriers to entry into OB anesthesiology and potential areas for improvement. Survey results will be highlighted in presentation at SOAP annual meeting.

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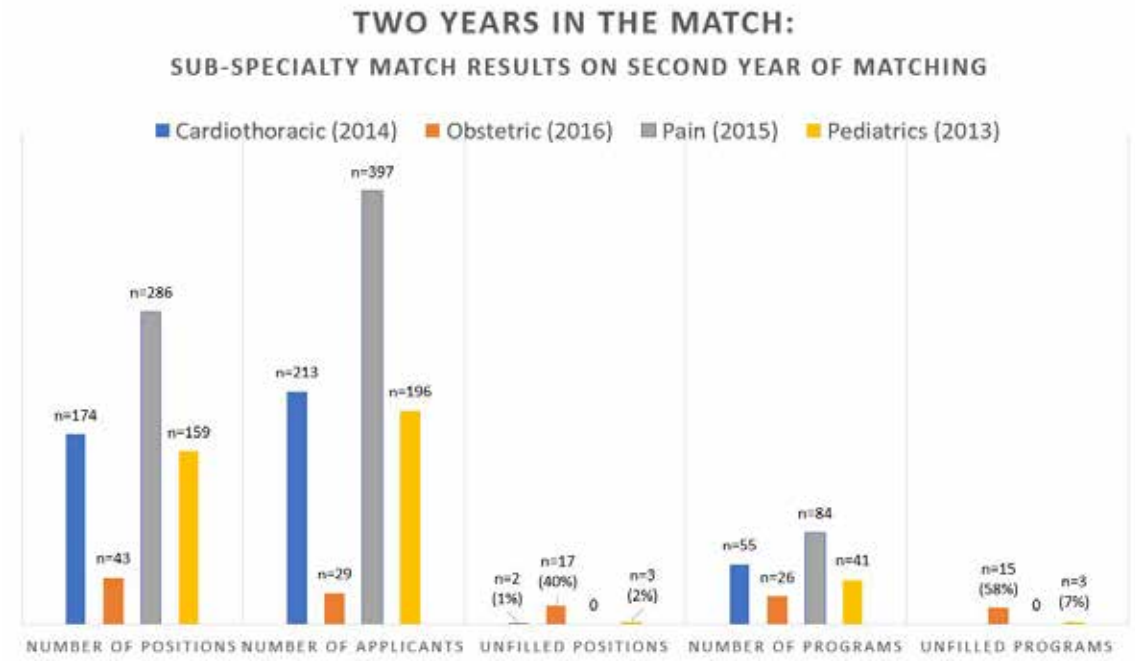

Abstract #:F-13

Opioid Prescription/Patient Use Mismatch: Prospective Cohort Study of Post-Discharge Opioid Use Following Cesarean

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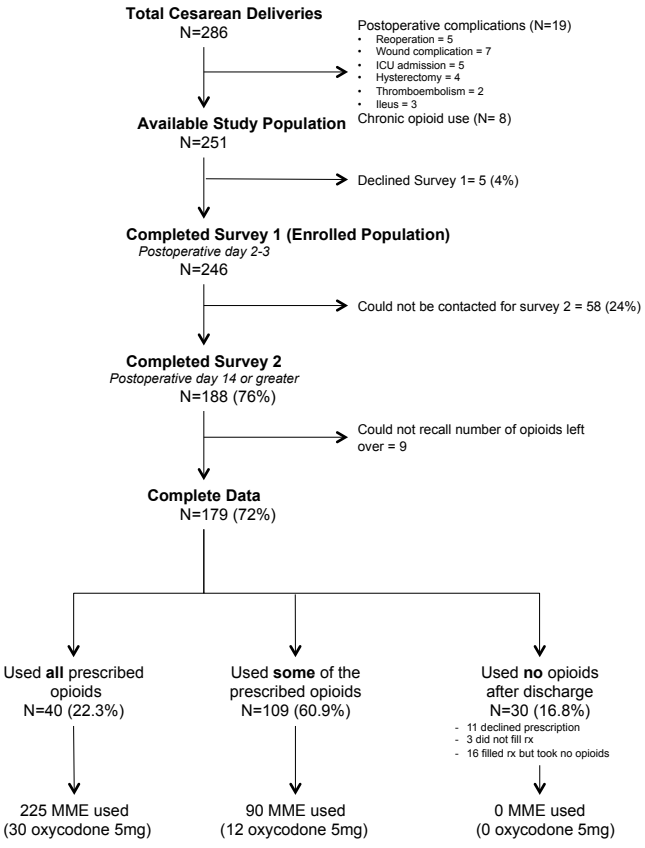
Aim: To compare opioids prescribed and opioids used by women following discharge after cesarean delivery (CD).

Methods: After IRB approval, all women undergoing CD over an 8 week period, without major chronic opioid use or peri-op morbidity, were recruited. Subjects were enrolled/surveyed on post-op day (POD) 1-2. Information on demographics, CD, and in-hospital opioid and non-opioid analgesic use was drawn from the medical record. Subjects were surveyed on POD 14 to assess post-op pain and quantify analgesic use. The TN Controlled Substance Monitoring Program was accessed to confirm that prescriptions were filled. All opioid use comparisons were made using morphine milligram equivalents (MME). The high post-discharge opioid use group (top quartile) was compared to average opioid use group (remainder). Multivariable logistic regression was used to evaluate associations between high MME use and variables found to be associated in univariate analysis. Manual backward elimination was used to select a model that retained only those variables significant at the 0.05 significance level.

Results: Of 286 CDs during the study period, 251 met inclusion eligibility. Of these, 246 participated. Complete data were available for 179, or 72% (Figure). Post-discharge prescribing practices were highly variable (60 to 630 MME). Most women (83%) used opioids after discharge, and for a median of 8 days (IQR 6-13 days). Of 165 women who filled their prescriptions, 125 (76%) had leftover pills (75 MME [IQR 0-187, max 630]). Most 77 (61%) reported keeping leftover pills in unsecured locations at home. Women who used all prescribed opioids were more likely to report that they received too few pills than women who used some or no prescribed opioids (33% vs 5%, p<0.05). Compared to the average post-discharge opioid use group, the high use group had greater in-hospital opioid MME use overall (103 +/- 51 vs 67 +/- 53, P<0.001), per hour (1.5+0.7 vs 0.9+0.7, <0.001), and during the 2nd, 3rd, and 4th 12-hour post-op epochs (P<0.001 for each comparison). Excess prescribed opioids totaled 19,046 MME for these 179 patients, equivalent to 2,540 unused oxycodone 5mg tablets (est. 16,500/yr).

Conclusion: Despite variable opioid prescription practices, most patients are prescribed far more than they use after discharge. Our results suggest that considering in-hospital opioid use to individualize post-discharge opioid prescriptions may help reduce excessive opioid prescribing practices.



Abstract #:F-14

In-Hospital Mortality and Hospital Readmissions in Parturients with Cardiovascular Disease: A National Readmissions Database Study

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Introduction: Cardiovascular disease (CVD) is the leading cause of mortality among parturients in the U.S.1. Potential causes for this include: women with congenital heart disease living longer, advanced maternal age, and a higher prevalence of comorbidities such as obesity, diabetes mellitus and hypertensive diseases of pregnancy. However, the incidence, outcomes and risk factors for readmission in patients with CVD at delivery are poorly characterized. Using a large national database, we examined the mortality rate and risk factors associated with 30-day readmission in parturients with CVD.

Methods: A retrospective cohort analysis was done using data from the National Readmission Database (NRD) for 2013-14. The NRD is maintained by the Agency for Healthcare Quality and Research and can be weighted to produce national estimates. Unweighted the NRD contains 14-million discharges for 2013, weighted it is approximately 35-million discharges, accounting for 51.2% of the U.S. population and 49.3 % of all U.S. hospitalizations2. Women admitted for delivery were further identified as having CVD using Clinical Classifications Software (CCS) definitions3 where patient diagnoses are clustered into clinically important categories. We used clustered logistic regression modeling to predict risk factors for readmissions.

Results: Of the 6,983,133 women who delivered during 2013-14, 825,371 (11.82%) had CVD. Overall, in-hospital mortality rate was 18/100,000 compared to 90.3/100,000 in patients with CVD and 8/100,000 in women without CVD. Overall, 30-day readmission in all women was 1.4%, 3.5% in women with CVD, and 1.13% in women without CVD. The mean time between initial discharge and readmission was 8.44 days in patients with CVD. The most common reasons for readmission included: hypertensive disorders (33%) and wound infection (10.9%). Most common risk factors for readmission were trauma, heart failure, venous thromboembolism, and chronic renal disease.

Conclusion: Cardiovascular disease during pregnancy is associated with substantial morbidity and mortality. Readmissions in this patient population are often related to hypertensive disorders and wound infection. Improved management of peripartum hypertension may lead to a decrease in readmissions for these patients.

References:

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Abstract #:F-14

	TABLE 1			
	Readmitted	**Not Readmitted**	**P-value**	**OR (95% CI)**
Variables	N=28451	N=787939		
Age Categories (years)			<0.0001	
15-24	6393(22.21)	214042(26.90)		Reference
25-34	13584(47.19)	421286(52.94)		**1.07(1.01-1.14)**
35-45	8809(30.60)	160447(20.16)		**1.53(1.44-1.64)**
Type of Admission			<0.0001	
Elective(1)	11122(38.73)	374412(47.15)		**0.73(0.7-0.77)**
Nonelective (0)	17595(61.27)	419701(52.85)		Reference
Associated diagnoses				
Pulmonary Hypertension	235(0.82)	1621(0.20)	<0.0001	**1.29(1-1.67)**
Chronic ischemic heart disease	405(1.41)	2183(0.27)	<0.0001	**1.7(1.35-2.16)**
SLE	504(1.75)	3064(0.39)	<0.0001	**1.72(1.43-2.08)**
Drug Abuse	1714(5.95)	20520(2.58)	<0.0001	**1.7(1.54-1.86)**
Chronic Renal Disease	1983(6.89)	8348(1.05)	<0.0001	**2.9(2.61-3.22)**
Sickle Cell Disease	485(1.69)	8090(1.02)	<0.0001	**1.32(1.07-1.58)**
Diabetes Mellitus	5867(20.38)	117697(14.79)	<0.0001	**1.15(1.09-1.21)**
Severe Pre-eclampsia	4203(14.6)	110541(13.89)	0.057	**1.11(1.04-1.84)**
C-section	16019(55.65)	376026(47.25)	<0.0001	**1.25(1.19-1.30)**
Multiple Gestation	1299(4.51)	30763(3.87)	0.001	**1.14(1.04-1.26)**
Postpartum Hemorrhage	1648(5.73)	40347(5.07)	0.003	**1.15(1.06-1.25)**
Heart Failure	958(3.33)	5053(0.63)	<0.0001	**2.23(1.95-2.55)**
Sepsis	655(2.27)	7217(0.91)	<0.0001	**1.67(1.44-1.92)**
Anesthesia Complications	193(0.67)	4130(0.52)	0.058	**1.26(1-1.61)**
Venous thromboembolism	112(0.39)	710(0.09)	<0.0001	**2.69(1.88-3.86)**
Eclampsia	227(0.79)	4227(0.53)	0.003	**1.41(1.12-1.79)**
Trauma	82(0.29)	724(0.09)	0.0014	**2(1.29-3.12)**
Magnesium Toxicity	591(2.05)	3623(.46)	<0.0001	**2.27(1.92-2.68)**

Abstract #:F-15

Blood transfusion in childbirth: Does it matter if you're preeclamptic?

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Introduction: Although hemorrhage remains one of the most important causes of maternal peripartum mortality, few studies have attempted to identify risk factors for peripartum hemorrhage (1,2,3). One potential risk factor might be preeclampsia. Preeclampsia can result in intravascular volume depletion, poor organ perfusion, and thrombocytopenia as part of HELLP syndrome (hemolysis, elevated liver enzymes, and low platelets). Preeclamptic patients could be at higher risk for red blood cell transfusion because of magnesium sulfate-induced uterine relaxation, prolonged induction of labor, impaired platelet function from aspirin ordered by obstetricians, or from thrombocytopenia. We hypothesized that preeclampsia is associated with an increased risk of transfusion during vaginal delivery or cesarean section, when compared to patients without preeclampsia.

Methods: We used an IRB-approved transfusion database described previously (3). Data collected from 2009 to 2015 were analyzed retrospectively, which included patient characteristics and diagnoses, mode of delivery, and administration of blood products. We identified a subset of patients with preeclampsia as diagnosed by the obstetrician. No patients were excluded. Numbers of patients who underwent red blood cell transfusion were compared in the two groups by t-test and one way analysis of variance.

Results: A total of 4447 and 917 patients without and with preeclampsia, respectively, underwent either vaginal delivery or cesarean section. Mean admission hemoglobin was lower for preeclamptics mean 11.2 (std dev 1.49) than those for nonpreeclamptics 11.4 (std dev 1.41, $P<0.0076$). The lowest hemoglobin revealed a similar trend: preeclamptics 9.73 (std dev 1.76) and nonpreeclamptic 10.4 (std dev 1.76, $P<0.001$). Preeclamptics received more red blood cell transfusion during their total hospital stay with mean 0.27 (std dev 1.29) compared to nonpreeclamptics 0.13 (std dev 0.85, $P<0.007$). Interestingly, preeclamptics had lower last hemoglobin prior to discharge at mean 10.2 (std dev 1.63) compared to nonpreeclamptics at mean 10.6 (std dev 1.65, $P<0.0002$).

Conclusions: We observed that preeclamptic patients received significantly more blood transfusions than nonpreeclamptic parturients during their hospital stay. Interestingly, they were also more anemic on admission and prior to discharge, despite the increased blood transfusion. Despite the less pronounced dilutional anemia due to intravascular depletion, and despite the uncommon incidence of HELLP syndrome, preeclamptics may still receive more red blood cell transfusion due to thrombocytopathia or inefficient uterine tone post delivery, for example. Knowledge of the increased risk of transfusion may lead to earlier recognition and improved care.

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Abstract #:F-16

A multidisciplinary team consensus on the allocation of resources, roles and responsibilities at emergency crash cesarean deliveries

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Introduction: Emergency crash cesarean deliveries are usually performed in a sporadic manner and are often chaotic moments on the Labor and Delivery floor (1). The necessary tasks are completed in a haphazard manner that risks patient safety and is often stressful for the health care professionals involved(2-4). The aims of this study are: 1) to identify the current barriers that limit the ability of the multidisciplinary team to perform emergency crash cesarean deliveries in an organized, co-ordinated and timely manner; 2) to generate a protocol to perform these tasks in an organized fashion.

Method: This is an ongoing study where a modified Delphi technique(5)is being used as a consensus building tool to obtain the opinions of an expert panel of anesthesiologists, obstetricians, obstetric nurses, respiratory therapists/anesthesia assistants and neonatologists. The study is being conducted in four rounds. An open-ended questionnaire was sent out in Round 1 to gather opinions on the current challenges in performing an emergency crash cesarean delivery and the possible suggested solutions. The level of agreement with the opinions stated in Round 1 was then sought in Round 2. Ideas that reached an agreement >70% were considered to have achieved consensus. These ideas will be used in Round 3 to build a list of resources, roles and tasks required for an emergency crash cesarean delivery, based on a face-to-face multidisciplinary discussion with 1-2 representative (s) of each stakeholder. We will then build a practical guideline/algorithm that details resource and task allocations as well as communication. Agreement on such document will be sought in Round 4.

Results: We invited 35 subjects representing the five stakeholder groups; 25 consented to the study. In Round 1, communication across the multi-disciplinary teams and human resource allocation were the main themes of the current challenges experienced by the team. In Round 2, there was consensus within the stakeholders about the following 1) need for an agreed definition of emergency crash cesarean delivery; 2) need for an agreed criteria for urgency; 3) need to improve handover of patient information across the specialities; 4) need to improve assistance available to anesthetists to provide general anesthesia; 5) need to improve the inefficiency of the process due to inadequate number of nurses to carry out tasks; 6) need to define a leader for the emergency situation.

Conclusion: Major deficiencies in our current system have been identified. The results of this study will provide a tool for education of the multidisciplinary team involved in emergency crash cesarean deliveries.

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Abstract #:F-17

Does an Epidural Precision Checklist, Scoring Tool, and Direct Feedback Enhance Resident Education?

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Introduction: Epidural teaching methods and feedback vary greatly not only from institution to institution but also from person to person leading to learner confusion and a potential delay in acquisition of competency (1). There is no standard of care or benchmark for the evaluation or education of resident skills during the placement of a lumbar epidural. One study reported that only 33% of initial residents felt prepared before their first epidural and 67% reported having workplace stress (2). We hypothesize that using a procedural checklist, using a grading scale for epidural placement, and providing direct feedback will help improve, enhance, and accelerate epidural competency for trainees.

Methods: We created a step-by-step checklist and guide on how to perform an epidural and distributed the checklist to residents before their OB rotation. We used a seven-domain global rating scale (GRS) for the assessment of residents performing the lumbar epidural. After being evaluated with the GRS tool, residents were given a post-epidural debriefing session. All residents were sent a pre and post-rotation survey to assess the value of each education component at the beginning and end of the rotation.

Results: 24 GRS assessments and debriefing sessions have been completed to date; recruitment is ongoing. 12 of the 18 residents (67%) completed the pre-rotation survey and 7 of the 18 residents (39%) completed the post-rotation survey. Interim results showed that 71% of the residents felt that debriefing after performing an epidural was helpful . The most helpful method of teaching was real-time feedback while performing the epidural. The least helpful method of teaching was Medhub evaluation and comments. Post-study survey results also demonstrated that the GRS and debriefing feedback methods sped up learning of procedural skills and is considered a fair way to evaluate residents (Table 1).

Conclusion: Our preliminary results indicate that the epidural checklist, GRS, and debriefing sessions are valuable educational tools. They provide immediate and direct objective feedback to trainees as opposed to the usual subjective feedback. Trainees can then focus on improving specific points on the grading scale and have a better understanding of the procedure, thereby, also, reducing their anxiety and stress while performing procedures.

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Table 1. How much do the new epidural assessment and debriefing sessions:		
	Mean*	Std Deviation
Speed up learning prodecural skills (epidural, regional blocks)	7.14	1.96
Help you learn professionalism	7	2.14
Seem like a fair way of evaluating residents and fellows	8.29	1.48
*based on a scale of 1 = not at all, 10 = definitely		

Abstract #:F-18

Severe and prolonged hypotension during spinal anesthesia for elective cesarean delivery is associated with transient tachypnea of newborn

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Introduction: Transient tachypnea of newborn (TTN) is one of the most common causes of respiratory distress in early life, with the risk 6-7 fold higher for infants born via elective cesarean compared to vaginal delivery. Though multiple hypotheses exist to explain this increased risk, no study has explored spinal anesthesia-induced hemodynamic instability as a possible mechanism. Our study aimed to determine the association between perioperative hemodynamic changes and TTN during elective cesarean delivery.

Materials and methods: In this case-control study, we reviewed the anesthesia records of all elective cesarean deliveries between July 2015 and January 2016 after IRB approval. We excluded women with pregnancy induced or chronic hypertension, diabetes, and babies with known congenital anomalies. Patients received spinal anesthesia according to institutional protocol. We defined intraoperative hypotension as SBP (systolic blood pressure) < 100 mmHg or < 80% of baseline SBP, and severe hypotension as either SBP < 90 mmHg or MAP (mean arterial pressure) < 65 mmHg prior to delivery. Demographic data, details of anesthetic management, degree and duration of hypotension, and total vasopressor requirement (as phenylephrine equivalents) were abstracted. Data were analysed with either Fisher's exact or student's t-test as appropriate and expressed as mean ± SD; $P < 0.05$ was accorded statistical significance.

Results: Overall, we identified 30 cases (Group T) and controls (Group C). Baseline characteristics such as maternal age, body mass index, gestational age, and neonatal birth weight were comparable between groups. The proportion of patients with post-spinal hypotension was not different between groups (26/30 vs. 29/30, Groups T and C, respectively; P=0.35). There was a trend towards a higher incidence of severe hypotension in Group T (20/30) compared to C (12/30) (P=0.07). Both SBP and MAP nadirs were more severe in Group T compared to Group C (83±14 and 60±10 vs. 91±12 and 66±8, mmHg; P=0.014 and 0.025, respectively). Furthermore, the duration of time when SBP < 90 mmHg was significantly higher in Group T (2.4 ± 2.7 min) compared to Group C (0.8 ± 1.4 min) (P=0.005). Similarly, the duration of severe hypotension (MAP < 65 mmHg) was also significantly higher in Group T (2.3 ± 2.8 min) than Group C (1.03 ± 1.8 mins) (P=0.046). Finally, total vasopressor use in terms of phenylephrine (μg) equivalents was significantly higher in Group T (663.95 ± 426.38) compared to Group C (298.85 ± 205.85) (P<0.001).

Conclusions: Our study provides convincing evidence that both the duration and the degree (lowest SBP and MAP attained) of severe maternal hypotension (SBP < 90 and MAP < 65 mmHg) following spinal anesthesia are associated with TTN during elective cesarean delivery. Our findings lend further evidence to support the prevailing notion of pre-emptive, rather than reactive, blood pressure control during elective cesarean delivery.

Abstract #:F-19

An Evidence Based Oxytocin Protocol for the Third Stage of Labor Decreases Postpartum Hemorrhage Rates

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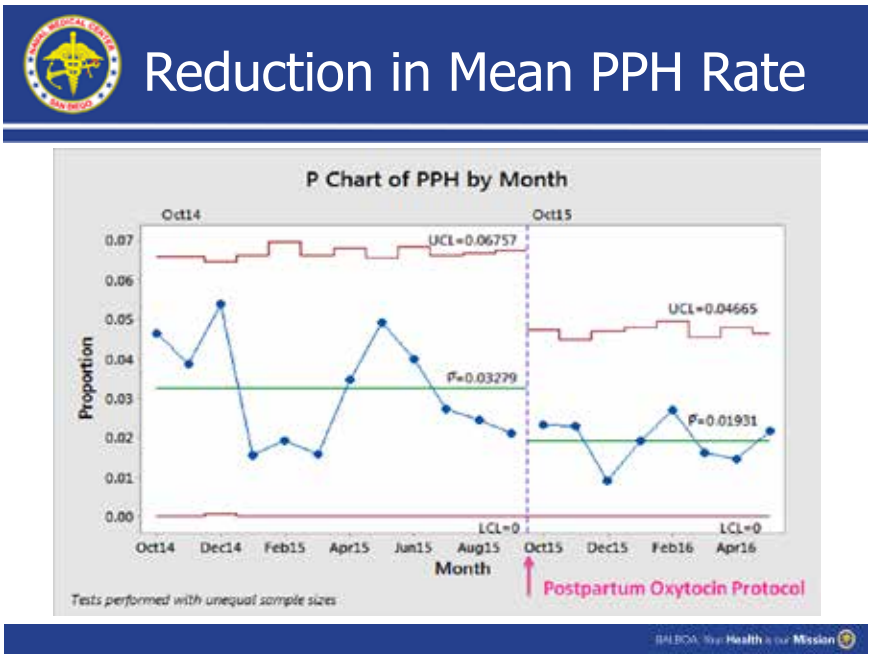
Introduction: The optimum dose, timing and duration of oxytocin in the third stage of labor is not well studied. We initiated an evidence based oxytocin protocol for management of the third stage of labor to decrease postpartum hemorrhage (PPH) rates.

Methods: Our institution prioritized adopting a protocol applicable to all modes of delivery which could be administered in the delivery suite and the operating room. The Departments of Anesthesiology and Obstetrics and Gynecology collaboratively developed an evidence based infusion protocol for oxytocin in the third stage of labor. After delivery, a three unit bolus of oxytocin was administered by infusion pump over three minutes. If uterine tone was inadequate, a second three unit bolus was administered. Following the bolus(es), an oxytocin infusion was started at 300 mU/hr x one hour, then 60 mU/hr for three hours. After IRB review, data on PPH, delayed PPH, uterotonics, and balloon tamponade use were collected for the six months prior to and six months following implementation of the protocol. Data collection is ongoing and data will be re-analyzed at 18 months post implementation. The proportion of events before and after implementation were compared, and linear regression modeling was used to compare PPH rates with mode of delivery.

Results: Six months following implementation, we demonstrated a 40% decrease in PPH from a proportion of 0.033 to 0.019. The rate of delayed PPH also decreased by 16.5%, from a proportion of 0.44 to 0.27. There was a negative correlation between cesarean delivery and PPH, r2 = 79.4%, and between vaginal delivery and PPH, r2 = 20.6%. The use of additional uterotonics was reduced by 50% after the implementation of the new protocol. Data will undergo another interval analysis in March 2017.

Conclusion: Implementation of a standardized oxytocin protocol in the third stage of labor resulted in a significant decrease in PPH and delayed PPH for both vaginal and cesarean deliveries.



Abstract #:F-20

Is oxytocin protective against pain? Evidence of an association between plasma oxytocin levels and acute and chronic pain after cesarean delivery

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Introduction: Persistent postsurgical pain has been a topic of increasing interest, with reported incidence ranging from 10-50%, dependent on surgery type [1]. Despite a relatively large incision and degree of tissue trauma, estimates for chronic post-cesarean pain are much lower (2-3%)[2,3], raising the question of whether some aspects of pregnancy or the postpartum condition may play a protective role. Oxytocin, the production of which is increased during the perinatal period, and which is administered intravenously to decrease postpartum hemorrhage, has been shown to have anti-nociceptive effects in both preclinical and clinical studies [4]. In the present pilot study of women undergoing elective cesarean delivery (CD), we investigated the hypothesis that an individual's serum oxytocin level would be inversely related to her acute and persistent incisional pain.

Methods: This prospective observational study included 18 patients scheduled for elective CD. Blood samples were obtained immediately prior to surgery and at 1 and 24 hours postpartum. Plasma samples were separated by centrifugation, stored at -80C, and subsequently extracted by C-18 column chromatography and analyzed by EIA. Acute and persistent pain were assessed at 1 day, 8 weeks, 3 months, and 6 months postoperatively using a postpartum pain questionnaire and numeric pain rating score. In addition, psychosocial factors (depression, anxiety, catastrophizing, somatization) were assessed longitudinally.

Results: Oxytocin plasma levels varied considerably among patients, but were highly correlated at different time points for a given individual (Spearman Rho's: 0.59-0.78, $p<0.01$). Although a range of total exogenous oxytocin was administered perioperatively (19-48 IU), this was not significantly associated with measured plasma oxytocin levels at any time point. Importantly, abdominal incisional pain at 24 hours was significantly negatively correlated with 1 hour and 24 hour oxytocin levels, such that those with higher plasma oxytocin reported lower pain severity (Rho:-0.52 and -0.66, $p<0.05$). Furthermore, baseline plasma oxytocin levels of subjects who went on to report abdominal pain at 6 months were significantly lower than those reporting no pain at 6 months ($t(9)=-2.52$, $p=0.036$). There was no significant correlation between plasma oxytocin and any psychosocial parameters.

Discussion: The preliminary findings of this pilot study potentially suggest a protective, analgesic effect of higher oxytocin levels in the postpartum period, as higher plasma levels were associated with lower report of acute and persistent pain following CD. Larger studies are needed to confirm this relationship and to establish the degree to which exogenous administration of oxytocin during delivery may affect postoperative pain.

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Abstract #:F-21

The impact of labor prior to cesarean delivery on postoperative pain and opioid consumption

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Introduction: Severe acute post-cesarean pain has been associated with an increased risk for persistent pain and postpartum depression [1]. Identification of women at increased risk for pain can be used to optimize post-cesarean analgesia [2]. To our knowledge, the impact of labor prior to cesarean delivery (CD) on acute post-operative pain has not been evaluated. We hypothesized that labor prior to CD, which has been associated with maternal exhaustion, affective distress related to an unexpected CD, and greater surgical trauma, would result in hypersensitization, higher postoperative pain scores and increased opioid intake.

Methods: Women undergoing CD at six academic medical centers in the United States between 9/2014 and 3/2016 were contacted by phone two weeks following discharge [3]. Participants completed a structured interview that included questions about their postoperative pain scores and opioid utilization. They were asked to estimate their maximal pain score on an 11-point numeric rating scale at multiple time points, including day of surgery, during hospitalization, immediately after discharge, 1st week, and 2nd week following discharge. Pain scores over time were assessed utilizing a generalized linear mixed-effects model, with the patient identifier being a random effect, adjusting for an a priori defined set of confounders. A multivariate negative binomial model was utilized to assess the association between labor prior to CD and opioid utilization after discharge, also adjusting for the same confounders. In the context of non-random prescription distribution, this model was constructed with an offset for the number of tablets dispensed.

Results: A total of 720 women were enrolled, 392 with and 328 without labor prior to CD. Patients who labored prior to CD were younger, less likely to be undergoing repeat CD or additional surgical procedures, and more likely to experience a complication of CD.

Pain scores on the day of surgery were higher in women with labor prior to CD (median 6, IQR 4 to 8 versus 5, IQR 3 to 7; $p<0.01$) even after adjustment for confounders ($p<0.01$). Pain scores at other time points were not different between the two groups. Women with labor prior to CD consumed more opioid tablets following discharge than women without labor (median 20, IQR 10 to 30 versus 17, IQR 6 to 30; $p<0.01$). This association persisted after adjustment for confounders (incidence rate ratio 1.16, 95% CI 1.05 to 1.29; $p<0.01$).

Discussion: Women who labored prior to CD had worse pain on the day of surgery, but not other time points. Opioid requirements following discharge were modestly increased.

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Abstract #:F-22

A Nationwide Survey of Neuraxial Anesthesia Practices in Parturients Receiving Systemic Anticoagulation

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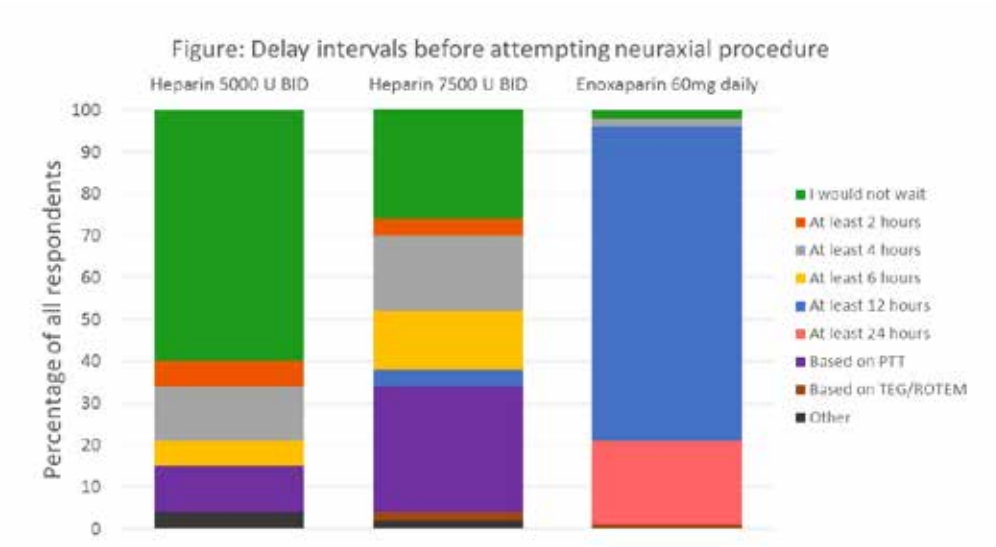
Introduction: The 2016 Council on Patient Safety in Women's Health Care Venous Thromboembolism bundle will result in more prevalent use of anticoagulation in parturients (1). This practice change may restrict use or complicate timing of neuraxial anesthesia. ASRA anticoagulation guidelines do not address some commonly used anticoagulation regimens in pregnancy. We sought to define academic institutional practices for neuraxial anesthesia in anticoagulated parturients. We hypothesized that >75% of units would have obstetric-specific guidelines for administration of neuraxial anesthesia in anticoagulated parturients.

Methods: A survey was developed by an expert panel. Inquiry domains included hospital characteristics, institutional guidelines and management practices using 5 clinical vignettes. The anesthetic recommendations for one vignette (prophylactic heparin, 5000 U SQ BID) were defined in the 2010 ASRA guidelines. 4 other vignettes presented commonly used anticoagulation regimens or clinical scenarios without clear recommendations for parturients. 103 obstetric anesthesia directors identified in the SOAP registry were surveyed by email. Univariate statistics were used to characterize responses.

Results: The survey response rate was 55%. 32% of responding units (95% [CI]: 19.1–44.0%) reported having a formal protocol to guide neuraxial anesthesia management in anticoagulated parturients, which was less than we hypothesized (P<0.005). 66% of respondents indicated that they do not delay initiation of neuraxial analgesia in patients prophylactically anticoagulated with SQ heparin. 40% of respondents delay restarting prophylactic heparin after delivery. There was no relationship between anticoagulation protocol presence and either of these practices (P>0.05). For other anticoagulation regimens, including enoxaparin 60mg SQ daily and heparin 7500 U SQ BID, delay intervals before attempting neuraxial anesthesia varied greatly among respondents (figure).

Conclusion: Few academic obstetric anesthesiology units report possessing institutional, obstetric-specific guidelines for neuraxial anesthesia management in anticoagulated women. Significant practice variability exists even with defined ASRA recommendations. Clear and comprehensive guidelines will be beneficial to ensure safe and consistent access to neuraxial analgesia as thromboprophylaxis becomes more prevalent.



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Abstract #:F-23

Identification of the L3-L4 Intervertebral Space in Obese Pregnant Women at Term in the Sitting and Lateral Positions: Palpation Method (Tuffier's Line) vs Ultrasound Imaging.

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Background: Tuffier's line (TL) allegedly at L4 or L4-L5 level may be an unreliable landmark in pregnant women and in obese patients for lumbar techniques (1,2). The correct identification of the intervertebral space (IVS) for combined spinal-epidural techniques is important to avoid medullar puncture (3). We hypothesized that the identification of the L3-L4 IVS by palpation (TL) in the lateral position would result in a greater risk of error of at least 2 levels compared to the sitting position in term pregnant women with a BMI ≥30 kg/m2.

Methods: Adult term non-laboring pregnant women with a BMI ≥30 were recruited. Prior spine surgery and scoliosis were exclusion criterias. For each patient, anesthesiologists identified the L3-L4 IVS using the palpation method in the sitting and lateral positions. The investigator then performed an ultrasound imaging (US) to determine the accuracy of the level found in both positions. The difference between the IVS by palpation vs US was recorded. The primary outcome was the prevalence of overestimation of the L3-L4 IVS by at least 2 levels when relying on palpation vs US in the sitting and lateral positions. Uterine height, waist size and patient comfort were recorded as secondary outcomes. The McNemar test, the Fisher exact test and the Wilcoxon Mann-Whitney test were used for statistical analysis.

Results: In 94 patients, a difference of at least 2 levels was found in 14 patients (15%) in the sitting position and in 9 patients (10%) in the lateral position. The McNemar test resulted in a NS value of 0.1317. In 5 cases, T12-L1 level was identified as the target level (4 in the sitting position, 1 in the lateral position). No difference was found in the secondary outcomes.

Discussion: We did not find any difference in the accuracy of the level assessment by palpation between the sitting and lateral positions compared to US. We considered a difference of at least 2 levels to be significant since it would result in performing a neuraxial technique too high (L1-L2). Although the majority of assessments was correct, 10-15% were at least 2 levels higher in both positions and, in some cases, overestimation placed the L3-L4 level at the T12-L1 IVS. Caution must be taken when choosing a level for a subarachnoid puncture in this population and the use of US may be a helpful tool.

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Difference in level	LATERAL POSITION →			
SITTING POSITION ↓	-1	0	+1	≥2
0	6	18	6	1
+1	2	20	25	2
≥2	0	2	6	6

-1: L4-L5, 0:L3-L4, +1:L2-L3, ≥2:L1-L2 or higher

Number of patients in cells. Concordant pairs in grey, discordant in white.

Abstract #:F-24

Assessment of Thromboelastography in Patients with Factor XI Deficiency

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Introduction: Factor XI (FXI) deficiency manifests with varying degrees of severity, but plasma levels do not correlate with bleeding risk.(1) Improved prenatal screening with gene chips has led to the detection of patients with heterozygous deficiency (hFXI). Although these patients may have very low plasma concentrations of FXI, no guidance for regional anesthesia exists. We investigated thromboelastography (TEG) in the clinical management of pregnant patients with confirmed hFXI.

Methods: FXI levels and TEG studies were obtained on third trimester patients diagnosed with hFXI as detected by first trimester prenatal genetic screening. 15 patients were identified and enrolled between 2014-2017. 15 healthy parturients matched for age and gestational age were enrolled as control subjects. Parturients were followed peripartum to determine type of labor analgesia offered, mode of delivery, and occurrence of any postpartum complications.

Results: Patients with hFXI deficiency demonstrated a longer time to fibrin formation (R time; Table); however, R was within normal control in all but one patient. There were no other significant differences in subsequent TEG parameters when compared to control curves. FXI levels were lower in the hFXI group (Table) compared to controls, but did not correlate with R time. All patients in the study and control groups safely received neuraxial analgesia or anesthesia for delivery. There were no instances in which prophylaxis (e.g. tranexamic acid, fresh frozen plasma, Factor XI concentrate) was required prior to neuraxial instrumentation. No anesthesia-related complications or significant postpartum bleeding occurred.

Conclusions: Our hFXI patients had subnormal factor plasma levels into the third trimester, but TEG values were on the higher side of normal. We observed a longer (but within normal) R time on TEG in patients with hFXI, but R time did not correlate with degree of factor deficiency. This parallels previous findings in third trimester parturients using ROTEM, which demonstrated a longer CT value.(2) There were no differences in remaining TEG parameters between patients with hFXI and controls. We believe this data suggest that heterozygous patients are safe for neuraxial anesthesia, and that TEG provides an additional means to assess global coagulation in parturients with Factor XI deficiency prior to safe delivery of anesthesia.

Table

	hFXI	Control	p
FXI (65-155%)	50.8 ± 8.6	92.2 ± 19.3	< 0.01
R (5-10 min)	5.2 ± 1.0	4.3 ± 0.8	0.01
K (1-3 min)	1.3 ± 0.4	1.1 ± 0.2	0.18
Angle (53-72 deg)	74.7 ± 3.2	74.7 ± 3.0	> 0.99
MA (50-70 mm)	65.9 ± 4.9	67.2 ± 6.4	0.54
LY30	1.5 ± 3.0	2.48 ± 3.4	0.41

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Abstract #:F-25

Paracervical Block Reduces Rate of Propofol Administration for Oocyte Retrieval

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Introduction: Multiple methods of analgesia/sedation have been studied for oocyte retrieval in women undergoing subsequent in vitro fertilization. None has emerged as the unequivocal optimal technique, although a multimodal technique may be superior to those that rely on a single agent (opioid-only).1

To improve patient comfort and satisfaction, a paracervical block has been adapted as a new standard of care at our institution.

In this study, we examine the effects of a bupivacaine paracervical block on the propofol infusion rate required to perform oocyte retrievals.

Methods: After obtaining a waiver for IRB approval, we performed a retrospective analysis before and after the introduction of paracervical blocks. The block was performed with 10 ml of bupivacaine 0.5%, placed after insertion of the speculum, by two different proceduralists for oocyte retrieval in our IVF procedure suite.

All women eligible for the procedure in this outpatient suite need to be ASA 1 or 2, BMI less than 40 and without significant co-morbidities.

We reviewed the anesthesia records and assessed propofol consumption and duration of anesthesia in minutes.

Our main outcome measure was an average mg propofol per minute (mg Propofol/min) calculated from the total dose of propofol administered divided by the duration of the recorded anesthesia time in minutes.

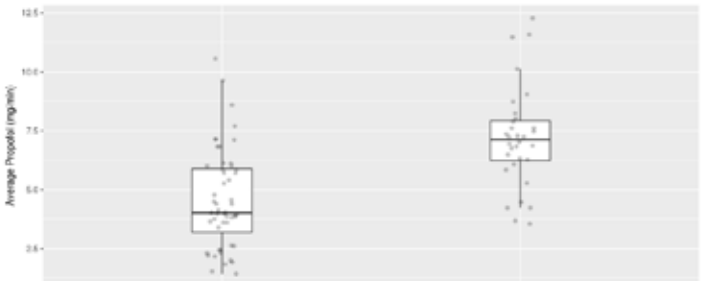
Differences between the two unequal sized groups were compared using Welch's unequal variances t-test.

Results: In the "no block" group, 31 consecutive women received midazolam, fentanyl, and propofol sedation. The "block" group consisted of 51 women patients undergoing the same procedure but with a paracervical block placed at the beginning of the surgery.

Women undergoing oocyte retrieval with the addition of a paracervical block received an average of 4.6 mg/min of propofol during the procedure, compared to 7.2 mg/min for those without a block (estimated difference 2.62 mg/ml, 95%CI 1.68 to 3.57, $p < 0.001$). Figure 1.

Figure 1

Average Propofol (mg/min) use by Group



Discussion: Our analysis suggests that a paracervical block placed before the oocyte retrieval reduces the rate of administered propofol required for the procedure. Further studies are warranted to evaluate effects on recovery room discharge times and oocyte survival.

References:

1. Kwan et al (2013) Cochrane Database Syst Rev.

Abstract #:F-26

The effect of labor anaglesia service on maternal-fetal outcomes: A Retrospective Case Series

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Introduction: The rate of cesarean deliveries has reached 50% in many hospitals, less than 1% of women in labor were given neuraxial labor analgesia 1. The aim of this study was to evaluate the impact of neuraxial (epidural) labor analgesia on maternal-fetal safety outcomes in a signal Chinese academic medical center.

Methods: A single-intervention impact study was conducted at The Second Affiliated Hospital, Wenzhou Medical University in Wenzhou. The study period was divided into 3 phases: Baseline data collection occurred between January 1 and June 30, 2009, when no analgesic method was routinely employed during labor; An intervention was then implemented, consisting of a neuraxial labor analgesia service, termed of phase-in period; The service was fully operational from June 1, 2010, and data were collected to June 30, 2011, which was defined as post-No Pain Labor N' Delivery (NPLD) phase. The maternal-fetal safety outcomes of delivery were compared between the different periods. Results were presented as crude and adjusted odds ratios or 99% CI.

Results: There were 15415 deliveries with 42.3% of nulliparous parturients in the 31-month study period. As the primary outcomes, the neuraxial labor analgesia rate increased from 0% to 57%, the vaginal delivery rate increased and cesarean delivery rate decreased by 3.5% after full implementation. As the secondary outcomes, there were significant decreases in the rate of episiotomy and severe perineal injury before and after the implementation periods. The intrapartum cesarean delivery rate and forceps delivery rate were unchanged. In addition, the oxytocin augmentation rate increased by 17.6%, the rates of postpartum oxytocin administration decreased by 17.8%, and the rate of naloxone administration decreased by 0.61%. No significant difference between the baseline and implementation periods was found in the rate of postpartum hemorrhage, neoneatal Apgar scores less than 7 at both 1 and 5min, 7 day mortality and the overall NICU admission rate.

Conclusion: Epidural labor analgesia can increase the vaginal delivery and reduce the frequency of cesarean delivery, especially the incidences of non-medical indications cesarean section. Moreover, the implementation of neuraxial labor analgesia is safe to maternal-fetal.

References:

1. Int J Gynecol Obstet 2007;98(3):205–7.

Abstract #:F-26

Table: Comparisons of Clinical Outcomes and Long-Term Effects

Clinical Outcome	Baseline Phase	Post NPLD phase	Difference *P*	Early Post NPLD	Late Post NPLD	Difference *P*
Monthly Deliveries	466 (464, 468)	542 (542, 543)	77 (16.5%) *P* < 0.001	539 (538, 540)	528 (526, 530)	-11 (-2.0%) *P* = 1.0
Monthly Obstetric Admission	496 (494, 498)	592 (591, 593)	96 (19.4%) *P*= 0.001	590 (587, 593)	584 (582, 585)	-6 (-1.0%) *P*=1.0
Monthly Obstetric Clinic Visits	3239 (3232, 3247)	7744 (7738, 7749)	4505 (139%) *P* < 0.001	8113 (8110, 8116)	7699 (7691, 7707)	-414 (-5.1%) *P* = 1.0
Neuraxial Labor Analgesia (%)‡	0	57.3 (57.0, 57.6)	57.3% *P*= 0.000	58.3 (58.1, 58.6)	56.6 (55.8, 57.4)	-1.8 % *P*= 0.58
Vaginal Delivery (%)	55.4 (55.2, 55.7)	59.0 (58.9, 59.1)	3.5% *P*=0.002	58.9 (58.9, 59.0)	57.5 (57.3, 57.8)	-1.4% *P*= 0.41
Forceps Delivery (%)	2.9 (2.6 3.4)	2.9 (2.6, 3.1)	-0.09% *P*= 0.98	3.5 (3.2, 3.8)	2.1 (1.7, 2.5)	-1.4% *P*= 0.07
Episiotomy (%)	55.3 (54.8, 55.8)	48.7 (48.5, 48.9)	-6.6% *P*< 0.001	46.1 (46.0, 46.3)	47.4 (47.0, 47.9)	1.3% *P*= 0.60
Traumatic VD (Episiotomy + ≥ 3rd degree Laceration) (%)	55.4 (54.9, 55.9)	48.8 (48.6, 49.0)	-6.5% P< 0.001	46.2 (46.0, 46.4)	47.5 (47.1, 48.0)	1.3% *P*= 0.608
Overall Cesarean Delivery (%):	44.6 (44.3, 44.8)	41.0 (40.9, 41.2)	-3.5% P<0.001	41.0 (40.9, 41.1)	42.5 (42.2, 42.8)	1.4% *P*=0.31
Vaginal to Cesarean Delivery (% TD)	14.4 (14.2, 14.8)	13.3 (13.2, 13.4)	-1.1% *P*= 0.162	12.7 (12.5, 12.9)	12.9 (12.8, 13.1)	0.25% *P*= 0.82
Non-Medically Indicated CD (% TD)	13.0 (12.7, 13.2)	2.5 (2.3, 2.6)	-10.5% *P*= 0.001	2.9 (2.5, 3.4)	2.7 (2.3, 3.1)	-0.27% *P*= 0.60

Data reported as mean (99% CI) and N(%)
† validated using independent database: discrepancy between two sources = 0.032%
‡ validated using independent database: discrepancy between two sources = 0.71%

Abstract #:F-27

Analgesia post elective cesarean delivery: make it simple and make it work

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Introduction: Good management of acute post cesarean delivery (CD) pain reduces maternal morbidity and improves the patient experience, which may facilitate earlier hospital discharge. We aimed to evaluate our service and put in place interventions to improve post elective CD analgesia, as part of an enhanced recovery initiative.

Methods: Elective CD were prospectively audited from Oct-Dec 2014 (n=50) and re-audited from Oct-Dec 2016 (n=57). Data included postoperative pain scores, analgesia received, opioid requirements, whether mothers felt they waited too long to receive analgesia, length of hospital stay and patient-perceived cause of delay to discharge. After the 2014 audit, actions were taken to improve the service including communication of findings to women's health; further audit of analgesia requirements evaluating the potential benefit of pre-filled syringes of oral morphine and requesting midwifery leads to seek necessary approvals for single-check oral morphine to reduce delays.

Results: (2014 vs. 2016). Regular post-CD analgesia received (100 vs. 98%); as required opioid analgesia received (63 vs. 66%); waited too long for analgesia (46 vs. 57%); pain score rated 'severe' on movement day 1 post-CD (46 vs. 41%); nausea post-CD (46 vs. 52%); length of stay (2.8 vs. 2.3 days); maternal satisfaction (85 vs. 79%). Causes of delay to discharge from the 2016 re-audit were described (Fig.1).

Discussion: Despite a drive to improve analgesic provision, pain following CD remains a significant issue at our institution and was the primary cause for delay to discharge. Relatively complex interventions were evaluated and planned after the 2014 audit, however after re-audit we have shifted our focus to more simple interventions: improving midwife and maternal education, disseminating these data to increase awareness that two-thirds of post elective CD mothers require additional opioid analgesia and over half feel they wait too long; a specific patient companion diary addressing analgesia through every step of enhanced recovery. We hope this will stimulate staff engagement and encourage proactive mothers. We suggest additional midwife-led pain rounds after regular rounds. We will re-evaluate the service following its implementation.

Reference:

1. Kuczkowski, KM. Postoperative pain control in the parturient: new challenges in the new millennium. J Matern Fetal Neonatal Med. 2011; 24: 301-4.

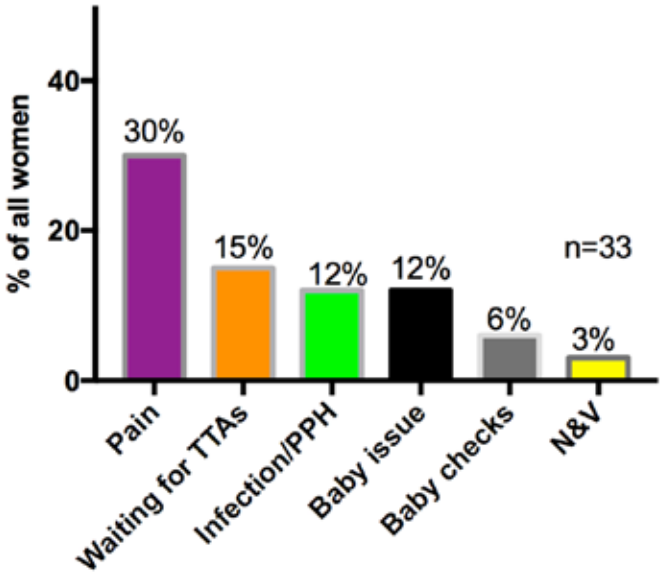

Figure 1. Patient-reported cause of delay to discharge (2016)

Abstract #:F-28

The Effect of Adding Intrathecal Epinephrine to Hyperbaric Bupivacaine and Preservative Free Morphine for Repeat Cesarean Delivery: A Double Blind Prospective Randomized Control Trial

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Background: Spinal anesthesia has become the most common type of anesthetic for cesarean delivery. The major limitation to spinal anesthesia is that the duration of the anesthetic may be outlasted by the increased operative time. Some practitioners add epinephrine to hyperbaric bupivacaine to increase the duration, although its effect has not been fully studied. We therefore aimed to evaluate whether adding epinephrine to the spinal medication prolongs the duration of action of the resultant block.

Methods: Sixty-eight patients were randomized to receive no epinephrine (NE group), 100 mcg (LD group), or 200 mcg (HD group) with a standardized spinal mixture (1.5 ml 0.75% hyperbaric bupivacaine with 0.25 mg morphine). Our primary outcome, regression of sensory blockade to T10 dermatome level, was measured by pinprick sensation; motor recovery was graded via a modified Bromage scale.

Results: Block onset time, vital sign changes, as well as the incidence of hypotension; nausea, and vomiting were similar between groups. Time to T-10 regression was significantly greater in the HD group (Median [95%CI] HD: 165 min [150-180], LD: 135 min [120-150], NE: 120 min [45-150]; $p<0.001$). The time to knee extension was also greatest in the HD group (Median [95% CI] HD: 172 min [150-210], LD: 150 min [135-150], NE: 120 min [105-120]; $p<0.001$).

Conclusions: In this single center, prospective, double-blind, randomized control trial, the addition of epinephrine 200 mcg to hyperbaric bupivacaine and preservative free morphine for cesarean section prolonged the duration of both the sensory and motor blockade and may have also enhanced block quality.

Abstract #:F-29

Functional Fibrinogen in Pregnancy

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Background: The management of obstetric hemorrhage is complex, and is currently one of the leading causes of anesthesiology malpractice claims.1 One of the best predictors of severity of hemorrhage as well as progression to more severe hemorrhage is the fibrinogen level, which is normally markedly higher in the parturient.2 These lab assessments, however, can have a long turnaround time, which limits their ability to guide clinical decisions at the time of the hemorrhagic event. Point of Care (POC) testing may be a way around this issue, as test results can be run in the operating room and interpreted in real time without any lab delays. Thromboelastography is one such test, which can be run to specifically measure clinical fibrinogen levels using the functional fibrinogen assay. This assay, however, has not been tested or verified in the parturient where baseline coagulation is abnormal. We therefore set out to examine this relationship.

Materials and Methods: 50 patients presenting to the labor floor for otherwise indicated coagulation testing were recruited. In addition to traditional tests such as Clauss fibrinogen assays, a separate coagulation tube was drawn for analysis via traditional thromboelastography and functional fibrinogen. Relationships between functional fibrinogen level, Clauss fibrinogen level, maximum amplitude, and platelet count were examined using Pearson correlation and simple linear regression.

Results: The most common indication for fibrinogen analysis was for [N(%)] rule out pre-eclampsia [26 (52)], followed by reassessment of confirmed pre-eclampsia [14 (28)], and hemorrhage [8 (16)]. Most patients were in their third trimester [41 (82)]. Both the functional fibrinogen and functional fibrinogen MA were highly correlated with the Clauss assay (R=0.891 p=0.00, R=0.872 p=0.00). Regression analysis confirmed the correlation as well with an R2= 0.795, a coefficient of 0.849 (p=0.00) and a constant of 115.53 (p=0.00). A regression analysis to determine the effect of platelet count on the difference for functional fibrinogen measurements was not significant (R2= 0.16 p=0.38). A regression analysis to determine the effect of kaolin MA on functional fibrinogen levels revealed the presence of correlation R=0.604, R2=0.365 (p=0.00), demonstrating the contribution of fibrinogen to the kaolin MA measurement.

Conclusion: POC functional fibrinogen assays are a potential substitute for formal Clauss fibrinogen in the pregnant population.

References:

1. Dutton et al. Massive hemorrhage: a report from the anesthesia closed claims project. Anesthesiology 2014;121:450–8
2. Collis RE, Collins PW. Haemostatic management of obstetric haemorrhage. Anaesthesia 2015;70 Suppl 1:78-e28

Abstract #:F-30

Design of a Novel Electronic Maternal Surveillance System on the Labor and Delivery Unit: Frequency of Automated Pages Based on Modifications to the Maternal Early Warning Criteria

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Introduction: The National Partnership for Maternal Safety encourages hospitals to adopt The Maternal Early Warning Criteria (MEWC) to improve early detection of maternal morbidity (1). Ideally, an automated system would continuously collect vital signs and alert clinicians with abnormal values (1). However, little is known about the frequency with which real or spurious vital signs would generate an alert during monitoring. As part of a quality improvement project, our institution designed an electronic maternal surveillance system that uses a paging alert algorithm to notify clinicians of aberrant vital signs. This new algorithm generates less paging alerts when compared to automated alerts meeting MEWC.

Methods: Automated paging alerts were created by modifying MEWC to more liberal vital sign triggers via institutional expert consensus (Table 1). Pages were not generated for bradycardia and low SpO2 readings due to the high frequency of artifact. Automated pages were suspended during stage 2 of labor given the common occurrence of tachycardia and hypertension. After a 10-minute delay, the paging system initially notifies the bedside nurse for confirmation and recheck of aberrant values. When severe-range values persist, the pages escalate to clinicians. A record is kept of the pages that are generated. For comparison, a database containing automated vital signs obtained by the bedside monitors was also queried.

Results: The frequency of automated vital signs that met MEWC between 9/29/16 and 12/1/16 across 34 labor and delivery rooms is shown in Table 1. For these 34 rooms, there was an average of 6.16 vital sign triggers per hour. Using a modified paging algorithm reduces these events to 0.48 pages per hour for bedside nurses and 0.22 pages per hour for the obstetrical service.

Conclusion: During a 63 day period, 34 continuously monitored labor and delivery beds triggered an average of 1 vital sign meeting MEWC every 9.7 minutes. These vital signs were automatically collected without nurse confirmation. Modifications to the MEWC, combined with a tiered paging algorithm, would reduce overall paging burden. To our knowledge, there were no patient safety events that were missed using the modified alerting system. While further investigation is needed, it appears this paging algorithm could strike an appropriate balance between recognition of maternal morbidity with prevention of alarm fatigue.

References:

1. Mhyre JM, et al. Obstet Gynecol 2014 Oct;124(4):782-6.

Total Number of Recorded Values	Maternal Early Warning Criteria - 1,512 Monitoring Hours			Authors' Institutional Paging Criteria - 1,512 Monitoring Hours		
	Criteria	Events	Events/Hour	Criteria	Events	Events/Hour
28317	Systolic BP < 90	825	0.55	Systolic BP < 80	223	0.15
28317				Diastolic BP < 40	248	0.16
28317	Systolic BP > 160	542	0.36	Systolic BP >= 160	617	0.41
28317	Diastolic BP > 100	656	0.43	Diastolic BP >= 110	255	0.17
62770	SpO2 < 95%	3713	2.46			
90578	Heart Rate < 50	371	0.25			
90578	Heart Rate > 120	3212	2.12	Heart Rate >= 130	1488	0.98
	Total Events Per Hour		6.16	Total Events Per Hour		1.87

	Automated Pages - Total			Automated Pages - Per Hour		
Criteria	All RNs	OB	Anes	All RNs	OB	Anes
Systolic BP < 80	42	20	20	0.03	0.01	0.01
Diastolic BP < 40	91	19	19	0.06	0.01	0.01
Systolic BP >= 160	345	165		0.23	0.11	
Diastolic BP >= 110	80	17		0.05	0.01	
Heart Rate >= 130	171	110	110	0.11	0.07	0.07
			Total	0.48	0.22	0.10

Abstract #:F-31

EFFECT OF THE EPIDURAL POSITIONING DEVICE ON THE ACOUSTIC TARGET WINDOW FOR LUMBAR NEURAXIAL ACCESS

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Introduction: Neuraxial anesthesia is frequently used in obstetric patients. During pregnancy, neuraxial anesthesia can be problematic due to anatomical changes. [1]. Positioning manoeuvres have been shown to improve the sonographic target window for needle access to the neuraxial space [2-3]. The effect of the epidural positioning device (EPD) on the lumbar sonographic target window has not been evaluated. The paramedian sonographic window provides superior ultrasound (US) images of structures within the vertebral canal, compared with a transverse midline view [4-6]. The visualization of the posterior longitudinal ligament (PLL) represents an open acoustic window between adjacent vertebral laminae [6]. We hypothesized that the application of the EPD would increase the measured lengths of the PLL (primary outcome), interlaminar distance (ILD) and ligamentum flavum (LF) (secondary outcomes).

Methods: Local REB approval was obtained. A convenience sample of 30 term pregnant, non-labouring women were consented and recruited. Two anesthesiologists independently scanned the L3-4 right paramedian space using a curvilinear ultrasound transducer (SonoSite M-Turbo, Bothell, WA, USA). Two positions were investigated for each patient: Position1 (P1): traditional sitting with lumbar flexion without the EPD; Position2 (P2): sitting with lumbar flexion with support from the EPD (Manual EPD, Meditek, Winnipeg, Manitoba, Canada). The PLL, ILD and LF lengths were measured using the ultrasound calliper software and recorded, with the anesthesiologists blinded to the results. Patients were asked to rate their comfort in both positions using a Likert scale.

Results: There were no significant differences between the measured lengths of the PLL, ILD and LF in the two positions (Table 1). Intraclass correlation coefficients showed good agreement for the primary outcome (0.8 for P1, 0.7 for P2) between anesthesiologists . Patient comfort was significantly higher with the application of the EPD (OR=10, 95% CI 2.4 to 88).

Discussion: The application of an EPD did not improve the paramedian lumbar acoustic window in term parturients. Future research is needed to verify clinical effects of the EPD for the obstetric population.

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1. BJA 2001; 86: 798–804.
2. Anaesth 2001; 56: 262–6.
3. Anaesth 2013; 68: 27–30.
4. J Clin Anesth 2001 May; 13: 213–7.
5. Reg Anaesth Pain Med 2009; 34: 581–5.
6. Anesthesiol 2011; 114: 1459–85

	Sitting	EPD	Difference (sitting – EPD) (95% CI)	P
PLL, cm (SD)	1.76 (0.45)	1.72 (0.37)	0.040 (-0.05 to 0.13)	0.38
ILD	3.24 (0.39)	3.18 (0.31)	0.06 (-0.06 to 0.18)	0.31
LF	1.34 (0.27)	1.26 (0.18)	0.08 (-0.01 to 0.16)	0.076

Table 1. P values from paired t test. EPD = epidural positioning device

Abstract #:F-32

Anesthesiologist/Obstetrician Combinations Influence Choice of Anesthesia for Cesarean Delivery in a Serbian Obstetric Hospital

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Introduction: In Serbia, the use of regional anesthesia (RA) in obstetrics has been low, despite local efforts to increase its use. A multi-year Kybele program was started in 2012 to help train physicians at the Clinical Center Vojvodine (CCV), Novi Sad, Serbia in the use of RA techniques for labor and cesarean delivery (CD). Last year we reported significant differences in use of RA between anesthesiologists 1 and marginally statistically significant differences among obstetricians2. The present study looked at anesthesiologist/obstetrician pairs and their influence on the type of anesthesia for CD.

Method: From the CCV delivery database for 1/1/2016-12/31/2016, data on the use of general anesthesia (GA) and RA for elective and non-elective CD were obtained. A generalized mixed linear model was constructed with the administration of GA as the dependent variable (modeled as Bernoulli-distributed). Indication for CD (elective v. non-elective) was introduced as a fixed factor. Anesthesiologist /obstetrician combinations were introduced as a random effect. The technique of best linear unbiased estimators (BLUEs) was used to generate a listing of estimated mean probabilities of GA (pGA) for each anesthesiologist/obstetrician pair, controlling for indication (whether CD was elective/non-elective).

Results: A total of 2117 cases, involving 10 anesthesiologists and 42 obstetricians (356 pairs) were studied. There was a highly significant difference ($p<0.001$) between elective pGA (mean 0.529; 95% CI 0.490-0.568; 1056 cases) and non-elective pGA (mean 0.753; 95% CI 0.016-0.721; 1052 cases). There was significant variability of GA among the 356 anesthesiologist/obstetrician pairs ($p<0.001$). Adjusted for indication, anesthesiologist/obstetrician pair-specific mean pGA ranged from 0.231 (95% CI 0.124- 0.391) to 0.821 (95% CI 0.606, 0.932) Averaged across all obstetricians, mean anesthesiologist specific pGA ranged from 0.545 to 0.671. Variability in the percentage of CD under GA was larger among obstetricians, (range, 87% -33%) than among anesthesiologists (range, 73% - 38%).

Conclusion: The use of RA/GA between anesthesiologists/obstetrician pairs varies widely, suggesting that more effort should be placed in the education of pairs with the highest rate of GA. Alternatively, effort can be made to reassign an anesthesiologist or obstetrician from a pair to work with another anesthesiologist or obstetrician more willing to use RA. The greater use of RA/GA among elective cases is similar to that reported in our previous studies at CCV.

References:

1. Baysinger C et al. Individual Anesthesiologist Use of Regional Anesthesia for Cesarean Delivery in a Serbian Obstetric Hospital. SOAP 48th Annual Meeting, Boston, MA, 2016
2. Velickovic I et al. The Influence of an Individual Obstetrician on the Use of Regional Anesthesia for Cesarean Section in a Serbian Obstetric Hospital. SOAP 48th Annual Meeting, Boston, MA, 2016

Abstract #:F-33

Anesthesiologist/Obstetrician Combinations Influence Choice of Anesthesia for Cesarean Delivery at an Urban New York Hospital

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Antonella Stanko M.D. - SUNY Downstate Medical Center - Brooklyn , NY
Marko Velickovic B.S. - University of Southern California - Los Angeles, CA
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Introduction: General anesthesia (GA) is used in less than 5% of elective Cesarean deliveries (CD) nationwide.1 There is evidence that the ratio of GA to regional anesthesia (RA) for CD varies as a function of practice environment2, but it is unclear if physician preference or patient risk factors are related to the ratio of GA to RA. XXXXXXXX Medical Center, which mostly serves socioeconomically disadvantaged populations, delivers 1,400 babies every year, of which about 40% are CD. This study examines factors that influence the probability of GA for CD.

Methods: All CD at XXXXXXXXXX 2011-2015 were included in this study. A generalized linear mixed model (GLMM) was constructed, dependent variable was whether GA was used (modeled as Bernoulli-distributed). Preoperative diagnosis (repeat/elective CD; arrest of labor; category 3 tracing; category 2 tracing; other) was a fixed factor. Surgeon-anesthesiologist dyad was a random effect. The technique of best linear unbiased estimators (BLUEs) was used to generate lists of estimated prevalence of general anesthesia for each anesthesiologist-surgeon dyad, controlling for diagnostic category. It is important to note that because 93% of the patients were African-American, only African-American patients (N=3409) were used for GLMM.

Results: Controlling for inter-operator effects, there were highly significant differences in prevalence of GA among diagnostic categories. Category 3 differed ($p<0.001$) from all other diagnostic groups. Controlling for differences in diagnosis type, there were highly significant differences among anesthesiologist-surgeon dyads ($p<0.001$): Adjusted for diagnostic category, dyad-specific prob(GA) varied from 0.165 (95% CI 0.064, 0.365) (based on 16 cases), to 0.012 (95% CI 0.004, 0.034) (based on 183 cases). Variability in the percentage of GA was similar for 17 anesthesiologists who performed 95% of CD, max = 8.3% (168 CD) and min = 1.5% (1121 CD) and 15 surgeons who performed 96% of CD, max = 8.5% (106 CD) and min = 2.3% (43CD). Although the overall rate of GA for CD was within national standards (4.9%) in the highest five dyads it was 3-6 times greater (16%-33%).

Conclusions: The Interaction between the obstetrician and anesthesiologist is a significant factor that affects the type of anesthesia for CD, even when controlling for differences in diagnosis type. Obstetricians and anesthesiologists who belong to dyads with the highest percentage of GA should be advised about the risks vs. benefits of GA and RA, and be potentially reassigned to work with colleagues who have a lower rate of GA. We were not able to evaluate the effect of the race on GA/RA ratio, however our rate of GA for CD for African-American patients is much less than what's reported in literature3.

References:

1. Bucklin B et al. Anesthesiology. 2005;103:645-653.
2. Johnson D et al. CJA. 2002;49:954-957.
3. Butwick A et al. Anesth Analg. 2016;122:472-479.

Abstract #:F-34

Influence of pulse width (1 msec vs 0.1 msec) on the Tsui test outcomes in pregnant women: a randomized crossover study

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Introduction: The epidural stimulation test (Tsui test) has been used to determine the correct placement of epidural catheters in a wide variety of patients (1). The typical response to the stimulation of a lumbar epidural catheter with a 0.2 msec pulse width stimulus in parturients is a unilateral contraction of the lower limbs; a bilateral response is much less frequent (95% vs 5 % respectively) (2). Studies demonstrate that longer pulse widths can stimulate peripheral nerves from a farther distance (3). Therefore, we designed a study to test the hypothesis that the epidural catheter stimulation with a 1.0 msec pulse width in parturients would increase the incidence of bilateral motor response, when compared to a 0.1 msec pulse width stimulus.

Methods: Parturients requesting epidural analgesia were recruited into this randomized crossover study. Epidural anesthesia was performed with the use of spinal ultrasound at the L2-L3 or L3-L4 interspace. The Tsui test was performed in each woman before and 5 minutes after an epidural test dose of 3 ml of 2% lidocaine, in randomized fashion, at both 0.1 and 1 msec pulse widths. A loading dose of 10 ml of 0.125% bupivacaine with 50 mcg of fentanyl was then administered, followed by a programed intermittent epidural bolus regimen with bupivacaine 0.0625% with fentanyl 2 mcg/mL. The primary outcome was the motor response pattern to the epidural catheter stimulation at baseline, either unilateral or bilateral. Secondary outcomes included the current required to elicit motor response at baseline and at 5 minutes following test dose, and sensory block levels at 20 minutes and 2 hours after initiation of the loading dose.

Results: Twenty women were recruited. The rate of unilateral motor response in the 0.1 msec (18/20) and 1 msec group (18/20) were both 90% (rate difference, 0%; 95% confidence interval, -0.32, 0.32; P = 1.0). The mean current (SD) required to elicit a motor response at baseline and at 5 minutes after the test dose was 4.2 mA (2.6) and 6.2 mA (3.1) in the 0.1 msec group and 1.7 mA (1.1) and 2.8 mA (1.3) in the 1 msec group, respectively.

Conclusion: The motor response pattern following the stimulation of a lumbar epidural catheter at pulse widths of 0.1 msec and 1 msec are similar and typically unilateral. Both pulse widths can be utilized when performing the Tsui test for lumbar epidural catheter placement in parturients.

References:

1. Reg Anesth Pain Med. 1999;24:17-23
2. Anesth Analg. 2016;123:950-954
3. Can J Anesth. 2014;61:249-253

Abstract #:F-35

Design and validation of an assessment tool that measures CA1s' knowledge about general anesthesia for urgent cesarean delivery

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Background: Teaching novice residents (CA1) the knowledge and skills to perform general anesthesia (GA) for cesarean delivery (CD) requires innovative strategies, as they may never manage such cases in training. As part of a teaching program involving a serious game (SG), we used a multistage design process to create a multiple-choice test as an assessment tool to evaluate CA1's knowledge related to this scenario at baseline, after SG training, and 3-6 months after training.

Methods: First, 3 faculty members created 33 questions (each stem with 1 correct answer and 3 distractors), categorized as: (1) physiologic changes of pregnancy (PCP), (2) pharmacology (PHA), (3) anesthetic implications of pregnancy (AIP), and (4) crisis resource management principles (CRM), based on a validated task list.(1)

A Delphi process (3 rounds) provided content validation. In round 1, experts (N=15 members of SOAP) anonymously rated the questions on a 7-point Likert scale (1 = "I feel this is not important at all", and 7 = "I feel this is extremely important"). Questions ranked 5 in importance by 70% of experts were retained; 5 questions were eliminated, several were revised and 1 added. In round 2 (N=14), consensus on 29 items was defined as a change of ≤10% in mean priority score for each item and a change of ≤ 5% in the average of absolute-value % changes in individual mean priority scores across all items. Consensus was reached in all except 8 questions. In round 3 (N=14), consensus was reached for 7 of these 8 questions; the underperforming question was kept as a provisional item during pilot testing.

Last, a pilot test evaluating internal consistency, reliability, and convergent validity was conducted with the July 2016 CA1 class (N=26) at another institution, CA2's (N=17) and attendings (N=10).

Results: Good internal consistency and reliability was demonstrated (α =0.76). Convergent validity coefficients suggested theoretical meaningfulness of the 4 sub-scales: PCP correlated at .65 with PHA, .47 with CRM, and .32 with AIP. PHA correlated with CRM and AIP at .55 and .43, respectively. The correlation between CRM and AIP was .28. The same question underperformed but will be retained as provisional item.

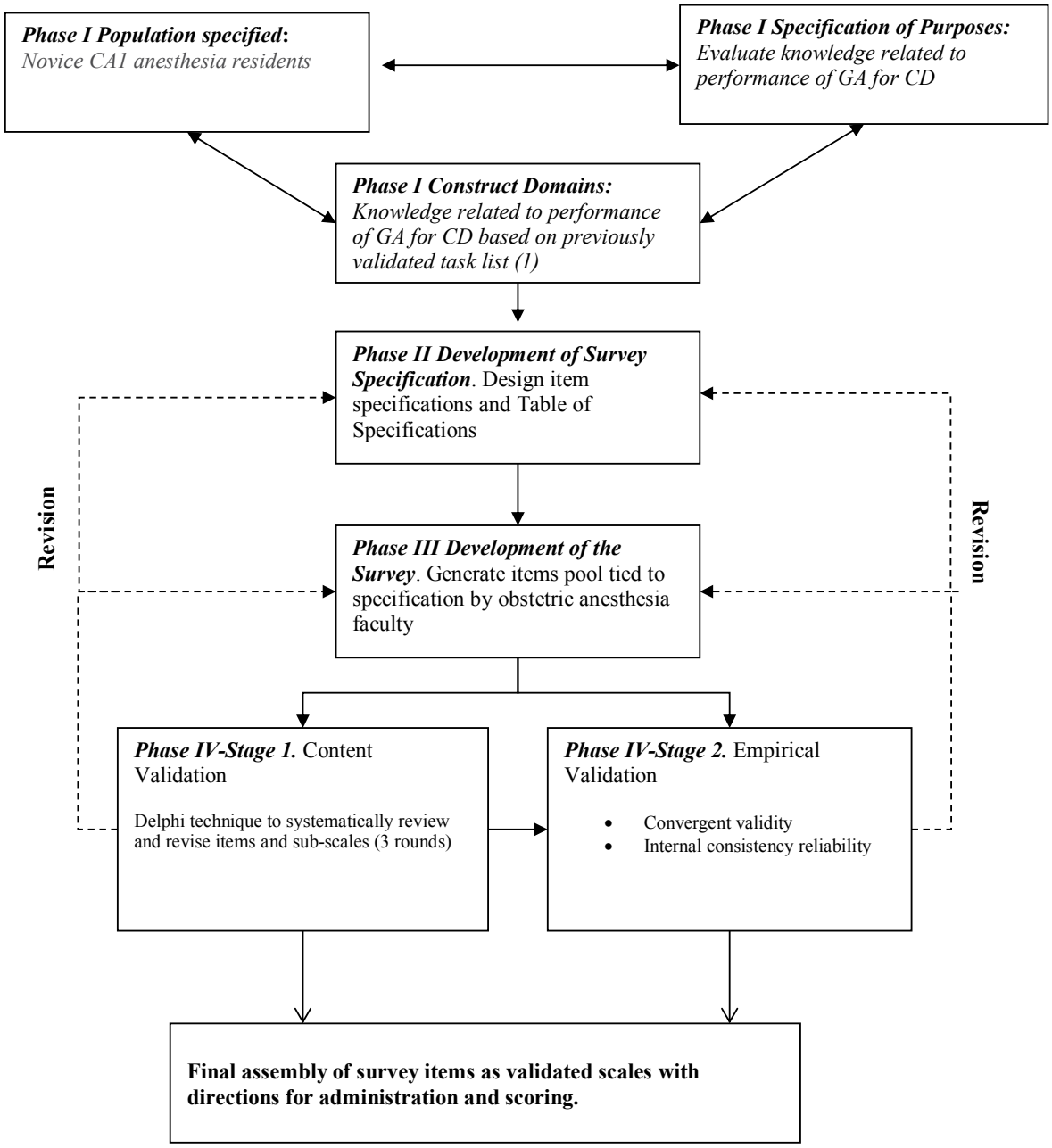
Discussion: Preliminary evidence indicates the test produces reliable scores to assess CA1's knowledge related to conduct of GA for emergent CD. Further reliability assessment will be conducted with ongoing use of the tool.

Reference:

1. Anesthesiology 2006;105:260-6.

Abstract #:F-35

Figure 1. Iterative Process for Designing and Validating a Knowledge Test



Abstract #:F-36

HEMODYNAMIC MANAGEMENT IN CESAREAN SECTION: CONTINUOUS VS INTERMITTENT NON-INVASIVE ARTERIAL PRESSURE MEASUREMENTS

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Background: An inconsistency of hypotension detection in women undergoing cesarean section with use of standard intermittent blood pressure monitoring versus with use of a continuous non-invasive arterial pressure device post spinal anesthetic has been previously noted (1). Although hypotension was significantly more often detected while utilizing continuous non-invasive monitoring, no associated study has evaluated the potential clinical implications regarding the total hemodynamic management between these two modalities.

Objective: Evaluate the clinical management of patients undergoing cesarean section with regard to fluid and pressor administration in the setting of intermittent vs continuous non-invasive blood pressure monitoring.

Methods: A total of 56 singleton parturients undergoing cesarean section under a spinal anesthetic were included in the study analysis. Blood pressure of one group of 28 subjects were assessed via a standard intermittent blood pressure cuff, while the other 28 subjects were assessed via a continuous non-invasive blood pressure device. No specific protocol for fluid management was utilized. Fluid administration (crystalloid and colloid), fluid equivalence administration based upon a conventional 3:1 colloid to crystalloid ratio, estimated blood loss (EBL), urine output (UOP), and vasoactive medication use (phenylephrine and ephedrine) were compared between the two groups.

Results: Total volume loss were non-significant between groups. No significant differences were identified between total fluid administration, fluid equivalence administration, and total vasoactive medication use.

Conclusions: Although continuous arterial pressure monitoring may detect hypotensive episodes more often than a traditional blood pressure cuff, our study suggests that no total hemodynamic management changes are demonstrated throughout an entire cesarean delivery when comparing the two.

References:

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Abstract #:F-37

Using continuous quality improvement methodology to reduce GA conversion rates in caesarean sections: 12 years experience

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Introduction: We analysed our performance against the Royal College of Anaesthetists standards for anaesthetic technique and conversion from regional to general anaesthesia in caesarean sections. Statistical process control was applied as a quality improvement tool to monitor our conversion rates.

Methods: We continuously collected data for 12 years using record books,theatre register and the anaesthetic database.

Results: Our conversion to GA in elective caesareans has ranged from 0.5 to 0.4% meeting the standard of below 1%. Our conversion rate in emergency CS has reached 5% meeting standards set.

Discussion: We have adapted a continuous quality improvement approach to reduce conversion rates to GA . Although our data suggests that we are meeting standards, applying statistical process control (SPC) suggests that there is a negative trend of our conversion rate in emergency sections.(Fig 1) Detailed breakdown of reasons for failure into 7 categories and SPC charting tracks data to identify 3 top improvement areas - failure to rescue poor labour epidurals (18.9%)which then fail when topped for sections, spinals which fail to work (16.2%) and failing epidurals due to time lack in an emergency (16.2%). We introduced a strategy in 2009 of aggressively re-siting under functioning epidurals, which had helped in reducing our conversion. Although this measure worked , our SPC chart tracks a falling trend demonstrating difficulties with sustaining positive change and a need for continuous education and monitoring. We believe that ultrasound assistance could reduce the underperforming spinals. However, despite attempts to educate, the uptake of ultrasound for neuraxial blocks remains low in our organisation and elsewhere.(2) Mandating this in the curriculum may be the way forward but will need approval from Royal College.We believe that CQI approach is vital to organisations to reduce GA and avoid unnecessary maternal mortality and morbidity.

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2. Mathieu, S. and Dalgleish, D. J. (2008), A survey of local opinion of NICE guidance on the use of ultrasound in the insertion of epidural catheters. Anaesthesia, 63: 1146–1147. doi:10.1111 /j.1365-2044.2008.05697

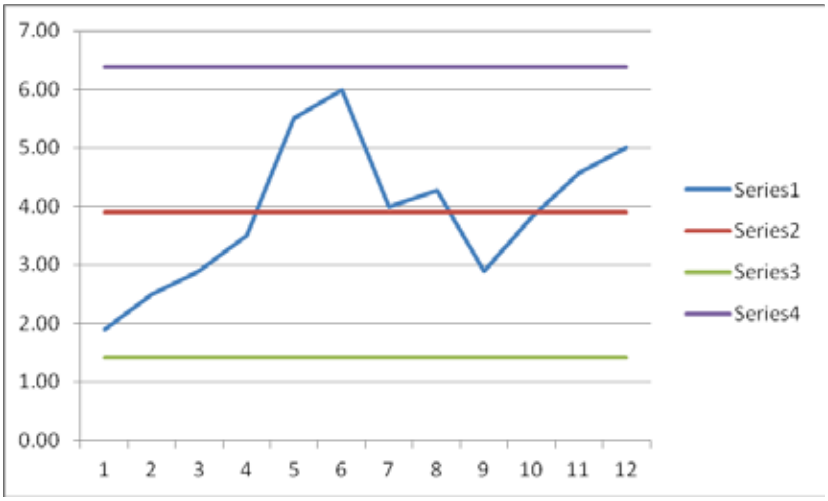

Figure 1:Statistical process control chart showing trend of emergency conversion to GA

Time in years vs percentage of conversion

Abstract #:F-38

Pulse pressure and carotid artery Doppler velocimetry as indicators of maternal volume status: a prospective cohort study

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Objective: Narrow pulse pressure (PP) has been demonstrated to indicate low central volume status. Volume status can also be estimated using Doppler velocimetry to assess hemodynamic changes in the carotid artery in response to autotransfusion with passive leg raise (PLR). Neither parameter has been prospectively evaluated in an obstetric population. The objective of this study was to assess PP and carotid artery Doppler as indicators of volume status in hemodynamically stable intrapartum women.

Methods: Healthy women with singleton gestations ≥35 weeks were recruited to this prospective cohort study. After informed consent, maternal carotid artery Doppler assessment was performed in all patients before and after PLR using a standard technique where carotid blood flow = π x (carotid artery diameter/2)² x (velocity time integral) x heart rate [1]. The velocity time integral was calculated from the Doppler wave form with angle adjustment. Participants were grouped by PP prior to PLR as 45 mmHg (narrow) or 50 mmHg (normal). We evaluated changes in carotid artery Doppler parameters after PLR within and between study groups.

Results: 33 women participated including 18 in the narrow and 15 in the normal PP groups (mean and standard deviation initial PP 57.3 ± 4.1 vs. 38.3 ± 4.4 mmHg). Initial vital signs, hemoglobin, BMI and obstetric characteristics were otherwise similar between groups. Carotid artery diameter and flow increased after PLR in both groups. The narrow PP group had a significantly greater increase in carotid artery diameter (0.08 vs. 0.02 cm, $p<0.0001$), carotid blood flow (79.4 vs. 16.0 mL/min, $p<0.0001$) and percent change in carotid blood flow (47.5 vs. 8.7%, $p<0.0001$) compared with the normal group. Initial PP was strongly correlated with the change in carotid flow after PLR ($r^2=0.60$, $p<0.0001$).

Conclusion: The hemodynamic response of the carotid artery to autotransfusion after PLR is significantly greater in women with narrow PP. This study provides physiologic evidence suggesting a strong correlation between PP and central volume status in hemodynamically stable obstetric patients. If corroborated, these methods of indirect volume assessment may guide the individualization of intrapartum fluid management.

Reference:

1. Marik PE et al. The use of bioreactance and carotid Doppler to determine volume responsiveness and blood flow redistribution following passive leg raising in hemodynamically unstable patients. Chest. 2013;143:364-70.

Table:

	Narrow Pulse Pressure N=18	p Prior vs After	Normal Pulse Pressure N=15	p Prior vs After	p Normal vs Narrow
Prior to PLR					
Carotid diameter (cm)	0.58 (0.04)		0.60 (0.03)		0.17
Velocity time integral (cm/s)	10.5 (1.38)		12.1 (3.11)		0.06
Carotid flow (mL/min)	167.2 (28.7)		203.3 (52.1)		**0.02**
After PLR					
Carotid diameter (cm)	0.66 (0.04)	**< 0.0001**	0.62 (0.03)	**0.01**	**0.003**
Velocity time integral (cm/s)	12.1 (2.1)	**0.0001**	12.2 (2.7)	0.79	0.86
Carotid flow (mL/min)	246.7 (54.7)	**< 0.0001**	219.3 (53.6)	**0.0004**	0.16
Change carotid diameter (cm)	0.08 (0.03)		0.02 (0.03)		**< 0.0001**
Change velocity time integral (cm/s)	1.52 (1.32)		0.06 (0.88)		**0.001**
Change flow (mL/min)	79.4 (36.4)		16 (13.5)		**< 0.0001**
% Change in Carotid Flow	47.5 (20)		8.4 (7.0)		**< 0.0001**

Data presented as mean(standard deviation) or n(%)
Analysis with paired t-test or Wilcoxon rank sum test where appropriate

Abstract #:F-39

Gene discovery in idiopathic preterm delivery or uterine atony

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Background: Preterm labor and delivery (PTD),(1,2) labor duration,(3) post-dates delivery (4) and uterine atony (UA) are believed to be in part genetic; however, no genes have been identified that specifically predict PTD ('uterine hypercontractility') or UA ('uterine hypocontractility'). Gene identification has proven challenging because of extreme difficulty identifying the subset of women with idiopathic PTD and UA and the challenges controlling for the many obstetric factors that may confound the diagnosis. We defined stringent criteria for identifying idiopathic PTD and UA, report on the results of exome sequencing, and use this foundational work to build a much larger cohort to drive gene discovery.

Methods: Using a cohort of 1969 women with obstetric and neonatal data and available DNA, we screened cases with PTD or UA. PTD was defined as delivery <37wks (252 days) with no chorioamnionitis, preeclampsia, uterine rupture, cord prolapse, placental abruption, fetal anomaly, in a singleton pregnancy with ≥1 episode of preterm labor; our search yielded N=13. UA was defined by 3 consecutive criteria: induction of labor > 40wks (280 days, post-dates), failure of labor (without non-reassuring fetal status) requiring an intrapartum cesarean delivery, and intraoperative uterine atony requiring 2nd-line uterotonics; our search yielded N=4.

Exome sequencing (Roche/Nimblegen SeqCap EZ V3.0) was performed on the 13 PTD and 4 UA cases. Following alignment and variant calling, genes previously implicated in abnormal deliveries were screened for low frequency candidate variants. Comprehensive gene-level association testing was also performed comparing cases to ~5000 ethnically-matched population controls looking for enrichment of rare, putatively protein-disrupting mutations.

Results: No genome-wide significant signals were detected at the gene-level in this small retrospectively-collected cohort; however, through by evaluating ~180 genes previously studied in the context of pregnancy (PTD, labor duration or postdates delivery), we identified one rare missense allele in IGF1R in one PTD case (NM_000875.3:c.1633G>A;p.(Gly545Ser). The IGF1R encodes insulin-like growth factor receptor 1, an important protein that may contribute to signaling of the onset of labor, and has been previously implicated in PTD through linkage analyses.(5)

Discussion: We developed well-defined phenotypic criteria to identify true idiopathic uterine hypo- or hyper-contractility, and report findings from the exome sequencing of selected cases from a large cohort. While the genetic basis remains elusive in this small cohort, we will use this framework to build a much larger prospectively-collected cohort that will likely quickly advance gene discovery and our ability to identify women at high risk for complicated births.

References:

1. BMC Genomics 2016:17:759
2. BJOG 2015:122:1387-94
3. Am J Obstet Gynecol 2012:207:184
4. BMC Med Genet 2010;11:105.
5. PLoS Genet 2011;7:e

Abstract #:F-40

Influence of surgical incision length on chronic postoperative pain after cesarean delivery

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Background: Reliable predictors for acute and chronic pain after cesarean delivery (CD) are not fully elucidated. In women undergoing a repeat CD, preoperative scar hyperalgesia was shown to predict acute pain and analgesic use after CD (1). We hypothesized that surgical incision length is an important factor that can help identify women at risk for acute pain and chronic pain after CD (CPCD). The primary aim was to evaluate the influence of surgical incision length on CPCD. Secondary aim was to evaluate the influence of preoperative scar length on pain outcomes among women with a repeat CD.

Methods: In this prospective study, 545 women undergoing elective CD with standardized spinal anesthesia and multimodal analgesia were followed up to 12 months postoperatively. Demographic data, CD incision length, mean acute evoked pain over 48h (verbal pain rating score (VPRS) 0-10), wound hyperalgesia area (WHA; cm2) at 48h, VPRS at 2, 6 and 12 months and self-report questionnaires (SF-MPQ2) were recorded in all women. In women with a repeat CD, preoperative CD scar length (cm) was measured and women classified in groups based on scar length: Short<14 cm (N=36); Medium=14-17 cm (N=118), Long>17 cm (N=16). \ CPCD was defined as VPRS>0 at 12 months.

Results: The overall CPCD rate was 3.7% (20/545 women). Surgical incision length was correlated with overall pain at 2 months (r=0.121, p=0.005), 6 months (r=0.334, p=0.001) and 12 months (r=0.113, p=0.012). Women with CPCD had greater acute pain (3.8±2.0 vs 2.9±2.2; p=0.037), longer incision length (16.9±2.0 vs 14.7±1.6; p<0.001), and larger WHA (0.97±1.0 vs 0.39±0.7; p=0.001).CPCD was present in 11/170 women after repeat CD vs 9/375 after primary CD (CPCD rate 6.5% vs 2.4%; p=0.02). Preoperative scar length, in women with repeat CD, was associated with pain at 2, 6 and 12 months (Table).

Discussion: We identified for the first time that previous CD scar and current CD incision lengths are associated with persistent and chronic pain after CD. Findings show the importance of minimizing incision length to reduce CPCD. In addition, we found that women with repeat compared to primary CD are at greater risk for CPCD.

The association between surgical incision length, wound hyperalgesia and pain characteristics including tingling suggest that neuropathic mechanisms may be involved, and further studies are needed to evaluate the contribution of scar length and central sensitization.

Reference:

1. Eur J Pain 2013;17:111-23

Table. Pain outcomes according to preoperative CD scar length and current CD incision length among women with a repeat CD (N=170)

	Preoperative CD Scar Length			
	Short (<14 cm) N=36	**Medium (14-17 cm) N=118**	**Long (>17 cm) N=16**	**P value**
BMI	28.9±3.5	30.1±4.1	37.1±7.3	<0.001
Evoked Pain at 24h (VPRS 0-10)	3.3±2.2	2.9±2.4	3.2±2.2	0.531
Wound Hyperalgesia Area at 48h (cm^2)	0.5±0.8	0.4±0.8	0.7±0.70	0.252
Tingling at 2 months (SFMPQ-2)	0.2±0.7	0.1±0.6	0.7±0.7	0.041
Overall Pain at 2 months (VPRS 0-10)	0.2±0.7	0.1±0.6	0.7±0.7	0.008
Overall Pain at 6 months (VPRS 0-10)	0.0±0.0	0.04±0.2	0.4±0.9	0.001
Overall Pain at 12months (VPRS 0-10)	0.06±0.2	0.03±0.3	0.5±0.7	<0.001
	Current CD Incision Length			
	Short (<14cm) N=35	**Medium (14-17cm) N=108**	**Long (>17cm) N=23**	
Overall Pain at 12 months (VPRS 0-10)	0.1±0.11	0.03±0.28	0.20±-0.73	0.004

Data presented as mean ± standard deviation; CD=cesarean delivery
ANOVA used for comparisons between 3 groups.

Abstract #:F-41

SPINAL ANESTHETIC TO INCISION DURING CESAREAN SECTION: HOW LONG IS TOO LONG?

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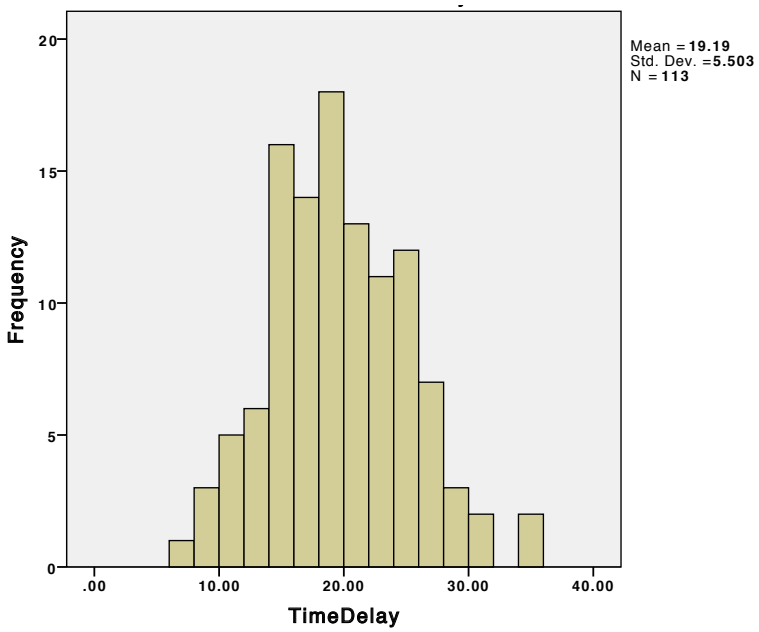
Background: Improving operating room safety and efficiency has received much attention over the past decade. This however has been relatively minimally translated into labor and delivery operating suites. In our academic practice, we have noted that prolonged delays in surgical start times may significantly contribute to sooner anesthetic ware and subsequent maternal exposure to supplemental anesthetics/analgesics. Within the context of improving both safety and efficiency, we sought to evaluate the average time interval between intrathecal anesthetic placement and surgical start.

Objective: Evaluate the average time between placement of intrathecal anesthetic to surgical incision during routine cesarean section. Secondary objectives included: (1) the frequency of supplemental anesthetic adjuncts utilized, in reference to both anesthetic technique as well as intra-operative times, and (2) the evaluation of neonatal outcomes based upon Apgar scoring at 1 and 5 minutes.

Methods: Retrospective pilot study of parturients undergoing non-emergent cesarean section. Data was collected from 113 subjects at a single academic institution whom had received intrathecal bupivacaine (10.5-12mg), morphine (150mcg) and fentanyl (15mcg) via either a single shot spinal (SSS) or a combined spinal/epidural (CSE). Anesthetic to incision time, total surgical time, total anesthetic time (anesthetic to incision time + total surgical time), delivery of supplemental anesthetic (e.g opiates, ketamine, nitrous, epidural agents), in addition to neonatal Apgar scores at 1 and 5 minutes were assessed.

Results: The average time between intrathecal anesthetic placement and surgical incision was 19.2 +/- 5.5 minutes. Those receiving a SSS had a relative risk (RR) of 1.73 ($p<0.05$) of receiving an adjunct anesthetic when the anesthetic to incision delay was greater than 19 minutes. No similar associations were identified within those whom had received a CSE (RR = 0.98). A significant correlation was also demonstrated between supplemental anesthetic administration to both total surgical time ($p<0.001$) and total anesthetic time ($P<0.05$).
No relationship was identified between anesthetic to incision time and neonatal Apgar scores.

Conclusions: The average spinal anesthetic placement to incision time was 19.2 minutes. A prolonged anesthetic to incision delay will significantly contribute to the frequency of supplemental anesthetics used, particularly to those receiving a single shot spinal.



Abstract #:F-42

The effect of assisted reproductive technology (ART) on the amount of bleeding during delivery under epidural analgesia

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Introduction: Assisted reproductive technology (ART) has been widely used to treat infertility. Recently, increasing numbers of women who conceived through ART have requested labor epidural analgesia. However, there are few reports investigating the relationship between the amount of bleeding and ART procedures. Thus, we conducted this retrospective study to investigate whether the amount of bleeding in ART cases is more than those spontaneously conceived.

Methods: This study was approved by the Institutional Review Board of Hamamatsu University Hospital (E16-219). We retrospectively investigated medical records of primiparas with singleton pregnancies who delivered under epidural analgesia at our hospital from 2005 to 2015. We compared the data between women conceived with ART (Group A [n=30]) and without ART (Group B [n=194]). Furthermore, we compared the amount of bleeding in deliveries between methods of ART (IVF-ET, frozen-thawed embryos transferred (FET) during either natural or hormonal cycle). Statistical analysis was performed using unpaired t-test or Mann-Whitney test for continuous variables depending on the sample distribution, and chi-square test for categorical data. The amount of bleeding was analyzed by one-way analysis of variance.

Results: There were significant differences in age (Group A 36.8 ± 4.2, Group B 31.8 ±4.6 ; p=0.000) and the amount of bleeding in delivery (Group A 1264.0 ± 1222.5 ml, Group B 791.8 ± 454.4 ml ; p=0.005). There was still significant difference after an analysis of covariance to remove the influence of age (p=0.0025). The percentage of patients with the amount of bleeding more than 1,000ml was significantly high in Group A (Group A 43.3% vs. Group B 23.1% ; p=0.019). Among 13 cases of bleeding more than 1,000ml in Group A, we found uterine atony in 4 cases, placental acreta in 2 cases, cervical laceration in one case, and the etiology was not clear in remaining 6 cases. There were no significant differences in height, weight, duration of delivery, rate of instrumental delivery, weight of the babies or umbilical cord blood pH. The methods of embryo transfer were revealed in 22 cases in Group A (IVF-ET in 4 cases, natural cycle-FET in 3 cases, and hormonal cycle-FET in 15 cases). The amounts of bleeding were 968.8 ± 432.8 ml, 431.7 ± 256.2 ml, 1208.3 ± 437.0 ml, respectively. We found significant difference between natural cycle-FET and hormonal cycle-FET; p=0.034.

Discussion: The results of this study suggest that careful postpartum management is recommended to the pregnant women who conceived with ART. The result that amount of bleeding was more in women with FET during hormonal cycle is consistent with previous report1). We should collect more cases and consider the point.

Abstract #:F-43

Antenatal Anemia and the Incidence of Maternal Small Volume Blood Transfusions

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Introduction: During a routine vaginal delivery blood loss is estimated to be 500mL or less, while a caesarean section is around 800-1000mL.* Prior to delivery a woman develops a physiologic anemia secondary to dilution and are classified as anemic when the hemoglobin is less than 11.0g/dL. A woman's antenatal hemoglobin level and the likelihood of receiving a transfusion during delivery or immediately in the postpartum period has not yet been studied. The objective of this study is to determine if antenatal anemia is associated with an increased risk of receiving a blood transfusion during delivery or immediately postpartum.

Methods: This study was conducted at a regional specialist maternity hospital from 1 December 2015 to 31 September 2016 and included 8100 deliveries. Deliveries excluded from the analysis were those that were missing a pre-delivery hemoglobin or women who received greater than 2 units of red blood cells (RBCs). The cohort was divided into non-anemic and anemic women defined as a hemoglobin less than 11.0g/dL. The first objective of the study looked at the frequency of requiring a small volume RBC transfusion(≤2 units pRBCs) in antenatal anemic versus non-anemic mothers. The second objective further divided the cohort based on the route of delivery to determine if the route of delivery impacted the frequency of requiring a small volume RBC transfusion. The statistical significance between antenatal anemia and receipt of postpartum RBC transfusions was determined using a Fischer's two-tailed exact test

Results: A total of 8100 women gave birth,of those 8039 had a pre-delivery hemoglobin and were analyzed. Of the women with antenatal anemia they were more likely to receive a small volume blood transfusion (OR 5.65, P = 0.0001, CI 3.54 – 9.02). Further division of the cohort found that women who underwent a caesarean section with anemia had an increased risk of receiving a small volume blood transfusion compared to non-anemic mothers (OR 5.58, P = 0.0001, CI 2.942 – 10.594). In women who had a vaginal delivery and antenatal anemia they had an increased risk of requiring a small volume blood transfusion compared to non-anemic women (OR 5.22, P = 0.0001, CI 3.542 – 9.02).

Conclusions: In expectant mothers with antenatal anemia they are at increased risk of requiring a small volume blood transfusion regardless of the route of delivery.

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Abstract #:F-44

Music in the Section Room? The Obstetricians' Perspective

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Introduction: Music in the operating room is a two-edged sword with studies showing conflicting risks and benefits. The OR is a noisy place and music compounds the problem. Intraoperative noise may impair concentration, communication(1) and increase stress among providers. In contrast, music can decrease team anxiety, increase cooperation(2) and even improve speed and efficiency of surgical closure(3). The obstetric OR often adds an additional consideration - the effect of music on the non-sedated patient under regional anesthesia. Music has been shown to reduce pre(4) and post-op anxiety and decrease pain and analgesic use after surgery(5). A Cochrane review of music during c-section showed improvements in maternal birth satisfaction and pulse rate. Unquestionably though, the primary focus must be on the effect of music on the obstetrician who has the single most important task in the section room. We conducted a survey to elucidate obstetricians' perspectives on music played in the OR.

Methods: We conducted a survey of academic obstetricians in the United States on their practice and opinions regarding music played during elective cesarean section under regional anesthesia.

Results: We received 116 responses. 47% of respondents reported music was played frequently (18%) or occasionally (24%) while 53% reported rarely or never. 50% felt music "created a more positive, relaxed environment" and "enjoyed operating with music". 42% were indifferent while 14% felt "it is a distraction and prefer the OR with less noise". Of those who prefer or didn't mind music, 82% felt it should be the patients' choice; 18% the obstetrician's. There were multiple comments on limiting the volume and on musical genre (heavy metal and rap most singled out unfavorably).

Discussion: The option of playing music during cesarean sections must be judiciously considered as a team decision. During cesarean births multiple personnel populate the operating room including the obstetric team,anesthesia, nursing, pediatrics, a support person, and ultimately, a (hopefully) screaming baby. This can lead to high levels of noise and its negative consequences. While music can increase noise levels it can potentially allay patient and provider anxiety as well. Our survey shows that half of obstetricians regard music positively while the vast majority (86%) would allow it. Most obstetricians accept the patient's choice of music. A study of cardiac surgeons showed reduced autonomic reactivity and improved task performance most significantly when they choose their own music(6). Provided the obstetric team is accepting, music may then be offered to patients. The anesthesiologist must be mindful of periods of high stress (e.g. delivery) and noise (post-delivery), control the volume and minimize distractions in the OR environment accordingly.

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Abstract #:F-45

Assessment of Environmental Exposure to Nitrous Oxide in Labor and Delivery Rooms During Self-administered Nitrous Oxide Labor Analgesia

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Introduction: Nitrous Oxide (N2O) is offered as a self-administered labor analgesic via facemask with patient-initiated expiratory scavenging (1). Ambient N20 levels are dependent on proper use of the scavenging system, mask fit, and proper mask use to capture expired gases (2,3). Chronic N20 exposure can cause adverse health effects (4,5). The objective of this study was to determine whether ambient N20 levels during self-administered use were elevated above the National Institute for Occupational Safety and Health (NIOSH) recommended exposure limit (REL) of 25 parts per million (ppm) based on a time-weighted average (TWA) concentration of exposure to waste anesthetic gas (6).

Methods: To assess ambient N20 levels, passive sampling badges were obtained from Assay Tech Labs, opened at the start of N2O administration, and placed in the patient's respiratory zone with the exposure duration recorded. In total, 48 badges were analyzed by gas chromatography to determine the average N2O concentration. Univariate statistical analysis was conducted using SAS version 9.3 to estimate the proportion of measurements exceeding the REL and characterize result variability and distribution.

Results: Statistical analyses showed appreciable variability in N2O concentrations (MN 201, SD 394 ppm), partially attributable to a few extreme values. However, a non-parametric analysis revealed a greater than 99% probability that the median value (85ppm) exceeded the NIOSH REL.

Conclusion: Initial study results indicate that labor and delivery personnel may be exposed to N2O in excess of the NIOSH REL. To further assess occupational exposure risks, we propose additional investigation with robust personal N20 exposure characterization to obtain direct exposure data for labor and delivery staff compared to hospital staff not associated with N20 use. Additionally, characterizing delivery room air exchange, patient compliance with scavenging, mass N20 removal daily, and equipment maintenance will allow for additional risk screening to identify current conditions and make recommendations to optimize safe N20 use in labor and delivery settings (7).

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Abstract #:F-46

The Development and Validation of an Obstetrical Hemorrhage Risk Prediction Index

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Background: Identification of women at heightened risk for obstetrical hemorrhage may lead to improved outcomes by allowing the care team to prepare for this complication, including performing appropriate pre-transfusion testing. Currently available risk stratification tools classify women as low, medium, and high risk based on individual risk factors. (Main et al, Obstet Gynecol, 2015) A risk score that weights risk factors based on the strength of their association with hemorrhage and that captures the impact of the presence of multiple risk factors has not been previously described.

Objective: To develop and validate an obstetrical hemorrhage risk prediction index.

Methods: Data were derived from a database of delivery hospitals in New York from 1998-2007. The primary outcome was defined as the transfusion of ≥4 units of packed red blood cells (pRBCs) during the delivery hospitalization, which is the definition used by the Joint Commission to define severe hemorrhage. The data set was divided into a development (2/3 of sample) and validation cohort (1/3 of sample). For the development cohort, a logistic regression model predicting the primary outcome was created using a stepwise selection algorithm that included 23 candidate antepartum risk factors for obstetrical hemorrhage. Each of the risk factors included in the final model was weighted based on its beta coefficient, and these were summed to calculate a risk score. Using the validation cohort, the performance characteristics of the index were evaluated. The performance of the risk index was also defined for alternative thresholds for defining hemorrhage including ≥1, ≥2, ≥3, and ≥10 units of pRBCs.

Results: A total of 690,742 completed pregnancies were analyzed, of which 0.4% (n=2,764) were complicated by the primary study outcome of transfusion of ≥4 units of pRBCs. The derived index included 17 risk factors (Table). Potential total scores on the index range from 0 to 68. For each point increase in the index, the relative risk for the primary outcome was 1.34 (95% confidence interval 1.32–1.36), such that a woman with an index of 0 had a 0.2% risk of the primary outcome and with an index of ≥13 the risk was 17%. The c-statistic for the model was 0.74. Calibration was similarly robust across the alternative thresholds for defining hemorrhage.

Conclusion: Our risk index provides a simple tool that can be used in during the antepartum period to identify women at excess risk for hemorrhage.

Results of the Derived Model Predicting Obstetrical Hemorrhage and the Associated Weights for Risk Factors

Risk Factor	Beta Coefficient	Relative Risk (95% CI)	Weight
Placenta accreta	4.7	111 (83.8–148.9)	16
Pre-existing coagulopathy	1.9	6.88 (5.20–9.10)	6
Placenta previa	1.7	5.86 (4.70–7.30)	6
Severe preeclampsia / Eclampsia	1.6	4.77 (3.90–5.82)	5
Antepartum hemorrhage due to causes other than previa or abruption	1.5	4.46 (3.23–6.17)	5
Placental abruption	1.4	4.18 (3.42–5.10)	5
Stillbirth	1.3	3.56 (2.73–4.65)	4
Chorioamnionitis	1.1	2.96 (2.43–3.61)	4
Chronic hypertension with superimposed preeclampsia	0.9	2.42 (1.52–3.87)	3
Antepartum anemia	0.8	2.15 (1.78–2.60)	3
Cesarean delivery	0.7	2.00 (1.81–2.12)	2
Mild preeclampsia	0.6	1.87 (1.49–2.35)	2
Thrombocytopenia	0.6	1.91 (1.41–2.60)	2
Multiple gestation	0.5	1.57 (1.29–1.92)	2
Obesity	0.4	1.52 (1.00–2.33)	1
Medical induction of labor	0.4	1.49 (1.31–1.69)	1
Uterine fibroid	0.3	1.40 (1.06–1.83)	1

Abstract #:F-47

Flow Characteristics of Contemporary Pencil-Point Spinal Needles from different Manufacturers

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Background: Research and improvement in tip design, diameter and orifice orientation in spinal needles have been focused to reduce PDPH. However, smaller diameter may have a lower CSF flow or needle stiffness that may entail greater technical difficulty leading to higher failure or multiple attempts with spinal anesthesia. Apparently same gauge spinal needles may produce significantly different flow and mechanical characteristics from different manufacturers. We compared the flow characteristics of contemporary pencil-point spinal needles among 4 different manufacturers.

Methods: Four brands (Becton Dickinson(BD), IMD Gertie Marx(IMD), Pajunk(PJ) and Pencan(PN)) of pencil-point spinal needles of three(22, 25 and 27) different gauges were investigated using a lumbar puncture simulation model (Genesis, Epidmed Anesthesia) attached to normal saline infused and calibrated at constant 50 cm H2O fluid pressure (replicating sitting CSF pressure). Each needle was introduced into the L4-L5 region of the simulation model in a midline approach until the dural space was encountered, the stylet was then withdrawn and a timer (precision to 1/100 seconds) began to count time to A. first visible appearance of saline (first flash), B. first drop (primary outcome) and C. 5mL of saline collected. Data were collected 5 times with 5 new needles for each gauge and each brand (total 60 needles). A sample size of 3 is required to detect a difference of >10% in time measured among groups with a power of 0.80 and alpha of 0.05. One way ANOVA and pairwise comparisons were performed with $P<0.05$ considered significant.

Results: The mean time to first drop and 5 mL of fluid collected and comparative summary of flow characteristics are shown in Table 1a-c. Higher gauge needle resulted in slower flow characteristics as expected. However, despite needles of same gauge and length, the flow characteristics differ significantly among different brands. The data shows PN needles possess characteristics of higher flow rate, faster first flash and 1st drop of fluid collected for 22 and 25G, while BD was better with 27G and IMD performed mostly in the middle of the needles studied.

Conclusion: Knowing the flow characteristics of different spinal needles may provide better evidence based choice of spinal needles. Other factors such as needle stiffness should also be incorporated to make optimal choice of spinal needles.

IMD provided GM spinal needles, supported by WFSM Anesth Research Fund.

Abstract #:F-47

Table 1. Comparative Summary of Flow Characteristics among Spinal Needles of different Gauges and Brands

Gauge and Length of Spinal Needles	BD	IMD	PJ	PN	Comparative Time	P-Value* (Compares different manufacturers)
Table 1a.	**Time (Average±SD) to First Drop of Fluid Obtained (Seconds)**				Shortest--> Longest	
22G, 90mm	4.30±0.15	3.18±0.73	3.71±0.32	2.59±0.21	PN< IMD, PJ <BD	<0.001
25G, 90mm	13.06±0.62	18.37±0.19	19.42±0.30	11.73±0.80	PN<BD< IMD <PJ	<0.001
27G, 90mm	21.82±1.97	36.54±1.72	27.28±1.14	27.33±3.23	BD< PJ, PN <IMD	<0.001
P-Value* (Compares different gauges)	<0.001	<0.001	<0.001	<0.001		
Table 1b.	**Time (Average±SD) to 5 mL of Fluid Obtained (Seconds)**				Shortest--> Longest	
22G, 90mm	119.63±4.10	90.34±5.01	87.41±1.47	53.94±0.83	PN< PJ, IMD <BD	<0.001
25G, 90mm	375.66±17.91	448.05±13.23	422.27±2.47	271.30±20.76	PN<BD< IMD <PJ	<0.001
27G, 90mm	601.86±42.92	898.81±8.97	719.69±15.52	611.52±48.76	BD, PN< PJ< IMD	<0.001
P-Value* (Compares different gauges)	<0.001	<0.001	<0.001	<0.001		

Table 1c. Comparative Summary of Flow Characteristics among Spinal Needles of Different Gauges and Manufacturers

Gauge and Length	Time to 5 mL	Flow Rate from 5 mL	Time to First Flash	Time to 1 Drop Collected
	Shortest------>Longest	Fastest ---------->Slowest	Shortest---------->Longest	Shortest---------->Longest
22 G , 90 mm	PN < PJ, IMD < BD	PN > PJ, IMD > BD	PN < IMD, BD, PJ	PN < IMD, PJ < BD
25 G, 90 mm	PN < BD < PJ < IMD	PN > BD > IMD, PJ	PN < BD, IMD < PJ	PN < BD < IMD < PJ
27 G, 90 mm	BD, PN < PJ < IMD	BN, PN > PJ > IMD	PJ, IMD < BD < PN	BD < PJ< PN < IMD

Brands of Spinal Needles : PN= Pencan; PJ = Pajunk; IMD= Gertie Marx, IMD ; BD= Becton Dickinson

"*" - One way ANOVA comparing needles from different manufacturers, or different gauges of same manufacturer.
"< " means less than (with statistical significant difference for pairwise comparison , P<0.001);
" >" means greater than (with statistical significant difference for pairwise comparison , P<0.001)
"," means similar (without statistical significant difference for pairwise comparison , P<0.001)

Abstract #:F-48

Assessment of fetal blood after therapeutic intrauterine transfusion

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Introduction: Fetal anemia is a complication of pregnancy that may progress to hydrops, with significant fetal morbidity and mortality. Current treatment involves intrauterine transfusion (IUT), with an overall fetal survival rate of about 90%. There are risks associated with this procedure, the most common being fetal bradycardia, seen in approximately 8% of IUTs.

The blood used for transfusion is frequently unwashed O-negative, irradiated, fully screened, CMV negative with a hematocrit of about 70%. The relatively high-volume transfusions likely impart large citrate and potassium loads to the fetus, which may contribute to arrhythmias and other complications during the procedure. Our study examines fetal electrolytes before and after successful IUT.

Methods: IRB approval and written subject consents were obtained. Once the umbilical cord was accessed, 0.25ml of additional fetal blood was sampled both prior to and after completion of the transfusion. These samples, as well as the donor blood, were analyzed from 3 IUT procedures. Due to the small sample size, all of the data is presented.

Results: All donor blood, despite being only 3 to 5 days old, had notably elevated levels of potassium (11.2, 12.3, 17.2 mEq/L) and undetectable (less than 0.25 mg/dL) amounts of ionized calcium (likely related to the sodium citrate storage solution). After intrauterine transfusion, increases in fetal potassium (4.1 toà8.4, 3.4 toà4.8, 3.5 toà5.2) and decreases in calcium (1.52àto 0.75, 1.47 toà0.69, 1.46 toà0.98) were seen consistently.

Discussion: IUTs may require substantial blood transfusion, sometimes more than 25% of a fetus's blood volume. Results from these three initial study patients suggest that the use of unwashed banked blood for IUTs can impact fetal electrolytes, particularly ionized calcium as well as potassium. The clinical implications of this are unknown, and further evaluation is warranted.

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	EFW	Fetal BV	Volume Transfused	% Blood Vol. Transfused	Donor		Fetal Hct (%)		Fetal K+ (mEq/L)		Fetal iCa (mg/dL)	
	(kg)	*(ml)*	*(ml)*	*(%)*	*Hct (%)*	*K+ (mEq/L)*	*Pre*	*Post*	*Pre*	*Post*	*Pre*	*Post*
IUT 1	2719	407	52	13%	58%	11.2	34%	49%	4.1	8.4	1.52	0.75
IUT 2	956	143	38	27%	62%	12.3	26%	39%	3.4	4.8	1.47	0.69
IUT 3	1598	240	60	25%	67%	17.2	26%	42%	3.5	5.2	1.46	0.98

Abstract #:F-49

Determinants of satisfaction among women who deliver vaginally using nitrous oxide as their sole labor analgesic: A conventional qualitative content analysis of recorded patient comments

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Aim: One in five laboring women at our center use nitrous oxide (N2O), and of those who go on to deliver vaginally, 60% use N2O as their sole analgesic. Most (93%) who use N2O report high satisfaction despite variable analgesic effectiveness (nearly half report low/intermediate effectiveness).[1] We analyzed postpartum survey comments of women who delivered vaginally using N2O as thier only analgesic. We aimed to identify factors contributing to satisfaction, and to better understand motivations to continue using N2O despite ineffective analgesia.

Methods: We performed conventional qualitative content analysis[2] of textual responses from a previously reported database.[1] Two investigators reviewed and coded responses independently, and developed a provisional coding manual using an inductive grounded approach. Analyses were compared, disagreements were resolved through consensus, and revised manuals were used to independently code a larger subset of responses. This was repeated for the entire data set. Emergent themes were identified collaboratively, and are presented with the number of coded textual references in each theme.

Results: Of 6507 vaginal deliveries over 34 months in 2011-2014, 1246 women used N2O, including 753 using N2O as their sole analgesic.[1] 678 of these had postpartum surveys, and 264 included clarifying comments for analysis. Of these, 33 failed to clarify positive experiences with N2O, and 41 failed to explain high satisfaction despite low analgesic effectiveness. Analysis of the remaining 190 comments revealed 11 emergent themes (Table). Parturients cited numerous beneficial non-analgesic attributes of N2O use, as well as partial analgesic effects that they deemed to be sufficient, or in keeping with their expectations. Numerous women described their N2O experience as consistent with their birth plan, including 14 who equated it with natural childbirth. Some described using N2O when neuraxial analgesia was not possible. Side effects were cited, as were difficulties using the apparatus/mask. Analysis revealed the importance of timely administration on request and attention to technical aspects, as well as a potential role for N2O analgesia for post-delivery procedures.

Discussion: Our results demonstrate that among parturients who choose N2O as their sole labor analgesic, determinants of patient satisfaction are more variable than previously understood.

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Abstract #:F-49

Coding Scheme – N2O labor analgesia / vaginal delivery

1. **Beneficial Non-Analgesic Effects and Coping**
    a. Tolerating; "Took the edge off" (18)
    b. Breathing / Focus (6)
    c. Distraction / Dissociation (5)
    d. Reduced Anxiety (5)
    e. Relaxation (5)
    f. Miscellaneous (2)
2. **Perspectives on Analgesic Effectiveness**
    a. Partial or transient analgesic effectiveness (31)
    b. Analgesia Relative to Expectations (14)
3. **Importance of birth plan**
    a. "Natural" childbirth plan (14)
    b. Facilitated Avoidance of Epidural (6)
    c. Nitrous Oxide When Birth Plan Was Denied (15)
4. **Comparisons with Prior Epidural Experiences [4]**
5. **Side effects**
    a. Nausea (18)
    b. Dizziness/ Lightheadedness (28)
    c. Sedation (3)
    d. Altered Cognition (5)
    e. Dysphoria (3)
    f. Claustrophobia (3)
    g. Dyspnea (2)
    h. Vision Changes (1)
    i. Itching (1)
6. **Issues related to N2O apparatus [21]**
    a. Apparatus / Mask Difficulties (12)
    b. Technical / Equipment Problems (6)
    c. Positive Experiences (3)
7. **Brevity of use [37]**
    a. Discontinued after short trial due to poor analgesia (6), or side effects (4), or both (1)
    b. Initiated shortly before delivery (20)
    c. Late in Labor (6)
8. **Post Delivery Analgesia [9] –** laceration repair (7); manual exploration (2)
9. **Future plans [31] –** favorable (25); unfavorable (6)
10. **Superlative Descriptors [11]**
11. **Timeliness [5]**

Abstract #:F-51

The effect of clonidine as an adjuvant in Transversus Abdominis Plane block after Cesarean delivery

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Introduction: Pain control in post-partum patients can pose a challenge after Cesarean section. Patients want to be awake enough to care for their baby, without the side effects of opioids given to them in the postoperative period. Transversus Abdominal Plane (TAP) blocks can be effective as part of a multimodal approach to provide postoperative pain control in this patient population. Multiple adjuvants can potentially extend the duration of analgesia from the block. One in particular, clonidine, has been shown to increase the duration of other regional blocks, but has not been specially studied in TAP blocks in this patient population. We conducted a double-blind, randomized, prospective study on the addition of clonidine to TAP blocks on postoperative opioid consumption and pain scores in the first 24 hours after Cesarean section.

Methods: Patients presenting for elective Cesarean delivery were randomly assigned to one of two groups: postoperative TAP block with the clonidine or postoperative TAP block with saline. Patients received spinal anesthesia with 12 mg bupivacaine and 15 mcg fentanyl for their primary anesthetic. Before leaving the operating room, patients received ultrasound-guided TAP block with 30cc ropivacaine 0.5% with 1:200K epinephrine and 4 mg dexamethasone (total dose divided bilaterally) with 50 mcg (0.5mL) of clonidine or 0.5 mL of saline given to the anesthesia provider by the pharmacy in identical, unmarked syringes. All caregivers and patients were blinded to study group. Multi-modal analgesia was offered to the patients consisting of acetaminophen, ibuprofen and hydromorphone PCA for the first 24 hours after Cesarean section and total dose was recorded. Primary outcome was amount of opiate pain medication given at 24 hrs. Secondary outcomes were pain scores, maternal satisfaction and side effects including nausea, vomiting, itching and drowsiness.

Results: Twenty-four patients received either TAP block with clonidine (n=12) or TAP block with saline (n=12). There were no significant differences between groups in terms of age, BMI and parity. Pain scores at 24 hours and total hydromorphone use was collected among the two groups. At 24 hours, there was no significant difference in maternal pain scores between the two groups (mean score 3.33 out of 10 in clonidine group vs 3.83 out of 10 in saline group, p=.39). Mean total hydromorphone use was also similar in both groups (5.04 mg in clonidine group vs 6.66 mg in saline group, p=.4).

Conclusion: TAP blocks can be part of multimodal analgesia for postoperative patients following Cesarean section as a means to decrease opioid consumption. Clonidine has been shown to increase the duration of peripheral nerve blocks when used as an adjuvant. However, in this patient population clonidine did not seem to make a significant difference in the duration of analgesia provided by TAP block. Mean total opioid consumption was similar in both groups as well as maternal pain scores.

Abstract #:F-52

Does inpatient opioid use after cesarean delivery predict outpatient opioid use post-discharge?

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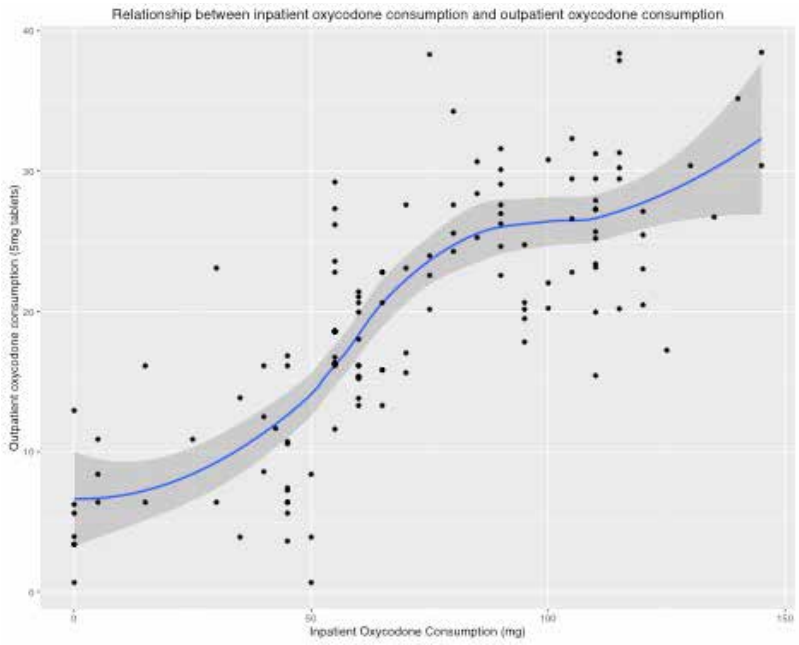
Background: Opioids are the mainstay of both inpatient and outpatient pain control following cesarean delivery (CD), and strategies are needed to better align the amount of opioid prescribed upon discharge with patient need [1]. The aim of this study was to determine if inpatient oxycodone use from 0-72 hours after CD predicts oxycodone consumption after hospital discharge.

Methods: Patients who underwent CD across 6 academic medical centers in the United States between 9/2014 and 3/2016 were surveyed via telephone 2 weeks after discharge regarding their outpatient oral opioid prescription and consumption [1]. In this secondary analysis, inpatient opioid consumption was abstracted for all survey patients from one institution for whom 40 tablets of oxycodone (5mg) were prescribed upon discharge. Multivariate linear regression models were constructed to determine the relationship between inpatient oxycodone use (in mg) from 0-72h and the number of oxycodone 5mg tablets consumed as an outpatient, controlling for (1) patient demographics and comorbidities, (2) procedural characteristics, and (3) in-hospital pain scores, in an additive manner.

Results: One hundred and thirty-three women were included in the analysis. The average age was 33 years; 69% had a primary CD, and 50% had a CD after labor. The median inpatient oxycodone consumption from 0-72h was 65mg (IQR 50-100 mg). The median outpatient oxycodone (5mg tablet) consumption was 20 tablets (IQR 4-35). The association between inpatient and outpatient oxycodone consumption is shown in Figure 1. After controlling for potential confounders, for every 10mg increase in inpatient oxycodone consumption from 0-72h post-CD, women consumed 1.82 additional 5mg tablets after discharge (95% CI: 1.04-2.59, p=<0.001).



Conclusions: Inpatient oxycodone use in the first 72 hours after CD is predictive of outpatient consumption post-discharge. Inpatient oxycodone consumption could potentially be used to inform the quantity of outpatient opioids prescribed at discharge. Better aligning the quantity of opioids prescribed with what patients use may decrease the amount of leftover opioids introduced into communities.

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Abstract #:F-53

Implementation of WHO Safe Surgical Checklist in a West African Teaching Hospital

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Introduction: To improve surgical morbidity and mortality globally, the World Health Organization (WHO) created the Surgical Safety Checklist (SSCL). This tool has decreased rates of surgical complications and death. It has been shown to enhance patient safety in the operating room. (1) In 2015, the Cape Coast Teaching Hospital (CCTH) in Cape Coast, Ghana completed the transition from community to teaching hospital. With this transition, an increase in the number and acuity of presenting cases was noted. In conjunction with a visiting team from Kybele, a non-profit humanitarian group, a strategy identified to improve morbidity and mortality after arrival at CCTH was the implementation of the SSCL. Based on the WHO template, the CCTH team created a SSCL specifically tailored to their institution. This project is an ongoing partnership between Kybele and CCTH.

Methods: This Quality Improvement (QI) project was designed to implement and assess the SSCL process at CCTH. REB was not sought as this is strictly QI. (2) In keeping with the guide from the WHO, implementation was initiated with didactic sessions and demonstrations in the operating rooms by Kybele members. Data was gathered at the time of implementation via staff opinion surveys. Twenty two surveys were distributed with a 100% return rate. Six months following implementation, Kybele members reviewed the implementation of the SSCL. The survey was recirculated and a random chart audit was also completed to identify both presence and completion of the document for each surgical patient. There were 29 post surveys returned, providing opinions from a variety of staff. Use of the SSCL was systematically observed in operating theatres during scheduled elective cases. Information collected was synthesized to allow for revision of the SSCL to accommodate the nuances of local practice.

Results: Data collected via 5-point Likert scale demonstrated an improvement in staff opinions of the SSCL including; endorsement of its role in improving communication and improving patient care. In additional comments, it was noted that time constraints (30%) and surgeon resistance (59%) were significant barriers to the use of the SSCL. Common themes included the identification of SSCL as a patient safety marker, as well as perceived improvement in nursing empowerment in the operating theatre.

Conclusion: Implementation of the SSCL at CCTH is a testament to the universality of the WHO initiative and confirmation of the described implementation plan. Initially part of a plan to reduce maternal and newborn mortality, in the hands of local leaders, the SSCL has been disseminated throughout CCTH and has become a standard of care.

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Abstract #:F-54

Analysis of anaesthetic times for category 1 caesarean delivery: A 5-year review of outcomes.

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Introduction: The Royal College of Obstetricians and Gynaecologists introduced a classification system for caesarean delivery (CD) in 2010. Category 1 CD describes immediate threat to life of the mother or fetus. Recommended times have been reported, but there is little data on anaesthetic times (defined as arrival to the operating theatre and surgery commencing) and neonatal outcomes for category 1 CD. We explored the relationship between level of anaesthetist, time of day and neonatal outcomes for category 1 CD performed over 5 years at our teaching hospital.

Methods: A retrospective analysis was performed of 3 prospective databases (anaesthetic, operating room and obstetric) between 2009-2014. The primary outcome for the study was anaesthetic time for category 1 CD and level of anaesthetist (consultant vs. trainee). Secondary outcomes were: relationship between anaesthetic time, time of day ('day'=8am-8pm, with consultant presence; 'night' 8pm-8am with trainee on duty) and neonatal admissions to the neonatal unit (NNU). Statistical analysis was performed using R (R version 3.3.0 (2016-05-03). Time-to-event analysis was performed using Cox's proportional hazards regression model.

Results: The databases contained 59,333 independent data entries. For the primary and secondary outcomes 508 data entries were available. The type of anaesthetic provided for category 1 CD was 26% (n=133) general anaesthesia, 25% (n=131) spinal, 50% (n=255) epidural top-up. There was no difference in anaesthetic times between consultant anaesthetists and trainees (HR 0.788;95% confidence interval (CI) 0.612-1.017;p=0.0669). There was no variation in the number of CDs depending on time of day. CDs were performed faster at night (HR 1.259, 95% CI 1.107-1.431;p=0.0004). Anaesthetic times of category 1 CDs performed by trainees only did not however differ with time of day (HR 1.149, 95% CI 0.962-1.373;p = 0.123). Controlling for NNU admission, there was no difference in anaesthetic timings, regardless of time of day. The anaesthetic technique chosen by consultant vs. trainee was: Top-up:27 (39%) vs. 228 (45%); CSE:15 (22%) vs 29 (6%), Spinal:11 (16%) vs. 120 (24%); Epidural:1 (1%) vs. 7 (1%); GA:15 (22%) vs. 118 (23%), other:0 (0%) vs. 4 (1%), respectively.

Discussion: There was no difference in anaesthetic time for category 1 CD when the anaesthetic was delivered by a consultant compared to a trainee. Category 1 CDs occurred evenly throughout a 24-hour period. Despite a faster anaesthetic time at night, admissions to the NNU were similar. All the CDs in this study were defined as category 1, although there are situations when the obstetrician may deem some category 1 CDs more urgent than others. Whilst we saw no impact of anaesthetic timings on neonatal outcome, this broad classification may obscure cases where changes in anaesthetic timings have an impact. Overall timings are quicker at night, this may occur due to a heavy bias from trainee led cases at night.

Abstract #:F-55

Analgesic Nitrous Oxide Use for Labor and Delivery

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Introduction: Epidural administration of local anesthetic agents and systemic opioids are frequently used for labor and delivery in the United States, while in many other countries a blend of nitrous oxide and oxygen (50:50) has been used since the early 1990's There have been no observations that report significant adverse effects in neonate resuscitation, alertness, maternal-infant bonding, and because of these reports, the interest to reestablish the use of the N2O/O2 mixture in the United States is on the rise. A review of the literature shows many anesthetic agents, including N2O/O2 mixtures, when administered during critical phases of early brain development, causes neurodegenerative changes and learning abnormalities in rat pups, but the use of analgesic doses have not been investigated. Our study is the first to compare changes in the brain of P0 rat pups subjected to 50% nitrous oxide for 1 hour prior to delivery.

Method and Study Design: The experiment consisted of pregnant rats in two experimental groups at day 23 exposed to every 5 minutes for 60 minutes to a 50% mixture of N2O/O2 prior to delivery, while the control rats were exposed to room air. Upon delivery, pup brains were collected and processed for histology. Brains were stained with Nissl stain and with antibodies against microglial and astrocytes.

Results: Preliminary analysis of the two groups showed both male and female rat pups exposed to 50% nitrous oxide for one minute every five minutes for 60 minutes prior to delivery had significant changes in the white matter compared with pups exposed to room air. The histology shows early injury reaction with glial cell and astrocytes (arrows). Data is consistent with acute brain changes that are associated with hypoxia. Normal preterm brain shows transient clusters of microglia in the white matter which are important for elimination of transcallosal projections during brain development. This area appears to be vulnerable to injury in the preterm brain. Microglial activation (orange cells in the figure) can lead to the production of proinflammatory mediators that damage the white matter.

Conclusion: The preliminary results showed early damage in the white matter which is consistent with hypoxia changes. Additional experiments are being performed to obtain statistical differences between the groups. Our results suggest studies are needed to determine if the damage is transient or leads to long term motor and learning deficits.

Abstract #:F-56

Irreversible Acquired Noncompaction Cardiomyopathy in a Parturient with Corrected Atrial Septal Defect

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Introduction: Left ventricular noncompaction (LVNC) is a rare cardiomyopathy characterized by hypertrabeculations in the left ventricle (LV)(1). Both congenital and acquired cases have been reported(2). Development of hypertrabeculations during pregnancy has been described, with most resolving completely after delivery. We report a case of unresolved pregnancy acquired LVNC cardiomyopathy.

Case presentation: A 33-year-old gravida 2 para 1 woman presented to our high risk obstetric anesthesia service for consultation during her second pregnancy. She was known to have an atrial septal defect (ASD) that had been repaired at the age of 10. Three years before, severe dyspnea during her first pregnancy had been investigated by echocardiography, which demonstrated hypertrabeculations and an LV ejection fraction of 45-50%. Since an echocardiogram performed 3 months prior had been normal, she was diagnosed with acquired LVNC syndrome. A vaginal delivery was attempted, but ventricular arrhythmias and congestive heart failure during labor resulted in an emergency cesarean delivery. Magnetic resonance imaging 2 months later confirmed hypertrabeculations and demonstrated a ratio of the thicker noncompacted endocardial layer (N) and thin epicardial compacted layer (C) (N/C ratio) ≥ 2.0 meeting the criteria for LVNC. Echocardiogram performed prior and during her second pregnancy demonstrated no resolution of her hypertrabeculations or improvement in her LV systolic function, even though she demonstrated only mild symptoms of congestive heart failure. It was decided to deliver this pregnancy by cesarean, which was performed uneventfully at term under epidural anesthesia using transthoracic echocardiography and FloTrac/Vigileo system.

Discussion: The pregnancy acquired hypertrabeculations of LVNC seem to develop at around 30-32 weeks gestation, coinciding with the concomitant increases in fluid volume. Gati et al(6) believe that this increased preload may be the mediator for the development of trabeculations, and report that the majority of cases resolve spontaneously. There were no findings of hypertrabeculations in our patient until dyspnea developed 30 weeks into her first pregnancy, which is consistent with this description. However in our case the hypertrabeculations persisted into a second pregnancy. Of note, her prior history of ASD may suggest that congenital defects unmasked by pregnancy could also have played a role in the development and persistence of the LVNC. Non-compaction cardiomyopathy developed in a parturient can lead to hemodynamic instability and may persist to impact future pregnancies.

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2. Munehisa Y, Watanabe H, Kosaka T, Kimura A, Ito H. Successful outcome in a pregnant woman with isolated noncompaction of the left ventricular myocardium. Internal medicine. 2007;46(6):285-9.

Abstract #:F-57

Anesthetic Management of a Gravid Patient with AML

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Introduction: The incidence of pregnancy associated acute myeloid leukemia is low, and guidelines for the management of these patients are not established yet. We report the case of a 29 year old pregnant woman diagnosed with AML with blast crisis at 33 weeks, who underwent a C-section in order to get induction chemotherapy. We also highlight the central role of the anesthesiology team in facilitating treatment discussions and decision making in a multidisciplinary approach.

Case report: A 29 year old G1P0 woman, presented at 33 weeks with 4 weeks of increasing dyspnea, subjective fevers, night sweats and progressive submandibular and cervical lymphadenopathy. PMHx included DMII and hypothyroidism. Physical exam was pertinent for dyspnea and tachypnea, bilateral submandibular and cervical non tender 2cm lymph nodes, airway with poor dentition and gingival hypertrophy, MP I, Thyromental distance >3cm. Labs revealed severe leukocytosis, thrombocytopenia, anemia [WBC 202, PLT 35, Hgb 6.1 (with WBC and PLT wnl 3 months prior)], and reported monoblasts on peripheral blood smear. Uric Acid 10 and LDH 1000 suggested spontaneous tumor lysis. CXR showed R basilar opacity which was concerning for infection vs. leukostasis. Hematology, Transfusion, Oncology and Critical Care services were consulted by Obstetrics, with the Anesthesiology team playing a central role in coordinating treatment discussions and decisions between the multidisciplinary services. Decision was made to initiate leukapharesis, with the goal to improve oxygenation, and optimize the patient for C-section under general anesthesia—spinal anesthesia contraindicated with PLT 36— followed by chemotherapy induction. Though the patient's WBC decreased to 80 s/p leukapharesis, patient remained dyspneic and tachypneic with saturations of 95% on non-rebreather mask. In light of her AML, the anesthesiology team requested a CT-PE protocol, which was negative for PE. The CT Thorax also enabled evaluation of the thorax for potential lymph nodes obstructing the bronchial trees or the mediastinum, but no enlarged mediastinal lymph nodes were seen.

Patient underwent a C-section under general anesthesia, with RSI, using propofol/fentanyl/succinylcholine and administration of blood products. Vital signs were stable during the procedure, and patient was transferred intubated to the ICU.

Conclusions: Though data on pregnancy-associated AML is scarce, a retrospective analysis of case reports showed that pregnant women diagnosed with AML carry a worse prognosis than non-pregnant women their age. To improve survival rate, the goal is to initiate chemotherapy as soon as possible, and thus possibly C-section the patient. AML pulmonary and cardiac involvement need to be considered prior to establishing an anesthetic plan. Furthermore, the anesthesiologist often acts as leader and facilitator in the setting of a multidisciplinary approach to treatment decision.

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Abstract #:F-58

Non-invasive cardiac output monitoring for cesarean delivery in patient with Eisenmenger's physiology

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Eisenmenger syndrome has an incidence of 3% among parturients with congenital heart defects. Peripartum period is associated with high morbidity and mortality and proper anesthetic management is critical for positive outcome. Case report:24 yo G2P0 at 35 weeks. History of CHF and Eisenmenger physiology due to persistent ductus arteriosus on medical treatment (digoxin, furosemide, metoprolol). Admitted for dyspnea with improvement after diuresis and starting sildenafil. Transthoracic echocardiography (TTE) showed severe pulmonary hypertension with estimated RVSP of 94mmHg, normal EF and Qp/Qs 0.94. After a multidisciplinary meeting involving MFM, anesthesiology and cardiology, plan was for cesarean delivery (CD) at 37w gestation for breech presentation. Monitoring included invasive blood pressure, CVP, non-invasive cardiac output (CO) monitor (ICON™) and pre and post-ductal SpO2. Epidural catheter was placed and 400mg lidocaine 2% with NaHCO3 2mEq and epinephrine 50mcg was dosed over 20 min. Five min after delivery patient complained of chest pain. A drop in systemic vascular resistace (SVR) was noted [figure 1] followed by a decrease in MAP to 65 from baseline of 90mmHg. SpO2 was maintained. Milrinone and vasopressin infusions started with clinical improvement. Patient was transferred to ICU where an epidural infusion of bupivacaine 0.125% was continued for 20h. Vasopressin was discontinued upon arrival and milrinone was discontinued 18h after delivery. Repeat TTE was unchanged except for Qp/Qs of 1.67. Postoperative course was uneventful and she was discharged after 9 days. Eisenmenger syndrome parturients are particularly vulnerable to hemodynamic changes induced by anesthesia, surgery and postpartum period. Care for these patients is complex and requires a multidisciplinary collaboration. CD should be reserved to obstetric indications. Perioperative goals are to maintain SVR, sinus rhythm and myocardial contractility while avoiding increases in pulmonary vascular resistance. Invasive monitoring is often necessary to help achieve these goals however carries risk of complications. ICON™ is a non-invasive CO monitor which uses thoracic bioreactance analysis to estimate hemodynamic indices. It has shown good agreement with TTE and it is especially valuable to display trends in hemodynamics. It may also be continued on postoperative period helping optimize hemodynamic management.

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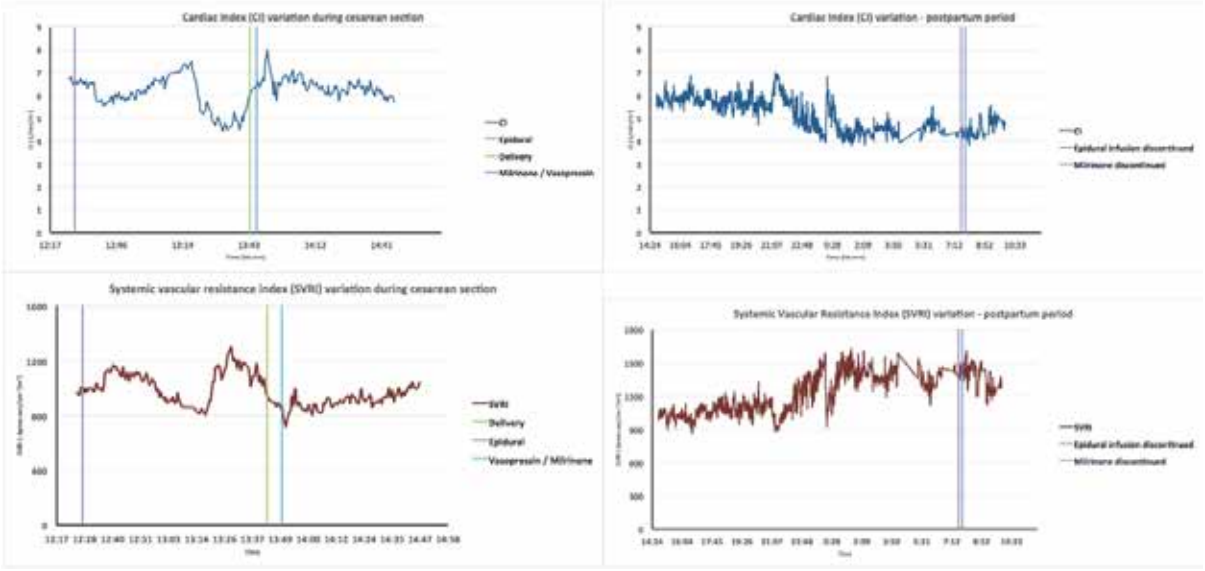

Abstract #:F-59

Cesarean Delivery, Embolization, Methotrexate, and Hysterectomy for a Jehovah's Witness Parturient with Placenta Percreta

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A 42 year old G5P2022 parturient at 27 weeks gestation with a history of 2 prior cesarean deliveries presented with vaginal bleeding. She had a known history of placental percreta. The patient was a Jehovah's Witness and refused all blood products, however she did accept cell salvage and erythropoietin. Multidisciplinary planning was coordinated among maternal fetal medicine, gynecology and oncology, urology, neonatology, interventional radiology, vascular surgery, trauma surgery, nursing, the center for blood conservation and obstetric anesthesiology. It was decided to proceed with cesarean hysterectomy.

General anesthesia was elected, access included two large bore peripheral IVs and a central line, and invasive monitoring was done with bilateral radial arterial lines. The patient's core temperature was maintained between 34-35 degrees to minimize oxygen consumption. Cell salvage was available. Before hysterotomy, embolization of the uterine blood supply was attempted while ultrasound was performed in a sterile fashion for fetal monitoring. However, embolization was abandoned due to extensive vascularity and the concern regarding excessive fetal radiation exposure if embolization was done. Cesarean delivery was performed uneventfully. The placenta was invading the pelvic wall, thus hysterectomy was foregone and the placenta remained in situ to avoid massive hemorrhage. Estimated blood loss was 500 mL; no cell salvage was given. She remained hemodynamically stable and was extubated.

Postoperatively, conservative management of the placenta percreta was attempted with IM methotrexate. Six weeks later, the patient had a few episodes of vaginal bleeding with cramping. Repeat MRI showed no placental regression and increased uterine vascularity due to collaterals. Thus, she was first taken to interventional radiology for embolization, then to the OR for hysterectomy. Embolization and hysterectomy were performed without complications.

Discussion: Maternal morbidity and mortality substantially increase with the number of repeat cesarean deliveries. The majority of the risk is related to abnormal placentation, massive hemorrhage and the need for hysterectomy (1). The preoperative approach of a Jehovah's Witness parturient undergoing major surgery should involve coordinated multidisciplinary care, preoperative supplementation with iron, epoetin alfa and folate and a surgical and anesthetic plan aiming to avoid excessive blood loss (2). Pharmacological therapies that may be considered for these patients include antifibrinolytics, prothrombin complex concentrates and desmopressin. Lastly, conservative management of morbidly adherent placenta with methotrexate and delayed hysterectomy may reduce the risk of hemorrhage, however further investigation is needed.

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Abstract #:F-60

Management of a parturient with known MEN type 2A and recurrence of Pheochromocytoma during pregnancy

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Introduction: MEN 2A in pregnancy is rare with limited case reports in literature. There are no consensus guidelines regarding anesthetic technique for managing parturient with untreated Pheochromocytoma. We report a case of successful management of a pregnant patient undergoing Caesarean section with known MEN 2A with recurrence of Pheochromocytoma.

Case: 30 y/o G2P1001 white female 38 weeks of gestation with known history of MEN type 2A and recurrence of Pheochromocytoma presents for anesthetic consultation regarding her delivery. She was diagnosed with MEN type 2A seventeen years ago when she presented with medullary thyroid cancer and consequently had a total thyroidectomy at age fourteen and later developed a right Pheochromocytoma and had a right adrenalectomy at age twenty one. During the first trimester of this pregnancy, surveillance testing of urine metanephrines and catecholamines were noted to be elevated. MRI showed a well circumscribed right adrenal mass confirming a recurrent pheochromocytoma. She was prescribed alpha blockade with phenoxybenzamine but was non compliant with treatment plan and follow up with her endocrinologist. In spite of her non-compliance, she surprisingly remained normotensive during her pregnancy with no episodic hypertensive events. Upon presentation to outside hospital at 38 weeks gestational age, she was transferred to our tertiary referral hospital for optimal management. A multidisciplinary team approach was initiated that included MFM obstetrician , endocrinologist, endocrine surgeon, and obstetric anesthesiologist. A consensus decision was made to proceed with elective Caesarean section with minimal uterine manipulation during delivery to avoid surge of catecholamines with subsequent resection of Pheochromocytoma at 6-8 weeks postpartum. Neuraxial anesthesia with combined spinal epidural technique was chosen with arterial line for close hemodynamic monitoring along with use of transthoracic echo to guide fluid management. During the surgery, the patient had remained hemodynamically stable without need for major pharmacological intervention and a healthy baby was delivered. She had an uneventful postoperative course and was discharged home five days after the procedure with instruction and follow up care planned with endocrine surgery and endocrinology in anticipation for adrenalectomy at 8 weeks postpartum.

Discussion: Untreated Pheochromocytoma during pregnancy can potentially be disastrous with catastrophic events to both mother and fetus leading to significant morbidity and mortality. A multidisciplinary approach considering all variables and treatments is a key to a successful outcome for these rare cases.

Abstract #:F-61

Impaired labor epidural analgesia following epidural blood patch complicated by arachnoiditis

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Epidural blood patch (EBP) rarely precedes epidural for labor analgesia. Conflicting reports exist on success of epidural analgesia following EBP with some reports finding increased failure months to years later(1) and others reporting success as soon as 3 days after EBP(2). We report a case of failed epidural analgesia 4 days after EBP and arachnoiditis causing pain and urinary incontinence.

A 26 yo G2P1 at 37w2d presented with headache (HA) 3 days after MRI and LP for workup of intermittent HA (findings negative). Following LP, she developed symptoms consistent with PDPH. She was offered EBP despite proximity to due date given the severity of her symptoms. She was counseled on possibility of inadequate epidural analgesia for labor. EBP was performed using 20mL of autologous blood with immediate relief. She returned in active labor 4 days after EBP. A labor epidural was placed, dosed and 2 top-ups given but she did not get relief. Replacement with CSE was offered but she delivered before replacement. She was discharged on postpartum day (PPD) 2. She returned on PPD 3 with severe low back pain radiating to her buttocks and urinary incontinence. No motor deficit was found on exam. An MRI revealed blood layering in the thecal sac at the S2 level, which neurosurgery felt could account for her symptoms. Back pain and ambulation improved within 24 hours and she was discharged with a urinary catheter. The catheter was removed on PPD 9 with successful voiding trial. Phone followup on PPD 11 confirmed continued resolution of all symptoms.

MRI following EBP shows that injected blood initially causes compression of the thecal sac, but is reabsorbed or translocated to the subcutaneous tissues within hours of injection and only small clots adherent to the thecal sac remain(3). The sustained presence of clot after EBP has been seen on MRI as far out as 22 months from EBP(4). Intrathecal blood is seen on MRI both prior to EBP in patients with PDPH and also after EBP, and is rarely associated with symptoms(3,5). Arachnoiditis is a rare complication of EBP. There are reports of arachnoiditis following large volume and repeat EBP(6,7), and one report describes MRI-proven inadvertent intrathecal injection causing arachnoiditis. Blood seen on MRI in our case may have been introduced at several time points; on initial LP, at time of EBP or as a result of translocation during dosing of labor epidural. Given the lack of other MRI findings, this blood most likely caused a transient arachnoiditis. Fortunately her symptoms resolved quickly, as there are reports of these symptoms persisting for months to years and even being permanent(8).

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Abstract #:F-62

Craniotomy for meningioma resection in a parturient at 28 weeks gestation complicated by intraoperative late decelerations

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A 31 year old G1P0 at 28 weeks gestation with no past medical history presented with 3 weeks of worsening visual acuity bilaterally. Magnetic resonance imaging showed a 4.5 x 4.0 x 2.5 cm mass in the tuberculum sella compressing the optic chiasm and a second mass 2.3 x 1.7 x 1 cm in the right temporal lobe. Both masses were consistent with meningiomas. Multidisciplinary management was coordinated among obstetrics, obstetric anesthesiology, and neurosurgery. The patient was scheduled for a craniotomy to resect both masses.

Continuous intraoperative fetal monitoring was done by an obstetric nurse. A cesarean delivery tray was available in the operating room in case a poor fetal tracing necessitated an emergency delivery. Rapid sequence induction was performed, 3 large-bore peripheral intravenous catheters and a radial arterial line were placed. Maintenance of anesthesia consisted of 1/2 minimum alveolar concentration of sevoflurane and a propofol infusion. A remifentanil infusion was added for analgesia at incision and discontinued once the dura was opened. In order to promote brain relaxation, 0.5 g/kg of mannitol was infused and the patient was hyperventilated to an end tidal CO2 between 28 and 30 mmHg. After 8 hours, the fetal heart tracing showed frequent late decelerations. In consultation with the maternal fetal medicine service, terbutaline was administered, followed by subsequent resolution of the late decelerations. Six hours later, the surgery was completed without further complications and the patient was extubated and transferred to the intensive care unit in stable condition.

Discussion: Limited information is available regarding neurological surgery in obstetric patients. Considerations for intraoperative care include the degree of hyperventilation and the use of mannitol. Although limited information is available regarding the effects of mannitol administration during pregnancy, fetal hyperosmolarity and reduced fetal lung fluid production can occur (1). Initial actions for a nonreassuring fetal heart tracing include optimization of maternal blood pressure, oxygenation, and acid-base status, as well as informing the surgical and obstetrical teams. In our case, terbutaline was administered for tocolysis and an obstetrical team was immediately available for a cesarean delivery. Multidisciplinary planning is essential for optimal care during nonobstetric surgery.

Abstract #:F-63

Anesthetic management dilemma in a pregnant patient with hereditary hemorrhagic telangiectasia

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Introduction: We report a case of a pregnant patient with Hereditary Hemorrhagic Telangiectasia (HHT) also known as Rendu-Osler-Weber syndrome presenting for delivery. HHT is characterized by recurrent epistaxis, mucocutaneous telangiectasias and arteriovenous malformations (AVMs) most commonly affecting the central nervous system, the gastrointestinal and respiratory system [1]. HHT can increase the risk of serious complications during pregnancy [2].

Case presentation: A 31-year-old female, pregnant at 32 weeks was admitted for medical optimization due fetal intrauterine growth restriction. Past medical history included morbid obesity (BMI 49), HHT, diabetes mellitus type 2, asthma, chronic back pain with prescription opioid dependence. On airway exam she had a Mallampati classification III. Due to pregnancy and HHT she had a higher risk of bleeding with airway manipulation. A magnetic resonance imaging study was suggested to the patient to identify potential cerebral, spinal or pulmonary AVMs, however the patient refused. That left us with the dilemma of doing a spinal anesthetic risking rupture of an undiagnosed spinal AVM or perform general anesthesia in a patient with a potentially difficult airway. We elected epidural anesthesia due to the low estimated incidence, about 1%, of spinal AVMs in this population [3] and due to the fact that our patient had a non-reassuring airway. Delivery was uneventful she was discharged on post-op day 2.

Discussion: HHT can complicate pregnancy and delivery and can pose a management dilemma for both the obstetric team and the anesthesiologist. Although theoretically a lot of catastrophic complications can happen including intracerebral bleeding, hemothorax, massive hemoptysis, heart failure and paralysis after puncture of spinal AVM, most women with HHT have an uneventful pregnancy and delivery [4]. In one of the few studies examining the outcomes of pregnancy in women with HHT, the most common delivery complication was uterine hemorrhage [2]. There is limited data regarding the optimal management of these patients; therefore, the obstetric and anesthetic plan should be tailored on a case-by-case basis taking into consideration the risks of AVMs in the brain, lungs and spine.

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Abstract #:F-64

Opioid-Only Epidural Analgesia: An Alternative to Controlling Pain in the Preterm Obstetric Patient with Stalled Cervical Dilation

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Case: A 19 year old G2P0101 at 34w3d gestation was admitted with preterm labor and advanced cervical dilation. Her PMH was significant for a previous preterm delivery and an anaphylactic reaction to morphine. As the obstetricians felt labor was progressing, epidural analgesia was initiated with 0.0625% bupivacaine and 2 mcg/mL fentanyl. After 24 hours, membranes were still intact, her cervix stopped changing and frequency of contractions decreased. The OBs requested epidural discontinuation, as they felt the patient was no longer in active labor. The epidural infusion was stopped and catheter left in place in case patient began laboring again. Later, the patient complained of constant severe contraction pain, but her cervix remained unchanged. Placental abruption, intraabdominal pathology and infectious causes were ruled out. Despite no contraindication, she was unwilling to utilize oxycodone due to her morphine allergy.

The obstetrician requested assistance in providing analgesia, but did not want patient to require bedrest or continuous fetal monitoring, as the plan was to transfer to antepartum. An opioid-only epidural infusion of hydromorphone was initiated at 120 mcg/hr after an 800 mcg loading dose. This controlled the patient's pain within 30 minutes with no changes noted on FHR tracing. Five hours later, the infusion was stopped as the pain had resolved. The epidural catheter was capped, and the patient was transferred to antepartum. She went on to deliver a healthy preterm infant without further epidural analgesia.

Discussion: This case highlights an alternative method for controlling pain in the non-laboring obstetric patient without requiring bedrest or continuous fetal monitoring. Local anesthetics are well known to cause lower extremity weakness which can confine the patient to bed. Studies in postoperative patients have shown decreased motor blockade and decreased hemodynamic instability with opioid only analgesia (1). Epidural hydromorphone provides similar pain relief but has decreased onset time as compared to morphine (2).

There is no current standard for epidural hydromorphone dosing. In post cesarean section patients a 1 mg bolus dose provided at least 6 hours of pain relief (1). Regarding epidural infusions, 30 to 40 mcg/hr hydromorphone plus a dilute dose of local anesthetic seems to provide effective analgesia with minimal adverse effects in laboring patients (3). Neuraxial hydromorphone can be utilized with or without local anesthetics to provide safe and effective pain control in obstetric patients (1).

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Abstract #:F-65

Varying Peripartum Courses in Two Parturients with Cardiac Sarcoidosis

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Sarcoidosis is an uncommon multisystem granulomatous disease with a predilection for reproductive-aged women. Cardiac sarcoidosis is a rare manifestation of the disease and has an estimated incidence in pregnancy of 0.05% (1). Cardiac sarcoidosis has life-threatening manifestations including left ventricular dysfunction, congestive heart failure, and atrioventricular block (2) and so these patients require close monitoring.

There is little literature about parturients with cardiac sarcoidosis. We present two cases of young women with cardiac sarcoidosis and their peripartum courses. One patient had isolated cardiac sarcoidosis. Her LVEF improved over the course of her pregnancy, from 36% in her first trimester to 49% at full term. She underwent a planned induction of labor at 38 weeks gestation due to her cardiomyopathy. She had an unremarkable spontaneous vaginal delivery with an epidural in labor. Her postpartum course was also uneventful and she was discharged home on postpartum day two. The second patient had chronic pulmonary and cardiac sarcoidosis. Her TTEs throughout pregnancy demonstrated a moderately reduced LVEF and global dysfunction. She required admission at 34 weeks gestation due to preterm premature rupture of membranes and was initially observed. She ultimately required an urgent repeat cesarean section due to concern for placental abruption and developing heart failure. A TTE on admission showed an LVEF of 36% and a mildly enlarged right heart with reduced function, which was a new echo finding. Her section was performed under general anesthesia with arterial and central lines and her induction was performed with high dose opioid medications to minimize hemodynamic changes. She remained intubated postoperatively due to suspected acute right heart failure. She was extubated on postoperative day two and was discharged home on postoperative day four.

Our two patients demonstrate that the peripartum courses of patients with cardiac sarcoidosis can vary widely. Case series suggest that some parturients with cardiac sarcoidosis do well in pregnancy and their disease may even improve, as was seen with our first patient's improved LVEF. This improvement may be partly attributed to pregnancy being an immunosuppressed state (1). Existing literature also suggests that patients with more severe sarcoidosis at pregnancy onset, as seen with our second patient, have a higher potential for peripartum decompensation. Clinicians cannot entirely predict which patients with cardiac sarcoidosis will do well and which will not. As a result, all parturients should be considered high risk, should have repeat echos if new symptoms arise and should be followed closely by a multidisciplinary team including Obstetrics, Anesthesiology, Cardiology and Intensive Care.

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Abstract #:F-66

Anesthetic Management of a Parturient with Type IV Osteogenesis Imperfecta Undergoing Cesarean Delivery

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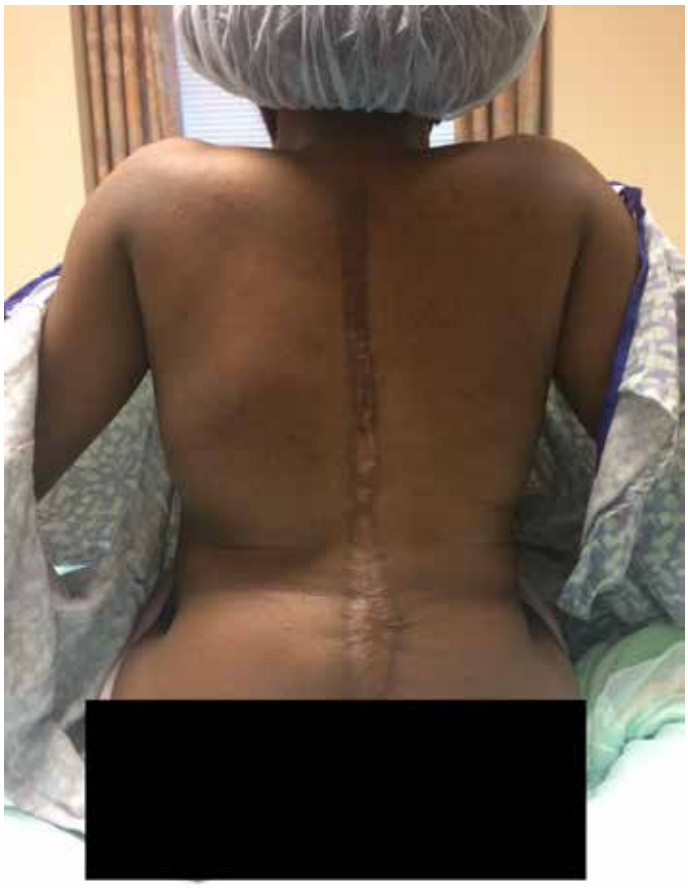
Introduction: Osteogenesis imperfecta (OI) is a rare group of genetic conditions of autosomal dominant inheritance characterized by bones that fracture easily due to collagen defects. Management of parturients with OI may present significant anesthetic challenges and literature is scarce on this topic. We describe successful cesarean delivery anesthesia in a patient with type IV OI.

Case Report: A 28-year-old term G3P2 with type IV OI presented for elective cesarean delivery (CD). Her past surgical history was significant for posterior spinal correction and fusion with Harrington instrumentation due to severe scoliosis. Physical examination revealed a height of 4'4", weight of 55 kg, and a Mallampati 1 airway. Notably, she had a barrel chest, persistent severe scoliosis despite spinal fusion, and an impressive keloid midline vertical scar extending from T1 to S2 that was 3 cm in width in the lumbar region. The decision was made to proceed with general endotracheal anesthesia via RSI with cricoid pressure. She was intubated using a video laryngoscope with a 6.5 ETT and an arterial line was placed immediately after induction. CD proceeded uneventfully. A healthy infant was born (Apgars 3/8) and the patient was successfully extubated.

Discussion: There are four well-established types of OI, with symptoms ranging from bone fragility to short stature, scoliosis, tooth breakage, and hearing loss. Both neuraxial and general anesthesia techniques have been described in the setting of OI. Neuraxial placement in patients with scoliosis and/or previous back surgery may be complicated by technical difficulty, positioning challenges, decreased efficacy, and unpredictable spread. There are many other anesthesia-related concerns associated with OI. The inflation of automated blood pressure cuffs may result in fractures; thus, the decision was made to utilize invasive blood pressure monitoring. Impaired platelet function has been documented in OI patients, requiring a patient's coagulation status to be evaluated prior to regional anesthesia. Succinylcholine should be avoided due to the potential for fractures from fasciculations. Finally, hyperthermia may be noted in these patients intraoperatively, but it is not a precursor for malignant hyperthermia.



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Abstract #:F-67

43 Years Old, Mechanical Heart Valves, Anticoagulation with a Complete Placenta Previa---Really?

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Intro: Placenta previa is a leading cause of third trimester hemorrhage, which can lead to morbidity and mortality to mother and fetus. Our case was complicated by a history of rheumatic fever with subsequent mechanical heart valve replacements, necessitating strict anticoagulation.

Case: A 43 year old female with a history of rheumatic fever requiring a mitral and aortic valve replacement and tricuspid repair 2 years earlier was admitted @ 33+4 week gestation, for conversion from warfarin to intravenous heparin prior to an elective cesarean section due to a complete placenta previa. The patient's symptoms included shortness of breath and orthopnea. The patient was in atrial fibrillation and echocardiogram revealed moderate aortic stenosis, moderate pulmonary hypertension with dilated atria and right ventricle and normal LV function with an EF of 50%. Thirty-six hours prior to the scheduled procedure, the patient began bleeding. The heparin infusion was stopped, the patient was transfused 2 units of PRBC's, and an urgent cesarean section was performed under general anesthesia (GA). After placement of an arterial line, the patient underwent a modified rapid sequence induction with etomidate, fentanyl and succinylcholine. The patient's blood pressure ranged from 120-150 systolic to 60-85 diastolic; a transesophageal echo (TEE) was placed and demonstrated a LVEF of 45-50%, dilated atria and moderate pulmonic and tricuspid regurgitation. A viable female infant was delivered weighing 1.63 kg, with Apgars 8 and 8, and was sent to the NICU. Fortunately, the placenta separated easily and the blood loss was only 700 ml. The patient was extubated at the end of the procedure in stable condition. Unfortunately, while converting her back to warfarin in the postpartum period, her PTT became markedly prolonged on the 4th postpartum day and she was taken to the OR for an intra-abdominal hemorrhage that required packing and subsequent removal of packs and closure on the 6th postpartum day.

Discussion: This case involving a complete previa was complicated by significant heart disease and the need for anticoagulation. Either a GA or a neuraxial anesthesia (RA) is a viable option for cesarean section for placenta previa (1). A RA was originally planned with electively stopping the heparin infusion for 4 hours, assuming a normal PTT. However with the acute hemorrhage, a GA was the only option but it afforded the opportunity for TEE placement and monitoring her cardiac status for the duration of the case. Despite planning for an elective procedure, an acute hemorrhage necessitated a change in plans and despite the urgency, the ongoing cooperative and communicative efforts among the sub- specialties, obstetrics, cardiology, anesthesia, neonatology and nursing, facilitated this difficult situation.

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Abstract #:F-68

PLACENTA PERCRETA COMPLICATED BY PULMONARY EMBOLISM IN A PREGNANT PATIENT

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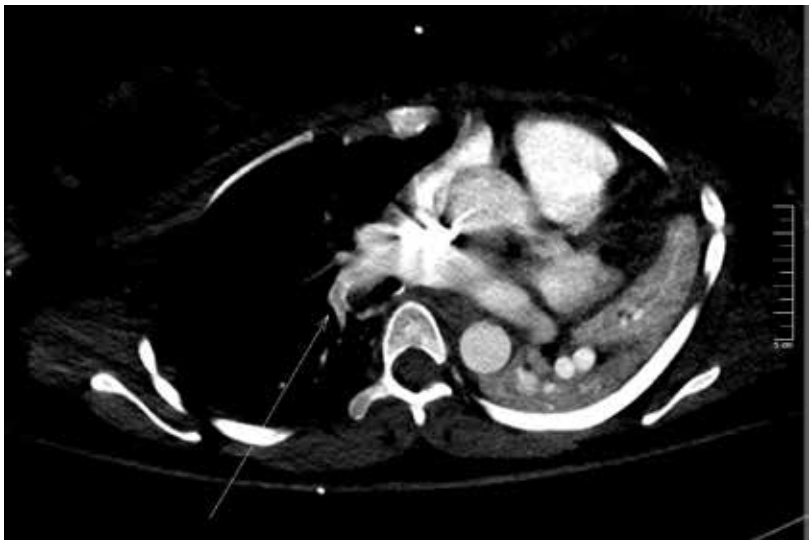
Introduction: Placenta accreta is a potentially life-threatening condition in obstetrics. With the increasing rate of cesarean deliveries, the incidence of placenta accreta is steadily increasing. Here we present a case of a parturient with history of two prior c-sections and placenta percreta with an unexpected course.

Case Description: 25 year old female with complete posterior placenta previa presented at 37 weeks for repeat c-section. MRI revealed placenta percreta with possible bladder involvement. Multidisciplinary meeting was held among obstetrics, anesthesiology, gynecologic oncology, urology, neonatology and interventional radiology. Patient was scheduled for cystoscopy, cesarean hysterectomy, embolization of internal iliac arteries and possible bladder repair.

In the OR, two large bore IVs and a rapid infusion catheter were inserted. Standard ASA monitors and arterial line were placed. Combined spinal-epidural was performed. Cystoscopy and ureteral stents were placed. Bilateral internal iliac artery balloon catheters were placed under fluoroscopy. Epidural catheter was bolused with 2% lidocaine with epinephrine. C-section was initiated via mid-line vertical incision. Immediately after delivery, the patient became unresponsive and profoundly hypotensive. Airway was secured via RSI. Boluses of pressors and chest compressions were started with ROSC in 10-20 seconds. After a few minutes, patient's blood pressure was again not measurable. Second round of chest compression started with ROSC in 10-20 seconds. Massive transfusion protocol initiated. Internal iliac arteries were embolized. Hysterectomy was completed and the bladder dome was repaired. Fibrinogen levels dropped ~40% during this time. Final estimated blood loss ~5L. Patient received a total of 5L of crystalloids, 7 units PRBC, 9 units FFP, 2 units platelets, 4 units cryoprecipitate and 100ml of 25% albumin.

Postoperative CTA showed bibasilar segmental emboli, greater on the right with evidence of right heart strain. Patient was extubated the day after and started on a heparin infusion and transitioned to low molecular weight heparin. Patient was discharged home day 5.

Discussion: Placenta accreta is associated with significant risk of morbidity and mortality secondary to hemorrhage and is the most common indication for peripartum hysterectomy. Placentation abnormalities account for 1.7% of maternal deaths in the U.S. and 24% of perinatal deaths. A multidisciplinary approach is essential for optimal outcomes. Anesthetic considerations include adequate IV access, invasive hemodynamic monitoring, choice of anesthetic technique as well as preparing for potential massive hemorrhage. In the setting of hemodynamic collapse,embolism must also be high on the differential. There is a five-fold odd of thromboembolic events during pregnancy compared to non-pregnant patients. Thromboembolic events account for ~20% of all maternal deaths. Early recognition, diagnosis and treatment is critical.



Abstract #:F-69

Proposed Perioperative Management of A Parturient with Type I Hereditary Angioedema: Multidisciplinary Team Approach

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Hereditary Angioedema (HAE) is a rare, autosomal dominantly inherited blood disorder. Some forms of HAE arise from deficiency or dysfunction of C1 inhibitor (C1INH). HAE, Type I represents approximately 80 to 85% of HAE cases and is characterized by reduced secretion of the C1INH protein. Patients present with episodic attacks of swelling that may affect the face, extremities, genitals, gastrointestinal tract and upper airways. Although the swelling is self-limited and resolves in two to five days without treatment, laryngeal involvement may cause fatal asphyxiation (1,2). Pregnancy and labor in these patients are often challenging requiring close follow up, specific interventions and multidisciplinary planning (3). We describe a case of a 21 year old G1P0 female patient with a documented diagnosis of Type I Hereditary Angioedema and absent C1 inhibitor function who presented for an elective cesarean section. Patient had multiple ER visits and ICU admissions for HAE flare-ups with life threatening airway swelling that required multiple emergent intubations. A multidisciplinary care plan was outlined before delivery, which included personnel from Labor and Delivery, Anesthesiology, Allergy medicine and ENT. We concluded that perioperative administration of C1 inhibitor therapy seems to be essential for short term prophylaxis, with regional anesthesia as a safe option, thus providing surgical anesthesia and avoiding airway manipulation.

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Abstract #:F-70

Labor Analgesia in a Paturient with Ehler's Danlos Hypermobility Type, Congenital Ventral Septal Defect, and Chiari Malformation Type I

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This is a case of a 34 year old female G1P0 with a history of Ehler's Danlos Syndrome (EDS) hypermobility type, Congenital VSD w/ spontaneous resolution after birth, Osteoarthritis, chronic pain, migraines, nocturnal bruxism, jaw dislocation, postural hypotension without loss of consciousness, diffuse tendinitis & bursitis, gastroesophageal reflux, gastroparesis, unrepaired hiatal hernia, and asymptomatic Chiari malformation type I presenting for labor.

The patient desired a natural birth but was open to inhaled nitrous oxide, neuraxial anesthesia and IV anesthesia. Four days before her scheduled induction, the patient had severe range blood pressure at a routine prenatal appointment. She was admitted to the hospital for induction of labor. The patient asked for inhaled nitrous oxide which she used successfully for two hours. She then requested a labor epidural which was placed without difficulty. The patient delivered spontaneously but had a second degree tear and mild postpartum hemorrhage which resolved with rectal misoprostol, bimanual compression, and intravenous oxytocin. Her estimated blood loss was 600 milliliters.

EDS is an autosomal dominant genetic disorder; this patient has Hypermobility EDS. There are no clear recommendations for anesthetic management with hypermobile EDS. Successful use of neuraxial anesthesia has been reported. There is some concern for occult dural ectasia, which could increase the risk of inadvertent dural puncture with epidural placement and may result in unpredictability of spinal anesthesia. EDS carries increased risk of pulmonary blebs and subsequent pneumothorax, but the patient had used nitrous oxide for past dental procedures without issue. Due to known Chiari Malformation type I, any neuraxial anesthesia recommended for vaginal delivery or caesarean section would be epidural with the goal to prevent intentional dural puncture and therefore decrease risk of tonsillar herniation. Due to the patient's history of jaw dislocation and hiatal hernia, video laryngoscopy with rapid sequence intubation in the event of emergency c-section was planned.

Patients with congenital malformations and comorbidities often present for labor analgesia. This patient is an interesting risk-benefit tradeoff related to possible dural ectasia which increases risk of dural puncture as well as Arnold Chiari Malformation which could rapidly lead to catastrophic brain herniation in the event of a puncture. It is important to consider all aspects of disease states and anesthetic considerations.

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Abstract #:F-71

Anesthetic Management of a Parturient with Chiari Malformation Type I and Syringomyelia

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Introduction: Chiari malformation (CM) Type I is a condition in which the posterior fossa of the cerebellum is relatively small or abnormally shaped resulting in the protrusion of the cerebellar tonsils into the foramen magnum. Tonsillar herniation can result in obstruction of CSF flow between the 4th ventricle and the apertures that connect to the subarachnoid space. This obstruction can lead to increased ICP and a buildup of CSF along the central canal of the spinal cord which can cause the formation of a syrinx (30-50% of cases). Most are asymptomatic until young adulthood as this malformation occurs as a person grows. Symptoms may vary in character and intensity presenting as headaches, neck pain, vertigo, nausea, and neurologic symptoms. The presentation depends upon the extent of herniation and the presence of an associated syrinx. The prevalence of CM1 is estimated to be less than 1:1000, with the majority of cases being asymptomatic, and a female to male ratio of 3:1.

Case: A 30 yo G1P0 at 40w6d presented for induction of labor. This pregnancy was complicated by CM I with holocord syrinx. She originally presented to her PCP a year prior with complaints of numbness, tingling, and decreased heat sensation in her left arm with spread to her left side and left leg. After obtaining an MRI, she was diagnosed with a CM type I and a syrinx extending from C1- T12 level. She was scheduled for surgical decompression, however she had a positive UPT and the intervention was postponed until after delivery. Throughout her pregnancy symptoms became more severe and she developed left sided headaches and weakness. The patient was sent for an OB Anesthesia consult. Due to the severity of her symptoms and known pathology she was not considered a candidate for neuraxial anesthesia. Other options for labor analgesia and a plan for c-section were discussed. During induction of labor, she was given nitrous oxide and later a remifentanil PCA for analgesia. She had arrest of dilation at 6 cm and was taken for c-section. She was induced under general anesthesia and intubated without complication. A healthy baby was delivered. Patient had no anesthetic complications and no change in her neurologic symptoms.

Discussion: This case highlights the necessity of careful consideration of anesthetic technique for patients presenting with known CM and syringomyelia. In our case, the patient had a known syrinx and worsening neurologic symptoms. The concern with epidural placement was causing increased pressure around the spinal cord due to epidural boluses leading to elevated ICP and exacerbation of her symptoms. There was also concern for inadvertent dural puncture resulting in an increasing craniospinal pressure gradient and potentially catastrophic herniation. While GA is not without its risk in obstetric patients in this particular scenario it was the safest, most conservative management.

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Abstract #:F-72

Case Report: Meningioma with Symptomatic Mass Effect Requiring Urgent Cesarean Delivery

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Case Report: Meningioma with Symptomatic Mass Effect Requiring Urgent Cesarean Delivery

A 28 year old primigravida at 35 weeks was admitted for scheduled primary cesarean for symptomatic petroclival meningioma. Written permission was obtained for this report.

Antepartum course was uneventful until 20 weeks gestation when she developed trouble swallowing followed by right-sided facial weakness. MRI revealed large right-sided petroclival mass with midline shift. At 33 weeks gestation worsening symptoms included right facial droop and sixth nerve palsy, reduced gag reflex, hearing loss, and daily headaches concerning for elevated ICP. Neurosurgeon prescribed steroids. Although symptoms did not improve, neurosurgeon recommended delivery at 35 weeks. Due to concerns for elevated ICP, multidisciplinary team including obstetric anesthesiologist recommended delivery by scheduled cesarean to avoid ICP increase with vaginal delivery, plus passive second stage would require neuraxial technique.

On day of surgery, routine preoperative fetal heart rate monitor revealed prolonged decel prompting emergent delivery.

Fetal status was reassessed in the OR. Decision was made to place arterial line followed by rapid sequence induction with remifentanil, propofol and rocuronium; intubation with video laryngoscope. Anesthesia was maintained with isoflurane and remifentanil infusion. Hemodynamics stable throughout. Patient was extubated in the OR, then recovered uneventfully in PACU. Neurological exam remained unchanged. She was discharged home on POD 3. Apgar scores were 4 and 8, at 1 and 5 minutes. Neonate was intubated for RDS and admitted to NICU for 3 days and discharged home at day of life 7.

At 4 weeks postpartum, she underwent transpetrosal transsigmoidal meningioma resection. Procedure was noted to be challenging, with tumor crossing midline and evidence of hydrocephalus. The tumor engulfed cranial nerves and blood vessels, with substantial, yet subtotal resection.

At 4 months postop, she had improved facial symmetry, yet persistent hearing loss and mild facial weakness. She is currently undergoing radiation therapy.

Discussion: Not all intracranial lesions lead to increased ICP.1 Assessment of intracranial compliance is critical in assessing the safety of regional techniques in parturients with space occupying lesions. Regional technique in the setting of increased ICP has serious potential complications as rapid changes in spinal pressure from a dural puncture can cause brain herniation, intracranial hemorrhage, and subdural hemorrhage.2 General anesthesia can be safely performed with particular focus on minimizing elevations in ICP.

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2. El-Refai NAE-R. Anesthetic management for parturients with neurological disorders. Anesthesia, Essays and Researches. 2013;7(2):147-154.

Abstract #:F-73

Management of Pregnant Patient with History of Tetralogy Of Fallot (TOF) Repair

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Introduction: The prevalence of cardiac disease in pregnancy has not changed over the past few decades although congenital heart disease (60-80%) has replaced rheumatic heart disease. Maternal outcome correlates well with New York Heart Association functional status. Class III and IV patients have a mortality rate between 5%-15% and perinatal mortality between 20%-30%. Exceptions are patients with pulmonary hypertension, severe left ventricle dysfunction and severe cases of Marfan's syndrome. These lesions are high risk and may contraindicate pregnancy regardless of the classification. However, when patients present with uncorrected lesions, or partially corrected lesions, the obstetric and anesthetic management becomes more challenging.

Case Report: We present a case of a 34 years female, at 31 weeks for anesthesia consult. Patient had past history of Tetralogy of Fallot repaired at 6 years of age and stroke at 3 years with residual left sided weakness, contracture of left hand and forearm, and Barrets esophagus. Patient's exercise tolerance was poor; dyspnea after walking up 1 flight of steps. Echo showed moderately enlarged RV, severe pulmonic valve regurgitation, mild pulmonic stenosis, normal LV function EF 60%. As per cardiologist patient was cleared for pregnancy and vaginal delivery. Prophylactic antibiotics recommended.

Prior to delivery, a multidisciplinary meeting was held with Anesthesia, Obstetrics, neonatology and Cardiology. At 36 weeks patient was admitted for pre-eclampsia. Cardiology and Anesthesia were immediately notified. A CCU nurse was present to monitor the patient. Patient was placed on magnesium and induction of labor was started. Epidural catheter was placed. Decision was made to perform C-Section for worsening preeclampsia. Epidural was loaded with 0.5% Ropivicaine. C/S was uneventful and patient was transferred to PACU.

Discussion: Tetralogy of Fallot is the most common congenital cyanotic heart disease. Very few women reach child bearing age without corrective surgery. Surgical correction involves closure of the VSD and widening of the pulmonary outflow tract. Majority of times the surgery is successful and patient remains asymptomatic. However, overtime some residual lesions can manifest . Pregnancy may unmask symptoms. Patient should have a recent echocardiogram prior to and during pregnancy.

Anesthetic management includes continuous monitoring during labor to detect ventricular arrhythmias. Care must be taken not to decrease SVR which will increase right to left shunt. Intravascular volume and venous return should be maintained. Early neuraxial block is recommended to prevent sympathetic stimulation and increase in pulmonary vascular resistance. For cesarean delivery, regional anesthesia should be administered slowly to avoid abrupt decrease in SVR. Careful planning and multispecialty collaboration is essential for optimal outcomes.

Reference:

Chestnut, D. Obstetric Anesthesia

Abstract #:F-74

Anesthesia management in a patient with seizure activity in the third trimester for emergency C-section, Epilepsy vs Eclampsia?

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Introduction: Seizure disorders are present in less than 1% of all pregnancies1. If seizures have been under control, it is rare that they will occur later in gestation and seizure presentation in the third trimester of pregnancy or in the early postpartum period may be difficult to distinguish from eclampsia. We present a case of previous head trauma and subsequent seizure disorder that had been under control until the patient presented to the emergency room with neurologic symptoms and subsequent seizures in the third trimester.

Case presentation: A 26 year old G1P1001 @ 38 weeks+5 day presented to the ER with hypertension and left sided weakness. She was started on LMWH and Aspirin with concerns of a possible stroke (?). The patient's pertinent history included a traumatic fall from a horse in 2014 and required a cranioplasty and tracheostomy with a prolonged hospital stay. Subsequent sequelae from the trauma included subglottic stenosis and vocal cord dysfunction in 2015, and seizures treated with Zonisamide since 2014. Symptoms seemed to resolve but she had problems with fine motor movements. 36 hours after admission, patient noticed fullness of the head and headache. She had 2 episodes of seizure activity and was admitted to the Neuro ICU. When she discovered that she was pregnant, she stopped her anti-epileptics and Folic acid. She was treated with lorazepam and levetiracetam for epilepsy. She was also loaded with 2 grams of MgSO4 and started on an IV infusion of MgSO4 due to the possibility of eclampsia. She was electively intubated with 7.0 size ETT, concerned with her airway mainly her subglottic stenosis. An MRI was performed with no evidence of a bleed or acute pathology, which was followed by an emergent C-section. The patient was induced with propofol and vecuronium on arrival to the labor and delivery OR. Sevoflurane was also administered along with a BIS monitor during the procedure. After the delivery of a viable male infant with Apgar's of 3 and 5, Midazolam and fentanyl were administered. Patient was transported to Neuro ICU intubated. Patient was stable during the transport and was extubated in Neuro ICU on the next day. The patient was discharged home on the fifth postpartum day.

Discussion. Seizures during the latter part of pregnancy is commonly due to eclampsia, however, the effect of pregnancy on previous seizure disorder is variable, but can increase due to the increased volume of distribution and increases in renal and hepatic clearance during gestation and lack of patient compliance due to concerns of potential fetal anomalies. Although, the likelihood of eclampsia in this case was small, it could not be ignored especially with hypertension and a prolonged seizure-free period during gestation and prior to admission.

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Abstract #:F-75

Anesthetic Management of a Parturient with Severe Preeclampsia and Diabetic Ketoacidosis for Emergent Cesarean Section

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A 40 year old Female, G4P3, at 38 weeks with unknown PMH presented emergently to the labor and delivery floor with complaints of abdominal pain, nausea/vomiting, and headaches. The patient had no prenatal care prior to arrival at the hospital. Upon arrival to the triage bay, a category 3 tracing was noted on fetal monitors. The patient's blood pressures were measured greater than 160/90, and the patient endorsed severe headaches for the past several weeks, indicating a high suspicion for severe preeclampsia. In addition a finger stick was performed with glucose greater than 600, and ketones were noted on urine dipstick, consistent with a diagnosis of Diabetic Ketoacidosis (DKA). The patient was obese and had an unfavorable airway examination, and had eaten a full meal within the last hour.

The decision was made to proceed to the operating room for emergent cesarean section. No laboratory data was available at the time of emergent transfer to the operating room. With a high suspicion for preeclampsia with severe features, an unfavorable airway exam and high risk of aspiration given the recent meal, a calculated decision was made to perform the cesarean section under neuraxial anesthesia. Spinal anesthesia was induced uneventfully and the patient developed a T4 level bilaterally. Two large bore peripheral IVs and arterial line was placed prior to skin incision. ABG prior to incision showed a pH of 7.20, paCO2 of 15, HCO3- of 9, lactate of 2.5, glucose of 600. In addition, the patient was noted to be markedly hyponatremic with a Na 128, as well as profoundly anemic with a starting Hct of 21%. Creatinine was also elevated at 1.2mg/dl, indicating signs of renal dysfunction.

The baby was delivered uneventfully, with APGARs of 6/8, and an initial finger stick glucose greater than 500mg/dl. Good uterine tone and hemostasis was achieved post-delivery.

Serial ABGs were performed throughout the cesarean section and the DKA was managed with an initial insulin bolus followed by an insulin infusion. The patient was hydrated with isotonic balanced salt saline. Electrolytes, including potassium were repleted intraoperatively. The patient was transferred to the medical ICU for further management post operatively.

Discussion: This case highlights a successful anesthetic management of a parturient with severe preeclampsia and concomitant DKA undergoing an emergent cesarean section. Both preeclampsia and DKA are associated with a significant maternal and fetal mortality. DKA is associated with multiple metabolic and electrolyte abnormalities which need to be judiciously treated and monitored. When combined with severe preeclampsia, anesthetic and intraoperative management becomes even more complex. Our case demonstrates key management points for both disorders.

Abstract #:F-76

Neuraxial Labor Analgesia in a Hemophilia A Carrier with Decreased Factor VIII

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Neuraxial Labor Analgesia in a Hemophilia A Carrier with Decreased Factor VIII

Case: A 33 year old woman, G1P0 at 39 weeks gestation presented to labor and delivery for an elective induction. The patient had been seen by the anesthesia service for an antenatal consultation, referred by her Obstetrician for a family history of Hemophilia A and von Willebrand disease. The patient was evaluated by Hematology during the pregnancy, who discovered a Factor VIII level of 30% (normal 50-150%). The patient denied any history of bleeding with previous dental procedures or an appendectomy, but did complain of easy bruising. The patient's mother is a known carrier of Hemophilia A and has von Willebrand disease (unknown type). The Hematology consult recommended transfusion with human recombinant antihemophilic factor/von willebrand factor (Humate-P) at the start of labor to minimize risk of bleeding during labor and delivery and prior to placement of neuraxial anesthesia. Patient was transfused to bring her Factor VIII level to 100% (by calculation of the Hematologist) on labor and delivery soon after initiation of induction. A combined spinal-epidural was placed uneventfully after transfusion. The patient had a normal spontaneous vaginal delivery 12 hours after infusion of human recombinant antihemophilic factor/von willebrand factor with a 300 ml blood loss. The human recombinant antihemophilic factor/von willebrand factor was redosed at 12 hours, as recommended by the Hematologist. The epidural catheter was removed two hours after delivery without complication. The patient had an uneventful hospital course and was discharged home on postpartum day two.

Discussion: Pregnancy is often accompanied by a marked rise in Factor VIII (1), so the 30% Factor VIII level in this patient was significant at term. Additionally, this patient had no previous testing for von Willebrand Factor (vWF), but due to the normal rise in vWF at term, it was not possible for Hematology to diagnose this on their antenatal evaluation. Regardless, this patient was treated as if she had von Willebrand disease in addition to the decreased Factor VIII. While patients with decreased Factor VIII can have successful neuraxial anesthesia, restoration of levels to normal is recommended for labor and prior to placing neuraxial anesthesia. This patient's case also demonstrated the importance of antenatal anesthesia consultation for parturients with coagulopathies and a multidisciplinary approach to their care.

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Abstract #:F-77

Lumbar laminectomy and tumor resection in an 18 week parturient with Cauda Equina Syndrome for Recurrent Giant cell tumor of lumbar spine.

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Introduction: In general 1% - 2% of pregnant women undergo non-obstetric surgery; the most common surgeries are acute appendicitis, cholecystitis, maternal trauma and malignancy(1). But we present a rare complicated case of lumbar laminectomy and tumor resection in a 18 week parturient with Cauda equina syndrome in prone position

Case Report: 20 yr old morbidly obese parturient at 18 weeks of gestation was admitted for worsening severe back pain radiating to her lower extremities. She had a past medical history of giant cell tumor of the lumbar spine and cauda equina syndrome, s/p lumbar laminectomy and decompression few months prior to this admission. MRI on admission, showed recurrence of her lumbar tumor resulting in severe lumbar spinal compression at L4-L5 and L5-S1 level. Neurosurgery advised that she needed total resection of the lumbar tumor but preferred to delay the surgery due the complexity of the surgery during pregnancy.

However during the next few days, she had worsening severe back pain and also developed urinary incontinence. So surgery become imminent and OB recommended operating during this time as she was in her second trimester. Patient was counseled regarding the possible risk of threatened abortion during the procedure or immediately after, and she consented for the procedure. Fetal heart tones were monitored preoperatively and noted to be appropriate. She underwent Lumbar laminectomy, tumor resection at L5 and decompression under general anesthesia. For monitoring, patient had standard ASA monitors with an arterial line. She was positioned prone for the entire procedure and had approximately 1500ml of blood loss. She tolerated the procedure well and stable throughout the case; did not require blood transfusion. Fetal heart tones were monitored postoperatively and noted to be appropriate. Her U/S scan showed a viable fetus with good heart tones. Patient's neurological deficits and symptoms considerably improved postoperatively. OB/GYN continued to follow her throughout the hospital course. She was discharged two weeks post operatively. She is currently 24 weeks of gestation and the fetus continues to do well without any complications.

Discussion: According to literature, spine surgeries generally have good outcomes during pregnancy(1). Second trimester would be the best time to perform non obstetric surgeries on the parturient. Whenever feasible, regional anesthesia is preferred over general anesthesia during pregnancy. The key anesthetic considerations during complicated non obstetric surgeries like this case is to maintain adequate maternal oxygenation, perfusion and homeostasis to maintain adequate uteroplacental perfusion in order to bring out the best outcome both for the mother and the fetus.

References:

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Abstract #:F-78

Visceral traction induced vasovagal cardiac arrest during cesarean section and hysterectomy

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We report a case of sudden vasovagal cardiac arrest precipitated by visceral ligament traction during c-section and hysterectomy. The patient is a 29yo healthy G3P1 parturient with 35w2d IUP complicated by complete placenta previa with percreta extending into the bladder. All labs were within normal limits.

In the OR an awake radial arterial line and right IJ central line were placed. The patient was prepped and draped and an uneventful rapid sequence induction was performed. Delivery of the neonate occurred within 3 minutes. The vertical hysterotomy was then closed. At this time EBL was 2L with 1.6L of LR and 5 units pRBCs transfused. All vital signs remained stable. Operative focus turned to the hysterectomy. Upward traction was placed on the uterus while attempting to clamp the uterine vessels. Within seconds the heart rate went from 90 to 40 to 22, then 0. The SBP was above 90 mmHg then suddenly 0. Chest compressions were initiated following ACLS protocol. Pulseless ventricular tachycardia was seen and a 200J shock delivered. Chest compressions resumed with return of spontaneous circulation (ROSC). HR returned to sinus tachycardia with palpable pulses and vital signs stable. Immediate post-code HCT was 34. Following ROSC the surgical team was able to complete the hysterectomy without further incident. The patient remained intubated and was transferred to the ICU. A TTE and CT angiogram ruled out wall motion abnormalities or possible pulmonary emboli. The patient was extubated on POD#2 and discharged home on POD#7.

Multiple etiologies for sudden cardiac arrest in a healthy female were considered including hemorrhagic shock, electrolyte abnormalities, uterine traction vagal response, venous air embolism (VAE), and amniotic fluid embolism (AFE). The post-code ABG showed normal pH and electrolytes, and HCT 34. The patient was placed in slight reverse trendelenberg at case start to maintain the uterine venous plexus below the level of the heart, hence VAE and AFE were diagnoses of exclusion. Review of all labs and the temporal sequence of events led us to conclude that the most plausible explanation was a vasovagal response due to uterine ligament traction.

A vasovagal response manifests as bradycardia with concomitant hypotension. The bradycardia is due to vagal nerve efferent cardiac input while dilation of arterial vessels is due to an imbalance between parasympathetic and adrenergic inputs. Multiple etiologies may precipitate this reflex such as the oculocardiac, laryngeal, and Bezold Jarisch reflexes, abdominal insufflation, visceral and ligamentous traction[1]. The surgical team must remain vigilant in employing the minimum visceral traction necessary to achieve surgical exposure and remain cognizant that traction is a significant risk in precipitating a vasovagal response.

Reference:

1. Perioperative Vasovagal Syncope with Focus on Obstetric Anesthesia. Tsai, Pei-Shan et al. Taiwanese Journal of Obstetrics and Gynecology, Vol 45, Issue 3, 208-14

Abstract #:F-79

Anesthetic management of a parturient with multi-centric hemangiomas

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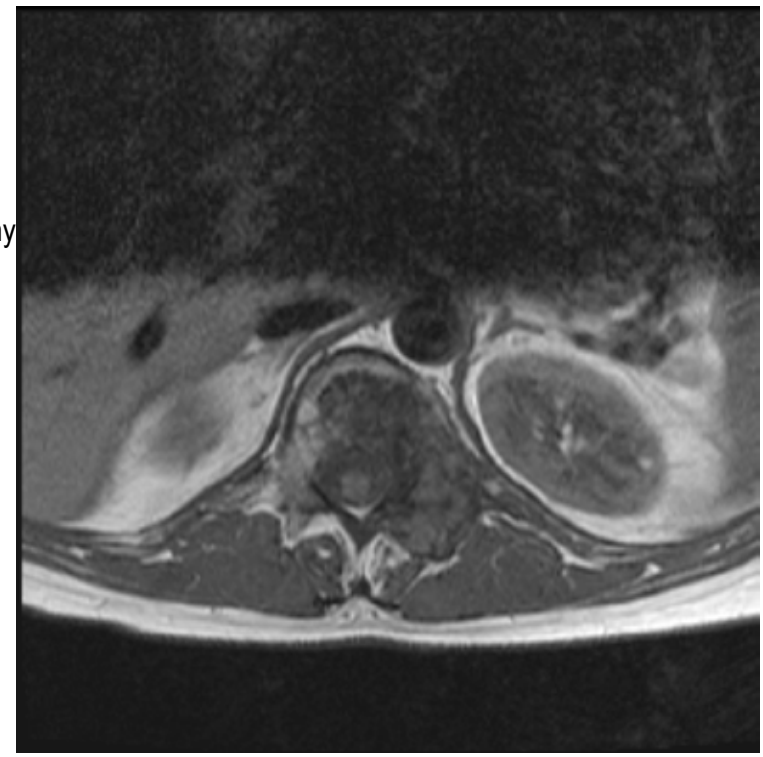
Introduction: Vertebral hemangiomas are the most common benign vertebral neoplasms and most are asymptomatic. Pregnancy is a recognized risk factor for quiescent vertebral hemangiomas becoming symptomatic leading to radicular pain and even neurological compromise. There are several case reports of pregnancy-related vertebral hemagiomas leading to spastic paresis.1,2 Vertebral hemagiomas also present a complication from an anesthetic perspective with regard to analgesia during labor and choice of anesthetic for operative delivery.

Case: 32 year old nulliparous female presenting for a preanesthesia consultation for a history of muticentric hemagiomas involved her femurs, pelvic bones, and vertebrae. Initial diagnosis was made prior to pregnancy after presenting with significant pain in her left lower extremity and some pain in her lower back and gluteal region. The patient planned vaginal delivery and wished to discuss neuraxial labor analgesia options.

Lumbar spine MR images demonstrated significant involvement of the T12 and L2 vertebrae, extending past the vertebral bodies and involving the pedicles and lamina. The disease appeared primarily left-sided. Prior pathological reports indicated these lesions to be hemangiomas.

After careful literature review and multidisciplinary discussion, it was determined that the risks of neuraxial labor analgesia outweighed the benefits. There was concern that despite even correct localization with ultrasound, it would be very difficult to avoid contacting one of these lesions, which could result in a quickly expanding hematoma in the immediate proximity of the spinal cord. Therefore, the plan was made to utilize a Fentanyl PCA without basal rate for labor analgesia. Patient had an uncomplicated vaginal delivery and recovery.

Discussion: This case illustrates the potential complications that vertebral hemangiomas present for the anesthetic management of a parturient. Vertebral hemangiomas may lead to epidural hematoma or vascular steal with spinal cord ischemia and neurological compromise. There are increased risks associated with neuraxial technique in these patients that may outweigh any benefits.



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Abstract #:F-80

Epidural Anesthesia in a Parturient with a History of Spina Bifida and Tethered Cord: an Algorithmic Approach to Evaluate the Safety of Neuraxial Anesthesia

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Spinal dysraphisms result from abnormal development of embryonic neural and vertebral precursors with deformities of the axial skeleton and distal spinal cord that can impact the safety and efficacy of obstetric neuraxial anesthesia. We present a case of pregnant woman with a history of spina bifida and tethered spinal cord and suggest an algorithm for her care.

A 38 year-old G2P1 at 36 weeks gestation presented for cesarean delivery of twins. Spina bifida with tethered cord was diagnosed radiologically at age 11 during an enuresis workup when a lumbar skin tag was noted. She then had two spinal cord release procedures (age 11, 20) after which she could void but required self-catheterization for bladder emptying.

Before her first vaginal delivery, she was deemed not to be a candidate for epidural labor analgesia (outside records unavailable; details unknown by patient). She did, however, receive a labor epidural analgesic. There were no complications, but her rapid delivery obscured appraisal of epidural catheter function.

Physical exam this admission showed a favorable airway and well healed scar from her coccyx to L4. Lower extremity sensory and motor exams were normal, but the left calf girth was less than the right.

Multidisciplinary anesthetic planning with her neurosurgeon followed structured questions with a novel algorithm that can be generalized to other patients.(Fig) Spinal anesthesia was felt to have a low chance of success due to intrathecal scarring from prior surgeries. Although there was also concern about epidural scarring, neither spinal nor epidural techniques were deemed unsafe. As the patient strongly preferred neuraxial anesthesia and understood the possible need for conversion to GA, an epidural catheter was placed under ultrasound-guidance (L2-L3 interspace). After a test dose, 10cc of 3% chloroprocaine was given to quickly demonstrate an appropriate rising sensory level, followed by 15+cc of 2% lidocaine. The epidural anesthetic functioned optimally, intraoperatively, with a bilateral T4 sensory level and no neurologic complications.

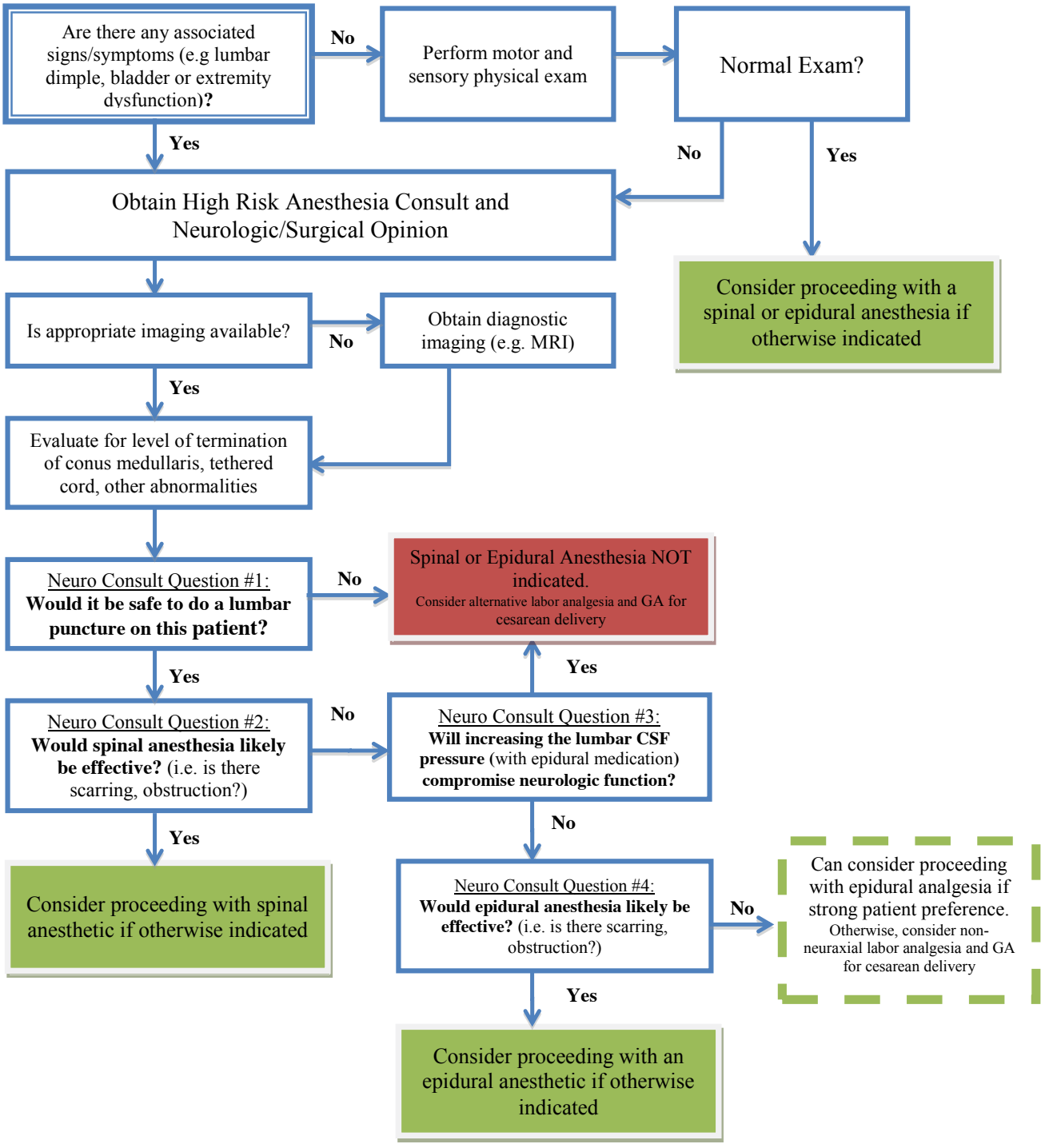
The approach to neuraxial anesthesia in parturients with spinal dysraphisms varies by pathology and provider. A recent review of relevant anesthetics estimates only 52 reported cases of epidural and 15 spinal anesthetics.(1) We present a successful case of epidural anesthesia with an algorithm to evaluate the safety of neuraxial anesthesia in this population.

Reference:

1. Murphy, Int J Obstet Anesth. 2015

Abstract #:F-80

An Algorithm to Guide Decision-Making Regarding Neuraxial Anesthesia in Patients with Spina Bifida



Abstract #:F-81

Contact dermatitis from Mastisol® spray adhesive used to secure epidural catheters in laboring women

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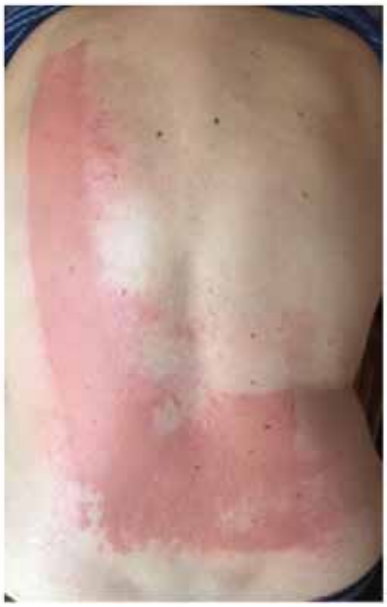
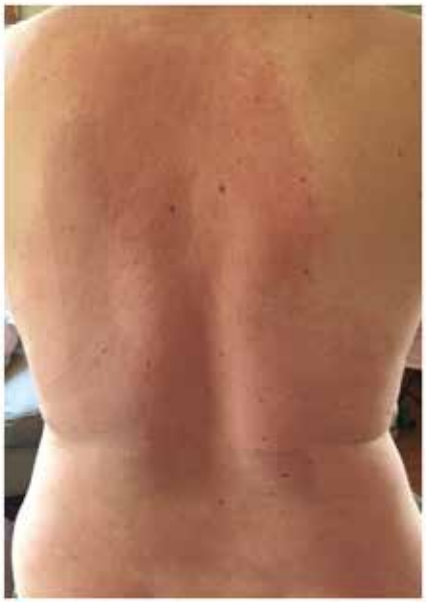
Introduction: Many women choose epidural analgesia for labor and adhesive spray is commonly used to prevent dislodgement of the catheter during labor and delivery. We discuss an increased incidence of contact dermatitis after switching from Vi-Drape® (Medical Concepts) adhesive to Mastisol® (Ferndale Laboratories).

Case: 33 yo G2P1 presenting for induction of labor for preeclampsia. Patient received a combined spinal-epidural procedure for labor analgesia and catheter was secured with Mastisol® spray, Tegaderm™ (3M™) and silk tape. Labor and delivery progressed uneventfully. The epidural catheter, Tegaderm™ and tape were removed after delivery with no signs of irritation. On post-delivery day 2, she requested steroid cream for pruritic rash on her back, originally in the distribution of the Tegaderm™ and tape, but eventually covering entire back/flanks. Patient was sent home with topical/oral steroids, antihistamines and dermatology follow-up. The rash resolved after 3 weeks. Of note, patient delivered 2 years prior without issue. Our procedure for securing the epidural catheter had not changed in the 2 years with the exception of adhesive spray used. We were alerted to 3 other women with similar symptoms within 2 months of this case.

Discussion: Adhesive sprays are used for many applications. We routinely use adhesive to secure the epidural catheter in laboring women. We used Vi-Drape® adhesive spray (active ingredients: Isopropyl Alcohol, Dimethyl Phthalate), until the product was discontinued. At that time, we switched to Mastisol® (active ingredients: gum mastic, Styrax, Alcohol, methyl salicylate). Styrax is a genus name and might indicate Styrax benzoin. There are many reports of severe allergic reactions to Mastisol® spray.1-3 Surprisingly; it is extremely difficult to find complete ingredient lists for adhesive sprays, making identification of the culprit substance difficult. We assumed Mastisol® was the causative agent in our case, given her previous uncomplicated delivery and same securing process, with the exception of the adhesive. The increase in contact dermatitis cases and lack of alternate led us to change our procedure. We now secure the catheter with only Tegaderm™ and tape, with only 1 accidental dislodgement, calling into question the need for adhesive spray at all.





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Abstract #:F-82

Anesthetic Management of Cesarean Delivery for a Parturient with Moyamoya Disease, Acute Exacerbation of Chronic Headaches, and Preeclampsia with Severe Features

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A 37-year-old G4P2012 woman at 37 weeks gestation with a history of moyamoya disease (MMD) presented for repeat cesarean delivery due to preeclampsia with severe features. She was diagnosed with MMD after a stroke during her first pregnancy, which resulted in a residual left sided hemiparesis. She subsequently underwent bilateral superficial temporal artery-middle cerebral artery bypass, but continued to have chronic, intractable headaches that had worsened during pregnancy. Multidisciplinary planning was coordinated among obstetrics, neurology, and anesthesiology.

A neuraxial technique was preferred to general anesthesia in order to monitor her neurological status and to avoid hypertension associated with direct laryngoscopy and extubation in the setting of MMD and elevated blood pressures. Conventional epidural was chosen as opposed to a combined spinal epidural or spinal neuraxial technique so as to minimize any dural puncture that may lead to post dural puncture headache (PDPH) in this patient with intractable headache. It also allowed for incremental anesthetic dosing to maintain hemodynamic stability. She remained stable during epidural dosing and surgery; the peripartum course was uneventful. Her headaches returned to baseline shortly after delivery and she was discharged home on postoperative day 3.

Discussion: MMD is a rare, chronic progressive cerebrovascular disease distinguished by stenosis or occlusion of the distal internal carotid arteries and proximal Circle of Willis vessels, resulting in the development of fragile collateral blood vessels and often microaneurysms (1). Headache and neurological deficits due to cerebral hemorrhage or ischemia are the most common presenting symptoms. There is no evidence for an increased risk of cerebral hemorrhage or ischemia during pregnancy or delivery, however physiologic changes (increased circulating volume, hypercoagulability) and stressors during labor (sympathetic response to pain, hyperventilation, valsalva) can exacerbate clinical symptoms (3).

Optimal peripartum management begins with multidisciplinary planning. Recommendations for anesthetic management during cesarean delivery are based on case reports and small reviews. Goals include avoiding hypotension (decreased cerebral blood flow) and hypertension (increased stroke risk), as well as maintaining normocapnia (2). Pain and anxiety leading to hyperventilation causes hypocapnia and decreased cerebral blood flow. Excessive sedation leading to hypercapnia causes decreased perfusion to affected areas of brain via cerebrovascular steal phenomenon. For our patient with intractable headaches as a persistent symptom, we also forewent dural puncture to avoid PDPH.

References:

1. Scott RM, et al. N Engl J Med. 2009;360:1226-37
2. Kato R, et al. Int J Obstet Anesth. 2006;15:152–8
3. Yun J Yung, et al. Yonsei Med J 2015;56(3):793–797

Abstract #:F-83

Anesthetic management of a parturient with severe aortic stenosis and triplets

Presenting Author: Tanmay Shah MD,MBBS
Presenting Author's Institution: University of Oklahoma Health Science Center - Oklahoma city, OK
Co-Author: Kofi Vandyck MD - University of Oklahoma Health Science Center - Oklahoma city, OK

Cardiovascular disease during pregnancy is one of the most common cause of non-obstetric maternal deaths. Cardiac output (CO) and blood volume increase by 40-50% during pregnancy. After delivery, CO further increases by 80% which can be detrimental for parturient with fixed valvular stenosis like mitral and aortic stenosis (AS). Cesarean delivery is usually preferred for patients with AS to avoid hemodynamic changes of labor.

We describe a case of 22 year-old gravida 3, para 2 with dichorionic/triamniotic triplets at 28 weeks who was scheduled for elective cesarean delivery. Past medical history was significant for congenital bicuspid aortic valve with severe AS. Patient had two balloon valvuloplasty in the past and scheduled to undergo Ross procedure but was found to be pregnant at time of workup. Patient was followed by her cardiologist during her pregnancy and was noted to have worsening dyspnea at 26 weeks of gestation. Transthoracic echocardiography (TTE) showed septal dyskinesia, ejection fraction of 55-60%, mean aortic valve gradient of 61 mmHg and peak gradient of 110 mmHg. Based on these findings, decision was made to perform cesarean delivery at 28 weeks. Patient was admitted and optimized by cardiologist who started her on oral digoxin with weekly TTE assessment. TTE prior to surgery showed improvement in septal dyskinesia with decrease in mean gradient of 46 mm of Hg.

Anesthetic plan was to perform an awake arterial and central line placement before induction of general anesthesia. After multiple attempts to get an access for arterial line under ultrasound guidance, procedure was aborted and general anesthesia was induced with intravenous etomidate and succinylcholine via central line in right internal jugular vein. Arterial line was placed successfully immediately after induction. Continuous TEE monitoring was performed after patient was sleep and patient remained hemodynamically stable through out the procedure with all three neonates delivered safely. Patient was extubated at the end of the procedure without any adverse cardiac event and was transferred to ICU for further post-operative care.

The Registry on Pregnancy and Cardiac Diseases (ROPAC) which is a multinational observational registry of parturient with structural heart disease emphasize that women with congenital AS, including bicuspid aortic valve, who become pregnant should be followed very closely by multidisciplinary team. ROPAC showed that patients with moderate AS had successful pregnancies with no mortality, although patients with severe AS can have some complications. Although our patient did not have any cardiac event, anesthesiologist should be ready to manage adverse events like acute heart failure, arrhythmia and ascending aortic dissection. The goal of this presentation is to focus on perioperative multi-disciplinary management of a parturient with severe AS who had triplets, which will be valuable addition to existing literature.

Abstract #:F-84

Preoperative 'bloodletting' in a patient with severe cardiomyopathy presenting for Cesarean delivery

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A 37 year old G3P1 at 37 weeks gestation with a history of cardiomyopathy, LVEF 30-35% and severe global hypokinesis at term, presents for induction of labor. Throughout pregnancy, she was followed closely by cardiology, placed on metoprolol and furosemide, and was instructed to wear a 'Life Vest'. At term, she complained of shortness of breath and dyspnea on exertion. An early epidural was placed after rupture of membranes without complication. An arterial line was also placed to closely monitor her blood pressures during labor. The patient failed to progress past 5 cm dilation, and due to persistent category II tracings, the obstetric team decided to proceed with Cesarean section.

Concerned about fluid overload immediately postpartum, the anesthesia team decided to place a rapid infusion catheter (RIC) line in the patient's forearm, which was used to remove 400 mL of blood preoperatively (with storage in sodium citrate in case it was needed postpartum). Defibrillation pads were placed on the patient in the OR, and she underwent an uncomplicated Cesarean delivery via epidural anesthesia. Postoperatively, a CBC was checked, which revealed a hematocrit of 32 (compared to a preoperative value of 34). An echocardiogram was performed, which demonstrated slightly increased RAP (5-10), compared to her exam a week prior. With this information, she was deemed euvolemic, so the patient's autologous blood was discarded. The rest of her recovery was uncomplicated, and she was discharged home in stable condition on post-op day 3.

In the immediate postpartum period, cardiac output may increase 75% above pre-delivery levels, due in part to auto-transfusion from the contracted uterus (approximately 500 mL), leading to increased venous return, larger stroke volumes, as well as alterations in sympathetic nervous system activity. Cardiac output may also rise with relief of aortocaval compression, diminished lower extremity venous pressure, and a reduction in maternal vascular capacitance (1). With this patient's severe cardiomyopathy, there was concern for fluid overload and resultant pulmonary edema if she could not tolerate such physiologic changes immediately postpartum. We thus present a novel preoperative 'bloodletting' technique, to potentially minimize adverse hemodynamic effects in the immediate postpartum period in a patient with severe cardiomyopathy.

References:

1. Chestnut, David H. Chestnut's Obstetric Anesthesia: Principles and Practice. 4th ed. Philadelphia: Mosby/Elsevier, 2009.

Abstract #:F-85

DELIVERY IN A PARTURIENT WITH COEXISTING IDIOPATHIC INTRACRANIAL HYPERTENSION AND CHIARI MALFORMATION TYPE 1- A CASE REPORT AND REVIEW OF LITERATURE

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Introduction: Idiopathic Intracranial hypertension (IIH)is a syndrome of elevated ICP without ventricular enlargement or mass lesions. Chiari malformation type 1 (CM)is a congenital or acquired condition characterized by herniation of cerebellar tonsils > 5 mm below the foramen magnum. We describe a case where these two conditions coexisted and review relevant literature regarding mode of delivery and anesthesia.

Case: A 20 year old parturient G1P0 presented to our preanesthetic clinic at 32 weeks gestation. She gave history of IIH diagnosed 4 years ago. The condition had been refractory to medical therapy, with improvement in her headaches after receiving serial lumbar punctures. She had also been diagnosed with CM based on MRI. Currently she reported no other symptoms. MRI brain now done showed the extent of herniation to be about 10mm with no hydrocephalus. An ophthalmology consult done ruled out papilledema. She subsequently had an uneventful vaginal delivery with epidural analgesia.

Discussion: Both IIH and CM have similar symptomatology. Both have been found to coexist, though a cause- and- effect has yet to be proven. IIH occurs more in obese females and symptoms such as headache and blurring of vision are said to worsen during pregnancy. The aim of therapy is to preserve vision and improve symptoms. Labor may be allowed, however the uterine contractions and bearing down efforts can increase CSF pressure worsening any papilledema, c section has been preferred in such cases.(1) Neuraxial anesthesia has been used effectively and elevated ICP does not imply herniation risk after dural puncture.(2) Lumbar puncture in these patients is beneficial and safe as it allows CSF drainage reducing CSF pressure. The presence of a lumbo-peritoneal shunt placed for treatment of IIH may be an exception.

Patients with congenital CM can be asymptomatic as our patient, or have symptoms and signs due to increased ICP. The uterine contractions and bearing down efforts of labor can worsen herniation, optimal pain relief (small, slow, epidural boluses preferred) and a short 2nd stage of labor can prevent worsening of symptoms.(3) C-section is often done if high ICP exists. In this scenario, the reduction in lumbar CSF volume that occurs with an intentional spinal anesthetic, inadvertent dural puncture during epidural placement or epidural catheter dosing, can cause brain shifts, placing parturients at risk for neurological deterioration.

To safely perform dural puncture, there should be preserved continuous CSF flow and absence of a large pressure differential between intracranial and intraspinal compartments. Both factors are preserved in IIH, but may be compromised in CM contraindicating neuraxial anesthesia. Our patient had IIH, and significant CM with both factors preserved, allowing for safe neuraxial anesthesia.(2)

References:

1. Bagga R et al Med Gen Med 2005.
2. Leffert L et al Anesthesiology 2013
3. Choi CK et al Case reports in Anesthesiology 2013

Saturday, May 13, 2017

Oral Presentations
Moderator: Philip E. Hess, M.D.

Is Birth Becoming Safer in the World - and What Can We Do? -
Speaker: Jerker Liljestrand, M.D., Ph.D.

Gerard W. Ostheimer Lecture: What's New in Obstetric Anesthesia?
Speaker: Brian T. Bateman, M.D., M.Sc.

Controversies of Obstetric Hemorrhage Management
Moderator: Alexander Butwick, M.B.B.S., M.S., F.R.C.A.; Speakers: John T. Sullivan, M.D., M.B.A.; Jonathan H. Waters, M.D.

Enhanced Recovery After Cesarean Delivery
Moderator: Mohamed Tiouririne, M.D.; Speakers: Ashraf S. Habib, M.B., B.Ch., M.H.Sc., F.R.C.A.; Eric J. Hunt, M.D., Ph.D.; Ruth Landau, M.D.; Pervez Sultan, M.B., B.S., F.R.C.A.

Saturday Abstracts

Abstract #:O-01

Programmed intermittent epidural bolus for labor analgesia during first stage of labor: a biased-coin up and down sequential allocation trial to determine the optimum interval time between boluses of a fixed volume of 5ml of bupivacaine 0.125% plus fentan

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Kristi Downey MSc - Department of Anesthesia and Pain Management, Mount Sinai Hospital, University of Toronto - Toronto, Ontario
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Background: Programmed Intermittent Epidural Bolus (PIEB) analgesia has been shown to be superior to Continuous Epidural Analgesia (CEI) (1). While PIEB regimens with bupivacaine 0.0625% with fentanyl produce highly effective analgesia, sensory block levels may be unnecessarily high (2). It is unknown whether regimens administering higher concentration and smaller volume of bupivacaine will result in lower levels of sensory block while maintaining the same quality of analgesia. We conducted a study to establish the optimal time interval between boluses of 5ml of bupivacaine 0.125% plus fentanyl 2mcg/ml to produce analgesia in 90% of women during first stage of labor without breakthrough pain.

Methods: This was a double-blind sequential allocation trial with a biased-coin up and down design to determine the effective interval 90% (EI90) for the PIEB regimen. We recruited nulliparous women requesting epidural analgesia. Epidural catheter placement was performed with the assistance of ultrasound at L2/L3 or L3/L4. A multi-orifice epidural catheter was inserted 5 cm into the epidural space. A 3mL test dose of bupivacaine 0.125% plus fentanyl 3.3 mcg/ml was followed by a loading dose of 12ml of the same solution. After 20 minutes, in those whose pain scores achieved Verbal Numerical Rating Scores ≤ 1/10, the PIEB regimen was set to start one hour after the loading dose. The PIEB bolus dose was fixed at 5 ml of bupivacaine 0.125% plus fentanyl 2mcg/ml. The PIEB interval for the first patient was 60 minutes. The PIEB interval for subsequent patients was set at varying time intervals (60, 50, 40 and 30 minutes) according to the biased-coin design. The PIEB regimen included a PCEA of 5 ml with a lockout of 10 minutes. The primary outcome was effective analgesia, defined as no requirement for PCEA or MD administered bolus for 6 hours after the initiation of PIEB, or until the patient presented full cervical dilatation, whichever occurred first. Pain scores, sensory block levels to ice and pinprick, degree of motor block and non-invasive blood pressure were recorded every hour.

Results: We studied 40 patients. The EI90 was 36.5 minutes (95%CI 34.0, 39.0) using the truncated Dixon and Mood method and 34.2 minutes (95%CI 30.8, 41.5) using Isotonic Regression analysis. Overall, sensory block was above T6 in 20/40 women when assessed by ice and in 10/34 women when assessed by pinprick. Overall, 34/40 women exhibited no motor block. No patient required treatment for hypotension.

Discussion: The optimal time interval between programmed intermittent boluses of 5 mL of bupivacaine 0.125% with fentanyl 2 mcg/mL is approximately 35 minutes. A significant number of women will exhibit sensory block above T6 to ice. Our results suggest no advantage of this regimen over regimens utilizing larger volumes of bupivacaine 0.0625% (2).

References:

1. Anesth Analg 2013; 116:133-44
2. Anesth Analg 2017; 124: 537-541.

Abstract #:O-02

Comparative potency of calcium-activated chloride channel anoctamin 1 antagonists on human uterine smooth muscle (USM) contractility.

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Wen Fu PhD - Columbia University College of Physicians and Surgeons - New York, NY
Joy Vink MD - Columbia University College of Physicians and Surgeons - New York, NY
George Gallos MD - Columbia University College of Physicians and Surgeons - New York, NY

Objective: Pre-term birth resulting from preterm labor is a major health care challenge facing the United States. We previously described that anoctamin 1 (ANO-1) channel blockade results in relaxation of pre-contracted human USM. Three drug classes possess ANO-1 anatagonism and have been safely used in humans (gallotannins, benzofurans and anthranilic acid derivatives). In this study, we compared the relative potency between these drug classes to promote human USM relaxation and inhibit contraction frequency.

Methods: With IRB approval (#AAAL4005), ex vivo organ bath experiments were performed utilizing strips of late gestation human USM (n=5 patients). Samples were pre-contracted with oxytocin (0.5 μM), equilibrated for 60 minutes, and treated with sequentially increasing doses of an ANO-1 antagonist (benzbromarone, Tannic acid and MONNA;1 μM - 500 μM) or vehicle control (0.1% DMSO final). Resulting changes in force/time were processed as an integral measured over 60 minutes, processed as a percentage of reduction in integral force (g*sec) from baseline contractility, and compiled then plotted (mean + SEM) using a variable slope sigmoidal dose-response curve to determine IC_{50} and I_{max} values. Statistical analysis utilized ANOVA with Bonferroni's Multiple Comparison Test ($p<0.05$ was taken as significant). Percent reduction in contraction frequency (contractions/hr) was also plotted using a variable slope sigmoidal dose-response curve and ANOVA analysis.

Results: The IC_{50} of benzbromarone, tannic acid and MONNA on oxytocin- induced contractility of human USM is 34 μM, 45 μM and 59 μM respectively (Figure 1B). The threshold concentration to achieve I_{max} for benzbromarone, tannic acid and MONNA on oxytocin-induced contractility is 50 μM, 100 μM or 100 μM respectively. We also observed ANO-1 antagonism mediated by benzbromarone at 1 μM (***$p<0.001$), tannic acid at 10 μM (***$p<0.001$) or MONNA at 10 μM (***$p<0.001$) allowed for statistically significant reductions in frequency (Figure 1C).

Conclusions: Blockade of ANO-1 attenuates oxytocin- induced contractions in pregnant human uterine tissue. Of the compounds tested, benzbromarone is the most potent tocolytic drug ex vivo.

Reference:

1. Bernstein K, et al. Calcium-activated chloride channels anoctamin 1 and 2 promote murine uterine smooth muscle contractility. Am J Obstet Gynecol 2014; 211: 688.e1-10

Abstract #:O-02

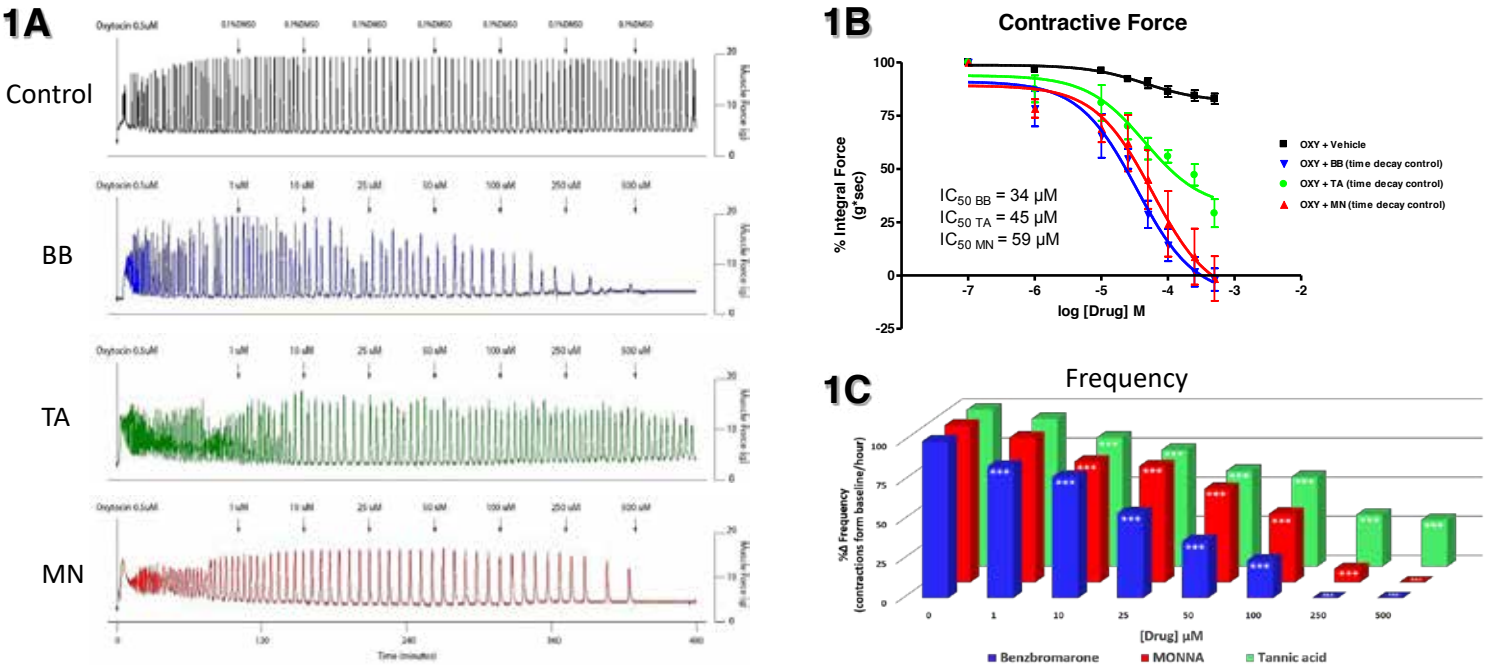

Figure. 1. Comparative pharmicological antagonism of human uterine smooth muscle (USM) anoctamin-1 on oxytocin-induced enhanced force
Organ bath experiments were performed with pregnant human USM(n=5 patients). Following contractile stimulation with oxytocin(0.5 µM) each bath was treated with increasing doses of benzbromarone, tannic acid, MONNA (1µM-500µM) or vehicle control (0.1% DMSO). Integral change in force was then measured over 60 minutes per dose and processed as a percentage of reduction in integral force (g*sec) from baseline oxytocin-induced contractility.
1A. Representative force tracing showing the differential potency (BB>MN>TA) of benzbromarone (blue tracing), tannic acid (green tracing) and MONNA (red tracing) on contractive frequency and force compared to vehicle control (black tracing). *BB=benzbromarone, TA=tannic acid, MN=MONNA.
1B. Determination of IC_{50}. Percent reduction in integral force (g*sec) calculated from baseline oxytocin contractility was plotted using a variable slope sigmoidal dose-response curve [Y=Bottom + (Top-Bottom)/(1+10^((LogEC50-X)*HillSlope))]. The IC_{50} of benzbromarone, tannic acid and MONNA on Oxytocin-induced contractility of human USM is 34 µM, 45 µM or 59 µM respectively.
1C. Determination of contraction frequency. Baseline contraction frequency was assessed following 0.5 µM oxytocin over 60 minutes. Subsequent contraction frequency was measured after varying doses of benzbromarone, tannic acid , MONNA (1 µM-500 µM) or vehicle control (0.1% DMSO) over 60 minute time intervals. The data is expressed as % changes from baseline frequency/hour and analyzed using one way ANOVA and Bonferroni's Multiple Comparison Test to detect statistical significance from the vehicle control. ANO1 antagonism mediated by benzbromarone at 1µM (***p<0.001), tannic acid at 10µM (***p<0.001) or MONNA at 10µM (***p<0.001) allowed for statistically significant reductions in frequency.

Abstract #:O-03

CSF protein signature in preeclampsia converges on TGF-beta, VEGFA, AGT, and IL-6 signaling pathways

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S. Ananth Karumanchi MD - Beth Israel Deaconess Medical Center - Boston, MA
Philip Hess MD - Beth Israel Deaconess Medical Center - Boston, MA

Introduction: A wide range of pathological changes at the molecular level can be postulated to explain the heightened excitability, visual changes, headache, and seizure susceptibility that can occur in preeclampsia (PE). We know that dysregulated endothelial signaling, vascular remodeling and widespread inflammation are principal contributors to the pathogenesis of systemic features of PE [1, 2], but scarce data have implicated these pathways or any others specifically in the development of its central nervous system (CNS) manifestations. In this study, we analyzed the relationships of signaling molecules that emerged from a proteomics screen comparing the cerebrospinal fluid (CSF) protein content of patients with PE to normal controls.

Methods: Based on results of a SOMAscan aptamer-based array of CSF proteins, we performed Ingenuity Pathway Analysis to highlight relationships between target proteins found to be significantly up- or down-regulated in PE. For two members of the TGF-beta pathway, INHBA and FSTL3 (also known as Activin A and FLRG, respectively), we validated the difference in protein concentration between groups by ELISA, using commercially available kits (Ansh Labs; R&D Systems). Mean concentrations and SEM were calculated and unpaired student t-test was applied to determine statistical significance of the differences between groups.

Results: The differentially expressed proteins showed significant convergence around four signaling molecules (Figure 1A): transforming growth factor beta (TGF-beta), vascular endothelial growth factor A (VEGFA), angiotensinogen (AGT), and interleukin 6 (IL-6). Within the TGF-beta pathway, upregulation of Activin A (301.6 ± 47.4 pg/mL versus 151.6 ± 20.5 pg/mL, $p = 0.0074$) and FLRG (5129 ± 347 pg/mL versus 3016 ± 188 pg/mL, $p < 0.0001$) in PE was confirmed by ELISA (Figure 1B).

Conclusions: Signaling pathways important for vascular remodeling, neuronal survival, and inflammation were well represented among the proteins found to have altered expression levels in CSF in patients with PE. Future work will help determine which changes reflect primary insults versus collateral damage and compensatory modulation. With a clear understanding of the pathogenic mechanisms underlying the CNS manifestations of PE, we can hope to achieve better treatment and prevention of these potentially devastating clinical outcomes.

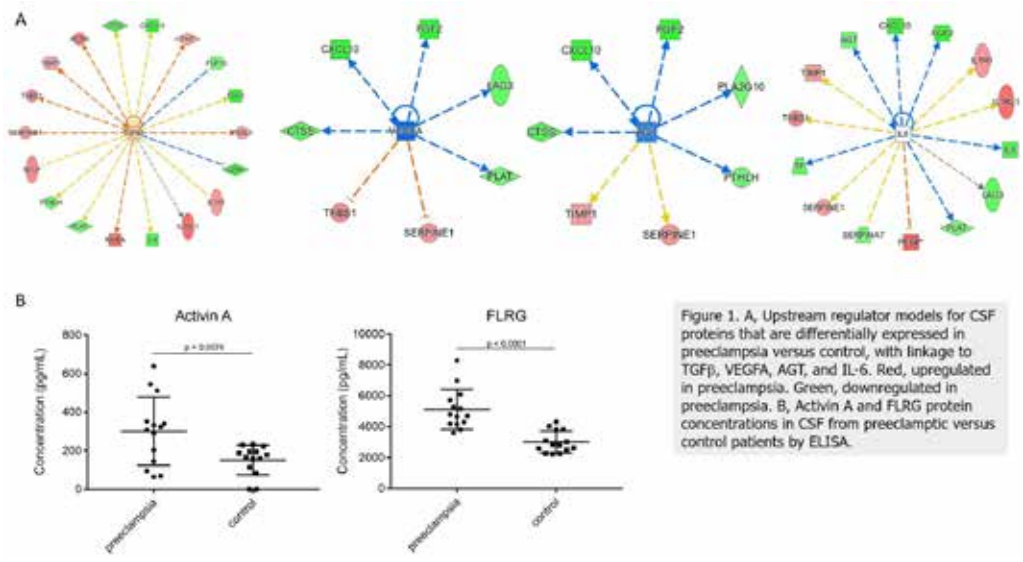

Figure 1. A, Upstream regulator models for CSF proteins that are differentially expressed in preeclampsia versus control, with linkage to TGFβ, VEGFA, AGT, and IL-6. Red, upregulated in preeclampsia. Green, downregulated in preeclampsia. B, Activin A and FLRG protein concentrations in CSF from preeclamptic versus control patients by ELISA.

References:

1. Nat Med, 2006. 12(6): p. 642-9.
2. J Clin Invest, 2016. 126(7): p. 2561-74.

Abstract #:O-04

Clinically Evident Right Ventricular Strain and Fractional Area Change During Routine Cesarean Section

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Background: Clinically detectable right ventricular (RV) strain and troponin leak during the peri-cesarean section (C-section) period may be present in the otherwise healthy parturient. Causes may include intermittent embolic events (air, amniotic fluid) or changes in loading conditions during the delivery period. The identification of these etiologies may be seen on transthoracic echocardiography (TTE). The aim of this study is to quantify and correlate RV strain, cardiac biomarker leak and the presence of RV or LV dysfunction during this period.

Methods: Patients undergoing scheduled cesarean underwent bedside transthoracic echocardiographic examination intra-operatively, during uterotomy and delivery, and postoperatively immediately after leaving the operating room. Cardiac biomarkers (troponin, CPK-MB, BNP) were collected pre- and post-operatively. Transthoracic measures included RV and LV ejection fraction, percentage RV fractional area change (FAC) and myocardial strain, which was calculated using 2D-speckle tracking.

Results: 30 patients' images were analyzed for this study. There was no significant change in the RV strain from pre- to post-delivery (mean -5.28 vs. -5.72; p = 0.69). FAC decreased by a mean of 4.1% from pre- to post- delivery (p<0.014). FAC was also abnormal pre- and post- delivery indicating at least moderate dysfunction in most patients. Left ventricular (LV) circumferential strain increase was significant (-6.43 vs. -18.53; p =0.002). Cardiac troponin was significantly increased in 1 patient who also showed decreased LV strain. Difference in BNP over all patients was not significantly increased (p=0.09) neither was CK-MB (p=0.50). Only one patient demonstrated imaging consistent with significant intra-delivery embolism.

Conclusions: Our analysis shows that it is possible to image parturients during cesarean and quantify right ventricular dysfunction as assessed by longitudinal strain and FAC. Though strain is a sensitive marker, current literature is mixed on the applicability t right heart dysfunction.
The presence of worsened FAC% indicates the presence of dysfunction despite lack of change in RV strain. The LV responds well to increased preload conditions, which was demonstrated by and more negative circumferential strain value. No evidence of increased BNP, CK-MB, troponin or significant emboli was seen with continuous TTE imaging in this cohort.

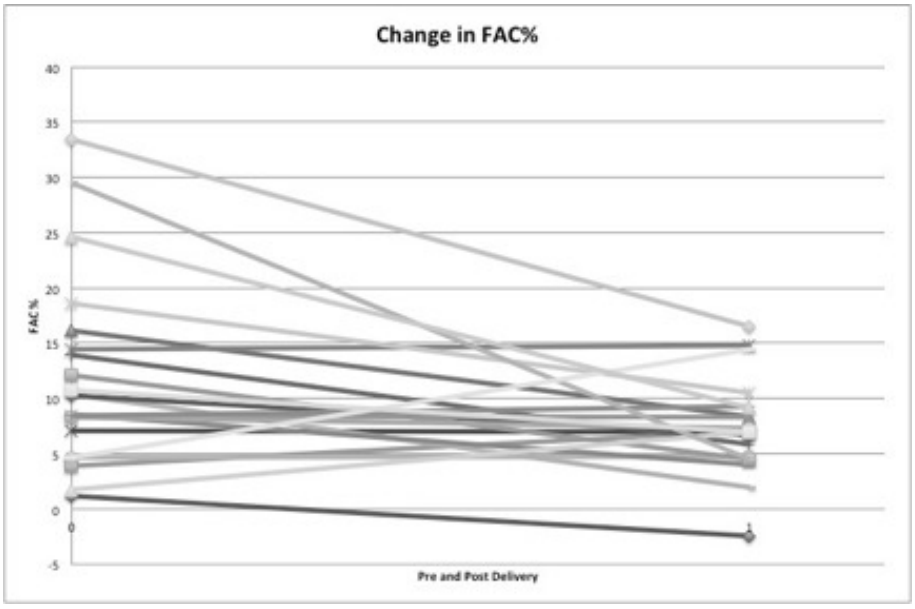

Figure 1. Changes in fractional area change pre and post-delivery p = 0.014

Abstract #:O-05

Comparison of the effects of phenylephrine versus ephedrine on maternal ECG changes and cardiac output during cesarean delivery under spinal anesthesia

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Introduction: ECG changes during cesarean delivery (CD) under spinal anesthesia are common. Ischemic changes may occur due to an imbalance of myocardial oxygen demand and supply, phenylephrine may have a favorable oxygen supply: demand ratio compared to ephedrine. Previous studies used intermittent boluses to maintain blood pressure (BP) rather than the currently accepted prophylactic infusion regimen. We studied the effect of titrated infusions of phenylephrine and ephedrine to maintain systolic BP (SBP) in women undergoing elective CD. Primary outcome was incidence of ischemic ECG changes when maternal BP is maintained with infusions of phenylephrine or ephedrine. Secondary outcomes included evidence of myocardial ischemia related to ECG changes and troponin levels; SBP, maternal heart rate (HR), cardiac output (CO) and neonatal outcome.

Methods: Single center, randomized, double-blind study of 29 women for elective CD under spinal anesthesia. A Holter monitor was used to analyze the ECG during and 4-hours post-CD. Spinal anesthesia was administered (11mg of 0.5% hyperbaric bupivacaine plus 15µg fentanyl). Infusions of phenylephrine at 50µg/min or ephedrine 4mg/min were commenced and titrated as per protocol to maintain baseline SBP. Crystalloid co-load (1L) was administered. A suprasternal Doppler measured CO, stroke volume (SV), flow time corrected (FTc) and peak velocity every 5 min post-spinal to 5 min post-delivery. Troponin-T was measured at 24 hours. Apgar scores and umbilical cord gases were recorded. Data were analyzed using mixed linear models, analysis of covariance (ANCOVA); Tukey-Kramer post-tests, Student t, Mann-Whitney U- and Fisher exact tests. Significance was defined as $P < 0.05$.

Results: Arrhythmia occurred more frequently with ephedrine (50% v 31%, P=0.43) but this was not significant. There were higher troponin levels with ephedrine (≤0.003ng/mL, P=0.093). Ephedrine was more effective at maintaining maternal SBP, significantly higher at 5, 20, 25 and 30 min post-spinal (13%, P=0.0036), but HR was similar (P=0.11). Although CO was similar (P=0.20), there were significant effects over time for FTc and SV. Neonatal outcomes such as Apgar scores, umbilical pH, HCO_3, base excess and PCO_2 were not significantly different.

Discussion: We found non-significant, higher rates of arrhythmia and troponin levels with ephedrine. Ephedrine also resulted in significantly higher SBP post-spinal. However, in the choice between phenylephrine and ephedrine for maintenance of BP during CD under spinal anesthesia, phenylephrine appears favorable in reducing maternal myocardial work, and could be associated with fewer arrhythmias. Further research with larger trials is required.

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1. Zakowski MI. Electrocardiographic Changes during Cesarean Section: A Cause for Concern? Anesthesia Analgesia 1993;76: 162-7
2. Warwick NKD. Vasopressors in obstetrics: what should we be using? Current Opinion in Anaesthesiology 2006;19: 238-243

Abstract #:O-06

Comparison of carbetocin administration by bolus or infusion on maternal vascular resistance during cesarean delivery: a randomized controlled trial using ccNexfin®

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Introduction: The Society of Obstetricians & Gynecologists of Canada recommends carbetocin to prevent post-partum hemorrhage at elective cesarean delivery (CD).1 Its side effects include hypotension, tachycardia, flushing, nausea & vomiting,2 likely due to reduced vascular resistance.3 The purpose of our study was to ascertain if the cardiovascular and clinical effects of carbetocin are influenced by its rate of administration; we hypothesized that administering carbetocin slower than currently recommended would reduce its cardiovascular and adverse effects.

Methods: Healthy parturients electing for CD under spinal anesthesia were randomized to receive 50mcg carbetocin after cord clamping either by 30 second bolus (Group B) or 5 minute infusion (Group I).

Parturients received similar spinal & fluid regimens. Variable rate phenylephrine infusion (PEI) kept each parturient's blood pressure within 10% of baseline following her spinal; after peritoneal incision the PEI was fixed so it was constant during the study period. Maternal hemodynamic data were recorded using a ccNexfin® monitor (Edwards Lifesciences LLC, Canada). The primary outcome was change in maternal systemic vascular resistance index (ΔSVRI) over ten minutes following carbetocin, analyzed using linear mixed-model regression; secondary outcomes were incidence of side effects, adequacy of uterine tone and need for further uterotonics, analyzed using Fisher's Exact test.

Results: Forty eight parturients were analyzed (group B = 23, group I = 25). There was no difference in overall ΔSVRI over ten minutes (Fig 1a). ΔSVRI was greater ($p<0.0001$) in group B than group I at 1 minute, this difference was attenuated by 2 minutes (Fig 1b). Side effects occurred in 74% in group B & 52% in group I ($p>0.05$); adequacy of uterine tone and additional uterotonic requirements were similar between groups.

Discussion: Healthy parturients having elective CD under spinal experience no difference in overall ΔSVRI whether carbetocin is given by bolus or infusion over five minutes; however, there is a significant difference in the first two minutes. Whilst not associated with an observed difference in side effects, less healthy parturients might not tolerate this change; giving carbetocin by infusion may be safer and is as effective in this population. Further studies are needed to evaluate its effect in emergency CD.

References:

1. J Obst Gyn Can 2009;31(10):980–993
2. CJA 2014;61:242-48
3. IJOA 2010;19:313–319

Abstract #:O-06

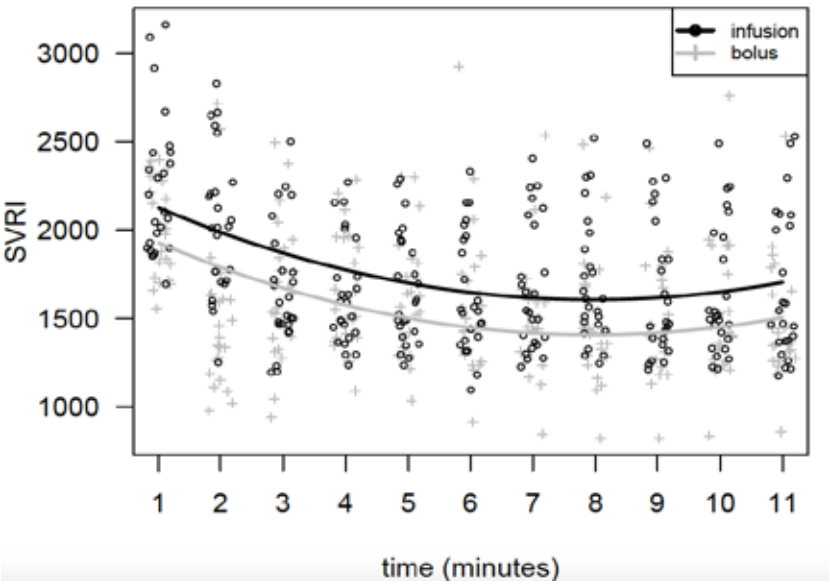

Fig 1a. Trajectory of SVRI over time. 1 = 0 minutes (baseline), 11 = 10 minutes. The points are offset by a small random amount along the x-axis to minimize overlap. The lines show the trajectory for the median phenylephrine rate of 40 µg.min^{-1}. The parallel nature of the lines demonstrates similar overall change in SVRI between groups despite the infusion group baseline being higher.

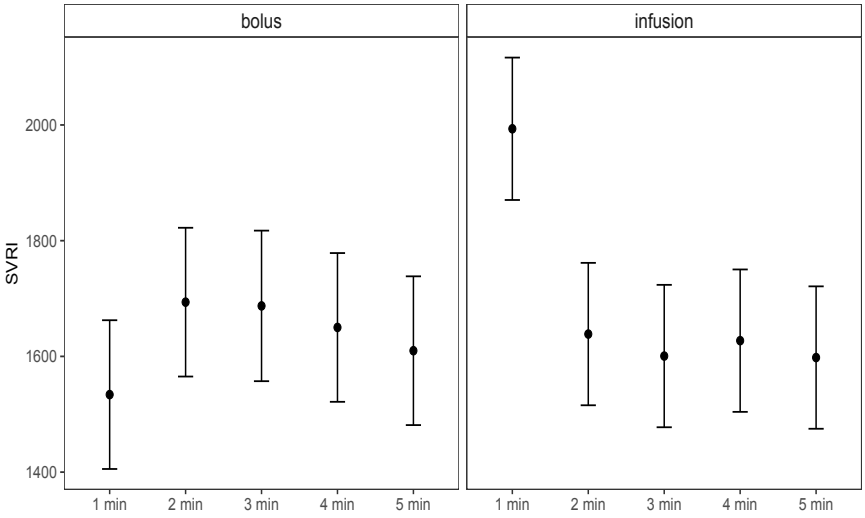

Fig 1b. Predicted mean SVRI between 1 and 5 minutes post-baseline for bolus and infusion groups separately, adjusted for baseline SVRI and phenylephrine rate covariates. The filled circles indicate the predicted means and the whiskers show the 95%CI of those estimates.

Abstract #:O-07

Programmed intermittent epidural bolus for labor analgesia during first stage of labor: A sequential trial to determine the optimum bolus dose of bupivacaine 0.0625% plus fentanyl 2 mcg/ml at fixed intervals of 40 minutes

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Background: The effective PIEB interval time for 10 ml boluses of bupivacaine 0.0625% + fentanyl 2 mcg/mL has been suggested to be 40 minutes. This regimen has shown to be effective without the use of PCEA in 90% of women during first stage of labor (1). However, although not associated with hypotension or motor block, 34% of women undergoing this regimen exhibited a sensory block to ice above T6. It is unknown whether it is possible to reduce the PIEB volume while keeping the PIEB interval at 40 minutes and still provide adequate analgesia. We sought to study the effective PIEB volume of bupivacaine 0.0625% + fentanyl 2 mcg/mL at a fixed interval of 40 minutes to provide effective analgesia in 90% of women (EV90) during the first stage of labor, without the use of PCEA.

Methods: This was a prospective double-blind dose-finding study using the biased coin up-down sequential allocation method (2). Inclusion criteria included nulliparous women requesting epidural analgesia with a term singleton pregnancy. Ultrasound assisted epidural catheter insertion was at either the L2-3 or L3-4 interspace. A test dose of 3 mL of bupivacaine 0.125% + fentanyl 3.3 mcg/mL was administered, followed by a loading dose of 12 mL of the same solution. In order to remain eligible for the study, women had to achieve a Verbal Numerical Rating Score ≤ 1/10 within 20 minutes of completion of the loading dose. Labor analgesia was maintained with bupivacaine 0.0625% + fentanyl 2 mcg/mL. The first PIEB bolus was given 1 hour after the completion of the loading dose and all subsequent PIEB boluses were given at a fixed interval of 40 minutes. The first patient enrolled in the study received a PIEB bolus of 7 mL. Subsequent patients received 7, 8, 9, 10, 11 or 12 mL, based on the biased-coin allocation. The primary outcome was adequate analgesia, defined as no use of PCEA or request for manual boluses for 6 hours after the loading dose or until the patient's cervix was fully dilated, whichever occurred first. Secondary outcomes included motor block, hypotension, and sensory level to ice and pinprick.

Results: We studied 40 women. The estimated EV90 was 11 mL (95% CI 10.32-11.65) with the Isotonic Regression Method and 10.65 mL (95% CI 10.27-11.03) with the Truncated Dixon and Mood Method. Overall, sensory block was above T6 in 18/40 women when assessed by ice and in 11/40 women when assessed by pinprick. Overall, 37/40 women exhibited no motor block. No patient required treatment for hypotension.

Discussion: It is not possible to reduce the PIEB volume from 10 mL in our current PIEB regimen without compromising the quality of analgesia. Not surprisingly, a significant proportion of women will exhibit sensory block above T6 to both ice and pinprick. Sensory block to pinprick may be more reassuring in this context. Motor block and hypotension requiring treatment were virtually non-existent.

References:

1. Anesth Analg, 2017;124:537-541
2. Anesthesiology, 2007;107:144-152

Abstract #:O-08

Readmissions After Anesthetic Complications During Delivery. A Nationwide Cohort Study from 2013-2014

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Ariel Mueller MA - Beth Israel Deaconess Medical Center - Boston, MA
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sajid shahul MD - University of Chicago Hospitals - CHICAGO, IL

Introduction: In recent years, there has been a marked decline in peripartum anesthetic related mortality (1,2). However, anesthetic related morbidity still exists and outcomes associated with anesthetic complications, specifically subsequent readmissions, are incompletely understood. Using a large national database, we examined risk factors, outcomes, and subsequent 30–day readmissions associated with anesthesia complications during delivery.

Methods: We performed a retrospective cohort analysis using combined data from the 2013 and 2014 National Readmissions Databases (NRD). For each year, the NRD database provides discharge data on approximately 14 million hospital stays. NRD has data from up to 22 geographically diverse states and represents 49.3% of all US hospitalizations. The NRD can be weighted to produce national estimates.

Results: Of the 70,886,775 weighted national discharges, 6,983133 were 'delivery' discharges in 15-45 year age group. Anesthetic complications occurred in 0.4%, most common being related to: neuraxial anesthesia (50.3%), unspecified complications (45.9%), and cardiopulmonary complications (1.8%). The 30-day readmission rate was 2.9% compared to 1.4% in all parturients. The most common risk factors for readmission included: obesity, severe pre-eclampsia, drug abuse, delivery in a metropolitan hospital, and lower income quartile (Table 1). The median length of stay for readmissions was 1.82 days (1.65-1.99).

The most common reasons for readmission were related to: anesthetic complications (17.5%), surgical complications (8.2%), and eclampsia (6.8%). The most common procedures performed during readmission were epidural blood patch (29.7%) and packed red blood cell transfusion (5.8%).

Conclusion: Although rare, peripartum anesthetic complications contribute to increased resource utilization. Specifically, women who suffer from a peripartum anesthetic related complication are twice as likely to be readmitted compared to all parturients. Endeavors to further reduce anesthetic related complications in this patient population will help reduce overall readmissions after delivery.

References:

1. Mhyre JM1, Bateman BT. Stemming the Tide of Obstetric Morbidity: An opportunity for the Anesthesiologist to Embrace the Role of Peridelivery Physician. Anesthesiology. 2015 Novl123(5):986-9
2. Creanga AA, Berg CJ, Syverson C et al. Pregnancy-Related Mortality in the United States, 2006-10. Obstet Gynecol. 2015 Jan;125(1):5-12

Abstract #:O-08

Table 1

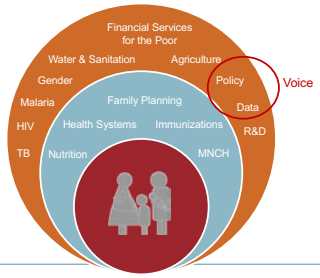
Variables	Readmitted	Not Readmitted	P-values	OR (95% CI)
Median Household Income (per quartile of patient's zip code)			0.0032	
1st quartile ($1-$37999 for 2013); ($1-$39999 for 2014)	268(34.2)	6483(24.72)		Baseline
2nd quartile ($38K-$47999 for 2013); ($40K-$50999 for 2014)	190(24.18)	7004(26.71)		**0.71(0.52-0.98)**
3rd quartile ($48K-$63999 for 2013); ($51K-$65999 for 2014)	187(23.85)	6661(25.4)		**0.68(0.5-0.94)**
4th quartile ($64000+ for 2013); ($66000+ for 2014)	139(17.7)	6080(23.18)		**0.55(0.4-0.77)**
Teaching status of Urban Hospitals			0.0004	
Non-metropolitan hospital	64(8.08)	3817(14.40)		Baseline
Metropolitan non teaching hospital	230(26.89)	7877(29.71)		**2.0(1.26-3-1.6)**
Metropolitan teaching hospital	502(63.03)	14818(55.89)		**2.16(1.39-3.35)**
Hospital Bedsize			0.079	
Small	118(14.81)	4093(15.44)		Baseline
Medium	183(23)	7554(28.49)		0.82(0.56-1.23)
Large	495(62.19)	14864(56.07)		1.06(0.76-1.46)
Associated diagnoses				
Drug abuse	51(6.4)	487(1.84)	0.006	**2.84(1.55-5.19)**
Diabetes Mellitus	96(12.01)	2347(8.85)	0.08	1.2(0.84-1.7)
Severe Pre-eclampsia	37(4.69)	582(2.2)	0.03	**1.73(1.01-2.96)**
Deficiency Anemias	147(18.48)	3154(11.90)	0.007	1.56(0.94-2.59)
Blood Loss Anemia	175(22.01)	4297(16.21)	0.03	0.94(0.57-1.53)
Chronic Lung Disease	74(9.27)	1504(5.67)	0.08	1.27(0.75-2.16)
Fluid and Electrolyte disorders	27(3.42)	330(1.24)	0.03	1.92(0.94-3.92)
Obesity	134(16.81)	2632(9.93)	0.001	**1.62(1.18-2.2)**
Psychoses	22(2.7)	304(1.99)	0.06	1.52(0.75-3.03)

WHAT I'LL SHARE

- The Gates Foundation Approach
- Global Development Today
- Maternal and Newborn Health
- Key Takeaways

THE GATES FOUNDATION APPROACH

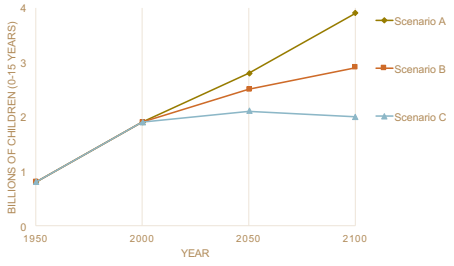
How We Work:



REMINDER:

MORTALITY AND POVERTY

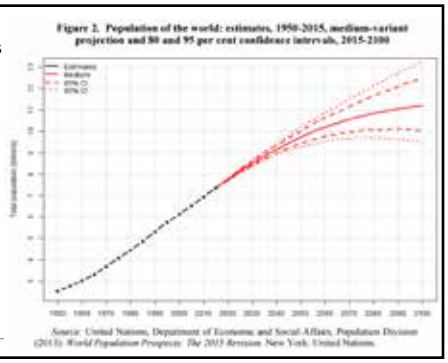
HOW MANY CHILDREN WILL THERE BE GLOBALLY IN 2100?



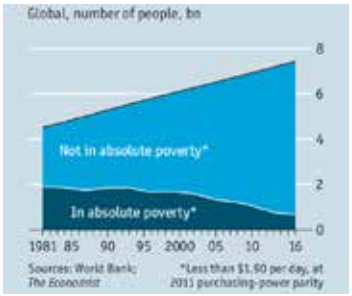
Source: UN's Population Division

- Child population is steadying, yet total population is increasing.

  How can this be?



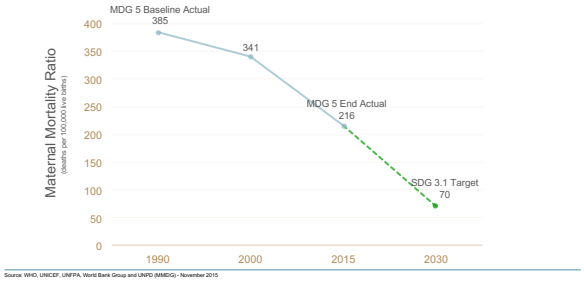
- ELIMINATING POVERTY GETS HARDER. WHY?
  - Gender inequality
  - Fragile countries
  - Population growth and fertility



- Maternal & Newborn Health

- ANNA'S STORY A happy ending after overcoming many challenges.

- THE GLOBAL MATERNAL MORTALITY RATIO IS DECREASING

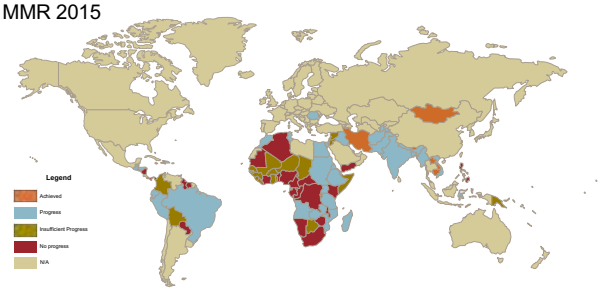


- WHY?

  Facility births are on the rise.

  Yet challenges remain.

MMR 2015



Trends in Maternal Mortality: 1990 to 2015: Estimates by WHO, UNICEF, UNFPA, World Bank Group and the United Nations Population Division

5 MAIN CAUSES OF MATERNAL DEATH

Causes	Ways to Address the Cause
Postpartum Hemorrhage	PPH "bundle" including Uterine Balloon Tamponade (UBT) or NASG, Misoprostol, and Tranexamic Acid (TXA)
Preeclampsia/ Eclampsia	*New bundle needed*
Unsafe Abortion	Family Planning, Post-Abortion Care, and more
Sepsis	Infection Control, Cesarean Section, Interventions, Antibiotic Use, Monitoring
Obstructed Labor	Transport, Assisted Vaginal Delivery

INTERVENTION BUNDLE FOR PPH

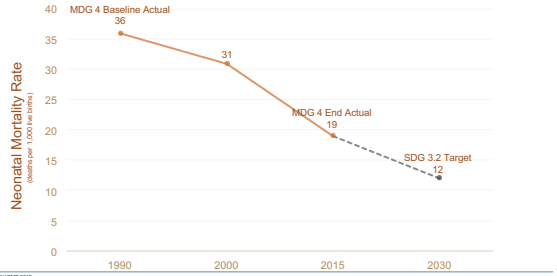
Level of Care	Intervention Package	
Hospital Birth	• Blood transfusion • Laparotomy • Compression sutures	• Uterine artery resection • Hysterectomy
PHC Birth	• AMTSL + patient monitoring • Administer uterotonic • Evacuate placental rests & suture wounds	• Aorta compression • Insert UBT or apply NASG (or both) • TXA (Tranexamic Acid)
PHC Antenatal Care	• Referral to hospital birth for high-risk PPH women • Provision of bed-nets & IPPT (malaria)	• Iron and Folic Acid provision • (potential) De-worming • Misoprostol for home use
Community Health	• Self-help groups • Awareness raising • Misoprostol for home use	• Anemia + Malaria screening • Birth Planning

KEY ISSUES

- Overmedicalization
- Adherence to guidelines for evidence-based interventions
- Respectful maternity care

Source: Lancet, Maternal Health, September 2016

NEONATAL MORTALITY IS ALSO DECREASING



Source: UN IGME 2015

3 MAIN CAUSES OF NEWBORN MORTALITY (+STILLBIRTHS)

Cause	Ways to Address the Cause
ASPHYXIA	Better Labor Monitoring, Assisted Vaginal Birth, Cesarean Section, Helping Babies Breathe
"PRETERM"	KMC, more research needed
SEPSIS	Link to AMR, PSBI (Possible Severe Bacterial Infection approach)

KEY CHALLENGES & LEARNINGS

- Cesarean Section Epidemic
- AMR
- Supporting Normal Birth
- **Anesthesia staff**
- **Pain relief in labor**
- **Collaboration maternal team ⇔ newborn team**

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SUMMARY

Huge changes in the world in last 50 years……and even more in last 25 years
We can eliminate absolute poverty => 2030
Necessary: Reducing child/NB deaths ⇔ decrease fertility ⇔ eliminate poverty

Change in "ecology of human birth" - >75% now in facilities
Increases focus on quality of care, including health system strengthening
Decline in MMR and NBMR

SDGs for MMR (70/100,000 live births) and NBMR (12/1,000 live births) within reach

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THANK YOU

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THE GATES FOUNDATION APPROACH

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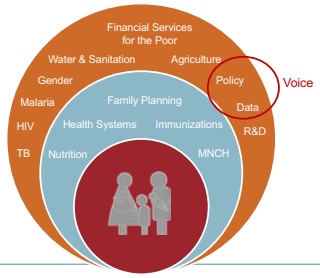

QUIZ on Global Development Today

Text GATESFDN to 22333 to join our survey, then vote using number 1-9

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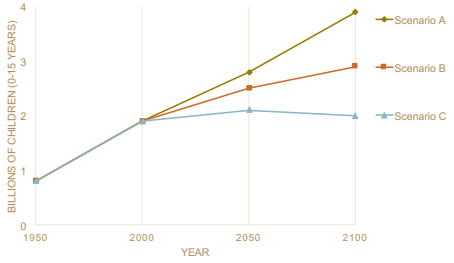

Source: UN's Population Division

Gerard W. Ostheimer Lecture Syllabus
***What's New in Obstetric Anesthesia?* – 2016**
Brian T. Bateman, M.D., M.Sc.

Journals included in the review

Anesthesia
Anesthesia and Analgesia, Anesthesiology, British Journal of Anesthesia, Canadian Journal of Anesthesia, International Journal of Obstetric Anesthesia

Obstetrics and Gynecology Journals
American Journal of Obstetrics and Gynecology, Obstetrics and Gynecology, British Journal of Obstetrics and Gynecology

Perinatology and Pediatric Journals
JAMA Pediatrics, Pediatrics

General Medical Journals
American Journal of Epidemiology, Annals of Internal Medicine, Blood, British Medical Journal, Canadian Medical Association Journal, Circulation, Epidemiology, Hypertension, JAMA, JAMA Internal Medicine, Journal of Thrombosis and Haemostasis, Lancet, Lancet Global Health, New England Journal of Medicine, Thrombosis and Haemostasis

Article summaries

1. Adesope OA, Einhorn LM, Olufolabi AJ, Cooter M, Habib AS. The impact of gestational age and fetal weight on the risk of failure of spinal anesthesia for cesarean delivery. *International journal of obstetric anesthesia.* 2016; 26:8-14.

The authors examined the frequency of failure to achieve an adequate level of surgical anesthesia with ≥10.5 mg of bupivacaine in association with gestational age at the time of cesarean delivery. The rates of block failure were 10.8% for <28 weeks, 7.7% for <28 to <32, 5.3% for 32 to <37 to and 5% for 37weeks or greater. In a multivariable model, low birthweight was also associated with catheter failure.

2. FDA Drug Safety Communication: FDA review results in new warnings about using general anesthetics and sedation drugs in young children and pregnant women. 2016.

Citing data from animal studies, the FDA issued a warning about repeated or lengthy use of general anesthesia or sedating drugs in children < 3 and pregnant women in the third trimester owing to the risks of neurotoxicity. It states: "Health care professionals should balance the benefits of appropriate anesthesia in young children and pregnant women against the potential risks, especially for procedures that may last longer than 3 hours."

3. Aiken CE, Aiken AR, Scott JG, Brockelsby JC. The influence of hours worked prior to delivery on maternal and neonatal outcomes: a retrospective cohort study. *Am J Obstet Gynecol.* 2016; 215(5):634.e631-634.e637.

This retrospective cohort study followed 24,506 unscheduled deliveries at a single tertiary care center in the UK. The investigators sought to examine the impact of time of day and hours worked prior to delivery on a variety of obstetrical and neonatal outcomes including PPH, low cord pH, failed instrumental vaginal delivery, delayed neonatal respiration, and severe perinatal trauma. There was no significant difference in specified outcomes between deliveries occurring during the day and the night. However, the risk of some of the outcomes (>1.5 L blood loss, low cord pH) was highest late in the shift, suggesting that the risk of adverse outcomes may increase in association with provider fatigue.

4. Alisic S, Boet S, Sutherland S, Bould M. A qualitative study exploring mentorship in anesthesiology: perspectives from both sides of the relationship. *Canadian Journal of Anaesthesia.* 2016; 63(7):851-861.

This qualitative study based on semi-structure interviews, examined the mentorship relationship from both the perspective of the mentees (residents) and mentors (faculty) at the University of Ottawa. They identified 3 factors that influenced the success of the mentorship relationship: clear expectations of the mentor/mentees for the relationship, compatibility and shared interests, and structure of the mentorship program.

5. Angle PJ, Kurtz Landy C, Djordjevic J, et al. Performance of the Angle Labor Pain Questionnaire during Initiation of Epidural Analgesia in Early Active Labor. *Anesthesia and analgesia.* 2016; 123(6):1546-1553.
6. Editorial: Carvalho B, Mhyre JM. Moving Beyond the 0–10 Scale for Labor Pain Measurement. *Anesthesia and Analgesia.* 2016; 123(6):1351.

This study examined the performance characteristics of the Angle Labor Pain Questionnaire (A-LPQ), which was evaluated in association with the initiation of epidural analgesia. The A-LPQ is a 22 item questionnaire that is designed to measure the five most important dimensions of women's childbirth pain experiences: the enormity of pain, fear/anxiety, uterine contraction pain, birthing pain, and back pain/long haul. This study, which included 51 patients, showed that A-LPQ was able to detect reductions in women's experience of pain across multiple dimensions associated with the initiation of epidural anesthesia. This tool promises a way to more fully characterize women's experience of pain associated with labor in comparison to the 11 point numeric pain scales that are commonly used both in practice and research settings.

7. Ariyo P, Trelles M, Helmand R, et al. Providing Anesthesia Care in Resource-limited Settings: A 6-year Analysis of Anesthesia Services Provided at Medecins Sans Frontieres Facilities. *Anesthesiology.* 2016; 124(3):561-569.

This retrospective analysis examined anesthetic procedures performed from 2008 to 2014 at 45 Medecins Sans Frontieres facilities. The article reviews the essential medications and equipment provided at these facilities and evaluates the frequency of and risk factors for perioperative mortality. About half of the cases were in the fields of obstetrics, gynecology, or urology. Spinals were used for 45% of the cases. The observed mortality rate was 0.25%. Overall, the data suggest that a range of surgical procedures can be safely provided by trained providers in settings with limited resources.

8. Azad MB, Konya T, Persaud RR, et al. Impact of maternal intrapartum antibiotics, method of birth and breastfeeding on gut microbiota during the first year of life: a prospective cohort study. *BJOG: an international journal of obstetrics and gynaecology.* 2016; 123(6):983-993.
9. Editorial: Hughes BL. Antibiotic prophylaxis in pregnancy-benefit without harm? *BJOG: an international journal of obstetrics and gynaecology.* 2016; 123(6):994.

This study of 198 healthy term infants from the Canadian Healthy Infant Longitudinal Development compared the gut microbiota during the first year of life in infants from pregnancies exposed to antibiotics for either group B streptococcus prophylaxis, pre-labor rupture of membranes, or cesarean delivery. The infant microbiotas were significantly different at 3 months for all types of antibiotic exposure. They differences continued to be present at 12 months for infants exposed to antibiotics in the setting of an emergency cesarean delivery.

10. Bailey SR, Field N, Townsend CL, Rodger AJ, Brocklehurst P. Antibiotic prophylaxis for women undergoing caesarean section and infant health. *BJOG: an international journal of obstetrics and gynaecology.* 2016; 123(6):875-876.

This commentary points out that broad spectrum, prophylactic antibiotics affect the infant microbiome. Abnormal microbiota has been linked to atopic dermatitis, inflammatory bowel disease, and type 1 diabetes. The commentary notes the need for long term studies to generate the high quality evidence needed to weigh the short term benefits of antibiotics in decreasing maternal infection with the possible long term effects on infant health.

11. Bateman BT, Franklin JM, Bykov K, et al. Persistent opioid use following cesarean delivery: patterns and predictors among opioid-naïve women. *American Journal of Obstetrics and Gynecology.* 2016; 215(3):353.e351-353.e318.

Opioids are routinely prescribed following cesarean delivery. Opioid exposure for legitimate indications has been shown to be a potential trigger for chronic opioid use. This study used a cohort of 80,000 opioid naive women who received an opioid following cesarean delivery to determine the frequency with which these patients become persistent users in the year following delivery. It found that approximately 1 in 300 women became persistent users and that this behavior tended to occur in women with psychiatric comorbidity, certain pain conditions, and a history of non-opioid substance use/abuse.

12. Bell J, Towers CV, Hennessy MD, Heitzman C, Smith B, Chattin K. Detoxification from opiate drugs during pregnancy. *American Journal of Obstetrics and Gynecology.* 2016; 215(3):374.e371-376.
13. Editorial: Campbell WA. Opioid detoxification during pregnancy: the door continues to open. *American Journal of Obstetrics and Gynecology.* 2016; 215(3):258-260.

Current practice recommendations suggest avoiding opioid detoxification during pregnancy because of the concern that the acute stress associated with this may lead to preterm labor, fetal distress or fetal demise. This retrospective study reviewed records of 301 women who underwent detoxification. There were no adverse fetal outcomes associated with detoxification, but rates of relapse and subsequent neonatal abstinence syndrome were very high (31% overall and 70% in women who underwent inpatient detoxification without intense outpatient follow-up).

14. Berger JS, Gonzalez A, Hopkins A, et al. Dose-response of intrathecal morphine when administered with intravenous ketorolac for post-cesarean analgesia: a two-center, prospective, randomized, blinded trial. *International Journal of Obstetric Anesthesia.* 2016; 28:3-11.

This two-center, blinded RCT randomized 144 healthy women undergoing cesarean delivery to 50, 100, or 150 micrograms of intrathecal morphine, in addition to routine IV ketorolac. All patients had access to morphine PCAs. The primary endpoint was

morphine consumption in the 24 hours after delivery. There was no difference in morphine consumption between the three groups, nor were there differences in the secondary endpoints of VAS pain scores or nausea. Pruritus was more common in the higher dose groups at some time points.

15. Bernstein J, Hua B, Kahana M, Shaparin N, Yu S, Davila-Velazquez J. Neuraxial Anesthesia in Parturients with Low Platelet Counts. *Anesthesia and Analgesia.* 2016; 123(1):165-167.

This single center, retrospective cohort study examined the use of neuraxial anesthesia in thrombocytopenic parturients (platelet count <100,000/mm3). Of the 20,244 patients included in the cohort, 1.8% of patients were thrombocytopenic and 69% of these patients received a neuraxial anesthetic. No epidural hematomas were observed. The upper bound of the 95% CI for this analysis suggested the risk of epidural hematoma was 1.2%.

16. Booth JL, Harris LC, Eisenach JC, Pan AP. A Randomized Controlled Trial Comparing Two Multimodal Analgesic Techniques in Patients Predicted to Have Severe Pain After Cesarean Delivery. *Anesthesia and analgesia.* 2016; 122(4):1114-1119.

This RCT randomized patients undergoing elective cesarean delivery who were predicted to be above the 80th percentile for evoked pain intensity based on a 3-item preoperative screening questionnaire, to either a higher dose of intrathecal morphine (300 mcg) with scheduled acetaminophen or the usual dose of morphine (100 mcg) plus placebo tablets. In the intervention group, the mean evoked pain scores with movement based on a 100mm VAS was decreased by 15 mm (p=0.009). There were no differences in persistent pain or depression associated with the intervention.

17. Booth JM, Pan JC, Ross VH, Russell GB, Harris LC, Pan PH. Combined Spinal Epidural Technique for Labor Analgesia Does Not Delay Recognition of Epidural Catheter Failures: A Single-center Retrospective Cohort Survival Analysis. *Anesthesiology.* 2016; 125(3):516-524.

This retrospective cohort study compared the rate of epidural failure in 1440 women receiving a CSE to 955 women receiving a traditional epidural. In a multivariable model that adjusted for relevant confounders, CSEs had a failure rate that was about one-half the rate of traditional epidurals (HR 0.58, 95% CI 0.43 to 0.79). Failure with CSE was also more likely to be recognized in the first 30 minutes after placement.

18. Bor P, Ledertoug S, Boie S, Knoblauch NO, Stornes I. Continuation versus discontinuation of oxytocin infusion during the active phase of labour: a randomised controlled trial. *BJOG: an international journal of obstetrics and gynaecology.* 2016; 123(1):129-135.

This single center RCT evaluated whether the discontinuation of oxytocin infusion at 5 cm dilation in women who were either induced or augmented with oxytocin was associated with a reduction in maternal and neonatal complications. One hundred women were randomized to each arm. There was a longer duration of the active phase of labor in the discontinuation group versus the continuation group (median 125 minutes versus 85 minutes), but a significantly lower incidence of fetal heart rate abnormalities (20% vs. 51%) and uterine hyperstimulation (2% versus 12%). There was a non-significant reduction in cesarean delivery, tachysystole, postpartum hemorrhage, and pH<7 associated with discontinuation. Additional studies are needed to determine if discontinuation of oxytocin during the active phase of labor may be advantageous for some patients.

19. Briody VA, Albright CM, Has P, Hughes BL. Use of Cefazolin for Group B Streptococci Prophylaxis in Women Reporting a Penicillin Allergy Without Anaphylaxis. *Obstetrics and gynecology.* 2016; 127(3):577-583.

This single center retrospective cohort study examined the patterns of antibiotic use in group B streptococci (GBS) colonized women who reported a penicillin allergy. Guidelines recommend that women who report a penicillin allergy without a history of penicillin or cephalosporin induced anaphylaxis, angioedema, respiratory distress, or urticaria should receive cefazolin. In this cohort, only 44% received appropriate antibiotics. If the results from this single center are generalizable nationwide, this suggests a need for improved adherence to this practice guideline.

20. Brown JD, Doshi PA, Pauly NJ, Talbert JC. Rates of Neonatal Abstinence Syndrome amid Efforts to Combat the Opioid Abuse Epidemic. *JAMA pediatrics.* 2016; 170(11):1110-1112.

This research letter examined rates of neonatal abstinence syndrome using data from nationwide hospitalizations, as well as hospitalizations in Kentucky. Nationwide rates more than doubled from 2008 to 2015, from 2.8 to 7.3 per 1,000 births. The rates in Kentucky increased more than 4-fold from 2008 to 2014, from 5.0 to 21.2 per 1,000 births. NAS rates have now reached epidemic proportions, with certain areas of the country, like Appalachia, disproportionately affected.

21. Burtch R, Scott C, Zimmerman L, Patel A. Blood Loss as a Function of Body Surface Area: Redefining Parameters of Obstetric Blood Loss. *Obstetrics and gynecology.* 2016; 128(6):1274-1280.

This single center observational study examined 459 singleton deliveries over a 7 month period. The authors argue that blood loss in obstetrics should be defined as a function of the percentage of total blood loss, rather than as a single threshold volume for defining hemorrhage. They make the point that blood volume varies as a function of body surface area and show that estimated blood loss increases as body surface area quintile increases.

22. Butwick AJ, Blumenfeld YJ, Brookfield KF, Nelson LM, Weiniger CF. Racial and Ethnic Disparities in Mode of Anesthesia for Cesarean Delivery. *Anesthesia and analgesia.* 2016; 122(2):472-479.
23. Editorial: Caughey AB. Racial and Ethnic Disparities in General Anesthesia for Cesarean: What Are the Implications? *Anesthesia and analgesia.* 2016; 122(2):297-298.

Prior studies have established racial/ethnic disparities in the use of neuraxial anesthesia. This study sought to examine whether disparities were also present in the use of general anesthesia for cesarean delivery. Data were drawn from the Maternal-Fetal Medicine Units Network from 1999 to 2002. African Americans had the highest rates of GA. Even after adjusting for confounding factors, African Americans had a 70% higher risk of GA compared with whites. The adjusted risk for Hispanics was 10% higher and for "non-Hispanic others" was 20% higher.

24. Cecatti JG, Costa ML, Haddad SM, et al. Network for Surveillance of Severe Maternal Morbidity: a powerful national collaboration generating data on maternal health outcomes and care. *BJOG: an international journal of obstetrics and gynaecology.* 2016; 123(6):946-953.
25. Editorial: Knight M. Severe maternal morbidity-actions are more important than definitions. *BJOG: an international journal of obstetrics and gynaecology.* 2016; 123(6):954.

There has been increasing interest in tracking severe maternal morbidity in developed countries. This study extends that focus to hospitals in middle-income countries. In this study, 27 referral hospitals from all regions of Brazil prospectively tracked all cases of severe maternal morbidity using WHO criteria. They found that hypertension was the leading cause of maternal near miss morbidity (45%), followed by hemorrhage (41%).

26. Champaneria R, Shah L, Wilson MJ, Daniels JP. Clinical effectiveness of transversus abdominis plane (TAP) blocks for pain relief after caesarean section: a meta-analysis. *International journal of obstetric anesthesia.* 2016; 28:45-60.

This metaanalysis of available RCTs examines the clinical effectiveness of transversus abdominis plane (TAP) blocks for acute post-cesarean pain. Twenty studies were identified for inclusion. When compared to controls, TAP blocks resulted in a significant reduction

in pain scores at rest for 6 hours and a non-significant reduction at rest for 24 hours; results were similar for pain with movement. When TAP blocks were compared to intrathecal morphine, TAP blocks provided inferior pain scores at rest and with movement. In studies that examined the intrathecal morphine with and without TAP blocks, the addition of TAP blocks provided a very small but significant reduction in pain measures at 6 hours but not 24 hours.

27. Clapp MA, Little SE, Zheng J, Robinson JN. A multi-state analysis of postpartum readmissions in the United States. *American Journal of Obstetrics and Gynecology.* 2016; 215(1):113.e111-113.e110 110p.

This study used statewide administrative data from 3 states from 2004 to 2011 to evaluate patterns of postpartum readmission. The readmission rate increased from 1.7% to 2.2% during the study period. Risk factors for readmission identified included public insurance, black race, hypertensive disorders, and diabetes. Infection, hypertension, and psychiatric indications were the most common reasons for readmission.

28. Cnattingius S, Villamor E. Weight change between successive pregnancies and risks of stillbirth and infant mortality: a nationwide cohort study. *The Lancet.*387 (10018):558-565.
29. Editorial: McCowan LM, McKinlay CJ, Poston L. Interpregnancy weight gain-a modifiable cause of stillbirth? *Lancet (London, England).* 2015.

This population-based cohort in Sweden evaluated the association between weight gain between the first and second pregnancy and the risk of stillbirth and neonatal death. The cohort included 456, 711 women. Compared to women who maintained a stable weight between pregnancies, there was a 55% higher risk of stillbirth and a 29% higher risk of neonatal mortality associated with an increase in BMI of four or more units.

30. Cobb B, Cho Y, Hilton G, Ting V, Carvalho B. Active Warming Utilizing Combined IV Fluid and Forced-Air Warming Decreases Hypothermia and Improves Maternal Comfort During Cesarean Delivery: A Randomized Control Trial. *Anesthesia and analgesia.* 2016; 122(5):1490-1497.

This single-center, double-blind RCT, randomized 46 healthy women undergoing scheduled cesarean deliveries to either active warming with warmed IV fluid and a lower body forced-air warmer or warming by blankets only. The primary outcome was maternal temperature on arrival in the PACU, which was significantly higher in the active warming group (mean difference 0.4 degrees Celsius, p=0.006). The proportion of patients who were hypothermic on arrival to the PACU was lower in the active warming group (64% vs. 91%, p=0.031). There was a non-significant reduction in shivering (22% vs. 45%, p=0.11).

31. Cohn J, Moaveni D, Sznol J, Ranasinghe J. Complications of 761 short-term intrathecal macrocatheters in obstetric patients: a retrospective review of cases over a 12-year period. *International journal of obstetric anesthesia.* 2016; 25:30-36.

This retrospective review, evaluated complications associated with 761 intrathecal catheters placed either intentionally for high risk patients or following advertent intrathecal puncture. There were no cases of meningitis, epidural or spinal abscess, hematoma, arachnoiditis, or cauda equina syndrome. PDPH occurred in 41% of patients.

32. Cole NM, Carvalho JC, Erik-Soussi M, Ramachandran N, Balki M. In Vitro Comparative Effect of Carbetocin and Oxytocin in Pregnant Human Myometrium with and without Oxytocin Pretreatment. *Anesthesiology.* 2016; 124(2):378-386.

This was an in vitro study of the contractile effects of carbetocin vs. oxytocin. The investigation was conducted with myometrial samples collected from women undergoing elective cesarean deliveries. The samples were exposed to these drugs with and without pretreatment with oxytocin. Under both conditions, oxytocin produced stronger contractions than carbetocin. Oxytocin pretreatment lessened the strength of the contractions associated with treatment with both agents.

33. Costantine MM, Cleary K, Hebert MF, et al. Safety and pharmacokinetics of pravastatin used for the prevention of preeclampsia in high-risk pregnant women: a pilot randomized controlled trial. *Am J Obstet Gynecol.* 2016; 214(6):720.e721-720.e717.

Statins have been demonstrated in animal studies to reverse the endothelial dysfunction associated with preeclampsia. This pilot RCT randomized 20 pregnant women at high risk for preeclampsia between weeks 12 and 16 of pregnancy to either pravastatin or a placebo. Four women in the placebo group and none in the pravastatin group developed preeclampsia. Birth weights did not differ between the two groups. In addition, there were no perinatal deaths in either group. Maternal cholesterol was lower in the statin arm, but umbilical cholesterol concentrations were similar in each group.

34. Cuypers V, Van de Velde M, Devroe S. Intracranial subdural haematoma following neuraxial anaesthesia in the obstetric population: a literature review with analysis of 56 reported cases. *International journal of obstetric anesthesia.* 2016; 25:58-65.

This study presents the results of a systematic review of all published intracranial subdural hematomas associated with neuraxial anesthesia in obstetric patients. There were 56 case reported in the literature. Headache that was no longer postural was present in 83% of cases. Focal neurological changes were present in 69% of patients. The mortality rate for reported cases was 7%.

35. D'Alton ME, Friedman AM, Smiley RM, et al. National Partnership for Maternal Safety: Consensus Bundle on Venous Thromboembolism. *Journal of Midwifery and Women's Health.* 2016(5):649.
36. Editorial: Friedman AM, Smiley RM. Expanding Venous Thromboembolism Prophylaxis for At-Risk Obstetric Patients: Recommendations From the National Partnership Bundle. *Anesthesia and Analgesia.* 2016; 123(4):806-808.
37. Editorial: Leffert L, Landau R. Integrating the New Thromboprophylaxis Guidelines into Obstetric Anesthesia Practice. *Anesthesia and Analgesia.* 2016; 123(4):809-811.

These guidelines, issued from the National Partnership for Maternal Safety (NPMS), feature a comprehensive bundle of recommendations for the prevention and management of Venous Thromboprophylaxis in the obstetric population. The bundle generally recommends more widespread use of VTE prophylaxis than prior US guidelines. As a consequence of the bundle, far more patients will likely be anticoagulated. This will create challenges for anesthesiologists deciding whether to perform neuraxial anesthetics.

38. Davidson AJ, Disma N, de Graaff JC, et al. Neurodevelopmental outcome at 2 years of age after general anaesthesia and awake-regional anaesthesia in infancy (GAS): an international multicentre, randomised controlled trial. *Lancet (London, England).* 2016; 387(10015):239-250.
39. Editorial: Warner DO, Flick RP. Anaesthetics, infants, and neurodevelopment: case closed? *Lancet (London, England).* 2016; 387(10015):202-204.

The General Anaesthesia compared to Spinal anaesthesia (GAS) trial was established to assess whether general anesthesia in infancy impacts neurodevelopmental outcomes. This manuscript is a interim analysis of a trial which randomized 363 infants undergoing inguinal herniorrhaphy at less than 60 weeks postmenstrual age to either awake-regional or general anesthesia. The median duration of anesthesia was 54 minutes. At 2 years of age, cognitive composite scores as assessed by the Bayley Scales of Infant and Toddler development were equivalent in both groups. The primary outcome of the trial is IQ at 5 years which will be reported separately.

40. Drukker L, Hants Y, Farkash R, et al. Impact of surgeon annual volume on short-term maternal outcome in cesarean delivery. *Am J Obstet Gynecol.* 2016; 215(1):85.e81-88.

This single center study from a high-volume tertiary care center evaluated the association between the annual number of cesarean deliveries performed/supervised by an obstetrician and a variety of adverse maternal outcomes. High annual volume was defined as being above the median case volume. Low volume obstetricians (compared to high volume obstetricians) had higher rates of urinary/GI tract injury, hemoglobin drop > 3 g/dL, and prolonged maternal hospitalization.

41. Ducloy-Bouthors AS, Duhamel A, Kipnis E, et al. Postpartum haemorrhage related early increase in D-dimers is inhibited by tranexamic acid: haemostasis parameters of a randomized controlled open labelled trial. *British journal of anaesthesia.* 2016; 116(5):641-648.

This is a post-hoc secondary analysis of a multicenter RCT that evaluated the efficacy of tranexamic acid (TXA) in women with PPH following vaginal delivery. The analysis for this study included 3 groups: a hemorrhage group treated with TXA (n=72), a hemorrhage group without TXA (n=72), and a non-hemorrhage group (n=23). The study assessed parameters in blood samples collected as part of the trial. It found that the untreated hemorrhage group had higher levels of D-dimers and plasmin-antiplasmin complexes than non-hemorrhage controls, suggesting that PPH is associated with early fibrinolysis. Treatment with 4 grams of TXA blunted these increases.

42. Duryea EL, Nelson DB, Wyckoff MH, et al. The impact of ambient operating room temperature on neonatal and maternal hypothermia and associated morbidities: a randomized controlled trial. *Am J Obstet Gynecol.* 2016; 214(4):505.e501-507.

Neonatal hypothermia is associated with a range of adverse infant outcomes including hypoglycemia, metabolic acidosis, intraventricular hemorrhage, and respiratory distress. Maternal hypothermia is also associated with an increased risk for certain postoperative complications. This single center, cluster randomized RCT, adjusted the operating room temperatures weekly to either 67 degrees F or 73 degrees F (the maximum allowed according to hospital regulations). There were approximately 400 deliveries in each arm. Neonatal hypothermia was significantly less common at the higher temperature (35% vs. 50%), as was moderate-to-severe hypothermia (5% vs. 19%). Maternal temperature was also slightly higher on arrival in the PACU. Severe adverse neonatal outcomes were not different between the two groups, but power for these rare outcomes was limited.

43. Edmunds LD, Ovseiko PV, Shepperd S, et al. Why do women choose or reject careers in academic medicine? A narrative review of empirical evidence. *Lancet (London, England).* 2016.

This systematic and narrative review of studies published between 1985 and 2015 examining women's decisions on pursuing careers in academic medicine. The authors identify and reflect on a number of themes present across studies and develop approaches for academic centers to increase the participation of women.

44. Fitzpatrick KE, Tuffnell D, Kurinczuk JJ, Knight M. Incidence, risk factors, management and outcomes of amniotic-fluid embolism: a population-based cohort and nested case-control study. *BJOG: an international journal of obstetrics and gynaecology.* 2016; 123(1):100-109.

This population-based cohort and nested case-control study from the UK Obstetric Surveillance system estimated the incidence of AFE as 1.7 per 100,000 pregnancies. The

case fatality rate was 19%. Risk factors identified include age (35 years and older), multiple pregnancies, induction of labor, and placenta previa.

45. Frieden TR, Houry D. Reducing the Risks of Relief--The CDC Opioid-Prescribing Guideline. *The New England journal of medicine.* 2016; 374(16):1501-1504.

This editorial accompanied the release of the CDC opioid prescribing guidelines. Deaths from prescription opioid overdose have increased four-fold over the past decade and a half in the US. Similar increases have been observed for the prevalence of opioid use disorders. These increases parallel the rise in the quantity of opioids prescribed by clinicians. The CDC guidelines lay out 12 recommendations to inform the use of these medications including promoting the use of nonpharmacologic and non-opioid medications for the treatment of chronic pain, limiting the quantity and duration of prescriptions for acute indications, and avoiding high opioid doses and co-prescriptions of benzodiazepines. Multiple studies have shown that opioids are commonly prescribed during pregnancy, so these guidelines are likely to impact on the treatment of pain in pregnancy.

46. Frolova AI, Stout MJ, Tuuli MG, Lopez JD, Macones GA, Cahill AG. Duration of the Third Stage of Labor and Risk of Postpartum Hemorrhage. *Obstetrics and gynecology.* 2016; 127(5):951-956.

This retrospective observational study of 7,121 women, who underwent vaginal delivery after 37 weeks gestation, examines the association between the duration of the third stage of labor and postpartum hemorrhage. The risk of PPH begins to increase at 20 minutes duration. Compared to pregnancies where the duration of the 3rd stage was 0-4 minutes, durations of 20 to 24 minutes were associated with a 2-fold increase in PPH risk, 25 to 29 minutes a 2.6-fold increase, and >= 30 minutes a 5.8-fold increase in risk. The authors call for a reevaluation of the current definition for prolonged third stage of labor (which is 30 minutes).

47. Gimovsky AC, Berghella V. Randomized controlled trial of prolonged second stage: extending the time limit vs. usual guidelines. *Am J Obstet Gynecol.* 2016; 214(3):361.e361-366.

This study randomized 78 women meeting criteria for prolonged second stage of labor (3 hours with an epidural and 2 hours without) to either extended labor for at least one hour or expedited delivery via cesarean or instrumented vaginal delivery. The incidence of cesarean delivery was markedly reduced in the extended labor group (19% vs. 43%). Other measures of maternal and neonatal morbidity were similar between the two groups, but power was limited for these secondary outcomes.

48. Groden J, Gonzalez-Fiol A, Aaronson J, Sachs A, Smiley R. Catheter failure rates and time course with epidural versus combined spinal-epidural analgesia in labor. *International journal of obstetric anesthesia.* 2016; 26:4-7.

This retrospective cohort study compared the frequency of catheter failure, defined as the need to replace the catheter, in CSEs and traditional epidurals. Overall, 2.1% of CSE catheters and 3.9% of traditional epidural catheters were replaced during labor (p<0.001). Time to replacement was higher for catheters placed as part of a CSE than those placed as traditional epidurals.

49. Guglielminotti J, Deneux-Tharaux C, Wong CA, Li G. Hospital-Level Factors Associated with Anesthesia-Related Adverse Events in Cesarean Deliveries, New York State, 2009-2011. *Anesthesia and analgesia.* 2016; 122(6):1947-1956.

This study used statewide data from New York from 2009 to 2011 to define hospital level factors that are associated with anesthesia-relate adverse events in cesarean deliveries. The strongest predictor of anesthesia-relate adverse events in a multilevel model of risk factors was annual hospital cesarean delivery volume. This accounted for 15% of the between-hospital variation in the rates of these complications.

50. Gyamfi-Bannerman C, Thom EA, Blackwell SC, et al. Antenatal betamethasone for women at risk for late preterm delivery. *The New England journal of medicine.* 2016(18):1311.
51. Editorial: Crowther CA, Harding JE. Antenatal Glucocorticoids for Late Preterm Birth? *The New England journal of medicine.* 2016; 374(14):1376-1377.

Infants born late preterm are at heightened risk for respiratory complications compared to those born at term. This trial randomized women with singleton pregnancies at 34 weeks, 0 days gestation to 36 weeks, 5 days gestation at risk for delivery before 37 weeks to either 2 injections of betamethasone or placebo. The primary study endpoint was a composite of treatments for neonatal respiratory complications (CPAP, high flow nasal cannula, etc) within 72 hours after delivery. This outcome occurred in 11.6% of the betamethasone group and 14.4% of the placebo group (p=0.02). There was no significant difference in maternal or neonatal infectious complications.

52. Hanley GE, Smolina K, Mintzes B, Oberlander TF, Morgan SG. Postpartum Hemorrhage and Use of Serotonin Reuptake Inhibitor Antidepressants in Pregnancy. *Obstetrics and gynecology.* 2016; 127(3):553-561.

This population-based cohort study of approximately 300 thousand pregnancies examined the association between SSRI and SNRI exposure around the time of delivery and the risk of PPH. This association is biologically plausible as these medications may inhibit serotonin's role in platelet aggregation and/or compromise myometrial contraction that may be mediated by serotonin. After controlling for confounders, SNRIs were associated

with a 76% increase in PPH risk. SSRIs were associated with a 9 to 14% increase in the risk of PPH, but this association did not reach statistical significance in the primary analysis.

53. Heddle NM, Cook RJ, Arnold DM, et al. Effect of Short-Term vs. Long-Term Blood Storage on Mortality after Transfusion. *The New England journal of medicine.* 2016.
54. Editorial: Tobian AAR, Ness PM. Red Cells - Aging Gracefully in the Blood Bank. *The New England journal of medicine.* 2016.

Observational studies suggest that long-term storage of blood prior to transfusion may increase the risk of cardiovascular events. This pragmatic RCT at six hospitals randomized 31,497 patients who required red-cell transfusion in a 1 to 2 ratio to either a short-term storage group (mean storage duration 13 days) versus a long-term storage group (mean storage duration 23.6 days). There was no association between short- versus long-term storage and in-hospital mortality (odds ratio, 1.05, 95% CI 0.95 to 1.16).

55. Hilton G, Daniels K, Goldhaber-Fiebert SN, Lipman S, Carvalho B, Butwick A. Checklists and multidisciplinary team performance during simulated obstetric hemorrhage. *International journal of obstetric anesthesia.* 2016; 25:9-16.

This prospective observational study evaluated the use of a checklist by 14 teams participating in an obstetric hemorrhage simulation. Teams received training on the use of checklists prior to the drill. 86% of teams used the checklist. Teams rapidly activated the massive transfusion protocol and transfused packed cells. 58% of teams designated a reader and 67% completed the 15-point checklist within 20 minutes of the start of the scenario. As system-based approaches are embraced to address the maternal morbidity and mortality associated with hemorrhage, checklists promise to have an expanded role in practice. While teams generally used the checklist, the study notes areas for improvement in the way in which they are used (e.g., utilizing the entire checklist, designating a reader).

56. Howell EA, Egorova N, Balbierz A, Zeitlin J, Hebert PL. Black-white differences in severe maternal morbidity and site of care. *Am J Obstet Gynecol.* 2016; 214(1):122 e121-127.

Using data from the Nationwide Inpatient Sample from 2010 and 2011, this study examined whether "racial differences in the site of delivery contribute to black-white disparities in severe maternal morbidity." They found that severe maternal morbidity was higher in high black serving hospitals compared to low or medium black serving hospitals. Interestingly, this trend was true for both white and black patients. This suggests that the site of delivery may play an important role in racial disparities in severe maternal morbidity and highlights the need for quality improvement initiatives targeting these hospitals.

57. Howell EA, Egorova NN, Balbierz A, Zeitlin J, Hebert PL. Site of delivery contribution to black-white severe maternal morbidity disparity. *American Journal of Obstetrics and Gynecology*. 2016; 215(2):143-152.

This population based study, based on discharge and birth certificate datasets from New York City sought to examine black-white disparities in severe maternal morbidity. Black women were at a higher risk by over 2-fold for severe morbidity after adjusting for patient characteristics and comorbidities. Blacks were far less likely than whites to deliver at low morbidity hospitals. The investigators models suggest that about half of the disparity in severe morbidity is attributable to site of delivery.

58. Hu LQ, Flood P, Li Y, et al. No Pain Labor and Delivery: A Global Health Initiative's Impact on Clinical Outcomes in China. *Anesthesia and analgesia.* 2016; 122(6):1931-1938.

The nongovernmental organization "No Pain Labor & Delivery" was established on 2008 by faculty members at Northwestern with the goal of educating Chinese women and health providers about the use of labor analgesia. China has the world's highest rate of cesarean delivery and this may be due in part to infrequent use of neuraxial analgesia during labor. The organization facilitates the visit of multidisciplinary teams to hospitals in China and provides a weeklong educational program designed with the goal of supplying the knowledge necessary to establish a 24/7 obstetrical anesthesia service. Thirty one hospitals had been engaged at the time of the publication and 24 of these had established 24/7 coverage. Impact studies suggest implementation of these services is associated with higher rates of labor epidural (>50%) and a reduction in cesarean delivery, episiotomy, postpartum hemorrhage, and neonatal morbidity.

59. Huffmyer JL, Moncrief M, Tashjian JA, et al. Driving Performance of Residents after Six Consecutive Overnight Work Shifts. *Anesthesiology*. 2016; 124(6):1396-1403.

This study assessed the driving performance of 29 residents at the University of Virginia by a driving simulator after working 6 consecutive overnight shifts. The residents exhibited impaired control in each of the driving variables evaluated. Future work is needed to establish the optimal approach to scheduling residents (and other providers) to ensure the safety of both patients and providers.

60. Hunt TD, Guglielminotti J, Li G. Costs Associated with Anesthesia-Related Adverse Events during Labor and Delivery in New York State, 2010. *Anesthesia and analgesia.* 2016; 122(6):2007-2016.

This study attempts to calculate the excess hospital costs associated with anesthesia-related adverse events using statewide inpatient data from New York from 2010. The adjusted excess cost attributable to each of these complications was $1189. The excess cost per

admission for adverse anesthesia events was $5.49 which was significantly less than that of preeclampsia and hemorrhage, where the costs were $17.07 and $58.16, respectively.

61. Jagannathan DK, Arriaga AF, Elterman KG, et al. Effect of neuraxial technique after inadvertent dural puncture on obstetric outcomes and anesthetic complications. *International journal of obstetric anesthesia.* 2016; 25:23-29.

This retrospective cohort study assessed the complication of an inadvertent dural puncture in 235 patients from attempted epidural placement. 73% had an intrathecal catheter placed and 27% had the epidural catheter re-sited. The two groups did not differ in the proportion of patients who had a prolonged second stage of labor or in the frequency of cesarean delivery. Intrathecal catheters failed at a higher rate (14% vs. 2%, p=0.005).

62. Johansson MA, Mier-y-Teran-Romero L, Reefhuis J, Gilboa SM, Hills SL. Zika and the Risk of Microcephaly. *The New England journal of medicine.* 2016; 375(1):1-4.

This Perspectives piece uses epidemiological data from French Polynesia and Bahia, Brazil to demonstrate the likely causal association between first-trimester exposure to Zika virus and microcephaly.

63. Kainu JP, Halmesmaki E, Korttila KT, Sarvela PJ. Persistent Pain after Cesarean Delivery and Vaginal Delivery: A Prospective Cohort Study. *Anesthesia and analgesia.* 2016; 123(6):1535-1545.

This survey study examined the frequency of persistent pain in 1052 women who delivered vaginally and 502 women who delivered by cesarean. The prevalence of persistent pain at 1 year was 22% following cesarean versus 8% following vaginal delivery. Measures of pain immediately after delivery predicted pain at 1 year. Complications (e.g., vacuum extractions, episiotomy, etc) were not associated with persistent pain.

64. Ker K, Shakur H, Roberts I. Does tranexamic acid prevent postpartum haemorrhage? A systematic review of randomised controlled trials. *BJOG: an international journal of obstetrics and gynaecology.* 2016; 123(11):1745-1752.

This systematic review of RCTs examined the use of tranexamic acid to prevent PPH. The authors identified 26 trials that included a total of 4191 women. Most studies were single-center, small, and of poor quality. Many of the trials had serious irregularities including duplicated text from other studies and/or lack of ethics committee approval. The authors concluded that there is no reliable evidence to support the use of TXA to prevent PPH and that further trials are needed.

65. Kilpatrick SJ, Abreo A, Greene N, et al. Severe maternal morbidity in a large cohort of women with acute severe intrapartum hypertension. *American Journal of Obstetrics and Gynecology*. 2016; 215(1):91.e91-97.

The CDC has developed a definition for defining severe maternal morbidity using administrative data. The aim of this study was to validate this definition by evaluating potential cases of severe morbidity identified using the CDC algorithm by chart review. The investigators found that the CDC definition has a sensitivity of 77% and a PPV of 44%. Most false positives were women who received less than 4 units of pRBCs. The authors concluded that the CDC ICD-9 based definition is a valid measure of severe maternal morbidity.

66. Kozhimannil KB, Casey MM, Hung P, Prasad S, Moscovice IS. Location of childbirth for rural women: implications for maternal levels of care. *Am J Obstet Gynecol.* 2016; 214(5):661.e661-661.e610.

ACOG and SMFM have promoted designating levels of maternity care in order to facilitate triaging of women with high-risk conditions to centers with appropriate expertise and resources. There is concern about the challenges of implementing this in rural areas. This study uses statewide data from 9 states to describe where rural women deliver. Overall, 75% of rural women deliver at local hospitals. As expected, those with preterm delivery or complications were more likely to deliver at non-local hospitals. However, even after controlling for these conditions, rural Medicaid beneficiaries were less likely to deliver at non-local hospitals, suggesting that strategies will need to be defined to engage this population.

67. Krans EE, Patrick SW. Opioid Use Disorder in Pregnancy: Health Policy and Practice in the Midst of an Epidemic. *Obstetrics and Gynecology*. 2016; 128(1):4-10.

This paper reviews health policy issues at the intersection of the opioid epidemic and pregnancy. The authors note the need for expanded access to medication assisted treatment for pregnant women with opioid use disorders.

68. Little SE, Orav EJ, Robinson JN, Caughey AB, Jha AK. The relationship between variations in cesarean delivery and regional health care use in the United States. *Am J Obstet Gynecol.* 2016; 214(6):735.e731-738.

This study examined the association between cesarean delivery rates and measures of healthcare utilization across the United States by pooling multiple national databases including birth-certificate data from the CDC and Medicare data. Cesarean delivery rates varied markedly across communities—from 4 to 65%. These rates correlated with Medicare spending and measures of resource utilization at the end of life. Approximately 30% of the variation in cesarean rates was explained by differences in healthcare use intensity.

69. Liu X, Lynch CD, Cheng WW, Landon MB. Lowering the high rate of caesarean delivery in China: an experience from Shanghai. *BJOG: an international journal of obstetrics and gynaecology.* 2016; 123(10):1620-1628.
70. Editorial: Geirsson RT. From half to a third: a step towards reducing unnecessary caesarean sections. *BJOG: an international journal of obstetrics and gynaecology.* 2016; 123(10):1628.

In the WHO global survey in 2010, the cesarean delivery rate in China was the highest in the world—46%. In response, the Chinese government put forward initiatives to promote vaginal delivery. This study examined the impact of lowering the CD rate at the largest obstetrical hospital in Shanghai, the International Peace Maternity and Child Healthcare Hospital. The CD rate decreased from 51.5% in 2008 to 36.1%, which was largely attributable to a reduction in elective CD. The frequencies of measures of neonatal morbidity and mortality were unchanged despite this reduction.

71. Lund S, Boas IM, Bedesa T, Fekede W, Nielsen HS, Sorensen BL. Association between the Safe Delivery App and Quality of Care and Perinatal Survival in Ethiopia: A Randomized Clinical Trial. *JAMA pediatrics.* 2016; 170(8):765-771.

The investigators developed a "safe delivery app" to train providers to manage obstetrical and neonatal emergencies. This cluster-randomized clinical trial randomized 73 Ethiopian healthcare facilities in 5 rural districts to either mobile phone-based training or routine care. The intervention was associated with a non-significant reduction on perinatal mortality (14 vs. 23 deaths per 1,000). It was associated with a significant increase in skills and knowledge of providers.

72. MacDorman MF, Declercq E, Cabral H, Morton C. Recent Increases in the U.S. Maternal Mortality Rate: Disentangling Trends from Measurement Issues. *Obstetrics and gynecology.* 2016; 128(3):447-455.

In 2003, states began to implement a check box on death certificates to ascertain if the decedent was pregnant or postpartum at the time of death. However, in many states, there was a delay in the adoption of this checkbox, resulting in challenges in estimating the maternal mortality rate in the US. This study developed a methodology to perform analyses of trends in maternal mortality by taking into account state revision dates and different question formats. The estimates suggest that the maternal mortality rate (per 100,000 live births) increased 27% from 2000 to 2014, from 18.8 to 23.8.

73. Magro-Malosso ER, Saccone G, Di Tommaso M, Mele M, Berghella V. Neuraxial analgesia to increase the success rate of external cephalic version: a systematic review and meta-analysis of randomized controlled trials. *American Journal of Obstetrics and Gynecology.* 2016; 215(3):276-286.

This systematic review and metaanalysis of RCTs examined the impact of neuraxial analgesia on success rates for external cephalic version (ECV). The aggregated results from these trials show that the use of neuraxial analgesia resulted in a higher rate of successful ECV (58% vs. 43%) and vaginal delivery (54% vs. 45%). There were also significant reductions in maternal discomfort and pain. The rates of emergency cesarean delivery, nonreassuring fetal testing, and abruption did not differ between the 2 groups.

74. Main EK, Abreo A, McNulty J, et al. Measuring severe maternal morbidity: validation of potential measures. *Am J Obstet Gynecol.* 2016; 214(5):643.e641-643.e610.

This study validated the Centers for Disease Control and Prevention International Classification of Diseases, 9th revision criteria for defining severe maternal morbidity using data from 16 California hospitals. The performance characteristics of the criteria, when compared to a gold standard of severe maternal morbidity were acceptable; the sensitivity of the criteria was 0.77 and a positive predictive value was 0.44, with a C-statistic of 0.87. The most common source of misclassification was transfusion of 1 to 2 units of packed red blood cells.

75. Malin GL, Bugg GJ, Thornton J, et al. Does oral carbohydrate supplementation improve labour outcome? A systematic review and individual patient data meta-analysis. *BJOG: an international journal of obstetrics and gynaecology.* 2016; 123(4):510-517.
76. Editorial: Sutton C, Butwick AJ. Can extra carbs improve perinatal outcomes? *BJOG: an international journal of obstetrics and gynaecology.* 2016; 123(4):518.

This is a metaanalysis of RCTs examining the impact of oral carbohydrate supplementation on labor outcomes versus placebo or standard of care. Data from 4 trials were included. There was no difference associated with carbohydrate supplementation for any of the obstetrical outcomes assessed including cesarean delivery instrumented vaginal delivery, or Apgar score <7.

77. Mankowitz SKW, Gonzalez Fiol A, Smiley R. Failure to Extend Epidural Labor Analgesia for Cesarean Delivery Anesthesia: A Focused Review. *Anesthesia and Analgesia.* 2016.
78. Editorial: Bauer ME, Mhyre JM. Active Management of Labor Epidural Analgesia Is the Key to Successful Conversion of Epidural Analgesia to Cesarean Delivery Anesthesia. *Anesthesia and Analgesia.* 2016.

This excellent review discusses the risk factors for epidural failure to convert for cesarean delivery anesthesia. The article and accompanying editorial emphasize the need for the active management of epidural catheters and early recognition and replacement of poorly

functioning catheters. The article also makes recommendations for approaches to undertake when the catheter fails.

79. Martin AS, Monsour M, Kissin DM, Jamieson DJ, Callaghan WM, Boulet SL. Trends in Severe Maternal Morbidity After Assisted Reproductive Technology in the United States, 2008-2012. *Obstetrics and gynecology.* 2016; 127(1):59-66.

This retrospective cohort study used data from a large commercial insurer to examine the impact of ART on measures of severe maternal morbidity. It found that singleton ART pregnancies were at an increased risk of severe maternal morbidity compared to that of singleton non-ART pregnancies, but found no significant difference in this measure between ART and non-ART multiple gestation pregnancies.

80. McKenzie CP, Cobb B, Riley ET, Carvalho B. Programmed intermittent epidural boluses for maintenance of labor analgesia: an impact study. *International journal of obstetric anesthesia.* 2016; 26:32-38.

This single center, retrospective study evaluated the impact of a change from continuous epidural infusion (CEI) + PCEA to programmed intermittent epidural bolus (PIEB) + PCEA. The epidural mix used at the study institution was 0.0625% bupivacaine + sufentanil 0.4 mcg/mL. The CEI rate as 12 mL/hr with PCEA set at 12 mL bolus, lockout 15 minutes. The PIEB setting was a 9 mL every 45 minutes with a PCEA setting of 10 mL bolus with a 10 minute lockout period. Epidurals placed in the 2 months prior to the change (n=333) were compared with those placed in the 2 months after implementation (n=276). The proportion of women requiring clinician rescue bolus decreased from 19% to 12% (p=0.01). There was also a significant reduction in the highest VPS after epidural and before delivery (median 2, IQR 0 to 5 to median 0, IQR 0 to 4, p=0.03) and the proportion with a documented unilateral block (5.4% to 1.8%, p=0.02).

81. McKinnon B, Yang S, Kramer MS, Bushnik T, Sheppard AJ, Kaufman JS. Comparison of black-white disparities in preterm birth between Canada and the United States. *CMAJ: Canadian Medical Association journal = journal de l'Association medicale canadienne.* 2016; 188(1):E19-26.

Black women in the US have a higher risk of preterm birth compared with white women. The authors hypothesized that the black-white disparity in preterm birth might be smaller in Canada because racial and socioeconomic disparities in access to care are smaller in Canada. The investigators found that this was not the case—the adjusted relative risks for preterm birth associated with black race were similar in Canada and in the US.

82. Meara JG, Leather AJ, Hagander L, et al. Global Surgery 2030: evidence and solutions for achieving health, welfare, and economic development. *International journal of obstetric anesthesia.* 2016; 25:75-78.

This executive summary of a report from the Lancet Commission on Global Surgery highlights the large economic and human burden of untreated surgical conditions in low-income and middle-income countries. It calls for a focus on developing systems-based approaches to meeting this unmet need and for the monitoring of indicators of access to safe and affordable surgical and anesthesia care.

83. Moaddab A, Dildy GA, Brown HL, et al. Health Care Disparity and State-Specific Pregnancy-Related Mortality in the United States, 2005-2014. *Obstetrics and Gynecology.* 2016; 128(4):869-875.

There are significant interstate differences in maternal mortality in the United States. This study sought to examine factors associated with maternal mortality and define how these correlated with states' maternal mortality ratio. The investigators used data from the CDC Wonder database which contains data based on death certificates from 2005 to 2014. There was a correlation between states proportion of deliveries to non-Hispanic Black women and its maternal mortality. Other state-specific characteristics and maternal mortality included unintended pregnancy, 4 or fewer prenatal visits, cesarean delivery, and unmarried mothers. The authors conclude that racial disparities and social factors are important drivers in the observed interstate variation in maternal mortality.

84. Mogos MF, Salemi JL, Spooner KK, McFarlin BL, Salihu HM. Differences in Mortality Between Pregnant and Nonpregnant Women After Cardiopulmonary Resuscitation. *Obstetrics and gynecology.* 2016; 128(4):880-888.

Using Nationwide Inpatient Sample from 2002 to 2011, this analysis compared the mortality rate in pregnant and non-pregnant women receiving inpatient CPR. In-hospital mortality was 71% for pregnant patients and 49% for non-pregnant patients. This difference persisted after adjusting for measured confounders (adjusted odds ratio 0.46, 95% CI 0.39 to 0.56).

85. Mor O, Stavsky M, Yitshak-Sade M, et al. Early onset preeclampsia and cerebral palsy: a double hit model? *Am J Obstet Gynecol.* 2016; 214(1):105 e101-109.

This was a cohort study of 229,192 singleton pregnancies delivered at a single center, which sought to evaluate the association between preeclampsia and cerebral palsy. Preeclampsia doubled the risk of cerebral palsy. Early onset preeclampsia increased this risk approximately 8-fold. Among pregnancies complicated by preeclampsia, additional risk factors including SGA birth asphyxia, and infection further augmented this risk.

86. Morris JM, Roberts CL, Bowen JR, et al. Immediate delivery compared with expectant management after preterm pre-labour rupture of the membranes close to term (PPROMT trial): a randomised controlled trial. *Lancet (London, England).* 2015.

PPROM managed expectantly is associated with an increased risk for neonatal infection, but immediate delivery may result in the sequalae associated with prematurity. This multicenter RCT randomized1839 women with PPROM from 34 weeks and 0 days and 36 weeks 6 days gestation without signs of infection to either immediate delivery or expectant management. There was no difference in the rate of neonatal sepsis, the primary outcome, which occurred in 2% of the immediate birth and 3% of the expectant management groups. A composite measure of neonatal morbidity and mortality was also similar in the two groups. The immediate delivery group had significantly higher risk of respiratory distress, mechanical ventilation, and longer time spent in the NICU. The immediate delivery had lower risk for maternal hemorrhage, fever and postpartum antibiotics, and shorter hospital stays, but higher risk for cesarean delivery.

87. Nair M, Knight M, Kurinczuk JJ. Risk factors and newborn outcomes associated with maternal deaths in the UK from 2009 to 2013: a national case-control study. *BJOG: an international journal of obstetrics and gynaecology.* 2016; 123(10):1654-1662.
88. Editorial: Drife J. Risk factors for maternal death revisited. *BJOG: an international journal of obstetrics and gynaecology.* 2016; 123(10):1663.

This case control analysis examined risk factors for maternal death in the UK from either direct or indirect causes. There were 383 women who died and 1516 controls included in the analysis. Seven factors predicted maternal death: pre-existing medical comorbidities, anemia during pregnancy, previous pregnancy problems, inadequate prenatal care, substance misuse and unemployment. Adverse neonatal outcomes (stillbirth, NICU admission) were also increased in women who subsequently died.

89. Ngaka TC, Coetzee JF, Dyer RA. The Influence of Body Mass Index on Sensorimotor Block and Vasopressor Requirement during Spinal Anesthesia for Elective Cesarean Delivery. *Anesthesia and analgesia.* 2016; 123(6):1527-1534.

This prospective observational study of 50 parturients (25 obese and 25 non-obese) undergoing elective cesarean delivery compared the effect of obesity on vasopressor requirement and block height associated with spinal anesthesia. Patients in both groups received 10 mg of intrathecal hyperbaric bupivicaine. Block height did not differ as measured by touch at 5 or 25 minutes. As measured by temperature sensation, the median block height was 2 dermatomes in the obese patients at 25 minutes. Vasopressor requirements were equivalent, as was hand grip strength and peak flow rate. The median time to recovery of touch sensation at T10 was 20 minutes longer in the obese group.

90. Oberg AS, D'Onofrio BM, Rickert ME, et al. Association of Labor Induction With Offspring Risk of Autism Spectrum Disorders. *JAMA pediatrics.* 2016; 170(9):e160965-e160965.

Prior observational studies had suggested a potential association between the induction of labor and autism in the offspring. This study used a sibling design (comparing siblings discordant for induction status) to show that the association of induction of labor and autism is unlikely to be causal.

91. Oladapo OT, Adetoro OO, Ekele BA, et al. When getting there is not enough: a nationwide cross-sectional study of 998 maternal deaths and 1451 near-misses in public tertiary hospitals in a low-income country. *BJOG: an international journal of obstetrics and gynaecology.* 2016; 123(6):928-938.
92. Editorial: Kongnyuy EJ. We can eliminate maternal deaths in resource-poor countries. *BJOG: an international journal of obstetrics and gynaecology.* 2016; 123(6):939.

This nationwide cross-sectional study of 42 tertiary care hospitals in Nigeria, including 91 thousand live births sought to prospectively define the incidence of maternal near-miss and maternal death. The rate of near miss was 1.6% and the rate of maternal death was 1.1%. Over 90% of these cases were admitted in critical condition. Preeclampsia/eclampsia and postpartum hemorrhage were the leading causes of these outcomes. Late presentation for care, lack of insurance, and non-availability of blood products were the most commonly identified problems associated with deficiencies in care. Delay in diagnosis, delay in treatment, and poor monitoring were also common preventable deficiencies in care.

93. Ozimek JA, Eddins RM, Greene N, et al. Opportunities for improvement in care among women with severe maternal morbidity. *American Journal of Obstetrics and Gynecology.* 2016; 215(4):509.e501-506.

This study described the implementation of a standardized review process for severe maternal morbidity at Cedar-Sinai Medical Center over a 1.5 year period. EMRs were screened for potential cases by the CDC ICD 9 based definition, prolonged length of stay, ICU admission, transfusion of four or greater units of pRBCs or hospital readmission within 30 days. 2% of their approximately 16,000 deliveries screened positive. After detailed review, true severe morbidity was found to complicate 0.9% of deliveries. Of these, there was the potential for improved care in 44% of cases.

94. Palmerola KL, D'Alton ME, Brock CO, Friedman AM. A comparison of recommendations for pharmacologic thromboembolism prophylaxis after caesarean delivery from three major guidelines. *BJOG: An International Journal of Obstetrics and Gynaecology.* 2016(13):2157.

This cross-sectional study at a tertiary referral hospital (Columbia) highlights the significant difference in ACOG, RCOG, and ACCP guidelines for venous

thromboprophylaxis after cesarean delivery. For 293 post-cesarean patients included in the study, venous thromboprophylaxis would be recommended for 85% of patients under the RCOG guidelines, 1.0% under the ACOG guidelines and 34.8% under the ACCP guidelines. Additional research is needed to define best clinical practice.

95. Pourrat O, Dorey M, Ragot S, et al. High-Dose Methylprednisolone to Prevent Platelet Decline in Preeclampsia: A Randomized Controlled Trial. *Obstetrics and Gynecology.* 2016; 128(1):153-158.

This RCT examined the impact of high-dose methylprednisolone to prevent a decline in platelets in women presenting with preeclampsia and platelet counts from 50 X 10^9/L to 150 X 10^9/L. The primary outcome was the proportion of women with platelet counts of <100 X10^9/L 36 hours after the first administration of medication. The study included 36 patients who received methylprednisolone and 34 who received placebo. The groups did not differ in the proportion of patients who were thrombocytopenic at 36 hours (83% vs. 85%), nor did they differ in the proportion of patients who received neuraxial anesthesia.

96. Prin M, Guglielminotti J, Moitra V, Li G. Prophylactic Ondansetron for the Prevention of Intrathecal Fentanyl- or Sufentanil-Mediated Pruritus: A Meta-Analysis of Randomized Trials. *Anesthesia and analgesia.* 2016; 122(2):402-409.

This metaanalysis aggregated the results of RCTs examining the effect of prophylactic administration of ondansetron to prevent pruritus associated with intrathecal fentanyl or sufentanil-mediated pruritus. Six trails including a total of 555 patients were identified. Ondansetron did not result in a significant reduction in the occurrence of pruritus (RR 0.90, 95% CI 0.72 to 1.13), but there was a significant reduction in the administration of rescue medication.

97. Purwosunu Y, Sarkoen W, Arulkumaran S, Segnitz J. Control of Postpartum Hemorrhage Using Vacuum-Induced Uterine Tamponade. *Obstetrics and Gynecology.* 2016; 128(1):33-36.

This prospective, proof-of-concept investigation tested a device that creates vacuum-induced uterine tamponade in 10 women with PPH refractory to first-line therapies. The device is inserted into the uterus and is inflated at the level of the external cervical os. Negative pressure is then created through a vacuum causing the uterine cavity to collapse and self tamponade. In all 10 cases, uterine tone was quickly established and the hemorrhage controlled.

98. Quibel T, Ghout I, Goffinet F, et al. Active Management of the Third Stage of Labor with a Combination of Oxytocin and Misoprostol to Prevent Postpartum Hemorrhage: A Randomized Controlled Trial. *Obstetrics and gynecology.* 2016; 128(4):805-811.

This multicenter, double-blind RCT enrolled women in the first stage of labor with expected vaginal deliveries at term. All participants received IV oxytocin and were

randomized to either 400 mcg of misoprostol or placebo administered orally immediately after delivery. The study's primary outcome was defined as a PPH greater than 500 cc of blood loss in the 2 hours following delivery. The study was designed to have 80% power to detect a 33% decrease in the occurrence of PPH with a two-tailed p-value of 0.05%; this would require 1550 patients per arm. An interim analysis was conducted that included 1721 patients, at which point the trial was stopped due to a significantly higher risk of adverse effects in the misoprostol groups without difference in the primary outcome. PPH rate was 8.4% in the misoprostol group an 8.3% in the placebo group. Fever was the most common adverse effect and it occurred in 30.4% of the misoprostol group and 6.3% of the placebo group.

99. Rasmussen SA, Jamieson DJ, Honein MA, Petersen LR. Zika Virus and Birth Defects--Reviewing the Evidence for Causality. *The New England journal of medicine.* 2016; 374(20):1981-1987.

This special report from authors at the CDC reviews the evidence for a causal relationship between Zika exposure and birth defects using the Shepard Criteria for proof of teratogenicity and the Bradford Hill criteria. It shows that on the basis of these criteria, there is sufficient evidence to "infer a causal association."

100. Reddy UM. Screening, Prevention, and Treatment of Opioid Use Disorder During Pregnancy: Expectant Mothers Are Depending on You! *Obstetrics and Gynecology.* 2016; 128(1):1-3 3p.

This health policy review examined legislative and other systems-based initiatives aimed at addressing the opioid abuse epidemic in pregnancy. It emphasized the need to conceptualize addiction as a chronic disease and to have policies in place to facilitate medication-assisted treatment. It also noted the importance of avoiding policies that penalize pregnant women for disclosing substance use issues to providers.

101. Richards JL, Kramer MS, Deb-Rinker P, et al. Temporal Trends in Late Preterm and Early Term Birth Rates in 6 High-Income Countries in North America and Europe and Association With Clinician-Initiated Obstetric Interventions. *JAMA: Journal of the American Medical Association.* 2016; 316(4):410-419.
102. Editorial: Spong CY. Improving Birth Outcomes Key to Improving Global Health. *JAMA.* 2016; 316(4):395-396.

There have been initiatives aimed at curbing elective late-preterm and early-term birth. This study evaluated temporal trends across 6 countries—the US, Canada, Denmark, Finland, Norway and Sweden—from 2006 to the latest available year of data (ranging from 2010 to 2015, depending on the country). Late preterm birth rates decreased for the US and Norway. Early term birth rates decreased for the US, Norway, and Sweden. In the

US, the decrease in early term deliveries was associated with a decrease in obstetric interventions.

103. Saccone G, Berghella V. Antenatal corticosteroids for maturity of term or near term fetuses: systematic review and meta-analysis of randomized controlled trials. *BMJ (Clinical Research Ed).* 2016; 355:i5044-i5044.

The administration of antenatal corticosteroids for fetal lung maturation is a standard of care for women at risk of delivery within 7 days between 24 and 33 weeks gestation. The use in term or near term pregnancies is controversial. This systematic review and metaanalysis of RCTs evaluated the effectiveness of antenatal corticosteroids given at ≥34 weeks' gestation. Six trials involving 5698 singleton pregnancies were included in the analysis. Trials examining those with imminent late preterm delivery and planned cesarean delivery at greater than 37 weeks showed a reduction in multiple measures of neonatal respiratory morbidity.

104. Shekhar S, Gupta N, Kirubakaran R, Pareek P. Oral nifedipine versus intravenous labetalol for severe hypertension during pregnancy: a systematic review and meta-analysis. *BJOG: an international journal of obstetrics and gynaecology.* 2016; 123(1):40-47.

This metaanalysis aggregated RCTs comparing oral nifedipine with IV labetalol for the treatment of severe hypertension during pregnancy. Seven trials involving 363 patients were identified. Oral nifedipine resulted in a lower risk of persistent hypertension (RR 0.42, 95% CI 0.18 to 0.96), but the quality of the evidence informing this estimate was judged to be low.

105. Shields LE, Wiesner S, Klein C, Pelletreau B, Hedriana HL. Use of Maternal Early Warning Trigger tool reduces maternal morbidity. *Am J Obstet Gynecol.* 2016; 214(4):527.e521-526.

This study examined the implementation of a maternal early warning trigger tool tied to clinical management pathways at 6 hospitals and assessed the incidence of CDC-defined severe maternal morbidity in the 24 months prior to and 18 months after the intervention. 23 hospitals within the same system did not implement the system and served as controls. Significant reductions in composite morbidity measures were associated with the implementation of the tool. Individual measures of morbidity generally trended downward. These measures were either stable or increased in the control hospitals.

106. Sliwa K, Anthony J. Late maternal deaths: a neglected responsibility. *The Lancet.*387 (10033):2072-2073.

Most countries only track maternal deaths out to 42 days postpartum. This commentary drew attention to the high burden of late maternal deaths due to pregnancy-related

conditions like peripartum cardiomyopathy, pregnancy-induced worsening of chronic diseases, and psychiatric diseases. Authors offered suggestions for improving the tracking of these deaths and argued for a need to increase awareness of this issue and thereby improve care in this vulnerable period.

107. Sobhy S, Zamora J, Dharmarajah K, et al. Anaesthesia-related maternal mortality in low-income and middle-income countries: a systematic review and meta-analysis. *The Lancet Global health.* 2016; 4(5):e320-327.
108. Editorial: Mhyre JM. The critical role of obstetric anaesthesia in low-income and middle-income countries. *The Lancet Global health.* 2016; 4(5):e290-291.

This metaanalysis and systematic review evaluated anesthesia-related maternal deaths in countries that are classified as low-income and middle-income by the WHO. The authors identified 44 studies for inclusion in the analysis. The pooled estimate for deaths attributable to anesthesia was 1.2 per 1,000 women undergoing obstetrical procedures. Anesthesia related complications accounted for 2.8% of all maternal deaths and, remarkably, 13.8% of deaths after cesarean delivery. General anesthesia increased the risk of maternal death 3-fold compared to neuraxial anesthesia. Maternal death was more than twice as common when the anesthetic management was performed by non-physician anesthetists.

109. Souza JP, Betran AP, Dumont A, et al. A global reference for caesarean section rates (C-Model): a multicountry cross-sectional study. *BJOG: an international journal of obstetrics and gynaecology.* 2016; 123(3):427-436.
110. Editorial: Robson M. A global reference for CS at health facilities? Yes, but there is work to do. *BJOG: an international journal of obstetrics and gynaecology.* 2016; 123(3):437.

While there is general consensus that a cesarean delivery around 15% is a reasonable benchmark, robust approaches to generate customized benchmarks that account for differences in maternal and obstetrical characteristics are lacking. In this study, the authors derive and validate a tool, "the C-model" that provides risk-adjusted benchmarks for cesarean rates that can be used by facilities and health systems.

111. Sultan AA, West J, Grainge MJ, et al. Development and validation of risk prediction model for venous thromboembolism in postpartum women: multinational cohort study. *BMJ (Clinical research Ed).* 2016; 355:i6253.

The investigators develop a prediction model to identify women at high risk for postpartum VTE using data from the England based Clinical Practice Research Datalink. Emergency cesarean delivery, stillbirth, varicose veins, preeclampsia/eclampsia, postpartum infection, and comorbidities were the strongest risk factors identified. The model was then externally validated using data from a Swedish medical birth registry. The c-statistic for the model was 0.70 and excellent calibration. The sensitivity of the model was better than that of existing English and Swedish guidelines.

112. Sultan P, Halpern SH, Pushpanathan E, Patel S, Carvalho B. The Effect of Intrathecal Morphine Dose on Outcomes after Elective Cesarean Delivery: A Meta-Analysis. *Anesthesia and Analgesia.* 2016; 123(1):154-164.

This metaanalysis of RCTs compared the effects of high dose (>100 mcg) and low dose (50 to 100 mcg) intrathecal morphine in patients undergoing elective cesarean deliveries. . 11 articles that included a total of 480 patients were included in the study. High dose morphine was associated with a longer time to first analgesic request (mean difference 4.5 hours, p=0.0008), but also with a significantly higher incidence of nausea/vomiting and pruritus.

113. Sun EC, Darnall BD, Baker LC, Mackey S. Incidence of and Risk Factors for Chronic Opioid Use Among Opioid-Naive Patients in the Postoperative Period. *JAMA Internal Medicine.* 2016; 176(9):1286-1293.

This study evaluated the question of whether opioid-naive patients are at increased risk for chronic opioid use following surgery. The study included approximately 650 thousand patients who were followed for a year after surgery. For most surgeries, there was an increase in the risk of chronic opioid use compared to control patients. About 200,000 patients in the cohort underwent cesarean delivery. These patients were at a 28% higher risk of chronic opioid use compared to controls after adjusting for relevant confounders.

114. Sun LS, Li G, Miller TLK, et al. Association Between a Single General Anesthesia Exposure Before Age 36 Months and Neurocognitive Outcomes in Later Childhood. *JAMA.* 2016; 315(21):2312-2320.

This sibling-matched cohort study, conducted at 4 university-based US tertiary care hospitals, evaluated the effect of general anesthesia exposure in 105 sibling pairs in which one of the siblings underwent inguinal hernia surgery prior to 36 months of age. The sibling pairs were then subjected to detailed neuropsychological testing at a mean age of 10 years old. There were no significant differences in any of the cognitive domains assessed.

115. Sung Soo K, Yeyi Z, Grantz KL, et al. Obstetric and Neonatal Risks Among Obese Women Without Chronic Disease. *Obstetrics and Gynecology.* 2016; 128(1):104-112 109p.

This study assessed the association between pre-pregnancy BMI and a range of adverse pregnancy outcomes in a large cohort (N=112,309) of singleton deliveries in women without pre-existing chronic disease. Obese women were at markedly increased risk for many of the complications assessed. The novel insight that this study provides is that obese women are at heightened risk of adverse pregnancy outcomes even in the absence of pre-existing disease.

116. Tita ATN, Szychowski JM, Boggess K, et al. Adjunctive Azithromycin Prophylaxis for Cesarean Delivery. *New England Journal of Medicine.* 2016; 375(13):1231-1241.
117. Editorial: Weinstein RA, Boyer KM. Antibiotic Prophylaxis for Cesarean Delivery - When Broader Is Better. *The New England journal of medicine.* 2016; 375(13):1284-1286.

This study evaluated the addition of azithromycin to standard antibiotic prophylaxis prior to skin infection. The rationale for the addition of this agent was coverage of ureaplasma species, which are commonly associated with infection after cesarean delivery. This 14-center RCT randomized 2013 women presenting with singleton pregnancy at 24 weeks gestation or greater and were undergoing cesarean delivery during labor or after membrane rupture to either 500 mg of intravenous azithromycin or a placebo. There was a significant reduction in endometritis (3.8% vs. 6.1%), wound infection (2.4% vs. 6.6%), and serious maternal adverse events (1.5% vs. 2.9%).

The accompanying editorial pointed to several important considerations for interpreting this study. Most notably, 73% of the trial subjects had BMIs greater than 30, raising the possibility that cefazolin may have been under dosed.

118. Toledo P, Eosakul ST, Grobman WA, Feinglass J, Hasnain-Wynia R. Primary Spoken Language and Neuraxial Labor Analgesia Use Among Hispanic Medicaid Recipients. *Anesthesia and analgesia.* 2016; 122(1):204-209.

Several studies have demonstrated that Hispanic women are less likely to use neuraxial anesthesia than non-Hispanic Caucasians. The impact of primary language on this disparity had not been previously examined. This retrospective cross sectional study included 932 Hispanic Medicaid recipients. After adjusting for confounders, Spanish speaking women were 30% less likely to plan for neuraxial anesthesia and 20% less likely to receive neuraxial anesthesia.

119. Traynor AJ, Aragon M, Ghosh D, et al. Obstetric Anesthesia Workforce Survey: A 30-Year Update. *Anesthesia and analgesia.* 2016; 122(6):1939-1946.

This fourth update of the Obstetrical Anesthesia Workforce Survey was performed in 2012 (the first was performed in 1981). Hospitals were sampled based on the number of births per year (>=1500, 500 to 1499, <500) and census region and were sent electronic questionnaires by e-mail. There were a number of notable changes since 2001; in-house availability of neuraxial anesthesia increased from 80% to 86% for hospitals in the top delivery volume stratum, 20% to 41% in the second stratum, and 3% to 15% in the bottom stratum. There was a marked growth in the use of PCEA (86% in the top two strata and 75% in the bottom strata). There was also substantial increase in the independent CRNA practice in the smallest hospitals, increasing from 34% in 2001 to 68% in 2012.

120. Tuuli MG, Liu J, Stout MJ, et al. A Randomized Trial Comparing Skin Antiseptic Agents at Cesarean Delivery. *The New England journal of medicine.* 2016; 374(7):647-655.

This single center RCT compared chlorhexidine-alcohol versus iodine-alcohol for the prevention of surgical site infection after cesarean delivery and randomized 1147 patients to each arm. 4.0% in the chlorhexidine-alcohol group developed surgical site infections compared with 7.3% in the iodine-alcohol group (p=0.02). There was a trend towards lower rates of infection for both superficial and deep infections.

121. van Vliet EO, Nijman TA, Schuit E, et al. Nifedipine versus atosiban for threatened preterm birth (APOSTEL III): a multicentre, randomised controlled trial. *Lancet (London, England).* 2016.

Tocolytics are frequently administered in women presenting with preterm labor for 48 hours in order to administer corticosteroids. This RCT enrolled women presenting with threatened preterm birth between 25 and 34 weeks and randomized patients to either oral nifedipine or intravenous atosiban, an oxytocin inhibitor. The primary outcome was a composite of adverse perinatal outcomes (e.g., mortality, sepsis, brochopulmonary dysplasia, IVH, etc). Approximately 250 women were randomized to each arm. The primary outcome occurred in 14% of the nifedipine and 15% of the atosiban group.

122. Vetter C, Devore EE, Wegrzyn LR, et al. Association Between Rotating Night Shift Work and Risk of Coronary Heart Disease Among Women. *Jama.* 2016; 315(16):1726-1734.

This analysis of the large, prospectively collected Nurses' Health Studies, examined the impact of night shift work on the risk of coronary heart disease. There was a small, but significant increase in the risk of heart disease associated with night shift work. The risk was highest among nurses who had the greatest number of years spent doing night shift work. This is possibly explained by disruption of biological and social rhythms associated with performing night work.

123. Volkow ND. Opioids in pregnancy. *BMJ (Clinical research Ed).* 2016; 352:i19.

This editorial by the Director of the National Institute on Drug Abuse brought attention to the issue of the high prevalence of opioid exposure during pregnancy from both licit and illicit sources. It noted that there has been a marked increase in the number of infants affected by neonatal abstinence syndrome over the past 15 years. It also made the point that there is limited information on the effects of opioid exposure on the developing fetus, but that data from both animal and epidemiological studies raise concerns for potentially increased risk for certain congenital malformations and impaired mother/infant bonding.

124. Walker KF, Bugg GJ, Macpherson M, et al. Randomized Trial of Labor Induction in Women 35 Years of Age or Older. *The New England journal of medicine.* 2016; 374(9):813-822.

Rates of stillbirth are elevated in parturients of advanced maternal age. While induction of labor near term may reduce the risk of stillbirth, there is concern that induction may increase the risk of cesarean delivery. In this trial, 619 women who were 35 years or older were randomized to either induction during the 36th week of pregnancy or expectant management. There was no increase in the risk of cesarean delivery (32% vs. 33%). The study was not powered to examine the risk of stillbirth.

125. Global, regional, and national levels of maternal mortality, 1990-2015: a systematic analysis for the Global Burden of Disease Study 2015. *Lancet (London, England).* 2016; 388(10053):1775-1812.

This systematic analysis for the Global Burden of Disease Study examined trends in maternal mortality for 195 countries and territories. From 1990 to 2015, the was a 29% reduction in the frequency of maternal mortality. At the most recent estimate (2015) there were 275,288 maternal annually. Direct obstetric causes account for 86% of maternal death, with hemorrhage and hypertensive disorders each accounting for about a quarter of maternal death.

126. Global, regional, national, and selected subnational levels of stillbirths, neonatal, infant, and under-5 mortality, 1980-2015: a systematic analysis for the Global Burden of Disease Study 2015. *Lancet (London, England).* 2016; 388(10053):1725-1774.

This systematic analysis for the Global Burden of Disease Study examined trends in stillbirth, neonatal, infant, and under 5 mortality for 195 countries and territories using sophisticated sampling methods. The authors found that in 2015, there were 5.8 million deaths in children under 5, which was a 52% decrease since 1990. During the same interval, neonatal deaths decreased by 42% and stillbirths by 47%. The decline in under-5 deaths was largely attributable to a decline in communicable diseases. Countries in sub-Saharan Africa continue to have high rates of under-5 mortality.

Acknowledgements:
My heartfelt thanks to Stephanie Hopp and Eloise Dubois for their outstanding administrative support of this work.

Patient Blood Management
Life's Liquid Organ

Massive Transfusion Protocols: When, How, Why?

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Massive Transfusion Protocols

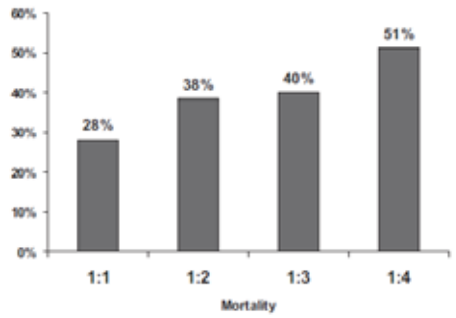
Table 1 Sample adult MTP. Modified from Table 2 in Cushing and Shaz,[1] with permission from Minerva Anestesiologica, Edizioni Minerva Medica S.p.A. RBC, red blood cell; SDP, single-donor platelets; Cryo, cryoprecipitate; rFVIIa, recombinant activated factor VII; AB, blood type AB

Study	Package 1	Package 2	Package 3	Comments
Cotton and colleagues[47]	10 RBC units 4 AB plasma units 2 SDP units	6 RBC units 4 plasma units 2 SDP units	Repeat package 2	Cryo will be given upon physician's request
Dente and colleagues[48]	6 RBC units 6 AB plasma units	6 RBC units 6 plasma units 1 SDP unit	4 RBC units 6 plasma units 10 cryo units	rFVIIa will be considered upon physician's request
O'Keeffe and colleagues[17]	5 RBC units 2 AB plasma units	5 RBC units 2 plasma units 1 SDP unit	5 RBC units 2 plasma units 10 cryo units rFVIIa	
Nunez and colleagues[19]	10 RBC units 6 AB plasma units 2 SDP units	Repeat package 1	Repeat package 1	
Boisen and colleagues[18]	6 RBC units 4 plasma units 1 SDP unit	Repeat package 1	Repeat package 1	rFVIIa will be considered after 2 rounds of blood products given

Pham & Shaz BJA 2013;111:i71

2

Fixed Ratio Transfusion



Duchesne JC et al. J Trauma 2009;67:33-9

Author, year	Study Design	F/U	Intervention	Control	Outcome
Borgman, 2007	Retrospective, cohort	NR	FFP:PRBC ratios from 1:8 and 1:2.5	FFP:PRBC ratio 1:1.4	High FFP, lower death
Cotton, 2008	Non-randomized pre- post-	30 days	TEP (PRBC:FFP:Plts 10:4:2)	No TEP less FFP, also needed > 10 units PRBC in first 24 hours	TEP reduced death
Cotton, AAST, 2008	Non-randomized pre- post-	NR	TEP (PRBC:FFP 3:2)	No TEP, less FFP	TEP reduced MOF
Gunter, 2008	Non-randomized pre- post-	30 days	PRBC:FFP 3:2 or greater	PRBC:FFP 3:2 or less	High FFP, lower death
Holcomb, 2008	Retrospective cohort	30 days	High plasma to PRBC ≥ 1:2	Low plasma to PRBC > 1:2	High FFP, lower death
Kashuk, 2008	Retrospective cohort	Death, or LOS	FFP:PRBC ratios from 1:1 to 1:4	FFP:PRBC ratio 1:5	No benefit
Moore, 2008	Prospective cohort, retrospective control	Death, or LOS	MT protocol, subgroups of early, late death, survivors	No MT	MT provides better outcomes
Scalea, 2008	Prospective, cohort	Death, or LOS	Transfusion, stratification by ratio	No transfusion	No benefit
Sperry, 2008	Prospective, cohort	Death, or LOS	PRBC:FFP <1:1.5	PRBC:FFP > 1:1.5	High FFP, lower death, higher ARDS
Dente, 2009	Prospective, cohort	30 days	MTP 1:1:1	No MTP	Reduces short term mortality but no difference at 30 days
Snyder, 2009	Retrospective ,cohort	Death, or LOS	Survivors	Non-survivors	PRBC:FFP ratio predictive of death but survival bias negated effect
Zink, 2009	Retrospective, cohort	30 days	PRBC:FFP 1:1	PRBC:FFP > 1:1	Survival better in 1:1
Teixeira, 2009	Retrospective, cohort	Death, or LOS	PRBC:FFP 1:1	PRBC:FFP in lower ratios	Survival better in 1:1

The effect of plasma transfusion on morbidity and mortality: a systematic review and meta-analysis

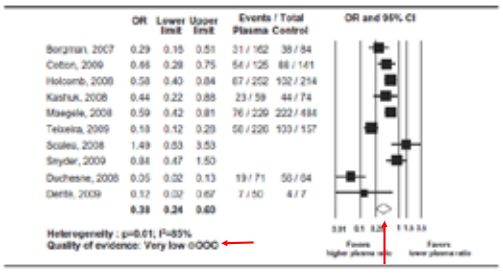


Fig. 2. Mortality in patients undergoing massive transfusion.

Murad MH et al. Transfusion 2010;50:1370

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FIGURE 1-16 An attempt at resuscitating an apparently drowned person using the modified Dutch method. One resuscitator is assisting respiration by massaging the chest. The fumigator is instilling tobacco smoke through the rectum. (*From Morch, 1985, with permission.*)

Definition of Massive Transfusion

- Transfusion of > 10 RBC units in 24 hours
- Transfusion of > 4 RBC units in 1 hour with anticipation of continued need
- Replacement of > 50% of the total blood volume within 3 hours

UPMC LIFE CHANGING MEDICINE

Does more plasma help military trauma victims?

- Retrospective study
- Based on Joint Theater Trauma Registry data
- All patients received ≥10 RBCs or WB in 24 hours
- Patients were divided into 3 groups by plasma:RBC ratio
  - A. Low: 1:8
  - B. Medium: 1:2.5
  - C. High: 1:1.4
- Primary outcome was hospital discharge or mortality

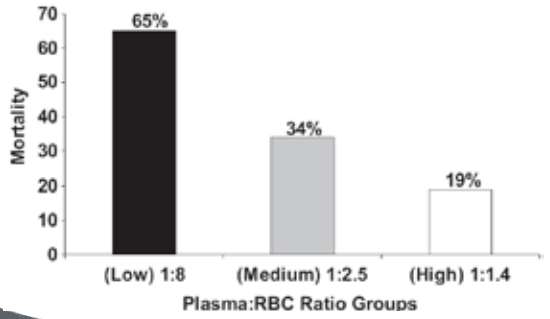
Borgman MA et al. J Trauma, 2007

The 3 groups were not particularly well matched

Variable Median (IQR)	Low Ratio Group (n = 31) 1:8 (0.12–1.5)	Medium Ratio Group (n = 53) 1:2.5 (1.3.0–1.2.3)	High Ratio Group (n = 16) 1:1.4 (1.1.7–1.1.2)
ISS[†]	18 (16–25)	17 (13–25)	18 (16–25)
ISS >25 (%)	23	21	22
AIS score (% 4 or 5)			
Head/neck	16	6	10
Face	0	0	0.6
Thorax[§]	26[#]	9[#]	7[#]
Abdomen	26	23	27
Pelvis/extremity	19	23	28
% penetrating trauma	94	92	95
% blunt trauma	6	8	5
INR, n = 212	1.78 (1.00–2.86), n = 21	1.57 (1.31–2.10), n = 42	1.54 (1.30–2.20), n = 140
Hgb,[†] n = 234	9.4 (7.1–11.1), n = 27[#]	10.8 (8.5–12.7), n = 48[#]	10.9 (9.1–13.1), n = 159[#]
Plt concentration, n = 174	225 (120–281), n = 14	177 (128–241), n = 33	218 (154–278), n = 127
Base deficit, n = 201	13 (4–14), n = 22	9 (3–14), n = 42	8 (4–13), n = 137
Temperature (°F), n = 195	97 (94.9–97.6), n = 18	96.2 (94.1–98.0), n = 45	95.9 (94.0–97.3), n = 132
Heart rate, n = 233	122 (97–146), n = 29	118 (104–133), n = 51	111 (96–128), n = 153
SBP, n = 231	90 (80–106), n = 29	98 (74–116), n = 49	97 (80–122), n = 153

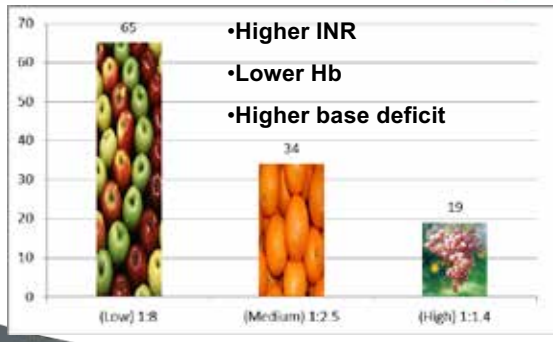
Borgman MA et al. *J Trauma*, 2007

Does more plasma really save lives?



Borgman MA et al. J Trauma, 2007

Does more plasma really save lives?



- Higher INR
- Lower Hb
- Higher base deficit

Modified from Borgman MA et al. J Trauma, 2007

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Hard to compare dose of plasma due to different survival lengths

Variable Median (IQR)	Low Ratio Group,* n = 31 1:8 (1:22–1:5)	Medium Ratio Group, n = 53 1:2.5 (1:3.0–1:2.3)	High Ratio Group, n = 162 1:1.4 (1:1.7–1:1.2)
Crystalloid (L)[15]	7.0 (2.0–9.6)[a]	8.0 (4.4–11.5)[ab]	9.6 (6.0–12.9)[b]
Crystalloid (L/h)[5]	1.8 (0.36–4.2)[a]	0.6 (0.3–1.5)[ab]	0.5 (0.4–0.7)[b]
RBC	16 (12–18)	18 (12–26)	17 (12–24)
RBC/h[5]	4 (0.5–11.8)[a]	0.9 (0.6–4.0)[ab]	0.8 (0.6–1.3)[b]
FWB	0 (0–0) [0.1]	0 (0–2) [1.1]	0 (0–4) [3.1]
FWB/h[5]	0 (0–0) [0.01][a]	0 (0–0.1) [0.15][a]	0 (0–0.2) [0.23][b]
Plasma[5]	2 (0–3)[a]	6 (4–10)[b]	12 (9–18)[c]
Plasma/h[5]	0.1 (0–0.4) [0.57][a]	0.3 (0.2–1.4) [1.1][b]	0.6 (0.4–1.0) [1.1][c]
aPLT[5]	None received*	0 (0–0) [0.4][a]	0 (0–1) [0.8][a]
aPLT/h[5]	None received*	0 (0–0) [0.02][ab]	0 (0–0) [.05][b]
Cryoprecipitate[5]	0 (0–0) [1.6][a]	0 (0–10) [6.6][b]	9 (0–10) [9.1][b]
Cryoprecipitate/h[5]	0 (0–0) [0.7][a]	0 (0–1.3) [0.9][b]	0.4 (0–0.8) [0.6][b]
rFVIIa use[5]	16%[a]	26%[ab]	38%[b]
Time to death, median	2 (1-4)	4 (2-16)	38 (4-155)
Mortality	65%	34%	19%

Borgman MA et al. J Trauma, 2007

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Hemorrhage was main cause of death in all groups

Cause of death	Low	Medium	High
Hemorrhage %[1]	92.5 [a]	78 [a]	37 [b]
Sepsis %	5	6	19
MOF %	0	11	13
Airway/Breathing %	0	6	8
CNS %	2.5	0	23
Time to death, median	2 (1-4)	4 (2-16)	38 (4-155)

Borgman MA et al. J Trauma, 2007

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Does more plasma help military trauma victims?

- Retrospective study
- Impossible to draw firm conclusions as study groups were not well matched
  - How many other confounders exist?
- Sickest patients were in the Low ratio group
  - Survivor bias!
- When was the plasma administered?
  - Survival advantage if given >2 hours after admission?
- Any transfusion reactions?

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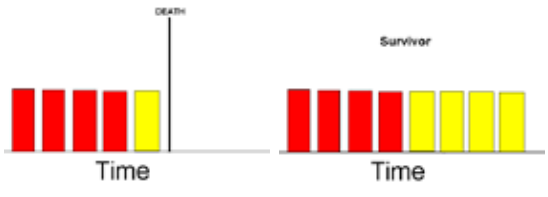
Survivor bias



The Relationship of Blood Product Ratio to Mortality: Survival Benefit or Survival Bias?

Christopher W. Snyder, MD, Jordan A. Weinberg, MD, Gerald McGwin, Jr., MS, PhD, Sherry M. Melton, MD, Richard L. George, MD, Donald A. Reiff, MD, James M. Cross, MD, Jennifer Hubbard-Brown, BS, Loring W. Rue, III, MD, and Jeffrey D. Kerby, MD, PhD

1. Patients requiring massive transfusion (> 10 units in 24 hours)
2. Trauma registry review of 134 patients
3. High ratio FFP:RBC > 1:2 or low ratio FFP:RBC<1:2

Snyder et al. J Trauma 2009;66:358-64

Table 1 Characteristics of In-Hospital Survivors and Non-Survivors (N = 134)

	Survivors (N = 67)	Non-survivors (N = 67)
Initial presentation		
Age, mean	36.8	41.6
Male, %	64.2	77.6
ISS*	28.7	38.4
Blunt injury mechanism, %	40.3	38.8
Head injury, %	20.9	22.9
Base deficit*	−9.5	−12.6
INR	1.60	1.88
Thrombocytopenia, %*	11.9	29.9
Subsequent management		
PRBC units transfused, median*	15.0	18.5
Cell saver units transfused, median	1	2
FFP units transfused, median	10	7.5
Platelet units transfused, median	2	2
Received cryoprecipitate, %*	56	33
Received factor VIIa, %	7	7
Treated operatively, %	94	88
Time from arrival to OR start, median (minutes)*	86	67

* $P < 0.05$.

Snyder et al. J Trauma 2009;66:358-64

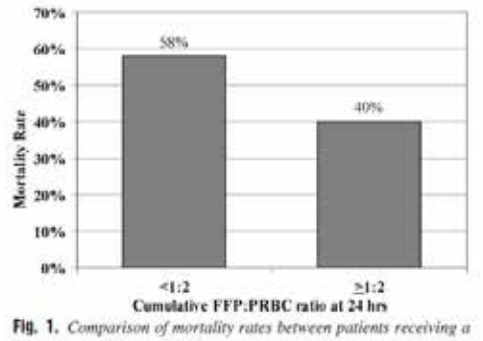


Fig. 1. *Comparison of mortality rates between patients receiving a 24-hour cumulative FFP:PRBC ratio of <1:2 versus ≥1:2.*

Snyder et al. J Trauma 2009;66:358-64

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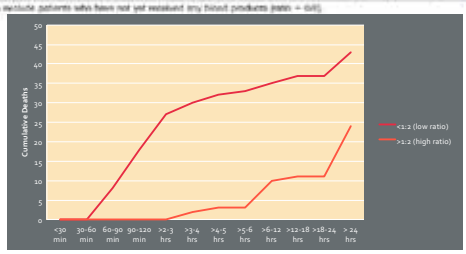
Table 2 Group Sizes* and Numbers of Deaths in Low (<1:2) and High (≥1:2) FFP:PRBC Ratio Groups by Time Interval of Hospitalization



Snyder et al. J Trauma 2009;66:358-64

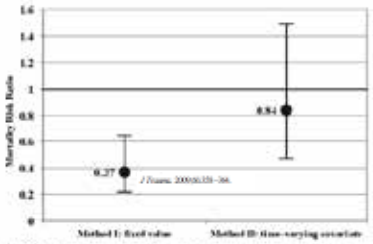


Fig. 2. *Comparison of relative risks of mortality for patients receiving a high (≥1:2) versus a low (<1:2) FFP:PRBC ratio, calculated using the fixed ratio at 24 hours (method I, RR 0.37, CI 0.22–0.64) versus the ratio as a time-varying covariate to account for survival bias (method II, RR 0.84, CI 0.47–1.50).*

Snyder et al. J Trauma 2009;66:358-64

Does more plasma help civilian trauma victims?

- Retrospective study
- 16 level 1 trauma centers
- 466 trauma patients received massive transfusion
  - Also had to survive >30 min in ED
- Survival and a variety of clinical outcomes were evaluated
- A standard MTP was not shared by these 16 centers
- High FFP/plasma:RBC and PLT:RBC ratio ≥1:2 (0.50)

  Low ratios were considered <1:2

Holcomb JB et al. Ann Surg 2008

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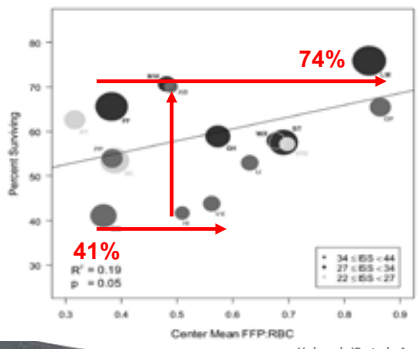
Significant inter-center variability



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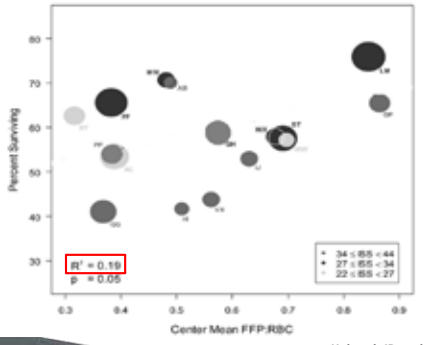
Holcomb JB et al. Ann Surg 2008

Significant inter-center variability



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Holcomb JB et al. Ann Surg 2008

Does more plasma help civilian trauma victims?

Characteristic	Total
N	466
Overall survival	59%
Age (yr)	39 ± 18
Men (%)	76
Blunt injury, (%)	65
Admission SBP (mm Hg)	107 ± 33
Heart rate (bpm)	114 ± 28
Admission base deficit	−11.7 ± 7.7
pH	7.2 ± 0.2
INR	1.6 ± 0.9
Admission temperature (°C)	36 ± 1.3
Admission GCS	9 ± 5
Injury severity score	32 ± 16

- Overall, plasma:RBC and PLT:RBC ≥1:2 were associated with improved 30 day survival

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Does more plasma help civilian trauma victims?

- Patients were stratified by amount of plasma and PLT
- No PLT count or TEG results presented

	High Plasma		Low Plasma		
	High Platelets (N = 151)	Low Platelets (n = 101)	High Platelets (n = 83)	Low Platelets (n = 131)	P
Age (yr)	36 ± 18	41 ± 18	42 ± 16	40 ± 19	0.005
Men (%)	83	74	65	74	0.06
Blunt injury (%)	69	68	71	64	0.35
Admission SBP (mm Hg)	110 ± 34	114 ± 35	101 ± 30	100 ± 31	0.005
Heart rate (bpm)	119 ± 29	114 ± 27	113 ± 26	110 ± 27	0.2
Admission base deficit (meq/L)	−12 ± 9	−10 ± 6	−11 ± 6	−13 ± 7	0.01
pH	7.2 ± 0.2	7.2 ± 0.2	7.2 ± 0.2	7.1 ± 0.2	0.35
INR	1.6 ± 0.7	1.7 ± 1	1.5 ± 1.5	1.5 ± 0.6	0.004
Admission temperature (°C)	36 ± 1	36 ± 2	36 ± 1	36 ± 2	0.09
Admission platelet count	197	208	217	211	0.46
Admission GCS	9 ± 5	8 ± 6	10 ± 6	9 ± 6	0.02
Injury severity score	30 ± 14	35 ± 16	32 ± 17	32 ± 17	0.06
Maximum head AIS	2 ± 2	2 ± 2	2 ± 2	1 ± 2	0.22
Maximum chest AIS	2 ± 2	2 ± 2	2 ± 2	2 ± 2	0.26

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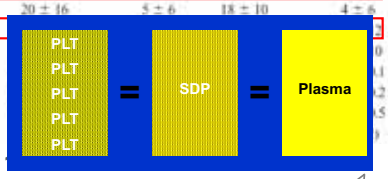
Holcomb JB et al. Ann Surg 2008

	High Plasma		Low Plasma		
	High Platelets (n = 151)	Low Platelets (n = 101)	High Platelets (n = 83)	Low Platelets (n = 131)	P
FFP (units)	17 ± 12	16 ± 10	7 ± 5	6 ± 6	<0.001
Platelets (units)	20 ± 16	5 ± 6	18 ± 10	4 ± 6	<0.001
RBC (units)	22 ± 17	21 ± 12	21 ± 11	21 ± 12	0.91
Crystalloid (L)	14 ± 10	13 ± 7	17 ± 12	11 ± 10	<0.001
FFP:RBC ratio	0.8 ± 0.3	0.8 ± 0.3	0.3 ± 0.1	0.2 ± 0.1	<0.001
Platelet:RBC ratio	0.9 ± 0.5	0.2 ± 0.2	0.9 ± 0.5	0.2 ± 0.2	<0.001
Crystalloid:RBC ratio	0.6 ± 0.3	0.6 ± 0.3	0.8 ± 0.4	0.5 ± 0.3	<0.001
Received rFVIIa (%)	3	3	6	1	0.006



1:2

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PLTs contain plasma, too

	High Plasma		Low Plasma		
	High Platelets (n = 151)	Low Platelets (n = 101)	High Platelets (n = 83)	Low Platelets (n = 131)	P
FFP (units)	17 ± 12	16 ± 10	7 ± 5	6 ± 6	<0.001
Platelets (units)	20 ± 16	5 ± 6	18 ± 10	4 ± 6	<0.001
RBC (units)	22 ± 17	21 ± 12	21 ± 11	21 ± 12	0.91
Crystalloid (L)	14 ± 10	13 ± 7	17 ± 12	11 ± 10	<0.001
FFP:RBC ratio	0.8 ± 0.3	0.8 ± 0.3	0.3 ± 0.1	0.2 ± 0.1	<0.001
Median time to death	35	18	6	4	
Rate of FFP /hr	0.49	0.89	1.17	1.5	
Rate of RBC /hr	0.63	1.17	3.5	5.25	

Holcomb JB et al. Ann Surg 2008

FFP is ineffective for correcting minimally elevated INR

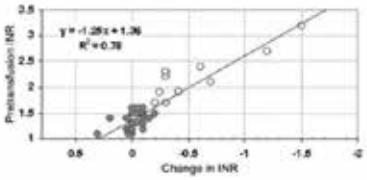


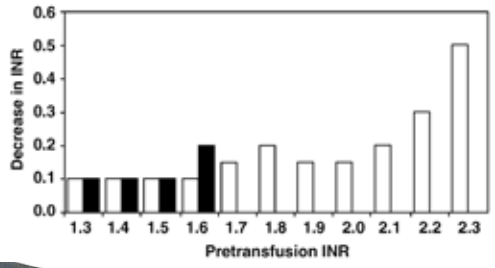
Fig. 1. Changes in recipients' INRs after transfusions of FFP that were within guidelines (INR, Lit; □ n = 10 units) compared to transfusions of FFP outside guidelines (● n = 68 units). Only 20 filled circles appear in the figure because 48 additional results were overlapping.

Holland LL et al. Transfusion 2005;45:1234

Diminishing returns with low INR

Adult patients transfused with mean of either 800 mL or 650 mL

- **Trauma, OR, DIC, and patients given PCC excluded**



Holland & Brooks Am J Clin Pathol 2006;126:133-139

FFP is ineffective for correcting minimally elevated INR

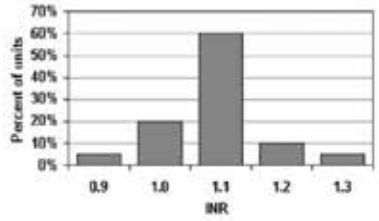
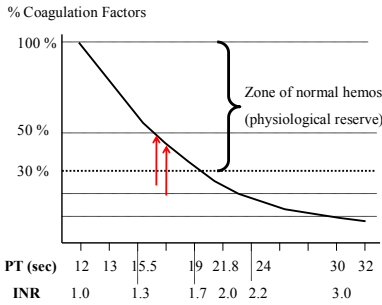
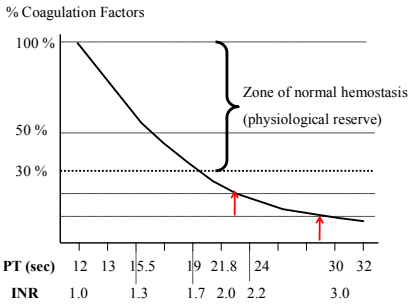


Fig. 2. Mean INR of aliquots of single-donor FFP (n = 20 units).

Holland LL et al. Transfusion 2005;45:1234





Another study of civilian trauma

- Retrospective, multi-centric study
- Patients accrued in study of proteomics and genomics of trauma
- Patients who received ≥8 RBCs in12 hours analyzed
- High FFP:RBC group: >1:1.5 (0.67) (n=102)
- Low group <1:1.5 (n=313)

Sperry JL et al. J Trauma 2008

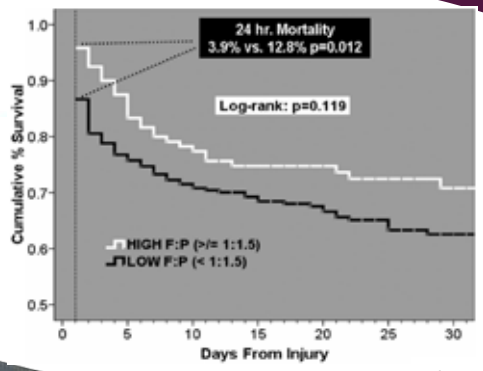
35

When did the patients die?

	High F:P (n = 102) 1:1	Low F:P (n = 313) 1:3	p
12 h Postinjury			
Blood (unit)	14.3 ± 7	20.5 ± 15	0.001*
Fresh frozen plasma (unit)	14.0 ± 7	6.8 ± 7	0.001*
Crystalloid (L)	15.5 ± 7	15.3 ± 8	0.798
Platelet (unit)	1.4 ± 1	1.3 ± 2	0.744
Cryoprecipitate (unit)	3.2 ± 4	2.0 ± 4	0.006*
24 h Postinjury			
Blood (unit)	16.0 ± 9	22.0 ± 17	0.001*
Fresh frozen plasma (unit)	15.2 ± 9	7.6 ± 9	0.001*
Crystalloid (L)	18.8 ± 9	18.7 ± 11	0.892
Platelet (unit)	1.8 ± 2	1.6 ± 2	0.525
Cryoprecipitate (unit)	3.3 ± 4	2.3 ± 4	0.030*

Sperry JL et al. J Trauma 2008

Improved survival at 12 hours in High group



Sperry JL et al. J Trauma 2008

- Causes/times of death?

Increased rates of ARDS

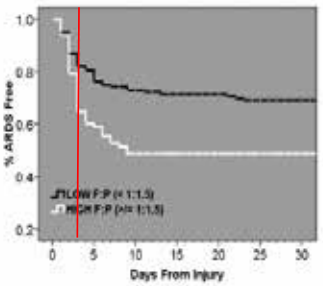


Fig. 6. *Kaplan-Meier time to event analysis for the development of ARDS for high F:P and low F:P transfusion ratios.*

Sperry JL et al. J Trauma 2008

38

Plasma use in non-massive trauma patients

- Trauma patients not massively transfused (< 10 u PRBC.
- 1716 patient received non-massive transfusion

Inaba et al. J Am Coll Surg 2010;210:957-65

UPMC LIFE CHANGING MEDICINE

Plasma use in non-massive trauma patients

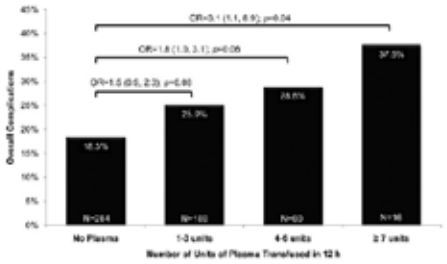


Figure 2. Overall complication rates stratified by the number of units of plasma transfused in 12 hours. OR, odds ratio (95% confidence interval); p-values were derived from McNemar's chi-square test.

Inaba et al. J Am Coll Surg 2010;210:957-65

Effect of Blood Products Transfusion on the Development of Postinjury Multiple Organ Failure

Jeffrey L. Johnson, MD; Ernest E. Moore, MD; Jeffry B. Kashuk, MD; Anirban Banerjee, PhD; C. Clay Cothren, MD; Walter L. Biffl, MD; Angela Sauaia, MD, PhD

- 1440 critically injured patients
- Organ dysfunction defined by the Denver MOF score

Johnson, J L, et al Arch Surg, 2010;145:973-77

FFP: Cause for Concern?

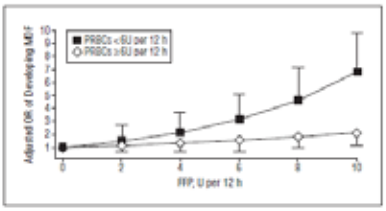


Figure. Odds ratio (OR) of developing postinjury multiple organ failure (MOF) associated with fresh frozen plasma (FFP) and packed red blood cell (PRBC) transfusion, adjusted for age, Injury Severity Score, and transfusion of platelets.

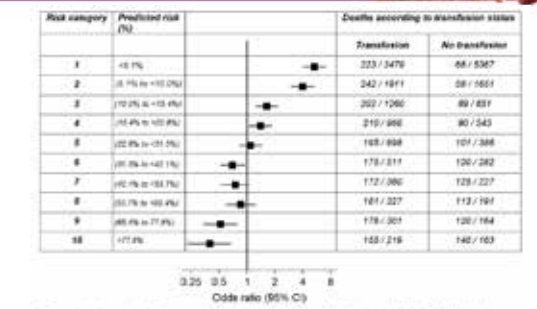
Johnson, J L, et al Arch Surg, 2010;145:973-77

FFP: Cause for Concern?

- "FFP transfusion is an independent risk factor for the development of MOF"
- "1:1 approaches are predicated on the concept of early postinjury coagulopathy rather than synergistic effects of tissue injury and shock which lead to activation of protein C and increased tPA"
- "Untimely infusion of FFP may augment the early coagulopathy of trauma"

Johnson, J L, et al Arch Surg, 2010;145:973-77

Red Cell Transfusion and mortality in Trauma Patients

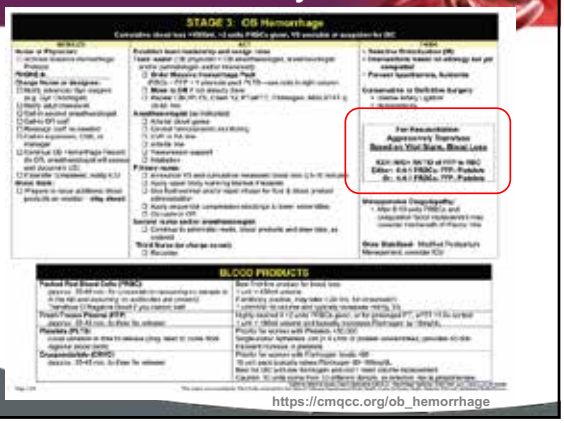


Risk categories created with approximately an equal number of deaths in each of the 10 categories

Conclusions: The association of transfusion with all-cause mortality appears to vary according to the predicted risk of death. Transfusion may reduce mortality in patients at high risk of death but increase mortality in those at low risk. The effect of transfusion in low-risk patients should be further tested in a randomized trial.

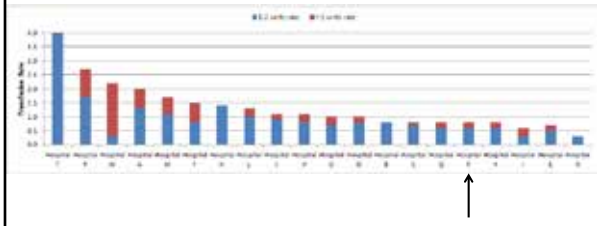
Perel P, et al. PLoS Med 2014

California Maternal Quality Care Collaborative

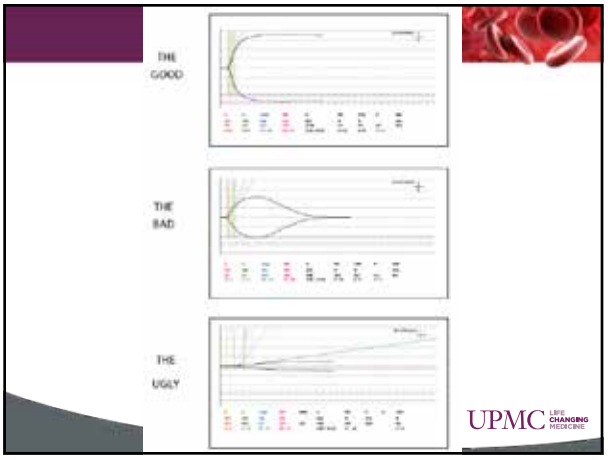


https://cmqcc.org/ob_hemorrhage

PA OB Quality Care Collaborative



18 months: 99 patients that received "1-2 units", 28 patients that received ">2 units" and 16,768 deliveries for an overall rate of 0.8%. None received > 10 units.

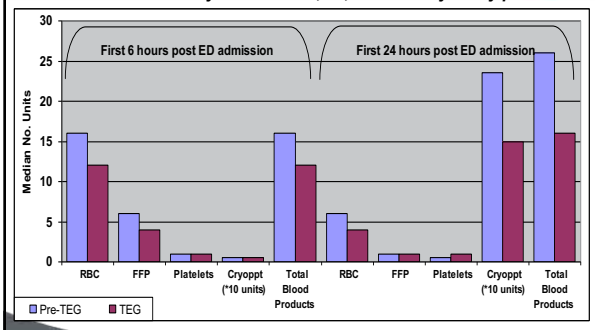


GOAL DIRECTED THERAPY via r-TEG at Denver Health Medical Center

Courtesy of Jeffry Kashuk MD

Pre-TEG vs. TEG Crystalloid and blood products (n=68)

- *No difference in crystalloids at 6, 12, 24 hours by study phase*



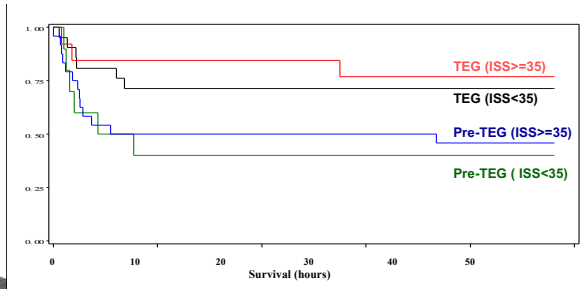
- *Consistent decrease in blood product use during the TEG phase*

* Wilcoxon non-parametric Test

Courtesy of Jeffry Kashuk MD

Pre-TEG vs. TEG: Causes of Death and Survival (n=68)

	Coagulopathy	Exsanguination	MOF and others
Pre-TEG	35%	55%	10%
TEG	10%	70%	20%



Improved survival in early phases favoring TEG (all ISS categories)

TEG-guided resuscitation is superior to standardized MTP resuscitation in massively transfused penetrating trauma patients

Nicole M. Tapia, MD, Alex Chang, MD, Michael Norman, MD, Francis Welsh, MD, Bradford Scott, MD, Matthew J. Wall, Jr., MD, Kenneth L. Mattox, MD, *and* James Sullburk, MD, *Houston, Texas*

TABLE 4. Mortality Rate

Pre-MTP (TEG guided) 165 pts; MTP (1:1:1) 124 pts

CMAJ RESEARCH

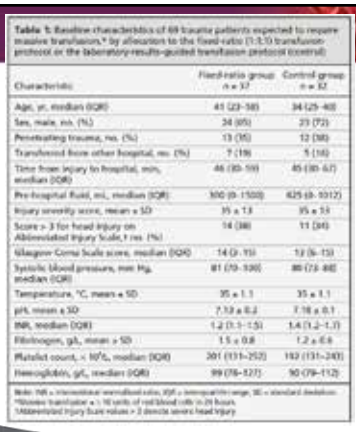
Effect of a fixed-ratio (1:1:1) transfusion protocol versus laboratory-results–guided transfusion in patients with severe trauma: a randomized feasibility trial

Bartolomeu Nascimento MD MSc, Jeannie Callum MD, Homer Tien MD MSc, Gordon Rubenfeld MD MSc, Ruxandra Pinto PhD, Yulia Lin MD, Sandro Rizoli MD PhD

1. Randomized Control Trial
1. Fixed ratio group (1:1:1)
2. Control Group (Blood work Q2 hours)

CMAJ 2013;185:E583

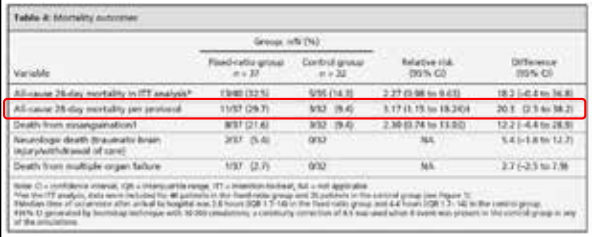
52



CMAJ 2013;185:E583

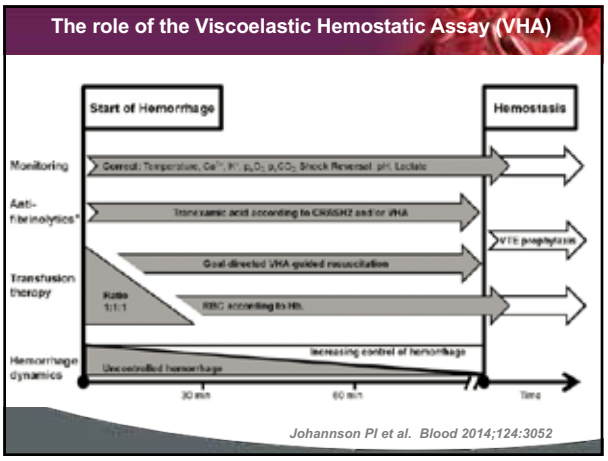
53

All cause mortality higher in fixed ratio group



CMAJ 2013;185:E583

54


The role of the Viscoelastic Hemostatic Assay (VHA)
Start of Hemorrhage
Hemostasis
Monitoring
Anti-fibrinolytics*
Transfusion therapy
Ratio 1:1:1
Hemorrhage dynamics
Increasing control of hemorrhage
Uncontrolled hemorrhage
30 min
60 min
Time
Johannson PI et al. Blood 2014;124:3052

Duke Anesthesiology

Enhanced Recovery after Cesarean Delivery Panel: Management of PONV

Ashraf S Habib, MBBCh, MSc, MHSc, FRCA
Professor of Anesthesiology
Professor in Obstetrics and Gynecology
Chief, Division of Women's Anesthesia

Patient Preferences for Anesthesia Outcomes Associated with Cesarean Delivery

Brendan Carvalho, MBBCh, FRCA*, Sheila E. Cohen, MB, ChB, FRCA*, Steven S. Lipman, MD†, Andrea Fuller, MD†, Anbu D. Mathusamy, MD†, and Alex Macario, MD†

Outcome	Rank	Relative Value
Pain During Cesarean	8.4 ± 2.2	27 ± 18
Pain After Cesarean	8.3 ± 1.8	18 ± 10
Vomiting	7.8 ± 1.5	12 ± 7
Nausea	6.8 ± 1.7	11± 7
Cramping	6.0 ± 1.9	10 ± 8
Itching	5.6 ± 2.1	9 ± 8
Shivering	4.6 ± 1.7	6 ± 6
Anxiety	4.1 ± 1.9	5 ± 4
Somnolence	2.9 ± 1.4	3 ± 3

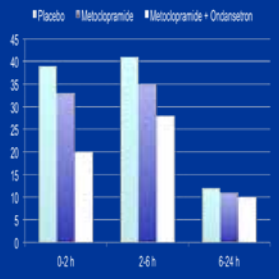
Carvalho B. Anesth Analg 2005; 101 (4): 1182-7

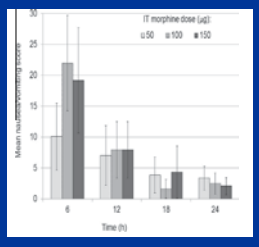
Objectives

- Incidence of PONV
- Risk factors for PONV/Risk scores
- Prophylactic strategies

INCIDENCE OF PONV

Incidence of PONV





Habib AS. Obstet Gynecol 2013; 101: 615-23
Berger JS. Int J Obstet Anesth 2016; 28: 3-11

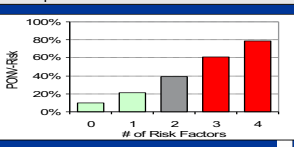
Objectives

- Incidence of PONV
- Risk factors for PONV/Risk scores
- Prophylactic strategies

PONV Risk Factors

Patient Factors	Anesthesia Factors	Surgical Factors
Female Gender	GA	Type of surgery
Non-smoker	Inhaled agents	
History of PONV	N_2O	
History of motion sickness	Duration of anesthesia	
Young age	Postoperative opioids	

Risk Factors	Points
Female Gender	1
Non-Smoker	1
History of PONV	1
Postoperative Opioids	1
Sum =	0 ... 4

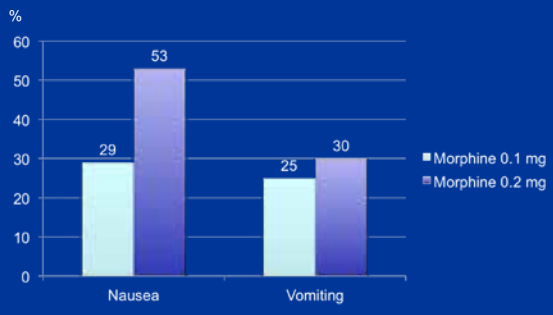


Gan TJ. Anesth Analg 2014; 118: 85-113
Apfel CC. Anesthesiology 1999; 91:693-700

Risk Factors for PONV after CD

- Neuraxial morphine
- Intraoperative Nausea and Vomiting (IONV)
- Early Feeding

ITM Dose and PONV



Dahl JB. Anesthesiology 1999; 91: 1919-27

ITM Dose and PONV

Table 4. Summary of Maternal Secondary Outcomes

Outcomes	No. studies	No. patients (low dose, high dose)	MD/OR	MD/OR (95% CI)	P	I^2	NNT/NNH
Pain scores at 12 h	2	74, 72	MD	2.54 (−2.55 to 7.63)	0.33	0	NA
Pain scores at 24 h	1	18, 19	MD	1.00 (−2.50 to 4.50)	0.58	NA	NA
Pruritus	8	228, 192	OR	0.34 (0.20 to 0.59)	0.0001	0	5.9
Severe pruritus	5	156, 131	OR	0.32 (0.16 to 0.61)	0.0006	0	7.0
Vomiting	7	180, 138	OR	0.38 (0.19 to 0.75)	0.005	0.03	7.7
Nausea or vomiting	7	196, 174	OR	0.44 (0.27 to 0.73)	0.002	0	8.3
Antiemetics	2	79, 75	OR	0.69 (0.32 to 1.45)	0.33	0	NA

CI = confidence interval; MD = weighted mean difference; NA = not applicable; NNH = numbers needed to harm; NNT = numbers needed to treat; OR = odds ratio.

Sultan P. Anesth Analg 2016; 123: 154-64

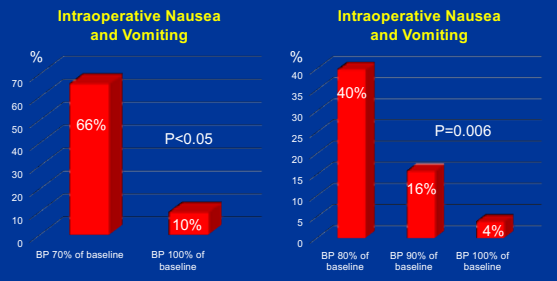
Risk Factors for PONV after CD

- Neuraxial morphine
- Intraoperative Nausea and Vomiting (IONV)
- Early Feeding

IONV

- Anesthetic related factors
- Surgical factors

Hypotension



Datta S. Anesthesiology 1982; 56: 68-70
Ngan Kee W. Br J Anaesth 2004; 92: 469-74

Vasopressors

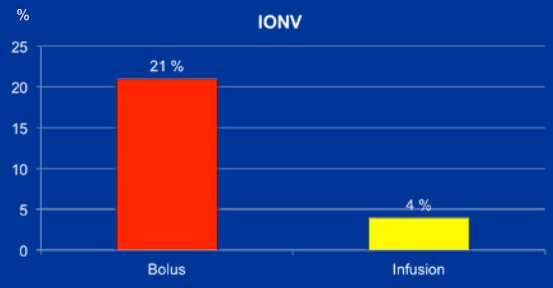
- Phenylephrine vs. Ephedrine
- Prophylaxis vs. Treatment

IONV with Ephedrine vs. Phenylephrine

Study	Method	Ephedrine	Phenylephrine
Ngan Kee 2008	Bolus	13 %	0 %
Prakash 2010	Bolus	13 %	4 %
Ngan Kee 2009	Infusion	35 %	2 %
Ngan Kee 2008	Infusion	40 %	0 %
Cooper 2002	Infusion	66 %	17 %

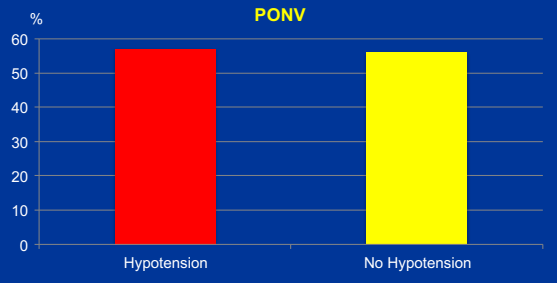
Ngan Kee WD. Anaesthesia 2008; 63: 1319-26
Prakash. Int J Obstet Anesth 2010; 19: 24-30
Ngan Kee WD. Anesthesiology 2009; 111: 506-12
Ngan Kee WD. Anesth Analg 2008; 107: 1295-302
Cooper D. Anesthesiology 2002; 97: 1582-90

IONV with PE infusion vs. bolus



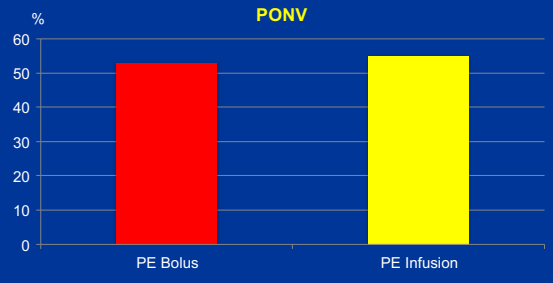
Ngan Kee W. Anesth Analg 2004; 98: 815-21

Intraoperative hypotension and PONV



Habib AS. SOAP Meeting 2015: T06

Phenylephrine Administration Method and PONV



Habib AS. SOAP Meeting 2015: T06

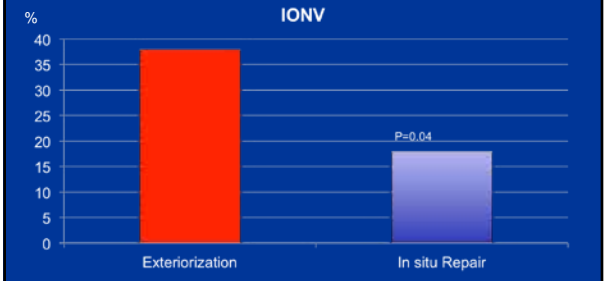
IONV

- Anesthetic related factors
- **Surgical factors**

Complications of Exteriorized Compared With In Situ Uterine Repair at Cesarean Delivery Under Spinal Anesthesia

A Randomized Controlled Trial

Mughisa Siddiqui, MD, Eric Goldszmidt, MD, Shafiqh Fallah, PhD, John Kingdom, MD, Rory Windrim, MD, and Jose C. A. Carvalho, MD, PhD



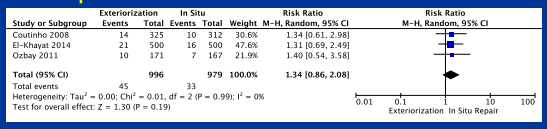
Siddiqui M. Obstet Gynecol 2007; 110: 570-5

Uterine exteriorization compared with *in situ* repair for Cesarean delivery: a systematic review and meta-analysis

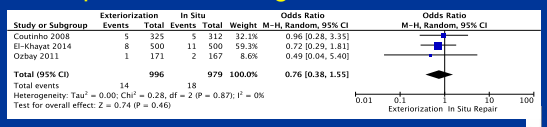
Extériorisation de l'utérus *vs.* réparation *in situ* lors de césarienne: revue systématique et méta-analyse

Valerie Zaphiratos, MD · Ronald B. George, MD · J. Colin Boyd, MSc · Ashraf S. Habib, MBChB

Postoperative Nausea

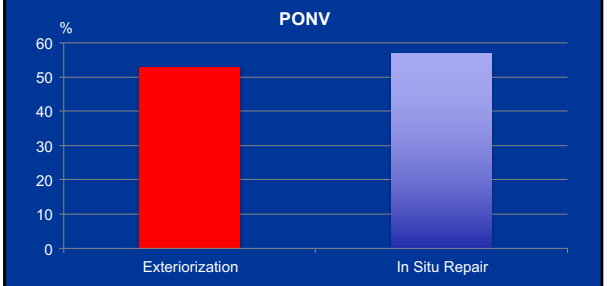


Postoperative Vomiting



Zaphiratos V. Can J Anesth 2015; 62:1209-20

Exteriorization and PONV



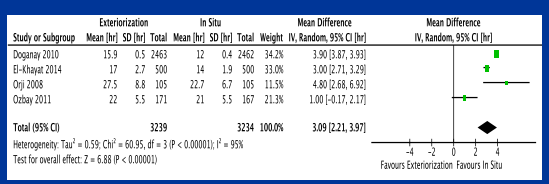
Habib AS. SOAP Meeting 2015: T06

Uterine exteriorization compared with *in situ* repair for Cesarean delivery: a systematic review and meta-analysis

Extériorisation de l'utérus *vs.* réparation *in situ* lors de césarienne: revue systématique et méta-analyse

Valerie Zaphiratos, MD · Ronald B. George, MD · J. Colin Boyd, MSc · Ashraf S. Habib, MBChB

Return of bowel function

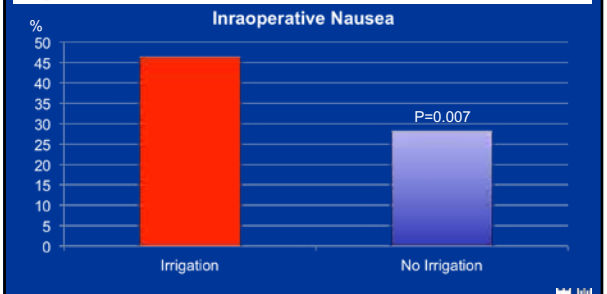


Zaphiratos V. Can J Anesth 2015; 62:1209-20

Intra-abdominal Irrigation at Cesarean Delivery

A Randomized Controlled Trial

Reagan Viney, MD, Christine Haas, MD, and David Chelmow, MD

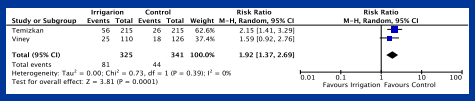


Viney R. Obstet Gynecol 2012; 119: 1106-11

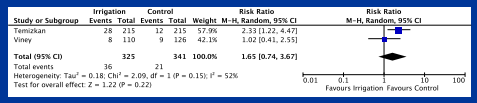
Intra-abdominal saline irrigation at cesarean section: a systematic review and meta-analysis

Ahizechukwu Chigoziem Eke[1], Ghadear Hussein Shukr[2], Tina Taissir Chaalan[2], Sereen Khaled Nashif[2], and George Uchenna Eleje[3]

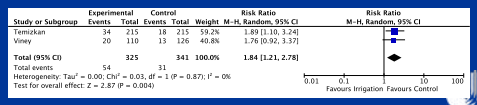
Postoperative Nausea



Postoperative Vomiting



Need for Rescue Antiemetics



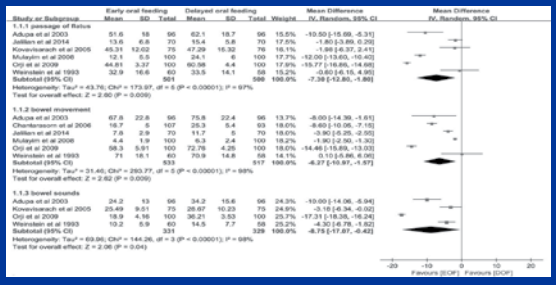
Eke AC. J Matern Fetal Neonatal Med 2016;29:1588-94

Risk Factors for PONV after CD

- Neuraxial morphine
- Intraoperative Nausea and Vomiting (IONV)
- Early Feeding

Early oral feeding compared with delayed oral feeding after cesarean section: a meta-analysis

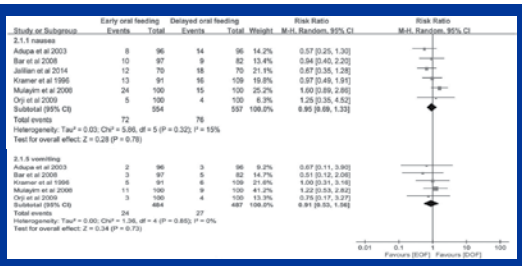
Huaping Huang, Haiyan Wang & Mei He



Huang H. J Matern Fetal Neonatal Med 2016; 29: 423-9

Early oral feeding compared with delayed oral feeding after cesarean section: a meta-analysis

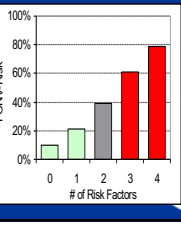
Huaping Huang, Haiyan Wang & Mei He



Huang H. J Matern Fetal Neonatal Med 2016; 29: 423-9

RISK SCORES

Risk Factors	Points
Female Gender	1
Non-Smoker	1
History of PONV	1
Postoperative Opioids	1
Sum =	0 ... 4



Risk Factors for PONV following CD

Post hoc analysis of data from 2 RCTs with IONV/PONV as primary outcomes

n=460, PONV= 54.4 %

Apfel Risk Factors	Additional Risk Factors
History of PONV or motion sickness	History of morning sickness
Non-smoking status	History of hyperemesis gravidarum
Female gender	Preoperative nausea
Postoperative opioids	IONV/ Need for rescue antiemetics
	Exteriorization of the uterus
	Intraoperative Hypotension

Risk Factors for PONV following CD

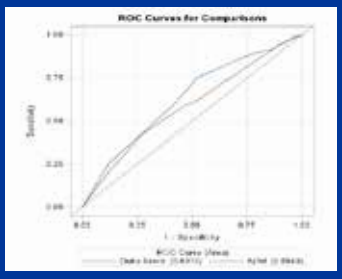
Risk Factors	OR (95 % CI)
History of PONV after previous CD	1.7 (1.0, 2.8)
Never smoked	2.0 (1.1, 3.8)

n= 460
PONV=54.4%

Factors Not Associated with Increased Risk
History of PONV after other surgeries
History of motion sickness
History of morning sickness (p=0.08)
Preoperative nausea
IONV/ Intraoperative rescue
Exteriorization of the uterus
Intraoperative hypotension/ Use of PE infusion

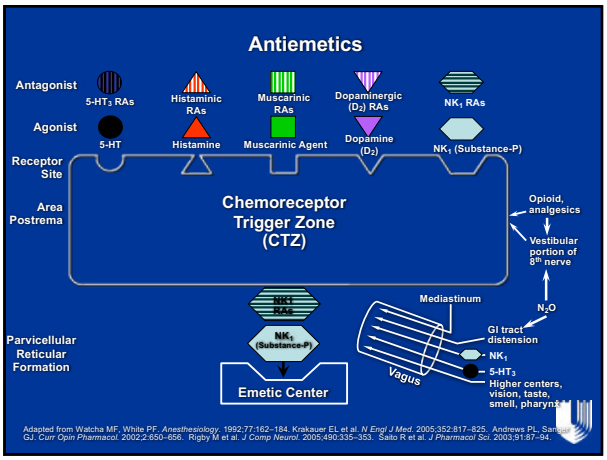
Habib AS. SOAP Meeting 2015: T06

Apfel score vs. Duke score



Duke score:
1 point: history of PONV after CD or history of morning sickness
1 point: Non-smoker during pregnancy
1 point: never smoked

ANTIEMETICS



Adapted from Watcha MF, White PF. *Anesthesiology*. 1992;77:162–184. Krakauer EL et al. *N Engl J Med*. 2005;352:817–825. Andrews PL, Sanger GJ. *Curr Opin Pharmacol*. 2002;2:650–656. Rigby M et al. *J Comp Neurol*. 2005;490:335–353. Saito R et al. *J Pharmacol Sci*. 2003;91:87–94.

Interventions for preventing nausea and vomiting in women undergoing regional anaesthesia for caesarean section (Review)

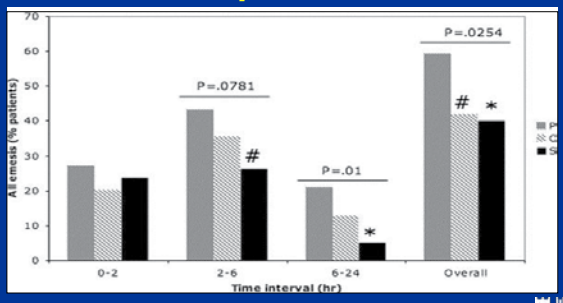
Griffiths JD, Gyte GML, Paranjothy S, Brown HC, Broughton HK, Thomas J

Effective Interventions

Intervention (n studies)	Postoperative Nausea RR (95 % CI) (n patients)	Postoperative Vomiting RR (95 % CI) (n patients)
$5HT_3$RAs (5)	0.40 (0.25, 0.64) (405)	0.50 (0.32, 0.77) (565)
Dopamine Antagonists (6)	0.60 (0.40, 0.91) (412)	0.57 (0.36, 0.91) (472)
Antihistamines (3)	0.38 (0.26, 0.59) (365)	0.50 (0.30, 0.86) (184)
Anticholinergics (1)		0.55 (0.41, 0.74) (161)

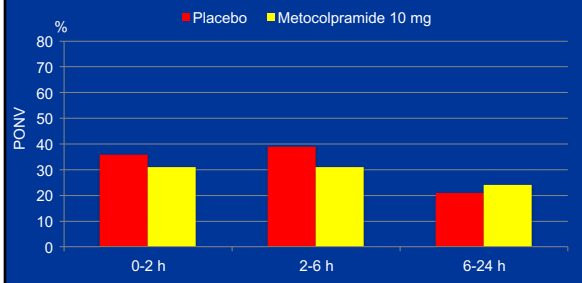
Griffiths JD. Cochrane Database Syst Rev. 2012 Sep 12;(9):CD007579

Prophylaxis against PONV Scopolamine



Harnett M. Anesth Analg 2007; 105: 764-9

Prophylaxis against PONV Metoclopramide



Intrathecal Morphine 0.15 mg
n=100/group

Habib AS. Obstet Gynecol 2013; 101: 615-23

Interventions for preventing nausea and vomiting in women undergoing regional anaesthesia for caesarean section (Review)

Griffiths JD, Gyte GML, Paranjothy S, Brown HC, Broughton HK, Thomas J

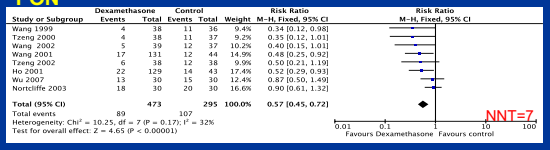
Ineffective Interventions

Intervention (n studies)	Postoperative Nausea RR (95 % CI) (n patients)	Postoperative Vomiting RR (95 % CI) (n patients)
Dexamethasone (3)	0.75 (0.52, 1.07) (235)	0.78 (0.54, 1.12) (295)
Nalbuphine (1)	0.75 (0.39, 1.45) (120)	1.25 (0.35, 4.43) (120)
Supplemental Oxygen (1)	0.65 (0.31, 1.36) (89)	
P6 Stimulation (3)	0.83 (0.68, 1) (429)	0.69 (0.45, 1.06) (429)

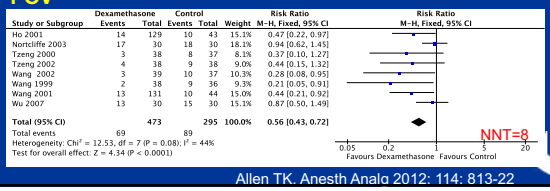
Griffiths JD. Cochrane Database Syst Rev. 2012 Sep 12;(9):CD007579

Prophylaxis against PONV Dexamethasone

PON

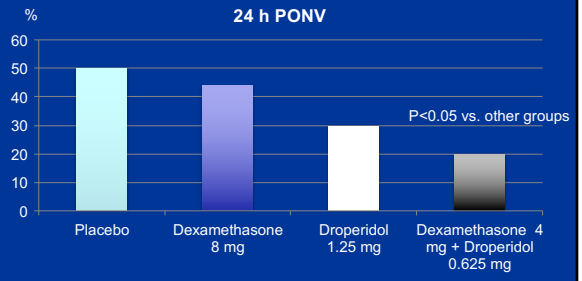


POV



Allen TK. Anesth Analg 2012; 114: 813-22

Combination Antiemetics



Wu JI. Int J Obstet Anesth 2007;16:122-7

Conclusions

- Dose of ITM
- Multimodal analgesia
- Combination antiemetics
- Avoid irrigation

SOAP

Society for Obstetric Anesthesia and Perinatology
The SOAP 49th Annual Meeting
Saturday, May 13, 2017

Enhanced Recovery After Cesarean Delivery

Eric J Hunt, MD, PhD
Chair Obstetric Anesthesia
Permanente Medical Group
Kaiser Northern California

DISCLOSURE: I have no financial relationships with commercial support to disclose.

Learning Objectives

At the conclusion of this activity, participants should be able to:

1. Describe the multidisciplinary coordination necessary to establish a program to enhance recovery after Cesarean delivery.
2. Describe changes in obstetric anesthesia care to enhance recovery after Cesarean delivery
3. Understand data to follow implementation of an enhanced recovery after Cesarean delivery program.

Kaiser Permanente Northern California

4.1 Million Members

The Permanente Medical Group, multidisciplinary physician led established 1948

- 9,000 Physicians
- 16,000 Nurses
- 15 Hospitals with maternity services
- 42,035 deliveries in 2016, with > 43,000 expected in 2017
- ~11,000 Cesarean deliveries

24 X 7 OB coverage in house at each hospital:

- Two anesthesia providers: one exclusively dedicated to OB, at least one anesthesiologist in house
- Obstetrician and surgical assist
- Midwifery care in 13 of the 15 hospitals

Enhanced Recovery after Cesarean Delivery: Initial Efforts

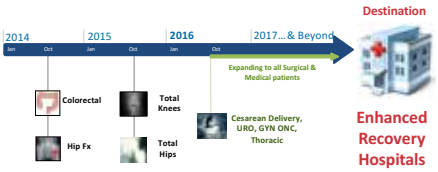
Obstetric Anesthesia Chiefs

OB Anesthesia Directors from all KP maternity hospitals.
Mission: Implement evidence-based practice, standardize care, & cordinate patient centered care improvement with the perinatal care team.

Difficulty with initial efforts

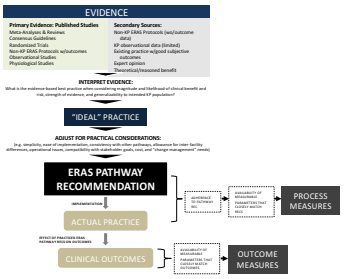
Created pathway for preop, intraop & post partum care, however,
-Difficult to coordinate with OB, perinatology, neonatology…
-Challenged to rein in variation in anesthesia care
-Impossible to coordinate with nursing without order sets.
-No documantation tools.

Enhanced Recovery After Cesarean Delivery establishes the Peripartum Surgical Home!

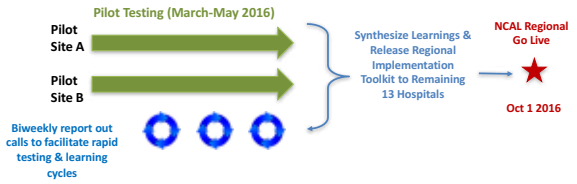


Integrate Cesarean care with other regional objectives.

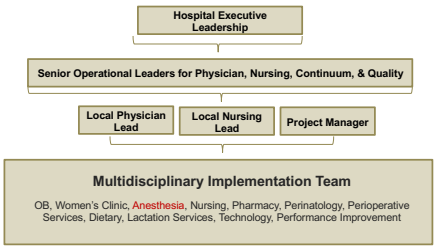
Framework for Creating Pathway Recommendations & Metrics



Enhanced Recovery after Cesarean Delivery
Pilot at 2 hospitals



Local Infrastructure to Rollout OB Enhanced Recovery



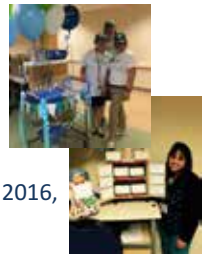
Enhanced Recovery after Cesarean Delivery

What's New for OB Anesthesia?

- Guideline-based NPO Instruction
- Active warming
- Neuraxial anesthesia guidelines
- Prevention of hypotension
- Multimodal Analgesia
- Intraoperative skin to skin neurobehavioral support
- Standard PONV/Aspiration Prophylaxis
- Optimize uterotonic administration
- Support Early Nutrition and ambulation

Feedback at Pilot sites

1. RN feedback: *"Patients reach their **goal of comfort while decreasing opioid usage**"*
2. Lactation Consultant stated that *"Patients are more **alert and retaining more of what we teach**"*
3. OB and CNM feedback: patients are **more alert, engaged with recovery process**
4. Anesthesia feedback: patients experience **less intraoperative nausea** and are **more comfortable post op**
5. All: The Enhanced Recovery after Cesarean Delivery Pathway allows us to follow the ***"same plan"*** for our Cesarean delivery patients



Expanded to all 15 hospitals Oct. 1, 2016, now with 6 months of experience…

Enhanced Recovery after Cesarean Delivery: Provides women with preoperative fluids and nutritional support.

Enhanced Recovery after Cesarean Delivery:
Provides multimodal analgesia for post Cesarean analgesia
(IV acetaminophen and ketorolac was administered after OR)

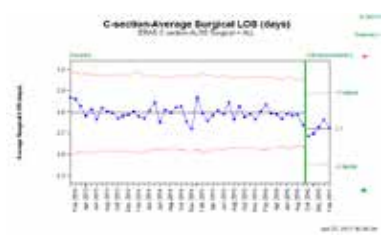
Enhanced Recovery after Cesarean Delivery:
Improved nutritional support for mothers after delivery.
(Meal eaten within 12 hr of OR departure.)

Enhanced Recovery after Cesarean Delivery:
Increased sustained ambulation after delivery.
(Ambulated at least once in 16 hr, at least twice at >16 hr.)

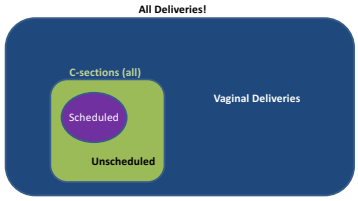
Enhanced Recovery after Cesarean Delivery:
Reduced opioid use by 50%.

Enhanced Recovery after Cesarean Delivery:
Reduced pain scores while simultaneously reducing opioid use. (Sum of delta pain scores form OR exit to POD #3.)

Enhanced Recovery after Cesarean Delivery:
Has little impact on the length of stay.
(Days from OR arrival to discharge.)



Obstetric Enhanced Recovery pathways are now incorporated in the care plan for all maternity patients!



1

Abstract #:SAT-01

Category of caesarean delivery, anaesthetic times and neonatal outcomes.

Presenting Author: Edward Palmer MBBS BSc. (hons) FRCA
Presenting Author's Institution: University College London Hospital - London, London
Co-Author: Sarah Ciechanowicz MA BMBCh Res. - University College London Hospital - London, London
Sioned Phillips MBBS BSc. FRCA - University College London Hospital - London, London
Ali Reeve MB BCh BAO LRCPI&SI (Hons) - University College London Hospital - London, London
Stephen Harris PhD FRCA FFICM - University College London Hospital - London, London
Pervez Sultan MbChB MD FRCA - University College London Hospital - London, London

Introduction: The Royal College of Obstetricians and Gynaecologists introduced a classification system for caesarean delivery (CD), in 2010, to grade the urgency of surgery. Category 1 CD describes an immediate threat to the life of the mother or fetus and is the most urgent and category 4 CD represents a planned CD at a time to suite the mother and obstetricians. The time to provide anaesthesia for these different categories of CD has not been well studied. We analysed the different categories of CD, the time taken for anaesthesia to be delivered and neonatal outcomes. We also examined the effect of maternal body mass index (BMI) on anaesthetic time.

Methods: We obtained ethical approval to analyse data from 3 separate databases used within labour ward. These were the anaesthetic procedure, operating theatre and obstetric databases. Paired data were used from each database over a 5-year period (2009-2014). We examined the relationship between the category of CD and the anaesthetic time (defined as the time taken from entering theatre to being ready for surgery) as well as neonatal outcome parameters; admission to neonatal intensive care and arterial cord pH. Statistical analysis was performed using R (version 3.3.0 2016-05-03), survival analysis was performed by Cox's proportional hazards regression model.

Results: The 3 databases contained 59,333 cases. We had complete paired data for women undergoing CD in 8,524 sets of records. As the urgency of CD increased the time taken to deliver the anaesthetic decreased. The anaesthetic times for category 1,2,3,4 CD were 11 [7-18], 21 [15-29], 28 [21-37] and 33 [24-43] minutes respectively (median and interquartile range shown). There was no difference in the rates of admission to the neonatal intensive care unit or arterial cord pH when compared to the anaesthetic time. Compared to normal BMI (18.5-25) anaesthetic times were longer in overweight (BMI 25-30) patients (hazard ratio 0.92; 95% confidence interval 0.87-0.96; P 0.002) and obese patients (BMI >35) (HR 0.81;95% CI 0.75-0.86;P<0.001).

Discussion: This is the largest published dataset analysing anaesthetic time and category of CD. The categorisation of obstetric urgency for CD is an effective means to communicate the speed at which the baby requires delivery and in this study correlated well with anaesthetic times. As the mothers BMI increases so does the anaesthetic time. This is an important factor when preparing a woman for category 1-2 CD and may influence the use of, and consent for epidurals during labour in this group of parturients.

Abstract #:SAT-02

Outcomes of breech presentation with or without external cephalic version in a large academic United States medical center

Presenting Author: Giselle Jaconia BS
Presenting Author's Institution: Columbia University - New York, NY
Co-Author: Thomas Lavin BS - Columbia University - New York, NY
Richard Smiley MD, PhD - Columbia University - New York, NY
Carolyn F Weiniger MB ChB - Hadassah Hebrew University Medical Center - Jerusalem
Ruth Landau MD - Columbia University - New York, NY

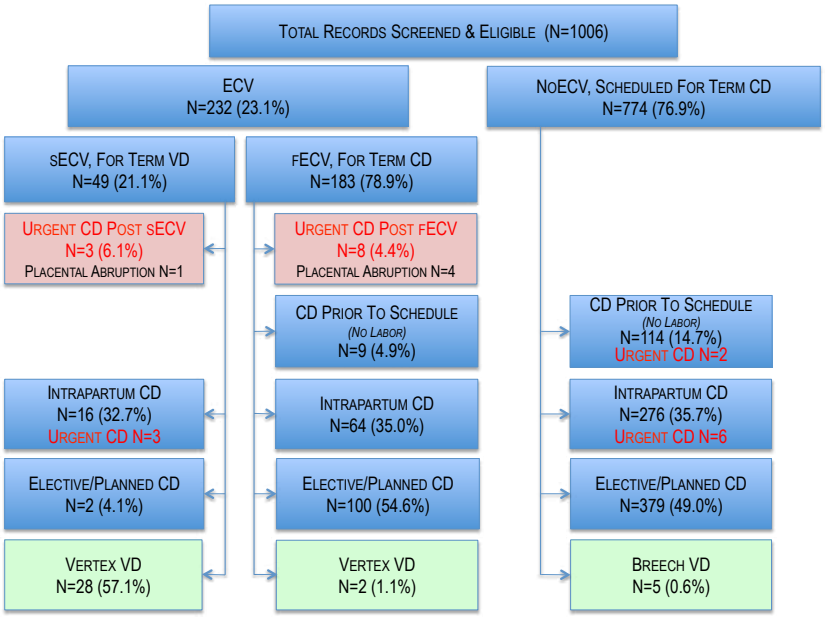
Background: Breech presentation occurs in 3-4% of term singleton pregnancies and external cephalic version (ECV) may reduce the cesarean delivery (CD) rate and complications associated with breech vaginal delivery (BVD).1 Despite a successful ECV (sECV), an urgent CD following ECV or at a later stage during labor may be required. The primary study aim was to evaluate the CD rate among women selecting ECV, and to compare outcomes with women who chose a term planned CD.

Methods: We identified all singleton pregnancies with a diagnosis of breech presentation that delivered >36wks (2010-2016) in a single U.S. academic center through a retrospective chart review. Breech cases were classified in groups based on obstetrical outcome; noECV/CD (planned CD without attempted ECV-CD at or before scheduled date), sECV/VD (sECV resulting in vertex vaginal delivery-VD), sECV/CD (sECV resulting in CD at term-intrapartum or secondary to breech), and fECV/CD (failed ECV resulting in CD-urgent or as planned). Use of neuraxial anesthesia was recorded.

Results: Among 1006 eligible case-charts, 769 proceeded with CD (noECV/CD; 76.4%), 232 attempted ECV (23.1%) and 5 had a BVD (Figure). ECV was successful in 49 cases (sECV; 21.1%) of which 28 ultimately delivered vaginally (sECV/VD; 57.1%). Urgent CD hours following ECV occurred in 11 cases (4.7%), and placental abruption within 48h of ECV occurred in 5 cases (2.2%). Of remaining sECV, 16 had an intrapartum CD (32.7%), 3 of them urgently. Among the fECV/CD, 100 (54.6%) CDs were performed electively as scheduled and 64 were intrapartum. Neuraxial anesthesia was performed in 65/232 ECV (28.0%); ECV success rate with anesthesia was 35.4% and 15.5% without.

Discussion: In our cohort of 1006 women covering 7 years of breech presentation, ECV was attempted in less than 25% of cases, and only 12.1% of all women with ECV successfully delivered vaginally. Although the ECV success rate was low, we confirm that neuraxial anesthesia increases the likelihood of success. These numbers suggest that ECV may not be particularly effective in reducing the overall CD rate, with more than 85% of women delivering via CD. Placental abruption and urgent CD occurred in a non-negligible number of cases.

Further comparisons of obstetrical and neonatal outcomes in women who deliver vaginally versus controls with spontaneous vertex presentations will be needed to further evaluate the risk;benefit ratio of ECV procedures.



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Abstract #:SAT-03

Anesthetic & recovery profiles of chloroprocaine versus mepivacaine for spinal anesthesia in parturients undergoing cervical cerclage

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Purpose: Transvaginal cervical cerclages are routinely performed under neuraxial anesthesia. Longer acting neuraxial techniques are usually less desirable as a cerclage is typically an outpatient surgery procedure; and discharge is dependent upon the patient's ability to void and ambulate. Therefore, this study is investigating the difference between intermediate and short acting neuraxial anesthetics, mepivacaine and chloroprocaine, to determine efficacy and length of PACU stay.

Materials and Methods: This is a prospective, randomized, controlled, double blinded trial using two accepted doses of intrathecal chloroprocaine and mepivacaine as part of a spinal anesthetic. 36 patients were enrolled in the study following a review of medical records. Informed written consent was obtained from each patient. Each patient was randomly assigned to receive either 45 mg of 1.5 % mepivacaine with fentanyl 10 mcg or 45 mg of 3% chloroprocaine with fentanyl 10 mcg intrathecally. Two of the 36 patients were excluded from the study due to a deviation from the study protocol. One patient had a non-functioning spinal requiring a second neuraxial attempt, while the other did not receive the correct study dose.

After time out was performed, the lumbar area was prepped and draped in sterile fashion. After localization of the skin and subcutaneous tissue with 3mL 1% lidocaine, a spinal technique was performed by an anesthesia provider. The patient was then laid supine for transvaginal cervical cerclage. At this time, a blinded anesthesia provider assumed care of the patient. Blood pressure was monitored at 1 minute intervals, with any reading greater than 10% less than baseline treated with IV vasopressor as per standard of care. Dermatomal level was checked by sensation to pinprick at 5, 10, and 15 minutes following intrathecal dose administration, as well as 30 and 60 minutes after completion of the procedure. Any adverse events or use of adjuvant intravenous analgesics were recorded.

Results: The groups were compared using a paired t-test. No significant difference in age ($t=0.43$, $p=0.67$), BMI ($t= 0.85$, $p=0.39$), or gestational age ($t=1.1$,$p=0.28$) existed between the mepivacaine and chloroprocaine groups. Median block height reached at 10 minutes was also the same between groups with a greater deviation in the chloroprocaine group. However, there was a statistically significant difference in the length of time from spinal dose to ambulation ($p=0.0136$) and micturition ($p=0.0103$). The mean length of time to ambulation and micturation for the chloroprocaine group was 152.2 minutes and 159.5 minutes, respectively compared with 210 and 214.9 minutes for mepivacaine. Therefore, we concluded that the PACU stay could be significantly shortened for these procedures when using chloroprocaine.

Abstract #:SAT-04

The Perfect Storm: IVH due to postpartum HELLP in a patient with antithrombin III (ATIII) deficiency and an undiagnosed Arteriovenous Malformation (AVM)

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Introduction: The prevalence of AVM is estimated to be 0.01-0.5% and usually presents between 20-40 y/o, corresponding with childbearing age(1,2). While some AVMs have symptoms allowing for prompt diagnosis, others have a hemorrhagic presentation in peripartum resulting in increased maternal mortality(1,2). This is a case of a 30 y/o pt who had a hemorrhagic presentation of an undiagnosed AVM in the postpartum period. Due to confounding factors, including the concurrent development of HELLP in an anticoagulated patient, she was at a particularly high risk for complications.

Case Report: A 30 y/o G1P0 with an IUP at 39 weeks EGA presented for induction of labor. Her history was significant for ATIII deficiency and PE. Patient was on Lovenox and then transitioned to heparin. She was started on Pitocin, had an epidural placed and delivered after 30 minutes of pushing.

Postpartum, she was restarted on Lovenox. 8 hrs after, she began complaining of a HA, abdominal pain, chest pain, SOB and N/V. Her SBP was in the 150-190 range. She was started on magnesium and given labetalol. CTA chest was negative for PE. Platelets were 170 K/uL. AST and ALT had increased. 6 hrs later, the patient became unresponsive with minimal response to sternal rub and SBP in the 180's. CT revealed a large IVH with non-communicating hydrocephalus. She was taken to the ICU where an arterial line was placed and patient was intubated.

Platelets then decreased to 38 K/uL while AST and ALT increased to 1665 and 1170 respectively. A left frontal craniotomy was performed revealing a ruptured AVM. This was resected requiring multiple blood products. She was weaned to extubation and discharged to rehab on POD 27 with aphasia and right hemiplegia.

Discussion: Coagulopathies, HTN, and eclampsia are well known causes of hemorrhagic strokes during pregnancy(3,4). However, in a survey conducted by Takhashi et al., over 50% of hemorrhagic strokes were the result of underlying cerebrovascular disease. Of those, 87% of the lesions were undiagnosed until the onset of stroke with AVMs being the most frequent(3). Although there have been numerous studies on the hemorrhagic risk of AVM during pregnancy, they provide insufficient evidence on whether pregnancy increases the risk of rupture(2). While MRI and cerebral angiography can help identify the characteristics of an AVM, in the case of an acute hemorrhage with worsening neurologic status, quick imaging with CT and emergency neurosurgical intervention is warranted(2). In our case, the pt had multiple factors increasing her risk for ICH. She was being anticoagulated, became hypertensive and developed HELLP resulting in a severe coagulopathy. While these factors alone have been responsible for ICH occurring in some pregnant patients, they further complicated the management of our patient whose ICH occurred due to the rupture of a previously undiagnosed AVM.

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Abstract #:SAT-05

A modified Delphi approach to establish a consensus expert opinion on whether to proceed with neuraxial anesthesia in pregnant women receiving thromboprophylaxis

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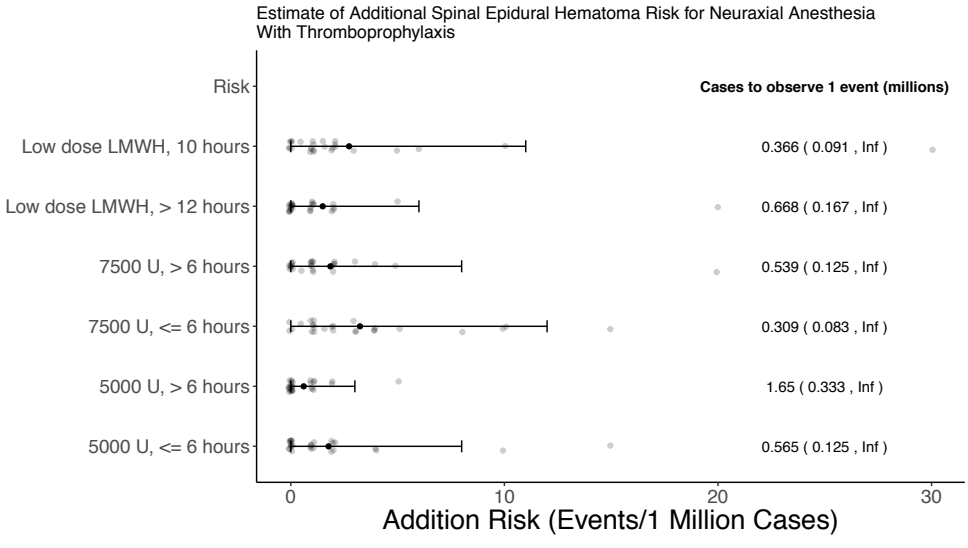
Background: A SOAP Taskforce convened to create a consensus statement in response to the 2016 National Partnership for Maternal Safety Obstetric Thromboprophylaxis Bundle.(1)Given sparse data on the anticoagulant pharmacokinetics in pregnancy and associated spinal epidural hematoma (SEH) risk, experts in the field were asked to provide their opinion through a modified Delphi approach.

Methods: A REDCap survey was sent to obstetric anesthesia leaders and hematology experts. Respondents were asked to use 'clinical intuition to answer' and to 'estimate the # of additional obstetric patients who would experience a SEH for each million neuraxial procedures' at select heparin doses at varying time intervals since last dose. The SEH rate of 3-4:1,000,000 in obstetric cases was the baseline.

Analyses included descriptive statistics appropriate to measurements, including frequency counts (%) and median and IQR (25th, 75th percentile). The central tendency (expected value) and variation (95%CI) in clinical assessments were estimated assuming the distribution of events would follow a negative binomial distribution.

Results: The majority of experts (17/27 [63%]) estimated the SEH risk to be comparable to baseline risk if neuraxial was performed >6h after 5000U SQ UFH (Fig). For 5000U SQ < 6h, the additional risk estimate was also low (median +1 additional SEH:1,000,000; IQR: 0, 2) and 77% of respondents would proceed with neuraxial labor analgesia (NLA). If parturient was morbidly obese with a Category II fetal heart tracing, 85% would proceed with NLA and 96% with neuraxial anesthesia for CS. However, the estimated additional risk increased with 7500U and 10,000U: only 46% would proceed if the woman had received 7500U SQ within 6h, and only 8%, if she received 10,000U SQ within 6h. Most (89%) would not proceed with NLA within 10 hours of an enoxaparin 60mg SQ dose.

Conclusions: This modified Delphi of experts describes perceived risk of SEH with obstetric thromboprophylaxis and identifies minimal additional risk of proceeding with NLA within 6h of 5000U SQ UFH. Increasing concern at higher doses highlights the need for rigorous multidisciplinary planning for the peridelivery management of thromboprophylaxis. These results also demonstrate the experts' commitment to neuraxial labor analgesia and anesthesia when general anesthesia-associated complications appear to outweigh the perceived risk of SEH.



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Abstract #:SAT-06

A comparison of intermittent intravenous boluses of phenylephrine and norepinephrine to prevent spinal-induced hypotension in cesarean deliveries: a randomized controlled study

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Introduction: Hypotension is a common complication of spinal anesthesia for cesarean delivery. Currently the alpha agonist phenylephrine is the vasopressor of choice for both the prevention and treatment of spinal induced hypotension (1). However, the reflex bradycardia and associated reduction in cardiac output seen with phenylephrine is of concern to the obstetric anesthetist. Of late, norepinephrine has been postulated as a better alternative to phenylephrine given its dual alpha and beta activity. When used as an infusion it is as effective at maintaining blood pressure while providing a more stable heart rate and cardiac output when compared to phenylephrine(2). In a recent study(3) to determine the ED90 of intermittent bolus doses of norepinephrine to prevent post spinal hypotension,secondary data analysis showed a 75% relative decrease in the incidence of bradycardia as compared to a similar study with phenylephrine(2). We hypothetized that equipotent intravenous bolus doses of norepinephrine administered intermittently to prevent post spinal induced hypotension at elective cesarean delivery would result in a 70% decrease in the rate of bradycardia when compared to phenylephrine.

Method: This is an ongoing double-blind randomized controlled trial. Spinal anesthesia is induced with 1.8ml of 0.75% hyperbaric bupivacaine mixed with fentanyl 10µg and morphine 100g. Women are randomized into two treatment groups to receive either phenylephrine or norepinephrine to prevent hypotension (SBP < 80% of baseline). The doses used are 100 mcg of phenylephrine(2) or 6 mcg of norepinephrine (3). Blood pressure is assessed every minute from induction of spinal anesthesia until delivery of the fetus, and a 1 mL bolus of the vasopressor is given via the peripheral IV cannula every time the SBP is below the baseline value. Ephedrine 5-10mg is given by intravenous bolus if the SBP is below baseline and the heart rate is less than 60 bpm. A bolus of ephedrine is also given if the SBP is less than 80% of baseline for two consecutive readings regardless of heart rate. The primary outcome is bradycardia(HR <50 bpm) in the pre-delivery period.

Results: Enrollment began on January 4th 2017. A sample size of 106 will achieve 80% power to detect at least a 70% decrease in the incidence of bradycardia at the significant level of 0.05. To date 30 women have been enrolled with an average enrollment rate of 7.5 study subjects per week. Recruitment success rate has been high at 73% and we have had no violations of protocol thus far. The projected date of completion for this study is April 14th 2017 and results will be presented in full at SOAP 2017.

Conclusion: This trial will be of significant importance in elucidating the role of NE intermittent boluses to prevent spinal induced hypotension during cesarean delivery.

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Abstract #:SAT-07

Dexamethasone as analgesic adjunct for post-cesarean delivery

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Introduction: Poorly controlled pain after cesarean delivery (CD) can be a significant source of morbidity including an increased risk of venous thromboembolism, chronic pain, and depression. Dexamethasone (DEX), a commonly administered antiemetic, might have analgesic properties for general surgical patients. However, analgesic effects of DEX in women undergoing CD under spinal anesthesia remains unclear. We hypothesized that a single perioperative dose of DEX 8 mg would significantly reduce postoperative opioid consumption at 24-h in women who underwent CD under spinal anesthesia.

Methods: ASA 1-3 women scheduled to undergo CD were randomized to receive either IV DEX 8mg or placebo after administration of spinal anesthesia (hyperbaric bupivacaine 12 mg, morphine 150 mcg and fentanyl 15 mcg) but prior to skin incision. Randomization was stratified by presence or absence of mechanical temporal summation. Postoperatively, all patients received scheduled acetaminophen and naproxen in combination with PRN oxycodone and IV morphine. All postoperative opioids were converted to IV morphine equivalents. The primary outcome was opioid consumption at 24-h. Secondary outcomes included time to first analgesic request, opioid consumption at 48-h, pain scores at rest and on movement at 2, 24 and 48-h, need for rescue antiemetics, and incidence and severity of nausea and vomiting. Wilcoxon rank sum and chi-square tests were used as appropriate. Log-rank test was used to test the Kaplan-Meier survival curves between groups for time to first analgesic request. Multivariable regression models were used to test the treatment effect with covariate adjustment.

Results: There were no differences in patient characteristics and preoperative risk factors for nausea and vomiting between the 2 groups. The results are summarized in the table. In univariate analysis, there were no differences in opioid consumption, pain scores, or time to first analgesic request between the groups. When controlled for covariates, DEX reduced 24-h pain scores at rest (parameter estimate=-1.213, p=0.032). DEX also reduced vomiting episodes and need for postoperative antiemetics at 2-h.

Conclusion: Administration of DEX does not appear to reduce opioid consumption, but it may be associated with a modest reduction in postoperative pain scores and nausea and vomiting. A single dose of DEX may not be a useful analgesic adjunct in a multimodal postoperative analgesia regime after CD.

Abstract #:SAT-07

	Dexamethasone (n = 23)	Placebo (n = 24)	p value
Total opioid consumption in morphine equivalent in mg[1]			
24 h	15 (7.5, 20.0)	13.75 (2.5, 31.25)	0.73991
48 h	20 (10.0, 40.0)	22.5 (3.75, 48.75)	0.70861
Pain score at rest[1]			
2 h	2 (0.0, 4.0)	3.5(1.5, 5.0)	0.17052
24 h	2 (0.0, 3.0)	2.5 (1.0, 4.25)	0.26681
48 h	2 (0.0, 3.0)	2 (0.0, 4.0)	0.49091
Pain score with movement[1]			
2 h	5 (2.0, 7.0)	5 (4.0, 7.0)	0.20412
24 h	5 (3.0, 7.0)	5 (4.0, 6.75)	0.51812
48 h	4 (3.0, 6.0)	5 (3.0, 7.0)	0.52471
Incidence of postoperative nausea[2]	10 (43.5%)	15 (62.5%)	0.1914
Nausea score[1]			
2 h	0 (0.0, 4.0)	1.5 (0.0, 8.5)	0.05811
24 h	0 (0.0, 0.0)	0 (0.0, 4.5)	0.14911
Incidence of postoperative vomiting/retching[2]			
2 h	4 (17.4%)	11 (45.8%)	0.05993
24 h	4 (17.4%)	10 (41.6%)	0.11073
Number of vomiting/retching episodes[1]			
2 h	0 (0.0, 0.0)	0 (0.0, 2.0)	0.0458
24 h	0 (0.0, 0.0)	0 (0.0, 2.0)	0.0651
Postoperative antiemetic administered[2]	10 (43.5%)	18 (75.0%)	0.02774
Nausea/Vomiting Complete Response at 24 h[2,3]	14 (60.9%)	11 (45.8%)	0.3017

[1]Median values (Q1, Q3) [2]n (%) [3]Patients without nausea, vomiting, or need of rescue antiemetic medication

Abstract #:SAT-08

Impact of an Enhanced Recovery After Surgery protocol on post Cesarean section opiate consumption and patient's satisfaction with pain management

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Background: Enhanced recovery after surgery (ERAS) protocols aim at improving patient outcomes and reducing variability in care delivery. In gynecologic surgery, implementation of an ERAS protocol has proven to hasten patient recovery improve patient satisfaction(1). One of the mainstays of ERAS protocols is multimodal analgesia with avoidance of opioid use. In this single institution prospective observational quality improvement study we assessed the impact of an ERAS protocol for cesarean delivery on postoperative opioid use.

Methods: Patients undergoing elective Cesarean Section at the University of Virginia were enrolled in an ERAS protocol pathway. Patients in the ERAS protocol were encouraged to drink clear liquids up to 2 hours prior to induction of anesthesia. Spinal anesthesia was achieved with 1.6-2.0 mL of 0.75% Bupivicaine, 20 mcg of Fentanyl and 100-200 mcg of preservative free Morphine. Post-operatively, pain was managed using scheduled Ketorolac 30mg and Acetaminophen 975mg with opiates as rescue pain medication only. Patients in the non-ERAS pathway received standard preoperative and intraoperative care and received Oxycodone with acetaminophen and naproxen sodium for post-operative pain.

Results: To date, 54 patients have been enrolled in the ERAS recovery pathway. Patients in a non-ERAS pathway were matched to patients in the ERAS pathway for age, parity and number of surgeries. Patients enrolled in the ERAS protocol used less postoperative opioids than those in the non-ERAS pathway [36.2 mg MSO4 vs. 18.1 mg MgSO4, p = 0.0002]. Pain scores were similar in both groups. Patient satisfaction with pain management also improved. Secondary data included and recapitulated in the attached table.

Conclusion: In this preliminary analysis of our institutional ERAS for Cesarean section protocol, we found that patients who received the ERAS protocol used less post-operative opioid than matched controls despite similar pain scores. This observation sheds light on the potential role that a more standardized intra and post-operative pain regimen may have not only on hastened recovery but in the reduction of post-operative opiate consumption in cesarian delivery patients.

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Abstract #:SAT-08

	Pre- ERAS (n=54)	ERAS (n=54)	p-value
Age (years)	31	30	
Youngest age	20	20	
Oldest age	42	40	
BMI	35.4	32.7	
Gatorade/Clear liquids on DOS	n/a	36	
Length of Stay (days)	2.43	2.30	0.24
Opioid consumption			
Morphine equivalents – intraoperative	4.6	3.1	0.04
Morphine equivalents – post-operative	36.2	18.1	0.0002
Pain score			
Highest	7.28	6.85	0.29
POD 0	3.5	3.28	0.59
POD 1	3.75	3.9	0.69
Fluid administration			
Intraoperative	937	904	0.82
Net I/O	-322	-939	0.14

Table 1. Preliminary comparison of Pre and Post ERAS Implementation for Cesarean Section

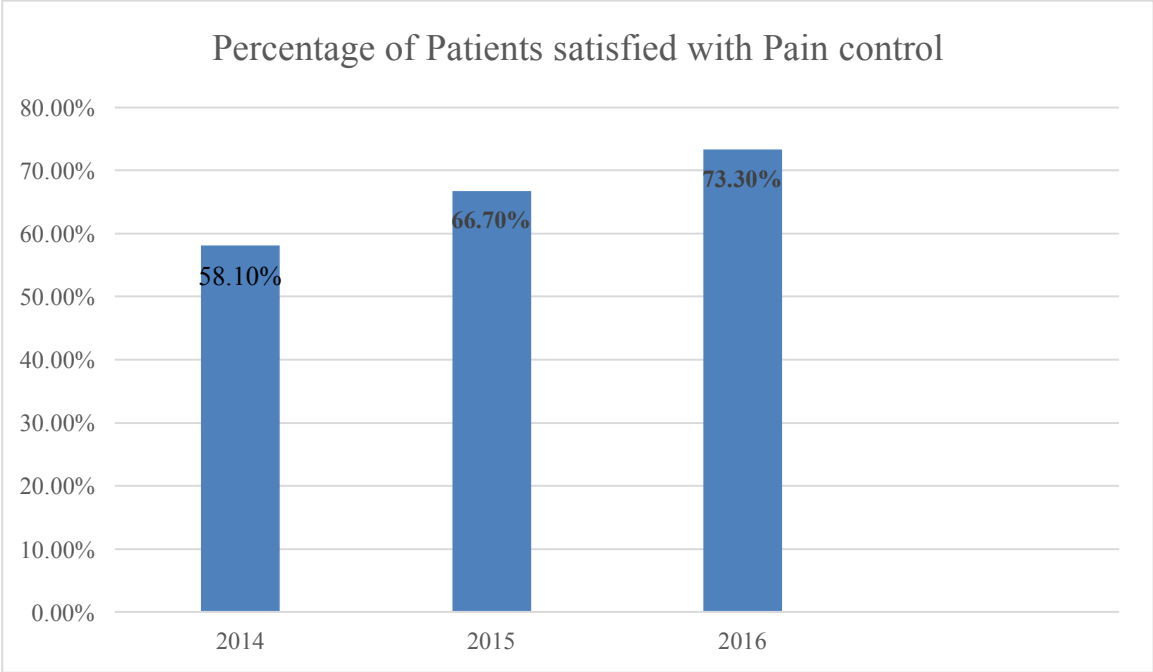

Figure 1. Patient satisfaction with Pain control

Abstract #:SAT-09

Does automated interpretation of lumbar spine ultrasound images increase success rate of spinal anesthesia placement for cesarean birth among residents in training?

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Background: Spinal anesthesia is commonly administered using landmark technique. However, finding landmarks is at times difficult (obesity, hyperlordosis, etc). In such instances, ultrasound (US) has been advocated to aid with spinal placement. Operator experience with US remains the key to successful placement in most studies. Recent development of a hand-held ultrasound called the Accuro™[2D US with 3D image rendering for easy sono-anatomy recognition] may improve spinal placement among residents in training. In this study, we compared resident's success in administering spinal anesthesia using the Accuro versus landmark technique for patients undergoing Cesarean section.

Methods: Second through fourth year anesthesia residents rotating through OB Anesthesia at the University of Virginia without previous experience with neuraxial ultrasound or using Accuro were randomized to traditional (landmark) spinal placement versus Accuro guided spinal placement in patients undergoing C-Section. During the Accuro guided cases, residents performed the US scanning and were not allowed to palpate the patient's back for landmarks at any point during the procedure. Prior to using the Accuro in the study, all residents watched a 10 min training video regarding the use of Accuro and scanned one volunteer to gain familiarity with the device. None of the residents had used the device before entering the study.

Results: 105 patients were recruited for this randomized controlled trial and 25 residents participated in the study. Overall, first insertion attempt success rate was not different among groups. In subgroup analysis, use of Accuro improved first insertion success rates in patients with BMI ≥ 30 and residents who had performed ≥ 50 procedures prior to the study (29% vs. 64%, p=0.038). The average number of passes prior to successful placement decreased (7.6 vs. 3.9, p=0.018), and there was an increase in spinals placed within the first 10 passes (95% vs. 54%, p = 0.008). There was no significant increase in procedure time between the landmark and Accuro groups. In less experienced residents (<50 procedures) there was no significant difference in any of these measures Data attached [Fig 2].

Conclusion: The results of this study indicate that, in "clinically experienced residents", the use of Accuro significantly improved first-attempt spinal anesthesia placement success rates and reduced the number of passes required for spinal placement. More importantly, these results were achieved in the setting of novices with regards to ultrasound use.

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Table 1: Analysis of spinal placement success among all residents and all patients

	CG	UG	*p*-value
BMI (kg/m^2)	34.3 ± 7.3	36.6 ± 8.9	0.18
1st insertion success	28/45 62 (47-76) %	27/45 60 (44-74) %	0.83
1st pass success	12/45 27 (15-42) %	13/45 29 (16-44) %	0.83
Success within 5 passes	28/41 68 (52-82) %	23/34 68 (50-83) %	1.0
Success within 10 passes	33/41 80 (65-91) %	32/34 94 (80-99) %	0.08
Number of insertions	1.4 ± 0.7 [1 – 3]	1.2 ± 0.5 [1 – 3]	0.27
Number of passes	5.3 ± 5.5 [1 – 23]	4.1 ± 4.0 [1 – 19]	0.28
Time find landmarks	3.9 ± 1.4	6.0 ± 2.1	< 0.001
Time to place spinal	5.0 ± 5.2	4.0 ± 3.4	0.33
Total procedure time	15.5 ± 6.2	17.6 ± 5.4	0.13

Table 2: Subgroup analysis among obese patients and grouped by resident experience

	BMI ≥ 30 kg/m^2					
	Experience: < 50 procedures			Experience: ≥ 50 procedures		
	Control	Ultrasound	*p*-value	Control	Ultrasound	*p*-value
BMI (kg/m^2)	36.7 ± 3.7	35.6 ± 3.0	0.37	41.3 ± 5.5	39.1 ± 11.6	0.51
1st insertion success	10/13 77 (46-95) %	10/18 56 (31-79) %	0.36	4/14 29 (8-58) %	14/22 64 (41-83) %	0.038
1st pass success	6/13 46 (19-75) %	6/18 33 (13-59) %	0.47	2/14 14 (2-43) %	6/22 27 (11-50) %	0.31
Success within 5 passes	9/13 69 (39-91) %	10/11 91 (59-99) %	0.20	5/11 45 (17-77) %	11/19 58 (34-78) %	0.50
Success within 10 passes	10/13 77 (46-95) %	10/11 91 (59-99) %	0.37	6/11 54 (23-83) %	18/19 95 (74-99) %	0.008
Number of insertions	1.2 ± 0.6 [1 – 3]	1.1 ± 0.3 [1 – 2]	0.62	1.8 ± 1.7 [1 – 3]	1.3 ± 0.6 [1 – 3]	0.25
Number of passes	5.9 ± 7.8 [1 – 23]	3.1 ± 5.1 [1 – 19]	0.32	7.6 ± 4.9 [1 – 14]	3.9 ± 3.2 [1 – 12]	0.018
Time to landmarks	4.0 ± 1.6	7.3 ± 2.0	< 0.001	3.6 ± 1.5	5.6 ± 1.8	0.004
Time to place spinal	5.0 ± 3.8	3.9 ± 3.3	0.46	7.0 ± 7.6	4.2 ± 3.7	0.18
Total procedure time	16.1 ± 5.6	18.6 ± 3.9	0.23	18.0 ± 8.2	17.9 ± 6.2	0.97

Abstract #:SAT-10

Does Socioeconomic Status Predict Anesthesia Type for Cesarean Sections?

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Background: General anesthesia for Cesarean section (GACS) is often used as "back-up" anesthesia because GACS prevents a parturient's participation in delivery and risks failed intubation. For this reason, neuraxial anesthesia for Cesarean section (NACS) is used primarily. Maternal comorbid factors have clearly been defined as risk factors for GACS, but maternal socioeconomic status (SES) has not. The aim of this research is to identify maternal markers of SES that are risk factors for GACS.

Methods: We performed a case-control study to evaluate if SES markers are associated with increased risk of GACS. We reviewed all Cesarean sections (CS) performed at our major university hospital between July 2013 and June 2016. Cases were patients receiving GACS and controls were patients that underwent CS with neuraxial (spinal and epidural) anesthesia. SES markers extracted from health records included race/ethnicity, marital status, smoking status, and practice location for prenatal care. We excluded patients with multi-gestational pregnancy, intraoperative fetal demise, or missing exposure data. We used chi-square to compare exposure variables between cases and controls. We used logistic regression to generate odds ratios (OR) of each exposure variable in relation to GACS. p-value <0.05 was considered significant.

Results: Among a total of 3,417 CS included in our study, GACS (cases) accounted for 9.1% of subjects and NACS (controls) accounted for 90.9% of subjects. Racial and ethnic percentages of subjects were Black (65.1%), White (19.8%), Asian (6.2%), other (5.8%), and Hispanic (3.0%). No differences were found between the cases and controls regarding age and ASA status. Using univariate logistic regression, the SES risk-factors for GACS were black race (OR=1.7, 95% CI 1.29-2.2), smoking status (OR= 1.47, 95% CI 1.13-1.91), single marital status (OR= 1.68, 95% CI 1.28-2.20), low-income prenatal care practice (OR=1.61, 95% CI 1.24-2.09), and outside care network prenatal care (OR=2.23, 95% CI 1.48-3.27). After using multivariate logistic regression, only black race (aOR=1.58, 95% CI 1.11-2.23) and current smoking status (aOR=1.53, 95% CI 1.17-1.99) remained statistically significant (p<0.05).

Conclusion: Black race and current smoking status are associated with higher use of GACS. Further research is needed to understand how maternal socioeconomic status may influence anesthetic choice for Cesarean section.

Abstract #:SAT-11

Obstetric Anesthesiology in the United States: Current and Future Demand for Fellowship-Trained Subspecialists

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Introduction: The US has one of the highest maternal mortality rates (MMR) in the developed world; even more alarming, MMR has been increasing 1. Preexisting medical conditions in parturients have been increasing 2, along with maternal obesity 3, and maternal age 4. The US cesarean delivery rate is 32%, and high risk cesarean deliveries have increased 4. A physician anesthesiologist specializing in obstetric (OB) anesthesiology is uniquely qualified to assist in the reduction of OB-related morbidity and mortality 5, but their workforce need has never been estimated.

Methods: After IRB exemption, we queried the 2015 American Hospital Association (AHA) Annual Survey Database for hospitals doing deliveries, # of deliveries annually, and OB Level of Care (Level 3 = "all serious illnesses and abnormalities"). The national need for Fellowship trained OB anesthesiologists was estimated. Low estimate assumptions were: 1) hospitals with >4000 deliveries need at least one OB anesthesiologist on staff (additional staffing for high volume services), and 2) hospitals with 2000-3999 deliveries that are OB Level 3 also need an OB anesthesiologist on staff. The high estimate assumptions were: 1) hospitals doing > 1500 deliveries per year need an OB anesthesiologist on staff (additional staffing for high volume services) and 2) hospitals with <1500 deliveries that are OB Level 3 also need an OB anesthesiologist on staff.

Results: See Figure

Discussion: In 2015, ACOG/SMFM established maternal levels of care, I-IV; levels III & IV require an OB anesthesiologist to provide expertise and improve outcomes. The AHA Level 3 also reflects such regionalization of maternal care. The goal and trend of regionalized maternal care is to provide medical expertise, reducing maternal morbidity and mortality. The estimated demand for OB anesthesiologists to lead and staff these centers exceeds the current training/supply of 53 graduates per year from ACGME-accredited OB anesthesia fellowship programs for several years.

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4. Martin et al. Births in the US, 2015. CDC NCHS Data Brief 2016.
5. Bateman BT. Anesthesiologist as Epidemiologist. Anesthesiology 2014; 1311-12.

Number of Hospitals (Cumulative)	Number of Births Annually	
9	10,000	Low Estimate
12	9,000	167 Hospitals with > 4000 deliveries
22	8,000	103 Low estimate add'l staffing for high vol. services
26	7,000	247 Obstetric Level 3 hospitals, 2000-3999 deliveries
46	6,000	**517 TOTAL**
91	5,000	
167	4,000	High Estimate
324	3,000	848 Hospitals with > 1500 deliveries
628	2,000	206 High estimate add'l staffing for high vol. services
848	1,500	162 Obstetric Level 3 hospitals, <1500 deliveries
1248	1,000	**1216 TOTAL**
1884	500	
2826	100	

Abstract #:SAT-12

Process Change and Anesthesia Trainee Instruction Improve Obstetric Anesthesia Care in a Serbian Obstetric Hospital: A Report of an On-going International Collaboration

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Introduction: In Serbia, the use of neuraxial analgesia for labor (NAL) and for cesarean delivery (NACD) is low. The Department of Anesthesiology at Clinical Center Vojvodine (CCV) requested a multi-year collaboration with Kybele Inc. in 2012 to help train physicians in the use of NAL and NACD. Despite annual didactic courses, frequent communication between host and Kybele, and annual week-long clinical instruction visits through 2015, use of NAL and NACD plateaued in 2014 and NA experience among trainees did not increase. In January 2016, one author (CP) conducted a 4 month visit, focusing on resident instruction. In August 2016, CCV leadership mandated an evening clinical shift for one attending and trainees; daytime staffing was unchanged. We report on the effects of these 2 interventions on NAL, NACD, and resident education.

Methods: The Institutional Review Board approved data gathering for this quality improvement analysis. CP conducted a 4 month visit from early January 2016 through April 30 2016, focusing on clinical resident education; a Kybele team visit overlapped. Data on NAL and NACD in 2014, 2015 was compared to that collected during the 7 month interval prior to and 5 month period after the above staffing change. Data on resident experience with NAL and NACD in 2015 was compared to 2016. Student's T test and chi square test with adjustments for multiple comparisons were used where appropriate.

Results (Table 1): The percentage of NACD plateaued at approximately 25% during 2014 and 2015, but rose to over 50% in the last 5 months of 2016. The percentage of NAL declined 1/2016 – 7/2016, but more than doubled after. Trainee experience in NAL and NACD increased; some trainees reported over 25 experiences in both during a rotation. One author (BP) and 3 other CCV attendings adopted the method of resident instruction modeled by CP during their clinical work, particularly after the change in evening staffing.

Discussion: Goals for the Kybele – CCV collaboration are to increase NAL/NACD and improve education. In 2015, improvement plateaued. The drop in NAL in 1-7/2016 followed external nationwide mandates for NAL. The change in staffing hours improved staff utilization for NAL. The intensive 4 month trainee instruction demonstrated a model for CCV attendings to better utilize trainees for clinical care. Patient service increased and trainee education was enhanced. Better resident training may improve future obstetric anesthesia care in Serbia.

Table 1: Obstetric neuraxial anesthesia at CCV: Utilization for labor and cesarean delivery, and resident experience.

Year	Percentage CD under NA	Number of CD's
2014	26.4%	2004
2015	25.0%	1996
1/2016 – 7/2016	31.0% °	1235
8/2016 – 12/2016	51.0% °	881
Year	**Percentage NAL for Vaginal Delivery**	**Number of Vaginal Deliveries**
2015	10.5%	4574
1/2016 – 7/2016	6.1% °	2549
8/2016 – 12/2016	15.6% °	1820
Year / Number of Residents	**# Resident performed NAL for Vaginal Delivery**	**# Resident performed SAB for CD**
2015 / 30	25	80
2016 / 28	223 °	226 †

° $p < 0.0001$, compared to previous time interval above
† $p = 0.003$, compared to previous time interval above
#, number of; SAB, subarachnoid block; NAL, neuraxial analgesia for labor; NA, neuraxial anesthesia; CD, cesarean delivery

Abstract #:SAT-13

Current state of knowledge of CTG among obstetric Anaesthetists - A Survey

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Introduction: The UK National Institute of Clinical Excellence (NICE) recommends continuous 30 minutes CTG (cardiotocograph) monitoring in women receiving regional anaesthesia/analgesia1. An awareness of the principles & a systematic approach to CTG analysis is essential for the anaesthetists for communication & timely delivery of high risk fetus2. A 2014 Obstetric Anaesthetic Association(OAA) survey highlighted the knowledge deficiency &lack of standardized CTG module training for anaesthetsists, urging curriculum changes3. Anecdotal evidence suggested that this hadn't occurred locally. We devised a survey to assess if any improvement in knowledge had occurred in our institution.

Methods: A questionnaire survey was conducted among 12 obstetric anaesthetic trainees & 8 consultant obstetric anaesthetists in a large obstetric unit. Questions examined their training, confidence in interpreting CTGs & assessed their interpretation of 5 CTGs within a limited timeframe. They were also questioned about anaesthetic implications of the obstetric situation.

Results: 45% had undergone training sessions to analyze CTG mainly in medical school with no subsequent updates.70% didn't feel confident in basic CTG analysis.42 % of trainees & 40 % of consultants incorrectly interpreted CTG tracings. 62% correctly identified anaesthetic implications.75% of the respondents wanted training & identified that e learning (60%), courses (10%) & rounds (10%) would help.

Discussion: Our survey shows continued CTG knowledge gaps despite the recommendations of the 2014 survey. Although Obstetricians have the primary responsibility for making clinical decisions, knowledge about CTG amongst anaesthetists promotes timely patient care, avoidance of intrapartum harm & reduces litigation3. It is worrying that 42% trainees, who are front line providers, didn't interpret the CTG tracing, hence didn't correctly identify the anaesthetic implications. Previous confidential enquiries have shown lack of knowledge, poor training of staff contributing to maternal morbidity & mortality. Our results highlight an urgent need to review the curriculum to improve training & mandate regular refresher training for senior anaesthetists.Our labour ward induction programme has changed, ensuring all new trainees have access to an e-learning module & have focused time with labour ward practitioners to help with experiential learning. We believe that this needs to be replicated in other institutes to improve maternal care .

References:

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Abstract #:SAT-14

Can the double-fluorescent reporter mouse (ROSAnT/nG) be used to improve uterine smooth muscle (USM) specific protein knockdown in murine parturition studies.

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Objective: Assessing the necessary molecular targets in the initiation and maintenance of labor is an important goal to develop effective and novel approaches to treating pre-term labor. Currently, inducible gene-editing approaches (ie. Cre/Flox systems) provide the most reliable method for highly selective protein targeting. However, these approaches can be limited due to differential tissue expression and variability in induction. Furthermore, only a few reports exist using these systems to knockdown USM proteins involved in parturition and none provide a means for selection of successfully targeted USM cells. Novel double-fluorescent reporter mice (ROSA$^{nT/nG}$) provide a unique means to assess tissue knockdown by changes in fluorescence (red changes to green). We questioned if ROSA$^{nT/nG}$/Cre ER^{T2} recombination could be a useful tool to precisely target protein knockdown in murine USM tissue and cells.

Methods: With IACUC approval, we have begun triple breeding strategy to generate 2 mouse groups: ROSA$^{nT/nG}$/ SM22^{wt} (baseline control – Tamoxifen unresponsive); SM22-CreER^{T2}/ROSA$^{nT/nG}$ (fluorescent reporter, tamoxifen responsive). All groups will receive tamoxifen (1 mg /100 µL) i.p. for 5 days and smooth muscle (uterus and small intestine) will be harvested 7 days after the last injection. Changes in fluorescent expression will be assessed in histological samples by confocal microscopy and quantified by FACS cell sorting.

Results: Preliminary results show high RFP expression in uterine smooth muscle in the ROSA$^{nT/nG}$ baseline mice that does not alter under tamoxifen treatment (Figure 1).

Conclusions: Control studies reveal excellent RYP expression in our baseline mouse. Tamoxifen treatment (in our treatment control group) did not convert RFP into GFP – consistent with our hypothesis. We are awaiting sufficient female SM22-CreER^{T2}/ROSA$^{nT/nG}$ mice to assess the efficacy of this fluorescent reporting system.

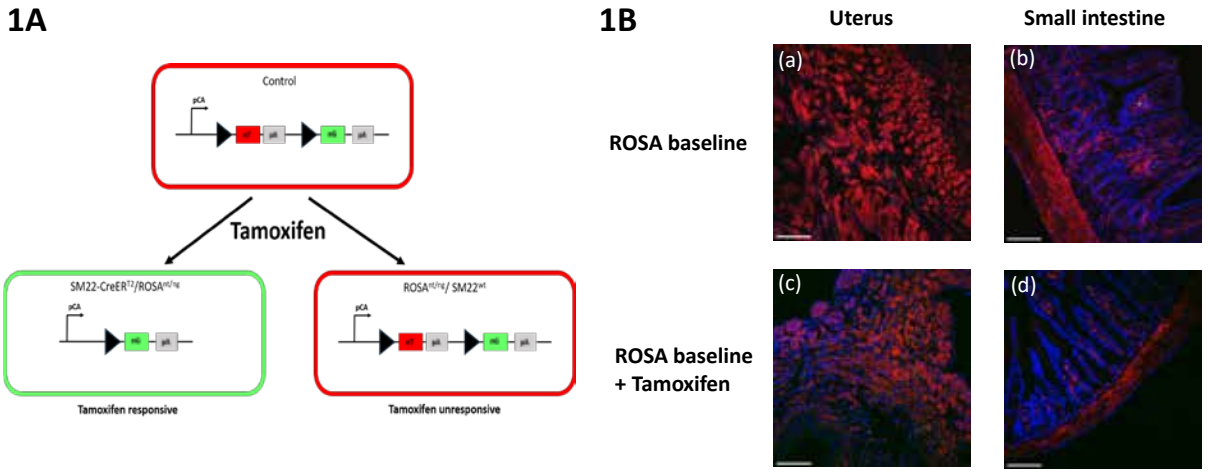

Figure 1.
1A.Schematic diagram of the *nT/nG* construct before and after Cre-mediated recombination. Representative cartoon of the dual fluorescent ROSA system illustrating conversion of cells from RYP (red) expression (top) to a GYP (green) fluorescent reporter. In tamoxifen- responsive mice excises the RYP segment allowing expression of enhanced green fluorescent protein. Arrows denote the direction of transcription. Triangles represent loxP target sites for Cre-mediated recombination. PA denotes polyadenylation sequences.
1B. Ubiquitous labeling in nT/nG mice prior to recombination. Confocal (20x objective) imaging showing high expression of red fluorescence in (a) uterus, (b) small intestine. We also observed no fluorescent conversion following tamoxifen treatment* in these control mice (as expected). (c) uterus (d) small intestine.
* i.p. tamoxifen (1 mg/100 µL) for 5 consecutive days and sacrificed 7 days after the last injection. Scale bars: 300 µm.

Abstract #:SAT-15

Pattern of Uterotonic usage in Canada: A National Survey of the Academic Hospitals

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Background: The pattern of uterotonic usage for the management of postpartum hemorrhage (PPH) in Canada is unknown. A recent retrospective study in the USA suggests that the pattern of 2nd line uterotonic usage is highly variable [1]. Oxytocin is the primary uterotonic agent used in the prevention of PPH [1,2]; however, Canadian uterotonic usage (as compared to the USA) is more complex due to the availability of carbetocin as an alternative to oxytocin. Canada is the only country to recommend carbetocin in the management of third stage of labor as part of obstetric practice guidelines [3]. The objective of this study was to determine the pattern of uterotonic usage in academic hospitals in Canada.

Methods: This study was conducted as a survey targeting chiefs or directors of Obstetrics and Gynecology, and Obstetric Anesthesia at university-affiliated hospitals across Canada. The survey was sent out electronically by the program 'SurveyMonkey' during the period November 2016 to January 2017. Two reminder emails were sent. We collected the following data: number of deliveries per year; epidural/cesarean delivery (CD) rate; institutional PPH rate; 1st and 2nd line uterotonic agents in vaginal and CDs; rationale behind choices of 1st and 2nd line uterotonic agents.

Results: The survey was sent to 109 clinicians of which 34 (31.2%) responded (21 Anesthesiologists, 13 Obstetricians). About 50% responders reported a delivery rate of 2500-5000/year and an epidural rate of 51-75% in their institutions. 77% responders reported their institutional CD rate of 21-30%. About 65% responders were unaware of the rate of PPH in their institution. The first line agent for vaginal deliveries was reported as oxytocin by 91% and carbetocin by 9% responders. For women at low risk for PPH undergoing CDs, 66% reported oxytocin while 34% reported carbetocin as the first line uterotonic. For CDs at high-risk for PPH, 60% reported oxytocin and 40% reported carbetocin as the first line agents. The use of 2nd line uterotonics was also variable amongst institutions with the use of additional oxytocin, carboprost, misoprostol and ergometrine reported by 48%, 28%, 17% and 7% responders, respectively. The majority of responders stated that choice of 1st and 2nd line uterotonic usage was based on efficacy.

Discussion: Our study reinforces the lack of a unified approach to the use of oxytocin, carbetocin and 2nd line uterotonics for prevention of PPH, and echoes the findings of a previous study from the USA [1]. The choice of 1st and 2nd line uterotonic agent was mainly based on presumed efficacies of the selected drugs, although the evidence in the literature is lacking. An evidence-based approach to uterotonic usage, as well as consensus of obstetricians and anesthesiologists is warranted in order to improve the prevention and management of PPH due to uterine atony.

References:

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2. Obstet Gynecol 2006;108:1039-47.
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Abstract #:SAT-16

Using high fidelity pressure monitoring to compare different loss of resistance techniques for epidural placement.

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Background: There are many approaches for epidural loss of resistance (LOR) technique; air vs saline, glass vs plastic syringes, continuous vs intermittent pressure. We hypothesized that high fidelity pressure monitoring from the epidural syringe will be able to provide quantifiable measures of compliance changes and identify one technique as more sensitive.

Methods: This study received formal IRB waiver as a non-human study. We evaluated B-Braun 5 cc glass syringes and Periflex 8mL plastic LOR syringes on the Genesis Epidural Spinal-Injector simulator, using 18G Touhy epidural needles (B-Braun). The epidural syringe was connected by 3-way stop cock to Edwards Lifesciences TruWave invasive pressure transducer with sampling interval of 6µsec. Data processing of signal was performed with Rugloop2, pressure-time curves were generated with MATLAB and Excel. All 24 members of the OB Anesthesia team (faculty, fellows and CRNA's) participated in this study; each performed epidural insertion under pressure monitoring using 8 separate techniques: continuous-glass-air (CGA), continuous-glass-saline (CGS), continuous-plastic-air (CPA), continuous-plastic-saline (CPS), intermittent-glass-air (IGA), intermittent-glass-saline (IGS), intermittent-plastic-air (IPA), intermittent-plastic-saline (IPS). Order was randomized. After each attempt, the provider reported sensitivity of LOR on an 11-point VAS (0-10). Data was de-identified and analyzed by 2 blinded investigators. For continuous pressure LOR, we assessed the slope of the "downstroke" (Fig 1A) as the linear slope from the 5% to the 50% change. We compared 4 data sets: CGA vs CGS; CPA vs CPA; CGS vs CPS and CGA vs CPA. We used four paired t-tests to compare data for all subjects; p=0.05/4=0.0125 (Bonferroni); data calculated using SPSS. For intermittent pressure LOR, we averaged 3 "upstrokes" (Fig 1B), before LOR and the upstroke after LOR; the endpoint was the %change in slope from BL.

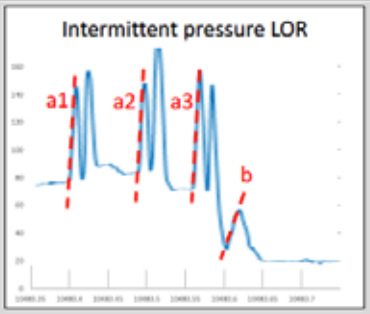
Results: The data for slopes of downstroke using continuous LOR are presented in Fig 1. There were no significant differences between any of the pairs assessed. Data for intermittent LOR was collected but not interpreted in time for the abstract but will be available by the time of the SOAP meeting.

Conclusion: For LOR with continuous pressure there was no quantitative difference between glass vs plastic syringes or air vs saline. Data has yet to be assessed for intermittent pressure.

Continuous pressure	Mean	SD
Glass - Air	2056	1618
Glass - Saline	2305	2684
Plastic - Air	1955	2163
Plastic - Saline	3342	4359

*There were no significant **differences** between pairs assessed (paired t-tests); GA vs GP; PA vs PS; GS vs PS; GA vs PA.*

Glass-air correlated well with plastic- air (p=0.001); glass-saline correlated well with plastic-saline (p=0.001). All other groups had no correlations.



Intermittent pressure LOR data has been collected but not yet analyzed.

Endpoint is calculated as the CHANGE in slope of the UPSTROKE of pressure during intermittent pressure exerted on epidural syringe. Prior to epidural (a) is averaged for three intermittent pressures before epidural; change in upstroke slope after epidural expressed as %change from BL

$= (\overline{a1\text{-}3} - b) / \overline{a1\text{-}3} * 100$

Abstract #:SAT-17

Maternal Obesity on Postpartum Hemorrhage: Effect Modification by Mode of Delivery.

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Introduction: Obesity has been associated with postpartum hemorrhage (PPH) risk. Also, the risk of PPH varies according to mode of delivery. However, it is unclear whether the relations between maternal BMI and PPH vary according to mode of delivery.

Methods: We performed a retrospective, cohort study of women who delivered in California between 2008-2012. Linked patient discharge and birth certificate data were obtained from the California OSPHD Data Center. PPH cases were identified using ICD-9 codes (666.x). For the main exposure of interest, pre-pregnancy body mass index (BMI) was categorized using the WHO criteria for adult underweight, overweight, and obesity class 1, 2, and 3. We utilized mixed effects logistic regression models stratified by mode of delivery to analyze the risk of PPH according to BMI class, accounting for relevant maternal and obstetric confounders. Secondary analyses were performed for atonic PPH and severe PPH (classified as PPH with transfusion) as outcome measures.

Results: There were 2,176,673 deliveries in our study cohort; PPH prevalences in each BMI group stratified by mode of delivery (spontaneous vaginal delivery [SVD]; instrumental delivery [ID], and cesarean delivery [CD]) are presented in Table 1. Table 1 presents our stratified data analyses. Among SVDs, compared to those with normal BMI, the adjusted odds of PPH were increased for overweight women (aOR=1.09; 95% CI=1.07-1.12), obesity class I women (aOR=1.17; 95% CI=1.13-1.2), obesity class II women (aOR=1.12; 95% CI=1.06-1.17), and obesity class III women (aOR= 1.15; 95% CI=1.08-1.23). Among IDs, overweight and obese women were not at increased odds of PPH or atonic PPH. Among CDs, the risk of PPH decreased with increases degrees of obesity. Similar findings were observed with models examining atonic PPH. No evidence of interaction was observed between maternal obesity and delivery mode in a logistic model with severe PPH as the outcome of interest.

Conclusion: After SVD, obese women are at slightly increased risk of PPH and atonic PPH. In contrast, after CD, obesity was protective against PPH. The strength and magnitude of the associations were similar between BMI class with PPH and atonic PPH after stratifying for mode of delivery. These findings suggest a modifying effect of delivery mode on the association between obesity and PPH, which warrants further investigation.

Table 1. Maternal BMI and the Risk of PPH stratified by Mode of Delivery.

	BMI											
	Underweight (<18.5)		Normal (18.5 – 24.9)		Overweight (25 – 29.9)		Obesity Class I (30 – 34.9)		Obesity Class II (35 – 35.9)		Obesity Class III (≥40)	
PPH prevalence stratified by Mode of Delivery												
	N=61,438		N=721,708		N=355,529		N=161,243		N=59,932		N=29,791	
SVD	1504	2.4%	20,432	2.8%	11,090	3.1%	5325	3.3%	1953	3.3%	1042	3.5%
	N=4887		N=46,242		N=16,840		N=6264		N=2119		N=1043	
ID	177	3.6%	1913	4.1%	743	4.4%	274	4.4%	80	3.8%	54	5.2%
	N=19,927		N=300,261		N=192,126		N=109,799		N=51,767		N=35,757	
CD	424	2.1%	7388	2.5%	4337	2.3%	2226	2%	977	1.9%	665	1.9%
Adjusted Odds Ratios for the Association between Maternal BMI and PPH Stratified by Mode of Delivery*												
	aOR (95% CI)				aOR (95% CI)		aOR (95% CI)		aOR (95% CI)		aOR (95% CI)	
SVD	0.92 (0.87 – 0.97)		Referent group		1.09 (1.07 – 1.12)		1.17 (1.13 – 1.2)		1.12 (1.06 – 1.17)		1.15 (1.08 – 1.23)	
ID	0.96 (0.81 – 1.12)		Referent group		1.09 (0.99 – 1.19)		1.13 (0.99 – 1.3)		0.97 (0.77 – 1.23)		1.28 (0.96 – 1.71)	
CD	0.9 (0.81 – 0.99)		Referent group		0.97 (0.93 – 1.0)		0.91 (0.86 – 0.95)		0.84 (0.78 – 0.9)		0.81 (0.75 – 0.89)	
Adjusted Odds Ratios for the Association between Maternal BMI and Atonic PPH Stratified by Mode of Delivery*												
	aOR (95% CI)				aOR (95% CI)		aOR (95% CI)		aOR (95% CI)		aOR (95% CI)	
SVD	0.9 (0.84 – 0.95)		Referent group		1.1 (1.07 – 1.13)		1.19 (1.15 – 1.24)		1.12 (1.06 – 1.19)		1.16 (1.07 – 1.24)	
ID	0.85 (0.71 – 1.02)		Referent group		1.1 (1.0 – 1.21)		1.12 (0.97 – 1.3)		1.04 (0.81 – 1.34)		1.21 (0.87 – 1.67)	
CD	0.88 (0.78 – 0.99)		Referent group		0.99 (0.94 – 1.03)		0.95 (0.9 – 1.0)		0.91 (0.84 – 0.98)		0.87 (0.79 – 0.95)	

* Adjusted for maternal age, race/ethnicity, insurance type, educational background, trimester prenatal care initiated, chronic hypertension, gestational age at delivery, multiparity, multiple pregnancy, prior cesarean, labor, prolonged labor, induction of labor, chorioamnionitis, placental abruption, polyhydramnios, placenta previa, fibroids, stillbirth as fixed effects, and hospital as a random effect.

Data presented as n (%); aOR (95% CI)

aOR= adjusted odds ratio; CI = confidence intervals

BMI = body mass index; CD = cesarean delivery; ID = instrumental delivery; PPH = postpartum hemorrhage; SVD = spontaneous vaginal delivery.

Abstract #:SAT-18

Incidence, co morbidities and outcomes in parturients with pheochromocytoma: Analysis from the National Inpatient Sample

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Incidence, co morbidities and outcomes in parturients with pheochromocytoma: Analysis from the National Inpatient Sample

Background: Pheochromocytoma is a rare cause of hypertension in pregnancy (1). Prior studies have suggested that pheochromocytoma worsens maternal outcomes; however, there is a paucity of data about the incidence of pheochromocytoma in pregnancy and associated comorbidities and complications. Using a large national database, we examined the incidence, comorbidities and outcomes of pheochromocytoma in pregnancy,

Methods: We performed a retrospective cohort analysis using data from the National Inpatient Sample (NIS) from 2002 to 2013. The NIS database is the largest inpatient healthcare database in the United States and provides discharge data on approximately seven million hospital stays annually. It is maintained by the Healthcare Utilization Project (HCUP) of the Agency for Healthcare Quality and Research. The NIS approximates a 20% stratified sample of all discharges from all HCUP hospitals (N= 4,924 in 2013). National estimates are obtained by weighting NIS data to provide data estimates for 95% of all inpatient hospitalization in the United States.

Results: Among 53523298 deliveries, 671 (1.25/100,000 hospitalization) had an associated diagnosis of pheochromocytoma. Parturients with pheochromocytoma experienced a higher mortality (1.4%) than healthy parturients (0.02%), although this was not statistically significant (p=0.16). Pheochromocytoma was associated with an increased incidence of Congestive heart failure (CHF), Peripartum cardiomyopathy (PPCM), hypertension, preeclampsia, renal failure and metabolic abnormalities (See Table).

Conclusion: Pheochromocytoma is associated with worse maternal outcomes and increased morbidity and mortality in pregnancy. Furtherwork needs to be performed to better improve outcomes in these patients

Characteristics of Pregnant Patients with and without Pheochromocytoma

		Weighted number of patients (%)		P-Value
		Pheochromocytoma Present	Pheochromocytoma Absent	
Patient Characteristic				
Age (years)	20-24	24 (3.61)	1310828 (2.47)	0.0522
	25-29	347 (51.72)	34025664 (64.20)	
	30-34	225 (33.51)	16257200 (30.68)	
	35-39	33 (4.96)	998771 (1.88)	
	40-44	37 (5.52)	41910 (0.08)	
Race	White	292 (51.05)	22248156 (51.49)	0.9184
	Black	106 (18.47)	6303115 (14.59)	
	Hispanic	120 (21.02)	10122700 (23.43)	
	Asian/ Pacific Islander	24 (4.21)	2101669 (4.86)	
	Other	25 (4.42)	2107305 (4.88)	
Congestive Heart Failure		24 (3.54)	61968 (0.12)	0.0303
Hypertension		275 (40.92)	1125409 (2.10)	0.0000
Renal Failure		28 (4.11)	34842 (0.07)	0.0170
Peripartum Cardiomyopathy		15 (2.16)	39261 (0.07)	0.0946
Preeclampsia		90 (13.39)	1227992 (2.28)	0.0002
Metabolic abnormalities		138 (20.53)	667140 (1.25)	0.0000

References:

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Abstract #:SAT-19

The Impact of Gestational Weight Gain on risk of Obstructive Sleep Apnea

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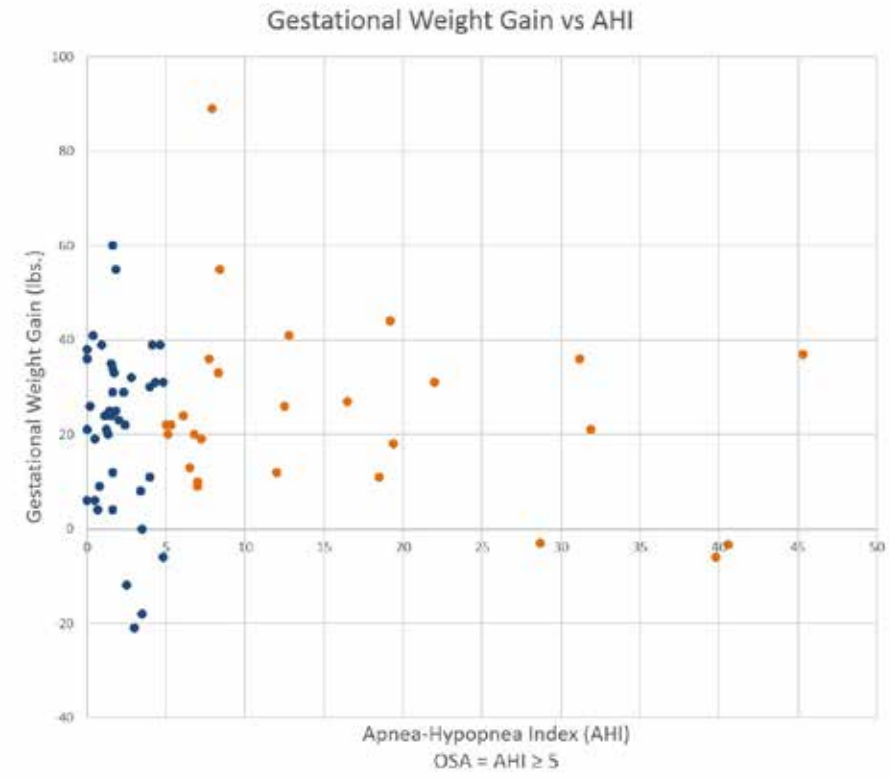
Objective: To determine whether the amount of gestational weight gain or adherence to Institute of Medicine(IOM) gestational weight gain guidelines impacts the risk of testing or screening positive for obstructive sleep apnea (OSA).

Study Design: This is a secondary analysis of a prospective cohort using overnight Watch-PAT200® to diagnose OSA. Women analyzed were at 32-35 6/7 weeks gestation, noted to have an anterior or posterior placenta and delivered at Forsyth Medical Center. OSA was defined as an apnea-hypopnea index (AHI) of ≥ 5. Minimum and average O2 saturation, responses to the Berlin questionnaire, STOP BANG scores, Mallampati score, medical and obstetric data were measured or abstracted. The hypothesis that women who have a larger gestational weight gain have an increased risk for screening or testing positive for OSA in the third trimester was tested using a Students T-test. Linear regression analysis was used to evaluate the relationship between gestational weight gain and minimum or average oxygen saturation values as measured by pulse oximeter during overnight Watch-PAT200® study.

Results: 73 women had complete sleep studies and screening data. Demographics were similar between groups. There was no difference in gestational weight gain in our cohort of women due to screening positive for OSA by Berlin Questionnaire (p = 0.15), STOP BANG Screening (p = 0.62), or Mallampati Score (p = 0.10). Additionally, there was no difference in gestational weight gain based on objective OSA diagnosis (p = 0.51) (Figure 1). There was no correlation between gestational weight gain and mean (p=0.17) or minimum (p=0.42) oxygen saturation during overnight Watch-PAT200® study in the third trimester.



Conclusion: In our cohort, no relationship was found between gestational weight gain and either screening or testing positive for obstructive sleep apnea in the third trimester. Additionally there were no differences in mean or minimum oxygen saturation levels during an overnight sleep study based on gestational weight gain.

Abstract #:SAT-20

SIMULATED INTERPROFESSIONAL TEAM TRAINING FOR OBSTETRIC EMERGENCIES OUTSIDE OF THE LABOR AND DELIVERY UNIT: UNCOVERING HIDDEN ERRORS

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Introduction: Integrating medical simulation into interprofessional (IP) provider education can improve responses to medical crisesand uncover latent systems errors. Obstetric (OB) emergencies that require transporting a maternal patient between floors require highly complex team coordination. Despite having a robust institutional labor and delivery (L&D) care model and culture, with anesthesia providers seemingly well-integrated into OB care decisions, OB emergencies occuring outside of L&D require coordinating care through unfamiliar pathways and communication systems. We sought to test our system for latent errors using both a focus group approach to uncover healthcare members' mental models, and in situ IP simulation using a simulated antepartum (AP) patient who develops an acute cord prolapse. We chose this combination to understand how providers in all role groups approach this emergency, both from a theoretical as well as an actual management standpoint.

Methods: This study was approved by IRB. We held focus groups using a semi-structured interview approach, followed by high-fidelity IP team training simulations and debriefings facilitated by experienced simulation instructors. Six focus groups were held according to role, and each consisted of either three RNs or three physician providers. The RN groups were made up of RNs from AP, postpartum, and L&D units. The physician focus groups contained OB/GYN generalists, maternal fetal medicine specialists, and anesthesia attendings. These transcripts were reviewed by two independent reviewers (EC, RDM). Seven IP team training simulations were conducted in situ with a simulated AP patient with fetal umbilical cord prolapse. Each simulation included two obstetric providers, two resource RNs, two staff RNs and one obstetric anesthesia attending, which paralleled typical OB care provider coverage. Each IP team training scenario was immediately followed by a debriefing.

Results: In focus group discussions of ideal management, all groups highlighted immediate transport to the operating room (OR) for emergent cesarean delivery. None of the groups highlighted notifying the OB anesthesia team during discussion despite universal agreement that the patient needed an emergent anesthestic. Simulations and debriefings highlighted challenges in transporting the patient to the OR, as well as having key team members present, with no standardized approach to alerting the anesthesia team. All groups noted challenges entering the L&D unit OR due to lack of standardized access.

Discussion: When faced with a simulated OB cord prolapse, our OB IP providers' care and communication differed from their mental models of ideal management, and they faced hidden challenges in coordinating care. This included physical transport of the patient to the OR, and uniformly including anesthesia providers. Addressing these through uniform processes may help support providers who care for maternal patients transported to L&D.

Abstract #:SAT-21

Effects of Epidural or General Anesthesia during C-Section on Newborn Neurodegeneration Biomarker S100β Short Title: Anesthetic Neurotoxicity in Newborn after C-section

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Background: Preclinical evidence suggests that general anesthetics can dose-dependently induce neurodegeneration in the developing brains of animals which can be reliably determined by measurement of blood S100β, but this correlation remains unclear in humans.

Methods: A prospective clinical study comparatively measured changes of brain damage biomarker S100β ratio of umbilical artery over vein (changes after fetus circulation) immediately after delivery under C-section with either epidural or general anesthesia. Newborn blood gas measurements, APGAR scores and maternal wellbeing were also compared.

Results: Compared to epidural anesthesia, general anesthesia significantly decreased the S100β ratio of umbilical artery over the vein, without changing the S100β level in the vein of the mother. There was no significant difference between general and epidural anesthesia when comparing other maternal and newborn parameters.

Conclusion: These results suggest there was no evidence of fetal brain damage between general versus epidural anesthesia used for C-sections, although S100β is higher in epidural anesthesia, with unclear mechanisms.

Key Words: Anesthesia, S100β, Neurodegeneration, C-section, Newborn.

Abstract #:SAT-22

Assessment of critical care education in the obstetric anesthesiology fellowship curriculum

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Introduction: Currently, the Accreditation Council for Graduate Medical Education (ACGME) does not require a formal intensive care unit (ICU) rotation during the OB anesthesiology fellowship year.1 Given the increasing rate of severe obstetric morbidity in the US, there may be a need for formal ICU training to be incorporated into OB anesthesiology fellowship curricula.2 We sought to identify whether formal ICU training exists among current US and Canadian OB anesthesiology fellowship programs.

Methods: In order to ascertain whether a gap in critical care education and training exists in the obstetrical anesthesiology fellowship curriculum, a survey of critical care curriculums was developed by an expert panel. After IRB approval, the electronic survey was emailed to the 49 ACGME (31) and non-ACGME (16) accredited OB anesthesiology fellowship program directors in the US and Canada. Responses were collected in an anonymous fashion. Univariate statistics were used to evaluate survey responses as percentages.

Results: The survey response rate was 49% (24 out of a total of 49 programs). The percentage of responding programs that require a formal ICU rotation was 12%. More than half of responding program directors (58%) felt that fellows would acquire critical care knowledge more easily if they rotated through a formal critical care setting that focused on care in the postpartum period. The majority (83%) of programs did not have a specific protocol to identify high-risk patients who may require peripartum ICU admission.

Conclusion: Despite increasing emphasis on ICU expertise in OB, our study reveals a heterogeneity and deficiency in standardized critical care curriculum among OB anesthesia fellowship programs. In our survey, only a minority of OB anesthesia fellowships include a specific ICU rotation. However, over half of respondents indicated that an ICU rotation would be of educational benefit to the fellow. The training process for OB anesthesiologists should be periodically reviewed.3 Our survey highlights OB critical care as a potential area of improvement in the OB anesthesiology fellowship curriculum. Efforts to enhance and standardize critical care curriculum in OB anesthesiology fellowship programs may be warranted.

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Abstract #:SAT-23

A retrospective analysis of labor analgesia and patient satisfaction about childbirth and pain relief: Is the HCAHPS score a useful tool?

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Background: Patient satisfaction has emerged as a critical factor for value-based incentive payments in the US healthcare system. The Affordable Care Act (ACA) uses the Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS), a 27-question survey designed to assess multiple domains of the patient experience, and the Centers for Medicare & Medicaid Services uses HCAHPS as a reimbursement modifier. Studies evaluating patient satisfaction and epidural pain relief have varying results; maternal satisfaction has correlated both directly and inversely with epidural analgesia.(1,2) We hypothesize that women who have labor analgesia and a successful vaginal delivery will report higher patient HCAHPS scores compared to women who opt for natural childbirth (NCB), or who require a cesarean delivery after trial of labor, due to enhanced patient satisfaction with labor pain relief and expected labor outcome.

Methods: After IRB approval, we performed a retrospective analysis of patients who completed the HCAHPS survey after their admission for labor and delivery at a single academic medical center between December 2015 and December 2016. Four HCAHPS-derived survey answers about pain relief and satisfaction were extracted. Mode of delivery, use of analgesia, and assisted second stage (forceps or vacuum) were evaluated. Failure to progress in labor with cesarean delivery, and failure of an expressed desire for natural childbirth (NCB) were noted. Fisher's exact test was performed.

Results: We identified 455 patients admitted for vaginal delivery during the study period who completed the HCAHPS survey upon hospital discharge. We found no association between higher HCAHPS scores and use of neuraxial analgesia for vaginal delivery compared to NCB, failed NCB or unplanned cesarean delivery.

Discussion: We found no clear correlation between labor pain relief or successful vaginal delivery and higher HCAHPS-based satisfaction scores. It is possible that the complex relationship between neuraxial analgesia and patient satisfaction cannot be determined by the HCAHPS-based satisfaction questions alone. A limitation is that HCAHPS response to general satisfaction questions are counted in a "top box" manner, which means that a positive response to a question with a scale from 1-10 is positive only if scored 9 or 10. This scoring mechanism limits the interpretation of results in a more nuanced fashion. Pre-labor expectations and antenatal education are important factors determining satisfaction outcomes that cannot be elicited from the HCAHPS survey. A complex relationship entailing psychological, societal and cultural factors exists between pain, labor analgesia and maternal satisfaction. A more tailored approach than HCAHPS may be necessary to determine the relationship between epidural pain relief and patient satisfaction.

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Abstract #:SAT-24

Development of a System to Identify Antenatal Non-Obstetric Surgery Cases: Meeting Fellowship Program Educational Goals and ACGME Requirements

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Background: Experience providing anesthesia for antenatal non-obstetric/non-fetal (NONF) surgery is not only an ACGME OB Anesthesiology fellowship program requirement, its importance stems from the spectrum of surgeries performed on pregnant women, and anesthetic/surgical effects on mother and fetus.(1) ACGME minimum case requirements for high-risk maternal and fetal deliveries, vaginal and cesarean, are routinely exceeded by a wide margin, as they are the exclusive domain of OB anesthesiologists. In contrast, antenatal case requirements are often just met, being performed away from L&D, often by non-subspecialists. Our aim was to increase advance identification of non-OB antenatal surgery cases in order to augment fellow participation in these educationally valuable cases.

Methods: Three sequential data-driven interventions:

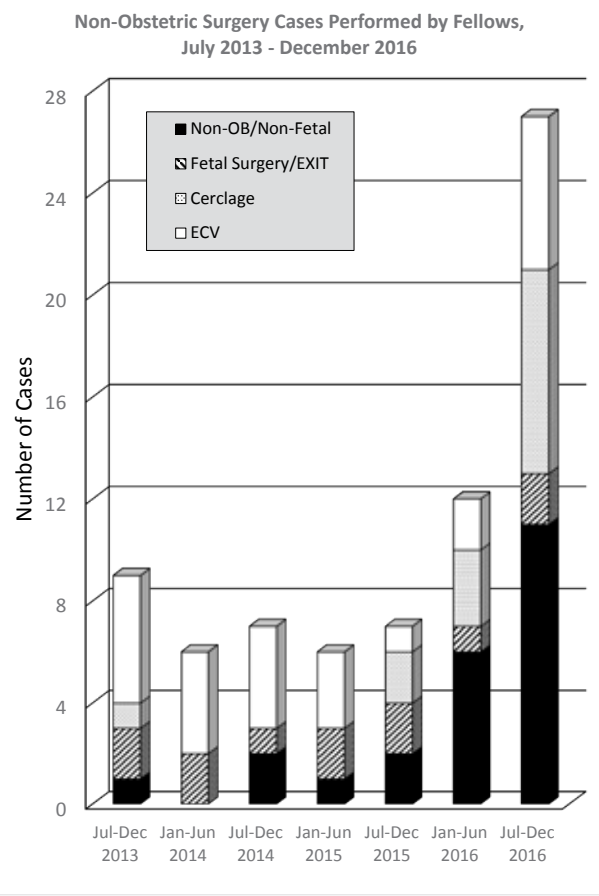
I-1: 9/2013-2/2014: "Agreements to notify" – clinical scheduler/leader-dependent; pregnant patients scheduled for non-OB surgery; requests for pre-op fetal assessment.

I-2: 11/2014-2/2015: "Automated email notify" – daily pre-op database query for words indicating pregnancy; +hCG results.

I-3: 6/2016: Enhanced sensitivity of automated notify – code revised; early morning database query; optimized hCG threshold level.

OB anesthesia fellow case logs (accurate & complete from AY 2013-14) were queried for antenatal surgical procedures. Antenatal case types: external cephalic version; cervical cerclage; fetal surgery/EXIT; and NONF.

Results: Number of fellows: one in each of AY2013-14, AY2014-15, AY2015-16; two in AY2016-17. Fellow participation in antenatal procedures is presented in 6-month epochs (Figure). I-1 had no impact on case numbers. Fellows participated in 15 cases in AY2013-14, 13 in AY2014-15, including only 4 NONF cases in both years combined. Similar case numbers were observed in 1st half AY2015-16 (7 total, 2 NONF), prior to I-2. After I-2, total cases (12) rose sharply, attributable to increase in NONF cases (6). Following I-3, a further increase (total 27) occurred in 1st half AY2016-17, owing to increases in cerclage (10) and NONF (11). Logged cases in excess of required 10 per fellow were 5 (AY13-14), 3(AY14-15), and 9(AY15-16). In 1st half AY2016-17, case numbers for two fellows are already 18 and 9.



Conclusion: Through an iterative improvement process, we were able to effect nearly a four-fold increase in our fellow's case experience using an automated IT solution.

Reference:

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Abstract #:SAT-25

Effect of bupivacaine dose in combined spinal epidurals in laboring parturients: A randomized double-blinded prospective study -- Preliminary results

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Effect of bupivacaine dose in combined spinal epidurals in laboring parturients: A randomized prospective double-blinded study— Preliminary results

Background: Combined spinal epidural anesthesia (CSE) is a safe and simple procedure which provides adequate analgesia in laboring patients. Two possible complications of this technique are maternal hypotension and fetal bradycardia, which have been demonstrated to result from both rapid pain relief and sympathetic blockade (1). Previous studies have shown the ED95 of bupivacaine to be 1.66mg (less than the standard 2.5mg being used) (2). It is not well-studied whether the smaller dose of local anesthetic will result in a lower complication rate.

Material and Methods: Two hundred patients (ASA 1-2) between 37-42 weeks gestational age were sought from Labor and Delivery patients who had expressed interest in neuraxial anesthesia for labor. Excluded patients were parturients with pre-eclampsia, gestational hypertension, and parturients in whom spinal anesthetics are contraindicated or cannot be performed. Patients were administered a spinal dose that was removed from the pyxis machine, loaded daily by pharmacy, labeled only with a numerical code. The syringe contained 20mcg of fentanyl with 2.5mg, 1.66mg, or 1.25 mg of bupivacaine. VAS pain score, fetal heart rate, and maternal blood pressure were recorded prior to administration and regularly for the first hour afterwards.

Results: Although currently 84 patients have been enrolled, some results are salient enough to report without unblinding of the dosing syringes. Of the 84 patients, only one had fetal bradycardia requiring treatment with nitroglycerin. Additionally, in 80 of the 84 patients, the VAS pain score at 8 minutes was less than 3.

Preliminary Conclusions: CSE with fentanyl 20mcg and varying doses of bupivicaine (1.25mg to 2.5mg) does not cause significant fetal bradycardia. Additionally, superior analgesia (VAS less than 3 at eight minutes) was achieved by all three doses of bupivacaine in the CSE. Unblinding the study after full enrollment will demonstrate the effect of the bupivicaine doses on maternal hypotension.

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Abstract #:SAT-26

Active Blood Management Practices on Labor and Delivery: Using Cost-Analysis to Evaluate Blood Product Utilization

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Introduction: Blood transfusion is one of the most overused procedures in the US.[1] Patient blood management (PBM) programs, including evidence-based transfusion practices and protocols reduce the use of blood products and patient morbidity in postpartum hemorrhage (PPH).[2,3,4] Hospitals have demonstrated cost savings after PBM program implementation.[5] This study analyzes blood utilization and cost-savings on labor and delivery (LD) after implementation of a PBM program and early cryoprecipitate (CRYO) repletion for PPH.

Methods: This IRB-approved retrospective analysis used the electronic database warehouse to identify women who received blood products on LD and the post-partum floor. Two time periods, pre (January 1, 2012 to October 31, 2013) and post-implementation (November 1, 2013 to December 31, 2015) of a PBM program were studied. The PBM program included: PPH protocol + protocol requiring Hgb checks between pRBC units in stable patients. Data was analyzed based on blood product transfusion before and after PBM program implementation. Data was also analyzed based on pRBC utilization with early (prior to or concomitant with pRBC) vs late or no CRYO transfusion. Institutional cost/unit data for blood products was used to determine average costs for the two time periods, and the average cost savings per group per time period were determined. A cost savings equates a decrease in utilization, and a cost increase indicates increased utilization.

Results: 351 patient received transfusions during the 4 yr period. Product type, location, date and order of product transfusion was available for analysis. Utilization of pRBCs, CRYO, platelets and FFP all declined during the study period. Cost analysis of product utilization following the implementation of the PBM strategy is presented in Table 1.

Discussion: This study demonstrates that PBM practices that include a PPH protocol, transfusion protocol (requiring CBC between pRBC units) and early repletion of fibrinogen may reduce the quantity of blood products used and therefore the cost associated with unnecessary transfusion. The estimated cost savings per year at our institution after the implementation of all three methodologies was 23.4%.

Table: Cost Savings Following Implementation of a Patient Blood Management Program

	Cost Savings* pRBC
Savings attributable to implementation of PBM**:	
Labor and Delivery	28.5%
Postpartum Floor	-29.2%
Combined	21.7%
Savings attributable to early CRYO usage†:	
Labor and Delivery	47.6%
Postpartum Floor	0.0%
Savings attributable to early CRYO usage post implementation of PBM‡:	
Labor and Delivery	44.1%
Postpartum Floor	13.6.%
	Cost Savings CRYO
Savings attributable to Implementation of PBM:	14.4%
	Cost Savings FFP
Savings attributable to Implementation of PBM	42.3%
	Cost Savings Platelets
Savings attributable to Implementation of PBM:	45.9%

Abbreviations: PBM – patient blood management, pRBC- packed red blood cells, CRYO – cryoprecipitate, FFP- fresh frozen plasma
*Cost savings indicates a reduction in blood product utilization
**PBM: the combined implementation of the PPH protocol and required CBC between pRBC units
†Comparison between patients who received early cryoprecipitate transfusion (prior to or concomitant with pRBC) vs late transfusion.
‡Comparison between patients who received early cryoprecipitate transfusion (prior to or concomitant with pRBC) pre and post-implementation of PMB.

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Abstract #:SAT-27

The Relationship of Longitudinal Inflammatory and Oxidative Stress Biomarkers During Pregnancy and Labor Epidural Associated Temperature Elevation

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Introduction: Labor epidural associated fever (LEAF) is the leading cause of non-infectious intrapartum fever. Although the associated risk factors overlap with intraamniotic infection, (1) LEAF appears to be independent and the consequence of an inflammatory reaction.(2-4) Differences in pro-inflammatory cytokines at the time of labor admission, specifically IL-6, have been identified in patients who go on to develop LEAF. (5) How and when cytokine profiles are altered is unknown; we hypothesized that such changes, as well as increased markers of oxidative stress, could be detected earlier in pregnancy. (6)

Methods: This study is a secondary analysis of prospectively collected data from a nested case control study that consisted of 130 women who delivered prior to 37 weeks and 352 randomly selected women who delivered at or after 37 weeks. (7) Maternal plasma and urine samples were obtained at 4 visits (median 9.7, 17.9, 26.0 and 35.1 weeks gestation). Multivariable logistic regression models were fit to assess the association between biomarker (IL-1b, IL-6, IL-10, TNF-a, CRP, 8-OHdG, 8-Isoprostane) levels and the development of clinical fever (≥38°C) or a temperature increase of ≥1°C above baseline during labor epidural analgesia. Appropriate exclusion criteria were used.

Results: Patients who developed a fever were more likely to be younger and primiparous with longer labors, longer duration of membrane rupture and had more cervical exams. After controlling for maternal age, primiparity, length of epidural, number of cervical exams, we found no significant difference between individual biomarkers averaged over visits 1-3 and the risk of temperature elevation or clinical fever. During visit 4, a significant association with IL-1b (OR 0.64, 95% CI (0.44, 0.92) and associations approaching significance with IL-6 (OR 0.62, 95% CI (0.37, 1.01) and 8-Isoprostane (OR 0.67, 95% CI (0.45, 1.00) were found with temperature elevation. No significant associations were found for clinical fever (≥ 38°C) at visit 4.

Conclusion: Elevated levels of maternal plasma inflammatory biomarkers and markers of oxidative stress measured longitudinally throughout pregnancy do not appear to be associated with LEAF. In contrast, higher levels of maternal plasma inflammatory biomarkers appeared in adjusted models to be protective against LEAF. Although the nested case-control study was not designed to investigate our specific outcome, the absence of observed differences in early gestational inflammatory and oxidative stress markers may indicate that LEAF is the result of alterations in late pregnancy or during labor.

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Abstract #:SAT-28

Epidural Labor Analgesia Dose Not Reduce The Score of Edinburgh Postnatal Depression Scale in Japan

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Background: Postpartum depression (PPD) is a common psychiatric disorder in parturients after delivery. The Edinburgh Postnatal Depression Scale (EPDS) is a widely used screening tool for PPD, and the reliability and validity of EPDS in Japanese women has been confirmed. However the etiology remains unclear, and multiple factors may be involved. In Japan, not many maternity hospitals and clinics use epidurals, most Japanese parturients alleviate pain in others ways such as breathing, movement, and massage. Furthermore, there is a more positive image of a women capable of natural birth. In this study, we investigated whether epidural labor analgesia was associated with a decreased risk of postpartum depression development in Japan.

Methods: Five hundred nineteen parturients who were preparing for a vaginal delivery were enrolled in this retrospective cohort study. Epidural labor analgesia was performed in 72 of 519 patients on their request. Parturients' mental status was assessed with the EPDS at 4 days and 2 weeks after delivery. We used the Japanese version of EPDS and the cut-off point of ≧9 in accordance with the previous study. A score of 9 or higher on the scale at 2 weeks was used as an indication of postpartum depression. Parturients' characteristics together with perinatal variables were collected. Multivariate logistic regression analysis was performed to assess an association between the use of epidural analgesia and the score of EDPH.

Results: Postpartum depression occurred in 8.3% (6 of 72) of parturients who received epidural labor analgesia and in 5.4% (24 of 447) of those who did not (P = 0.25). Use of epidural labor analgesia was not associated with a decreased risk of postpartum depression (odds ratio 1.31, 95% confidence interval 0.46–2.37). The median postpartum EPDS score at 2 weeks was 3 in labor epidural analgesia (range: 0–14, S.D.=3.40) and also 3 in no epidural labor analgesia (range: 0-18, S.D.=3.12). There was a higher correlation between the EPDS scores at 4 days and those at 2 weeks postpartum in who received epidural labor analgesia than those who did not (Pearson correlation coefficient = 0.74 vs 0.64). The decrease of the EPDS score at 2 weeks in parturients who did not receive epidural analgesia was greater than that of who recieved labor epidural ($P<0.01$ vs $p=0.11$).

Conclusions: Epidural labor analgesia was not associated with decreasing the score of EPDS in Japan. Further study with a large sample size is needed to evaluate the impact of epidural analgesia on the occurrence of postpartum depression.

Abstract #:SAT-29

Prerequisite to a smart spinal needle: Development of a pilot testing model to study spinal needle stiffness and buckling forces

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Introduction: Advancements in spinal needle size and tip design have given clinicians more choices when performing neuraxial procedures based on the patient and clinical scenario. Reducing the needle gauge has reduced the incidence of complications, such as postdural puncture headache, but may cause higher rates of placement failure or needle breakage in older or morbidly obese patients. The primary goal of the study is to design an experimental testing model to evaluate needle stiffness by comparing the forces required to buckle a spinal needle and the associated displacement of the needle from a straight trajectory.

Methods: Four gauges (22G, 24G, 25G, 27G) of ten 127mm IMD/Gertie Marx needles were inserted with increasing vertical force into a 50 mm uniform ballistic gel sample using a MTS servohydraulic test system with a custom designed needle grip fixture made on a 3D-printer. The 11% by mass 250 bloom Knox ballistic gel is composed of collagen and is comparable to human muscle tissue. The critical buckling load (N) was defined as the maximum compressive force sustained by the spinal needle during axial loading before buckling occurs. In addition, buckling displacement (mm), insertion energy (J), insertion stiffness (N/mm), and buckling energy (J) were determined with sensors and camera measurements with $p<0.05$ considered significant.

Results: The mean critical buckling load (elastic force, N) and the needle stiffness (N/mm) of the 127mm IMD spinal needle differed significantly at each of the four tested gauges ($p<0.0001$, see Figure). The critical buckling displacement and buckling energy differed significantly in all needles except between the 25G and 27G needles. Needle insertion energy and stiffness were significantly different between all needle gauges (data not shown).

Conclusion: This pilot testing model provides accurate and reproducible measurements of spinal needle stiffness and the forces required to initiate buckling in a human tissue equivalent design. Future studies comparing spinal needles of different lengths, gauges, and manufacturers can be studied at various tissue depths to provide useful clinical data to assist clinicians in appropriate needle choice.

IMD provided the spinal needles. Study supported by WFSM Anesthesia research grant.

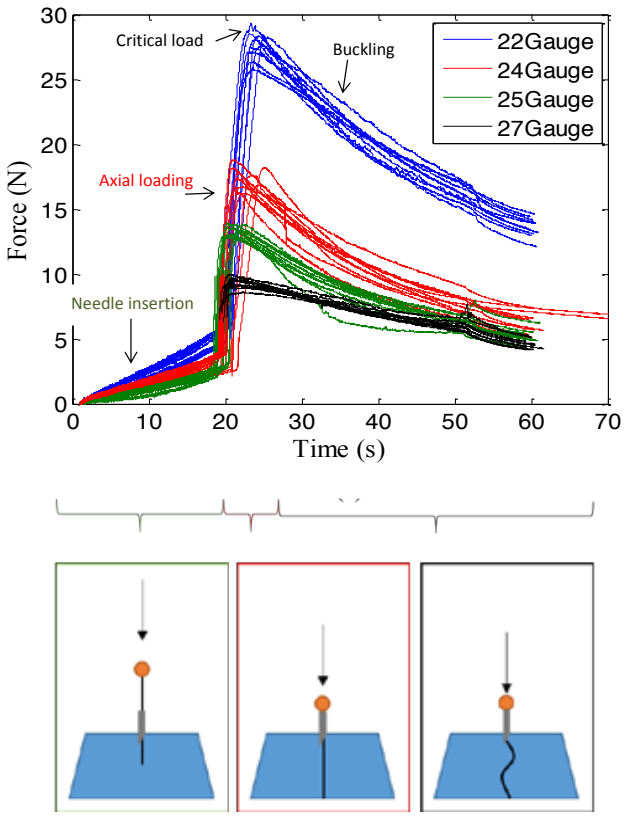

Figure 1. Force vs. time of ten buckling tests performed with IMD 22Gauge, IMD 24Gauge, IMD 25Gauge, and IMD 27Gauge spinal needles.

Abstract #:SAT-30

Retrospective review of blood patch placement rates for post-dural puncture headaches by neuraxial anesthetic technique type in an academic labor and delivery unit

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Background: Post-dural puncture headache (PDPH) is one of the more common complications from use of neuraxial techniques in the parturient. In severe cases, epidural blood patch may be required to treat PDPH. In addition to the conventional epidural technique (EPL), other neuraxial techniques for labor analgesia or cesarean delivery involve a dural puncture: single shot spinal injection (SSS), combined spinal epidural (CSE), and, most recently, dural puncture epidural (DPE) techniques. The comparative rates of complications for each have not been well established.

Objective: To review the rate of epidural blood patch procedures by neuraxial technique type in patients receiving care in the labor and delivery unit.

Methods: Retrospective chart review of neuraxial anesthetics was performed at a large academic center's labor and delivery unit. Data available on all patients over an 18-month span who received care from the obstetric anesthesia team was gathered from the institution's electronic medical record reporting tool as well as a manually maintained case followup database. We computed risk ratios for each technique compared to EPL as the reference with 95% confidence intervals and p-values using Fisher's exact test (SAS 9.4, Cary NC).

Results: During the review period, 4288 EPLs, 1304 SSSs, 592 CSEs, and 243 DPEs were performed. Among those who received neuraxial anesthesia, 38 patients developed PDPH requiring at least one blood patch. Compared to EPL, the relative risk ratio (RR) for SSS was 0.76 (95% confidence interval [CI] 0.32-1.85, p=0.16), CSE was 0.84 (95% CI 0.26-2.77, p=1.0), and DPE was 2.03 (95% CI 0.62-6.67, p=0.20).

Conclusions: The rate of blood patch use in patients receiving neuraxial techniques involving a small needle dural puncture are low and not significantly higher than the rates for an EPL technique. The SSS, CSE and DPE techniques should be offered for their salient advantages with minimal concern for increasing the rate of PDPH requiring blood patch.

Abstract #:SAT-31

The Effectiveness of Transversus Abdominis Plane Blocks for Post-Cesarean Delivery Analgesia in Women on Methadone or Buprenorphine Maintenance During Pregnancy: A Multi-center, Retrospective Cohort Study

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Introduction: Opioid abuse or dependence in pregnancy increased by 127% from 1998-2011 (1). Women on maintenance opioid therapy have a higher risk of cesarean delivery (CD) and increased postoperative pain requirements (2). Although post-CD analgesia with transversus abdominis plane (TAP) blockade offers little benefit compared to intrathecal morphine for patients in the general obstetric population (3), it is unclear whether TAP blockade may have greater benefit in select high-risk populations. Our hypothesis was that the addition of a TAP block to our multimodal pain regimen would confer superior post-CD analgesia in patients on methadone or buprenorphine maintenance opioid therapy during pregnancy.

Materials and Methods: After IRB approval, we reviewed the anesthesia records of women on buprenorphine or methadone maintenance during pregnancy who underwent CD with Pfannenstiel incision under spinal anesthesia at two academic institutions from January 2011 through January 2017. Exclusion criteria included women with uterine incision other than Pfannenstiel, general or epidural anesthesia without intrathecal opioid dosing, and significant perioperative morbidity. Our primary outcome was analgesia, defined as highest reported visual analog scale (VAS) for pain in the first and second 24 hours after surgery. Secondary outcomes were post-CD intravenous or oral opioid requirement and exposure to non-opioid analgesics. Wilcoxon rank sum and Fisher's exact tests were performed.

Results: We identified 114 patients, of which 55 met our inclusion criteria, and 5 received TAP block. Maximum VAS scores at 24 hours were 7.0 + 2.2 vs. 5.6 + 0.9 for non-TAP vs. TAP groups ($p = 0.158$) and maximum VAS scores at 48 hours were 6.3 + 1.9 vs. 8.2 + 1.6 for non-TAP vs. TAP groups ($p = 0.0765$). There was no difference in opioid requirement between the two groups. Use of multimodal pain regimens involving > 2 non-opioid analgesic adjuncts was standard in both TAP and non-TAP groups, with no difference in exposure.

Conclusion: Our study suggests no difference in 24- and 48-hour maximum VAS scores when a TAP block is added to a multimodal regimen for women on methadone or buprenorphine maintenance in pregnancy, after CD with intrathecal opioid. We demonstrate that despite extensive multimodal analgesic exposure, VAS scores are quite high in this patient population. Given the challenge in managing patients postoperatively who have substantial baseline opioid requirement, the importance of multimodal analgesia cannot be overstated. Analysis of additional patients in this study over time may further elucidate the role for TAP blockade, whether it benefits patients who do not receive intrathecal opioid or exposure to other analgesics, and temporal trends that may reinforce the need for catheter-based analgesics (TAP catheters or epidural infusion). Further studies are warranted.

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2. Meyer M et al. 2010
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Abstract #:SAT-32

Postpartum Tubal Ligation (PPTL) and Type of Anesthesia: How successful are our neuraxial interventions?

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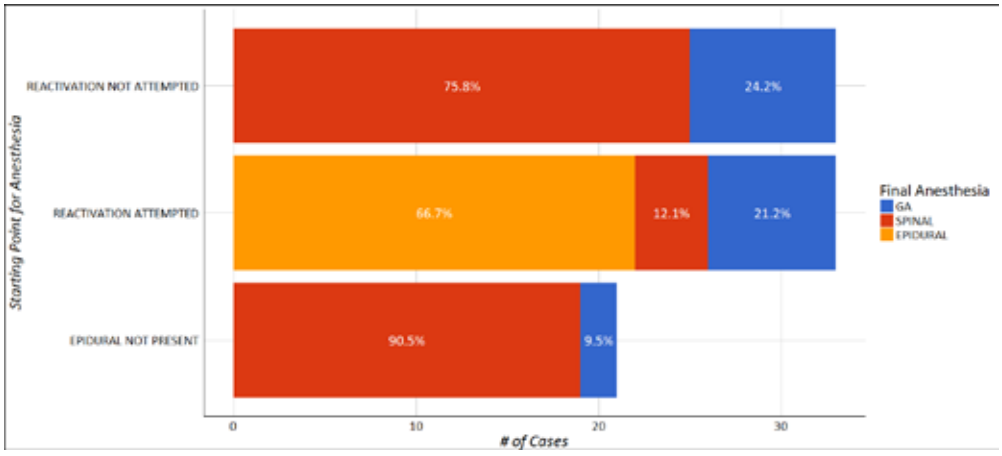
Background: Tubal ligation in the immediate postpartum period is typically performed on the Labor and Delivery Suite. Use of an existing epidural catheter has been advanced as an efficient way to provide anesthesia for PPTL(1). Reported epidural reactivation success rates vary from 74% to 92%. Predictors for failure include poor patient satisfaction with labor analgesia, increased delivery-to-reactivation time, and the need for top-ups during labor and delivery(2). Within our practice and the obstetric anesthesia community, some providers have suggested that labor analgesic epidurals activated for PPTL have a failure rate that does not justify leaving a catheter in place after delivery for subsequent attempts at reactivation. We undertook this study to evaluate this claim and determine if there are predictors that can refine our anesthetic decision making.

Methods: After obtaining IRB approval, a retrospective chart review from July 2010 to July 2016 was conducted using CPT codes. Demographic data, obstetric data and anesthetic data (labor analgesia administration, length of epidural catheter in epidural space, top-up requirements, time of catheter reactivation, final anesthetic technique and corresponding doses for spinal and epidural anesthesia) were obtained.

Results: Data from 93 patients were analyzed. Distribution of anesthetic technique used for the PPTL is presented in figure 1. 70 patients had labor neuraxial analgesia, and the reactivation success of epidural catheters was 66.7%. No demographic or anesthetic factors were predictive of failure to reactivate. The success rate for spinal anesthesia, both de novo and after unsuccessful epidural reactivation, was 80%. Intrathecal fentanyl doses above 20 mcg added to bupivacaine were associated with spinal failure (p=0.001).

Conclusions: Our successful postpartum epidural reactivation rate for tubal ligation is lower than the range reported in the literature. We found no association between previously reported risk factors and unsuccessful epidural reactivation. The success rates for both spinal anesthesia and epidural reactivation for PPTL is lower than the reported 95% for cesarean delivery(3). This may reflect a lower level of motivation on behalf of both the patients and anesthesia providers to tolerate suboptimal anesthesia when fetal considerations are removed.

Figure1. Distribution of Final Anesthetic Technique for Postpartum Tubal Ligation in Relation to Success of the Initial Technique



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Abstract #:SAT-33

Variable intrathecal opioid dose and incidence of prolonged decelerations after CSE analgesia for labor

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Background: Combined-spinal epidurals (CSE) for labor analgesia provide rapid onset and superior pain relief compared to lumbar epidurals. Prolonged decelerations (>2 minutes) may occur after CSE initiation, with a reported incidence between 4 and 21%(1,2) despite no significant changes in blood pressure(3) These abnormalities in fetal heart rate can require intrauterine resuscitation; and operative delivery may be warranted if they persist. We sought to quantify the incidence of prolonged decelerations after CSE in our institution and the need for emergent cesarean delivery.

Methods: Using a de-identified dataset, we conducted a retrospective chart review of labor CSEs placed between May and December 2016. We gathered demographic, obstetric (use of oxytocin, prolonged decelerations within 20 minutes of CSE placement, number of these incidents which led to immediate cesarean delivery) and anesthetic (pain scores, dose of intrathecal (IT) fentanyl, blood pressure before and after CSE, use of rescue medication for decelerations) data. Patients were grouped and analyzed by IT dose of fentanyl used in the CSE. Our standard CSE includes isobaric bupivacaine 2.5mg and 2.5-15mcg IT fentanyl per provider preference.

Results: A total of 585 records were reviewed. The overall incidence of prolonged deceleration after CSE was 4.3% (n=25), with a mean time to deceleration of 13 (±5) min. There was no association of incidence of fetal decelerations with varying opioid doses (p=0.11). Demographic data, use of oxytocin and incidence hypotension was similar between groups. Lower pain scores were observed in the 15mcg group compared to all other groups (p<0.05). Two cases of emergent cesarean delivery were recorded in the 10mcg dose range. See table 1.

Conclusions: The incidence of prolonged decelerations after CSE (4.3%) was comparable to published data and was independent of the IT fentanyl dose. CSE analgesia, introduced to our institution 8 years ago, has been widely accepted despite initial concerns about increased incidence of emergent cesarean delivery. The close multidisciplinary management (OB, anesthesiology and nursing) of prolonged decelerations has contributed to its success, and our findings support its safety.

Table 1. Demographic, obstetric and anesthetic variables by IT fentanyl group

	Intrathecal fentanyl dose (mcg)					
	2.5 (n=135)	5 (n=129)	10 (n=158)	15 (n=131)	Unknown (n=32)	p value
Age (years)	30 (6)	30 (5)	31(5)	30 (5)	30 (4)	0.24
BMI	32 (7)	31 (7)	31 (6)	31 (6)	31 (6)	0.58
Gestational age (weeks)	37 (5)	38 (4)	38 (3)	38 (2)	36 (5)	0.41
Oxytocin administration during labor	35%	29%	33%	43%	37%	0.18
VAPS	6.6 (4.0)	5.6 (4.2)	6.6 (3.6)	4.3 (4.0)*	4.8 (4.6)	<0.005
Decrease in MAP > 20% after CSE (n, %)	50, 37%	50, 39%	61, 39%	34, 34%	6, 18%	0.24
Prolonged decelerations (n,%)	6, 4.4%	3, 2.3%	12, 7.6%	4, 3%	0	0.11
Use of phenylephrine	2.2%	0.8%	2.5%	2.3%	3.1%	0.83
Use of ephedrine	1.5 %	1.6%	5%	0.8%	3.1%	0.12
Use of nitroglycerine	0.7%	0	1.25%	0	0	0.49
Use of terbutaline	0	0	0.6%	0	0	0.61
Emergent cesarean delivery (n,%)	0	0	2, 1.3%	0	0	0.25

BMI = Body Mass Index
VAPS = Verbal Analog Pain Score
MAP = Mean Arterial Pressure

Data presented as proportions (%) or means (± SD)
ANOVA, Tukey HSD test with Bonferroni and Holm multiple comparisons, Chi-square

References:

1. Carvalho B. JCA. 2007.
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Abstract #:SAT-34

Sequelae after cardiac arrest amongst parturients: Nationwide Readmissions Database study 2013-2014

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Background: Cardiac arrest during delivery is a rare event. While recent studies have examined risk factors for cardiac arrest among parturients, the literature regarding readmissions from such events is scant.

Methods: We performed a retrospective analysis of combined data from 2013 and 2014 National Readmission databases (NRD) to calculate 30 day readmission rate and evaluate reasons for readmission amongst women 15-45 years of age who suffered cardiac arrest during admission for delivery. We also analyzed risk factors for not being discharged alive from such admissions.

NRD databases provides discharge data on approximately 14 million hospital stays for each year. The NRD is maintained by the Healthcare Utilization Project's Agency for Healthcare and Quality and Research, represents 49% of US hospitalizations, and has data from up to 22 geographically diverse states and. The NRD can be weighted to produce national estimates. Analyses were performed using SAS 9.4 and SUDAAN 11.1. Weighted estimates were utilized to adjust for design effects of the sampling.

Results:

Of the 70,886,775 weighted national discharges, 6,983,133 were for delivery in the 15-45 year age group. Cardiac arrest occurred at the rate of 13.4 per 100,000 deliveries. 58.7% of arrest patients survived to discharge. Venous thromboembolism (OR=3.6), age between 35-45 years (OR=3.57), chronic renal disease (OR=2.66), and sepsis (OR=1.9) were more common amongst non-survivors (Table 1).

The 30-day readmission rate was 10.78%. Baseline readmission rates among women who delivered but did not have cardiac arrest was 1.4%. 92% of readmissions were non-elective. The median interval from discharge to readmission was 8 days (10th-90th centile: 1-27 days). The primary reasons for readmission were infection (29.7%), cardiac disease (18.6%), thromboembolism (12.32%). The most common procedures performed during readmission were related to respiratory support (9.4%), packed red cell transfusion 8.5% and central line placement 3.2%. The median length of stay at readmission was 4.87 days (95% CI: 3.18-6.56 days). 97% of patients were discharged alive on first readmission.

Conclusion: Readmission rates are very high among post-partum women who survive an initial arrest occurring during admission for delivery. Infection, cardiac disease and VTE are the most common reason for readmission. Further work is needed to better understand risk factors for readmission after admission for delivery

TABLE 1

Variables	Died	Not Died	P-values	OR(95% CI)
	N=387	N=549		
Age categories (years)			<0.0001	
15-24	50(12.91)	136(24.71)		Reference
25-34	136(35.16)	268(48.83)		1.6(0.83-3.10)
35-45	201(51.93)	145(26.47)		**3.57(1.84-6.94)**
Type of Admission			0.01	
Non-elective	266(69.37)	302(55.07)		Reference
Elective	117(30.63)	246(44.93)		0.65(0.39-1.08)
Associated diagnoses				
Chronic Renal Disease	45(11.66)	27(4.92)	0.03	**2.66(1.41-6.19)**
Diabetes Mellitus	81(21.04)	76(13.82)	0.1	1.43(0.74-2.75)
C-Section	257(66.39)	411(74.84)	0.1	0.62(0.37-1.04)
Sepsis	95(24.54)	79(14.40)	0.03	**1.9(1.03-3.54)**
Venous Thrmoboembolism	59(15.12)	25(4.52)	0.002	**3.6(1.5-6.7)**

Abstract #:SAT-35

The Impact of Neuraxial Clonidine on Postoperative Analgesia in Women Having Cesarean Section – A Systematic Review and Meta-Analysis

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Introduction: Neuraxial clonidine improves postoperative analgesia in the general surgical population. The efficacy and safety of neuraxial clonidine as a postoperative analgesic adjunct in the cesarean section population still remains unclear. This systematic review and meta-analysis aims to evaluate the effect of perioperative neuraxial clonidine on postoperative analgesia in women having cesarean section under neuraxial anesthesia.

Methods: We included randomized controlled trials comparing the analgesic efficacy of the perioperative administration of neuraxial clonidine alone or in combination with a local anesthetic and/or opioid in women having cesarean section under neuraxial anesthesia when compared with placebo. Pubmed, the Cochrane Central Register of Controlled Trials and EMBASE were searched. Our primary outcomes were intravenous opioid consumption in mg morphine equivalents at 24h and the time to first analgesic request. Secondary outcomes included the need for intraoperative analgesic supplementation, incidence of maternal intraoperative and postoperative adverse effects and neonatal umbilical artery pH and Apgar scores at 1 and 5 minutes. Data from dichotomous outcomes were summarized using odds ratio (OR) and 95% confidence intervals (CI). Continuous outcomes were summarized as mean difference (MD) and 95% CI. A random effects statistical model was used as the default for the analysis.

Results: Seventeen studies were included in the meta- analysis. Neuraxial clonidine reduced 24 h morphine consumption (MD: -7.2 mg; 95% CI: -11.4, -3.0, 7 studies) (Figure A) and prolonged time to first analgesic request (MD: 141 minutes; 95% CI: 106, 175 minutes, 15 studies) (Figure B) when compared with the control group. Neuraxial clonidine increased intraoperative hypotension (OR: 2.567; 95% CI: 1.187, 5.551), intraoperative sedation (OR: 2.355; 95%CI: 1.016, 5.459) but reduced the need for intraoperative analgesic supplementation (OR: 0.224; 95% CI: 0.076, 0.663). The effect of clonidine on intraoperative bradycardia, intraoperative and postoperative nausea and vomiting, postoperative sedation and pruritus were inconclusive. Neuraxial clonidine did not negatively impact neonatal umbilical artery pH and Apgar scores.

Conclusion: This review demonstrates that neuraxial clonidine enhances postoperative analgesia in women having cesarean section with neuraxial anesthesia but this has to be balanced against the increased maternal adverse effects.

Abstract #:SAT-35

24 h Morphine Consumption

Study name	Comparison	Difference in means	Lower limit	Upper limit	p-Value
Pan 1998	Control vs Clonidine 150 mcg	-3.10	-7.73	1.53	0.19
Van Tuijl 2006	Control vs Clonidine 75 mcg	-3.30	-8.63	2.03	0.23
Paech 2004	Combined	-5.75	-12.17	0.67	0.08
Lavandhomme 2005	Combined	-6.50	-12.87	-0.13	0.05
Massone 1998	Control vs Clonidine 150 mcg	-7.50	-12.99	-2.01	0.01
Mendez 1990	Combined	-17.50	-30.68	-4.32	0.01
Hunfoon 1992	Combined	-41.20	-63.53	-18.87	0.00
		-7.18	-11.38	-2.97	0.00

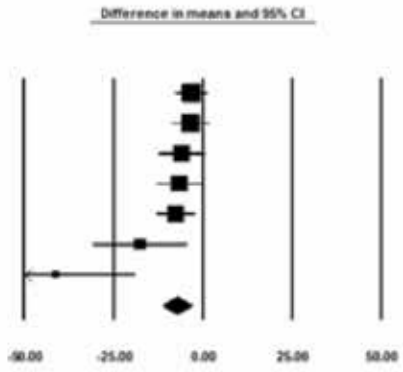

Figure A

Time to first analgesic request

Study name	Comparison	Difference in means	Lower limit	Upper limit	p-Value
Braga 2012	Control vs clonidine 75	19.450	0.700	38.200	0.042
Bajwa 2010	Control vs Clonidine 75	20.970	7.761	34.179	0.002
Cho 2003	Control vs Clonidine 75	48.000	31.838	64.162	0.000
Benhamou 1998	Combined	62.000	28.611	95.389	0.000
Lavandhomme 2005	Combined	73.000	53.666	92.334	0.000
van Tuijl 2006	Control vs clonidine 75	74.000	62.862	85.138	0.000
Li 2014	Control vs Clonidine 75	74.120	58.914	89.326	0.000
Onat 2000	Control vs clonidine 150	104.500	83.793	125.207	0.000
Paech 2004	Combined	111.000	76.799	145.201	0.000
Shidaye 2014	Control vs Clonidine 60	180.950	103.092	258.808	0.000
Pan 1998	Control vs clonidine 150	258.000	168.055	347.945	0.000
Kherzi 2014	Control vs Clonidine 75	284.810	252.127	315.893	0.000
Massone 1998	Control vs clonidine 150	291.000	49.356	532.664	0.018
Singh 2013	Combined	375.875	300.656	451.094	0.000
Capogna 1995	Combined	668.400	525.276	811.524	0.000
		140.720	106.029	175.411	0.000

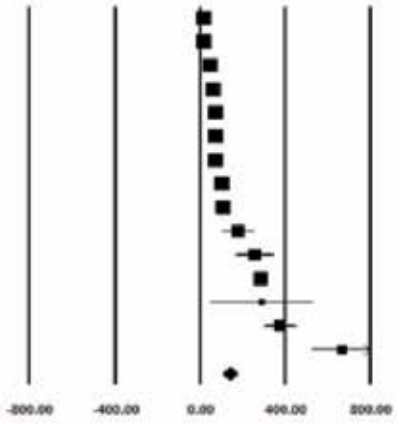

Figure B

Abstract #:SAT-36

Comparison of the Apfel risk score to a newly derived risk score for PONV following cesarean delivery under spinal anesthesia

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Introduction: There are limited data about risk factors for postoperative nausea and vomiting (PONV) in obstetric patients. The commonly used simplified Apfel risk score includes female gender, and expected receipt of postoperative opioids, which might limit its applicability to obstetric patients receiving neuraxial opioids, since all will have at least 2 risk factors. We therefore performed this study to derive a risk score for PONV in women undergoing cesarean delivery (CD) and to compare its performance to that of Apfel's.

Methods: We included data from two multicenter randomized controlled trials investigating PONV. Anesthetic management in both studies included spinal anesthesia with 12 mg hyperbaric bupivacaine, 15 mcg fentanyl and 150 mcg morphine. We only included patients who did not receive prophylactic antiemetics. Potential risk factors for PONV based on literature with some added pregnancy specific factors were collected (table). We identified factors significantly associated with PONV in our cohort using multivariate mixed models and derived a new simplified risk score by assigning 1 point to each identified risk factor The association of this score and Apfel's with PONV was assessed using Cochran-Armitage Trend tests. We compared our score to the Apfel score using Mann-Whitney U test of difference in AUC, and Integrated Discrimination Improvement (IDI).

Results: Data from 260 patients were included in the analysis. Of the risk factors evaluated, only smoking pattern and history of PONV after CD or history of morning sickness were significantly associated with PONV (table). We therefore created a score that gives 1 point to history of PONV following CD or morning sickness, and 1 point for stopping smoking during pregnancy plus 1 point for never smoking. There was a significant association between PONV and higher values of our score (risk of PONV with 0, 1, 2, 3 points of 33, 39, 52 and 65%, p= 0.002), but not the Apfel score (risk of PONV with 2, 3, 4 points of 39, 57, 61%, p=0.12). The estimated AUC of our score and that of Apfel's were 0.63 [0.56,0.70] and 0.58 [0.52,0.65] (p= 0.20). The IDI was 0.032, meaning the average PONV risk prediction improved by 3.2% using our score compared to Apfel's.

Conclusions: There was no statistically significant difference in the performance of our derived risk score compared to the Apfel score. However, our score showed modest incremental improvements by using variables specific to CD patients.

Table 1: Descriptive Statistics of analysis cohort by PONV outcome status.

	PONV Outcome Group			Univariate Mixed Model
	No PONV (N=114)	Yes PONV (N=146)	Total (N=260)	P-value
Apfel Risk Factors				
Non-Smoker during pregnancy	90 (78.9%)	131 (89.7%)	221 (85.0%)	0.0212
History of PONV or Motion Sickness	39 (34.2%)	57 (39.0%)	96 (36.9%)	0.5728
Other Risk Factors				
Smoking by Period*				0.0210
Smoker during and prior to pregnancy	18 (16.7%)	13 (9.1%)	31 (12.4%)	
Smoker prior to pregnancy only	27 (25.0%)	27 (18.9%)	54 (21.5%)	
Never Smoker	63 (58.3%)	103 (72.0%)	166 (66.1%)	
History of PONV after CD or morning Sickness	83 (72.8%)	124 (84.9%)	207 (79.6%)	0.0195
Previous CD	93 (81.6%)	110 (75.3%)	203 (78.1%)	0.3203
Phenylephrine Administration				0.8215
Bolus	37 (32.5%)	42 (28.8%)	79 (30.4%)	
Infusion	77 (67.5%)	104 (71.2%)	181 (69.6%)	
Age At Delivery	32.0 [28.0, 35.0]	32.0 [28.0, 36.0]	32.0 [28.0, 35.0]	0.4482
BMI	38.7 [35.1, 41.8]	37.6 [33.0, 40.7]	38.3 [34.2, 41.4]	0.8333
Surgery Duration (mins)	47.0 [37.0, 61.0]	47.0 [39.0, 62.0]	47.0 [38.0, 61.5]	0.5191
Hx hyperemesis gravidarum	2 (1.8%)	2 (1.4%)	4 (1.5%)	0.7621
BL Nausea	22 (19.3%)	27 (18.8%)	49 (19.0%)	0.9466
Any Intra-op Nausea/Vomiting/Rescue	61 (53.5%)	84 (57.5%)	145 (55.8%)	0.4101
SBP fall > 20%	40 (35.1%)	60 (41.1%)	100 (38.5%)	0.1018
Intra-op antiemetic	33 (28.9%)	49 (33.6%)	82 (31.5%)	0.3732
Uterus exteriorized	63 (55.3%)	82 (56.2%)	145 (55.8%)	0.7004
Total fluids given (L)	2.0 [1.8, 2.4]	2.0 [1.9, 2.5]	2.0 [1.9, 2.5]	0.1297

*prior smoking status missing for 9

Abstract #:SAT-37

The Relationship of Dural Puncture and Labor Epidural Associated Temperature Change

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Introduction: The elevation in temperature with labor epidural analgesia contrasts with the reduction in temperature associated with spinal anesthesia.(1,2) The etiology for these differences in temperature modulation are not fully understood, however, centrally acting intrathecal opioids appear to create a reduction in temperature. Consequently, we hypothesized that women who receive a combined spinal epidural (CSE) or a dural puncture epidural (DPE) technique would have a less pronounced increase in temperature than those who received a conventional epidural technique.

Methods: This study is a secondary analysis of prospectively collected data from a randomized clinical trial assessing the efficacy and side-effect profiles of epidurals (EPL), DPE and CSE.(3) A total 120 healthy women at term gestation were randomly allocated to one of the three epidural groups. The EPL and DPE groups received an initial bolus of 20 mL of 0.125% bupivacaine with fentanyl 2 µg/mL, while the CSE group received bupivacaine 1.7mg and fentanyl 17µg. All groups received a background infusion of bupivacaine 1.25 mg/mL with fentanyl 2 µg/mL at 6 mL/h. Oral temperature was taken at the time of epidural placement and every ninety minutes until delivery. Multivariable linear regression models were fit to assess the association of epidural type (EPI, DPE, CSE) with the maximum change in temperature.

Results: There were no clinically significant differences between the patients in each group. After controlling for maternal age, BMI, primiparity and length of epidural infusion there were no statistically significant differences when comparing each category of epidural and the magnitude of temperature change, although the mean temperature increase was less in the CSE group. See Table.

Conclusion: The presence of a dural puncture did not appear to significantly influence temperature change during labor epidural analgesia. Whether these findings are the result of the lipophilic properties of fentanyl and rapid clearance from the CSF, preferential binding to white matter, or the inability to penetrate deeper brain structures, will need further examination. (4-6)

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The Relationship of Dural Puncture and Labor Epidural Associated Temperature Change

Table. Adjusted[a] Linear Regression for the relationship of epidural technique and temperature change.

Technique Comparison	Mean Difference (95% CI)	p-value
DPE vs EPL	0.03 (-0.09, 0.14)	0.6249
CSE vs EPL	-0.03 (-0.15, 0.09)	0.6085
CSE vs DPE	-0.06 (-0.18, 0.06)	0.3122
EPL vs DPE and CSE	0 (-0.1, 0.1)	0.9949

[a]adjusted for maternal age, BMI, primiparity and length of epidural infusion

Abstract #:SAT-38

A cost-effectiveness analysis of OSA screening with home sleep testing for pregnant women with chronic hypertension

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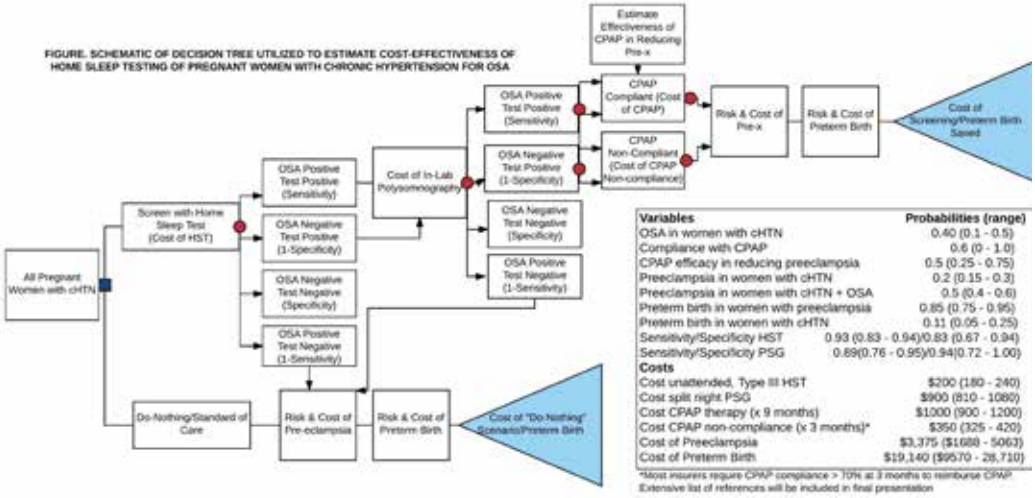
Introduction: 17 to 29% of pregnant women with cHTN will go on to develop preeclampsia (PEC); both diseases increase a woman's risk of preterm delivery and other morbidities. CHTN and PEC are both associated with obstructive sleep apnea (OSA) in pregnancy. OSA may complicate the pregnancies of more than 40% of pregnant women with cHTN. CHTN in premenopausal women may indicate underlying sympathetic activation due to OSA. Established OSA screening tools have not performed well in pregnant populations and are associated with a high false referral rate for overnight, in-lab polysomnography (PSG). Portable home sleep testing (HST) is emerging as a reliable and cost-effective method of screening for OSA. Our objective here was to utilize decision modeling to estimate the cost-effectiveness of routine OSA screening with HST of pregnant women with cHTN.

Methods: We created a decision tree to estimate and compare the cost of HST early in pregnancy followed by PSG in women with cHTN compared to the "do-nothing" scenario (FIGURE). We assumed that the prevalence of PEC and preterm birth could be affected by diagnosing OSA and treating with continuous positive airway pressure (CPAP). We conducted a literature search using the PubMed database to find the best available evidence to support the model, and constructed the model and conducted the analysis using TreeAgePro 2016. Our primary outcome was cost/preterm birth saved. We performed a one-way, sensitivity analysis in which model probabilities and costs were tested across a range of values, as well as a sensitivity cost-effectiveness analysis to test the effect of CPAP compliance on cost and preterm birth rate.

Results: Screening for OSA with HST and treating if PSG was positive cost an average of $12.41 less than the "do-nothing" scenario ($7,705 vs. $7,718), and decreased the rate of preterm birth among women with cHTN by 4% (31% vs. 35%). The sensitivity analysis showed that cost-savings began when compliance with CPAP therapy was 60% or greater, with maximal savings and reduction of preterm birth at 100% CPAP compliance ($276 saved, 6% decrease in preterm birth).

Conclusions: Using decision analysis tools, we estimated that OSA screening with HST and CPAP treatment for all pregnant women with cHTN is cost saving and reduces the incidence of preterm birth when compliance with CPAP therapy exceeds 60% based on the assumption that CPAP therapy reduces the risk of PEC in women with cHTN and OSA.

FIGURE. SCHEMATIC OF DECISION TREE UTILIZED TO ESTIMATE COST-EFFECTIVENESS OF HOME SLEEP TESTING OF PREGNANT WOMEN WITH CHRONIC HYPERTENSION FOR OSA



Variables	Probabilities (range)
OSA in women with cHTN	0.40 (0.1 - 0.5)
Compliance with CPAP	0.6 (0 - 1.0)
CPAP efficacy in reducing preeclampsia	0.5 (0.25 - 0.75)
Preeclampsia in women with cHTN	0.2 (0.15 - 0.3)
Preeclampsia in women with cHTN + OSA	0.5 (0.4 - 0.6)
Preterm birth in women with preeclampsia	0.85 (0.75 - 0.95)
Preterm birth in women with cHTN	0.11 (0.05 - 0.25)
Sensitivity/Specificity HST	0.93 (0.83 - 0.94)/0.83 (0.67 - 0.94)
Sensitivity/Specificity PSG	0.89(0.76 - 0.95)/0.94(0.72 - 1.00)
Costs	
Cost unattended, Type III HST	$200 (180 - 240)
Cost split night PSG	$900 (810 - 1080)
Cost CPAP therapy (x 9 months)	$1000 (900 - 1200)
Cost CPAP non-compliance (x 3 months)*	$350 (325 - 420)
Cost of Preeclampsia	$3,375 ($1688 - 5063)
Cost of Preterm Birth	$19,140 ($9570 - 28,710)

*Most insurers require CPAP compliance > 70% at 3 months to reimburse CPAP
Extensive list of references will be included in final presentation

Abstract #:SAT-39

Predictors of post-cesarean delivery pain in a prospective, randomized controlled trial of dexamethasone vs. placebo

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Introduction: Previous work has suggested that certain patient characteristics, responses to standardized questions, and to mechanical temporal summation (MTS) predict pain control after CD. Most of those results have not been validated in other centers. Therefore, we performed this analysis to assess if quantitative sensory testing and questionnaires could predict postoperative pain scores and opioid consumption in women undergoing CD.

Methods: Data were collected as part of a prospective, randomized controlled trial for post-CD pain control. Following IRB approval and informed consent, ASA 1-3 women scheduled to undergo primary or repeat CD were randomized to receive either IV dexamethasone 8mg or placebo after administration of a standardized spinal anesthetic. but prior to skin incision. Randomization was stratified by MTS response. Prior to surgery, subjects underwent MTS testing and were asked to rate their pain (NRS 0-10), anxiety (0-100), anticipated pain after surgery (NRS 0-100), and anticipated pain medication consumption after surgery (0-5). Postoperatively, subjects received pain medication according to a standardized protocol. Opioid consumption and pain scores at rest and with movement were collected at 2, 24, and 48-h after surgery. All postoperative opioids were converted to IV morphine equivalents. We performed multivariable regression analysis for 3 outcome variables: total postoperative opioid consumption at 24-h; postoperative pain at rest and with movement at 24-h. A set of candidate variables were included in the initial model on the criteria of $p<0.15$ and some clinically meaningful covariates. We performed backward variable selection by eliminating the variable with the largest p-value over 0.05 at each step until we reached the smallest AIC or BIC. Parameters in the final model were estimated and reported for each outcome separately.

Results: Data from 47 subjects were obtained and analyzed. Higher postoperative opioid consumption at 24-h was associated with older age ($p = 0.01$) and anticipated medication consumption ($p = 0.01$). Higher anticipated medication consumption was also associated with higher 24-h postoperative pain scores at rest ($p = 0.04$) and with movement ($p = 0.05$). Increasing gravidity was associated with higher pain scores at 24-h at rest ($p < 0.0001$), and with movement ($p = 0.004$). MTP-status was not associated with opioid consumption or pain scores.

Conclusions: Subjects' predictions of post-op opioid consumption prior to CD were positively associated with actual post-op opioid consumption at 24-h. Older age was also associated with higher postoperative opioid consumption at 24-h. Increasing gravidity and anticipated medication consumption were both associated with higher 24-h pain scores at rest and with movement. We did not find that other predictors of postoperative pain, such as anxiety and anticipated pain after surgery, were significantly associated with postoperative pain control.

Abstract #:SAT-40

Web-based information on analgesia in labor: usage, sourcing, rating of availability and quality by mothers

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Introduction: Approximately 4.5% of internet searches are health-related, and 40% of searches by pregnant women relate to the peripartum setting. In a recent survey, pregnant women were dissatisfied with information provided by healthcare professionals, and subsequently utilized the internet to supplement information from their providers. Patient education regarding labor analgesia by an anesthesiologist is often limited to the labor setting, despite data that knowledge regarding anesthesia reduces anxiety, pain, and length of stay. We conducted a web-based survey to evaluate where patients obtained information about labor analgesia, how accurate the information was, how labor analgesia met their expectations, and interest in internet-based educational resources.

Methods: Women were approached post-partum for participation in a twelve multi-part question survey based on the 5-point Likert scale. Questions regarding sources of information were presented as a list of options for patients to rank. Exclusion to the study were non-English speaking, minors, delivery of a stillbirth, or severe fetal anomalies.

Results: Regarding mode of delivery, 59% of births were vaginal, 7% required instrumentation (vacuum or forceps), and 34% were cesarean deliveries. A substantial portion (74%) of respondents were primiparous, while 26% were multiparous. All respondents had neuraxial anesthesia, while 55% also used fentanyl and 53% used nitrous oxide. It terms of information resources, prenatal classes were ranked the most useful, followed by family and friends, books, obstetricians, and finally internet resources. The most useful resource did not correlate with the likelihood of labor pain relief meeting patient expectations. Greater than 90% of patients agreed or strongly agreed that information from books, prenatal classes, and obstetricians was accurate, while 78% similarly regarded information from family and friends, and only 59% felt similarly regarding information from the internet. 86% of respondents access the internet more than 5 times daily. Regarding an institution-specific website with information about pain management during labor, 74% of respondents expressed interest.

Discussion: Our survey demonstrates that women do not find the internet particularly useful or accurate compared to other resources for information regarding labor pain management. There is strong interest in an institution-sponsored educational website regarding this important topic.

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Abstract #:SAT-41

Pharmacokinetic modeling and placental transfer of ampicillin administered to laboring women

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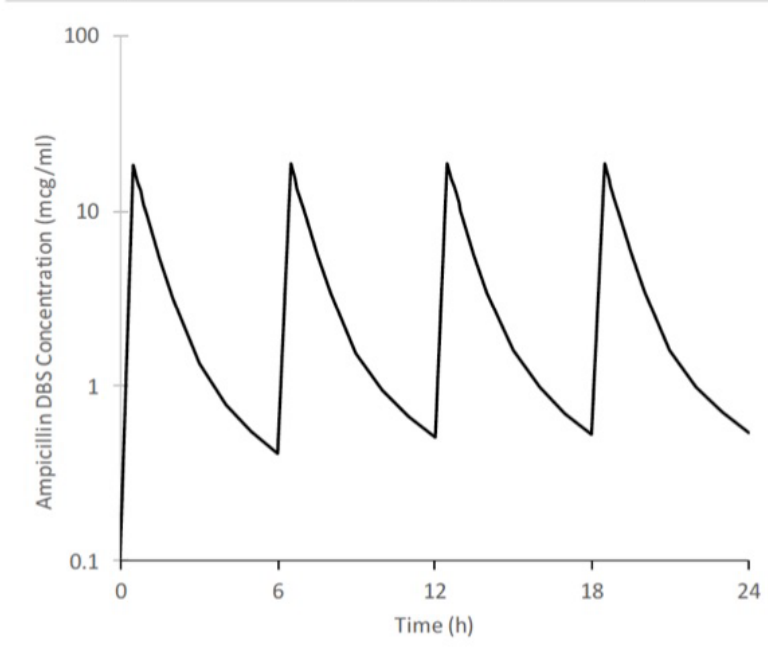
Background: Ampicillin is used for multiple peripartum indications including prevention of neonatal group beta streptococcus (GBS) and treatment of intrapartum chorioamnionitis. Despite its widespread use in pregnancy, existing pharmacokinetic data for ampicillin does not address current recommended dosing paradigms or indications for use. The aim of this study was to characterize the pharmacokinetic profile and placental transfer of ampicillin administered to laboring women, and to compare these findings to existing pharmacokinetic data.

Methods: Prospective cohort IRB-approved study of pregnant women prescribed intravenous ampicillin for neonatal GBS prevention or chorioamnionitis treatment. Women received a 2-g loading dose with 1-g administered every 4 h (GBS indication), or 2-g loading dose with 2-g every 6 h (chorioamnionitis indication). Maternal blood samples were collected at baseline, 5, 15 and 30 min, mid-point of dosing interval (2-3 h), immediately prior to next dose (4-6 h), and at delivery (MV). Whole blood dried blood spots sampling technique was utilized, and pharmacokinetics were analyzed via a population approach with mixed-effect modeling. Umbilical cord arterial (UA) and venous (UV) blood were sampled at time of delivery, and UA:MV and UA:UV ratios determined.

Results: Pharmacokinetic profiles of 28 women were analyzed. Best fit to the data was with a two-compartment model. Analysis revealed a central volume of distribution (V1) of 81.0 L and clearance (Cl) of 86.2 L/h. Inter-compartmental Cl was 21.1 L/h and peripheral volume of distribution (V2) was 65.6 L. Variation in CL and V1 between patients was large (42% and 54% respectively). Ampicillin concentrations over time are depicted the Figure. The UV:MA and UA:UV ratios were 0.64 ± 0.33 and 0.86 ± 1.00 respectively.

Conclusion: Our study revealed a V and Cl for ampicillin that is greater than previously published in pregnant and non-pregnant subjects (1,2). The presence of infection may have increased the V and Cl for ampicillin. Prior studies have focused on patients receiving ampicillin for cesarean delivery, and not laboring women or women with acute infections. Results from this study highlight the importance of studying drugs in both the population (pregnant vs. non-pregnant) and indication (laboring, active infection vs. cesarean) of interest.

Figure: Median ampicillin dried blood spots (DBS) concentration over time after a 2-gram loading dose (administered over 30 min) and ongoing 2-gram doses every 6 hours.



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Abstract #:SAT-42

Patterns of patient-controlled epidural analgesia use in laboring women

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Introduction: Maintenance of labor analgesia with timed intermittent bolus (TIB), in addition to patient-controlled epidural analgesia (PCEA), results in superior analgesia compared to continuous infusion with PCEA. However, as epidural pumps capable of delivering timed boluses only recently became available, an alternative strategy is to use a low-rate infusion with a large PCEA volume in order to simulate the TIB effect. The typical pattern of PCEA use using this maintenance strategy is unknown. The objective of this study was to evaluate the patterns of PCEA use, and differences in PCEA use patterns among women that required clinician interventions for breakthrough pain.

Methods: Nulliparous women with a singleton pregnancy, undergoing a post-dates induction, and at a cervical dilation of <5cm at request for neuraxial analgesia, were eligible for this prospective observational study. Combined spinal-epidural analgesia was initiated with an intrathecal dose of 25mcg fentanyl. Epidural analgesia was maintained using a continuous infusion of 0.0625% bupivacaine with fentanyl (8mL/hr) and a PCEA (8mL, up to three times/hr). Instructions on PCEA use were provided using a standard script. Patients were stratified into adequate and inadequate labor analgesia (i.e. required supplemental analgesia) and PCEA patterns were evaluated (number of requests, deliveries and request/delivery ratio). Numeric literacy was assessed using the Lipkus 7-item expanded numeracy test. Categorical data between groups were evaluated using the chi-squared or Fisher's exact tests. Continuous data were compared using a student's t-test or rank sum test.

Results: A total of 89 patients completed the study. Patients required a median of 2.3 PCEA requests per hour (interquartile range: 1.2-3.3). There were no demographic differences between the two groups. Patients that required supplemental analgesia were more likely to request and receive PCEA boluses. They were also more likely to have a higher hourly bupivacaine requirement during labor. There were no differences in numeric literacy between groups.

Conclusions: Using a low-rate maintenance infusion requires active patient engagement to maintain analgesia. Patients who ultimately require treatment of breakthrough pain have higher PCEA demands and deliveries. It would be useful to utilize PCEA utilization data to identify patients with higher maintenance requirements and better match the maintenance rate based on patient pain demands.

	Required supplemental analgesia (n=40)	Did not require supplemental analgesia (n=49)	*P*
Age	31 (29-34)	32 (30-33)	0.84
Race			
White	29 (72.5)	38 (77.6)	
Black	1 (2.5)	1 (2.0)	
Hispanic	6 (15.0)	6 (12.2)	
Asian	4 (10.0)	2 (4.1)	
Other	0 (0.0)	2 (4.1)	0.56
EGA (weeks)	41 (41.0-41.2)	41.1 (41.0-41.3)	0.44
BMI (kg/m^2)	30 (27.4-33.7)	28.6 (26-31.3)	0.14
Cervical dilation at time of CSE	3.2 (2.7-4.0)	3.0 (2.5-4.0)	0.71
Mode of delivery			
NSVD	20 (50.0)	33 (67.4)	
Forceps	7 (17.5)	6 (12.2)	
Vacuum	1 (2.5)	2 (4.1)	
Cesarean	12 (30.0)	8 (16.3)	0.32
PCEA boluses delivered	17 (13-26)	10 (7-16)	0.0001
PCEA boluses demanded	33.5 (21.5-64.0)	15 (8-26)	0.0001
Demand to delivery ratio	1.9 (1.5-2.6)	1.3 (1.1-1.8)	<0.001
Total redoses (mg)	18.75 (12.5-31.25)	N/A	
Total amount bupivacaine via epidural infusion (mg)	228.8 (166.3-325.0)	141.9 (101.3-191.3)	0.0001
Total hourly bupivacaine (mg)	19.9 (17.2-25.2)	17.4(13.5-20.4)	<0.01
Lipkus score	6.5 (5-7)	7 (5-7)	0.99

EGA: estimated gestational age; BMI: body mass index; CSE: combined spinal-epidural; PCEA: patient controlled epidural anesthesia
Data presented as n (%) or median (interquartile range)

Abstract #:SAT-43

Association between intrapartum magnesium administration and the incidence of maternal fever: a propensity analysis

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Introduction: Maternal fever, defined as a temperature ≥ 38° C (100.4° F), is associated with several adverse neonatal outcomes. An association between the use of intrapartum neuraxial analgesia and maternal fever exists, possibly mediated by interleukin-6 (IL-6). In a rat model, magnesium sulfate suppressed IL-6-induced increases in maternal temperature. Retrospective data suggest a decreased incidence of maternal fever in women receiving magnesium. We hypothesized that patients exposed to intrapartum magnesium would have a lower incidence of fever than those patients not exposed.

Methods: In this retrospective, cross-sectional study, electronic medical record data from all deliveries at Northwestern Memorial Hospital between 2007 and 2014 were queried. Cases without temperature data and without intent for vaginal delivery were excluded. Extracted data included parity, gestational age, labor type, membrane status, mode of delivery, the use of neuraxial analgesia, diagnosis of preeclampsia, and magnesium sulfate administration. Using this data set a propensity score model was created to evaluate the association between magnesium and fever. Propensity score matching was used to reduce potential bias from non-random selection of magnesium administration. Only cases in which there were no missing data were used for propensity analysis.

Results: A total of 58,541 women met inclusion criteria; 1179 received magnesium. Fifty-seven patients were missing at least one variable and could not be matched for propensity scoring. Using a caliper method to set the maximum acceptable distance between score matches, 959 (85.5%) of 1122 subjects were matched in a 1:1 fashion with a non-recipient. Fisher's exact tests were used to test the balance between study groups in the propensity model; no comparison P-values were less than 0.05. Using the total sample of 1918 subjects, the relationship between fever and magnesium was modeled using a logistic regression. The odds ratio in the single variable model was 0.68 (95% CI of 0.48 to 0.98).

Conclusions: Our data suggest that magnesium is associated with a lower incidence of maternal fever. Future work should evaluate the association between the duration of magnesium administration and the development of fever, as well as evaluate neonatal outcomes. These findings should be validated in prospective study, in order to inform the use of magnesium as a potential intervention.

Abstract #:SAT-43

Propensity Score

	Before Matching		After Matching		
	Magnesium therapy (n= 1179)	No magnesium (n= 57,362)	Magnesium therapy (n= 959)	No magnesium (n=959)	*P*-value
Preeclampsia	75.7	3.9	75.2	72.8	0.25
Admission to NICU	34.2	4.6	29.9	27.6	0.29
Labor > 10 hours	87.0	54.9	85.5	84.8	0.70
Newborn resuscitation*	27.9	2.5	24.8	24.8	> 0.99
Acetaminophen administration	35.6	7.8	30.2	27.3	0.17
Systemic opioid administration	29.4	8.2	28.1	24.9	0.13
Neuraxial labor analgesia	89.1	89.1	89.0	91.4	0.08
SROM	25.2	39.0	27.6	29.0	0.54
Chorioamnionitis	5.5	6.1	5.4	5.3	> 0.99
Antibiotic administration	51.8	29.6	48.1	49.4	0.58
Group B streptococcus positive	11.7	19.8	12.5	12.7	0.95
Cesarean delivery	23.1	13.9	23.3	23.0	0.91
White race	41.1	52.4	40.3	41.1	0.71
Preterm	52.9	7.8	48.5	45.5	0.20

Data presented as %.
NICU, neonatal intensive care unit; SROM, spontaneous rupture of membranes.
* Per Northwestern Memorial Hospital policy, a pediatric hospitalist is the first-line pediatric provider at deliveries in which neonatal evaluation is anticipated, such as those complicated by intrapartum fever or chorioamnionitis. If a higher level of neonatal care is anticipated or becomes necessary for resuscitation, a neonatologist is added to the pediatric team.

Abstract #:SAT-44

Evaluation of a patient-centered analgesic counseling tool

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Background: The decision to use, or not use, neuraxial labor analgesia is a complex decision, with both maternal and fetal considerations. Patients have many concerns about neuraxial analgesia that may not be addressed in routine counseling. Physicians must ensure that patients understand the risks, benefits, and alternatives to neuraxial analgesia when obtaining informed consent. Our group developed a labor analgesic counseling tool to help guide women in their analgesic decision making. The objective of this study was to evaluate the impact of the counseling tool on analgesic counseling content.

Methods: The counseling tool content was developed through a review of the literature and qualitiative interviews with stakeholders. The tool was written at a low-literacy level (6th grade). Twenty anesthesiologists (10 resident physicians and 10 attending physicians) were recruited for participation. Participants were asked to provide analgesic counseling to a standardized patient who was admitted to L&D for labor. Participants were oriented to the counseling tool and at least one week after orientation, were asked to provide another analgesic counseling session. The counseling sessions were video recorded and the counseling content was scored using a previously developed scoring matrix (25 point total). A paired t-test was used to compare the counseling content prior to and following counseling tool orientation. Counseling content was compared between resident and attending anesthesiologists using a two-tailed t-test.

Results: The mean counseling tool score prior to counseling tool orientation was 13 ± 3. Following counseling tool orientation, the mean counseling tool score increased to 18 ± 5 (P = 0.002). There were no differences in counseling content between attending and resident physicians either prior to or following counseling tool orientation. The difference in means (residents compared to attendings) prior to counseling tool orientation was -2 (95% confidence interval [CI]: -5 to 1) and following counseling tool orientation was 2 (95% confidence interval [CI]: -5 to 8). Improvements were seen in discussion of why the interview was occurring (76% vs. 100%), analgesic options (29% vs. 88%), and in certain risks that are of concern to patients, such as paralysis (12% vs 76%).

Conclusions: The use of a low-literacy counseling tool increased the amount of information delivered during analgesic counseling. While there are no formal guidelines as to what information needs to be included in informed consent for labor analgesia, information about risks, benefits, and alternatives should be included. Inconsistent delivery of information may result in poor-quality decision-making, emphasizing the need for a more standardized process for informed consent. Future work should evaluate implementation of the counseling tool on patient knowledge and satisfaction with analgesic counseling, as well as the impact on use of neuraxial labor analgesia.

Abstract #:SAT-45

Rethinking Volume Status in Normal Pregnancy versus Preeclampsia

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Objective: Women with preeclampsia (PEC) are thought to be intravascularly depleted from endothelial dysfunction and subsequent third spacing, which is supported by limited data from invasive intracardiac pressure measurements. Echocardiographic (ECHO) assessment of the right heart offers a noninvasive estimate of intravascular volume status. Therefore, we sought to determine if ECHO findings were consistent with decreased intravascular volume in those with PEC.

Study Design: We performed a prospective case control in singleton pregnancies > 23 weeks. Cases included women with PEC with severe features (PEC-SF) or superimposed PEC on preexisting hypertension (SI-PEC) based on ACOG Hypertension in Pregnancy, 2013 guidelines. We excluded those with known valvular malformations, previous cardiac surgery, known pulmonary hypertension, history of pulmonary embolism, or interstitial lung disease. Normotensive controls were recruited from the outpatient setting. Group comparisons were performed using t-tests and ANOVA (STATA, version 13). The sample size is adequate to detect a between-group difference at a $p < 0.05$ with 80% power.

Results: We recruited 41 women with PEC-SF, 15 with SI-PEC, and 24 controls. Demographic parameters were similar between groups (Table 1). There were no significant ECHO differences in surrogate markers of intravascular volume status in women with PEC-SF, SI-PEC, and normal controls (Table 2).

Conclusion: Although women with PEC are presumed to have a lower intravascular volume, our ECHO data suggests that women with PEC-SF or SI-PEC are not more intravascularly volume depleted than normal pregnant women. Larger cohorts with noninvasive measurements are needed to further assess surrogate markers of volume in both normal pregnancy and PEC patients, which could guide fluid management strategies in these populations.

Table 2. Right Sided Cardiac Function in Normal Pregnancy versus in Women with Preeclampsia with Severe Features (PEC-SF) and Superimposed Preeclampsia (SI-PEC)

	Normal Values	Controls (n=24)	PEC-SF (n=41)	SI-PEC (n=15)	p-value
RA area mean (ml/m2)	15-27	14.46 (3.49)	14.75 (2.88)	14.93 (2.58)	NS
RA pressure mean (mmHg)	5-10	4.62 (1.91)	4.54 (1.91)	4.86 (2.82)	NS
IVC diameter end expiration mean (cm)	< 2.1	1.32 (0.43)	1.45 (0.42)	1.43 (0.31)	NS

Data are mean ± (SD).

RA = Right Atrium; IVC = Inferior Vena Cava

Abstract #:SAT-46

Assessement of Hemodynamic Changes Associated With Uterine Displacement Using Noninvasive Cardiac Output Monitoring and Transthoracic Echocardiography: (LUDCO)

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Introduction: Cardiac arrest during pregnancy occurs in approximately 1:12,000 hospital admissions (1), with significant maternal and fetal morbidity and mortality. The gravid uterus decreases cardiac preload by aortocaval compression (ACC) and improvements in ejection fraction, stroke volume, and cardiac output have been documented with left lateral decubitus position. Three methods of uterine displacement are recommended in the 2015 AHA Scientific Statement on Cardiac Arrest in Pregnancy, however, their hemodynamic impact has not been directly compared. We hypothesized that the use of left uterine displacement, when compared to the supine positioning with uterine displacement by pushing or pulling, would offer the optimal alterations in pregnant cardiac hemodynamics when measured by echocardiography and non-invasive cardiac output monitoring (NICOM).

Methods: Following IRB approval and informed consent, non-laboring pregnant women scheduled for elective cesarean delivery were enrolled. Exclusion criteria include patient refusal, NPO status, cardiovascular disease (chronic or gestational hypertension, pre-eclampsia, congenital heart disease), cerebral vascular disease (stroke, aneurysm), and multiple gestation. With the NICOM attached and the echocardiographer blinded to the measurements, the three uterine displacement maneuvers were produced. Velocity time integral (VTI) heart rate (HR), and cardiac output (CO) was recorded. The left ventricular outflow tract diameter was measured.

Results: To date, 12/25 patients have enrolled and completed their participation. With LLD considered to be the standard comparator, uterine pushing, versus pulling, provided consistently better maternal hemodynamics. NICOM consistently provided lower CO and CI values.

Conclusions: When compared to LLD, uterine pushing was better than pulling in preserving maternal hemodynamics. Cardiac output was different between two forms of monitors (TTE and NICOM), but consistent trends were observed. The data presents valuable insight into the hemodynamic changes associated with manual left uterine displacement in a pregnant patient, particularly in the setting of cardiac arrest. Additional investigation is necessary.

	TTE		
Outcome	LLD	Pull	Push
VTI	16.43 (4.25)	14.42 (3.15); p=0.05	15.18 (3.51); p=0.27
CO	6.28 (1.15)	5.78 (1.3) p = 0.008	6.04 (1.44) p = 0.20
CI	4180.34 (1783.87)	3504.73 (1178.53) p = 0.04	3629.57 (1114.98) p = 0.16
	NICOM		
CO	3.6 (0.73)	3.15 (0.68); p = 0.02	3.28 (0.92); p = 0.06
CI	2360.55 (988.19)	1982.24 (680.64) p = 0.04	2043.6 (605.59) p = 0.15

Table 1: Cardiac parameters as measured by TTE (Transthoracic Echo) and NICOM (Non-invasive cardiac output monitor). P values in comparison to LLD.

References:

1. Lipman et al. Anesth Analg 2014;188:1003-1016
2. Bamber et al. Anesth Analg 2003;97:256-8.

Abstract #:SAT-47

Health Literacy, Racial/ Ethnicity, and Knowledge of Labor Neuraxial Analgesia

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Background: Neuraxial analgesia is the most effective method of relieving labor pain; however, a racial/ethnic disparity exists in labor neuraxial analgesia use. The decision to use neuraxial labor analgesia is multifactorial, and incorporates both prior experiences and preconceived opinions of the procedure. Health literacy is the degree to which patients can understand basic health information. We hypothesized that patients with low health literacy will have less knowledge of neuraxial analgesia than patients with high health literacy.

Methods: A survey was developed and tested for content validity. In-person interviews were conducted upon admission to the labor and delivery ward, prior to a pre-anesthetic consultation at both Northwestern University and the University of Illinois at Chicago. Data collected included demographic data, analgesic plans, source of information on labor analgesia, knowledge of neuraxial analgesia, and health literacy evaluated by s-TOFLA. Inadequate health literacy was defined as an s-TOFLA score < 23. Data were analyzed using $\chi 2$ statistic. $P < 0.05$ was significant.

Results: Two hundred patients were interviewed with 194 completing the survey. White patients were more likely to be married, college educated, have private insurance and higher incomes than minority patients ($P<0.01$ for all). Six patients had inadequate health literacy, and there were no differences in health literacy among the racial/ethnic groups ($P=0.09$). Patients with inadequate health literacy scored below the median on the neuraxial knowledge assessment ($P=0.005$). Patients with low neuraxial knowledge assessment scores were also less likely to use neuraxial analgesia compared to those with high scores (81% vs. 95%, $P=0.02$). Hispanics were least likely to plan and receive neuraxial analgesia for labor ($P< 0.05$ for both).

Conclusions: Although most patients had adequate health literacy, all patients with inadequate health literacy scored below the median on the neuraxial anesthesia knowledge assessment. Knowledge of neuraxial analgesia was associated with neuraxial analgesia use. Future studies should evaluate whether low-literacy prenatal educational interventions alter knowledge and use of neuraxial labor analgesia.

Abstract #:SAT-48

Hepatic capsule rupture presenting as interscapular pain in a patient with severe preeclampsia receiving neuraxial labor analgesia

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Introduction: Hepatic capsule rupture has a reported incidence between 1:45,000 and 1:220,000 births (1). It is often seen in patients with severe preeclampsia or HELLP syndromes. Symptoms associated with capsule rupture include right upper quadrant abdominal pain, right shoulder pain, and nausea. Additionally, there may exist hemodynamic instability that can progress to circulatory collapse if left untreated. However, when a patient presents with interscapular pain, the initial evaluation is often focused elsewhere. As early as the 1984, there have been publications of the development of interscapular pain with the administration of epidural medication (2). The first large retrospective review describing interscapular pain cited an incidence of 0.46% in patients receiving epidural analgesia for labor (3).

Case Presentation: We present the case of a 35-year-old G2P0 being induced at 35 5/7 weeks for preeclampsia with severe features. Included in her laboratory derangements and symptomatic findings were a significantly elevated aspartate aminotransferase level and severe epigastric pain. A combined spinal-epidural was performed for labor analgesia. Later, after receiving a redose, she began to complain of interscapular pain not associated with contractions. She ultimately went for a cesarean delivery secondary to non-reassuring fetal heart tracing. Her epidural was further dosed with 3% 2-chlorprocaine to achieve a surgical anesthetic level, without complaint of interscapular pain. Immediately following incision, the surgeons noted frank blood in the abdominal cavity, and the presence of a hepatic capsule rupture. She was converted to general endotracheal anesthesia for repair of the hepatic injury. Estimated blood loss for the case was three liters.

Discussion: The maternal mortality rate associated with hepatic capsule rupture is reported between 1% and 24%, while the perinatal mortality rate is up to 70%. Multigravida status, maternal age approaching menopause, and concurrent preeclampsia/eclampsia or HELLP syndromes have been associated with hepatic capsule rupture (1). The development of interscapular pain due to epidural injection is still not well understood, however it is postulated that volume and duration of epidural medication administration may be responsible. In the patient reported, epidural infusion occurred for three hours before reporting interscapular pain, a similar timing of onset as reported in the literature (2). Considering the ultimate finding of hepatic capsule rupture, blood irritating the gastric body, which is innervated by the nerve roots of T5-T9, may have resulted in referred pain to the mid thoracic back, causing the symptoms reported by the patient.

References:

1. Palvis, T et al. (2009) J Surg Educ 66: 163-7.
2. Campbell, A (1984) Anaesthesia 39: 940-1.
3. Ross, V et al. (2007) Anesthesiology 107: A1780.

Abstract #:SAT-49

Postpartum Complications and Anesthetic Considerations in Parturients Infected with Human Immunodeficiency Virus: Case Series and Literature Review

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Background: It has been reported that 75.9% of women infected with the human immunodeficiency virus (HIV) are at childbearing age. This study aims to offer renewed information about anesthesia and postpartum complications and changes in immune function and viral load in HIV-infected parturients.

Methods: A retrospective review of medical records from 2002 to 2016 and a review of the literature were conducted. Data endpoints included: newly onset complications in 6 months after delivery and differences of indices assessing immune function (CD4 and CD8 T-cell lymphocyte counts, CD4/CD8 ratio) and HIV-1 viral load between baseline and postpartum values. Paired T-test and Wilcoxon Rank Sum test were used for statistical analysis according to different requirements of data.

Results: We collected and analyzed data of totally 50 patients. There were 36 cases of epidural anesthesia (72%), 9 of spinal anesthesia (18%), 3 of combined spinal epidural anesthesia (6%), and 2 of general anesthesia (4%, for the safety for fetus). 19 minor complications were noted. There were no differences between the indices values (of CD4 count, CD8 count, CD4/CD8 ratio, and HIV-1 viral load) before and after delivery. With the available medication records of 49 patients, all of them received regular ART medication continuously.

Discussion: Hughes et al found in 18 HIV-infected parturients administered with epidural or spinal anesthesia for delivery that there were no changes in the immunologic parameters, and HIV disease remained stable in the peripartum period. It is known that general anesthesia may exacerbate the stress response to surgery and lead to impaired immune function. We confirmed the stability of HIV disease in a longer period (6 months) after delivery without significant complications in parturients received either neuraxial or general anesthesia. Tom et al administered autologous EBP to 6 patients who experienced PDPH after diagnostic lumbar puncture and did not identify morbidity attributable to EBP with a two-year follow-up. However, the case with suspected PDPH in our study was not received EBP. In the guidelines from ACOG, current trend for HIV-infected women is to take ART before, during and after their pregnancies. This study also supports the benefits of ART from the aspect of anesthesia for HIV-infected parturients.

References:

1. Hughes SC, et al. Anesthesiology 1995; 82: 32
2. Tom DJ, et al. Anesthesiology 1992; 76:943

Table 1 Complications within Six Months after Delivery in HIV-infected Parturients (N=50)

Systems	Complications	Cases
Dermatological	Rash	3
Neurological and psychiatric	Low back pain	2
	Aneurysm	1
	Postpartum depression	1
	Diplopia, headache and left cranial nerve VI palsy; questionable PDPH?	1
Urological	Urinary tract infection	1
	Dysuria	1
Gynecologic	Endometritis and abscess adjacent to uterus	1
	Breast mass	1
Pulmonary	Respiratory infection	1
GI	Fever, vomiting, chills and diarrhea, and epigastric pain	1
	Anorexia	1
	Diarrhea	1
ENT	Periorbital infection and conjunctivitis	1
	Abscessed tooth	1
Skeletal and muscular	Right ganglion cyst and bilateral knee arthritis	1

Table 2 Immunology and Virology Results in HIV-infected Parturients

	Before delivery (-3 months to 0d)	After delivery (4 to 6 months)	*P*
CD4 T-cell lymphocytes (cells/mm^3) (N=26)	525 (342, 667)	580 (443, 715)	0.42
CD8 T-cell lymphocytes (cells/ mm^3) (N=24)	731 (613, 878)	823 (702, 1033)	0.16
CD4/CD8 ratio (N=23)	0.74 ± 0.35	0.70 ± 0.30	0.37
HIV-1viral load (copies/ml) (N=28)	25(0, 25)	25 (0, 69)	0.35

Values are Median (Interquartile Range) or Mean ± SD. There were no statistical differences between values before and after delivery.

Abstract #:SAT-50

Complexity of Cesarean Delivery Procedure Is Associated with Postpartum Depression: A Retrospective Cohort Study

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Background: The prevalence of postpartum depression (PPD) is estimated at around 10%, which results in negative personal and child developmental outcomes. Lots of physical, psychological and social factors have influences on PPD. The aim of our study was to evaluate the association between cesarean delivery (CD) and PPD and other potential risk factors that may have impacts on PPD.

Methods: Retrospective chart review of all the parturients who delivered from 5/30/2015 to 2/4/2017 was conducted. Data including demographics, diagnosis and procedures were collected. Other risk factors as independent variables included anesthesia mode, anesthesia complexity, delivery mode, procedure complexity and coexisted conditions. Complexity of a procedure was counted as the number of various associated procedures patient received and evaluated with a score (0: without any additional step; each one additional step, such as hysterectomy, increases 1 score). Dependence variable was the occurrence of PPD. Logistic regression analysis was used for analysis of associations and interactions among these independent variables and dependent variable.

Results: In a total of 8,968 parturients, 207 (2.3%) cases with postpartum depression were identified. The complexity of procedure significantly influenced on PPD occurrence ($p=0.003$), and the incidence of PPD increased with the level of complexity of procedure. There was a significant interaction between delivery procedure mode and procedure complexity ($p=0.012$). With the procedure complexity increasing, the possibility of PPD occurrence increased in women who experienced CD, while the possibility of PPD occurrence did not change for women who went through VD or failure to progress. Neither anesthesia modes nor delivery procedure modes had significant associations with occurrence of PPD. Coexisted uterine leiomyoma during pregnancy was an independent risk factor associated with PPD as well ($p=0.004$).

Discussion: Previous studies reported with inconsistent results concerning the association between CD and PPD. However, meta-analyses of suitable studies failed to find evidence for a significant association. The explanations for these diverse findings may lie in the methodological weakness of some previous studies, the women's vulnerabilities to PPD, and diversities of CD manifestation. Our results further demonstrated a positive association of complexity of procedure with PPD occurrence and an interaction between delivery procedure mode and procedure complexity, indicating that CD may not be an influence factor by itself but act as a risk factor when the procedure is complex. We did not detected significant associations with other risk factors except for coexisted uterine leiomyoma, which may be due to the limitation of the sample size.

References:

1. Blom EA, et al. BJOG 2010;117:1390
2. Carter FA, et al. Psychosom Med2006;68:321
3. Silverman ME, et al. Depress Anxiety 2017;34:178

Abstract #:SAT-51

Sugammadex and Hormonal Contraceptives: How Many Are At Risk?

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Introduction: Sugammadex is newly approved by the US Food and Drug Administration (FDA) for rapid reversal of steroidal neuromuscular blockade, however has not been assigned a pregnancy category. Although a low side effect profile, sugammadex interacts with other steroids(1, 2). The manufacturer recommends patients on hormonal contraceptives use an additional non-hormonal contraceptive for seven days after receiving sugammadex.

Methods: Three months (10/8/2016-1/20/2017) of intraoperative sugammadex administration were retrospectively reviewed for a total of 184 patients. Patient demographic data, neuromuscular drug dosing, sugammadex dosing, train of four data, and hormonal contraceptive use were gathered from the anesthesia record. Exclusion criteria were deceased patients and those with restricted access records.

Results: Of 184 sugammadex administrations, 117 (63.5%) were to women, and 53 (28.8%) were to women between the ages of 18-59. Eleven (6.1%) were to women with hormonal contraceptives listed as home medications: 9 were on oral contraceptives, one had a hormonal intrauterine device, and one was on injections for In Vitro Fertilization. No postoperative counseling regarding contraception was noted in the anesthesia records.

The majority of the total sugammadex administrations were after rocuronium with only 11 after vecuronium. Fifty seven records indicated a train-of-four (TOF) of 0 prior to sugammadex administration, 53 with TOF of 1 and 14 with TOF of 2. Of those with TOF 0-1, 57 were dosed with sugammadex 3.5-4.5 mg/kg, (manufacturer's guideline= 4 mg/kg), 44 were underdosed, and 6 were dosed >4.5 mg/kg. For those with TOF 2-4; 39 were dosed between 1.5-2.5 mg/kg, close to the guideline of 2 mg/kg. One was underdosed and twenty four were dosed greater than 2.5 mg/kg. Only 68 patients had documented recovery of TOF to 4 after the administration of sugammadex, and many records were missing TOF documentation.

Conclusion: This retrospective review demonstrated that sugammadex was frequently given to women of childbearing age including some using hormonal contraceptives. It is imperative that these patients are counseled so they are aware of the potential reproductive sequelae. Further investigation is needed on the effect of sugammadex on infertility treatments and on breastfeeding as animal studies have shown a 1:1 milk to plasma ratio (2). We advocate for documentation of TOF prior to sugammadex and adhering to the drug dosing presented by the product label.

References:

1. Carron M, Zarantonello F, Tellaroli P, Ori C. Efficacy and safety of sugammadex compared to neostigmine for reversal of neuromuscular blockade: a meta-analysis of randomized controlled trials. J Clin Anesth 2016;35:1-12.
2. Package insert Bridion. 2015. https://www.merck.com/product/usa/pi_circulars/b/bridion/bridion_pi.pdf . Manufactured by Patheon Manufacturing Services LLC, NC 27834. Manufactured for Merck Sharpe & Dohme

Abstract #:SAT-52

Do Ethnicity and Body Mass Index Make a Difference in the Incidence of Unintentional Dural Puncture and Epidural Blood Patch?: A Retrospective Study

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Introduction: Unintentional dural puncture (UDP) occurs in approximately 1% of parturients who receive labor analgesia. While body mass index (BMI) varies among people with difference ethnicity backgrounds, there has been no study with focus on the relationship of incidence of UDP and ethnicity background. We hypothesize that 1) the incidences of UDP and EBP differ across ethnicity; 2) BMI plays a role in the occurrence of UDP and EBP.

Methods: We identified 67,295 epidurals and combined-spinal-epidural procedures performed from January 1, 2005 to December 31, 2016. Chart review of all the cases with obstetric anesthesia complication follow-up was conducted. The primary outcome was the incidence of UDP and subsequent EBP. The association between BMI, ethnicity, UDP and EBP was analyzed by using modified Poisson regression. Given the limitation of electronic medical record (EMR) system and time constrain, ethnicity ratio composite of the population was estimated using a sample size of 8,909, of which the ethnicity data were extracted from EMR.

Results: UDP was identified in 308 parturients. The overall incidence of UDP was 0.46%. The incidence of UDP in each ethnicity was 0.06% (Asian), 0.07% (Black), 0.07% (Hispanic) and 0.26% (White/Caucasian). After adjusting for BMI, the Asian population had a 1.62 times greater risk for UDP than that of the White/Caucasian population [Risk ratio (95% CI) 1.62 (1.15 to 2.28), p-value=0.006]. However, there is no difference of the incidence of UDP in other ethnicities compared to the White/Caucasian population. BMI is significantly associated with the incidence of UDP [Risk ratio (95% CI) 1.07 (1.05 to 1.08), p-value<0.001]. Meanwhile, we analyzed the relationship between parturients' BMI and the incidence of UDP and EBP after adjustment for ethnicity, and no significant association was identified.

Table 1. Statistical analysis of the association between Ethnicity, BMI and the incidence of UDP

		Multivariate	
		Risk ratio (95% CI)	*P*-values
Ethnicity	White/Caucasian	Reference	-
	Asian	1.62 (1.15 to 2.28)	0.006
	Black	0.9 (0.65 to 1.24)	0.522
	Hispanic	1.12 (0.8 to 1.57)	0.494
BMI	Continuous	1.07 (1.05 to 1.08)*	<0.001*

Note: * indicates statistical significance

Discussion: Our data demonstrated that Asian population has a higher risk of UDP than other ethnicities when compared to White/Caucasian population. Possible explanations include the thinner subcutaneous tissue and ligament in Asian parturients' compared to that of other ethnicities, provider's technical skill and experience. Increased BMI also contributes to an increased UDP rate. However, we did not see an association between BMI and the incidence of EBP, of which the literature has shown strong

Table 2. Statistical analysis of the association between Ethnicity, BMI and EBP

		Multivariate	
		Risk ratio (95% CI)	*P*-values
Ethnicity	White/Caucasian	Reference	-
	Asian	0.63 (0.24 to 1.63)	0.342
	Black	0.52 (0.19 to 1.37)	0.184
	Hispanic	1.3 (0.71 to 2.38)	0.398
BMI	Continuous	0.96 (0.92 to 1)	0.042

References:

1. Hollister N, et al. IJOA 2012;21(3):236-41.
2. Peralta F, et al. Anesth & Analg 2015;21(2):451-6.

Abstract #:SAT-53

What is the Best Sitting Posture for Labor Neuraxial Approach: A Randomized Ultrasound and Survey Study

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Background: Labor neuraxial analgesia and anesthesia are commonly administered to parturients who undergo labor and/or cesarean delivery. In the United States, labor neuraxial technique is often performed with the parturients in the sitting position. However, there is wide variation of sitting postures that provider may choose. During the recent years, ultrasound (US) has been used as point of care device to assist neuraxial placement. Our goal of this study was to use US to evaluate the lumbar spine anatomical landmarks in order to determine the best sitting posture for neuraxial approach.

Methods: Thirty termed parturients were recruited for this study. They were positioned into 5 different sitting postures in a randomized sequence. These 5 sitting postures were sitting with feet dangling (P1), sitting with the feet on support (P2), sitting with the legs stretching straight forward (P3), sitting with the crossed legs (lotus position) (P4), and sitting with embracing the partner in front (P5). Lumbar spinous process intervals and the articular process facet joint intervals between L2-L3, L3-L4, L4-L5 levels were measured. All parturients were inquired for their ranks of these postures with their preferences. A Student's T test was used in the analyses.

Results: Our data did not show evidence that any one particular posture was overwhelmingly better than others in terms of providing wider space for lumbar neuraxial approach. With regards to parturients' preferences, there were 16 (53.3%) parturients who ranked the P5 the best.

Discussion: Keplinger studied the lumbar anatomical changes throughout pregnancy, during which they concluded that L2-3 level is the most appropriate puncture site for epidural placement in parturients. Our study could not provide a rank of among the 5 sitting postures with regard to the lumbar spine openings. At the L3-4 interval, there are several comparisons between postures with statistical significance, indicating it is the most versatile interspace among the lumbar area that studied. From the parturients' perspectives, P5 was the most preferred posture, which could be resulted from the intimate contact that it offered with their partners who provided emotional and physical support to their labor and delivery processes.

Table 1. Statistical analysis of lumbar articular process intervals and spinous process intervals

P value	P1-P2	P1-P3	P1-P4	P1-P5	P2-P3	P2-P4	P2-P5	P3-P4	P3-P5	P4-P5
Articular Process L2-L3	0.154	0.402	0.573	0.813	**0.04***	0.558	0.155	0.239	0.522	0.528
Articular Process L3-L4	0.886	0.161	0.209	0.389	0.053	0.311	0.36	**0.01***	0.482	0.068
Articular Process L4-L5	0.189	0.423	0.156	0.392	0.534	0.87	0.537	0.423	1	0.441
Spinous process L2-L3	0.759	0.924	0.349	0.505	0.701	0.641	0.357	0.36	0.594	0.206
Spinous process L3-L4	0.077	0.484	0.222	0.164	**0.006***	0.607	**0.001***	0.088	0.379	**0.005***
Spinous process L4-L5	0.562	0.089	0.528	0.087	0.337	0.866	0.336	0.373	0.941	0.378

Note: P1, sitting with feet dangling; P2, sitting with the feet on support; P3, sitting with the legs stretching straight forward; P4, sitting with the crossed legs (lotus position); P5, sitting with embracing the partner in front. * indicates statistical significance

Table 2. Rank of parturients' posture preference

	P1	P2	P3	P4	P5
Average rank	2.93	2.57	3.93	3.3	2.27
Suggested preference rank	3	2	5	4	1

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2. Keplinger M, et al. Anaesthesia 2016. doi: 10.111/anae.13399
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Abstract #:SAT-54

Indications and Newborn Outcomes of 705 Parturients Undergoing Cesarean Delivery with General Anesthesia: Retrospective Review of Labor and Delivery Data in A Major Tertiary Teaching Hospital in China

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Background: Recent data revealed improved overall cesarean rate in mainland China. However, in October 2015, the Chinese government abolished the one-child policy. We have been experiencing a surge of cesarean delivery at a major tertiary teaching hospital. In addition, an increased rate of general anesthesia was induced for these cases. We conducted this study to review the indications and outcomes of these cases.

Methods: Medical records of patients underwent cesarean delivery under general anesthesia or neuraxial anesthesia at Qilu Hospital of Shangdong University from January 2013 to December 2016 were reviewed. Data of comorbidities, causes for general anesthesia and Apgar scores of their newborns were collected and analyzed.

Results: From January 2013 to December 2016, the annual number (and rate) of cesarean deliveries were 1962 (55.5%), 2660 (54.1%), 1977 (58.1%) and 3060 (57.1%), respectively. During the aforementioned period, a total of 705 (7.3%) parturients underwent cesarean delivery under general anesthesia, while 8954 (92.7%) parturients were performed under neuraxial anesthesia. (Figure 1a, b) The indications for general anesthesia include central nervous diseases (7, 1.0%), hematological diseases (133, 18.9%), obstetric related indications (503, 71.3%), immunological diseases (26, 3.7%) and unknown reasons (36, 5.1%). With regards to the obstetric related indications: HELLP (71, 14.1%), acute fatty liver (49, 9.7%), placenta previa (225, 44.7%), placental abruption (21, 4.2%), preeclampsia with severe feature(s) (133, 26.4%) and gestational hypertension (3, 0.6%). The average Apgar score (1 min, 5 min) were (9.7±0.5, 10.0±0.0) in the group of parturients with central nervous diseases, (9.7±1.0, 10.0±0.3) in that of hematological diseases, (8.5±2.4, 9.2±1.8) in that with obstetric related indications, (9.7±0.8, 10.0±0.2) with immunological diseases, and (8.7±2.4, 9.3±1.8) in unknown group.

Discussion: Cesarean rate remained high in our institution. There was a surge of general anesthesia utilization, resulting from the increased number of parturients with comorbidities. While the outcome from general anesthesia for cesarean delivery was acceptable, general acceptance of neuraxial anesthesia was still low. The general system parturient care model and workflow could also play a role.

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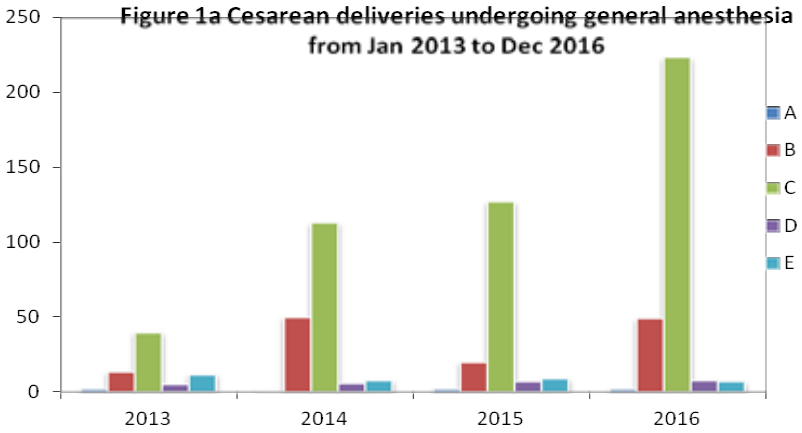
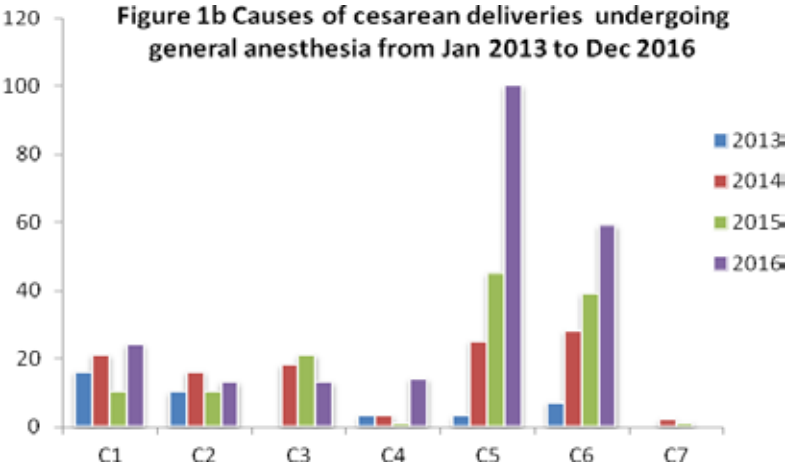
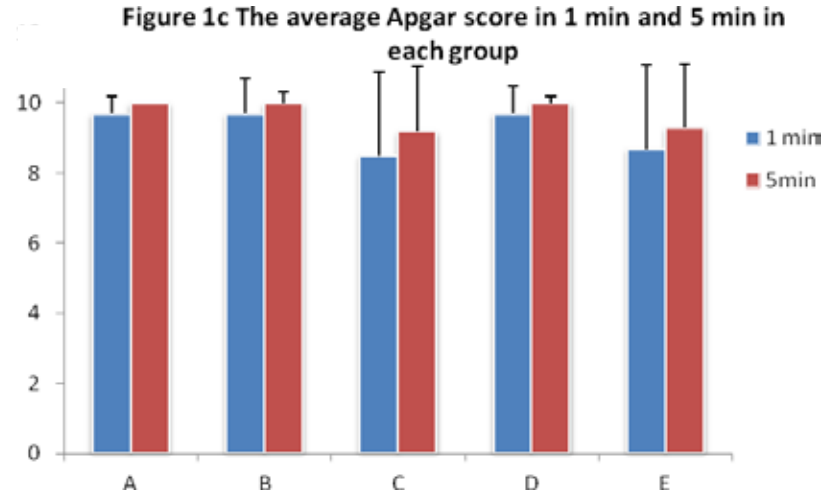
Abstract #:SAT-54







Note: A=central nervous diseases, B=hematological diseases, C=obstetric problems, D=immunological diseases, E=other problems; C1= HELLP, C2=acute fatty liver, C3=placenta previa, C4=placental abruption, C5=dangerous placenta previa, C6=severe preeclampsia, C7=gestational hypertension

Abstract #:SAT-55

Impact of Government Healthcare Policy and Clinical Practice Guideline on Obstetric Anesthesia Professional Reimbursement: Retrospective Review of Anesthesia Billing from 2002 to 2016

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Tianyue Mi MS - Brigham and Women's Hospital - Boston, MA

Background: In 2006, Mitt Romney's health care insurance reform laws passed in Massachusetts. We hypothesize that healthcare related policies change may affect anesthesia professional billing.

Methods: We extracted professional billing data from Department of Anesthesiology, Brigham and Women's Hospital for the year of 2002-2016. The data was organized by procedure, namely anesthesia for cesarean delivery only, neuraxial labor analgesia/anesthesia for planned vaginal delivery, and anesthesia for cesarean delivery following neuraxial labor analgesia/anesthesia. Kruskal-Wallis H test was used to analyze the unpaid charge (UC), difference between per patient charge and per patient pay.

Results: Our data demonstrated that per patient charge and pay for anesthesia for cesarean delivery reached its nadir in between year 2003-2004. After a steady increase for a decade, the charge and pay decreased proportionally from 2015. (Figure 1) A similar trend was seen in anesthesia charge and pay for the labor analgesia. (Figure 2) There is an upward trend for the UC portion of labor analgesia anesthesia billing. There is a noted trend of decreased UC for the anesthesia for cesarean delivery following neuraxial labor analgesia during the first 10 years of this century. However, the UC portion increased significantly starting 2012. (Figure 3) The UC portion of charge after 2012 were significant higher than those of 2010 and 2011 (P=0.000). [2010: $620 (212, 1178) (n=4540); 2011: $572 (242, 1250) (n=7898); 2012: $704 (407, 1493) (n=5016); 2013: $780 (339, 1560) (n=5007); 2014: $741 (256, 1648) (n=4279)] (Median (Interquartile Range))

Discussion: The data of per patient charge and per patient pay in neuraxial labor analgesia/anesthesia for planned vaginal delivery during the past a few years were inversely proportional. Several possibilities could be contributing to it. Firstly, the change of pay schedule might have an impact I. Secondly, it could be caused by the payer mix change shift. Interestingly, it is also coincidently aligned with the recent change of obstetric care in relation to the extended length of first and second stage labor recommended by ACOG in 2011. While insurance professional fee reimbursement caps by anesthesia time, extension of labor analgesia could lead to increased workload and labor cost.

References:

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Abstract #:SAT-55

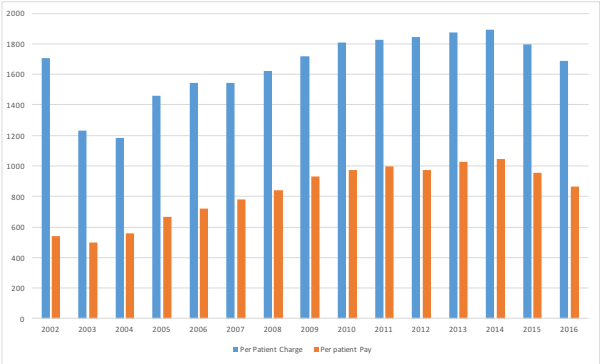

Figure 1. Per patient charge and per patient pay for anesthesia for cesarean delivery only through 2002-2016.

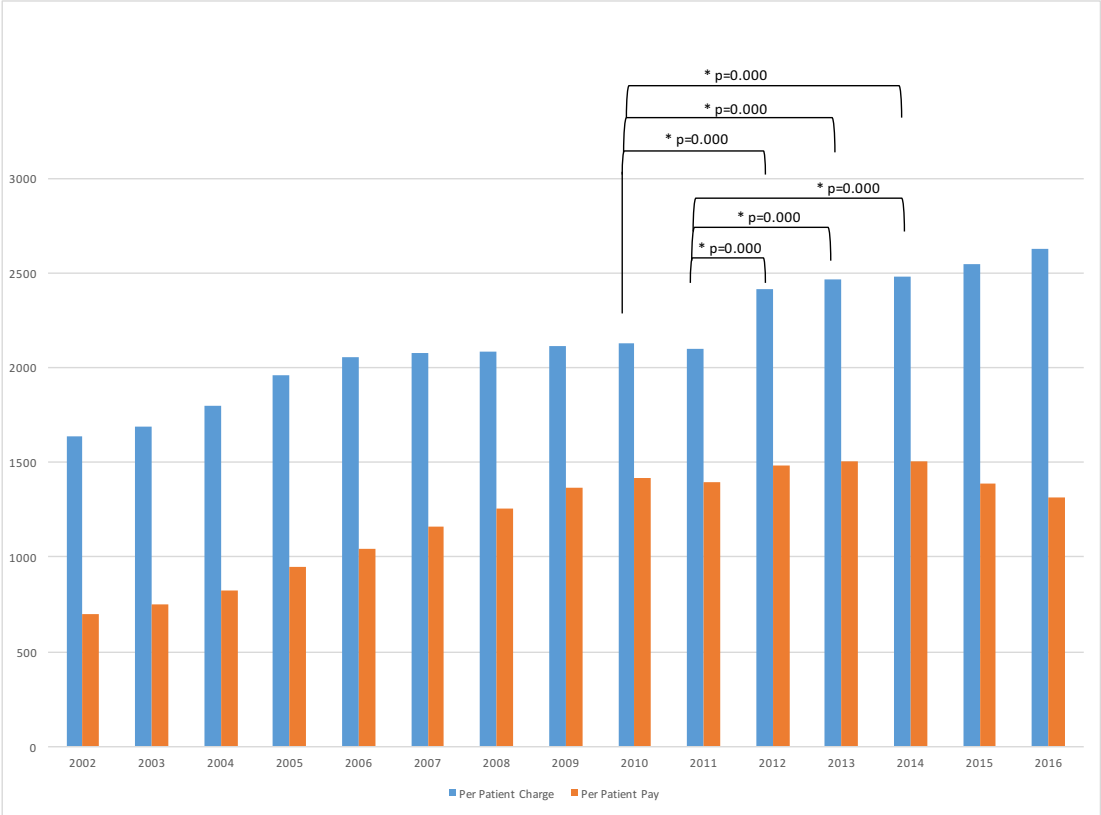

Figure 2. Per patient charge and per patient pay for neuraxia labor analgesia/anesthesia for planned vaginal delivery through 2002-2016.

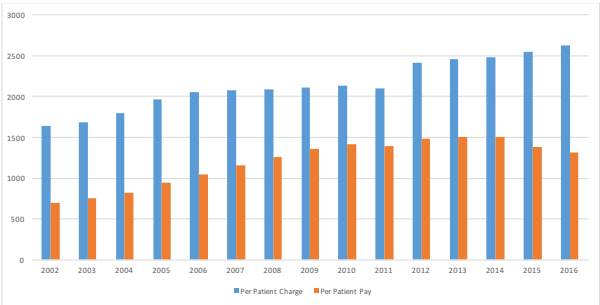

Figure 3. Per patient charge and per patient pay for anesthesia for cesarean delivery following neuraxial labor analgesia/anesthesia through 2002-2016.

Abstract #:SAT-56

Does "Troublesome" Labor Epidural Predict Failure to Progress Labor: A Retrospective Matched Cohort Study

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Background: Problematic labor analgesic processes pose challenge to anesthesiologists. We speculate that some of these problems indicate early signs of the need of cesarean delivery (CD) from failed labor progress. This is a retrospective pilot study aimed to compare the process of normal vaginal delivery (VD) with epidural labor analgesia to women who had cesarean delivery (CD) from failed labor progress.

Methods: Labor and Delivery data from July 2015 to December 2015, at the Brigham and Women's Hospital was reviewed. One hundred primparous partuients' medical records were selected randomly, half of which were those who successfully delivered vaginally and the other half were those who failed labor progress and delivered via CD. Patient demographic data, and some anesthesia related information were collected. Data points include: the interval time from labor analgesia to delivery versus to operating room, total number of anesthesia intervention, average interval of anesthesia interventions, total dosage of epidural analgesia, pain complaint, number of epidural top-ups and the counts of fatal heart rate (FHR) deceleration.

Results: Compared with the VD group, CD group carried longer interval time from epidural analgesia to delivery time ($p<0.001$), higher number of analgesia interventions ($p<0.001$), higher dose of epidural consumption ($p<0.001$), and higher number of epidural top-off demands ($p=0.015$). Multivariate analysis revealed that a high gestational age and long epidural analgesia time were strongly associated with higher possibility of CD.

Discussion: Zhang et al demonstrated that for nulliparous parturient the 95% percentile length of 1st stage labor starting from 4 cm cervical dilation was averaged at 4.2 hours. Cheng and other reported longer 2nd stage labor time of 336 minutes with labor epidural, which led to the ACOG's consensus for safe prevention of the primary CD. However, these prolonged second stage labor were not trouble free. Our preliminary data revealed that while we are allowing the prolongation of 2nd stage labor, the labor epidural may have more "trouble" for the anesthesia team. We are further investigating the fetal ultrasound data, maternal size, the nursing and other care requirements data for the extended 2nd stage labor. We will report the complete data at the SOAP meeting.

Table. Potential risk factors of labor epidural analgesia associated with failure to progress cesarean delivery

Potential Risk Factors of PCEA	VD (n=50)	CD (n=50)	P value
Interval from PCEA to delivery (h)	7.5±3.28	13.47±4.57	<0.001*
Total number of anesthesia analgesia intervention	4.4±2.04	7.84±2.79	<0.001*
Interval between two anesthesia interventions (h)	1.81±0.56	1.77±0.44	0.75
Total volume of PCEA infused (ml)	44.21±20.58	79.89±29.61	<0.001*
Number of PCEA top-off	0.84±1.09	1.52±1.59	0.015*
Number of pain reduction	0.82±1.06	0.9±0.95	0.693

VD: Vaginal Delivery; CD: Cesarean Delivery; PCEA: Patient Controlled Epidural Analgesia

References:

1. Zhang J. Obstet Gynecol 2010;116:1281
2. Cheng YW. Obstet Gynecol 2014;123:527
3. ACOG Consensus No 1. Obstet Gynecol 2014;123:693

Abstract #:SAT-57

The Weiss Epidural Needle

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In 1901, two French physicians Jean-Anthanase Sicard and Fernand Cathelin established the intentional administration of epidural anesthesia. Since then, epidural needles have developed during the past several decades as physicians and manufacturers have kept exploring innovative techniques to influence the quality of anesthesia.

Exactly one hundred years ago, Jess Bernard Weiss, was born on January 11th, 1917 in New York City, who is best known for designing the Weiss epidural needle. He spent first two years of college at City College of New York and transferred to University of Alabama. Dr. Weiss went to medical school at St. Mungoes Medical School at the University of Glasgow, Scotland; returned to the U.S. because of World War II, and graduated from Middlesex Medical School in Massachusetts. He was drafted into Navy after his internship during World War II. After completing a residency in anesthesia at the Massachusetts Memorial Hospital, which is called Boston University now, in the early 1950s after being a general practitioner, Dr. Weiss was recalled into the Navy. His whole family went to Guam for two years, and he was the only anesthesiologist for many thousand square miles.

Later, he completed an anesthesiology residency at Boston University. Dr. Weiss returned to practice at Boston Lying-In Hospital Harvard Medical School after another tour in the Navy, and later the Peter Bent Brigham Hospital. He served as Vice Chair of Anesthesia at the Brigham and Women's Hospital before his retirement.

Dr. Weiss made valuable contributions to the design of the epidural needle. In 1961, he added wings at the end of the needle which allow the users to have better control over the needle. Because Dr. Weiss practiced "hanging drop" method, the addition of wings accommodated him ability to hold the needle with both hands while observing the fluid flowing as the tip of needle arrived epidural space. The slightly curved wing-design also added ergonomics to the needle which fits the human's thumbs better while adding stability and control. Dr. Weiss hand sanded the tip of the first Weiss needle. The myth of this move made majority of people believed that he "dulled the needle tip" or he "advocated for a blunt tip" to the epidural needle. The new tip design slightly moved the dura before it being torn by the needle. These design changes saved tens of thousands patients from wet-taps over the decades. Dr. Sanjay Datta also mentioned the advantage of Weiss needle tip would allow the practitioner to "push the dura mater forward without perforating it, thus artificially creating the negative epidural pressure necessary for the 'hanging drop' method in the pregnant women".

References:

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2. Frölich MA, et al. Anesthesia and Analgesia 2001.
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Abstract #:SAT-58

An initial look at identification of L3-L4 interspace in parturients by palpation: Can we teach residents to be better than chance?

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Identification of the L3-L4 interspace is based on palpation of the intercristal line; however, published literature shows that this method is inaccurate (success rate 13-76%)(1). This may be because the intercristal line is based on radiographic imaging not landmark palpation. Ultrasound is a readily accessible tool that we hypothesized could provide real-time feedback to improve resident palpation skills.

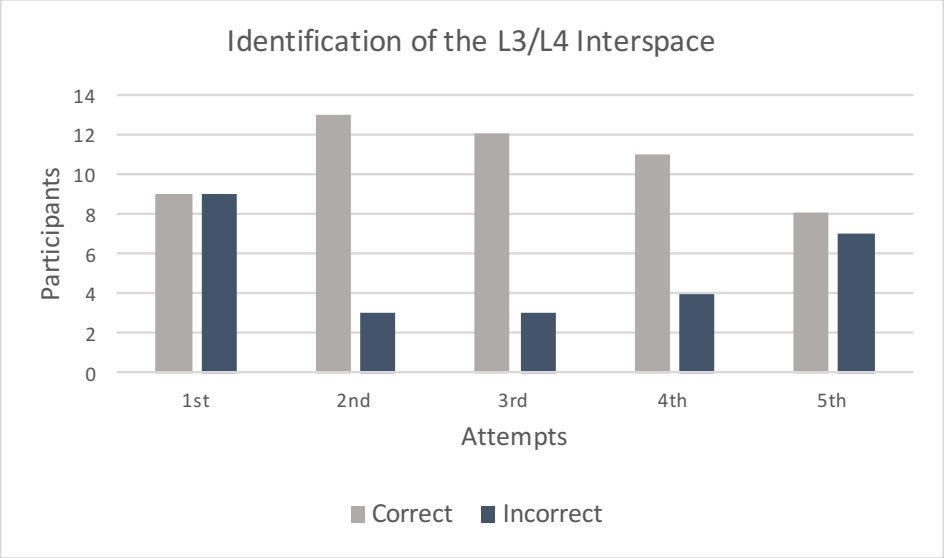
Methods: We performed an observational, education-based study to improve resident's ability to correctly identify the L3-L4 interspace. Residents were trained in a 2-week program using ultrasound via an online module and hands-on teaching on live models. The program taught intercristal line identification by correlating ultrasound imaging with palpation. After training, each resident was tested on five parturients by having to identify the L3-L4 interspace using palpation alone. The resident's site was confirmed using ultrasound. Analyses were conducted using SAS 9.3.

Results: A convenience sample of 18 CA-1 residents participated. The rate of correct identification was 65.8%. Fourteen percent of attempts were one level below, 16.5% attempts one level above, and 3.8% attempts two or more levels above the targeted L3/4 interspace. Residents improved their success significantly after their first attempt with ultrasound feedback (Figure 1). No statistical difference between age, height, weight or BMI was found amongst patients who had correct versus incorrect interspace identification.

We compared our results to 11 studies totaling 1701 patients where an experienced anesthesiologist attempted to identify a lumbar interspace. The average success (55.7%) was significantly less than our result (p=0.038). When focusing on OB patients with a similar BMI (mean 29.9 kg/m2) compared to our patients (mean 29.4 kg/m2), success rate was reduced to 39.7% (p<0.001 vs. our results).

Discussion: Our study reflects the utility of ultrasound as an education tool to improve resident palpation skills. We had an overall success rate to 65.8% for new CA-1 residents within their first month of training, which exceeds the comparison data from experienced anesthesiologists, especially when OB comparison was used.

This preliminary study represents a novel, promising method of real-time ultrasound feedback to improve resident education of interspace palpation skills. What remains to be investigated is if our results are sustained on long-term follow-up.



Reference:

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Abstract #:SAT-59

ANESTHETIC MANAGEMENT FOR A CESAREAN SECTION IN A PARTURIENT WITH UNSPECIFIED INHERITED BLEEDING DISORDER

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Hani Y El-Omrani M.D. - University of Washington - Seattle, WA
Laurent A Bollag M.D. - University of Washington - Seattle, WA

Introduction: Neuraxial anesthesia, as the standard of care for Cesarean deliveries (CD), is associated with decreased blood loss[1]. However, parturients with inherited bleeding disorders are at an increased risk for epidural hematomas. A small retrospective study[2] has shown that parturients with known factor deficiencies can safely undergo neuraxial anesthesia once the specific factors are replenished. We present the anesthetic management for a CD in a patient with an unspecified inherited bleeding disorder.

Case Details: A 39-year-old G6P3 95 kg woman at 37 6/7 weeks gestational age with an unspecified inherited bleeding disorder presented for a repeat CD. She reported easy bruising, frequent gum bleeds, and heavy menses as a teenager. She also had persistent menorrhagia after her first two CD, an intra-abdominal hemorrhage after her third CD, and a compartment syndrome from a hemorrhage after an ankle surgery. Additionally, her mother had heavy menses, her grandmother died from a postpartum hemorrhage, and her three children showed petechiae after coughing or crying. An extensive hematological workup, including platelet function tests, a von Willebrand panel, and several other factor levels, did not yield any abnormal laboratory findings.

On the day of her CD, the patient received 2 units of fresh frozen plasma, 10 units of cryoprecipitates, and 2 units of platelets per hematology recommendation, before the placement of her routine spinal anesthetic. Immediately after delivery of a healthy infant, aminocaproic acid was given. Uterine tone remained poor after routine oxytocin administration, but improved with methylergonovine and misoprostol. Blood loss was an estimated 1.5 liters; and no additional blood products were given intraoperatively. Postpartum, the patient continued her fibrinolysis inhibitors, and received 2 units of platelets prophylactically. Her recovery was uneventful.

Discussion: This patient had a considerably increased risk of peripartum bleeding due to an unspecified inherited bleeding disorder. All her previous surgeries, including the three CD, were complicated by hemorrhage. Despite the lack of a specific diagnosis, the hematology consult provided detailed recommendations for blood product administration, enabling a safe spinal anesthetic followed by CD. Fibrinolysis inhibitors were started after delivery to further reduce bleeding. A spinal anesthesia was preferred, despite being the fourth repeat CD, over a combined spinal epidural to decrease the risk of an epidural hematoma. Communication between obstetric and anesthesia teams was crucial to expedite the start of surgery after the spinal placement and to aim for its timely completion.

In summary, the careful planning among obstetrics, anesthesia, and hematology helped achieve an uneventful CD in this patient with an extremely high bleeding risk.

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2. Chi C et al. (2009) Thromb Haemost. 101(6):1104-11.

Abstract #:SAT-60

Anesthetic Management Of Spondylocostal Dysostois Patient Presenting For Cesarean Delivery

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Gillian Isaac M.D , PhD - Johns Hopkins Univeristy - Baltimore, MD
Jamie Murphy M.D - Johns Hopkins Univeristy - Baltimore, MD

A 22 years old Hispanic nulliparous female patient at 36 weeks of gestation presented to our institution for elective caesarian section.Our patient had past medical significant for spondylocostal dysostosis, also called Jarcho-Levin syndrome. Both neuroaxial anesthesia and general anesthesia approaches were challenging due to lumbar vertebral anomalies and cervical spine vertebrae fusion respectively. Physical examination showed short stature, severely restricted neck extension, grade 1 Mallampatti view, with epiglottis visible on mouth opening. Her imaging studies were significant for bony fusion of cervical spine from occiput to lower cervical spine, marked shortening of the spine and suboptimal visualization of the severely dysplastic, partially absent, thoracic and lumbar vertebrae and multiple rib fusions. Pulmonary function tests showed restrictive lung disease, echocardiogram showed normal size and function of the heart. Otolaryngology service was consulted for possible surgical airway in case of emergency and based on E.N.T evaluation appeared to be surgically challenging too. With very few case reports available in literature, awake fiberoptic intubation and general anaesthesia was thought to be the safest anesthetic approach for our patient.

Patient underwent an awake fiberoptic intubation where a sublgottic web was seen beyond the vocal cords requiring the use of smaller endotracheal tube. The patient had uneventful intraoperative and postoperative courses.

Discussion: In 1938 Saul Jarcho and Paul Levin at Johns Hopkins University first described the pattern of vertebral and costal anomalies 1, named after them, the eponym Jarcho-Levin syndrome was used for spondylocostal dysostosis (SCD) before the introduction of genetic based classification. There are 2 forms of SCD that are transmitted as autosomal recessive genetic traits. It is a rare anomaly caused by defective embryological development of the axial skeleton during early stages of gestation with incidence of 1:40,000 and a higher incidence in Hispanic population (2).

Few case reports are available for management of spondylocostal dysostosis, mostly cases regarding anesthetic management in pediatric patients where supralaryngeal devices were successfully used. Another case report showed the use of spinal anesthesia in a parturient with height adjusted dose of local anesthetic (3). Neuraxial anesthesia can be challenging due to vertebral anomalies but yet general anesthesia can be as challenging, both for securing the airway and maintaining adequate ventilation.For this patient ,we opted for awake fiberoptic intubation and general anesthesia

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Abstract #:SAT-61

Anesthetic Management of a Pregnant Patient with Reversible Cerebral Vasoconstrictive Syndrome

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Ingrid Moreno-Duarte MD - Tufts Medical Center - Boston, MA
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Introduction: Reversible cerebral vasoconstriction syndrome (RCVS) is rarely reported in anesthesia literature. We reported a case of RCVS in a parturient with attempted vaginal delivery.

Case report: A 24 year old G1P0 at 36 weeks with a history of obesity and headaches transferred from an OSH with 5 days of episodic right facial and arm numbness lasting for minutes with complete resolution. She had facial drooping which prompted her to seek treatment at the ER. MRA/MRI of the head and neck showed degrees of stenosis within multiple vessels. Upon arrival, she had a left sided Horner's syndrome, decreased sensation in the right V3 mandibular distribution, and impaired finger tapping of the right hand. Vital signs were normal except for systolic BPs of 140s. A repeated MRA/MRI confirmed stenosis of bilateral supraclinoid ICA, bilateral M1, and left A1 regions. Intra-arterial verapamil injection did not change vascular contour. She was started on nimodipine and aspirin, and monitored in the Neuro ICU with stable neuro exams prior to transfer to the L&D floor. A diagnosis of gestational HTN prompted recommendation for delivery at 37 weeks. The neurology team determined it was safe for the patient to have Valsalva maneuver (VM) and vaginal delivery. An A-line was inserted for BP control. An early epidural was placed and maintained with NS until her contractions started. The epidural was set in PCEA mode to minimize BP fluctuations. She progressed to 10 cm with Pitocin augmentation. She pushed for over 3 hours with minimal pelvic descent of the baby. A primary C-section was indicated. In the OR, her systolic BP was kept between 120 - 140s. The epidural and A-line were removed after surgery. Her intraoperative and postpartum course was uneventful.

Discussion: RCVS is associated with multifocal arterial constriction believed to be due to transient disturbance in cerebrovascular tone. In pregnant women, it mostly occurs in postpartum and resolves spontaneously within days to weeks (1). Our patient presented in the antepartum. The challenge for anesthesiologists was maintenance of cerebral perfusion (CP) in a patient who had documented neurological symptoms and stenosed blood vessels while laboring. Increased intrathoracic and intraabdominal pressure during pushing may increase ICP and decrease CP with subsequent cerebral ischemia. Therefore, most literature recommends avoiding VM. However, cerebral autoregulation is preserved during VM in normal patients (2), and probably in patient with RCVS(3). During VM, the MAP did not change much and Cerebral Blood Flow Velocity decreased transiently but restored quickly in normal volunteers (4). This makes BP control critical. In hypervolemic patients, BP drops significantly less than those in normovolemia and hypovolemia (5). We inserted an A-line to help with BP control. Our patient was asymptomatic during 3 h pushing.

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Abstract #:SAT-62

A case of anaphylaxis in a twin parturient

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Anaphylactic reactions during caesarean section are rare. Anaphylaxis during pregnancy occurs in approximately 3 per 100 000 deliveries.

A 31 year old Somalian twin parturient presented in pre term labour at 34 weeks gestation. The first twin delivered vaginally in the room. Foetal distress ensued in the second twin with an unstable lie. She underwent a category one general anaesthesia (GA) caesarean section. She was induced with intravenous alfentanyl 2 mg, propofol 250 mg and rocuronium 50 mg. Anaesthesia was maintained with 1% sevoflurane and 50% nitrous oxide. There were no ventilation problems during delivery. The ventilator started to alarm due to high inflation pressures shortly after delivery. It became difficult to manually ventilate her accompanied by a sudden and complete loss of end tidal carbon dioxide. At this point 100 mcg of intravenous adrenaline was given. Cardiopulmonary resuscitation (CPR) was started immediately for a pulseless electrical activity cardiac arrest. Three cycles of CPR was needed before return of spontaneous circulation. Her computerised tomography (CT) scan of her head was normal, however her CT pulmonary angiography demonstrated the surprise findings of bilateral moderate sized pneumothoraces without associated evidence of chest trauma. She was extubated the next day.

With the difficulty in ventilation and loss of cardiac output our differential diagnoses included anaphylaxis to rocuronium, amniotic fluid embolism and pulmonary embolism. With the clinical information ascertained at the time, anaphylaxis was most likely. We did consider the use of sugammadex, however there are case reports on sugammadex induced anaphylaxis. Sugammadex can be used for the treatment of rocuronium induced anaphylaxis by direct encapsulation. Interestingly there have been case reports pertaining to anaphylaxis secondary to the rocuronium - sugammadex complex. This complex can express new antigenicity even if rocuronium and sugammadex separately have no antigenicity. This case also highlights whether we should consider inserting epidurals in all twin parturients in labour. This patient did not have an epidural in situ and if she did, the GA may have been avoidable. In the United States it is common practice to deliver all twin parturients in theatre, a practice the United Kingdom may need to consider. However the practicalities of this may be some what challenging. It is important for anaesthetists to identify the causative drug of peri-operative anaphylaxis by appropriate tests to establish optimal risk reduction strategies and prevent recurrence.

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Abstract #:SAT-63

A novel approach to general anesthesia for the EXIT (ex utero intra-partum therapy) procedure, a case series

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Introduction: There are many ways to provide anesthesia for EXIT procedures; the largest case series used GA with 2-3 MAC volatile anesthetic.1 Others have combined neuraxial anesthesia with nitroglycerin (NTG) infusions for uterine relaxation,2 and added remifentanil for fetal anesthesia.3 One case combined two approaches, using 1 MAC GA with NTG.4 We report using 1 MAC GA with both NTG and remifentanil infusions.

Case 1: A 32 yo G3P1, at 35 wks, with history of IVDA, polyhydramnios, and fetal anomalies, including severe micrognathia. Due to an anticipated difficult EXIT, and patient desire, an RSI-GETA was performed, followed by insertion of an a-line. Anesthesia was maintained with 2.1% sevoflurane and remifentanil (0.3 mcg/kg/min) and ketamine infusions, with NTG (0.1 mcg/kg/min) and phenylephrine infusions before uterotomy.

After delivery of the fetus to shoulders, ENT noted an absent mandible and tongue, small mouth, low-set ears, and a blind end to the mouth and nares. Tracheostomy was performed. The radiologist confirmed normal FHR and correct tracheostomy tube position. EXIT time was 45 min with stable maternal vitals, minimal bleeding, and no fetal movement.

The remainder of the case was uneventful, with a change to TIVA after delivery. One dose of methylergonovine was needed. US-guided bilateral TAP catheters were placed before emergence. Post-op multimodal analgesia achieved good results. The patient was discharged on POD 3 and lost to follow-up. The neonate survived for 6 hrs; autopsy showed agnathia-otocephaly complex.

Case 2: A 107 kg 26 yo nulliparous patient at 37 wks presented with pre-eclampsia and a fetus with a 10 x 5 cm neck mass. The anxious patient strongly desired GA. In the OR, a thoracic epidural was placed at T10-11, and the patient underwent a RSI-GETA, with subsequent insertion of an a-line. Anesthesia was maintained with 1.7% sevoflurane and remifentanil (0.1 mcg/kg/min), with NTG (0.5 mcg/kg/min) and phenylephrine infusions before uterotomy.

The fetus was delivered to shoulders. A mass in the right piriform sinus obstructed the airway but spared the vocal cords. The fetus was intubated; a radiologist confirmed correct ETT location and a normal FHR. EXIT time was 5 min with stable maternal vitals, minimal bleeding, and no fetal movement. TIVA was used for the uneventful remainder of the case.

The epidural was bolused prior to emergence and used for a day. The patient was discharged on POD 3. The neonate was safely transported to a local pediatric hospital.

Conclusion: We performed two EXIT procedures with different fetal issues, using a novel technique of 1 MAC GA with remifentanil for maternal and fetal analgesia, and NTG for uterine relaxation. This combination provided excellent and safe surgical anesthesia for both mother and fetus, with quick return of uterine tone, unlike using high MAC alone.

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Abstract #:SAT-64

Metastatic Femur Fracture in Pregnancy: Obstetric and Anesthetic Considerations

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A 34 year old presented at 31 weeks gestation to the ER with back and rib pain. Exam was normal except for exquisite chest wall tenderness. A CT scan of the chest was negative for pulmonary emboli, but showed multiple lucent lesions throughout the chest wall, and collapse of the T8 vertebral body. Oncology diagnosed stage 4 metastatic invasive ductal breast carcinoma. CT revealed lytic lesion of the femoral meta-diaphysis requiring intramedullary (IM) nail stabilization. Metastatic involvement of multiple bones, impending pelvic/femur fractures, and vertebral body metastatic processes were found. Pelvic MRI showed innumerable lesions in the pelvis and femurs. MRI brain showed areas of osseous metastases to the calvarium and skull base. CT liver showed metastatic disease. A lumbar spine MRI was performed. It revealed multifocal metastatic lesions involving the the T12-L3 vertebral bodies and sacrum without retropulsion of bone into epidural space. She was started on a weekly chemotherapeutic regimen of paclitaxel and DVT prophylaxis with enoxaparin. Palliative care was consulted for pain management.

Debate occurred as to the proper timing for the femur stabilization and delivery given the risks of a combined procedure and the risk of delaying chemotherapy further than necessary. Multidisciplinary planning between Maternal-Fetal Medicine, Orthopedic Surgery, Pediatrics, and Anesthesiology took place. It was determined that the patient was a candidate for neuraxial anesthesia/analgesia. A combination cesarean delivery at 38 weeks followed immediately by IM nail was planned and undertaken.

Anesthetic management concerns were many. Unanticipated post-partum hemorrhage could be more difficult to diagnose during the IM nail procedure, and could complicate intraoperative management. Careful positioning in the lateral decubitus position and avoidance of rollerboard transfers would be paramount given spine fractures and vertebral metastases. Postoperative and cancer pain required multimodal pain management strategies.

Cesarean delivery was performed with uncomplicated spinal anesthesia. After delivery general endotracheal anesthesia was induced for length of procedure and patient toleration. Total intravenous anesthesia technique was used to avoid uterine relaxation from volatile anesthetics. Competing perioperative considerations are presented.

Abstract #:SAT-64

Anesthetic Planning for Cesarean Delivery and IM Nail in a Patient with Stage IV Metastatic Invasive Ductal Breast Carcinoma		
	Delivery	Intramedullary Nail
Surgical Timing:	• No obstetric or fetal indications for early delivery; able to delay delivery to allow continued fetal development • Six week chemotherapy delay following cesarean section	• Impending fracture rather than pathologic fracture; able to delay stabilization until post-partum period • Risk of obstetric bleeding complicating combined procedure • Six week chemotherapy delay following femur stabilization
Surgical considerations:	• High risk for trial of labor given high risk of pelvic fracture in setting of metastatic involvement of the pelvis and impending pathologic fractures	• Combined procedure offers less delay in beginning chemotherapy • Less delay in restarting venous thromboembolism prophylaxis as patient at high risk for venous thromboembolism in setting of orthopedic surgery and malignancy • Possibility of delaying stabilization in the case of a complicated delivery
Type of anesthetic:	• Imaging with no contraindications for neuraxial anesthetic • Ideal anesthetic for delivery, would be adequate for femur stabilization procedure in combination with sedation	• Patient wanted general anesthetic for personal reasons • Total intravenous anesthesia employed to avoid volatile anesthetic in peripartum setting to avoid uterine relaxation • Neuraxial anesthesia would have allowed avoidance of the obstetric airway and facilitated ideal conditions for positioning
Positioning concerns:	• Patient able to verbalize comfort during cesarean section positioning • Avoidance of roller board transfer in patient with pathological thoracic spine fractures and vertebral metastases	• Ideal for patient to position herself given thoracic spine fractures, however, not possible with general anesthesia • Avoidance of roller board transfer in patient with pathological thoracic spine fractures and vertebral metastases
Pain management:	• Pain management to include a multimodal strategy in a patient with cancer pain. Regimen included continuation of pain medications being prescribed by palliative medicine (scheduled extended release morphine and immediate release morphine as needed) with the addition of intravenous hydromorphone, acetaminophen, and ibuprofen	

Abstract #:SAT-65

Management of a parturient with autoimmune autonomic ganglionopathy

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Introduction: Autoimmune autonomic ganglionopathy (AAG) is a disorder mediated by antibodies to nicotinic acetylcholine receptors in autonomic ganglion. Patients with AAG present with a variety of symptoms, including orthostatic hypotension, gastrointestinal dysmotility, and bladder dysfunction.1 We report the management of a patient with AAG who presented for 2 Cesarean sections (CS) within 2 years.

Case: The patient is a 37 year-old G1P0 with AAG, migraines, and childhood seizures who presented at 39 weeks for CS. She was diagnosed with AAG at age 21, when she presented with orthostatic hypotension and gastroparesis, which both improved with IVIG and plasmapheresis. Current symptoms included urinary retention requiring catheterization, nausea, and constipation. In the OR, an epidural was placed to avoid abrupt sympathectomy. A phenylephrine infusion was initiated, followed by a test dose of 3 mL 2% lidocaine with epinephrine 1:200,000; then 20 mL lidocaine was given and a bilateral T7 level was achieved. She required an additional 5 mL lidocaine and fentanyl 100 mcg, resulting in a T4 level. The neonate was delivered 9 minutes after incision, when the patient reported sharp abdominal pain. She required nitrous oxide via mask and IV morphine, fentanyl, midazolam, and ketamine for relief. On POD 1 and 3, she received IVIG as planned. Her hospital stay was otherwise uneventful. Two years later, the patient again presented for CS. In the OR, a phenylephrine infusion was initiated and CSE was performed using 1.6 mL hyperbaric bupivacaine 0.75%, fentanyl 20 mcg and morphine 200 mcg. An epidural catheter threaded easily, and a bilateral T4 level was achieved. Sixteen minutes after incision, the patient complained of sharp abdominal pain, which persisted despite 10 mL 2% lidocaine with epinephrine via the epidural catheter, as well as epidural fentanyl, IV morphine, midazolam, and ketamine. Patient controlled epidural analgesia was ineffective for post-op analgesia. A hydromorphone IV PCA was started on POD 1.

Discussion: AAG is a rare disorder with sparse literature regarding anesthetic management. Dysautonomias pose significant anesthetic risks, especially when cardiovascular lability is present. There is no evidence to support either general or regional anesthesia in non-pregnant patients. Although there is a risk of marked hypotension with spinal anesthesia, studies involving non-pregnant patients with Shy-Drager syndrome indicate it may be modulated with adequate pre-operative volume replacement and vasopressor support.2 Resistance to local anesthetics in patients with autonomic dysfunction due to Shy-Drager syndrome has also been reported, but the mechanism is poorly understood. In our case, the patient remained hemodynamically stable, but required additional analgesics under spinal and epidural anesthesia. Both neuraxial techniques were safe, but less effective at the usual doses.

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Abstract #:SAT-66

Women Delivering After Liver Transplant at the University of Washington: A Single Center Experience

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Background: Women of reproductive age account for 8% of the liver transplant (LTX) recipients, while girls, which eventually reach the reproductive age, account for 5%. The rise in patient survival increases the number of pregnancies after LTX. These pregnancies are considered high risk for maternal, fetal, and neonatal complications. Graft rejection, requiring an escalation of immunosuppressive therapy and re-LTX, can occur during (10-17%) or after (3-12%) pregnancy.

Methods: We reviewed electronic medical records of peri-partum outcomes after LTX since the inception of the transplant program in 1989 at UWMC. Outside hospital deliveries were excluded. Peri-partum laboratory values (liver, renal, hematological function, and immunosuppression regimen) were recorded. We also examined etiology, time to delivery after transplantation, type of obstetric anesthesia utilized, fetal outcomes, immediate post-partum complications and pain management.

Results: 5 women received a LTX and subsequently delivered 9 children at UWMC. Peri-partum laboratory values were normal in all women. Creatinine was slightly elevated in two women. Immunosuppression was exclusively achieved with the calcineurin inhibitor tacrolimus. All women required regional anesthesia for their deliveries. Two cases of post-partum hemorrhages were reported. No ICU care was needed. Three out of 5 women received acetaminophen and were discharged without delay. None of the women were diagnosed with pre-eclampsia (Table1).

Discussion: Pregnancy can be safely completed after LTX. A 12-24 month waiting period is suggested until low dose immunosuppressive therapy and adequate allograft function are achieved; even though gonadal function returns earlier. A recent review found an increased incidence of pre-eclampsia, low birth weight and prematurity (1). In our series, no case of pre-eclampsia was found, but two newborns had low birth weight, one being a preterm delivery at 29 weeks. All other deliveries occurred at term. Monthly and, in the last 3rd trimester, weekly tacrolimus level monitoring is recommended to avoid toxic levels of unbound, active drug (2). Additionally, platelets, liver function and fetus growth need to be regularly followed, requiring an interdisciplinary team approach. Long-term effects on baby and graft outcome remain unknown to date and further studies are warranted.

Patient	1	2	3	4	5
Reason For Transplant	APAP Overdose	Autoimmune Hepatitis	Primary Biliary Cirrhosis	Autoimmune Hepatitis	Wilson's Disease
Age at LTX (years)	29	18, 29	37	8	16
Transplant Failure/Re-Transplant	Rejection: 1yr post LTX treated	Re LTX			Rejection: 3 Month postpartum after child 1 treated
Age at Deliveries (years)	32	32	40	19, 20, 23*	25, 29*
Tacrolimus Level (ng/ml)	6.5	6	4.9	4*	5*
Tacrolimus Regimen (p.o.)	3.5mg bid	3mg tid	4mg tid	2mg tid*	2mg tid*
Anti-Hypertensive Medication	None	Atenolol 50mg q day	None	None	None
Obstetric History	G2P1011	G1P0101	G7P4034	G4P3013*	G2P1102*
Gestational Age (weeks)	37	29	38	41, 39, 39*	38, 35*
Fetal Weight (grams)	2783	1055	3940	3699, 3361, 3640*	3299, 2621*
Delivery Type	Cd	Cd	NSVD	NSVD x 3	Cd x 2
Cesarean Indication	Failed IOL	NRFHT, IAI			Elective
Anesthetic used	CSE	Spinal	CSE	CSE*	LEP*
Tylenol Given	NO	NO	YES	YES*	YES*

Legend:
* = Provided information pertains most recent pregnancy.
APAP= Acetaminophen, IAI= intra-amniotic infection, Cd= Cesarean Delivery
NSVD= Vaginal Delivery, LTX= Liver Transplant, Bid, Tid= twice, three times per day
CSE= Combined Spinal Epidural, LEP=Lumbar Epidural, Spinal= Spinal Anesthesia

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Abstract #:SAT-67

Type 1 von Willebrand Disease: Factor levels don't always increase during pregnancy

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Von Willebrand Disease (vWD) is the most common inherited bleeding disorder. Over 100 type 1 vWD mutations have been identified, and the phenotypic presentation of type 1 vWD is highly variable with bleeding severity not necessarily predicted by von Willebrand factor (vWF) levels(1). Factor VIII and vWF levels generally increase during pregnancy to normal/supranormal levels, such that type 1 vWD patients rarely require intrapartum treatment with factor replacement and neuraxial analgesia for labor is considered safe(2,3). We describe the intrapartum management of 2 cases of type 1 vWD where vWF and factor VIII activity did not rise during pregnancy.

A 30 yo G3P1011 with gHTN, morbid obesity, lupus and type 1 vWD presented at 37w for repeat cesarean, desiring neuraxial anesthesia. Previous workup revealed she was a DDAVP nonresponder. During both this and her last pregnancy she had no appreciable increase in vWF activity (20% at baseline, 24% at 35w) or factor VIII activity (43% at baseline, 51% at 35w). Hematology recommended Humate 60units/kg and aminocaproic acid 4g loading dose 30 minutes prior to surgery. They stated her factor levels would be adequately corrected with this dosing and spinal anesthesia carried a low risk if placed within 30 minutes of factor replacement. Spinal anesthesia was induced with one attempt and cesarean delivery was uncomplicated. She was maintained on Humate infusions and oral tranexamic acid for 2 weeks post partum. A 28 yo G4P1021 was diagnosed with type 1 vWD at 15w gestation during workup for recurrent epistaxis. She had a term delivery 3 years prior at a birth center, and described mild PPH that did not necessitate transfusion. Throughout pregnancy there was no appreciable increase in vWF activity (12% at baseline, 15% at 37w) or factor VIII activity (47% at baseline, 60% at 37w). She presented for induction at 40w1d. Per Hematology recommendations, Humate 60units/kg was given at the onset of active labor. Epidural anesthesia was not offered; it was felt a Tuohy needle and indwelling catheter posed too high a risk of bleeding even if timing of catheter placement and removal could be coordinated with Humate dosing. She had an uncomplicated vaginal delivery and used nitrous oxide for labor analgesia.

When the quantitative deficit of vWF corrects during pregnancy, the risk of intrapartum bleeding is similar to patients without vWD. It is important to consider that type 1 vWD has high genetic and phenotypic variability. Factor levels should be reassessed throughout pregnancy to identify cases where replacement may prevent complications of hemorrhage and to counsel patients on the risks of neuraxial anesthesia.

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Abstract #:SAT-68

Management of a parturient with congenital heart disease and left transposition of the great arteries with symptomatic SVT presenting for ablation

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Background: Congenital cardiac disease in parturients presents unique challenges to the anesthesiologist. Specifically, patients with congenitally corrected transposition of the great arteries may have altered physiology, hemodynamically unstable arrhythmias and are more prone to have severe cardiopulmonary compromise during pregnancy. Solid understanding of the interactions between pregnancy and altered cardiac physiology helps the anesthesiologist anticipate and manage perioperative complications during non-obstetric procedures.

Case: We present a 24 year-old obese parturient (BMI 43) G2P1 at 17WGA with PMH of dextrocardia with congenitally corrected left transposition of the great arteries presenting with progressive dyspnea, palpitations and SVT on ECG. She was admitted and medically treated for refractory SVT with follow up recommendations for catheter ablation after delivery. Due to persistence of SVT and potential maternal and fetal compromise, a multidisciplinary discussion was held to discuss management. The plan included non-fluoroscopic SVT ablation performed via catheterization with the aid of a 3D electroanatomical mapping system to limit fetal radiation exposure. FHR monitoring was performed pre and post-operatively. Monitored anesthesia care was performed including patient positioning in LUD, O2 by nasal cannula, a pre-induction arterial line, IV midazolam for anxiolysis, and remifentanil infusion of 0.05 mcg/kg/min. SVT was induced during the procedure and the left accessory pathway was successfully ablated.

On the following morning, she re-entered SVT and was brought back for repeat ablation with the same MAC anesthesia regimen. Patient tolerated both procedures well and had no repeat occurrences. Her antiarrhythmic medications were discontinued and she was discharged home.

Discussion: Potential problems encountered with congenitally corrected transposition of the great arteries in pregnancy include dysfunction of a systemic right ventricle, atrial arrhythmias, atrio-ventricular block, and heart failure, as well as increased rate of fetal loss. Our patient presented with symptomatic SVT with signs of decompensation that was refractory to medical therapy. Her symptoms most likely would continue to worsen due to the increased cardiac output with increasing gestational age which necessitated a more definitive treatment modality such as non-fluoroscopic radiofrequency catheter ablation. Intraoperative considerations included maintaining patient hemodynamic status with close invasive monitoring. To optimize maternal as well as fetal safety, a multidisciplinary approach to management was undertaken by utilizing non-fluoroscopic technique and administering pharmacological agents that exhibit minimal fetal effect while providing anxiolysis and analgesia to the parturient.

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Abstract #:SAT-69

Double Outlet Right Ventricle Syndrome in an Obstetric Patient

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Double Outlet Right Ventricle (DORV) characterizes a heterogeneous group of congenital malformations in which the pulmonary artery and aorta both arise from the right ventricle. Additionally, a ventricular septal defect (VSD) is almost always present. Classifying the subtype of DORV is essential to developing an appropriate anesthetic plan. Multiple classification systems exist, and they are broadly classified according to the location of the VSD in relation to the great arteries including: subaortic, subpulmonary, doubly committed, and non-committed. The Society of Thoracic Surgeons database further classifies these conditions into 5 subtypes according to the physiology they mimic: VSD Type, Tetralogy of Fallot (TOF) Type, Transposition of the Great Arteries (TGA) Type, Remote VSD Type, and VSD with Atrioventricular Septal Defect (ASVD) Type. Each subtype has a series of implications for an obstetric patient that would depend on the type of correction, possible presence of pulmonic outflow obstruction, pulmonary hypertension, subaortic stenosis and/or aortic arch outflow obstruction, and congestive heart failure. Thus, it is essential to investigate the subtype of DORV and the correction status to guide anesthetic management.

A 21yo G2P1 at 37 weeks gestation with corrected DORV of unknown subtype presented for labor epidural and planned vaginal delivery with a passive second stage. During the anesthesia interview, she revealed that she had a Blalock-Taussig shunt shortly after birth and a subsequent Rastelli Procedure for pulmonary hypertension. She had been asymptomatic during pregnancy and denied any functional limitations. Electrocardiogram at the time of admission showed normal sinus rhythm with mild right axis deviation. Oxygen saturations were 100% on room air and no increased work of breathing was appreciated. Further cardiology records were obtained, and an echocardiogram prior to pregnancy revealed normal left ventricular function with an ejection fraction of 55% and normal pulmonary artery pressures. A clinic visit record noted that she was believed to have TGA type DORV status post correction of the transposition. After further delineating the nature of her cardiac anatomy following the outlined corrections, it was determined that her physiology should mimic natural flow and would therefore be amenable to a slowly titrated epidural. Prior to placement of the epidural, a second large bore IV was started and a one liter normal saline bolus was administered. The patient's epidural was placed without complication. Following a negative test dose, 0.25% Bupivacaine was administered slowly in 2mL doses for a total of 8mLs. No hemodynamic compromise was noted and a T10 sensory level was achieved. After 20 minutes, a continuous infusion epidural pump was started with 0.125% Bupivacaine with 2mcg/mL of Fentanyl at rate of 8cc/hr. The patient had an uncomplicated passive second stage delivery with adequate analgesia.

Abstract #:SAT-70

Anesthetic experience of cesarean section in permanent vegetative state pregnant

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We present here a case of anesthetic management of pregnant with permanent vegetative state.

A 37 year-old parturient with permanent vegetative state underwent general anesthesia for cesarian section. She has a history of hypoxic brain dagame during early pregnancy period. Bispectral index (BIS) was monitored for check sedation state and initial value was 92. 5 minutes after anesthetic induction with thiopental and rocuronium, BIS value was decreased to 0 and suppression ratio (SR) value was increased to 100. So, we discontinued inhalation agents. About 30 minutes later, BIS value started to increase and SR value started to decrease. 60 min after induction SR was decreased to zero.(Figure 1.) Total anesthetic time was 75 minutes and patient transferred to recovery room with adequate self respiration. On the next day, neurologist examined the patient's neurologic state and there were no changes compared with preoperative state.

Traditional dose of anesthetic agent can cause severe decrease in BIS value and burst suppression in permanant vegetative state patient. So, we should carefully use anesthetics and BIS monitoring can be helpful.

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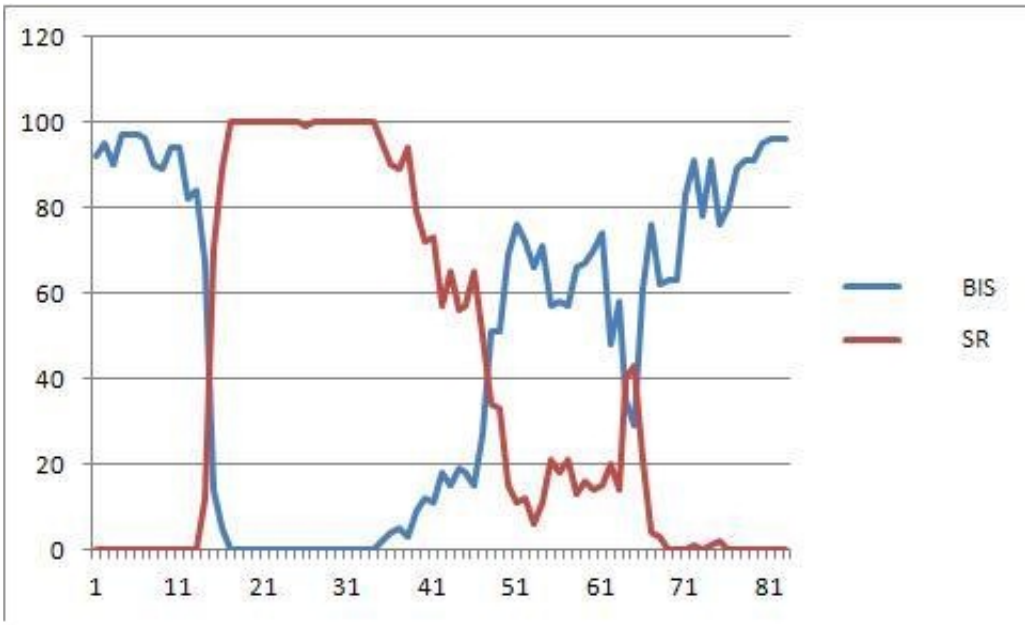

Abstract #:SAT-71

Chronic Inflammatory Demyelinating Polyneuritis in Pregnancy, a Case of Patient-Controlled Epidural Analgesia

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Introduction: Chronic inflammatory demyelinating polyneuritis (CIDP) is an acquired inflammatory disorder affecting peripheral nerves (1). CIDP is characterized by impaired sensation, symmetrical limb weakness, absent or diminished deep-tendon reflexes, and demyelination on nerve-conduction studies. We discuss a case of patient-controlled epidural analgesia (PCEA) in a 30-year-old, primigravida undergoing treatment with IV immunoglobulin (IVIG) for active CIDP symptoms.

Case: Our patient's initial symptoms consisted of difficulty going up and down stairs, generalized muscle cramps, and b/l lower extremity paresthesias. At 22-weeks gestation she began experiencing unprovoked falls and increased pain and cramping in her arms and hands. She was admitted at 24-weeks and received IVIG 2g/kg over 5 days; some neurologic improvement was noted at discharge. Our patient was admitted at 5 week intervals for additional IVIG. She reported no more falls after therapy.

At 39 weeks, labor was induced for thrombocytopenia, platelet count 79x10^9/L. Two units of pooled platelets were transfused with a repeat count of 122x10^9/L. At 5-cm dilation, an epidural catheter was placed at the L3-L4 interspace. PCEA was initiated with an infusion of 0.125% bupivacaine + 1.5mcg/mL fentanyl at a rate of 8-mL/hr, patient initiated bolus of 5-mL, and lockout of 10 minutes. Twelve hours after initial placement, she complained of inadequate pain relief and the epidural was replaced at L4-L5. Nine hours later she had an uncomplicated vaginal delivery and was discharged on POD #5. Follow-up at 2 months revealed no new or progressive symptoms.

Discussion: CIDP is an acquired condition affecting the peripheral nervous system, with a prevalence of about 1-2 per 100,000 adults. Symptoms include impaired sensation, absent or diminished deep tendon reflexes, paresthesias in the hands and/or feet, and symmetrical limb weakness. Diagnosis is based on these symptoms, demyelination on EMG, and greater than 2 month duration of illness. Pathogenesis is thought to be autoimmune related. Effective therapies include IVIG, plasma exchange, and corticosteroids. 60 to 80% of patients show improvement with these treatments.

There is little experience with administration of neuraxial anesthesia in patients with CIDP. What concentration of local anesthetic and duration of exposure is safe? A single case report describes PCEA analgesia in a laboring parturient (2). Her epidural was in place for only five hours and the analgesic mixture was different than ours (0.1% ropivacaine + fentanyl 2mcg/mL). Despite a much longer exposure to epidural local anesthetic (21 hrs), our patient did not develop an exacerbation of CIDP symptoms after delivery or 2 months later. This case suggests that prolonged contact with a dilute solution of epidural local anesthetic may be safe as well.

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Abstract #:SAT-72

Endobronchial Resection of a Tracheal Leiomyoma in a Parturient

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Bronchoscopy in pregnancy is generally avoided if possible because of the risks related to the procedure and sedation to both mother and fetus, which include aspiration, hypoxemia, barotrauma, and pulmonary hemorrhage. Delay of intervention to the postpartum period should be considered if possible without effect to the course of pregnancy or disease. Nonemergent bronchoscopies may be indicated and should be performed after consideration among multidisciplinary teams of the clinical setting, stage of pregnancy, and patient's status.

Case: A 38 yo G4P3003 at 31w6d presented for abnormal CXR showing left middle and lower lung opacification. She complained of moderate cough with sputum for 1 week though was afebrile on room air. CT suggested active granulomatous disease with a soft tissue lesion of the left main bronchus, mediastinal shift, and post obstructive pneumonia, consistent with tuberculosis. However once TB work up was negative, the patient was scheduled for bronchoscopy with biopsy to evaluate the lung lesion of unknown cause. We planned for general anesthesia with continuous FHR monitoring and an obstetrics team available for emergent cesarean delivery. Betamethasone was administered for fetal lung maturity.

We performed an RSI with fentanyl, lidocaine, propofol and succinylcholine, and an 8.0 ETT was easily placed via direct laryngoscopy. A pedunculated near obstructing mass was noted in the left main bronchus during bronchoscopy. Cardiothoracic surgery was consulted and recommended resection due to risk of significant purulent drainage distal to the lesion. A 1.5cm mass was resected via endobronchial electrocautery snare, which required intermittent decreases in FiO2 to 30%. The patient remained hemodynamically stable with oxygen saturations >93% and peak inspiratory pressure <35 cmH2O. The patient was extubated, afterwards continued to improve on CXR and clinically, and was then discharged stable on room air. Biopsy results ultimately revealed leiomyoma. The patient later presented in active labor at 35w5d and delivered a healthy baby vaginally, which was otherwise uneventful.

Discussion: Endobronchial leiomyomas are rare benign tumors from smooth muscle cells of the bronchial tree and occur in the 3rd-4th decade of life in females. Patients usually present with symptoms due to obstruction of the affected bronchus, such as wheezing, orthopnea, hemoptysis, recurrent pneumonia and subsequent bronchiectasis. Bronchoscopic intervention is an option for pedunculated lesions that avoids surgical resection required of broad-based lesions which recur. In this case of a parturient reporting a cough with sputum discovered to be an endobronchial leiomyoma, bronchoscopy with electrocautery snare resection was performed safely and effectively because of multidisciplinary coordination between pulmonary, obstetric, thoracic surgery, and anesthesia services.

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Abstract #:SAT-73

Cesarean Section in a Parturient With Severe Functional Mitral Stenosis Secondary to "Repaired" Mitral Dysplasia

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Cardiac disease is one of the leading causes of maternal morbidity and mortality in the USA (1). Pregnancy is associated with multiple changes in cardiac physiology that begin in the first trimester including increases in cardiac output and blood volume along with decreases in systemic vascular resistance and blood pressure. These hemodynamic changes are considered to be adaptations for normal pregnancy, but these changes may provoke cardiac complications in parturients with congenital heart disease (2). A multidisciplinary approach involving maternal-fetal-medicine, anesthesiology, cardiology, cardiothoracic surgery, and critical care is required for these patients. We present a 23yo G2P0010 with a history of congenital mitral dysplasia who was scheduled for a primary cesarean section (CS) at 35wks. The patient underwent mechanical mitral valve (MMV) placement at age 4yr, which had never been replaced, and she remained on life-long anticoagulation. The patient had no cardiac complications until she reached 11wk gestational age at which time she was hospitalized for significant volume overload and NYHA class IV symptoms. Her treatment involved aggressive diuresis and she was discharged home with a diuretic regimen in preparation for a planned CS. She was found to have severe functional mitral stenosis of her MMV that was significantly undersized for her current body surface area. Serial transthoracic echocardiograms revealed worsening mitral stenosis with a mean gradient of 25mmHg, moderate pulmonary hypertension (RVSP 40-45mmHg) and NYHA class II-III symptoms with preserved left ventricular ejection fraction 55-60%. She was readmitted for her CS at 34wks. Anesthesia for her CS was provided using a dural puncture epidural (DPE), invasive hemodynamic monitoring, and targeted vasopressor/fluid therapy. During DPE dosing, after a T10 level was obtained, cardiothoracic surgery performed a cut-down with wire placement in the femoral vessels in case there was a need to transition to ECMO emergently. Upon obtaining a T4 level of anesthesia, an uneventful CS, requiring minimal vasopressor support, resulted in delivery of a male infant with Apgars of 8 and 9. Uterine atony was prevented through the use of carefully titrated doses of methylergonovine maleate rather than an oxytocin infusion. She was admitted to the CICU for post-op observation, but was discharged to the postpartum floor 24hr later. We will discuss the anesthetic technique, the use of uterotonics, the consequences of prolonged maternal and fetal exposure to anticoagulation, and other peripartum considerations in this type of patient.

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Abstract #:SAT-74

Caesarian Section in a Parturient with Recurrent Peripartum Cardiomyopathy and Left Ventricle Ejection Fraction of 10%

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Introduction: Peripartum cardiomyopathy (PPCM) is defined as left ventricular systolic dysfunction of unknown cause in the final month of pregnancy or the first five months post-partum1. Management includes preload and afterload reduction as well as ionotropic support2. The ideal anesthetic technique for CS with PPCM is unknown. We present the successful use of slow-dosed epidural anesthesia as part of a multi-disciplinary approach to CS complicated by recurrent PPCM.

Case Report: A morbidly obese 33 year old G4P1 at 26 weeks gestation with history of prior CS and PPCM was admitted for acute pulmonary edema and worsened left ventricular ejection fraction (LVEF) from 40% to 16%. LVEF further deteriorated to 10% with evolution of pulmonary hypertension in the ICU. A multi-disciplinary team of OBGYN, OB and CT anesthesia, cardiology, neonatology, CT surgery, ICU, and perfusion was assembled for repeat CS and bilateral tubal ligation at 30 weeks gestation with standby VA ECMO.

The anesthesia team placed a central line, arterial line, PA catheter, and epidural which was dosed with 200 mcg fentanyl and 40 mg (2%) lidocaine boluses every 5 minutes to achieve a T6 level. A norepinephrine infusion was used to maintain MAP and a right femoral arterial catheter was placed for possible VA ECMO. Low dose epinephrine infusion was started at incision until delivery 8 minutes later. 200 mcg IM Methylergonovine and 3 units oxytocin were administered. CVP and PA pressures rose with auto-transfusion but systemic hemodynamics remained stable. Pressors were weaned prior to 48 hr post-op ICU stay. Mother and infant were discharged home without complication.

Discussion: Anesthetic management for CS complicated by PPCM requires meticulous preoperative preparation in a multi-disciplinary setting. Plans for circulatory support are necessary given the risk of cardiovascular collapse2. Few, if any, case reports exist documenting a successful delivery of anesthesia for CS in a parturient with LVEF 10%. This report demonstrates the utility of the slow-dosed epidural in minimizing acute hemodynamic change in the setting of PPCM.

Conclusion: Slow-dosed epidural is a good option for CS complicated by PPCM.

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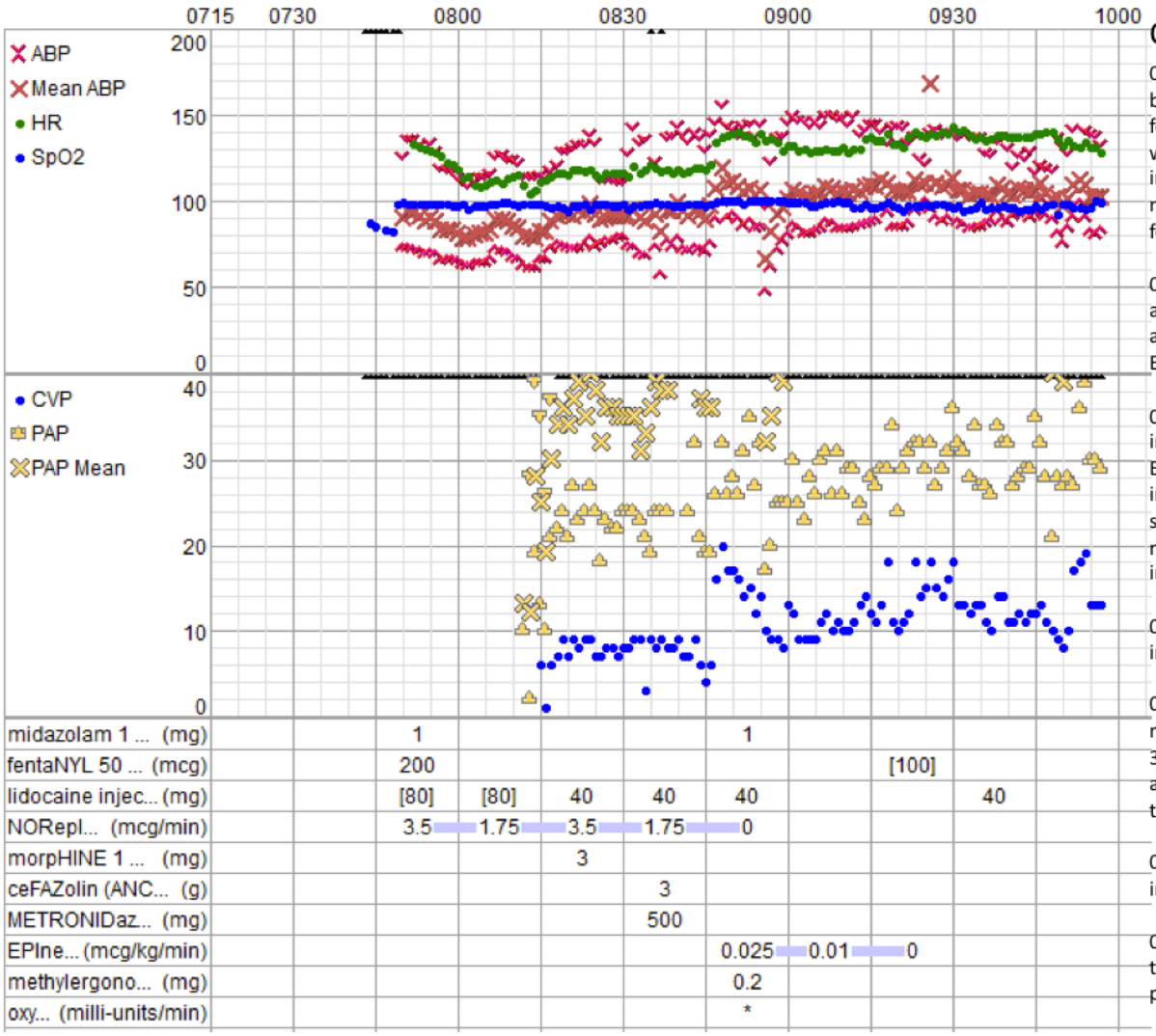
Abstract #:SAT-74



OR Timeline

07:53 – Epidural bolused 200 mcg fentanyl and slow load with 2% lidocaine initiated. Low dose norepinephrine used for afterload support

08:27 – Right femoral arterial line placed to assist in possible VA ECMO access

08:47 - Surgical incision made. Epinephrine infusion initiated for ionotropic support and norepinephring infusion stopped.

08:55 – Delivery of infant

08:56 – 200 mcg IM methylergonovine and 3 units IV oxytocin administered with mild, transient, hypotension

09:21 – Epinephrine infusion weaned off

09:56 – Patient trasported to ICU for post-op care

Abstract #:SAT-75

Intraoperative Diagnosis of Amniotic Fluid Embolism by Transthoracic Echocardiography during Emergent Cesarean Section

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Amniotic fluid embolism is a rare complication with significant maternal mortality in pregnancy. We are presenting a case of amniotic fluid embolism diagnosed by the application of intraoperative transthoracic echocardiography. A 29-year-old G3P2 with no significant medical history except bipolar disorder was admitted for induction of labor. She refused to have epidural analgesia for her labor pain. Her progression of labor was smooth until the day of emergent Cesarean section due to the vaginal bleeding and a sudden finding of fetal distress. She was emergently taken to the operating room for a crash C-section under general anesthesia. She was intubated with propofol and succinylcholine successfully. A baby girl was delivered within a couple minutes after intubation. The baby's APGAR score was 1/7/8. The obstetric surgeons noted a rupture of left side lower uterine segment. Massive transfusion protocol was activated. Additional 16 gauge PIV and a right radial a-line were established. 5 minutes after the baby delivered, the patient had a sudden onset of low SpO2 and SBP decreased to around 50's. DDx of hemorrhagic shock, anaphylaxis, and amniotic fluid embolism were entertained. Initial ABG showed PaO2 of 51 mmHg and a hct of 20%. She had received a total of 7 u of pRBC, 6 u of FFP, and 1 u of plts. She had also received 32 mcg of epinephrine and 20 units of vasopressin to maintain a stable BP. Intraoperative TTE revealed a flattened interventricular septum on PSAX view and a dilatation of right ventricle with prominent apical trabecular component on AP4 view. The follow-up TTE performed after ICU admission demonstrated the RV dilatation had returned to normal as well as the rest of the exam.

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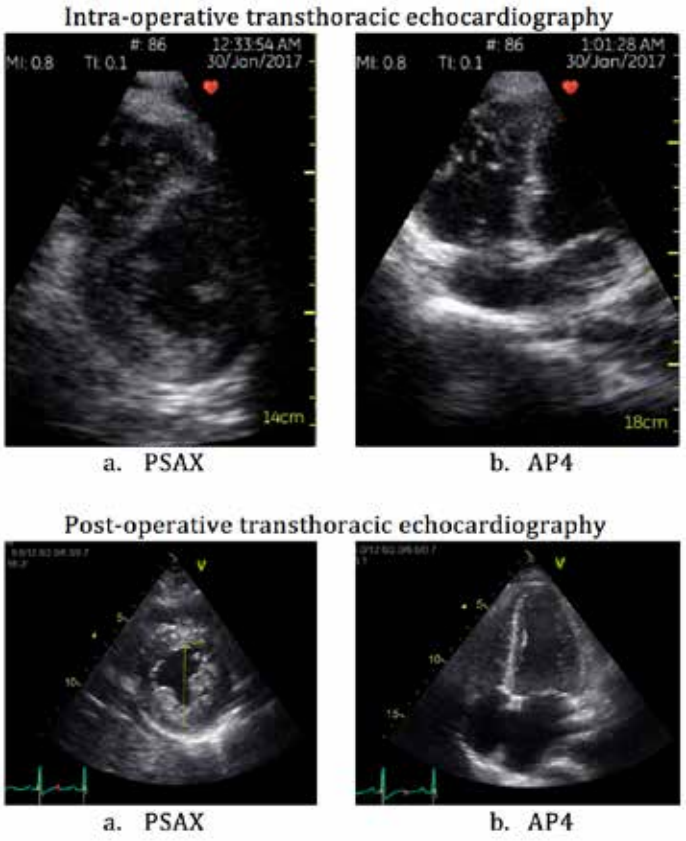

Abstract #:SAT-76

Cesarean Delivery in a Patient with a Type B Thoracic Dissection

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Introduction: Pregnancy-associated aortic dissections are rare and occur most often in the ascending thoracic aorta (Type A).1 Type B dissections occur less commonly and little is known about peripartum management. We present a patient with chronic Type B aortic dissection who underwent CD and offer recommendations.

Case: A 37 yo G1P0 woman at 37 wks had presented in 2011 with acute chest and back pain in the setting of poorly controlled hypertension and was diagnosed with Type B aortic dissection. She had no history of connective tissue disorders but had family members with aortic dissection. On yearly follow up for chronic dissection CTA showed aortic arch diameter 5.7-cm and dissection from just past the L common carotid artery nearly to the superior mesenteric artery. An intrauterine pregnancy was incidentally noted so surgical intervention was delayed and the patient received aggressive antihypertensive therapy (spironolactone, labetalol, amlodipine). Cardiologists and vascular surgeons recommended CD so to avoid Valsalva maneuvers and allow for better BP control, and postpartum open repair due to the dissection's proximity to the carotid artery. Two large-bore IV lines and a radial arterial line were placed, and an epidural was placed and slowly loaded with 20-mL 2% lidocaine/epinephrine/bicarbonate. After delivery oxytocin was infused at 300 mU/min. Intraoperative SBPs ranged from 85-150. The patient received 2L crystalloid and did not require vasopressors or anti-hypertensives. Epidural morphine and IV ketorolac were given for postoperative analgesia. Antihypertensive therapy was continued throughout the perioperative period. The patient spent POD0 in the SICU for careful BP monitoring before transferring to the postpartum unit where she had an uncomplicated course.

Discussion: Aortic dissection in the parturient is rare occurring in 1.23 in 100,000 pregnancies.2 Type B dissections are less common than Type A, possibly because they are less often symptomatic and under-diagnosed.3 Hormonal changes accompanying pregnancy and intrapartum fluid shifts and hemodynamic changes may extend dissection, and hypertensive disorders of pregnancy may increase the risk further.1 Surgical repair is recommended for Type A dissections, even during pregnancy, especially in those with Marfan's syndrome. Recommendations for the more rare Type B dissections during pregnancy are lacking. Outside of pregnancy, conservative treatment is often recommended for Type B dissections uncomplicated by rupture or ischemia.3 The primary aim of both antepartum and intrapartum management is avoidance of large fluid shifts and hypertension, including that due to anxiety or pain. We therefore chose invasive BP monitoring and slow titration of epidural anesthesia in order to avoid acute BP changes that could worsen dissection, and close postpartum BP monitoring and treatment.

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Abstract #:SAT-77

Anesthetic Management of a Pregnant Woman with Pulmonary Stenosis: A Case Report

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Management of pregnant women with pulmonary stenosis (PS) is controversial and challenging. PS refers to a dynamic or fixed anatomic obstruction to flow from the right ventricle (RV) to the pulmonary arterial vasculature. During pregnancy, women increase their cardiac output (CO) which increases further during labor and remains elevated after delivery. PS increases RV work and dramatically impairs left ventricular (LV) output. Cardio circulatory changes in PS can lead to RV (systemic) failure or dysfunction resulting in morbidity and mortality. Sudden cardiac arrest can occur during cesarean section (CS) or up to a month after birth.

Understanding of cardiac function, physiological adaptations, events and drugs that can alter the magnitude of RV outflow is required for optimal anesthetic management. Hemodynamic management includes maintenance of LV afterload, and RV preload, avoiding increase in pulmonary and systemic vascular resistance. Hypothermia, hypercarbia, acidosis, hypoxia and high ventilator pressures must be avoided. General anesthesia (GETA) is considered the safest approach for fluid management in patients with PS.

We report on the case of a 29 year-old G2P1 morbid obese female with BMI of 43.3, previous CS under GETA and mild PS of 4.2 m/s peak velocity, LVEF of 60% and RV hypertrophy diagnosed by echocardiogram, who was referred to our service for CS and bilateral partial salpingectomy at 38 weeks gestational age. Patient (pt) was hemodynamically stable, well oxygenated. A left radial artery and two peripheral IV lines were placed. While in sitting position, ASA monitors in place, anatomical landmarks were identified for insertion of an 18G Weiss epidural needle after sterile prep and drape. Clear CSF identified needle placement at subarachnoid space (SAS). No paresthesias occurred. A 20GA epidural catheter was placed and fixed 12 cm into the SAS without complications. Pt was then placed on supine position with an obstetric wedge under right hip. Titrated boluses of 1.5 mg of Bupivacaine 0.75% were administered in a long timely fashion to achieve a sensory level of T6 to pinprick, with careful monitoring of HR and arterial line pressure. A total of 7.5 mg Bupivacaine 0.75% was used. A titrated dose of 20mg oxytocin in 1L NSS was started post-partum. The procedure lasted one hour. Intra-operative BP ranged between 120/65 mmHg and 130/85, HR ranged from 65-97 bpm. Estimated blood loss was 1,100 mL and urine output was 1 mL/kg/hr. There were no major hemodynamic changes during the peri-operative period. Pt was transferred to Post Anesthesia Care Unit then to Obstetrics ward without adverse effects. Morphine 4mg was administered every 4 hours for pain control. Our multidisciplinary team followed the pt for three days until discharged home with no post-operative complications.

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Abstract #:SAT-78

When It's Not Preeclampsia: A Case Report of Acute Fatty Liver of Pregnancy

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Acute fatty liver of pregnancy (AFLP) is an uncommon disease, with an incidence of 1 in 7,000 to 1 in 20,000 deliveries and occurring primarily during the third trimester of pregnancy (1). Although rare, this disease can be potentially fatal for the parturient and her fetus. AFLP often presents with signs and symptoms similar to preeclampsia however can be distinguished by the presence of hepatic insufficiency.

We present a case of a 32 year old female at 34 weeks with a di-di pregnancy who was diagnosed with preeclampsia but was ultimately found to have AFLP. She was initially diagnosed with preeclampsia with severe features based on hypertension, transaminitis and proteinuria. Her lab work was also notable for uremia, hyperbilirubinemia, hypoglycemia, low fibrinogen and a metabolic acidosis. Given her severe features and fetal malpresentation, she was planned for urgent cesarean section. She underwent an uncomplicated cesarean delivery under spinal anesthesia. Post-operatively, she became hypotensive with altered mental status. Repeat lab work demonstrated worsening hypoglycemia and an INR 1.9. She continued to be hemodynamically unstable and an arterial line was place. She was transferred to the ICU for management of her hypoglycemia, coagulopathy and hepatic dysfunction. Her multidisciplinary team, including ICU, Maternal Fetal Medicine, Gastroenterology and Hematology, felt her presentation was most consistent with acute liver failure attributed to AFLP. Anesthesia was actively involved in her postpartum neurologic monitoring given the fact that her spinal was placed while she was coagulopathic. Her neurologic exam remained normal postpartum. Her hospital course was complicated by a worsening coagulopathy with development of a pelvic hematoma. By postoperative day 7 however, her acute liver failure improved and she was transferred to the floor.

Although rare, AFLP should be suspected in any parturient presenting with symptoms of preeclampsia and with signs of liver failure, including hypoglycemia and coagulopathy. AFLP has been reported to have maternal and fetal mortality rates of 12% and 66%, respectively (2). As a result, it is imperative to keep AFLP high on the differential diagnosis. This is especially true for the Anesthesiologist caring for the patient because the coagulopathy associated with the disease can significantly affect the anesthetic plan. Our patient's coagulopathy put her at risk of developing a spinal-epidural hematoma. Had AFLP had been diagnosed earlier, her section would likely have been performed under general anesthesia.

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Abstract #:SAT-79

Expedited Diagnosis of Preeclampsia Secondary to Emergency Airway Findings

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Co-Author: Eric Morell MD - Northwestern University Feinberg School of Medicine - Chicago, Illinois
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Introduction: Preeclampsia is characterized by multi-organ damage and hypoperfusion resulting from a complex interplay of genetic and environmental factors resulting in glomerular endotheliosis and generalized inflammation increasing vascular permeability.1 Apart from changes in coagulopathy and hemodynamics, anesthetic providers must also be aware of profound alterations in the upper airway of parturients and the resultant implications on securing an airway.2 While obstetricians follow patients throughout pregnancy and are often the first to recognize preeclampsia, anesthesiologists have unique insights that may aid in expedited diagnosis.

Case Presentation: Our patient is a 31YO G2P0 healthy parturient at 38 weeks gestation who presented for cesarean delivery from the office due to breech presentation in the setting of spontaneous rupture of membranes. During IV placement, she had a vasovagal episode with resultant fetal decelerations prompting rapid intervention. A single dose of 10mg of ephedrine was given for hypotension with resultant sustained hypertension with systolic blood pressures greater than 150mmHg. Despite initial improvement, the fetal heart rate tracing again deteriorated necessitating emergent delivery.

General anesthesia was induced, however multiple attempts at endotracheal intubation with various airway adjuncts were unsuccessful secondary to marked airway edema despite adequate view with a video laryngoscope. A laryngeal mask airway (LMA) was seated and ventilation was confirmed, at which time surgery was initiated. A subsequent attempt to secure an endotracheal tube via a fiberoptic scope through the LMA again revealed extremely edematous vocal cords and larynx. The case was completed shortly thereafter with ventilation via the LMA. The patient suffered no adverse outcome. The airway edema and sustained hypertension incited the anesthesia team to expedite a work up for preeclampsia demonstrating a protein to creatinine ratio of 3.8 and thus confirming a diagnosis of preeclampsia with severe features. Magnesium sulfate therapy was then initiated.

Discussion: The above case highlights the duty of all medical providers to be attentive to the possible presentations of preeclampsia as this disease process can significantly affect both the parturient and the fetus. In this instance it was gross edema, notably in the upper airway that demonstrated pathological vascular permeability. This case also highlights the importance of the difficult airway algorithm in emergency situations, especially in a pregnant patient, as the rate of failed intubation is much more common. Heightened caution and early activation of resources resulted in delivering a healthy newborn to a healthy mother.

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Abstract #:SAT-80

Successful Management of Placenta Percreta with Preservation of Uterus: A Case Report

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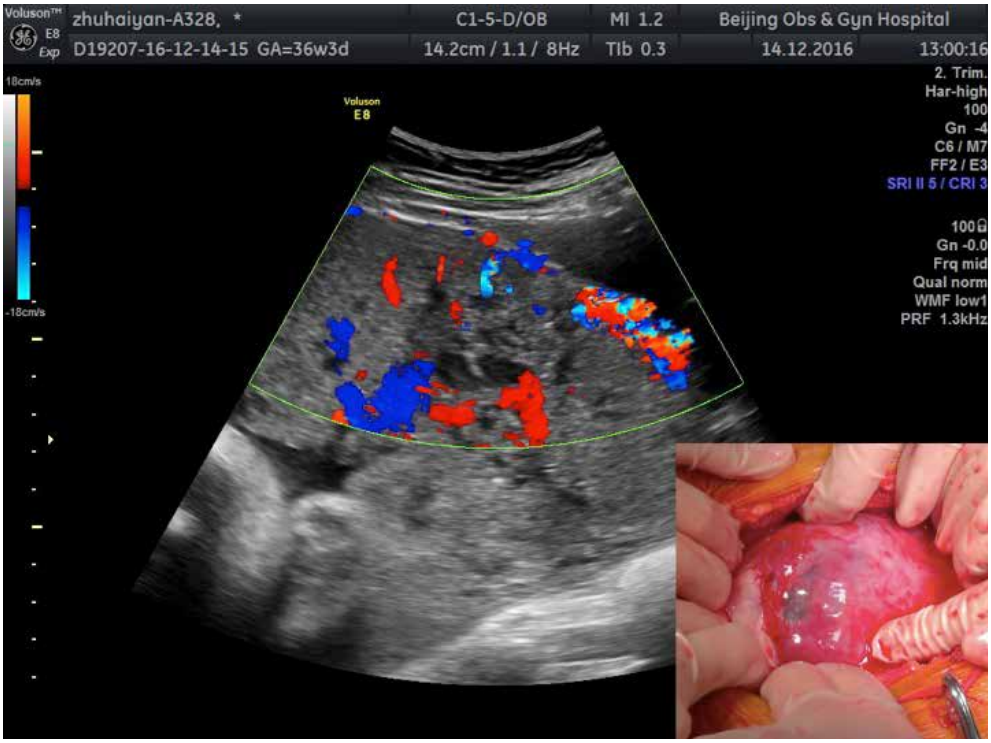
Background: Morbidly adherent placenta (MAP) can lead to catastrophic maternal hemorrhage and hysterctomy. In China, the increasing incidence of MAP has been attributed largely to the high rate of cesarean delivery during the recent years. The recently adopted "two children" family planning policy obviously will bring MAP to the frontline of maternal care. It has become a common issue and challenge for obstetric anesthesiologists in China. We present a cesarean delivery case with placenta percreta that was successfully managed by multidisciplinary team.

Case report: A 28-year-old G4P1 woman was transferred to our hospital because of vaginal bleeding and moderate anemia at 36-week gestation. She had history of one prior cesarean delivery and two prior D&Es. Magnetic resonance imaging and transabdominal ultrasound indicated central type of placental previa, placenta percreta and suspected invasion of bladder. However, the patient expressed strong preference for preservation of uterus. A multi-disciplinary team consisting of obstetricians, anesthesiologists, gynecologists, vascular surgeons, urologists, blood bank and NICU staff, and radiologists was assembled. After abdominal aorta balloon catheterization, the patient was transferred to OR for an elective cesarean delivery. Central line and radial artery catheterization were placed to monitor physiological and hemodynamic parameters. Epidural anesthesia was administered initially. With the consideration of limited RBC transfusion rate, RBC was initiated just before the abdominal incision. Intraoperatively, a large area of placenta in the size of 10cm x 12cm was firmly attached to lower uterine segment. General anesthesia was induced and aorta balloon was inflated to control bleeding after the delivery of the fetus. Intrauterine gauze tamponade and additional bilateral uterine artery embolization was placed. Cardiac hemodynamic parameter-guided volume therapy and vasoactive agent(s) were used to maintain stable circulation. Routine blood test and coagulation function test were conducted to direct blood transfusion. The total EBL was 4000ml. Epidural analgesia was used for pain management postoperatively. There were no intraoperative or postoperative complications.

Conclusion: Perfect evaluation and full preparation with a multi-disciplinary team is necessary for management of placenta percreta. Reliable invasive monitoring and bleeding preventive measures are preferred to achieve better maternal outcome.



Abstract #:SAT-81

Aortic Coarctation and Labor and Delivery—A Careful Balance.

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Case: 17 y.o. G1P0 with PMH of coarctation of aorta, bicuspid aortic valve (BAV) and chronic HTN presented for IOL at 39w6d. She underwent coarctation resection with end-to-end anastomosis as a neonate, and required redilation and stent placement for residual stenosis proximal to left subclavian at age 4 and 8. Recent echo showed a juxtaductal aortic peak gradient of 60mmHg and a mean gradient of 25mmHg at the stent. BPs in OB clinic were 140-150s/60s-90s, though location of measurement was not recorded.

BP was monitored during labor using right radial arterial line and left upper extremity NIPB cuff. Assisted second stage was planned to minimize hemodynamic effects of Valsalva. Primary cesarean was performed following failed operative vaginal delivery. On arrival to OR, right-sided ABPs were 186/78 (mean 114) and left sided NIBP was 103/72 (mean 82). The MAP showed 25-30mmHg discordance throughout the case, matching the mean gradient across her stent by echo. Epidural was incrementally dosed with lidocaine 2% with 1:200K epi and delivery and postpartum course were uneventful.

Discussion: Aortic coarctation represents 6-8% of congenital heart disease and is frequently associated with other anomalies, such as BAV. Typically repaired in infancy, most patients survive to childbearing years. Restenosis can occur and is usually treated with balloon angioplasty and stent placement (1). HTN develops from decreased arterial compliance and increased LV afterload (2). Hormone induced vascular remodeling, increased plasma volume and increased cardiac output during pregnancy increases gradients and places parturients at risk for aortic dissection (3).

Twenty-two to 30% of patients with aortic coarctation develop hypertensive disorders of pregnancy, compared to 8% of general population (1,3). As residual stenosis was proximal to the left subclavian, arterial line was placed on the right to monitor for severe proximal hypertension, which increases risk of dissection. Left sided pressures were used to monitor pressure distal to the stent, where hypotension may compromise uterine blood flow (3,4).

Coarctation patients have an underlying aortopathy that predisposes them to dissection and merits formal cardiac assessment (5). Location of each recorded blood pressure is pertinent, as hemodynamic goals should be set based on location of measurement (4). For those with significant aortic pressure gradients undergoing labor, dual arterial blood pressure monitoring pre and post coarctation is recommended. This allows for the careful balance between decreasing risk for aortic dissection while preventing uterine hypoperfusion (4).

References:

1. European Heart Journal (2005) 26, 2173–2178
2. Curr Treat Options Cardiovasc Med. 2016 Jun;18(6):40
3. J Am Coll Cardiol. 2001;38:1728–33
4. J Clin Anesth. 2006 Jun;18(4):300-3
5. Ann Thorac Surg. 2013 Jun;95(6):1961-7

Abstract #:SAT-82

Acute coronary syndrome postpartum requiring five vessel CABG

Presenting Author: Michael Pettus MD
Presenting Author's Institution: Ohio State University Wexner Medical Center - Columbus, OH
Co-Author: Blair Herndon MD - Ohio State University Wexner Medical Center - Columbus, OH
Kasey Fiorini MD - Ohio State University Wexner Medical Center - Columbus, OH
Sonia Ristev MD - Ohio State University Wexner Medical Center - Columbus, OH
Yun Xia MD - Ohio State University Wexner Medical Center - Columbus, OH

Case: 37yo G4P2103 at 35w4d with PMHx of poorly controlled DM2, obesity BMI 36, cHTN, and tobacco abuse presented for IOL for intrauterine fetal demise. On admission she was hypertensive and diagnosed with superimposed pre-eclampsia without severe features, and labetalol was initiated. Her most recent HgbA1c was 5.5% (previously 10%) other labs were unremarkable. An epidural was placed HD1 (platelets 127) in anticipation for TOLAC. She had an uneventful VBAC and was discharged home on PPD1 without complications or cardiopulmonary symptoms.

On PPD2 she presented to an OSH with acute onset shortness of breath and back pain. A chest CT angiogram was performed to evaluate for thromboembolic disease. It showed pleural effusions and multifocal infiltrates. Troponin was 1.83ng/mL and she was transferred to our facility for further workup. Admission labs showed troponin of 3.96ng/mL, ECG with ST elevation in aVR, ST depression in inferolateral leads. Cardiology performed an emergent heart catheterization, which revealed triple vessel disease and diastolic dysfunction. She was started on aspirin, statin, nitroglycerin, and furosemide. Multidisciplinary discussion determined that the pulmonary edema and hypertensive disease were likely due to pre-eclampsia. She underwent 5 vessel CABG on PPD5. She tolerated surgery well and was discharged home on POD4 (PPD 9).

Discussion: Cardiovascular disease is the leading cause of maternal mortality and is a growing concern with advancing maternal age, obesity, DM and cHTN (3% of parturients)(1). Increased cardiac output and hormone-induced vascular changes of pregnancy are detrimental in the setting of pre-existing cHTN (1,2). Peripartum acute coronary syndrome (ACS) is rare, especially in patients with no prior cardiac disease. ACS occurs in 0.003-0.01% of pregnancies, with one-third of these cases occurring postpartum. Risks for peripartum ACS include thrombophilia, HTN, age>35, smoking, and eclampsia. 40% is due to CAD (2). Maternal mortality after ACS is estimated at 5–10% (can be as high as 37%)(4). Survival is improved with percutaneous or surgical revascularization (2). Before delivery, ACS may result in fetal mortality and prematurity, the risk is mainly related to the severity of maternal heart disease (3). IUFD is associated with consumptive coagulopathy and DIC, which may increase maternal morbidity. The contribution of IUFD to peripartum ACS is unknown, but there are common risk factors between the two (5).

The good outcome in our case shows the importance of rapid recognition of ACS in a peripartum patient. Anesthesiologists must be vigilant while managing the growing population of parturients with CVD risk factors, especially in the critical peripartum period.

References:

1. Cardiovasc Res (2014) 101(4): 554-560
2. Intervent Cardiology Review, 2013;8(1):8-13
3. Eur Heart J. 2011;32(24)
4. Catheter Cardiovasc Interv, 2001;52:88–94
5. Journal of women's health. 2009,18(4)

Abstract #:SAT-83

Anesthetic Management of Parturient with Spinal Muscular Atrophy

Presenting Author: Alaeldin A Darwich MD
Presenting Author's Institution: New York Presbyterian-Weill Cornell Medicine - New York, New York
Co-Author: Sharon Abramovitz MD - New York Presbyterian-Weill Cornell Medicine - New York, New York

Introduction: Spinal muscular atrophy (SMA) is a rare genetic neuromuscular disorder characterized by degeneration of the neuronal cells of the anterior horn of the spinal cord. There are four types of SMA based on the age of onset. Earlier onset of the disease correlates with the severity and the progression of muscle wasting and motor impairment. The majority of patients with SMA are wheelchair-bound secondary to weakness and atrophy of the proximal muscles of the lower extremities. Pulmonary complications are common due to respiratory muscle involvement. Many patients undergo early spinal instrumentation to correct progressive scoliosis due to weak paraspinal muscles.

Case: This 30 year-old nulliparous female with a history of SMA type III, SLE and anemia received a pre-anesthesia consultation regarding options for labor analgesia and anesthesia for CS secondary to extensive back surgery. She was later admitted to the hospital at 37 weeks gestation for dyspnea and preterm labor. Due to a failure of induction of labor, she was taken to the OR for Cesarean section (CS). She had a history of severe scoliosis and spinal fusion from T2 to the sacrum at the age of 12, complicated by prolonged tracheal intubation for 2 weeks due to severe atelectasis. General anesthesia (GA) was planned using awake fiber-optic (FOB) tracheal intubation, facilitated by remifentanil intravenous infusion, midazolam and topicalization of the airway with lidocaine. After successful tracheal intubation, GA was induced with propofol; neuromuscular blocking agents were not used. A healthy neonate was born with APGAR scores of 9/9. The patient was extubated at the end of the procedure in the OR and the post-operative course was uneventful.

Discussion: Regional anesthesia (RA) has been successfully reported in patients with SMA. However, these patients usually present with extensive spinal surgery, making RA technically challenging with a higher chance of failed or inadequate block. Also, the patient presented with dyspnea and RA with high thoracic block can lead to respiratory decompensation. Succinylcholine is contraindicated in SMA because of the risk of life threatening hyperkalemia. In addition, there is increased sensitivity to non-depolarizing muscle relaxants (NDMR), which may require prolonged ventilation, so these are best avoided.

Awake FOB intubation was used to manage the airway, to avoid NDMR and remifentanil is useful due to its rapid metabolism in both mother and fetal circulation. This case highlights the importance of early anesthetic consultation in high-risk parturients and the utilization of FOB skills when regional techniques and muscle relaxants are contraindicated.

As less GA is utilized for CS, FOB intubation should be performed regularly in non-obstetric settings or through the use of simulation to maintain skills.

References:

1. Giuseppe et al. JCA 2012;573-7
2. Habib et al. Int J Obstet Anesth 2005;366-7
3. Popat et al. Int J Obstet Anesth 2000;78-82

Abstract #:SAT-84

Anesthetic Management of a Parturient with Spina Bifida Meningomyelocele

Presenting Author: Elizabeth C Devlin MD
Presenting Author's Institution: Ochsner Medical Center - New Orleans, LA
Co-Author: Liane Germond MD - Ochsner Medical Center - New Orleans, LA

Introduction: The incidence of neural tube defects is approximately 1/1,000 with spina bifida being the most common. Multiple types of spina bifida can occur and are classified according to severity. Spina bifida meningomyelocele is one of the most severe forms in which an unfused portion of the vertebral structure allows the protrusion of the spinal cord and meninges. Typically, the spinal nerves that are involved are damaged manifesting clinically as: paralysis or reduced ambulation, loss of bladder or bowel control, sensory deficits, and deformities of the lower joints and limbs.

Case: A 33 y/o G1P0 presented at 34w0d with pre-eclampsia with severe features. Her past medical history was significant for spina bifida meningomyelocele, immobility (wheelchair bound), neurogenic bladder, scoliosis (s/p Harrington rod placement between T2-L4), morbid obesity, short stature, chronic HTN, and previous reconstructive hip surgery. Her pregnancy was complicated by parvovirus infection in the second trimester and recurrent UTIs. Due to her body habitus it was unlikely she could deliver vaginally and she was consented to deliver via c-section. In addition to her back deformity, the patient expressed extreme anxiety and a low pain threshold, as well as great discomfort lying flat. Prolonged surgery was expected due to her prior abdominal and urological procedures, making a CSE or epidural our only options for neuraxial anesthesia. A high likelihood for inadequate epidural spread made this choice less ideal. While a spinal catheter was considered, if PDPH occurred, she would not be offered a blood patch due to her hardware. Ultimately, the decision made in consultation with the patient, obstetrician, and consulting teams (urology and general surgery) was for induction of general anesthesia for cesarean delivery. She was intubated without difficulty and a vigorous neonate was delivered. The patient suffered no anesthetic complications and her postoperative course was uneventful.

Discussion: Significant improvements in the surgical and medical management of spina bifida over the last few decades have resulted in many of these patients living to child bearing age. There is limited literature discussing labor analgesia in these women and because of this, no specific guidelines exist. Recommendations are based on case reports such as ours. Neuraxial anesthesia can be attempted, but most case reports highlight the unpredictable nature of a block in this patient population. If neuraxial anesthesia is attempted, it is recommended to be placed above the level of the lesion, making imaging of the spine crucial. While general anesthesia is not without its inherent risks in obstetric patients, we considered it to be the most conservative management of our patient.

References:

1. Sharpe, 2014
2. Hopkins, 2014
3. Kuczkowski, 2007

Abstract #:SAT-85

New onset post partum DKA in a previously undiagnosed Type 1 Diabetic

Presenting Author: Richard C Robertson, Jr. M.D.
Presenting Author's Institution: Ochsner Clinic Foundation - New Orleans, LA
Co-Author: Liane Germond M.D. - Ochsner Clinic Foundation - New Orleans, LA

Introduction: Diabetic ketoacidosis confers a significant risk of morbidity and mortality in pregnant patients with a history of Type I, Type II, or Gestational diabetes mellitus. It most commonly presents itself as nausea and vomiting, and is often in the setting of lower blood glucose than in the non-pregnant patient. We present a case of DKA in a post-partum patient with no diabetic history.

Case: A 41 y/o G2P1 female at 38w4d with a history of HSV, anemia, anxiety and one previous cesarean delivery presented to the obstetric ED complaining of body aches and chills. She was afebrile with a negative rapid flu. She had an uneventful prenatal course with normal glucose testing. In the ED, fetal monitoring was non-reassuring and she underwent an emergent c section under spinal anesthesia. A vigorous male infant was delivered and the procedure was completed uneventfully. In the PACU, the patient was hypotensive (BP: 80s/50s), but asymptomatic. She was treated with fluids and phenylephrine boluses. She complained of shortness of breath and blurry vision a few hours after arriving to the postpartum unit, but stated that her vision changes started about a week ago. Two hours later, after ambulating, she complained of worsening dyspnea and chest pain. Her vitals revealed RR: 36 and BP: 137/64. The differential at this time included pre-eclampsia, anxiety, and PE. One hour later, the patient was found to be obtunded and tachycardic to the 120s, BP: 173/83. A fingerstick was performed due to her worsening mental status and was > 700. She was transferred to the ICU where she was treated for DKA of unclear etiology (pancreatitis vs. sepsis vs. new onset type I DM). Her C-peptide was low (0.1) and Hgb A1C was found to be 6.1%, providing a diagnosis of new onset Type I DM. She remained in the hospital for 8 days post c-section, due to difficulty in blood glucose control.

Discussion: The incidence of diabetic ketoacidosis in pregnancy has been estimated at 1-2% of parturients and has decreased in the last decade, most likely due to increased prenatal counseling and tight glucose control in diabetic patients. It may be for this reason that a significant amount of patients that experience DKA have no previous history of diabetes either prior to or during pregnancy. These parturients, as exemplified by our current case report, may exhibit vague symptoms of hyperglycemia. However, with no heightened suspicion for abnormal glucose tolerance, blood glucose testing is often not initially performed, causing the clinical picture to deteriorate. It is therefore imperative to remember DKA in one's differential diagnosis especially in parturients without previous history of diabetes.

References:

1. Dalfra MG. Ketoacidosis in diabetic pregnancy. J Matern Fetal Neonal Med. 2016.
2. De Veciana M. Diabetes ketoacidosis in pregnancy. Semin Perinatol. 2013.
3. Parker JA. Diabetic ketoacidosis in pregnancy. Obstet Gynecol Clin North Am. 2007.

Sunday, May 14, 2017

Best Case Report Panel - Case Report Review with the Experts

Moderator: Katherine W. Arendt, M.D.; Panelists: Lisa R. Leffert, M.D.; Barbara M. Scavone, M.D.; Lawrence C. Tsen, M.D.

Ethical Dilemmas in Obstetric Anesthesia

Moderator: Laurent A. Bollag, M.D.; Speakers: Robert R. Gaiser, M.D.; Caitlin D. Sutton, M.D.; Paloma Toledo, M.D., M.P.H.

Sunday Abstracts

Medicine's Not So Secret Secret

ROBERT GAISER, M.D., M.S.ED.
PROFESSOR AND CHAIR
UNIVERSITY OF KENTUCKY

Disclosure: Director for ABA

Just Another Day on L&D

- Practice: Number of Deliveries is 4800 annual
- Separate physician/team covering L&D
- Team covering Operating room extremely busy with transplants/trauma
- The group covering L&D is two men

Three scenarios

- 24-year old G1P0 3 cm cervical dilation requests epidural analgesia(VAS Pain 4)
- 24-year old G1P) 8 cm cervical dilation requests epidural analgesia (screams coming from the room)
- 24-year old G1P0 3 cm dilation; FHR 60 bpm; refusing anesthesia

Medicine's "Not So" Secret Secret

- Patients routinely refuse or demand medical treatment based upon gender, race, or religion
- Almost all the time, the request is honored
- Conflict between professional obligation to provide nondiscriminatory care and ethical obligation to respect autonomy

Lawsuit

- Man with swastika tattoo insisted no black nurses care for his newborn
- Note on board: No African-American nurse to care of baby
- Successfully sued the hospital – case settled
- 2010 Michigan Decision – federal Civil Rights Act prohibits nursing homes from making decisions based on resident's racial preference

Honoring Patient Requests

- Survey to America College of Emergency Physicians
- 176 respondents
- Request for provider based upon gender, race, and religion
- Woman physicians more likely to accommodate request
- Women, Muslim, and non-white most likely to have request honored

Emerg Med J 2010;27:465e469.

Gender Influence

- Patients avoid care because of gender of provider:
  - Feel not acceptable
  - Family feels it is not acceptable
  - Fear of judgment
  - May not feel comfortable sharing
- A patient has the freedom to decide what a physician or other health care professional will and won't do.
- It is unethical to physically force or coerce a patient into a treatment against their will if they are of sound mind and are mentally capable of making an informed decision.

Global Public Health 2008;3:90

Autonomy vs Discrimination

- Autonomy
  - Patient has the right to refuse medical care
  - Includes treatment by an unwanted physician
- Discrimination
  - Treatment or consideration of, or making a distinction in favor of or against, a person based on the group, class, or category to which the person or thing is perceived to belong rather than on individual attributes

Discrimination

- Title VII of Civil Rights Act – employers may not discriminate based on race, color, religion, sex, or national origin
- HOWEVER
- BFOQ – bona fide occupational qualification allows employers openly and legitimately base employment decision on sex, religion, or national origin (but not race)

UCLA Law Review 2012

Informed Consent

- Approval to perform procedure
- Disclose information about risks of treatment
- Alternatives
- Protects patient's status as a human
- Based upon law of battery which protects patients from unwanted physical contact

UCLA Law Review 2012

Patients Who Prefer Women Providers

- 1.6 Muslims worldwide, 7 million reside in the United States
- Muslims perceive medical field positively due to strong emphasis on health in Qu'ran
- Female patient may refuse male provider or shake hands
- In Islam, modesty is important and culturally emphasized.
- Many Islamic scholars argue that the general guidelines of modest dress and covering do not apply in the health care setting

Obstet Gynecol 2015;126:969

ASA Stance on Subject

- Optimal Goals for Anesthesia Care in Obstetrics
  - Availability of licensed practitioner who is credentialed to administer an appropriate anesthetic when necessary
  - Availability of anesthesia and surgical personnel to permit start of cesarean delivery in a timely manner
- Guidelines for the Ethical Practice of Anesthesiology
  - A physician must recognize responsibility to patients.
  - A physician shall in the provision of appropriate care except in emergencies be free to choose whom to serve, with whom to associate, and the environment in which to provide medical care.
  - Anesthesiologists respect the right of every patient to self-determination

ASA Oct 26, 2016

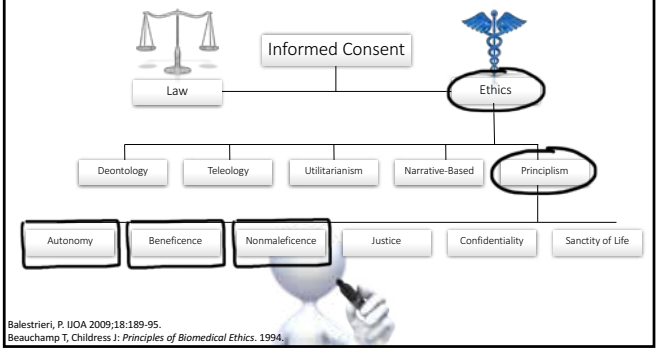

Summary
It is not uncommon for patient's to request a provider of a specific gender, race, color, or religion.
In the ER, the request is almost always accommodated.
Principle of Autonomy – patient's have a right to refuse care
Discrimination – Legal precedent for race
JUDGMENT
experience

Ethics of Consent for the Obstetric Anesthesiologist

Caitlin Sutton, MD
Texas Children's Hospital · Baylor College of Medicine
SOAP 2017, Bellevue, Washington

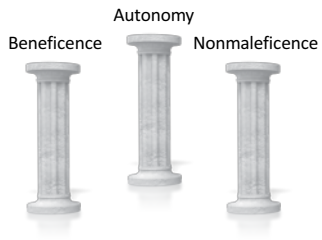
I have no disclosures.

Informed Consent: An Ethical Framework



Balestrieri, P. IJOA 2009;18:189-95.
Beauchamp T, Childress J: *Principles of Biomedical Ethics*. 1994.

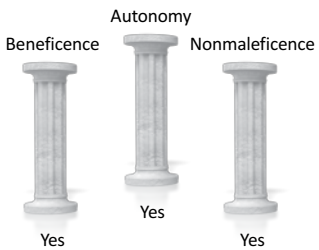
Principlism and Informed Consent



Chervenak, F. Anesth Analg 2003;96:1480-5.
Van Norman, G: *Clinical Ethics in Anesthesiology*. 2011.

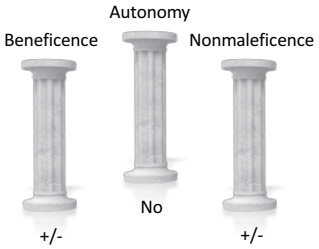
Case 1: Should you place an epidural?

Patient in pain, wants an epidural, no contraindications



Case 2: Should you place an epidural?

Patient presents for TOLAC, otherwise healthy, does *not* want an epidural



Resolving Conflict in Principlism

- Autonomy: first & only
- A priori ranking
- Prima facie principle

Broaddus, B. Anesth Analg 2011;112:912-5.
Chervenak, F. Anesth Analg 2003;96:1480-5.
Hoehner, P. J Clin Anesth 2003;15:586-600.

Informed Consent in Practice

Process of Informed Consent

Threshold Elements → Informational Elements → Consent Elements

- Decision-making capacity
- Freedom and voluntariness of decision

- Adequate disclosure of material information
- Recommendation
- Understanding

- Decision
- Authorization

Beauchamp T, Childress J: *Principles of Biomedical Ethics*. 1994.

Process of Informed Consent

Threshold Elements → Informational Elements → Consent Elements

- **Decision-making capacity**
- **Freedom and voluntariness of decision**

- **Adequate disclosure of material information**
- **Recommendation**
- Understanding

- **Decision**
- Authorization

Beauchamp T, Childress J: *Principles of Biomedical Ethics*. 1994.

Threshold Elements | Informational Elements | Consent Elements

Decision-Making Capacity

To what extent must a pregnant woman understand medical information?

- Must be fully educated before the decision can be considered "informed"
- Must understand basic options and consequences only
- Requisite understanding depends on the decision

Do pregnant laboring women have decision-making capacity?

- Yes
- No
- It doesn't matter

Saunders TA, IJOA 2006; 15: 98-103.
Black JD, Anaesth Intensive Care 2006; 34: 254-60.
Jackson, Can J Anaesth 2000; 47:1068.

Threshold Elements | Informational Elements | Consent Elements

Freedom and Voluntariness of Decision

Is the decision free from external constraints?

- I have over-emphasized the risks about a procedure to dissuade a patient from choosing it.
- I have not shared all of the risks about a procedure because I didn't want to make a patient worry too much.

Hoehner, P. J Clin Anesth 2003;15:586-600.
Jones JW, Surg Clin N Am 2007.
Williamson WK, J Vasc Surg 2001.

Threshold Elements | Informational Elements | Consent Elements

Adequate disclosure of material information

What risks do we need to tell?

- Most common risks
- Most serious risks
- All risks

When do we need to tell them?

- Consent process must be complete before starting the procedure
- Can continue the consent process during the procedure
- It's okay to complete the consent process after the procedure

Broaddus, B. Anesth Analg 2011;112:912-5.
Landau R. IJOA 2006;15:301-305.
Paech, M. Anaesth Int Care 2006;34,2:147-9.

Threshold Elements | Informational Elements | Consent Elements

Recommend or Offer Options

How do you most often complete your consent process?

- Have the patient decide from the list of options
- Make a recommendation to the patient

Kotaska, A. Birth 2017; 1-5.

Threshold Elements | Informational Elements | Consent Elements

Decision

What if her decision is counter to your recommendation?

- I have performed a procedure that I was not comfortable doing because the patient insisted on it.
- I have insisted that a patient undergo a procedure she didn't want because I was not comfortable with the risk she incurred by not doing so.

Chervenak, F. Anesth Analg 2003;96:1480-5.
Kotaska, A. Birth 2017;1-5.

Summary

- Using principlism to resolve conflicts in informed consent
- Decision-making capacity
- Freedom and voluntariness of decisions
- Adequate disclosure of material information
- Recommending versus offering options
- Decision conflicts

Abstract #:SUN-01

Combined spinal epidural in a parturient with tinea versicolor

Presenting Author: Milly Turakhia MD
Presenting Author's Institution: Northwestern Memorial Hospital - Chicago, IL
Co-Author: Jeanette Bauchat MD - Northwestern Memorial Hospital - Chicago, IL

A 33-year-old parturient with history of tinea versicolor presented in active labor requesting epidural analgesia. Physical examination revealed a diffuse maculopapular rash on her back from the cervical to sacral regions (Figure 1). The patient ceased treatment of tinea versicolor in pregnancy. The theoretically small but unknown risk of introducing a subcutaneous yeast infection into the neuraxial space was discussed and informed consent was obtained.

Sterile skin preparation was performed for 30 seconds using 2% chlorhexidine gluconate/70% isopropyl alcohol. This preparation dried for three minutes and the sequence was repeated. The skin was infiltrated with 1% lidocaine. A combined spinal epidural technique was performed. The epidural space was identified using a 17G Touhy needle. A 27G spinal needle was used for intrathecal administration of bupivacaine and fentanyl. Labor analgesia utilized a programmed intermittent epidural bolus with patient controlled demand boluses. The catheter remained in situ for 13 hours. The patient delivered via cesarean delivery with an uneventful postoperative course.

Tinea versicolor is a benign superficial fungal infection caused by yeasts in the genus Malassezia and has an estimated prevalence of 2-8% in healthy adults. This infection presents with asymptomatic or mildly pruritic hypopigmented, hyperpigmented, or erythematous macules on the neck, torso and proximal upper extremities and is treated with topical or systemic antifungals. Two case reports of lumbar epidural analgesia in parturients with tinea versicolor have been reported; ours is the first case of combined spinal epidural analgesia. Despite the prevalence of tinea versicolor, systemic or CNS infection with Malassezia after neuraxial anesthesia has not been reported.

Rashes in the lumbar area should be accurately diagnosed prior to neuraxial placement. Microorganisms may be introduced into the neuraxial space via lapse in aseptic technique or colonization from skin. Despite placement of labor epidurals in bacteremic women and evidence of routine bacterial colonization of postoperative epidural catheters, epidural infections are rare, suggesting that the presence of microorganisms is necessary, but not sufficient, to cause neuraxial infections. The skin preparation, 2% chlorhexidine gluconate/70% isopropyl alcohol penetrates five layers of dermis and has antifungal properties. Local anesthetics have antimicrobial activity against both bacteria and fungi as well. The antifungal properties of both the skin preparation and local anesthetic solution as well as patient's intrinsic immunologic defenses likely contribute to very low risk of neuraxial infections in parturients with tinea versicolor.

References:

1. Dermatol Clin. 2003;21:413.
2. IJOA 2013;22(3):265-266.
3. Reg Anesth Pain Med. 2006;31:324-33.
4. Surg Infect. 2002;3:359-65.
5. Becton Dickinson. ChloraPrep: The Benefits. 2016.
6. Infect Dis Obstet Gynecol. 2000;8:124-137.

Abstract #:SUN-02

Placental abruption and autoimmune haemolytic anaemia in a parturient who had undergone lymphocyte immunization therapy

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Presenting Author's Institution: University College London Hospital - London, London
Co-Author: Sioned Phillips MBBS BSc MCEM MRCP FRCA MAcadEd - University College London Hospital - London, London
Edward Burdett MBBS FRCA - University College London Hospital - London, London
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A 42-year-old woman with a complex obstetric and hematological history presented to labor ward with acute shortness of breath, at 24 weeks' gestation. She was G26 P0, with 4 previous intrauterine deaths and 21 miscarriages. The patient was on treatment dose low molecular weight heparin for a pro-thrombotic state despite a negative thrombophilia screen. The patient was undergoing lymphocyte immunization therapy (LIT) injection of her husband and 3rd parties' blood subcutaneously with the aim to prevent further miscarriage. She walked into the delivery suite with BP 115/60mmHg, HR 126 b/min and Hb 37g/L. Further labs revealed a hematocrit 0.124%, MCV 93.9fL, MCHC 338g/L, platelets 198x109/L and LDH 444 U/L, with a normal clotting profile and fibrinogen of 4.8 mg/dL. Immediate resuscitation was commenced with packed red cells (PRCs). Urgent advice from hematology was sought, but with little was known about complications of LIT. After 90 minutes of resuscitation (4 units PRCs, 1 L crystalloid), venous blood gas demonstrated Hb 50 g/L and a lactate of 4 mmol/L. Ongoing bleeding was suspected, so caesarean delivery under general anesthesia was commenced. Despite 2L of intra-uterine blood and evidence of placental abruption, a live infant was delivered. The patient was transfused a further 8 units PRCs, 4 units FFP and fibrinogen concentrate without the need for vasopressors. She was transferred to intensive care and extubated at 6 hours. There was a good recovery despite developing autoimmune hemolytic anaemia (AIHA) on day 3, requiring treatment with intravenous immunoglobulin.

LIT is an immunotherapy involving exposure to paternal or 3rd party antigens to ameliorate immunological rejection of the fetus. Concerns have been raised regarding the manufacturing and preparation of the cells administered, leading to transmission of communicable disease. There are contrasting studies on the benefits of LIT. One study showed a higher rate of subsequent miscarriage compared to placebo.1 A Cochrane review did not support the use of LIT to improve live birth rate after recurrent miscarriage.2 Severe anaemia in this patient did not improve despite blood transfusion which suggested ongoing bleeding. Recent invasive allogenic immunotherapy potentially complicated further blood product transfusion. AIHA may have been precipitated or exacerbated by LIT and further blood transfusion.

In summary, LIT may have contributed to the placental abruption and subsequent AIHA in this patient. Further work is needed to investigate the hematological side-effects of this procedure on patients with previous allogenic immunotherapy or hematological intervention.

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1. Ober C et al. Mononuclear-cell immunisation in prevention of recurrent miscarriages: a randomised trial. The Lancet. 1999;354:365.
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Abstract #:SUN-03

4th Cesarean Delivery Of A Severely Obese Parturient (BMI 96.7 kg/m2) With A Combined Spinal-Epidural Anesthetic

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Introduction: Obesity is a global epidemic crossing all demographic and socioeconomic lines. Paralleling, the incidence of severely obese (BMI > 35 kg/m2) parturients is growing.1,2 These patients require several unique anesthetic, obstetric, and post-operative pain considerations. We present the case of a 25 year old G4P3 at 39 weeks with a BMI of 96.7 kg/m2, the highest documented in the literature, who successfully underwent repeat cesarean delivery with a combined spinal-epidural (CSE).

Case: The patient presented at 39 weeks GA having been turned away from multiple hospitals due to her weight. With scant prenatal care, she got a TTE, gen. surgery consultation for an untreated breast abscess, ultrasound for asymmetric lower extremity swelling and respiratory therapy consultation for CPAP fitting.

She had a h/o 3 prior cesarean deliveries, and a fundal placentation was noted on the prenatal ultrasound this pregnancy.

Due to poor vascular access and an inability to measure blood pressures, a central,- and arterial line were placed prior to surgery. Intubation wedge, video laryngoscope and 2 units of typed and crossed red blood cells were readily available.

Due to absent anatomical landmarks, midline and distance to the epidural space were identified with ultrasound. Consistent with ultrasound estimation, LOR was found at 15cm with a 6" 17 gauge GM epidural needle at the L3/2 interspace. A 190mm 25 gauge GM spinal needle was passed into the subarachnoid space, and 10mg of 0.75% hyperbaric bupivacaine and 10mcg of fentanyl injected. No neuraxial morphine was given due to concerns of respiratory complications. An epidural catheter was uneventfully threaded and taped at 20cm skin. Five subsequent epidural boluses of 2% lidocaine were required for the 89 minute surgery, which completed with a V.A.C placement.

Estimated blood loss was 1,5L. A female infant was delivered with APGARs of 3, 7, and 8 and taken briefly to the NICU following delivery for non-invasive respiratory support and hypoglycemia. For post-op. pain management, the epidural catheter was left in place, and 0.1% bupivacaine with 2mcg/ml fentanyl was infused for 24 hrs until the patient successfully transitioned to oral analgesics. The patient recovered on in the L&D unit, although an ICU bed had been made available.

Discussion: A multidisciplinary approach to this patient's care assured the safest delivery for this severely obese patient. A CSE allowed for profound anesthesia for a complex operative case, while the epidural catheter provided flexibility and safety for an uncertain surgical course as well as post-operative analgesia to minimize systemic opioid use.

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Abstract #:SUN-04

Management of a Patient with Glanzmann's Thrombasthenia Scheduled for Cesarean Section

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Glanzmann's Thrombasthenia (GT) is a rare, autosomal recessive platelet disorder. The defect is an absence of the GPIIb–IIIa complex on the surface of the platelet membrane. Platelet aggregation is severely impaired by the absence of this integral membrane complex.

Case Report: A 35 years female with a diagnosis with GT was scheduled for repeat C-Section at 38 weeks of gestation. History was significant for frequent gum and nose bleeds and multiple transfusions as a child. A multi-disciplinary team discussion between hematologist, obstetrician, blood bank and the anesthesia team was held throughout this pregnancy for her care. Prior to C-Section she was optimized with IV iron therapy and supplemented with oral iron, B12 and pre-natal vitamins.

Pre-operative hematocrit was 32 and platelets were 224. Amicar and tranexamic acid, as well as 1 unit of HLA matched platelets for transfusion were available prior to C-Section. To treat uncontrolled bleeding, recombinant Factor VIIa was obtained. A right antecubital 7 french RICC catheter and 18 gauge IV catheter in the left arm were placed in the holding area. HLA matched platelets were transfused en route to the operating room.

In the OR, GA was induced with 200 mg of propofol and 100 mg of succinylcholine and intubated with cricoid pressure. 5 grams loading dose of amicar was administered and maintained at 1 gram per hour. A propofol infusion at 75 mcg/kg/hr and 0.4% Sevoflurane with 50% nitrous oxide was started. Baby was delivered with apgar scores of 8 and 9. Excessive oozing was noted upon closure of fascia and one unit of single donor platelets was transfused. Final EBL was 1500 L, and 2500 ml of crystalloids was administered. Patient was extubated in the OR and transferred to PACU. Patient remained hemodynamically stable without signs of abnormal bleeding. Post-op CBC: HCT 28 PLT 117K. Patient was discharged on POD 3.

Discussion: The incidence of morbidity and mortality associated with GT is largely unknown although it is estimated that 1:1,000,000 have GT. Clinical presentation of patients with the disorder includes hemorrhagic manifestations like purpurae, epistaxis, gingival hemorrhage, menorrhagia and mucocutaneous bleeding. Laboratory studies show prolonged bleeding time, with normal platelet count and normal coagulation studies. Light transmission aggregometry is the gold standard of diagnosis.

Patients are at increased risk for severe bleeding during pregnancy extending well into the postpartum period. Various peripartum treatments are described to limit associated obstetric hemorrhage; platelet and factor 7 transfusion, gamma globulins and plasmapheresis. Studies have suggested allogeneic matched bone marrow transplantation to be the definitive therapy in patients with intractable bleeding and has resulted in successful resolution of bleeding episodes. However, there remains no consensus regarding best management strategies.

Abstract #:SUN-05

Subdural Hematomas and Posterior Reversible Encephalopathy Syndrome Associated with Unrecognized Unintentional Dural Puncture In a Preeclamptic Patient

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A healthy 23 year-old G1P0 parturient presented in labor at term. Combined spinal-epidural (CSE) labor analgesia was attempted. After multiple failed attempts to obtain cerebrospinal fluid, the CSE was abandoned and an epidural catheter was placed, which functioned well. The patient became hypertensive and proteinuric and was diagnosed with preeclampsia without severe features.

On postpartum day (PPD) 1 she complained of a mild postural headache. On PPD 2 she became nauseous, vomited, and developed a severe positional headache. She was offered an epidural blood patch (EBP) but opted for conservative management and was discharged on PPD 3 with a positional headache. On PPD 5 she presented to the anesthesia team complaining of a severe non-positional headache with photophobia accompanied by a BP of 174/102. The anesthesia team consulted their obstetric colleagues who diagnosed preeclampsia with severe features and started Mg and labetalol. An MRI was obtained due to the severity and non-positional nature of the headache. It demonstrated increased FLAIR and T2 signals in the basal ganglia consistent with posterior reversible encephalopathy syndrome (PRES), displacement of the pons and cerebral tonsils suggesting intracranial hypotension, and bilateral subdural hematomas (SDH). She was transferred to the neuro-ICU, given nicardipine by infusion for BP control for PRES and received an EBP to stabilize her SDH. Her headache resolved, her SDH remained stable, and the patient was discharged on hospital day 8.

The differential diagnosis of postpartum headache is broad and encompasses obstetric and anesthetic complications. Our patient's headache was a result of unrecognized unintentional dural puncture (UDP) leading to intracranial hypotension and SDH, as well as PRES. Up to 35% of UDPs may be unrecognized (1) highlighting the need for close follow up after neuraxial anesthesia. SDH after dural puncture is rare and thought to be secondary to decreased ICP with traction-induced tears in bridging veins (2). A change in the character of headache should raise the possibility of SDH (2). EBP allows for restoration of normal ICP, ameliorating the headache and, in the rare instances in which it occurs, stabilizing SDH. In addition to developing SDH, our patient developed PRES, which is well-described in association with preeclampsia, and results from impaired cerebral autoregulation with vascular leakage and vasogenic edema (3). It presents as encephalopathy, with or without headache, visual disturbances, and seizures. Given that PRES has also been associated with UDP (4), it is possible that preeclamptics with UDP may be at increased risk for PRES. Our case highlights rare but serious complications of neuraxial procedures and preeclampsia and highlights the need for thorough investigation and prompt treatment of severe postpartum headaches.

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Abstract #:SUN-06

Transfusion management in a pregnant patient with IgA deficiency undergoing cesarean delivery

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Introduction: IgA deficiency is associated with anaphylaxis following blood transfusion. We present a case of a parturient scheduled for repeat cesarean delivery who had combined variable immunodeficiency (CVID) with IgA deficiency and discuss the relevant blood component therapy considerations.

Case: 27 year-old G3P2 presented at 39.1 weeks for her scheduled third cesarean delivery. Her medical history was notable for CVID diagnosed in the interval between her second and third pregnancies. Her symptoms included multiple bouts of sinusitis, pneumonia and empyema that required a thoracotomy. She was being treated with 35g of immune globulin (IVIg) every 3 weeks. She also had A2 gestational diabetes mellitus, well controlled on glyburide. Her most recent IgA levels were from 2014 and were <25 mg/dL (normal>70 mg/dL). The blood bank pathologist recommended drawing anti-IgA antibodies and IgA levels, and noted that she would require single-washed packed red blood cells (pRBCs) and double-washed platelets if clinically indicated. IgA deficient fresh frozen plasma (FFP) and cryoprecipitate (cryo) were not immediately available, and would have to be requested from a regional blood bank center, taking several hours to days to procure. Given her low risk for postpartum hemorrhage, we proceeded with cesarean delivery after cross-matching for 2 units of single-washed pRBCs, and it was uneventful with no transfusions required.

Discussion: The incidence of IgA-related anaphylactic reactions to blood transfusions is approximately 1 in 50,000 (1). Although more common in patients with undetectable IgA levels (<0.05 mg/dL) or those with a history of previous reactions, it is important to be aware of blood product availability and transfusion management in parturients presenting for cesarean delivery. Considerable time is needed for single-washed pRBCs (at least 1 hour) and double-washed platelets (at least 2 hours). FFP and cryo must be procured from IgA deficient patients, which can be very difficult depending on location and blood bank supply. The American Rare Donor Program tracks availability and regulates the supply of IgA-deficient plasma, and generally requires demonstration of anti-IgA antibodies prior to dispensation. The overall predictive value of anti-IgA antibodies causing anaphylaxis is questionable, with anaphylaxis occurring in only 2.4% of patients with positive antibodies, and antibodies detected in only 18.1% of patients with presumed IgA-related anaphlyaxis (2). This case demonstrates the importance of preanesthesia consultation and communication between the multiple disciplines in all complicated patients.

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Abstract #:SUN-07

An Unexpected Faun Tail when Prepping for Labor Epidural

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Introduction: Spinal dysraphism describes a heterogeneous group of disorders of the vertebral arches, spinal cord and meningeal layers. Although the prevalence is relatively high, detailed descriptions of peripartum analgesia and anesthesia methods are limited.

Case: A 38-year-old, gravida 4 para 2, recent Honduran immigrant, with a single intrauterine pregnancy presented in labor at 39 2/7 weeks. She previously delivered two healthy children via uncomplicated vaginal delivery without neuraxial anesthesia. Upon admission, she requested epidural analgesia and during preparation, an area of hypertrichosis was noted extending from the patient's mid-thoracic to lumbar area (see Image). The patient denied neurological complications at birth or a medical history of spina bifida. A physical exam demonstrated no neurological deficits. A CSE was placed in the L4-5 interspace without complication. Preservative-free morphine 150 mcg and Fentanyl 15 mcg was placed intrathecally, and patient controlled epidural anesthesia (PCEA) with bupivicaine 0.125% at a rate of 6 ml/hr was started following a 6 ml initial bolus. Ninety-minutes after placement, the patient complained of pain. She had an L1 level on the right and no level on the left. The epidural catheter was withdrawn 1.5 cm, infusion rate increased to 8 ml/hr and bupivicaine 0.125% 10 ml bolused, resulting in effective pain control for SVD. A post-partum thoracic MRI revealed previously undiagnosed T7-9 non-fusion of posterior vertebral bodies with partial extension of the thecal sac into the defect. The patient was informed of the findings and discharged postpartum day one. On postpartum day five the patient developed a postdural puncture headache. It resolved at home with conservative measures.

Discussion: Successful neuraxial labor analgesia is possible in select patients with spinal dysraphism. The risk of failure and complications is higher. This patient had 27 encounters with healthcare providers between entry to care and delivery; however, no anomalous findings were documented. The initial prenatal encounter should include a basic back exam for any patient who may require neuraxial anesthesia. Mandatory folic acid fortification in Latin American countries began in 1993. Providers should have a higher index of suspicion for neural tube defects in women born before 1993 from these countries.

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Abstract #:SUN-08

Obstetric anesthetic management in a patient with Loeys Dietz syndrome and prior spontaneous coronary artery dissection

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Background: Loeys Dietz syndrome (LDS) is a rare genetic condition involving a mutation in the TGF-β signaling pathway, resulting in vascular and connective tissue abnormalities. Parturients with LDS carry an increased risk of uterine rupture and aortic dissection due to the increased hemodynamic stress of pregnancy, portending a significant increase in maternal morbidity and mortality. Accordingly, obstetric and anesthetic management should focus on early detection and monitoring, aggressive blood pressure control, reduction in sympathetic stimulation via early labor analgesia, and close follow up (1).

Case: A 40 year old G2P1 with LDS presented for induction of labor at 40 3/7 weeks gestation. She had a history of known aortopathy with a mildly dilated aortic root (39 mm) and fibromuscular dysplasia of the vertebral, carotid, renal, and iliac arteries. In addition, she had a history of spontaneous coronary artery dissection five months following her first delivery.

Induction was initiated with vaginal misoprostol and augmented via artificial rupture of membranes. An arterial line was placed and continuous ECG monitoring was employed for close hemodynamic monitoring. An epidural was placed for labor analgesia early in labor. A healthy male infant was delivered via normal spontaneous vaginal delivery. The patient received a prophylactic dose of rectal misoprostol, then a dose of carboprost for continued bleeding. She subsequently reported dyspnea, which resolved spontaneously. Postpartum, she was observed in the intensive care unit for 24 hours. No untoward cardiac events were observed.

The patient experienced atypical chest pain 3 weeks postpartum, which spontaneously resolved. Evaluation revealed stable aortic dilation and cardiac function with no evidence of recurrent dissection.

Discussion: LDS is associated with significant maternal morbidity and mortality. Patients should undergo CT or MR angiography to monitor for vascular abnormalities, serial maternal echocardiography to monitor for aortopathies and cardiomyopathies, and a fetal echocardiogram. In the peripartum period, patients should have close hemodynamic monitoring, aggressive blood pressure control to reduce the risk of aneurysm or dissection, and consideration for assisted second stage of labor to reduce hemodynamic fluctuations. Early epidural placement for labor analgesia may reduce the sympathetic stimulation and aortic wall stress associated with labor. Cesarean delivery should be considered in particularly high risk patients to reduce the stress of labor. Careful selection of medications in the setting of postpartum hemorrhage is essential to avoid hypertension and uterine rupture; methylergonovine is relatively contraindicated, and the use of oxytocin in this population is the subject of ongoing research. Patients should have close follow up, as cardiac events may occur several months postpartum (1).

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Abstract #:SUN-09

Lymphocyte Immunisation Therapy and Placental Abruption

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A 42-year-old woman with a complex obstetric and hematological history presented to labor ward with acute shortness of breath, at 24 weeks gestation. She was G26 P0, with 4 previous intrauterine deaths and 21 miscarriages. The patient was on treatment dose low molecular weight heparin for a pro-thrombotic state despite a negative thrombophilia screen. The patient was undergoing lymphocyte immunization therapy (LIT) injection of her husband and 3rd parties' blood subcutaneously with the aim to prevent further miscarriage. She walked into the delivery suite with BP 115/60mmHg, HR 126 b/min and Hb 37g/L. Further labs revealed a hematocrit 0.12%, MCV 93.9fL, MCHC 338g/L, platelets 198x109/L and LDH 444 U/L, with a normal clotting profile and fibrinogen of 4.8 mg/dL. Immediate resuscitation was commenced with packed red cells (PRCs). Urgent advice from hematology was sought, but little was known about complications of LIT. After 90 minutes of resuscitation (4 units PRCs, 1 L crystalloid), venous blood gas demonstrated Hb 50 g/L and a lactate of 4 mmol/L. Ongoing bleeding was suspected, so caesarean delivery under general anesthesia was commenced. Despite 2L of intra-uterine blood and evidence of placental abruption, a live infant was delivered. The patient was transfused a further 8 units PRCs, 4 units FFP and fibrinogen concentrate without the need for vasopressors. She was transferred to intensive care and extubated at 6 hours. There was a good recovery despite developing autoimmune hemolytic anaemia (AIHA) on day 3, requiring treatment with intravenous immunoglobulin.

LIT is an immunotherapy involving exposure to paternal or 3rd party antigens to ameliorate immunological rejection of the fetus. Concerns have been raised regarding the manufacturing and preparation of the cells administered, leading to transmission of communicable disease. There are contrasting studies on the benefits of LIT. One study showed a higher rate of subsequent miscarriage compared to placebo.1 A Cochrane review did not support the use of LIT to improve live birth rate after recurrent miscarriage.2 Severe anaemia in this patient did not improve despite blood transfusion which suggested ongoing bleeding. Recent invasive allogenic immunotherapy potentially complicated further blood product transfusion. AIHA may have been precipitated or exacerbated by LIT and further blood transfusion.

In summary, LIT may have contributed to the placental abruption and subsequent AIHA in this patient. Further work is needed to investigate the hematological side-effects of this procedure on patients with previous allogenic immunotherapy or hematological intervention.

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1. Ober C et al. Mononuclear-cell immunisation in prevention of recurrent miscarriages: a randomised trial. The Lancet. 1999;354:365.
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Abstract #:SUN-10

Catecholamine-Induced Cardiomyopathy from Undiagnosed Pheochromocytoma in Pregnancy

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Limited few cases have detailed catecholamine-induced cardiomyopathy (CIC) in the parturient from a pheochromocytoma. Our patient decompensated during cesarean section as a result of CIC caused by an undiagnosed pheochromocytoma. 30 year old G2P1001 at 37w1d was admitted for hypertension. Her pregnancy was complicated by the diagnosis of gestational hypertension, headaches, and SVT. She underwent a cesarean section for breech presentation after a failed version. She became progressively more tachycardic and unstable despite pharmacologic treatment. She rapidly decompensated in the ICU, she arrested and had an impella placed prior to transfer to another hospital for venoarterial ECMO where she was found to have a LVEF of 10%. After a prolonged and complicated ICU course she was able to recover and was eventually discharged. During outpatient follow up she was found to have a pheochromocytoma and underwent a successful surgical resection.

Pheochromocytoma is a difficult medical problem in pregnancy that can be devastating when undiagnosed as it carries a 40.3% maternal mortality and 56% fetal mortality risk [1]. Triggers that stimulate the release of catecholamines in pregnancy include: increased intra-abdominal pressure, fetal movement, uterine contraction, the process of delivery, abdominal surgical intervention and even general anesthesia [2]. The management of pheochromocytoma is important in pregnancy because hypertensive crisis can lead to uteroplacental insufficiency, early separation of the placenta, or even fetal death [3]. If diagnosed early in pregnancy, the tumor may be resected after elective termination of the pregnancy or while the patient remains pregnant. After the 24th week it is recommended that long-term alpha blockade be accomplished with phenoxybenzamine to bring the fetus to term [4]. Numerous theories have been proposed to explain the pathophysiology that center around receptor-mediated effects, direct toxic effects, and increased adrenergic stimulation.

The patient's history of SVT, uncontrollable hypertension and tachycardia, and her cardiomyopathy were all manifestations of the tumor and the patient was fortunate as the prognosis for patients presenting with acute heart failure is poor, and fatality usually occurs within 24 hours [5].

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Abstract #:SUN-11

Operative vaginal delivery during extracorporeal membrane oxygenation support for severe acute respiratory distress syndrome

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The incidence of acute respiratory distress syndrome (ARDS) during pregnancy is estimated at 1.5-70/100,000 with a mortality of 23-50%. Management of severe ARDS with extracorporeal membrane oxygenation (ECMO) is described in a limited number of case reports/series. In the following report we describe a case of instrumented vaginal delivery of a viable fetus during ECMO.

A G8P2052 at 29w4d was admitted to the ICU for management of ARDS and septic shock due to multifocal H1N1 pneumonia. She was intubated within 24 hrs of admission for progressive hypoxemia and cannulated for ECMO on hospital day (HD) 7. Continuous fetal monitoring was started on admission, but was decreased to twice daily NSTs at the time of ECMO, as delivery would only be attempted for maternal decompensation. Approximately 24 hrs after ECMO initiation the patient had significant vaginal bleeding. The heparin infusion was discontinued and exam revealed complete dilation with bulging membranes. Resources and personnel were mobilized for expectant delivery of the now 30w3d fetus. Amniotomy was performed and the fetus progressed to 3+ station. This was associated with a sustained deceleration of the fetal heart rate and the decision was made to attempt an operative vaginal delivery. Forceps were applied and the fetus was delivered over 1 pull and passed to the NICU team after immediate cord clamping. The placenta was delivered with active management of the third stage of labor with rectal misoprostol and a 3u intravenous bolus of oxytocin followed by infusion of 40u of oxytocin mixed in 1000mL of lactated ringer's. Adequate uterine tone was rapidly achieved with no evidence of ongoing bleeding. Heparin correlation and aPTT were checked hourly, and heparin infusion was restarted 4 hrs after delivery. The neonate was initially intubated, but was extubated to nasal CPAP in <24 hrs, and discharged home on day 44 of life. Unfortunately, the mother's respiratory function failed to recover. She was terminally decannulated on ECMO day 13/ HD 20 and died after continued palliative care on HD 26.

Fetal monitoring in parturients on ECMO may be beneficial as a marker of maternal well-being. Unrecognized placental abruption or imminent delivery pose unique risks to a parturient who is therapeutically anticoagulated. Recognition of need for delivery may allow for discontinuation of anticoagulation and preparation for a potential post-partum hemorrhage. In this case fetal compromise was the primary indication for operative vaginal delivery, however, our patient also benefited from a shortened second stage of labor, allowing early treatment with uterotonic agents and a shortened interval without anticoagulation. Our case highlights how multidisciplinary care optimizes maternal and fetal survival in the critically ill parturient.

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Abstract #:SUN-12

Refractory hypoxia in a parturient with mixed connective tissue disease

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Interstitial lung disease (ILD) is rare in pregnancy. Many disease processes leading to ILD do not begin to manifest until after reproductive years. Demands on respiratory function increase in pregnancy, and limitations due to ILD may necessitate respiratory support in severe cases. Management of ILD patients is described in a limited number of case reports. We describe management of refractory hypoxia in a parturient with scleroderma.

A 26 yo G2P1 with scleroderma, on prednisone and azathioprine, presented at 23w5d with 3 weeks of worsening cough, pleuritic chest pain and SOB. Empiric treatment for community-acquired pneumonia was started. During a 6 min walk test she desaturated to 85% on room air at 4 min and completed the test on 2L oxygen. Bronchoscopy showed eosinophilia but no infection; antibiotics were discontinued and inhaled steroids started. On hospital day (HD) 3 she developed an increased oxygen requirement and was transferred to the ICU. BiPAP was started. A CT was negative for PE but showed worsening ground glass opacities. She was intubated on HD 4 and treated with aggressive diuresis and steroid burst. She was extubated to high flow nasal cannula (HFNC) on HD 5 and remained relatively stable for 2 weeks. Over HD 18-20, her respiratory function declined necessitating HFNC 40L/min, 100% FiO2. A multidisciplinary meeting (ICU, rheumatology, ILD specialist, MFM and OB anesthesia) convened for concern that pregnancy was worsening her respiratory status, as all other causes had been treated or ruled out. A decision was made to proceed with repeat cesarean delivery. On HD 21 she was transported to the operating room using an oximizer and non-rebreather facemask. Neuraxial anesthesia was contraindicated due to heparin administration. General anesthesia was induced, intubation performed and ventilation was maintained via pressure control ventilation. A 26w5d fetus was delivered uneventfully. The patient remained intubated postoperatively. Despite decreasing oxygen requirements, she developed a new fever on PPD 1 and empiric antibiotics were started. Over 2 days she developed very poor lung compliance and hypotension requiring maximal vasopressor therapy. Due to poor prognosis, her family and medical team decided to pursue comfort measures. She was terminally extubated and passed away shortly after.

The destruction of alveolar tissue in ILD leads to progressive hypoxia and hypercapnia. The increased oxygen demand in pregnancy puts further strain on an already limited supply. Critical illness in pregnancy involves complex ethical decision making. Although it was unclear whether delivery would improve her respiratory status, the patient strongly wished to proceed despite extreme prematurity. Given her rapid decline, delivering in a controlled manner seemed most appropriate to avoid complications of emergent delivery for acute decompensation.

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Abstract #:SUN-13

A Labor Epidural in a Cerebral Palsy Patient with Spasticity

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Introduction: Cerebral palsy (CP) is a neurologic condition described as an aberrant control of movement or posture that is non-progressive and permanent, appearing in early life because of an injury to the immature brain. The majority of research in CP focuses on it as neonatal sequelae or in the pediatric population, not as a comorbidity of adult patients. A literature review of CP in pregnant patients yielded case reports that suggested a higher risk of failure with regional anesthesia because of spinal deformities and postural and movement defects.[1] One case report suggested that spinal anesthesia could remove inhibition of athetoid movements and trigger a harmful athetotic crisis.[2]

Case: We report a case of a 36yo G1P0 at 39w1d with congenital spastic quadriplegic cerebral palsy and pre-eclampsia without severe features. The patient had presented to OB clinic one week prior to admission for acute non-traumatic left hip pain described as a tight, sharp pain worse with movement, and she was no longer able to bear weight. She claimed she was ambulatory at baseline with contractures of her wrists and hands, though because of choreoathetoid movements, she was unable to write. She denied any known trauma to her hip, stating her pain had started acutely and was not relieved by acetaminophen. She described her pain as 0/10 in severity at rest, yet 10/10 with walking, thus confining her to a wheelchair. An AP hip x-ray film noted pubic symphysis diastasis of 2cm, and she was discharged after an orthopedics consult recommended rest and ice. A perinatal anesthesia consultation was requested to address the possibility of abdominal delivery if the patient was unable to push effectively or tolerate labor.

When the patient was admitted for active labor, she continued to complain of left hip pain that had not changed since last seen. The patient requested an epidural for increasingly painful contractions. There was difficulty in positioning the patient because of her spasticity, but an epidural at L4-L5 was then placed without further complication with an infusion of bupivacaine 0.125% with fentanyl 2 mcg/mL at 10mL/hr. The patient reported resolution of previous left hip discomfort and satisfaction with her pain control, and she progressed to spontaneous vaginal delivery after 10 hours. After epidural removal, she reported return of her severe left hip pain with movement, the same in perceived quality and characterization prior to delivery. On patient follow-up with physical therapy, the patient claimed to be at her ambulatory baseline with resolution of her pain.

Conclusion: Our case supports the notion that while cerebral palsy patients may be at higher risk for block failure, in the absence of a severe spinal deformity, this group of parturients can be effectively managed under epidural anesthesia.

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Abstract #:SUN-14

Twin Pregnancy With A Left Ventricular Assist Device

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Introduction: A 28 year old G4P2 woman with a left ventricular assist device (LVAD) presented with an eleven week twin pregnancy. Non-ischemic heart failure of unknown etiology was diagnosed in 2010 and an LVAD was placed in 2012 as a bridge to transplant eligibility. She was New York Heart Association (NYHA) Class IV with a left ventricular ejection fraction (LVEF) of 13%. Clinical course after LVAD placement was complicated by LVAD thrombosis, device-related and systemic infections, two pump replacements, and a hemorrhagic stroke requiring craniotomy. Obstetrical history included two prior Cesarean deliveries, both preceding the diagnosis of heart disease, and a therapeutic abortion amidst severe heart failure before LVAD placement.

Description: Despite appropriate use of contraception, a CT scan of her abdomen meant to investigate thrombus extension after admission for a DVT revealed a first trimester twin pregnancy. An ultrasound demonstrated diamniotic dichorionic twins at 11 weeks' gestational age. Despite recommendation to terminate, she elected to continue the pregnancy. Before discharge, her LVAD was interrogated and was running at a speed of 9400 rpm, a flow of 6.9L/min and power of 6.8 watts. The pulsatility index was 4.4. Multidisciplinary plans were being made regarding adjustment of LVAD settings to accommodate physiologic changes of pregnancy. Nine days after discharge, she returned severely somnolent with a focal headache. She had a supratherapeutic INR at 4.7 and was diagnosed with an intracerebral hemorrhage. She underwent emergent decompressive craniotomy and was transferred to the intensive care unit (ICU) intubated and requiring vasopressors. Her condition remained critical and four days later she had a spontaneous abortion in the ICU. A prolonged ICU stay ensued, complicated by several nosocomial infections, arrhythmias, LVAD thrombosis, and progression of her intracranial hematoma. After 43 days, her intracranial hematoma had expanded markedly, and anticoagulation was held. Progressive LVAD thrombosis ensued, resulting in device failure. She was transitioned to comfort care and her LVAD was disabled. She died from hyperkalemic cardiac arrest five days later.

Discussion: This is the first case report to document the death of a parturient secondary to LVAD related complications. There are currently two case reports of successful pregnancies in parturients with LVADs. It is not known what effect twin pregnancy has on LVAD related complications, nor is it known whether an LVAD can be reliably modified to accommodate the physiologic changes of pregnancy and support the hemodynamic demands of the fetus(es). Significant concern arises with the appropriate diagnosis and management of pregnancy related complications such as thrombosis and preeclampsia and safe delivery planning in a fully anticoagulated patient.

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Abstract #:SUN-15

Management of a Pregnant Patient with Scimitar Syndrome Presenting for Cesarean Delivery

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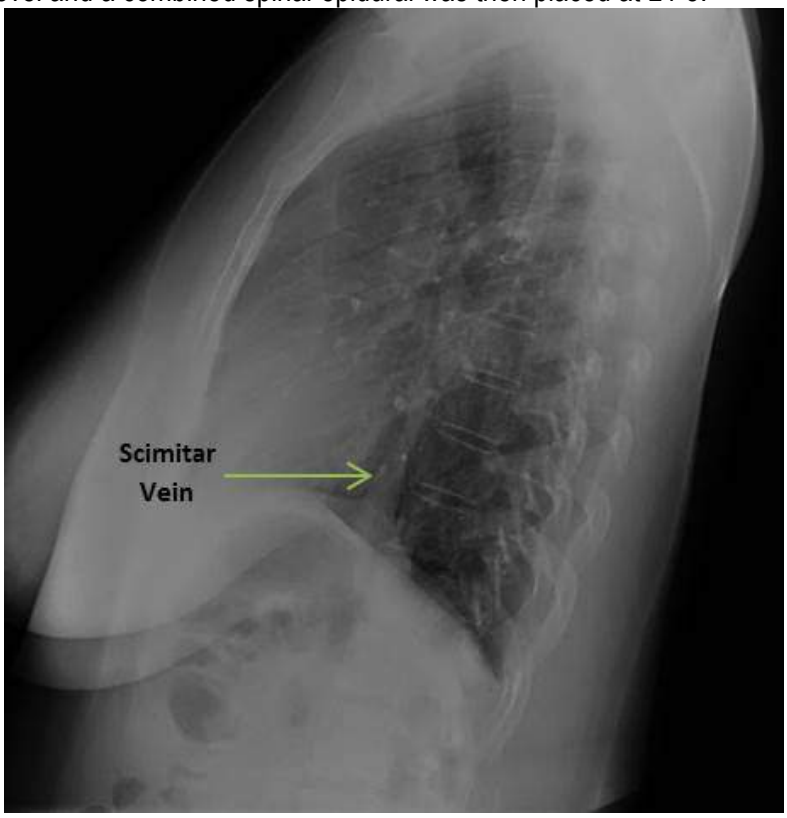
Patient History: A 40-year-old G3P2 with Scimitar syndrome presented for a primary cesarean delivery (CD) after myomectomy. She had a medical history significant for increased Factors XI and XII requiring anticoagulation. The patient had two uneventful vaginal deliveries prior to her cardiopulmonary diagnosis and myomectomy. The CXR demonstrated a hypoplastic right lung and the cardiac MR showed anomalous drainage of right upper pulmonary vein to the right atrium via a 'Scimitar' vein. Echocardiogram demonstrated a moderately dilated left and right ventricle, preserved systolic function, with elevated RVSP.

Operative Course: She underwent uneventful CD and bilateral tubal ligation. A spinal was performed at the L3-4 interspace; however, this provided an inadequate surgical level and a combined spinal-epidural was then placed at L4-5. She was hemodynamically stable throughout.



Discussion: Scimitar syndrome is a congenital anomaly characterized by a partial anomalous pulmonary venous return (PAPVR) from the right lung into the IVC associated with right lung hypoplasia and cardiac dextroposition. Infants present with pulmonary hypertension or heart failure; adults are often asymptomatic. The shadow of the anomalous right pulmonary vein gives the appearance of a Turkish sword or "scimitar" on CXR; this "scimitar sign" is diagnostic and can be confirmed by MR angiography.

Normal physiologic changes of pregnancy, including increased total blood volume and cardiac output with decreased SVR and PVR have important implications. Our goals were to maintain hemodynamic stability, minimize shunting and prevent worsening of the patient's pulmonary hypertension. Pain, hypoxemia, and hypercarbia were therefore avoided. Monitoring volume status was a priority as the pulmonary veins from the right lung draining into the IVC creates a left to right shunt, placing patients at risk of right heart failure secondary to volume overload. Moreover, during delivery there are increased fluid shifts secondary to blood loss, fluid administration, and uterine contraction causing auto-transfusion of blood back into systemic circulation.

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Abstract #:SUN-16

Ultrasound Guidance for Epidural Placement in a Patient With Posterior Spinal Fusion

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Introduction: Epidurals have been used as a form of labor analgesia for over 50 years. There have been few studies on the placement and efficacy of epidurals in women with a history of scoliosis corrected by spinal fusion. We report a case on the use of ultrasound for epidural placement in a patient with corrected scoliosis.

Case Report: A 27-year-old G1P0 with a history of idiopathic thoracolumbar scoliosis status post spinal fusion from T3-L4 at 16 years old presented with ROM at 39 weeks and requested an epidural. She reported no complications following her fusion and no longer follows with an orthopedist. On exam, a midline scar was present and spinous processes could be felt with mild scoliosis. The decision was made to proceed with an ultrasound guided epidural. A transverse approach was used to identify the location of the spinous processes, the optimal needle puncture site and angle for insertion, and the estimated depth of the epidural space. After identification of structures, an epidural was placed at the L4-5 interspace on the first attempt. The epidural with 0.1% Ropivacaine and Fentanyl 2mcg/mL was set to a rate of 10mL/hr. Pain scores with contractions decreased from 8/10 to 2/10 after 20 minutes, and a bilateral T10 level was present. She later delivered and the catheter was removed without difficulty. On post-delivery day 1 she reported no sensory or motor deficits, and was later discharged without complication.

Discussion: Epidurals were first reported in the 1940's, gaining momentum soon after. Advantages of epidurals include pain control during the first and second stages of labor, and the ability to provide analgesia for a cesarean section. Scoliosis commonly complicates placement, and is four times more common in females with an incidence of 2%. The operative and instrumental delivery rate is 2.5 times higher compared to women without scoliosis. Therefore, there is a need for regional technique to avoid the risks of general anesthesia. Studies have shown two-thirds of patients with corrected scoliosis have undergone successful neuraxial analgesia for labor. Other studies have shown using ultrasound for pre-procedural guidance in those with scoliosis led to fewer failed epidurals, needle passes, and interspaces attempted. This case demonstrated ultrasound guidance as being effective for epidural placement in patients with corrected scoliosis, and further research is suggested to establish its effectiveness in other situations of difficult epidural placement.

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Abstract #:SUN-17

New Technology for an Old Problem: Ultrasound-Assisted Spinal Anesthesia in a Parturient with History of Scoliosis Spine Surgery

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Parturients with corrected or uncorrected scoliosis pose a challenge to obstetric anesthesiologists. Ultrasound-assisted neuraxial anesthesia has aided performance of neuraxial anesthesia for patients with altered spinal anatomy. We report a case for which we used a handheld ultrasound (US) to identify the interlaminar space of a parturient with surgically corrected scoliosis.

A 21-year-old female G2P0100 at 19 weeks gestational age presented for cerclage placement. Physical examination revealed a patient with a Mallampati 2 airway, BMI 30.8 kg/m2, and a thoracolumbar spine scar. Her past medical history indicated severe scoliosis requiring surgery, but no imaging was available. In the sitting position, using a handheld US (Accuro, Rivanna Medical), the L3-L5 levels were identified using a paramedian oblique scan. The L3-L4 and L4-5 levels were then assessed using a transverse scan to determine the best lumbar interspaces for a spinal technique (Image 1). The sonoanatomy suggested L4-L5 to be the interspace with the most preserved anatomy. US-assisted findings identified the optimal intervertebral space to be significantly lateral to where midline appeared to the naked eye. Spinal anesthesia was performed under sterile conditions, and only one needle manipulation after the initial placement was necessary to obtain cerebrospinal fluid. The patient received Bupivacaine 0.75% 1.3 ml and 15 mcg of Fentanyl, and surgical level was obtained within 10 minutes. The cerclage was completed successfully.

Preprocedural US imaging has been shown to ease spinal anesthesia performance in nonobstetric and obstetric patients with spine surgeries(1,2). The Accuro US system may further facilitate neuraxial anesthesia placement due to its feature recognition software that automates midline and the epidural depth measurement. A particular limitation of typical US technology is its heavy dependence on sonographer skills and image interpretation. The Accuro system provides a 3D reconstruction of the spine, facilitating both obtaining and interpreting the images. Given our past experience with patients exhibiting severe scoliosis, we expect that this patient may have experienced an increased number of needle insertions, extended procedure time, and a potentially heightened risk of complications had we elected to not use US(2).

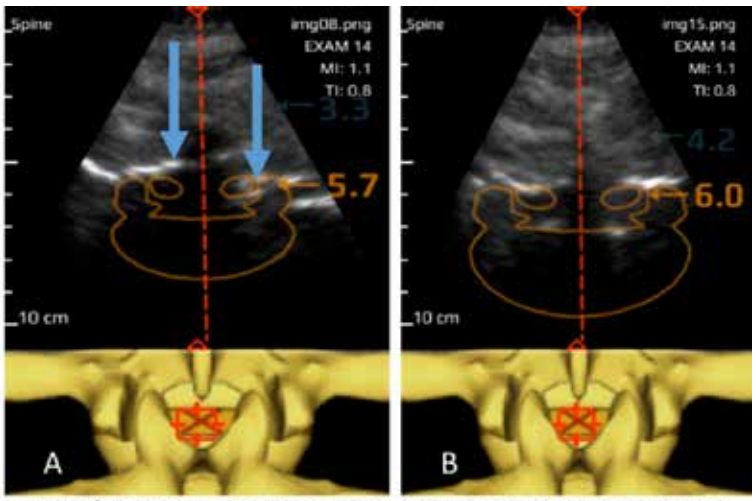

Image 1) Intervertebral space located using SpineNav3D™ and BoneEnhance™ technology. **1A.** L3-L4 intervertebral space. Uneven articular processes whch is characteristic of scoliosis are evident- blue arrow. **1B.** L4-L5 intervertebral space. Spine anatomy was better defined at this intervertebral space.

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Abstract #:SUN-18

New Onset Pulmonary Hypertension (PHTN) Presenting in Pregnancy

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Introduction: PHTN in pregnancy presents a unique challenge to healthcare providers due to the hemodynamic changes that occur during pregnancy and at the time of delivery. Despite advances in the management of these patients, maternal morbidity and mortality remains high and thus pregnancy is generally contraindicated in these patients. We present a case of an urgent cesarean delivery in a patient with no significant cardiac history who presented with new onset RV failure due to PHTN.

Case Report: A 27 y/o G2P1 with an IUP at 30 EGA presented to the ED with SOB and chest pressure. She reported a cough with associated chest pain for 3 months. She was also tachycardic and tachypneic. Exam was significant for increased work of breathing and JVD. CTA was obtained which was negative for PE. TTE was then performed which showed severely depressed systolic function and PAP of 89mmHg.

Several hours later, pt began having contractions. She also developed a new onset thrombocytopenia with platelets of 108 K/uL. Decision was made to transfer her to the hospital where ECMO is available with plan for cesarean delivery. CVP and swan ganz catheter were placed (PAPs were in the 40s-50s). The patient was induced with etomidate and succinylcholine, followed by successful intubation. TEE showed severely depressed RV function with bowing of the atrial and ventricular septum from R to L. She was then preemptively placed on NO. Following delivery, the patient's SBP rapidly declined requiring treatment with epinephrine and vasopressin boluses, followed by an epinephrine infusion. At the conclusion of the case, the NO was discontinued and the patient was successfully extubated. She was discharged on POD 5. Repeat echo showed normal PAP and moderately depressed RV.

Discussion: PHTN presents multiple challenges when present in a parturient. Recent studies report a mortality rate of 12-17%, while older studies show a mortality rate as high as 56%. 2 The poor outcomes in this patient population are the result of the inability of the pulmonary vasculature to respond to the hemodynamic changes of pregnancy. While it is unknown whether our patient actually had PHTN prior to becoming pregnant, her symptoms of worsening dyspnea did not present until the 2nd trimester. In our literature search, data on patients with newly diagnosed pulmonary hypertension first presenting during pregnancy was scarce. Moll et al. published a case report in 2015 on a patient who appeared to develop gestational PHTN in 3 separate pregnancies, which resolved upon termination or delivery. 1 Another article by Limoges et al. questions whether pregnancy may act as a trigger or accelerate idiopathic pulmonary hypertension. 3 In conclusion, PHTN poses a significant risk to the mother and fetus and requires multidisciplinary management during the peripartum period.

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Abstract #:SUN-19

The Challenges of an Emergency Cesarean Section in a Remote Location in a High Risk Cardiac Patient

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Introduction: Peripartum cardiomyopathy (PPCM) is a rare life threatening entity that affects parturients during the last trimester or first few months in the postpartum period. Some of these patients may require intensive monitoring and treatment to prevent further maternal and fetal morbidity, and possible mortality. Medical management of these cases frequently occurs outside of the labor and delivery suites. This places unique challenges on the obstetric, anesthesia and neonatal teams.

Case discussion: An 18 year old G1P0 at 33+6 week IUP was transferred to our hospital for PPCM with shortness of breath and pre-eclampsia. Echocardiogram revealed an EF 25-30% with bilateral pleural effusions. Cardiology was consulted and she was admitted to CCU for medical management and invasive monitoring. The OB plan was to perform a Cesarean section (CS) approximately 48 hours after admission depending on cardiovascular stabilization and betamethasone administration for the fetus. Anesthesia options included either regional or general anesthesia with invasive monitoring. Due to the patient's medical status and remote location in the CCU, a multidisciplinary team was prepared for an emergent CS plan with a bedside CS surgical tray, anesthesia and neonatal supplies and equipment. L&D nursing staff, technicians, pediatricians and anesthesiologists were identified for each shift and briefed on equipment and location. Approximately 40 hours after admission at 0450 am, sudden and persistent fetal bradycardia occurred and a decision to perform an emergent CS in the CCU under general anesthesia was made, within 15 minutes from the time of fetal deceleration. General anesthesia included a rapid sequence induction with Etomidate(20mg), Ketamine(50mg) and succinylcholine(100mg) and atraumatic endotracheal intubation and was maintained on100% oxygen and intravenous propofol(40+40mg), fentanyl(100mg+100mg) and midazolam(2mg+2mg) . A complete placental abruption was identified, and a viable infant was delivered with Apgars of 2 and 7, with a birth weight of 2.01 kg.

Conclusion: In addition to concerns regarding optimal subspecialty management of PPCM for either emergent or elective delivery, the major systems aspect of this patients care was the preparation for an emergent C-section outside of the delivery suite. Cultural, quality improvement, and patient safety initiatives instituted over the past few years provided a framework and awareness of the crucial need to rapidly plan for a potential emergent C-section in ICU settings. Systematic training in six sigma principles and the use of root cause analysis tools allowed for the development of an effective plan with each team rapidly deploying the onsite equipment and supplies necessary for an emergency. Preemptive team planning and communication allowed for the rapid and seamless delivery of care in a coordinated fashion during this crisis situation.

Abstract #:SUN-20

Multidisciplinary Management of Spontaneous Coronary Artery Dissection in a Parturient

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Case: 26 year old G6P5 at 37w5d with no PMH presented via EMS to an outside hospital with lethargy, altered mental status, and syncope. Initial troponin at OSH was negative, but increased to 0.342 ng/mL after 2 hours. EKG was classic for coronary artery dissection. She was transferred to our facility for further evaluation and management. CT chest was obtained to rule out aortic dissection, and TTE showed preserved ejection fraction with no regional wall motion abnormalities. Given hemodynamic stability with no evidence of ongoing ischemia, we proceeded with IOL prior to left heart catheterization (LHC). Left radial arterial line was placed, followed by incrementally dosed labor epidural. Hemodynamic perturbations due to epidural and labor were minimized. She had an uncomplicated vacuum assisted vaginal delivery. LHC on postpartum day 1 showed no evidence of coronary artery disease or dissection; cardiology proposed that a spontaneous coronary artery dissection may have sealed itself off, or the etiology of ACS was an embolic event which resolved. She was discharged on PPD2 on aspirin and metoprolol.

Discussion: Spontaneous coronary artery dissection (SCAD) is a rare cause of myocardial infarction; incidence is around 0.1% (1). Presentation and symptoms are similar to ACS due to ischemia or emboli, however the patient risk factors are different. Risk factors for SCAD include female sex, pregnancy, connective tissues disorders, HTN, vasculitis, extreme physical activity, and illegal drug use (2). Average age of patients with SCAD is 35-40. 70% occur in women (3)—30% during the peripartum period. Incidence of MI in pregnancy is cited as 1 in 16,129 pregnancies; SCAD accounts for 27% of cases (4,5). Coronary angiography, CT scan, echo, and EKG can assist with the diagnosis.

Treatments include stenting, bypass, and medical management (BP control, aspirin, and anticoagulants). It is vital to coordinate plans for LHC and anticoagulation with delivery and anesthetic plans that minimize risk to patient. Despite the rarity of SCAD, providers should maintain an elevated index of suspicion when peripartum patients present with ACS.

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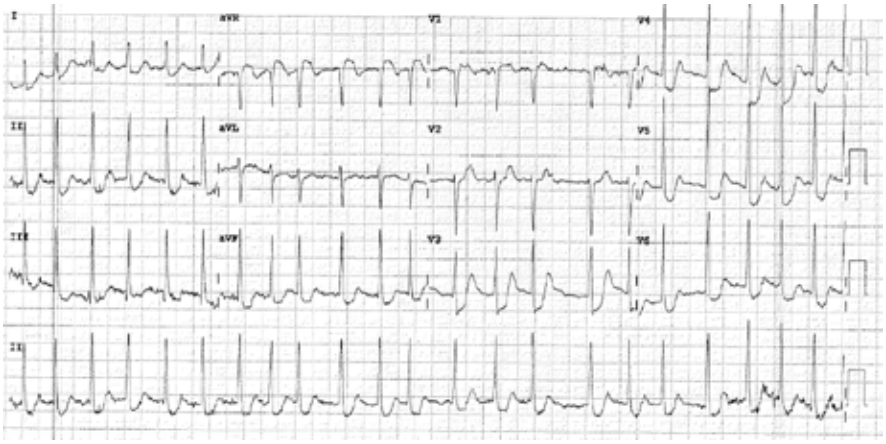

Figure 1. EKG with ST depression I, II, III, aVF, V2-6; ST elevation VI, aVR

Abstract #:SUN-21

Cesaran Delivery on a Parturient With Congenitally Corrected D-Transposition of the Great Arteries, Complicated with Intraoperative Cardiac Arrest and ECMO Initiation

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A 32 year old G6P0140 at 35 weeks gestation with past medical history of congenital D- transposition of the great arteries s/p mustard procedure and morbid obesity, for repeat cesarean delivery secondary to decreased fetal movement. Multidisciplinary management was coordinated among obstetrics, pediatric cardiology, congenital cardiac anesthesiology and obstetric anesthesiology.

Preoperative 2-D echocardiogram showed mildly dilated and hypertrophied right ventricle with moderate systolic dysfunction, VSD, mild tricuspid insufficiency and severe asymmetrical septal hypertrophy. Electrocardiogram revealed normal sinus rhythm. Patient was asymptomatic from a cardiovascular standpoint and had normal functional capacity.

After ASA standard monitors and 2 large bore peripheral IV's were placed, a modified combined spinal epidural technique was performed until a T4 anesthetic level was obtained. 10 minutes after delivery of the infant, the patient became agitated, unresponsive and severely bradycardic. Rhythm acutely changed to PEA and ACLS protocol was initiated. 30 minutes after intubation, copious blood tinged pulmonary exudate was noted, as well as high inspiratory peak pressures. TEE performed at this time, revealed severe systemic ventricular depression, moderate pulmonary ventricle depression and tricuspid regurgitation. Decision was made to initiate VA ECMO.

Patient was successfully weaned from ECMO and decannulated on postoperative day 3. She was extubated on postoperative day 4 without complications and the remaining of her hospital course was uneventful.

Discussion: Mustard operation is a procedure in which an intra-arterial baffle is created to direct pulmonary venous blood to the tricuspid valve and systemic venous blood to the mitral valve. Because the morphological right ventricle acts as the systemic ventricle, right ventricular dysfunction is a common finding among these patients. (1) The ability of patients to tolerate physiologic changes associated with pregnancy and peripartum depends on the severity of RV dysfunction and the presence of concomitant pulmonary hypertension or life-threatening arrhythmias. (1, 2)

The timing of our patient's dyspnea and altered mental status may be consistent with amniotic fluid embolism or pulmonary embolism. We also considered that her symptomatology might have be the result of fluid overload related to the increase in cardiac output that occurs immediately after delivery. Although asymptomatic, she presented with moderate RV systolic dysfunction and might not have been able to accommodate the increase in blood volume, with further dilation and decrease in function. Although less likely, local anesthetic toxicity may also explain her acute decompensation.

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Abstract #:SUN-22

The Peripartum Physician: We Can Offer More than Neuraxial Analgesia

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A 21-year-old woman, G2, P0, at 23 weeks' gestation, with a history of gestational trophoblastic disease with lung metastases, was admitted to the hospital with fever, hyperplasia of her gums, and oral mucosal bleeding and a diagnosis of acute myeloid leukemia (AML). On hospital day 15 the obstetric anesthesiology service was consulted to access the patient's subarachnoid space for intrathecal methotrexate administration in the setting of thrombocytopenia (platelet count 64,000). She was transfused a unit of platelets with a subsequent increase in her platelet count to 84,000, followed by successful dural puncture and deposition of methotrexate into the intrathecal space at the L3-4 interspace with a 22G Whitacre needle. The patient tolerated the procedure well without complication.

Given increasing concern for the development of preeclampsia with severe features, the maternal-fetal medicine service decided to induce labor at 26 3/7 weeks' gestation. At the start of her induction the patient's platelet count was 43,000. The patient was counseled regarding our inability to safely provide continuous epidural analgesia, and after a trial of inhaled nitrous oxide we offered systemic analgesia using continuous intravenous ketamine and remifentanil infusions. After obtaining patient consent, we initiated ketamine (3mcg/kg/min) and remifentanil (0.05mcg/kg/min), and we titrated the infusion rates based on the patient's pain score and sedation level. While sedation scores were not recorded, the ketamine infusion rate was decreased only once during her labor course due to increased somnolence. Her average pain score was a 3/10 and transiently peaked at 6/10 during stage 2, but she tolerated induction and vaginal delivery well and was satisfied with her care.

This case highlights the obstetric anesthesiologist's role as the peripartum physician, and the potential role of continuous remifentanil and ketamine infusions for labor analgesia in patients with a contraindication to neuraxial analgesia. Without sufficient evidence it is difficult to offer a definitive rule for a "safe" minimum platelet count for insertion of a needle into the neuraxis in patients with thrombocytopenia. However, in this case, access to the intrathecal space was necessary for the patient's complete chemotherapy regimen given her aggressive AML. As the peripartum physician most acquainted with the obstetric patient's physiology and potential complications of such a procedure, it is important that obstetric anesthesiologists are involved with the management of critically ill parturients. Finally, our knowledge of analgesic pharmacology is advantageous in offering alternatives to neuraxial analgesia. The use of ketamine and remifentanil infusions, while not standard practice for uncomplicated patients, provides a viable solution to offer effective analgesia and excellent patient satisfaction in patients in whom neuraxial analgesia is contraindicated.

Abstract #:SUN-23

Cesarean Delivery in a Patient with Transverse Myelitis on Anticoagulation

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Co-Author: Colleen Martel MD - Ochsner Clinic Foundation - New Orleans, LA

Introduction: Transverse Myelitis (TM) is an inflammatory disorder of the spinal cord which can occur following the administration of a neurotoxic substance in either the epidural or intrathecal (IT) space. This may lead to varying degrees of motor or sensory dysfunction. We report a case of transverse myelitis with completely recovered symptoms presenting for repeat cesarean delivery (CD).

Case: A 22 year old G4P3 at 39 4/7 presented in labor with a history of 3 prior CDs. Her past medical history includes a seizure disorder from IT digoxin administration with subsequent spinal toxidrome causing TM (during her 3rd cesarean delivery), thrombocytopenia (platelets: 109) and prior DVT (on lovenox 80 BID). Due to her anticoagulation, a GA was performed for a repeat CD. The surgery was uneventful and she delivered a full term infant with Apgars of 8/8. She was discharged home 3 days later in stable condition.

Discussion: While this case was essentially a straightforward quaternary CD, the patient's medical history brought up questions for her current anesthetic plan. During the patient's previous CD, a CSE was placed that did not result in loss of sensation. A single shot spinal was then performed. 90 minutes after the completion of surgery, she was found to be unresponsive with oxygen saturations in the 60s and BP 70/30. She was given narcan with minimal improvement and was subsequently intubated. An MRI/MRA of the head showed cortical ribboning concerning for cerebral vasospasm. It was determined that a drug error had occurred during the initial CSE placement and digoxin was used instead of bupivacaine. She slowly improved and was extubated on POD 9 at which time she was diagnosed with a right lower extremity DVT and put on lovenox. She initially had paralysis of her bilateral lower extremities and was diagnosed with TM but over the course of her stay she developed some movement and was transferred to rehab. Upon discharge, she remained with diplopia but otherwise normal neurologic function.

During her current admission, we performed a GA due to her anticoagulation status. However, the literature is unclear as to whether a spinal or epidural should be offered to someone with preexisting TM. This condition causes demyelination and increased susceptibility to the neurotoxicity of local anesthetics. In our patient, her MRI did not show any inflammation or scarring, although whether her spinal cord receptors were up or downregulated from the injury could not be determined. Due to the complete recovery of her lower extremity function, an epidural may have been considered as an alternative as the safety of neuraxial anesthesia continues to be debated with this disease process.

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Abstract #:SUN-24

Positional Hypotension in HELLP Syndrome

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Introduction: HELLP Syndrome is best known for its mnemonic: hemolysis, elevated liver enzymes, and low platelets (thrombocytopenia). Here we detail a case of HELLP syndrome with positional hypotension heralding one of its most dangerous complications.

Description: A 31-year-old G3P1 at 38 weeks was transferred from an outside hospital with HELLP syndrome. She endorsed 2 weeks of right shoulder pain that she assumed was from her sleep position. She also had right upper quadrant (RUQ) pain, lab evidence of hemolysis, transaminitis (AST 324, ALT 353), and thrombocytopenia (80K). Induction was started with Oxytocin and an epidural was placed.

At 6cm dilation, the patient became hypotensive to 70/30. She responded to fluids, 50-100mcg boluses of phenylephrine, and trendelenberg position. Each time the patient sat up she became hypotensive, nauseated, and the fetal heart rate would decelerate. Pelvic ultrasound was performed but the posterior placental location was difficult to assess for abruption.

An interdisciplinary discussion was held and decision was made for cesarean delivery. While moving from labor bed to OR table, the patient endorsed severe, constant abdominal pain unrelated to contractions.

Upon incision, 1-2L of blood rushed out from the RUQ. The liver bed was packed and Surgery was paged. A healthy neonate (APGARS 7, 8) was delivered. General anesthesia was induced, an arterial line was inserted, and transfusion via massive transfusion protocol was initiated. Rupture of a 21x19x5cm liver hematoma was discovered, and bleeding was controlled. The abdomen was packed and the patient was monitored in the ICU for 2 days until her coagulopathy resolved. She returned to the OR for closure and was extubated without difficulty.

Discussion: Subcapsular liver hematoma in HELLP is rare, with literature reports of < 2% of all cases. The pathogenesis is unclear, and signs and symptoms are nonspecific. Patients may present with RUQ or epigastric pain, nausea/vomiting, or hypotension. Ultrasound can be used for diagnosis, but is often difficult in the gravid patient. Management of stable patients is mostly conservative with close monitoring, fluids, and treatment of underlying HELLP/pre-eclampsia. Hepatic artery embolization can be utilized if the patient is hemodynamically unstable. Surgery is usually required. Uncontrollable bleeding from rupture can precipitate other complications such as disseminated intravascular coagulopathy, acute liver failure requiring transplant, and acute kidney injury.

Conclusion: This case discusses a rare complication of HELLP syndrome heralded by non-specific, persistent, and positional hypotension. Liver subcapsular hematoma rupture, although rare, should be on the differential for HELLP patients with RUQ pain and unexplained hypotension.

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Abstract #:SUN-25

Anesthetic Management of an Obstetric Patient with Lymphangioleiomyomatosis

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We present a case report of a 33 year old G1P0 at 37 weeks who arrived for induction of labor due to chronic placental abruption. Her past medical history includes lymphangioleiomyomatosis (LAM), bilateral renal angiomyolipomas (AML), hypertension, type II diabetes, asthma, transverse myelitis at 13 years old (residual right foot drop), and morbid obesity (BMI 46). Five years prior, rupture of an AML required blood transfusion and embolization; however, the diagnosis of LAM was not confirmed until she presented with hemoptysis in the 1st trimester of this pregnancy. Imaging confirmed multiple thin-walled cystic lesions throughout the lungs. During the 2nd trimester, she presented for another embolization of her renal AMLs due to concern for rupture of a rapidly enlarging AML (largest was 18 cm). Of note, she had a possible cortical tuber on a MRI Head scan, although genetic testing for tuberous sclerosis was non-diagnostic. After a multidisciplinary meeting, the plan was to have packed red blood cells typed and crossed, standard monitoring, additional peripheral IV access, and a labor epidural for pain control and hemodynamic stability. She was subsequently diagnosed with severe preeclampsia during her induction and was started on IV magnesium therapy. The remainder of her labor progressed uneventfully. She delivered vaginally, a healthy baby boy without any further interventions and was discharged on postpartum day 2.

Lymphangioleiomyomatosis (LAM) is a rare disorder resulting from abnormal smooth muscle proliferation in the lung, kidney, and axial lymphatics. Cystic destruction of the lung with progressive pulmonary dysfunction and the presence of abdominal tumors (eg. angiomyolipomas, lymphangioleiomyomas) characterize the disease. LAM typically occurs in premenopausal women, suggesting some involvement of hormones in disease pathogenesis. Thus, pregnancy may be advised against due to the possibility of disease exacerbation. Additionally, about 30% of patients diagnosed with tuberous sclerosis, a genetic disorder that results in benign tumor growths, have LAM. Patients are at increased risk for pneumothoraces, lymphatic obstruction, hemorrhage from blood vessels due to increased blood volume in pregnancy, and neurologic complications if the central nervous system is involved.[1] This case report highlights the importance of prior imaging and a multidisciplinary approach to management of a patient with a complicated and rare disease.

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Abstract #:SUN-26

Successful Delivery in a Parturient with Aortic Aneurysm and Chronic Stanford Type B Aortic Dissection

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We present an otherwise healthy 28-year-old who was diagnosed incidentally four years prior on CXR. It was surmised that the dissection occurred peripartum during her first pregnancy six years prior which was uncomplicated and ended with a normal vaginal delivery facilitated by epidural anesthesia. Pre-pregnancy MRA demonstrated an aortic dissection beginning distal to the left subclavian artery, causing descending aortic arch dilation to 46 mm; a separate abdominal aortic dissection identified at the level of the diaphragm continued caudally to the level of aortic bifurcation.

The patient presented after a positive home pregnancy test and underwent multidisciplinary evaluation by obstetrics, MFM, cardiac anesthesiology, and CT surgery. Maternal echocardiogram performed at 12 gestational weeks showed normal valvular and ventricular contractile function. No acute pathology or interval growth was demonstrated on MRA at 14 gestational weeks.

At 37 weeks and 0 days, the patient was admitted for a scheduled primary cesarean delivery to be conducted in the cardiac OR. A pre-spinal arterial line was placed with local anesthesia. A single-shot L3-L4 spinal anesthetic delivered 1.6mg bupivacaine, 0.1 mg preservative-free morphine, and 10 mg meperidine. General anesthesia would be induced for decompensated hemodynamics or if the patient demonstrated symptoms of aortic rupture or progressing aortic dissection. TEE was available in the OR. Cardiopulmonary bypass and the CT surgery team were immediately available on standby.

By titrating phenylephrine and nitroglycerin infusions, hemodynamic parameters were successfully kept within a range of SBP 90-110 mm Hg. A vigorous female infant was delivered. The remainder of the operative course was uneventful and the patient was transferred to the CTICU. On postpartum day 1, CT angiogram showed an interval increase in size of the aorta aneurysm from 46 to 50 mm in maximal diameter. The patient was monitored overnight and considered safe for transfer to the postpartum floor on POD 2.

Discussion: The absence of connective tissue disorders, vasculitis, familial aortic disease/premature death in this patient highlights the heterogeneity of aortic disease and the inherent risks associated with pregnancy. Providers should have a lower threshold for diagnostic testing in pregnant or postpartum patients than in non-pregnant women of similar age. The exact mechanisms by which pregnancy and the postpartum state increase the risk of aortic complications are unclear--increases in heart rate, stroke volume, cardiac output, and left ventricular dimensions occur in the presence of gravid uterus compression. This accumulation of forces may mediate the increased risk of aortic complications in pregnancy. Hemodynamic changes require 3-6 months to return to pre-pregnancy levels; as such, our patient will continue to be monitored closely as an outpatient, and is planned to undergo prompt multi-staged surgical aortic repair.

Abstract #:SUN-27

Delayed Postpartum Hemorrhage Secondary to Ruptured Uterine Artery Pseudoaneurysm

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Rapid diagnosis and early treatment of postpartum hemorrhage (PPH) is critical. Secondary PPH, occurring 24h after delivery, is commonly caused by retention of products of conception (POC) but vascular anomalies such as arteriovenous fistula or pseudoaneurysms can also be responsible. We describe the case of a primiparous patient who presented to the ED with severe PPH and syncope 16 days after cesarean section (CS) secondary to uterine artery pseudoaneurysm rupture (UAPR).

Case Presentation: A 23-year-old woman (gravida 1, para 0) underwent primary CS at term for arrest of descent in labor after an otherwise uneventful pregnancy. Immediate postoperative course was complicated by PPH of 800 ml, requiring administration of uterotonics, temporary placement of intrauterine tamponade balloon and extensive resuscitation with blood products. Urgent CT demonstrated an organized clot in the endometrial canal. She was stabilized in the SICU and discharged on POD 5.

She was re-admitted 16 days later with brisk vaginal bleeding. Physical exam revealed a low transverse CS incision appearing clean and dry. Her uterus was well-contracted. Bedside ultrasound showed a normal uterine stripe without evidence of POC. Labs were notable for severe anemia (Hb 6 from 9.3 g/dL). Profuse vaginal bleeding continued despite aggressive resuscitation. Anesthesiology was consulted to guide transfusion with the use of rotational thromboelastometry, which was normal with regards to clotting time, clot strength, and fibrinolysis. EBL was 4.5 L requiring massive transfusion. In view of her history, an alternative cause of bleeding was sought; interventional radiology (IR) was consulted and a pelvic angiography revealed a distal left uterine artery branch pseudoaneurysm that was successfully occluded by transarterial embolization. Post-embolization angiogram demonstrated a loss of blood flow to the pseudoaneurysm. The patient had complete resolution of her symptoms with no surgical exploration required.

Discussion: This patient's immediate PPH placed her at greater risk for secondary PPH. The rate of UAPR as a cause for secondary PPH has been cited as 3% and only after uterine trauma (1). However, it has been countered that UAPR occurs much more frequently, often going unrecognized as a cause for PPH. Furthermore, it can occur after non-traumatic vaginal delivery (2). The exact frequency and associated risk factors for UAPR have yet to be identified—until then, it is of utmost importance that clinicians recognize UAPR as a potential cause for secondary PPH so as to provide timely diagnostic therapy and avoid unnecessary surgical procedures.

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Abstract #:SUN-28

Epidural Analgesia and Anesthesia in a Parturient with Factor V Deficiency: A Case Report

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Introduction: Factor V deficiency, also called parahemophilia, is a rare coagulopathy that poses an anesthetic challenge. We discuss the peripartum management of a parturient with Factor V deficiency.

Case Report: A 27-year-old G2P0100 presented for anesthesia consultation at 31 weeks and 6 days in the setting of congenital Factor V deficiency. She had no history of severe bleeding and Factor V activity level was 34%. Hematology recommended a Factor V activity level of 50%, the lower limit of "normal", prior to neuraxial technique placement.

At 38 weeks and 6 days, our parturient presented for a planned induction of labor. After transfusing five units of fresh frozen plasma (FFP), Factor V activity reached 55% and a lumbar epidural catheter was placed. After 24 hours, her epidural catheter failed. Factor V activity was 43%, so another unit of FFP was given prior to catheter replacement.

On day four after induction of labor, the decision was made to perform cesarean delivery due to arrest of cervical dilation at 5cm. Factor V activity was 36% but FFP was not administered because she complained of shortness of breath which was concerning for volume overload. The patient delivered a healthy girl under epidural anesthesia and estimated blood loss was 700mL.

On the first postoperative day, Factor V activity again dropped to 34%. Platelets were used as a lower-volume alternative to FFP but failed to increase Factor V activity level. FFP was then transfused and the epidural catheter removed without any neurological sequelae.

Discussion: There are no guidelines to determine the safety of placing a neuraxial technique in Factor V deficiency. The only available case series of 5 parturients suggests that it may be safe if Factor V activity is ≥60%.[1] Factor V, which has a half-life of 12-36 hours, is not commercially available as a concentrate; it is primarily replaced by transfusing FFP.[2] Alternatives include platelets, recombinant Factor VII concentrate, anti-fibrinolytics and exchange transfusion. Transfusions carry risks of hemolysis, TRALI, TACO, anaphylaxis and infection.

In a previous case report, neuraxial analgesia was not offered when Factor V activity was 4%, which was associated with severe bleeding symptoms.[3] Certainly, we would not place a neuraxial technique in these settings either. However, that our parturient achieved adequate postpartum hemostasis despite Factor V activity in the 30% range suggests that repeated FFP transfusions might have exposed her to unnecessary risk with no benefit.

The important teaching point from our case is that the trend in Factor V activity levels combined with clinical presentation, rather than a single snapshot value, should be used to determine the safety of placing a neuraxial technique in the parturient with Factor V deficiency.

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Abstract #:SUN-29

Anesthetic Management of a Parturient with Tetraplegia for External Cephalic Version and Subsequent Cesarean Delivery: A Case Report

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Introduction: 85% of patients with spinal cord injury above T6 have autonomic dysreflexia (unopposed sympathetic discharge below injury) (1). It can be elicited by distention of the bladder, colon, or onset of uterine contractions. We present a parturient with severe autonomic dysreflexia from an incomplete C5-7 spinal cord injury for external cephalic version and subsequent C/S.

Case report: A 28 y/o G2P0, 37 1/7 wk female (BMI 28.8 kg/m2) presented with pyelonephritis and category 2 FHR trace for IV antibiotic therapy. PMH included C5-7 incomplete spinal cord injury with quadriplegia, severe autonomic dysreflexia, neurogenic bladder, decubitus ulcers, neurogenic diabetes insipidus, depression, and asthma. She developed FHR decelerations, necessitating expedited delivery and since her fetus was transverse lie, external cephalic version followed by induction of labor was planned. C/S would follow a failed version. After placing a combined spinal/epidural (CSE) (intrathecal bupivacaine 2.5 mg, 5 mcg sufentanil) and gentle abdominal pressure, the FHR dropped. A right radial artery catheter was placed and an urgent C/S commenced using epidural anesthesia. An epidural infusion (bupivacaine 0.125%, fentanyl 2 mcg/mL) provided postoperative analgesia.

Discussion: Uncontrolled autonomic dysreflexia can lead to intracranial hemorrhage, seizures, MI, pulmonary edema, coma and death (2). Severe hypertensive episodes may compromise uteroplacental perfusion but neuraxial anesthesia can blunt hypertensive responses and increase the success rate of ECV (3). Urgent C/S may become necessary (fetal intolerance, placental abruption, onset of labor) so our anesthetic plan consisted of CSE using a small spinal dose of bupivacaine and sufentanil for ECV, reserving the epidural for labor or subsequent C/S. Since spinal anesthesia for C/S may cause severe hypotension, an epidural permits slow titration and minimal hemodynamic fluctuation. One can monitor disappearance of spastic paresis, quality of BP control, and temperature changes to assess neuraxial anesthetic efficacy (4). Pin prick assessment was adequate in our patient. Since no method of anesthesia is completely effective in abolishing autonomic dysreflexia, we placed an arterial catheter and had short acting agents (nitroprusside, nitroglycerin, labetalol, nicardipine, phenylephrine, ephedrine) available to treat BP swings. Neuraxial anesthesia may not be possible in many spinal cord injured patients (spinal stabilization procedures, obliteration or scaring of epidural space) so general anesthesia with the associated risks of aspiration, possible difficult intubation, acute hyperkalemia from succinylcholine, and transfer of medications to the fetus, may be necessary. A low dose epidural infusion minimizes pain and uterine cramping in the postpartum period.

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Abstract #:SUN-30

Acute Pulmonary Edema after Electroconvulsive Therapy in a Third Trimester Patient

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Case: 35-year-old Caucasian female, G3P1011 at 31w1d GA was admitted with acute bipolar mania with suicidal ideations, tangential thought processes and mood lability. She was transferred to our institution for electroconvulsive therapy (ECT) treatments. She had history of bipolar disorder and had been effectively managed with aripirprazole and atomoxetine, though this was discontinued when she became pregnant to avoid fetal exposure. ECTs were planned in the labor and delivery ORs with continuous fetal heart tone (FHT) monitoring, general anesthesia with endotracheal intubation, and OB physicians on standby in case of an emergency. Following induction and intubation, the first ECT treatment was complicated by severe hypertension (HTN) after the seizure was initiated (peak BP 210-230 / 110-120), prolonged seizure duration (218 sec) that required IV midazolam 2mg to terminate, and prolonged FHT deceleration that almost prompted emergent cesarean delivery. After delayed emergence, she experienced prolonged post-ictal delirium, persistent coughing episodes and hypoxemia (SpO2 ~88-90%) on 6-10 LPM facemask O2. Pulmonary edema was confirmed by bilateral rales and CXR. Furosemide 10mg improved symptoms. The energy was reduced for subsequent ECT treatments, resulting in shorter seizure durations. No further episodes of FHT decelerations or respiratory complications occurred, though she did continue to have hemodynamic lability despite pre-treatment with anti-hypertensives and varied induction agents. Her mood and other symptoms improved after five ECT procedures, and no further procedures were scheduled given this improvement and the potential risks of undergoing further ECTs.

Discussion: ECT offers an effective non-pharmacologic option for pregnant patients requiring treatment of bipolar disorder.1 Coordination of care with the psychiatry and OB physicians, as well as readiness for potential cesarean delivery after fetal viability are paramount. Providers should be aware of commonly reported complications of ECT during pregnancy: FHT decelerations, preterm labor, uterine contractions, vaginal bleeding, abdominal pain, abruption, and arrhythmias.2,3

Pulmonary edema is a rarely reported complication of ECT, and we are not aware of any previous reports of this complication in pregnant women. Previous reports have attributed pulmonary edema after ECT to severe HTN during the procedure,4,5 which likely occurred in our case as well. However, others have reported neurogenic pulmonary edema, cardiogenic pulmonary edema, and negative pressure pulmonary edema after ECTs.6 Regardless of the exact etiology, it is critical that the anesthesiologist to maintain a high degree of clinical suspicion to promptly diagnose and treat this life-threatening complication.

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Abstract #:SUN-31

Timing of neuraxial anesthesia initiation in an obstetric patient presenting with antithrombin III deficiency and pre-eclampsia

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Introduction: Inherited antithrombin (AT) III deficiency is a rare autosomal dominant disorder with an incidence of 1:2,000-5,000 individuals. Antithrombin acts as a serine protease inhibitor mainly inactivating thrombin and factor Xa and its effect is accelerated 5,000-40,000 times in the presence of heparin. The risk of a thrombembolic event among women with AT deficiency is estimated at 60% during pregnancy and 30% in the puerperium. The use of plasma derived AT III during pregnancy and delivery is well described, however limited information is available on patients with ATIII deficiency on plasma-derived AT III and preeclampsia with thrombocytopenia in need of neuraxial anesthesia.

Case: A 29yo G1P0 at 37 weeks and 5 days gestation with a history of ATIII deficiency was admitted for induction of labor. Long term anticoagulation with warfarin was stopped at the onset of pregnancy and substituted with LMWH 80mg SC BID. She presented with moderately increased blood pressure (136/86mmHg), thrombocytopenia (110k/µl) and a 24hr urine protein of 311.7mg. AT III activity on admission was 35% (normal 80-120%). Replacement with plasma derived anti-thrombin was initiated and 12hrs after the first maintenance dose the AT III activity increased to 82%. On hospital day 3 platelet count had further decreased but stabilized at 91k/µl and AT-III activity had reached goal at 118%. In anticipation of a further decreasing platelets the decision was made to place an epidural catheter. Later that day, decelerations were noted requiring Cesarean section. The existing epidural catheter was used to provide for an adequate surgical level. The Cesarean section was completed uneventfully, and the epidural catheter was removed 2hrs post-op. LMWH 80mg SC QD was restarted on post-operative day (POD) 0 and was adjusted to therapeutic 120mg SC QD once postdelivery vaginal bleeding stopped on POD1.

Discussion: The case combined the clinical challenges of inherited AT-III deficiency and preeclampsia with a down-trending platelet count. Sufficient data and treatment guidelines are available for pregnant patients with AT-III or pre-eclampsia, however when faced with a combination of these two clinical scenarios there is very limited information guiding management. The patient's AT-III deficiency was stabilized with recombinant human anti-thrombin, however platelets were downtrending and stabilizing around 90k/mm3. An "early" epidural was placed, in expectation of further declining platelets. Successful epidural analgesia for labor and subsequent urgent Cesarean section was accomplished without complications.

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Abstract #:SUN-32

From the Dimple to Delivery: A Case Report of Labor Analgesia in Patient with Suspected Spinal Dysraphism

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Case Report: 22-yo G1P0 admitted for induction of labor for severe preeclampsia was requesting labor epidural. Medical history was unremarkable; however, on exam, sacral dimple with hair tuft was identified (Fig1A). Upon questioning, she reported left foot paresthesias and inability to dorsiflex left foot since childhood that was never investigated.

Given strong suspicion of spinal dysraphism and lack of spine imaging, remifentanil was initiated rather than neuraxial analgesia. Continuous oxygen saturation, noninvasive blood pressure, respiratory rate, and pain scores were monitored. She delivered vaginally a healthy neonate 6 hours later.

Spinal dysraphism of S2-S3 with dermal sinus extending from S3 level, low-lying conus with tip at L5, and thickened nerve roots from inferior L3 thru L4-5 were diagnosed on lumbar MRI 2 days postpartum (Fig1B).

Discussion: Our patient had occult spinal dysraphism, a disorder in which neurologic signs/symptoms (left foot paresthesias and inability to dorsiflex left foot in this case) or dyschromic areas on the skin or hair puffs (our patient had both) are associated with lumbar or sacral posterior bony anomalies (1). Spinal dysraphism refers to a group of disorders of the vertebral arches, spinal cord, and meninges. It includes a range of conditions, such as myelomeningocele, spina bifida occulta, and occult spinal dysraphism. Of concern regarding neuraxial anesthesia in spinal dysraphisms are structural and vascular abnormalities, abnormal spinal cord anatomy, and low-lying spinal cord. These abnormalities may make epidural space identification more difficult and increase risk of dural puncture, incomplete analgesia or block failure, and unpredictable spread of drug solution (2). Cases have been reported of temporary and permanent neurological deficits after uncomplicated lumbar neuraxial placement in patients with undiagnosed spinal dysraphism (3,4).

Fig1A. Sacral dimple with tuft of hair (seen while patient positioned for labor neuraxial procedure); CSE was not placed.

Fig1B. Spinal dysraphism of S2-S3 with dermal sinus extending from the S3 level (left red arrow), low-lying conus with tip at L5, thickened nerve roots extending from inferior L3 thru L4-5 level (right red arrow)

Conclusion: With high clinical suspicion of spinal dysraphism, as was the case with our patient once her lower back was examined, MRI should be considered, especially if sensory/motor abnormalities, limb deformities, and midline cutaneous abnormalities are present. If active labor precludes obtaining MRI, strongly consider other analgesics, such as remifentanil, to avoid possible complications associated with neuraxial procedures.

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Abstract #:SUN-33

Challenges in the management of an obstetric patient with familial periodic paralysis-when the story does not match the clinical picture

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Periodic paralysis (PP) is a set of genetic conditions characterized by episodes of muscle weakness and potential paralysis in the setting of various triggers. Two subclasses can be distinguished by the serum potassium (K) levels during these attacks: hypokalemic (hypok) PP (estimated prevalence of 1:100,000) and hyperkalemic (hyperk) PP (prevalence of around 1:200,000).

A 36 YO G1P000 was admitted at 39 weeks for scheduled C-section for breech presentation. She stated she has a history of hypokalemic familial PP. She reported daily episodes of upper (UE) and lower extremity (LE) weakness, often resolving with PO intake such as juice or bananas. Once or twice a year she would experience severe paralysis often related to episodes of a respiratory or GI illness. She was prescribed acetazolamide for more severe episodes. On the day of admission she was appropriately NPO, labs were notable for K of 4.6 mmol/L. She had no neurological deficit, strength 5/5 in UEs and LEs.

The patient received a standard spinal (L3-L4 level,1.2 mg hyperbaric bupivacaine +15 mcg fentanyl +100 mcg hydromorphone). T4 sensory level was confirmed. Intra-op she reported feeling weakness in her UEs, and the exam revealed 4+/5 strength in both proximal and distal UEs muscles. As spinal anesthesia was a confounding factor and the patient was stable, labs were sent without starting K supplementation. One hour post-op the patient reported worsening weakness in her UEs and LEs. K came back at 5.5 mmol/L. The exam revealed 3/5 strength in UEs and 2/5 in her LEs, with the weakness more evident in proximal muscle groups. 5 hours post-op her exam showed mildly improved strength and repeat labs revealed a K of 3.8 mmol/L. Per Neurology's recommendations the patient received acetazolamide 125 mg PO X1.

Upon reviewing her symptoms, labs, and family history, the anesthesia team felt that the patient likely has the hyperk rather than hypok form of PP. The combination of NPO status, peri-operative hypothermia, and the stress of delivery led to symptoms. Our suspicion was shared with the patient during her episode and was confirmed on POD 1 after the she contacted another family member with the condition who stated they indeed have the hyperk form.

Of note, acetazolamide has been reported as treatment in both hypo and hyperkalemic PP.

On POD 1 she was tolerating POs and reported increased strength. She had 5/5 strength in her LEs and 4+/5 in UEs. K was 3.4 mmol/L. She had an otherwise uneventful post-operative course leading to discharge on POD 4.

In conclusion, we report a case of obstetric anesthetic management in a patient with hyperkalemic PP, although she reported a history of hypokalemic PP. A thorough history and knowledge of the subtle differences in these two subtypes, as well as vigilant monitoring of symptoms and electrolytes lead us to avoid unnecessary and potentially dangerous K supplementation, establish the diagnosis and redirect treatment

Abstract #:SUN-34

Parturient with Delta Granule Platelet Storage Pool Disorder

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An 18 y.o. G1P0, 40w0d parturient presented for obstetric anesthesia consultation for history of delta platelet storage pool disorder and hypermobility type Ehlers-Danlos syndrome. Significant bleeding with prior surgical procedures was documented. Hematology consultation and workup resulted in a diagnosis of "very severe deficiency" of delta granules.

Platelet storage pool disorder (PSPD) is a group of inherited defects in platelet granules associated with a wide spectrum of bleeding diathesis and reduced platelet aggregation (2). Granules are the small sack-like bodies inside platelets that contain adhesive proteins (alpha granules), or ADP, ATP, pyrophosphate, serotonin and calcium (delta granules) (4). Platelet activation causes release of the granular proteins, allowing further platelet recruitment and aggregation. In PSPD, the granules can be absent, reduced in number, contain an inappropriate ratio of the above compounds, or fail to release their contents into the bloodstream (2). Patients typically present with excessive bleeding in the setting of normal PT, aPTT, and platelet count (2). PSPD is diagnosed based on the following laboratory findings: decreased or absent dense granules on electron microscopy, prolonged bleeding time, abnormal platelet aggregation studies, and abnormal ADP/ATP ratio (4).

Few reports of safety with neuraxial anesthesia in PSPD patients exist. Hematology assessment of the severity of the patient's PSPD is vital to plan for labor and delivery. Prophylactic administration of desmopressin and platelet transfusions are frequently required prior to a scheduled surgery or invasive procedure. Post operative antifibrinolytics are also used (2). In our patient, hematology recommended one unit of platelets prior to cesarean delivery, and transexamic acid 1300 mg po TID x 5-7 days postpartum.

Parturients diagnosed with PSPD create challenges for the obstetric anesthesiologist. Due to the small numbers of published case studies in patients with this disease, there exists an unknown risk of bleeding. Prominent bleeding can also be seen with Ehlers-Danlos Type 3 or hypermobility type (5). Our patient was scheduled by the obstetricians for induction of labor at 40w+0d. Remifentanil PCA was used for pain control during her labor contractions.

Cesarean delivery via general anesthesia was ultimately performed due non-reassuring fetal wellbeing. This parturient had an uncomplicated perioperative course and delivered a baby girl infant with APGAR scores of 9 and 9.

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Abstract #:SUN-35

Postpartum Headache: When An Epidural Blood Patch Is Not Enough

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Introduction: Headache is a common occurrence in the postpartum period. While the etiology of postpartum headache may be benign, a full differential diagnosis must be elicited to rule-out life-threatening processes. The incidence of cerebral venous sinus thrombosis (CVST) is 8.9 per 100,000 deliveries and can carry a 7% mortality. The pathophysiology is thought to occur from a two-hit phenomenon. First, damage to venous sinuses due to intracranial hypotension. Second, increased thrombotic tendency such as the hypercoagulable state of pregnancy as well as hereditary disorders of coagulation are thought to contribute to this process.

Case Description: 25-year-old G3P2002 parturient received an epidural for labor analgesia. The placement required two attempts, but was successfully placed at the L3-L4 level. There were no complications noted during the placement and good analgesia was achieved. The remainder of the patient's labor was uneventful and vaginal delivery ensued.

On postpartum day 1, the patient complained of a positional headache. An anesthesiology consultation was obtained and post-dural puncture headache was diagnosed. Management included caffeine pills and cosyntropin. Additionally, an epidural blood patch (EPB) was offered, but was declined and she was subsequently discharged home.

The patient returned to the emergency department on postpartum day 3 with complaints of positional headache. An EBP was performed with resolution of headache and the patient was discharged home. During the follow-up phone call the next day, the patient endorsed return of the positional headache. She returned to the hospital where a second EBP was performed, but with unsuccessful relief of headache. Additionally, during this second admission, the patient's blood pressure was noted to be elevated. Magnesium was administered to address possible pre-eclampsia.

An MRI was obtained, the preliminary results of which were interpreted as normal; however, the final result of the MRI was subsequently significant for CVST. The patient's neurological status had worsened as a syncopal vs seizure event occurred. The patient was transferred to ICU and was started on a heparin infusion. Over next two days, the patient improved and she was discharged home on warfarin.

Conclusion: Although rare, CVST should be considered in any postpartum patient presenting with headache due to the high morbidity and mortality if left untreated. A thorough clinical evaluation coupled with a high degree of suspicion should arise for patients presenting with refractory postpartum headache following epidural blood patch.

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Abstract #:SUN-36

Thrombosed mechanical heart valves requiring emergent cesarean delivery and extracorporeal membranous oxygenation

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Mechanical heart valves in pregnancy are associated with significant complications for the mother and fetus. Warfarin provides more reliable anticoagulation but is associated with high rates of fetal loss and embryopathy. LMWHs have a lower risk of fetal teratogenicity but are difficult to dose given changing pharmacokinetics throughout pregnancy. The risk of thrombosed mechanical heart valves should be considered in pregnant patients even on anticoagulation.

We present a 35 year old G3P2 at 28 weeks gestation with a history of rheumatic fever who previously had mechanical mitral and aortic valve replacement in 2008 that presented for worsening shortness of breath. She had been transitioned during her pregnancy from warfarin 5 mg PO daily to enoxaparin 60 mg SQ every 12 hours during her pregnancy for anticoagulation but admitted to being off anticoagulation for 1 week approximately six weeks prior to her presentation. Labs and imaging were consistent with acute congestive heart failure. TTE showed elevated mitral and aortic valve gradients, pulmonary hypertension, and global hypokinesis. She quickly decompensated requiring bi-level ventilation and vasopressors.

Because of her tenuous cardiopulmonary status, she was brought to the OR where the cardiothoracic surgery team placed femoral cannulas for urgent V-A ECMO if needed. After appropriate central and arterial access, she underwent a RSI with intubation using a Glidescope with pink frothy sputum noted. TEE evaluation was limited by valve artifact but did show EF 20-25% with severely restricted motion of the aortic valve leaflets. She underwent a cesarean delivery and then became more hypotensive despite vasopressor support and was subsequently placed on ECMO.

In order to visualize the valves better, a cardiac catheterization occurred on PPD 1 that confirmed a normal functioning mechanical mitral valve but fixed aortic valve leaflets. On PPD 2, she underwent an open AVR on CPB, mitral valve thrombectomy, and ECMO decannulation.

Discussion: This case highlights the challenges of mechanical heart valves in pregnancy and the requirement to have delivery of the fetus at an institution capable of ECMO given the risk of worsening cardiac function of the mother. It also draws attention to the need for a multidisciplinary approach to managing anticoagulation in patients with mechanical heart valves early in the pregnancy given the risks to both mother and fetus. The ACC/AHA guidelines suggest continuing low dose warfarin throughout pregnancy given the lower risk of thromboembolic complications as well as the difficulty dosing LMWH, however, this has to be weighed against the possibility of fetal loss.

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2. Halldorsdottir et al. Int J Obstet Anesth. 2016. May;26:75-8.

.Abstract #:SUN-37

A case of ventricular assist systems as a bridge to myocardial recovery in the therapy of drug treatment resistant peripartum cardiomyopathy

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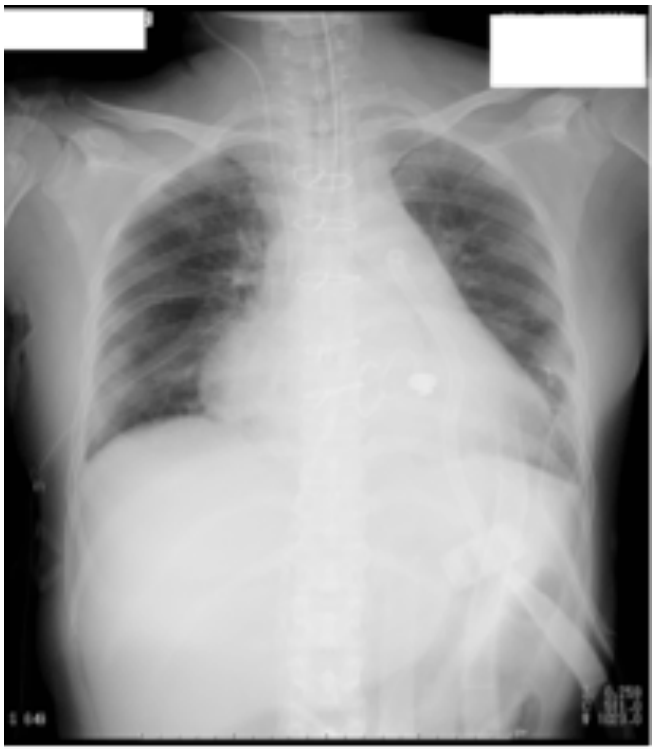
Introduction: Peripartum cardiomyopathy is an uncommon form of heart failure that happens during the last month of pregnancy or up to five months after giving birth. Ventricular assist device (VAD) is effective therapeutic option for end-stage heart failure patients as a bridge to cardiac transplantation and also has been drawing attention as a new therapeutic strategy that augment myocardial recovery and regeneration while supported by the VAD. In this case we implanted VAD in order to assist cardiac circulation and in anticipate of myocardial recovery. We will report the whole process and details of the course of VAD treatment for drug treatment resistant peripartum cardiomyopathy.

Case description: Thirty nine weeks G6P5 44-year-old female patient was admitted to our hospital intensive care unit because of severe peripartum cardiomyopathy (TTE; LVDd/Ds 62/52mm, LVEF 33%). Despite drug treatment with Bromocriptine, intra-aortic balloon pumping (IABP) and percutaneous cardio-pulmonary support, she had a persisting low cardiac index and a left VAD was implanted. And then a right VAD implantation has been needed. In the months following implantation the ventricular systolic function improved. She withdrew from VAD under IABP support on the 40th postoperative day, and withdrew IABP 6th days later. After that, she moved to regular floor with oral treatment of ACE inhibitors, β blockers, and diuretic and Cardiac function improved TTE; LVDd/Ds=48/33mm,LVEF=61%). About 5 months after the onset of heart failure, patient was discharged home.

Conclusion: We report a patient who received mechanical circulatory support and save her life. We suggest that for the case of drug treatment resistant peripartum cardiomyopathy, VAD support is an effective therapy in order to augment myocardial recovery and regeneration.



Abstract #:SUN-38

Safe and successful: labor analgesia for a rare case of congenital factor XIII deficiency

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Case: 33 y/o G5P0130 with a history of congenital factor XIII-B (FXIII) deficiency presented for induction of labor (IOL) at 39w1d gestational age (GA). She was followed closely by hematology and obstetrics given multiple miscarriages and a 25-week fetal demise likely due to her FXIII deficiency. Given this history, the frequency of her FXIII infusions were increased from monthly to every 2 weeks during IVF treatments and pregnancy (see table). Monthly FXIII trough levels were followed until 36 weeks GA, and the FXIII concentrate dose was adjusted based on these results (see table). At 36 weeks GA, FXIII dosing was increased to weekly intervals and weekly FXIII peak levels were assessed so that any necessary dosing adjustments could be made prior to IOL.

IOL was scheduled at 39 weeks GA to ensure that a dose of FXIII could be administered the day before delivery. An epidural catheter was placed uneventfully and provided effective labor analgesia. Estimated blood loss at delivery was 400mL. She began oral tranexamic acid on postpartum (PP) day 1 for one week and resumed pre-pregnancy FXIII infusion at 4 weeks PP.

Discussion: FXIII has a long half-life of 9-10 days, promotes fibrin crosslinking and is essential for clot stability, resistance to fibrinolysis, placental adherence and angiogenesis (1,2). Deficiency of FXIII has an estimated incidence of one in a million, and can result in bleeding complications, impaired wound healing, and frequent miscarriage secondary to poor placental adhesion (2-4).

Prophylactic FXIII infusions are recommended for to ensure successful pregnancy in these patients. Given the rarity of the disease, the optimal type, dose, and frequency of factor infusion are unclear and often rely on individual clinicians' experiences. Literature suggests to maintain FXIII trough levels >10% during pregnancy and >20% for delivery (3,4). Given her obstetric history, higher FXIII levels were targeted (>20% during pregnancy; >30% for delivery) and ultimately this approach led to a successful outcome.

With recent peak FXIII levels ~100%, it was felt that her bleeding risk was minimal and safe epidural placement could be accomplished. To our knowledge, only one other case of neuraxial anesthesia in a parturient with FXIII deficiency has been reported (5).

Gestational Age (weeks)	*Pre-pregnancy*	*5*	*6*	*12*	*16*	*20*	*24*	*28*	*30*	*32*	*36*	*36*	*37*	*38*	*39w1d (IOL & delivery)*
Factor XIII Level (%)		50% (Drawn 1 week after Factor XIII concentrate infusion)	27% (trough)	38% (trough)	33% (trough)	31% (trough)	30% (trough)	21% (trough)	105% (peak)	28% (trough)	25% (trough)	66% (peak)	70% (peak)	116% (peak)	
Factor XIII Concentrate Dose & Frequency	35 IU/kg every month; increased to 35 IU/kg every 2 weeks when undergoing IVF	40 IU/kg every 2 weeks						↑ to 60IU/kg every 2 weeks (~4000 U)			↑ to 60IU/kg weekly (~4000 U)				4000 U day prior to IOL and next dose 4 weeks PP; also discharged on TXA 1300mg PO tid x 7days

*Goal was to keep Factor XIII level > 20% throughout pregnancy, then > 30% prior to delivery. Given her history of late miscarriage despite factor XIII replacement, aimed for higher trough levels for her.

**Factor XIII trough levels drawn within a day prior to factor XIII infusion; factor XIII peak levels drawn within a day after infusion.

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5. Anaesthesia 2010;65:641-5

Abstract #:SUN-39

Ideal Balanced Anesthetic Technique for Ex Utero Intrapartum Treatment (EXIT) Procedure Performed Due to Severe Fetal Anomalies

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Introduction: The ex utero intrapartum treatment (EXIT) procedure has several stages with sequentially opposing physiologic goals. Prior to fetal delivery the goal is prolonged stable uterine tone; followed by intentional profound uterine atony just prior to and during the hysterotomy and EXIT portion; followed immediately by rapid return to stable uterine tone once the fetus is fully delivered1. An anesthesiologist must meet these surgical goals whilst maintaining maternal hemodynamic stability and adequate anesthesia and analgesia.

Case Report: The indication for performing the EXIT procedure was fetal bilateral cleft lip and cleft palate with severe micrognathia. In the operating theater, two large bore peripheral IVs and an arterial line were placed. The patient received a single-shot spinal containing intrathecal fentanyl and morphine, followed by induction of general anesthesia. Maintenance was via a Propofol and Remifentanil total-intravenous-anesthesia (TIVA) technique. Just prior to hysterotomy the anesthetic was converted from TIVA to an inhalation technique with Sevoflurane titrated to 2 minimum alveolar concentration (MAC) and Nitroglycerin infusion. A Phenylephrine infusion was titrated throughout the case for maintenance of appropriate mean arterial pressures (MAPs) >65. The fetal head and shoulder was delivered and the airway was secured by an ENT surgeon. Upon complete delivery of the now intubated baby, the Nitroglycerin and Sevoflurane were discontinued and the prior TIVA technique was reinstated for the duration of the surgical closure. Total time from hysterotomy to cord clamping and delivery was 6 minutes. Oxytocin infusion and prophylactic intramuscular Methylergonovine were administered with ensuing rapid return of appropriate uterine tone. During the case, maternal MAP deviated less than 10% from baseline and there were no noted fetal hemodynamic or heart rate abnormalities pre or post delivery. The mother was extubated shortly after closure and had an uneventful postoperative stay.

Discussion: The mixed TIVA and inhalation agent with Nitroglycerin techniques were chosen to optimize patient hemodynamics while facilitating EXIT procedure uterine goals. Uterine atony was rapidly achieved with the inhalational agent technique and just as quickly reversed after airway securement and delivery. This mixed anesthetic method appears to have met the goals of ideal conditions for uterine tone, maternal hemodynamic stability, maternal intra and post op analgesia, fetal hemodynamic stability, and minimal contribution to blood loss from atony.

Conclusion: Anesthetic delivery for EXIT procedure by intrathecal narcotic and TIVA followed by inhalational agent plus Nitroglycerin then return to TIVA provides ideal surgical and anesthetic conditions for the EXIT procedure.

Reference:

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Abstract #:SUN-40

'A Curious Case of a Tarlov Cyst'

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Spinal anaesthesia, whilst reliable, has a failure rate of 1-4%.[1] Multiple factors are implicated. One factor described in the literature, but not reported, relates to tarlov cysts. These meningeal cysts are fluid sacs containing cerebrospinal fluid (CSF), predominately affecting the lumbosacral region with a reported incidence of 5-9%[2].

In this case, a 38 year old patient presented for Caesarean section. With appropriate monitoring and access, the patient was seated for spinal anaesthesia. Following standard asepsis precautions, a 25 gauge whittaker needle was inserted between the third and fourth lumbar vertebrae by a Consultant. A good flow of CSF was obtained and standard anaesthetic dose injected containing heavy bupivacaine, fentanyl and morphine. CSF was freely aspirated twice during the injection of anaesthetic confirming needle placement.

Ten minutes later there was a complete absence of sensory or motor block. The same spinal dose was repeated at a space higher with good effect and surgery proceeded uneventfully.

Postoperatively the patient informed us of the presence of tarlov cysts reported on a previous MRI.

This being the cause of the failed spinal is supported by the ability to freely aspirate CSF but complete absence of block despite this. This suggests the anaesthetic mixture never entered the CSF circulation. The solutions injected were checked and cross referenced as standard.

The patient is to have a further MRI due to the potential for failed spinal again in the future.

References:

1. Failed Spinal Anaesthesia: Mechanism, management, and prevention. P.D.W Fettes et al. BJA 102 (6): 739-48 (2009)
2. American Association of Neurological Surgeons (November 2006)

Conflict of interest: None

Disclosures: Consent was given by the patient with regards to this case report

Abstract #:SUN-41

Parturient with systemic lupus erythematosus & acute onset diffuse alveolar hemorrhage

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Systemic lupus erythematosus (SLE) is an autoimmune, chronic inflammatory disease with multisystem abnormalities creating unique anesthetic challenges. Pregnancy in patients with SLE is high risk with known increase in fetal loss, preterm delivery, growth restriction & preeclampsia(1). We present a case of SLE in pregnancy complicated by vasculitis, lupus nephritis and diffuse alveolar hemorrhage (DAH).

An 18 yo nulliparous pt presented to our institution at 29-wks gestation with 4 days of dyspnea, epistaxis, cough, hemoptysis and progressive facial swelling. Pregnancy was complicated by noncompliance and SLE lupus nephritis. Nephritis was diagnosed 1 month prior to her admission with petechial rash & hematuria. Noncompliance with treatment led to further blood transfusions & continued flairs. On exam, she was normotensive, tachycardic, tachypneic with no apparent distress. Her admission ABG: 7.47/34/57 on 2L nasal cannula. Chest x-ray showed bilateral diffuse infiltrates. Bronchoscopy confirmed DAH. ICU care included broad-spectrum antibiotics, azathioprine, hydroxychloroquine, high dose pulse steroids & IVIG.

While in the ICU, non-reassuring fetal assessment was noted on external fetal monitoring. Anesthesia was consulted for possible emergent cesarean delivery. A multidisciplinary team discussed delivery planning. Controlled cesarean delivery under neuraxial anesthesia was preferred to avoid pulmonary hemorrhage from emergent intubation and positive pressure ventilation. Prophylactic administration of lovenox prevented neuraxial anesthesia. Expectant management & conservative measures were employed to improve fetal status, Over the next several hrs, fetal monitoring improved; however, she developed preeclampsia with severe features and required delivery for refractory hypertension. Epidural was placed without incident; a 1590g infant was vaginally delivered.

Clinical manifestations of SLE is heterogeneous; management plan should be tailored. SLE vasculitis with visceral involvement is rare and carries significant mortality. In non-obstetric population, DAH occurs in less than 2% of SLE patients with mortality as high as 70-90%(2). DAH is associated with lupus nephritis occurring in 64-100% of pts with active renal disease(3). New treatment options for lupus nephritis (e.g. IVIG) may affect overall outcome. Risk of hematoma from neuraxial block in presence of systemic small vessel vasculitis is unknown. This case highlights the importance of multidisciplinary, collaborative approach in managing pts with complicated & evolving clinical course.

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Abstract #:SUN-42

Triple Trouble: Successful management of a 28 week parturient with crack cocaine abuse leading to placental abruption, fetal death (IUFD) and disseminated intra vascular coagulation (DIC) using TEG as point of care.

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Introduction: The increased prevalence of cocaine use during pregnancy leads to many perinatal complications that pose an increased challenge to the obstetrician and anesthesiologist (1). We present the successful management of a parturient at 28 week of gestation with recent cocaine abuse, that led to placental abruption , fetal death(IUFD) and dessiminated intra vascular coagulation (DIC) delivered by cesarean section using Thromboelastogram (TEG) as point of care.

Case Report: 32 yr. G7P4A2 at 27w6d gestation was admitted with severe abdominal pain, vaginal bleeding and placental abruption due to recent cocaine/crack use. Patient's past medical history includes subdural hematoma secondary to cocaine use s/p craniotomy, multiple transient ischemic attacks, previous C-section at 33 weeks secondary to placental abruption, poly substance abuse and anemia. Patient disclosed that she used cocaine the previous night. On ultrasound fetal heart tone was not detected and IUFD was confirmed due to placental abruption. Significant laboratory results on admission were Hb 6.2/19, Platelets 67, INR 1.17 and fibrinogen 91. The obstetrician decided to correct the DIC and simultaneously started induction of labor to deliver the baby. Patient received 2u cryoprecipitate, 4 FFP, 6 PRBCs, and 4 platelets during that time. Lab results after 2 hrs. were H/H 5.7/17, Platelets 26, INR 1.22 and fibrinogen 90 and at 6hrs H/H 6.7/20.4. Platelets 101. INR 1.14 and fibrinogen 114. Since the induction was not successful, decided to proceed with Cesarean section. TEG was done to assist further management and the result showed, R 4.4(N 5-10), K 2(N 1-3),Angle degree 64.3 (N 53-72),MA 59.7(N 50-70) . Considering satisfactory TEG values, we proceeded with surgery under general anesthesia and delivered a non- viable fetus. 1 liter of blood clot was removed from the uterus. Uterine tone responded after repeated use of ergometrine, oxytocin and hemabate. She received 2 u PRBCs, 1 u FFP, 1 u plt, 1 u cryo intraoperatively. The patient was transferred to SICU for postoperative monitoring. The patient's condition and lab values were stabilized within few hours following the procedure. She was transferred to floor next day and discharged home on 4th post partum day in stable condition.

Discussion: Cocaine abuse in pregnancy causes several complications including vaginal bleeding, abruptio- placentae, premature rupture of the membranes, low birth weight and IUFD. Of this abruptio placentae is a rare and serious fatal complication results fetal death and increased maternal morbidity and mortality due to DIC. Aggressive correction of DIC and immediate delivery of the fetus are key in the management of these patients. Better maternal education and perinatal care could reduce these complications in future.

Reference:

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Abstract #:SUN-43

Inverted Takotsubo cardiomyopathy during cesarean delivery under spinal anesthesia

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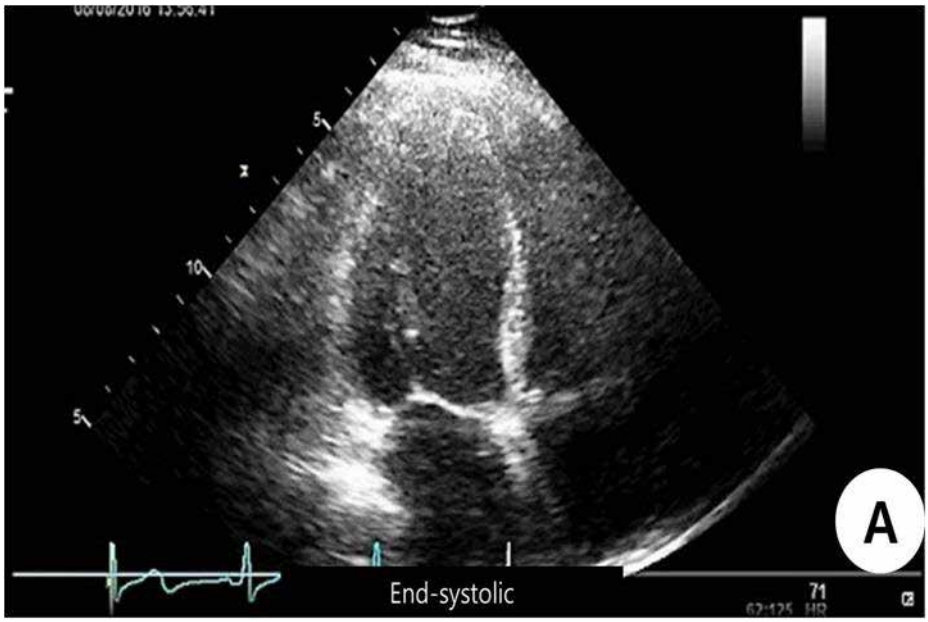
Introduction: Stress-induced cardiomyopathy (transient left ventricular apical ballooning, Takotsubo cardiomyopathy) is usually caused by triggering stress. It is characterized by reversible left ventricular dysfunction, chest pain or dyspnea, ST-segment elevation, minor elevations in cardiac enzymes, in the absence of significant coronary artery disease. It has been classified into 4 types(classic, reverse/inverted, mid-ventricular, localized type) and patients with reverse type are reported significantly younger compared with those with other types.

We present a case of acute reversible stress-induced cardiomyopathy(reverse type) associated with cesarean delivery under spinal anesthesia.

Case: 30 yrs, 157cm, 68.4kg, monoembrionic intrauterine gestational age 37 weeks 6 days, primipara admitted for elective cesarean delivery due to cephalopelvic disproportion.

No past history for cardiovascular disease. In OR, BP 126/83mmHg, HR 65/min and spinal anesthesia was done with 8ml of 0.5% bupivacaine + 10ug of fentanyl. 5 min after, BP 75/45 mmHg, phenylephrine 200ug infusion. 10 min after, BP 78/43mmHg, T4 in pinprick sensory level. 13 min after, BP 65/35 mmHg, HR 60/min, ephedrine 4mg IV, operation started. 15 min after, decreased HR 39/min, atropine 0.5mg IV, HR 170/min, T wave inversion on ECG, BP 170/120 mmHg, complained headache, chest discomfort and dyspnea, esmolol 10mg x 2 times, HR 120/min. 20 min after, baby out (Apgar score 8/9), midazolam 3mg IV and sustained ST segment depression(> 3mm), Isosorbide dinitrate continuous infusion + 100ug of phenylephrine infusion until end of operation (SBP: 75-90 mmHg). End of operation, BP 77/44 mmHg, HR 86/min, improved ST segment depression(0.8mm). In the post anesthesia care unit, BP 72/49 mmHg, HR 86/min, no more dyspnea and chest discomfort, T10 in pinprick sensory level. Echocardiography in PACU showed reduced LV systolic function(EF: 42%) with severe hypokinesia in all segments of base area. In POD #2, heart showed improved systolic function(EF: 47%) with mild to moderate hypokinesia. After 5 days, she discharged home without any specific problems. 1 month later, heart showed normal LV function(EF: 61%).

Conclusion: Woman in the peripartum period may represent vulnerable group for stress- induced cardiomyopathy.



Abstract #:SUN-44

A Case of Local Anesthetic Resistance in a Patient Undergoing Cesarean Delivery

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Background: Failure of neuraxial blocks following placement are generally attributed to technical difficulties, poor local anesthetic spread, or under dosing. We report the case of a patient that achieved a surgical block with intrathecal local anesthetic(LA) prior to cesarean delivery but required frequent re-dosing of LA through an insitu epidural catheter. We hypothesize this was due to LA resistance.

Case: A 17 year-old G1P0 at 40 weeks and 2 days with no significant PMH presented to L&D for induction of labor for postdates. An epidural was placed at L3/4, with good pain relief. The epidural was bloused for low pelvic pain/pressure when the patient was 10cm dilated, again with good relief. The patient was diagnosed with Stage 2 arrest after 2 hours of pushing and a cesarean section was scheduled. 15ml of 2% lidocaine with 1:200,000 epinephrine was administered in divided doses to achieve surgical anesthesia. After 10 minutes, the patient had a T8 block, with sparing over T12 dermatome and the decision was made to replace with a CSE.

An intrathecal dose of 6mg hyperbaric bupivacaine, 15mcg fentanyl and 150mcg morphine was administered and epidural placed at L3/4. A surgical block to the T-2 dermatome was achieved. The patient tolerated the low transverse cesarean section incision and uterine incision. However, 30 minutes after the spinal dose, at the initiation of hysterotomy repair, the patient experienced severe lower abdomen pain at the pfannenstiel incision described as "tearing". The epidural was bolused with 10ml 2% lidocaine with epi in divided doses with good relief of pain.

On arrival to the PACU, 1 hour after initial spinal dose and 30 minutes after lidocaine bolus through epidural, the patient reported no pain but was noted to have 5/5 strength and intact sensation in bilateral lower extremities. Upon further questioning, she reported a history of repeated failure of local anesthetic injections at the dentist.

Discussion: There is little research into LA resistance or rapid metabolism. Individuals with Ehrlers Danlos have been known to have resistance to LA (1). A recent genetic variant in voltage gated NA channels was identified in a family experiencing resistance and rapid metabolism of LA (2). This patient experienced good relief with intrathecal and epidural dosing, but had ultrafast offset of anesthesia, possibly indicating a genetic variant in the NA channel or other etiology of LA resistance. Patients should be asked prior to administration of epidural or spinal anesthesia if they have experienced symptoms of resistance in the past. If so, placement of an epidural catheter may be advised for cesarean in case re-dosing is required.

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Abstract #:SUN-45

Percutaneous Cerebrospinal Fluid Leakage after Continuous Intrathecal Catheter

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Recent literature supports the use of continuous intrathecal catheters after unintentional dural puncture in obstetric patients. Keeping intrathecal catheters in place for 24hours after unintentional puncture may reduce the risk of postdural puncture headache in patients and decrease the need for invasive management with epidural blood patch. Here we report an unusual complication of a continuous intrathecal catheter in the obstetric patient.

Case Presentation: A 37yo G1P0 at 34w6d gestational age presented with premature rupture of membranes and underwent augmentation of labor with oxytocin infusion for labor. She requested neuraxial anesthesia and after 4 unsuccessful attempts at epidural catheter placement had an unintentional postdural puncture with a 17g touhy needle. A 19g multiport closed tip catheter was placed easily intrathecally and maintained throughout labor with adequate analgesia without significant motor block. The catheter was removed immediately after delivery. She was discharged without reports of headache. She then returned to the hospital on postpartum day 4 with primary complaint of clear leakage at insertion site of intrathecal catheter with approximately one drop forming every 45 seconds. Although the fluid was never confirmed to be CSF, its appearance was highly suggestive it was. She reported only mild frontal non-postural headache without neurological symptoms. A suture was placed to control the percutaneous leak and no blood patch was performed.

Discussion: After unintentional post dural puncture, the rate of PDPH has been reported to be as high as 75% with its pathophysiology primarily from continued CSF leakage and resultant meningeal traction. This patient's presentation of delayed and continued CSF leakage from the puncture site is consistent with that of a rare complication of intrathecal catheters, a cerebrospinal fluid-cutaneous fistula. These case reports are primarily reported in non-obstetric literature such as pediatric neuraxial anesthesia and post laminectomy surgery. Although no set guidelines exist on the management of these fistulas, case reports describe successful treatment with conservative management with primary closure of the cutaneous portion of the fistula to epidural blood patchs.

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Abstract #:SUN-46

Anesthetic Management of Cesarean Section in a Rare Variant of Ehlers- Danlos Syndrome

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Introduction: Ehlers-Danlos Syndrome is a clinically and genetically heterogeneous group of inherited connective tissue disorders. It is characterized mainly by skin,vascular and tissue fragility and joint hypermobility but clinical presentations vary. Six major subtypes have been described with several additional, rare EDS variants. We present the first report describing management of cesarean section in a parturient with a rare variant of EDS type VI (kyphoscoliotic).

Case Report: A 25 yo G1,PO with EDS was scheduled for elective cesarean section at 37 wks. PMH included congenital hip dysplasia requiring hip replacement, repair of pectus excavatum, and multiple spine surgeries including Harrington rod placement for severe kyphoscoliosis. She was first sent for genetic testing for suspected EDS during this pregnancy. Testing revealed a rare variant in the FKB14 gene, which follows an autosomal recessive inheritance pattern. This variant is associated with kyphoscoliosis, myopathy and hearing loss and a variable constellation of signs due to connective tissue impairment affecting ocular, musculocutaneous, skeletal and cardiovascular systems.

Physical exam was significant for soft,stretchy skin,hyperextendible fingers and scoliosis. Echocardiogram showed good LV function with mild pulmonary HTN. PFTs were normal. Imaging of head, neck, hepatic and splenic arteries was done to rule out aneurysms, but the Harrington rods precluded imaging of the aorta.

Because of limited hip mobility after surgery, as well as the risks of uterine or vascular rupture, she was not considered a candidate for vaginal delivery. Regional anesthesia was ruled out due to her extensive back surgeries and persistent scoliosis.

After preoxygenation and induction with propofol,ketamine,lidocaine and succinylcholine, an atraumatic rapid sequence intubation was successful. A healthy boy, APGARS 8/9 was delivered. Anesthesia was maintained with sevoflurane, fentanyl, midazolam. Surgery was uneventful, EBL 700 ml. The patient was extubated and had a smooth post-operative course.

Discussion: Literature regarding obstetric anesthetic management of EDS is mostly in the form of case reports. Though many symptoms overlap, clinical presentation and management varies depending on subtype. In the rare subtype seen in our patient, considerations included: preoperative cardiac workup to exclude valvular and conduction defects; pulmonary testing to rule out dysfunction due to scoliosis; hypermobile joints necessitating careful intubation to avoid atlanto-axial subluxation or TMJ dislocation; possible traumatic intubation due to friable mucosa; careful positioning of arms to avoid hyperextension; padding of extremities to avoid tissue damage; low ETT cuff inflation pressures; low tidal volumes to avoid pneumothorax and preparation for potential hemorrhage. Had regional been considered, there may be increased risk of epidural hematoma or PDPH.

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Abstract #:SUN-47

Is a neuraxial technique contraindicated in the parturient with a history of cerebral arteriovenous malformation?

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Introduction: Cerebral arteriovenous malformations (AVM) are a rare abnormality of arteries and veins that pose a risk of rupture and hemorrhage. We present a case of a parturient in labor with a history of ruptured AVM.

Case: A 21-year-old G2P0 with a history of resected temporal hemorrhagic AVM at the age of 7 presented late for prenatal care. She had no residual neurological symptoms and cerebral angiography 3 months after resection showed no persistent vascular abnormality. Her grandmother and uncle had cerebral AVMs, but there was no personal/family history of epistaxis or telangiectasias.

Neurosurgery stated that while she did not have a clear contraindication to Valsalva, the possibility of recurrent AVM could not be ruled out without imaging. The obstetric anesthesia service determined that given the family history of AVMs, there was a possibility of a spinal AVM due to hereditary hemorrhagic telangiectasia (HHT). Given these concerns, a non-contrast MRI of the spine/brain was scheduled.

Prior to the MRI, she presented in labor and general anesthesia was recommended for her elective cesarean, however she wanted to be aware during the birth and elected to labor. A remifentanil PCA was ordered and IV nalbuphine was administered for pain control. Her labor progressed quickly and she delivered a healthy male infant.

Discussion: The prevalence of cerebral AVMs is less than 0.1%, and most are sporadic with a single malformation(1). A rare cause of cerebral AVMs is HHT, which predisposes patients to multiple pulmonary, gastrointestinal, and spinal AVMs. In the absence of imaging, an important question arose in the management of this parturient: could she safely have a vaginal delivery and neuraxial anesthesia? Given that the literature does not support an increased rate of rupture of cerebral AVMs in pregnancy, a cerebral AVM was not a contraindication to labor(2).

Even though the likelihood of HHT was low, a neuraxial technique was not offered given the possibility of a spinal AVM. In retrospect, this reasoning may have been flawed. A real risk of spinal AVM (1%) exists in HHT, but the risk of multiple pulmonary AVMs (50%) is much higher(3). Furthermore, the risk of difficult intubation is increased during pregnancy and labor(4). In this case, the risks of general anesthesia probably outweighed the risks of a neuraxial technique.

This case presents an important lesson in the decision making process for neuraxial vs general anesthesia during pregnancy. Although there may be relative contraindications to a neuraxial technique, contraindications to general anesthesia may outweigh those risks. Furthermore, spinal anesthesia has been previously administered safely in a parturient with HHT(3). Regardless of the diagnosis, this case teaches us that we should always consider the risks and benefits of both neuraxial and general anesthesia.

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Abstract #:SUN-48

Postpartum cardiac arrest secondary to ergometrine-induced coronary vasospasm

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Introduction: Ergometrine is a uterotonic and potent vasoconstrictor and is frequently used in obstetrics for prevention and management of postpartum haemorrhage. It has been used to provoke coronary artery spasm to investigate the role of vasoconstriction over thrombosis in acute coronary syndromes (ACS) in the context of variant angina. Despite its widespread use in obstetrics, such profound coronary vasospasm is very rare1, 2.

Case Report: A healthy 28-year-old Chinese female delivered a healthy baby via spontaneous vaginal delivery under epidural anaesthesia and the care of a midwife. Active management of the third stage of labour was facilitated by an intramuscular injection of oxytocin 5 IU and ergometrine 500 mcg. Postpartum blood loss of 700mls was recorded. The patient became unresponsive with confirmed loss of cardiac output 45 minutes later. Cardiopulmonary resuscitation and vasoactive drugs successfully achieved return of spontaneous circulation within 5 minutes. Blood tests revealed a haemoglobin of 55 g/L and a lactic acidosis (pH 7.32, BE -9, Lac 5.6). An electrocardiogram (ECG) revealed marked ST depression in leads II, III, aVF and V2-V6, suggesting an infero-lateral myocardial infarction. An echocardiogram revealed only hypovolaemia. Troponin T levels were elevated at 796 ng/L (normal range 0-13).

Two litres of IV crystalloid and 2 units of packed red cells were transfused. Further investigation including CT pulmonary angiogram and a coronary angiogram were normal. Coronary artery vasospasm secondary to ergometrine was the diagnosis of exclusion. Standard ACS therapy resulted in resolution of ECG changes and full recovery.

Discussion: Ergometrine can have profound systemic vasoactive actions. For this reason it is contraindicated in hypertensive and severe cardiac disorders. Although coronary artery spasm and myocardial ischaemia can occur in patients with normal coronary arteries there is no guidance as to which patients may be at increased risk. Recent studies, in non-pregnant patients, looking at the susceptibility of variant angina and coronary artery vasospasm in response to ergot alkaloids now suggest an increase in incidence in patients of Japanese ethnicity, when compared to Caucasians3. We believe this is the first such case, reported in the English medical literature, in a pregnant patient of chinese ethnicity. Further examination of the risk, of ergometrine administration to this patient group, is required.

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Abstract #:SUN-49

Placenta Percreta with Invasion of Pelvic Sidewall

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Case: An obese 29 year old woman, G8P2143 at 35.5 weeks with a placenta previa was scheduled for a cesarean hysterectomy due to ultrasound diagnosis highly suspicious for a placenta accreta, with possibility of percreta. The patient's history was significant for three previous cesarean deliveries and multiple dilation and curettage procedures. A multi-disciplinary conference was held with Maternal-Fetal Medicine, Gynecologic Oncology (Gyn Onc), Interventional Radiology (IR), Neonatology, Blood Bank, and Anesthesia.(1) Surgery was scheduled in the main OR. Two large bore IV's and a radial arterial line were placed. The patient was given a single-shot intrathecal preservative-free morphine injection prior to induction of anesthesia. General anesthesia was induced using rapid sequence and video laryngoscopy. Surgery progressed uneventfully and a healthy neonate was delivered. Soon after delivery significant bleeding ensued. The surgeons, in consultation with Gyn Onc, decided to proceed with the hysterectomy. The surgery was complicated by the invasion of the placenta into the surrounding pelvic sidewall and vaginal vault. Hemostasis was not possible, so after the hysterectomy, the pelvis was packed and retention sutures were placed by general surgery. The estimated blood loss at that time was twenty liters of blood, which was being replaced using massive transfusion protocol (2). The patient was taken to IR for embolization of pelvic vasculature. Hemostasis gradually improved and patient remained intubated in the ICU. On post-operative day 2, the patient returned to the operating room for attempted wound closure, but it was not possible due to bowel engorgement. On post-operative day four, closure was successfully reattempted by general surgery. The patient's trachea was extubated on postoperative day six. Her post-operative recovery was complicated by bilateral pelvic abscesses, which were drained percutaneously. The patient was discharged home on post-operative day 13 with IV antibiotics.

Discussion: This patient was presumed to have an invasive placenta due to the ultrasound in combined with her history of multiple cesarean deliveries, uterine curettage, and placenta previa. Based on this information, a multidisciplinary pre-operative conference and planning for the surgery occurred. The growth of this patient's placenta into sidewall structures meant that complete resection of placenta tissue was not possible and contributed to this patient's massive blood loss. Ultimately, the multi-disciplinary team approach to these complicated invasive placenta cases is the key to successful outcome.

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Abstract #:SUN-50

Intensity of post-dural puncture headaches and sphenopalatine ganglion blocks

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Introduction: Post-dural puncture headache (PDPH) is a common complication associated with neuraxial anesthesia, particularly in the obstetric population (1). Sphenopalatine ganglion blocks (SPGB) have been used effectively to treat cluster headaches, migraines, and post-dural puncture headaches (2,3,4,5). We present two case reports using SPGB for PDPH.

Summary: The first patient was a 27-year-old female who presented in labor at 32 weeks gestation. After multiple epidural attempts, she had an inadvertent dural puncture, and a catheter was threaded intrathecally. At catheter removal, CSF was noted to be leaking from the catheter cap. Patient complained of a bifrontal positional headache, dizziness, and nausea with ambulation. Her pain was 10/10, and she was reportedly unable to move from the supine position. A blood patch was attempted that resulted in a second dural puncture. Prior to receiving a fluoroscopic guided blood patch, the patient elected to try a SPGB. The patient was placed in supine position and received bilateral transnasal SPGB with 2% viscous lidocaine applied with cotton tip applicators. Immediately after the block, the patient reported a decrease in her pain to 4/10 as well as alleviation of her other symptoms, even with elevation of the head of the bed. Upon follow up, patient reported her pain and symptoms returned 2 hours after block application.

The second patient was 26-year-old female at 37 weeks who received spinal anesthesia for primary cesarean section. Two attempts for spinal were performed as the first spinal revealed a patchy block. Patient complained of a frontal-occipital headache worsening with postural changes, and she wanted to pursue options other than a blood patch to alleviate headache. Transnasal SPGB was performed in the same manner as noted in the first case. Her pain score prior to SPGB was 4/10. Patient reported immediate relief with pain score 0/10. On follow up 48 hours later, patient reported continued relief of headache following the block.

Conclusion: SPGB is potentially an effective therapy for PDPH that can be offered to patients prior to receiving a blood patch. The duration and degree of symptom relief experienced with the SPGB could be attributed to the intensity of the headache. SPGB could be used as a bridge until a blood patch can be placed in a patient demonstrating severe symptoms. In some cases, the block could replace the need for blood patch, as demonstrated by our second case. Further studies are needed to elucidate the relationship between PDPH severity and SPGB.

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Abstract #:SUN-51

Persistent cauda equina syndrome following uneventful spinal anesthesia with 0.75% hyperbaric bupivacaine in a healthy parturient

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Background: Cauda equina syndrome is a rare but serious complication that can occur following intrathecal administration of local anesthetics.[1,2] We present a case of persistent cauda equina syndrome six months following an uncomplicated spinal anesthetic in a parturient with 0.75% hyperbaric bupivacaine.

Case: A 33 year old healthy primiparous lady presented at term gestation for induction of labor. She had no pre-existing history of neurologic disorder. Upon request, labor epidural analgesia was placed uneventfully on first attempt at the level of L2-3. Analgesia was maintained using programmed intermittent epidural boluses with 0.08% bupivacaine and 2 mcg/mL fentanyl solution. Twelve hours later, the obstetrician recommended a cesarean delivery due to failure to progress and non-reassuring fetal heart tracing. An epidural-top-up was not attempted due to evidence of inadequate sensory block and a single-shot-spinal anesthetic was discussed with the patient. No motor block was present prior to the procedure. With the patient in the sitting position, a disposable 2% chlorhexidine swab stick was used for skin sterilization. An appropriate drying period was allowed prior to dural puncture at L3-4 using a 25G Whitacre needle. Clear CSF return was seen on first attempt, and 1.5mL 0.75% hyperbaric bupivacaine, 100 mcg preservative-free morphine and 10 mcg fentanyl was administered. Ten minutes following administration, the patient achieved symmetric T4 block to ice and surgery proceeded uneventfully. Twelve hours postpartum, there was absence of sensation and motor function below the L4 dermatome, with urinary retention requiring bladder catheterization. Lumbar spine MRIs performed at 24 hours, and repeated at 48 hours, showed the conus medullaris terminating normally at L1-2 with no evidence of cord or spinal canal abnormality. A subsequent MRI seven days postpartum, demonstrated enhancement of the conus and cauda equina nerve roots. Investigations with lumbar puncture and nerve conduction studies failed to identify the cause of injury. Pulsed intravenous steroids and immunoglobulins were empirically started for a possible autoimmune etiology. Six months postpartum, the patient continues to have significant sensory and motor deficits, and requires intermittent self-catheterization and assistance in defecation.

Discussion: Toxic polyradiculopathy due to hyperbaric bupivacaine was the presumptive cause of the injury; however there remains considerable diagnostic uncertainty with this case. Root cause analysis failed to identify an underlying cause of this sentinel event. The lack of an explanation is highly distressing for the patient, her family, and anesthesia providers. Studies into the possible risk factors and mechanism underlying bupivacaine neurotoxicity are desperately needed to help us understand how this devastating complication could be prevented.

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Abstract #:SUN-52

Low Dose Tranexamic Acid (TXA) Induced Generalized Tonic Clonic Seizure in Cesarean Section: A Case Report

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Tranexamic Acid (TXA) has been shown to be advantageous in cesarean sections in reducing blood loss in the intrapartum and postpartum period, decreasing maternal morbidity, and limiting the requirement for additional procoagulant products.1 Though a case of status epilepticus with accidental intrathecal injection of low dose TXA has been reported2, this uncommon side effect has been associated with the high doses most often used in cardiac surgical patients.3 There is currently limited literature regarding seizures with low dose TXA use during cesarean sections.

We provide a case report involving a healthy, 80.9 kg patient who experienced a generalized tonic clonic seizure seven minutes after receiving a split low-dose of TXA of 809 mg (10 mg/kg) following epidural placement. Prior to this event, the patient had had a routine pregnancy and no history of pre-eclampsia, seizures, or conditions contributing to lowering the seizure threshold. After the onset of seizure, general anesthesia was induced with propofol. The patient was intubated, delivered successfully, and taken to the surgical intensive care unit for further monitoring. CT of the head was unremarkable, and neurology ruled out other potential causes of epileptic activity. The patient recovered well and eventually was discharged home without further complications. As TXA use increases in obstetric anesthesia, this case report demonstrates that caution should be taken in its administration.

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Abstract #:SUN-53

Obstetric Anesthesia Considerations for Arrhythmogenic Right Ventricular Cardiomyopathy

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Case: A 29YO G2P1001 at 39w0d presented for induction of labor. Her PMH was notable for arrhythmogenic right ventricular cardiomyopathy (ARVC) necessitating placement of primary prevention AICD. Cardiac imaging showed fibrofatty replacement of a dysplastic RV, a midwall RV aneurysm, RBBB, RV dilation (RVEF 15%), tricuspid regurgitation and LVEF 55%. She was maintained on prophylactic low-molecular weight heparin (LMWH) due to a clot on an ICD wire. She was completely asymptomatic prior to and during her pregnancy with excellent functional status. This was her second pregnancy; she had not been advised against multiparity given the chronic and stable nature of her disease. She did not require beta blockers as part of her home regimen. She had no abnormal AICD activity prior to admission. Cardiology recommended holding LMWH in anticipation of IOL, careful preload maintenance, and avoidance of hypovolemia and any other vasodilators. An epidural was placed without difficulty and dosed incrementally to avoid hemodynamic instability. On HD2 shortly after AROM, a loop of cord was seen in the cervix and a stat cesarean delivery was performed under general anesthesia. Following induction, her systolic BP dropped to 90-100s. She was responsive to IV fluid and ephedrine boluses. Delivery proceeded uneventfully. There were no cardiac or hemodynamic concerns postoperatively and patient was discharged on HD4 with prophylactic LMWH.

Discussion: Arrhythmogenic right ventricular cardiomyopathy (ARVC) is characterized by the gradual replacement of the right ventricular myocardium with fibrous tissue and fat. It is an inherited cardiomyopathy that follows an autosomal dominant pattern on desmosome genes(1). It can be a major cause of sudden cardiac death from ventricular tachycardia, and there is variability in the history of the disease(2). Patients with ARVC often die at a young age due to fatal ventricular arrhythmias(3). Prevention of tachyarrhythmias is imperative for these patients. Symptoms of ARVC can include chest discomfort, palpitations, presyncope, syncope, and unexplained heart failure. Although the right ventricle is primarily involved, the left ventricle may be progressively affected thus resulting in biventricular failure(4). Generally sympathomimetic agonists should be avoided in ARVC, but our patient responded better to ephedrine than phenylephrine as it helped maintain her preload and heart rate in the setting of a diseased RV(5). Especially with the complication of emergent cesarean delivery, this case demonstrates successful management of a parturient with ARVC. Hemodynamic goals should be addressed both for the peripartum and intraoperative periods, especially in case of an emergency. Thorough multidisciplinary planning is necessary beginning in the early stages of pregnancy.

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Abstract #:SUN-54

Phantom Epidural Hematoma

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Introduction: Epidural hematoma (EH) is a rare but potentially catastrophic complication following neuraxial block. Spinal Epidural Lipomatosis (SEL) is also uncommon, and presenting symptoms can be like an EH. We present a case with presumed EH that was later determined to be epidural lipomatosis.

Case: A 19-year-old G3P3003 post-partum female with obesity (BMI 33) presented with complaints of new-onset urinary incontinence and severe back pain. 2-3 days prior to the onset of symptoms she had a spontaneous vaginal delivery at an outside hospital during which she experienced 3 unsuccessful attempts to place an epidural catheter for labor analgesia. CT and MRI of her lumbar spine showed a diffuse posterior EH resulting in central canal stenosis, severe in the lower lumbar spine. Neurosurgery agreed and performed a decompressive L3/L4 laminectomy. Upon surgical exposure, the surgeons noted no epidural hematoma but rather profuse lipomatosis. The area was debulked, and the site closed. The patient's symptoms improved by post-operative day 3, and on continued follow up there was complete resolution of symptoms.

Discussion: SEL is a rare condition characterized by excessive fat deposition in the spinal canal, which can be asymptomatic or result in significant spinal cord or nerve root compression. It is most often seen in men with exogenous steroid use, while also seen in individuals with elevated endogenous steroids (e.g., Cushing disease)(1). Many idiopathic cases have also been reported, and 70% of all cases are in obese patients(2). Clinical presentation may consist of pain, progressive paresthesia, or weakness in the lower extremities; however, acute neurological symptoms are uncommon(1). In a literature review conducted by D. Al-Khawaja et.al., surgical intervention was sought in 90% of all cases, with 60% of those presenting with lumbar disease involvement experiencing a full recovery(2). Our patient had never used exogenous steroids and had no signs or symptoms of overt endocrinopathy. Additionally, her clinical picture was clouded by the acute onset of her symptoms in addition to the recent neuraxial attempts.

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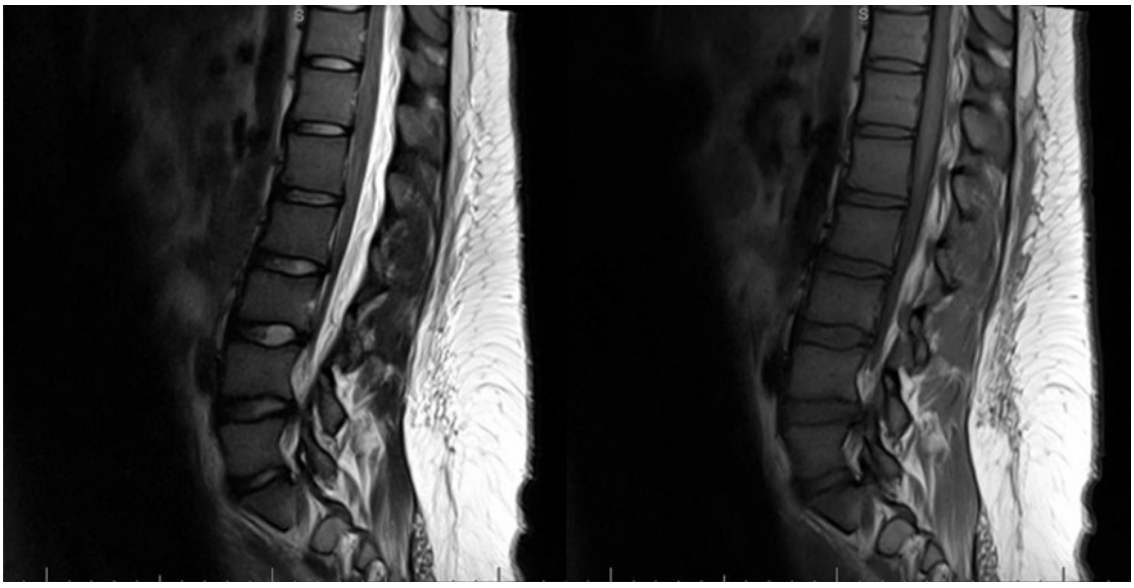

Abstract #:SUN-55

Continuous Spinal Anesthesia for the Management of a Pregnant Patient with Catecholaminergic Polymorphic Ventricular Tachycardia

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Introduction: Catecholaminergic Polymorphic Ventricular Tachycardia (CPVT) is a rare disease with a mortality rate of 31% by the age of 30 years. CPVT places patients at high risk of perioperative ventricular tachyarrhythmias with adrenergic stimuli. We discuss the anesthetic management of a 24 y/o G2T0P1A0L0 female with CPVT, who presented for C-section.

Case: The patient was referred to our service at 24 WGA with a past medical history remarkable for intermittent BA and peripartum cardiomyopathy. CPVT was diagnosed at 29 WGA of her first pregnancy after development of an arrhythmic storm and cardiac arrest. An implantable cardiac defibrillator was placed shortly after. During her second pregnancy, the patient was referred by her cardiologist to our institution at 24 WGA due to SOB associated to peripartum cardiomyopathy. TTE was remarkable for left ventricular dilatation and hypokinesis and an EF of 35%. EKG presented NSR with occasional PVCs and labile HR ranging from 50-120 noted on telemetry monitoring. Patient was rate controlled with metoprolol and follow-up TTE was unchanged at 32 WGA prior to planned C-section. After standard ASA monitors, a 20G radial arterial line and two 18G peripheral IV lines were established. Continuous Spinal anesthesia (CSA) at L4-L5 with an initial dose of 4.5 mg of 0.75% hyperbaric bupivacaine was given to achieve a T4 dermatome level. Under close hemodynamic monitoring 50 mcg of phenylephrine were administered shortly after. A second dose of 1.5 mg was administered the following hour. MAPs ranged from 74-87 mmHg, while HR ranged from 40-80 bpm. A TAP block was performed at the end of surgery and the spinal catheter removed. The patient was transferred to the surgical intensive care unit with an uneventful postoperative course and adequate analgesia.

Discussion: CPVT presents through development of ventricular tachyarrhythmias triggered by adrenergic responses to stress or physical activity. A family history of syncopal episodes or sudden cardiac death exists in 30-35% of patients, and a genetic correlation to mutations in ryanodine 2 receptor gene is found in 50% of patients. Scheduled C-section provides a controlled setting and avoids emergent surgery under possible hemodynamic instability. Single-dose spinal anesthesia has had poor outcomes when compared to GETA, and recent evidence points to potential advantages of regional anesthesia at incremental doses. CSA tends to provide better sensory block with lower doses of medication while maintaining hemodynamic stability.

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Abstract #:SUN-56

Peripartum Management of Cardiogenic Shock, Pseudoaneurysm and Aortic Valve Endocarditis

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Introduction: Cardiovascular disease and infection are significant contributors to the rising maternal mortality rate in the United States.1 Moderate aortic stenosis (AS) is associated with a relatively low risk in pregnancy; however severe symptomatic AS increases the risk of obstetric and cardiac complications requiring prolonged hospitalization.2

Case Presentation: A 30-year old G1P0 parturient at 36 4/7 weeks gestation presented in spontaneous labor. Her history was significant for a bioprosthetic aortic valve and ascending aortic graft performed 6 years prior for a stenotic bicuspid aortic valve with ascending aortic aneurysm. TTE one month prior to presentation revealed moderate AS (gradient 34 mmHg, EOA 1.39 cm2) with preserved left ventricular function (EF 66%). Due to refractory non-reassuring fetal status, she underwent urgent cesarean delivery under spinal anesthesia.

Intraoperatively, she remained persistently hypotensive with systolic blood pressures in 80mmHg range despite administration of intravenous fluids, ephedrine, and a phenylephrine infusion. A bedside TTE in the PACU revealed biventricular dysfunction (EF 25-30%), severe AS (gradient 40 mmHg, EOA 0.6 cm2) with new aortic regurgitation (AR) and sinus of Valsalva dilatation; CT angiogram demonstrated aortic root pseudoaneurysm with communication between the non-coronary cusp and posterior LVOT. Consequently emergent aortic valve and root replacement was performed. Intraoperative frank purulence was encountered in the aortic root requiring annular debridement, with intraoperative cultures revealing Streptococcus mitis. Following inability to separate from bypass due to left ventricular dysfunction, VA ECMO was initiated. Five days later she was transitioned to VV ECMO due to severe ARDS for another six days. Extubation was performed on postoperative day 14, and she had no neurologic deficit.

Discussion: This case illustrates undiagnosed subacute bacterial endocarditis resulting in severe AS and aortic root pseudoaneurysm, with clinical symptomatology obscured by intrapartum presentation. Moderate AS without cardiac dysfunction in the parturient is often uncomplicated but requires vigilant surveillance, particularly during the peripartum period. Infective endocarditis (IE) is associated with increased morbidity and mortality for the mother and fetus, with an incidence of approximately 1 in 100,000 pregnancies.3 Complications of IE include cardiac dysfunction, sinus of Valsalva aneurysm, perivalvular extension, and systemic embolization. In this case, immediate postoperative echocardiography, multidisciplinary coordination of care, and operative treatment were integral to patient survival.

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Abstract #:SUN-57

Can Amniotic Fluid Embolism (AFE) Occur without Hypoxia? A Case of Atypical AFE Presentation.

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Amniotic fluid embolism (AFE) is a rare but life-threatening complication of childbirth. As such, AFE is a leading cause of maternal death and is typically characterized by a two-phase response; the first phase is defined by acute respiratory failure (83-93%) and cardiac collapse(100%), and the second phase is characterized by coagulopathy and uncontrolled bleeding (83-100%). AFE presenting with severe coagulopathy and uterine atony without concomitant or limited respiratory compromise is rare. Such atypical presentation has been referred to as disseminated intravascular coagulopathy-type AFE, and may be difficult to diagnose.

An otherwise healthy 39 yo G1P0 at 38+1 weeks gestational age, was admitted in spontaneous labor and received a CSE for labor analgesia. Despite successful neuraxial placement and adequate sensory level, the patient continued to have lower abdominal pain. Due to nonreassuring fetal heart tones, the decision was made to proceed with an urgent primary cesarean delivery. Lidocaine with epinephrine was epidurally administered for surgical anesthesia, however, the block was inadequate. Fetal deceleration necessitated general anesthesia; rapid sequence induction and intubation were performed uneventfully. Following fetal delivery, the patient became extremely hypotensive and phenylephrine and epinephrine boluses were given. The surgical field did not reveal bleeding and uterine tone was deemed sufficient. Following skin closure, examination revealed additional vaginal bleeding (1.6L); uterotonic agents were administered. Bleeding continued (3L) despite good uterine tone and a Bakri Balloon was placed as the abdomen was noted to be enlarging. The patient continued to require fluid and pressor support. Laboratory values were consistent with consumptive coagulopathy. PT 20.4 sec, PTT 42 sec, INR 1.8, FBG 108 mg/dl, and platelet count 95,000/mm3. ABG was consistent with anion gap metabolic acidosis; p02 was 158 mmHg on 100% O2 administration. Following aggressive fluid and blood resuscitation, an emergency laparotomy was performed to evacuate a diffuse abdominal hematoma. The patient received a total of 17U pRBCs, 14U FFP, 6U cryoprecipitate, and 2U platelets, with a total EBL of 14.7L. She was stabilized and taken to ICU. On POD#2, uterine artery embolization was performed. Her labs normalized and she was discharged on POD#6.

While the etiology of AFE is unknown, it is speculated to be caused by a localized anaphylactoid reaction that usually leads to pulmonary vasospasm with platelet and complement system activation. Initial signs of hypoxemia and bronchospasm that usually accompany AFE may be masked in an intubated patient receiving supplemental O2 and early administration of epinephrine for hypotension. This case highlights the challenges of diagnosing AFE in a patient receiving general anesthesia for cesarean delivery.

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Abstract #:SUN-58

The Unique Challenge of Caring for an Obstetric Patient with Factitious Disorder: What Do You Do When You Don't Believe Your Patient?

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Introduction: Factitious disorder imposed on self (FDIS), formerly Munchausen Syndrome, presents unique challenges to healthcare providers, particularly in the parturient population. FDIS is characterized by misrepresentation of clinical symptoms as well as self-harming behaviors, frequently subjecting themselves to a battery of unnecessary tests, surgeries, and treatments in order to assume the sick role (1). FDIS is more likely to be found in women in the 4th decade of life who work in healthcare (2).

Case Presentation: A 36 y/o former RN G6P5 at 33w+6 s/p 3 previous CDs with extensive medical and surgical history presented in PTL. The patient reported a past medical history of MI x 2, COPD with oxygen dependence, pulmonary embolism, desquamating interstitial pneumonia s/p left lung wedge resection, recurrent urolithiasis and uro-sepsis s/p nephrostomy tubes, chronic pain syndrome with opioid dependence, tobacco abuse, anxiety and depression with multiple suicide attempts in her youth. The patient would not release her medical records due to perceived printing costs. Her vital signs were within normal limits (O2 sat 99% on RA). Physical exam was otherwise benign, with no scars to the chest wall to indicate previous thoracic surgery. Intrapartum work-up revealed an ECG without evidence of prior infarction, a TTE with normal left ventricular and valvular function, and PFTs with an isolated decreased diffusion capacity. A multidisciplinary approach was employed to facilitate her care consisting of MFM, cardiology, pulmonary, urology and anesthesiology services. Psychiatry consult was requested, but not performed prior to delivery. During labor, an epidural catheter was placed via CSE technique with intrathecal fentanyl given. The test dose of lidocaine with epinephrine was negative. The epidural was titrated with 0.125% bupivacaine + fentanyl 2mcg/mL to a T10 level. Due to labor progression, patient was taken for CD. Invasive monitoring was not utilized, but available if necessary and procedure was uncomplicated. She was discharged on POD #3 in stable condition.

Discussion: Given this patient's complicated self-reported medical history and refusal to release her medical records from outside hospitals, she posed a unique challenge to her team of healthcare providers. Her history was inconsistent with her physical exam and intrapartum work-up; therefore, the decision was made to manage her labor based on her clinical findings alone with a low threshold to escalate if medically indicated. The ultimate goals of care for a patient with FDIS are to provide safe and cost-effective healthcare while maintaining physician-patient rapport despite any inconsistencies. Providers need to address patient concerns and demonstrate respect for their medical narrative while using clinical assessment to guide care.

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Abstract #:SUN-59

Type A Aortic Dissection in Pregnancy: A Case Report

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Introduction: Acute aortic dissection is a rare but potentially devastating complication of pregnancy. A 32 year-old pregnant female with gestational hypertension presented with acute type A aortic dissection.

Case: A 32 y.o. female at 32 1/7 weeks gestation, PMH gestational hypertension on no medications, arrived from an outside hospital via helicopter. She presented earlier in the day with severe chest pain radiating to the abdomen and back, shortness of breath, diarrhea, and vomiting. CT of the chest/abdomen/pelvis at the outside hospital showed a Type A aortic dissection with a dissection flap extending from the aortic root to iliac arteries. She arrived on an esmolol drip and in our ICU had BP 97/71 and HR 93. She was awake, mentally alert, and moving all extremities. Multidisciplinary team planning occurred. Within an hour she was brought to the Cardiac OR for an emergency cesarean section and Type A aortic dissection repair.

In OR, she was placed supine in LUD and arterial line and central venous access obtained. General anesthesia was induced RSI with propofol, succinylcholine and fentanyl. TEE showed the aortic tear to be directly above the sinotubular junction extending into the noncoronary sinus. OB team performed Cesarean delivery. NICU team performed resuscitation; Apgars were 1, 2 and 3 at 10 min. Oxytocin infusion was started upon delivery, and continued during the cardiac portion of the case. After uterine closure and packing the pelvis, the cardiothoracic surgery team established cardiopulmonary bypass, deep hypothermic circulatory arrest, retrograde cerebral perfusion, and replacement of ascending aorta and aortic hemi-arch with a gelweave graft, with re-suspension and reconstruction of the sinotubular junction. Total circulatory arrest time was 30 minutes. Patient tolerated the procedure well and went to ICU. She was extubated the following day and was neurologically intact. She was discharged home on POD#8 and baby on POD#32.

Discussion: Acute aortic dissection is a rare but potentially devastating complication that is magnified when pregnant, most commonly associated with hypertension, connective tissue disorders, bicuspid aortic valve, or trauma. However our patient's only risk factor was her history of gestational hypertension. In women <40 y.o, half of the aortic dissections are associated with pregnancy, most frequently in the third trimester or immediate postpartum period. During pregnancy, the rate of aortic dissection was 0.0004% in the United Sates, and represented 0.1% of all dissection cases. Prompt multidisciplinary collaboration is necessary for optimal outcome.

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Abstract #:SUN-60

Profound hyponatremia as a cause of prolonged postoperative lethargy in a pre-eclamptic parturient.

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Introduction: Hyponatremia has a high risk of perioperative complications including nausea, confusion, lethargy, muscle spasms, weakness, seizures, and coma. We present an interesting case of acute hyponatremia as a cause of prolonged lethargy after cesarean section.

Case: A 35 y.o. primip at 34 weeks presented for medical induction of labor for pre-eclampsia (BP 160/90) and HA. PMH negative except for gestational hypertension, A1DM and intrauterine growth retardation. She was induced with dinoprostone and started on magnesium for seizure prophylaxis. Fetal bradycardia was noted 4 hrs after induction. The OB proceeded with emergent cesarean delivery under general anesthesia, with Apgars of 7/ 8 and signs of abruption. Oxytocin 40 units was administered in normal saline over 30 minutes after delivery per protocol. OR fluids were lactated ringers 3L, EBL 800 mL and urine 100 ml. In PACU, the patient was noted to be lethargic, briefly awakening to voice and maintaining eye opening for <10 seconds at a time (RASS score -2. VS BP 140/95 P74 R 12 Sat 99% on 4L O2). Four hours later, full reversal of benzodiazepines and opioids with flumazenil and naloxone were given with only mild improvement of her mental status and with still having brief apneic episodes. Neurologic status was non-focal. Work-up in PACU showed Mg 6.6mg/dL and Na 123; other electrolytes and LFTs WNL. Oral fluid intake was restricted and 3% sodium chloride was slowly administered to correct her hyponatremia in ICU. On postoperative day one, her sodium returned to 135 with no complications and resolution of her altered mental status. Discussion with the obstetrician revealed that the patient had copious excessive free water intake during her preoperative course. Preeclampsia with severe features may also predispose to hyponatremia.

Discussion: Primary polydipsia has been described but remains a rare cause of acute hyponatremia. Parturients are at risk of developing dilutional hyponatremia due to a reduction in the osmotic threshold for release of antidiuretic hormone (ADH) and the ADH-like effects of endogenous and synthetic oxytocin. In addition, parturition causes pain, stress, and nausea which stimulate the secretion of ADH. Oral fluid intake was not recorded in the fluid balance and may have played a role in diagnosing this complication. Our case emphasizes the need for an increased awareness of the potentially harming effects of primary polydipsia in the parturient and vigilance in PACU with an unusual cause of post-cesarean lethargy.

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Abstract #:SUN-61

Management of a Pregnant Patient with Incontinentia Pigmenti

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Patient History: A 29 year-old female G1P0 with a history incontentia pigmenti (IP) presented for induction of labor for oligohydramnios at 39.4 weeks. Her history was also notable for leg-length discrepancy, asthma, obesity, bicornuate uterus, and features of IP such as striated skin, scoliosis, mild mental retardation, and teeth irregularities.

Perioperative Course: Labor analgesia was requested and after multiple attempts a combined spinal-epidural was placed at the L3-4 interspace which functioned well throughout labor. Vaginal delivery was complicated by retained placenta. Twenty five minutes after delivery urgent manual extraction of placenta and suction D&C was required. This was attempted under neuraxial anesthesia with N2O and ketamine supplementation. However the patient was unable to tolerate the procedure and general anesthesia was induced. Extubation was complicated by airway obstruction and bronchospasm.

Discussion: Incontentia pigmenti, also known as Bloch-Sulzberger syndrome, is an X-linked dominant condition caused by a mutation in the NEMO gene with an estimated incidence of 0.7/100,000. IP is a genodermatosis that primarily affects the skin, eyes, hair, teeth, musculoskeletal and central nervous systems. The diagnostic feature is a full body rash that progresses through several stages and results in a characteristic swirling pattern. Key anesthetic concerns for patients with IP relate to oral and CNS abnormalities.

Dental anomalies include conical teeth, anodontia, and soft palate hypoplasia which may make airway manipulation more challenging. In this particular case, airway abnormalities combined with asthma and obesity may have contributed to respiratory compromise. IP affects the CNS and is associated with hemiplegia, hemiparesis, seizures, and mental retardation. Underlying disorders will affect the choice of anesthetic agents and the latter may impede communication with the patient and affect care. In this case, mental retardation contributed to the need for GETA. Musculoskeletal abnormalities also occur, including hemivertebra, congenital dislocation of the hip, and kyphoscoliosis. In this case, the presence of scoliosis made placement of a regional anesthetic challenging.

Less frequently, cardiovascular anomalies are present and may include atrial septal defects, ventricular endomyocardial fibrosis, and primary pulmonary hypertension. Given the rarity of the disorder, very few cases have been described in the literature and the purpose of this case is to highlight anesthetic challenges that may occur in the parturient with IP.

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Abstract #:SUN-62

SUCCESSFUL MANAGEMENT OF MOYAMOYA DISEASE AND SICKLE CELL DISEASE IN A SYSTEMICALLY ANTICOAGULATED PATIENT UNDERGOING A CAESAREAN DELIVERY

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Introduction: Moyamoya disease (MMD) is a rare cereberal vascular disease with progressive occlusion of the terminal internal carotid arteries and the vascular networks that act as collateral pathways. (1) Patients with MMD are at risk for both ischemic and hemorrhagic strokes within the collateral networks (2), and neurological complications have been reported at rate of 6%. (3) Both vaginal and caesarean deliveries are permissible, assuming hypocapnia, hypertension, and hypotension are avoided. (2) We describe a case of a patient with MMD that underwent a successful caesarean delivery.

Case Presentation: A 32 year-old G2P1 presented at 33 weeks in preterm labor. Her medical history was significant for MMD causing a cerebral vascular event in 2009 (no residual deficits) with subsequent external carotid to middle cerebral artery bypass in 2010, and sickle cell disease (SCD) requiring chronic opioids. Two weeks prior, she was diagnosed with a subsegmental pulmonary embolus (PE), and she started on therapeutic lovenox that was continued until one day prior to surgery. An arterial line was placed prior to rapid sequence induction with propofol, remifentanil, esmolol and succhylcholine. She was started on a ketamine infusion and administered interval doses of hydromorphone given her history of chronic opioid use.

Her intraoperative course was complicated by a hemorrhage of 2500 ml, due to atony and suspected focal accreta, that was treated with misoprostol, B-lynch suture, and a Bakri balloon. She received 2 units of both packed red blood cells and fresh frozen plasma during the case, and she was extubated without complication. Her hemorrhage resolved and she was restarted on lovenox on post-operative day one. The ketamine infusion was continued along with a hydromorphone PCA providing excellent pain control in a patient with chronic opioid use. No neurological deficits were noted post operatively, and she was discharged four days after delivery.

Discussion: Anesthetic considerations for parturient with MMD include adequate analgesia and anxiolysis, in order to avoid hypertension, tachypnea, and hypocapnia. Both neuraxial and general anesthesia may be utilized to achieve these goals. Our patient had additional complications of SCD and a recent PE. Her chronic opioid use provided a substantial challenge for pain control in the setting of therapeutic anticoagulation preventing the use of neuraxial techniques. We were able to maintain hemodynamic stability during induction using the short acting medications remifentanil and esmolol, and achieve postoperative pain control with a ketamine infusion and hydromorphone PCA.

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Abstract #:SUN-63

Intrapartum MRI? - Coordinating Care on the Fly

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Introduction: Neurofibromatosis (NF) is a rare neurocutaneous disorder with two distinct subtypes with different clinical manifestations. NF -1 accounts for 85% of the cases and is characterized by widespread proliferation of neural crest tissue. Manifestations include café au-lait spots, peripheral or central neurofibromas including spinal and pharyngeal lesions, and hypertension. Antenatal imaging is recommended in parturients with NF-1 due to risk of spinal or epidural hematoma after neuraxial placement, even in asymptomatic patients. In the absence of available imaging, providers may be hesitant to proceed with neuraxial placement, even in high risk patients who request labor analgesia. We describe a novel approach to coordinating care in a NF11 patient on labor and delivery without preoperative imaging.

Case: Our patient is a 22yo G3P0 at 31 weeks GA who presented for IOL secondary to pre-eclampsia with severe features (based on blood pressures and platelet values). Medical history included NF-1, SLE with pericarditis and pericardial effusion during her pregnancy that required percutaneous 1L drainage. The patient did not have recent imaging of the spine, however, she did not have neurologic complaints. The patient was receiving magnesium therapy, foley bulb was removed and no uterine contractions were noted on tocodynomometer when the anesthesia service was consulted for labor epidural catheter placement. Fetal heart rate tracing was a category I, maternal blood pressures were normalized and obstetric plan included oxytocin augmentation. After multidisciplinary discussion, it was determined that the patient would benefit from epidural catheter placement, but imaging would be required. Care was coordinated to halt induction and an MRI of the spine was performed emergently. No spinal lesions were noted and the patient received labor analgesia via a combined-spinal epidural catheter placement with an uneventful vaginal delivery.

Discussion: Optimal management of parturients with NF- I includes multi-disciplinary planning and preoperative anesthesiology evaluation as NF may affect the airway and spine. Exclusion of spinal lesions may facilitate neuraxial placement, but this is not always available on day of delivery. Antenatal assessment may be of even more importance for patients who are high risk such as this patient, whose medical history also included SLE with cardiac manifestations, pre-eclampsia with severe features and thrombocytopenia. While obtaining an intrapartum MRI may not seem feasible, a timely discussion with the obstetrician and patient allowed for imaging that influenced anesthetic management. In this case it supported epidural catheter placement. This case highlights that, in the absence of pre-delivery MRI, certain laboring parturients with NF-1 can obtain relevant imaging that influences anesthetic management with proper coordination of care.

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Abstract #:SUN-64

A Two-Day Interventional Radiologic Approach to Invasive Placenta Percreta

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Introduction: Placenta percreta is a disorder involving abnormal invasion of the placenta through the myometrium and into surrounding structures. This case presents a multi-specialty two-day staged cesarean hysterectomy.

Case: 40 yoF G7P2042 presents for tertiary care due to expected placenta percreta with MRI findings of invasion into the bladder and peri-rectal space. Significant past surgical history of 2 prior CDs, 1 ectopic pregnancy, 3 SABs and 2 D&Cs. Multidisciplinary meeting held with radiology, gyn oncology, urology, anesthesia, MFM, and neonatology. Operative day 1 patient underwent occlusion balloon placement in bilateral internal iliac arteries under sedation, followed by CD under GA uneventfully. She was immediately brought back to IR for bilateral hypogastric gel-foam embolization, including other small feeding vessels. Operative day 2 started in IR with re-embolization of anterior divisions of internal iliac and bilateral occlusion balloons. She was then brought to OR for hysterectomy and cystotomy with repair leading to 4 L EBL and massive transfusion despite embolization and occlusion balloons. She was extubated POD 1 with stable course.

Discussion: Despite multiple IR embolizations and balloon catheters, we still experienced a large hemorrhage intraoperatively. Without the help of embolization and staging, the likelihood of mortality is presumed high. This case highlights the importance of a multi-disciplinary team approach to reduce morbidity and mortality in these patients.

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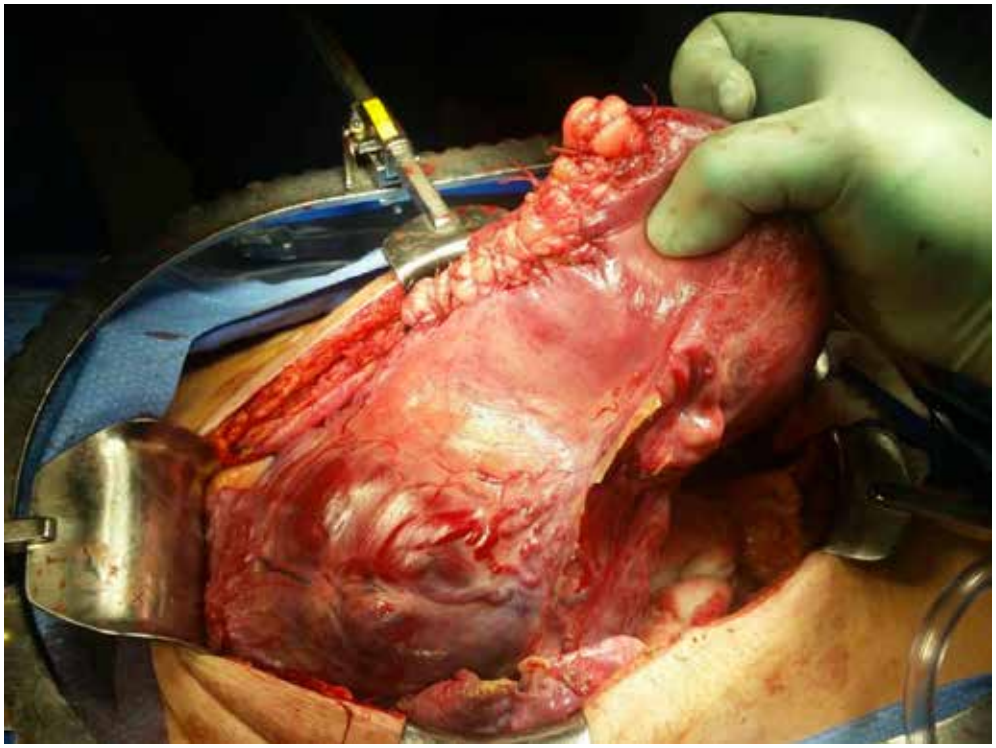

Abstract #:SUN-65

Abdominal Muscle Wall Rupture in Pregnancy

Presenting Author: Evan Thilo MD
Presenting Author's Institution: Oregon Health and Science University - Portland, OR

Introduction: The transversus abdominis plane (TAP) block is a regional anesthetic technique indicated for of the abdominal wall after surgery. We present the successful nontraditional use of a TAP catheter to treat pain associated with acute internal oblique muscle rupture in a laboring pregnant woman.

Case Presentation: A 28 year old otherwise healthy G1P0 patient at 38 weeks and 6 days gestation on the midwife service presented to the OB triage unit in early labor with onset of acute right-sided abdominal pain. Exam was notable for severe anterior R sided abdominal pain with swelling and a boggy fluid collection to the right of the umbilicus. Diagnostic ultrasound demonstrated a ruptured internal oblique muscle and a large fluid collection within the capsule of the muscle. She was admitted to Labor and Delivery for induction of labor in the setting of an acute muscle rupture. Though her labor pain was quite tolerable, her anterior abdominal wall pain was severe. Not long before admission she and her husband attended a birthing class where they decided to use nitrous oxide as her primary means of pain control for labor and did not desire an epidural. In line with her values, we placed a TAP catheter which after bolus-dose ropivacaine resulted in almost complete resolution of her anterior abdominal wall pain within 45 minutes. The patient maintained the ability to ambulate, use the restroom, remain un-monitored, and without a foley catheter which coincided with her desires in her birth plan. We maintained her analgesia using bolus-dose ropivacaine every 4 hours. She continued to labor on an oxytocin infusion utilizing nitrous oxide for labor analgesia for 28 more hours until her labor pain grew so severe that she desired epidural anesthesia. After placement of epidural she labored 20 hours more until declared failure to progress and underwent cesarean section. Post-operatively her anterior abdominal pain resolved spontaneously. The TAP catheter was removed at time of discharge.

Discussion: Transversus abdominis plane block is primarily indicated for post-operative analgesia as part of a multimodal approach in abdominal surgery. Though this is not a previously well-described indication, the TAP block was particularly suitable in treating this patient's chief complaint because her anterior abdominal pain only involved the cutaneous nerves of the abdomen. It is important to distinguish that this patient's primary chief complaint was anterior abdominal pain and was truly distinct from her tolerable pain of labor. She and her husband felt empowered in the birth experience because the interventions performed happened in a sequential fashion of necessity for the situation that presented at hand.

Abstract #:SUN-66

Anesthetic and Obstetric Considerations in a 32yo with Epidemic Kaposi's Sarcoma

Presenting Author: Erica M. Johnson MD
Presenting Author's Institution: Emory University - Atlanta, Georgia
Co-Author: Thanayi Barone-Smith MD - Emory University - Atlanta, Georgia

Kaposi's sarcoma (KS) is an opportunistic proliferative tumor that develops with increased frequency after human immunodeficiency virus (HIV) infection. KS is rare in women and even rarer in pregnancy secondary to human chorionic gonadotropin-like hormone causing apoptosis in KS cells (1). When present in women, the disease process is more aggressive with lesions present in the pulmonary and gastrointestinal systems as well as mucous membranes and along the vascular endothelium. With the rare occurrence of KS in pregnant women, it is questionable to which type of anesthesia provides the optimal safety and efficacy. We present a 32yo G3P2002 at 37 wks with AIDS and "undiagnosed KS" that presented for urgent cesarean section (CS) secondary to premature rupture of membranes with a high viral load. The patient was diagnosed with HIV in 2010, but was non-compliant with highly active antiretroviral therapy (HAART) with resulting labs: CD4 count 13mcl and viral load 4012 copies/mL. Comorbidities also included HIV dementia and bipolar disorder that made healthcare goals a challenge. Upon arrival to the operating room, multiple disseminated cutaneous lesions were discovered on the patient's trunk, arms, legs, and back of unknown origin. The patient had no previous diagnosis of KS, but given the poorly controlled AIDS history, the lesions were clinically diagnosed as Kaposi's nodules. Spinal anesthesia was performed where there were no visible lesions. The subcutaneous or non-visible lesions were our main concern when performing a spinal that could potentially cause neuraxial hematoma formation and/or extension of HIV/KS into the central nervous system. Previous literature supports neuraxial anesthesia in HIV parturients with no increased infection rates or neurological sequalea, but these studies include a majority of patients with HIV and CD4 counts >200, unlike our patient scenario (2). Fortunately, a T4 level with spinal anesthesia was obtained and an uneventful CS occurred with delivery of a male infant with Apgars 7 and 9. We will discuss risks that accompany both general and neuraxial anesthesia in KS patients, obstetric concerns that result in maternal and fetal morbidity, and highlight the affects of HAART therapy in HIV parturients and neonates in the peripartum period. Ultimately, the infectious disease team clinically diagnosed the patient with epidemic KS given the patients AIDS status and characteristic KS lesions. No adverse neurologic outcomes were observed and the patient and baby were discharged after a 5-day hospital stay.

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Abstract #:SUN-67

Ultrasonographic Assessment of Uterine Contractility During Primary Cesarean Section

Presenting Author: Edward J Kent III MD
Presenting Author's Institution: Northwestern University - Chicago, IL
Co-Author: Mahesh Vaidyanathan MD, MBA - Northwestern University - Chicago, IL

Ultrasonography is a widely used modality in both the obstetric and gynecologic fields for fetal, placental, tubo-ovarian, and endometrial evaluation(1,3). Intraoperative transabdominal ultrasound is used routinely during gynecologic procedures such as dilation and evacuation or curettage for elective termination, retained products of conception, and for postmenopausal bleeding(2,3,4). Kohlenberg et al described its use in a case study during hysteroscopic resection of uterine septae for infertility, where ultrasonography was used to guide the depth of their resection by measurement of the uterine myometrial thickness(5).

Uterine atony, or the lack of uterine contractility, is the leading cause of morbidity and mortality worldwide due to postpartum maternal hemorrhage(6). Assessment of uterine atony is guided by a subjective "uterine tone" by the obstetrician, by either transabdominal or direct palpation of the uterus. This subjective evaluation directs the use of uterotonics to limit the extent of hemorrhage(7). Currently there is no objective method to assess uterine tone or guide the effectiveness of uterotonics.

In this case series, we demonstrate decreased thickness of the posterior uterine body during subjectively adequate tone. In the images presented, measurement of distance from the internal cavity of the uterus to the external border of the posterior wall was used to show change as tone improves over time. It is evident, when analyzing the change in thickness from T1 to T3, that the distance shortens and the tissue density increases. As the uterine smooth muscle contracts after delivery, the wall of the organ narrows.

We have applied for IRB approval to perform a prospective evaluation of this technique. If our hypothesis is proven, the use of intraoperative ultrasonography could be used to eliminate inter-individual variation and establish a standard of care in assessing and evaluating the treatment of uterine atony.

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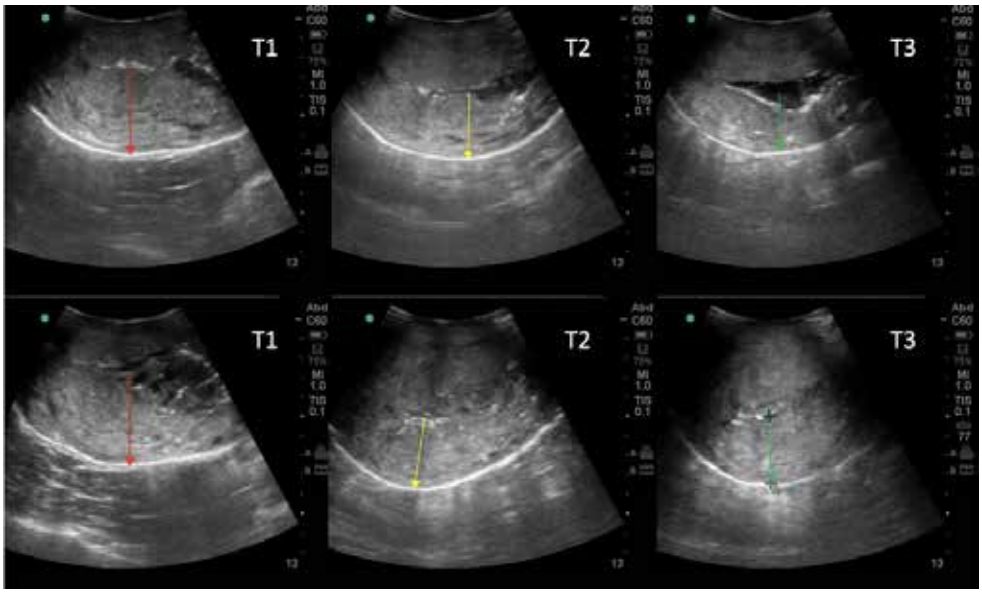

Abstract #:SUN-68

Difficulty in Removal of Continuous Lumbar Epidural Catheter Placed in Healthy Parturient for Labor Analgesia

Presenting Author: Garrett Roney M.D.
Presenting Author's Institution: Allegheny Health Network - Pittsburgh, PA
Co-Author: Kinga Klimowicz MD - Allegheny Health Network - Pittsburgh, PA

A 32-year-old G2P1 parturient underwent uneventful placement of (L3-L4) lumbar epidural catheter, which provided excellent labor analgesia. Multiple attempts to remove the catheter were unsuccessful, leading to stretching and lengthening of the catheter, therefore Interventional radiology was consulted. The patient had been ambulating, and sensation and strength had been preserved in both lower extremities. The catheter was eventually removed utilizing a left-lateral steep fetal position, applying moderate continuous pressure while bolusing saline through the catheter lumen. The catheter showed evidence of kinking as pictured.

This poster presentation will address the following learning objectives:

Recognizing that difficulty with removal of continuous catheters is a rare complication of neuraxial anesthesia.

Evaluating and assessing a continuous epidural catheter that is difficult to remove and identifying various etiologies that may contribute to this complication.

Applying positional and pharmaceutical techniques, as well as other other neuraxial approaches, in order to facilitate removal of a difficult-to-remove epidural catheter.

Knowing when to justify consultation of other services such as interventional radiology or neurosurgery for aid in removal of these catheters.

Describing potential morbidities involved with epidural catheters that are not easily removed.

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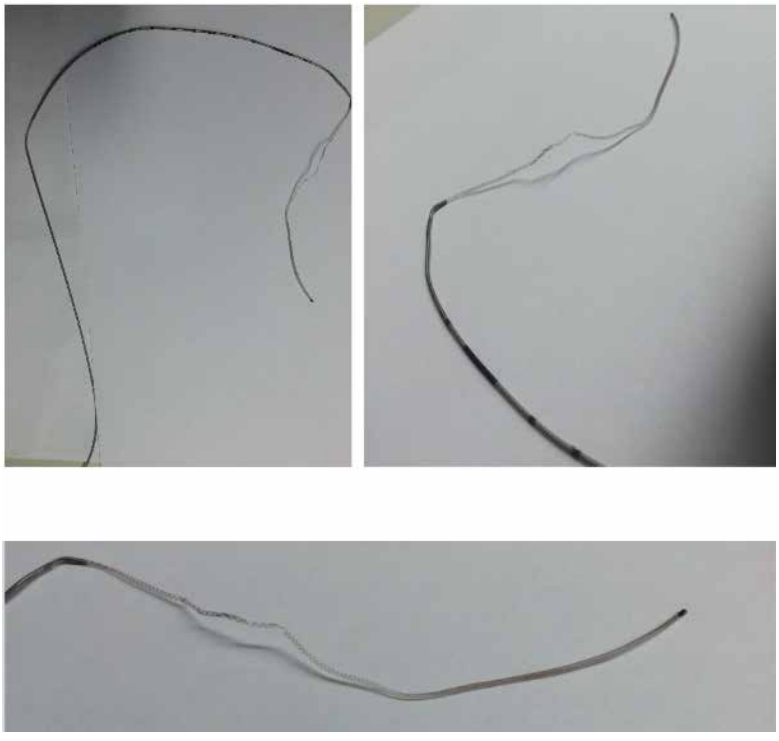

Abstract #:SUN-69

Medium-chain Acyl-CoA Dehydrogenase (MCAD) Deficiency Management in the Laboring Parturient

Presenting Author: Felipe D Perez MD
Presenting Author's Institution: Stanford University Medical Center - Stanford, California
Co-Author: John J Kowalczyk MD - Stanford University Medical Center - Stanford, California
Pamela Flood MD, MA - Stanford University Medical Center - Stanford, California
Andrea Traynor MD - Stanford University Medical Center - Stanford, California

Introduction: Medium-chain Acyl-CoA Dehydrogenase (MCAD) deficiency is an autosomal recessive disorder defined by the inability of the body to convert medium chain fatty acids into acetyl-CoA via oxidative catabolism (1). Patients undergoing fasting are at high risk of hypoketotic hypoglycemia, rhabdomyolysis, cardiac arrest, encephalopathy, respiratory arrest, and sudden death (2). This syndrome significantly increases risks to the fasting laboring parturient with increased metabolic demands.

Case Report: A 31yo G1P0 Caucasian female with MCAD deficiency and GDMA2 (on insulin) was admitted at 39 weeks' gestation for induction of labor. She was diagnosed on newborn screen and followed by endocrinology throughout her life, including during pregnancy. She was referred to the High-Risk Obstetric Anesthesiology Clinic for multidisciplinary peripartum planning. During early labor she was continued on her home medication of L-carnitine 1000mg BID and normal diet. Her blood glucose was checked every 4 hours by finger stick (FSBG) and corrected with a mild insulin sliding scale. Epidural was offered, but the patient preferred nitrous oxide for pain management. Oxytocin infusion was initiated 35 hours after admission at which point she was switched to clear liquids, and a dextrose 5% lactated ringers infusion. FSBG were checked every hour with mild insulin sliding scale. Her glucose ranged from 83 to 171. She used nitrous oxide for labor analgesia during active labor and had a spontaneous vaginal delivery. A healthy baby boy was delivered with APGARS of 8 and 9 at 1 and 5 minutes respectively. No neonatal hypo- or hyperglycemia was observed and 24-hour glucose levels were between 47-79 mg/dl.

Discussion: MCAD deficiency presents significant risk to the laboring parturient. There has only been one prior case reported in the literature of a nulliparous parturient with MCAD deficiency that received spinal-epidural anesthesia, fasted, and was induced for one hour prior to delivery (3). Our patient benefited from multidisciplinary planning and peripartum management given the longer time in labor. Laboring patients with MCAD deficiency require close glucose monitoring and dextrose infusion when fasting, in vomitus or active labor.

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Abstract #:SUN-70

Allergy testing during pregnancy – and the culprit is…

Presenting Author: Leslie Bobb OB Anesthesia Fellow
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Co-Author: Oscar Michael J Coppes MD - BWH - Boston, MA
Mihaela Podovei MD - BWH - Boston, MA

We discuss the case of a patient that presents to the labor floor carrying a history of local anesthetic reactions.

32 yo G2P1 at 30 wks gestation consults the OB anesthesia service to discuss options for labor analgesia. As a teenager, she received EMLA topical cream for laser hair removal, and had a delayed reaction that included shortness of breath and throat discomfort. She went to the ED where she was observed without treatment. About one year prior to the current visit she had a primary cesarean section for fetal intolerance to labor. The anesthesiologist discussed the risk and benefits of regional versus general, patient insisted to receive regional anesthesia despite the EMLA reaction, and as her reaction was nonspecific (happened at home, delayed compared to when she received the EMLA, and no drugs were administered in the ED), the cesarean section was performed under spinal anesthesia. 30 minutes after the spinal placement (1.6 mL of 0.75% bupivacaine in 8.25% dextrose, with 100mcg of preservative free hydromorphone and 15 mcg fentanyl), she developed eyelid/periorbital swelling. No shortness of breath/wheezes, no hives, hemodinamically stable. She received diphenhydramine, famotidine, hydrocortisone and the swelling resolved.

Based on her history, she was advised that, without consultation with an allergist, she is not a candidate for local anesthetics. She was not interested either in unmedicated childbirth or general anesthesia for cesarean section, so she agreed to follow up with the allergy clinic. Our service provided the allergy service with a list of medication she received during the case. She underwent skin testing for cefazolin, ondansetron, bupivacaine, lidocaine and chloroprocaine. She had negative skin testing for cefazoin, bupivacaine, lidocaine and chloroprocaine. In addition, the clinic went away and did lidocaine challenge testing, and was completely negative. Our patient did have positive skin testing to ondansetron. Upon reviewing her cesarean section record, ondansetron was the last medication administered minutes before the reaction was documented.

Allergy skin testing (ST) and local anesthetic challenges have been documented in pregnancy (1,2). Negative ST results obtained in pregnancy allow for safe use of the drug at the time of delivery (3). The main concern against doing testing while pregnant is the potential fetal morbidity in case of a maternal anaphylactic reaction. While we do no recommend routine testing in pregnancy, in certain cases, where the results can significantly alter the clinical management, careful testing is in the best interest of the patient. In our case, by testing, potential harm was prevented, as the ondansetron was not on our radar, and most of our patients receive this medication during their stay on labor and delivery.

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Abstract #:SUN-71

Apneic Oxygenation in a Pregnant Woman Requiring Tracheal Dilation.

Presenting Author: John J Kowalczyk MD
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Co-Author: Brendan Carvalho MBBCh, FRCA - Stanford University School of Medicine - Stanford, CA
Mary Yurashevich MD, MPH - Stanford University School of Medicine - Stanford, CA
Kelly Fedoruk MD, FRCPC - Stanford University School of Medicine - Stanford, CA
Jeremy Collins MBChB, FRCA - Stanford University School of Medicine - Stanford, CA

Introduction: Transnasal, humidified, rapid insufflation ventilatory exchange (THRIVE) maintains oxygenation and reduces PaCO2 rise in non-pregnant patients during general anesthesia when compared with classic apneic oxygenation (1). THRIVE has only been computer-modeled in pregnant women during apneic oxygenation under general anesthesia (2). Physiologic changes of pregnancy that increase metabolic rate may attenuate the utility of THRIVE in this population (3). This is the first report of using THRIVE for apneic oxygenation in a pregnant woman undergoing tracheal dilation.

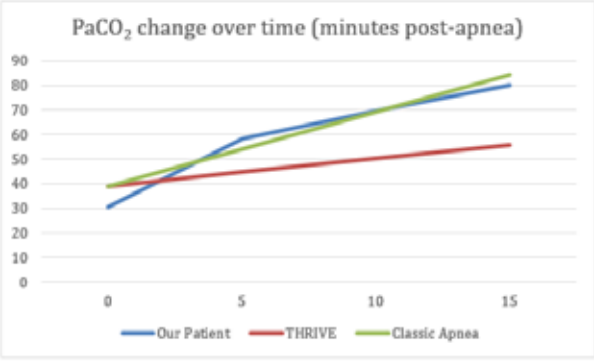
Case Report: A 42 yo G1P0 (BMI 26.3) at 31 weeks gestation presents with a history of idiopathic subglottic stenosis with increasing dyspnea. Repeat tracheal dilation was planned, which required general anesthesia without intubation. We elected to maintain oxygenation with THRIVE. Repeated ABG measurements were obtained due to concern for rapid CO2 rise with associated acidosis. Following preoxygenation with 100% O2 at 30 L/min, anesthesia was induced with propofol 160 mg and neuromuscular blockade provided with rocuronium 30 mg. The larynx was suspended with a rigid operating laryngoscope and O2 was increased to 70 L/min. Anesthesia was maintained with a propofol and remifentanil infusion. ABG was measured every 5 minutes during apnea with a point-of-care iSTAT® (Abbott, NJ). Supraglottic jet ventilation was available if significant hypercapnia and acidosis developed. ABG results at baseline prior to preoxygenation, during apnea and in recovery are shown in Fig 1a. The case was completed uneventfully.

Discussion: Data from our case supports prior reports in non-pregnant patients showing a markedly extended time to desaturation; our patient maintained a SaO2 of 99% at 15 min. However, the rise in PaCO2 over time is increased compared to THRIVE applied to non-pregnant patients (2), and more closely mirrors classic apneic oxygenation in non-obstetric patients. Our data supports prior computer-modeled apneic oxygenation with THRIVE in pregnancy (3). Although we showed sustained oxygen saturation, the rise in PaCO2 and corresponding decrease in pH may limit the effectiveness of THRIVE for prolonged apnea in pregnant surgical patients.

Fig 1a: Physiological Variables During Apneic Oxygenation with THRIVE Applied

Variables	Baseline	Apnea		Recovery
		5 min	10 min	15 min	30 min post-apnea
SpO_2 (%)	98	100	100	99	100
PaO_2 (mmHg)	110	320	225	170	253
$PaCO_2$ (mmHg)	31	58	70	80	39
pH	7.43	7.24	7.22	7.14	7.40

Fig 1b: $PaCO_2$ change over time in our pregnant patient, THRIVE applied to a non-pregnant apneic cohort and classic apneic oxygenation during general anesthesia.



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Abstract #:SUN-72

Acute Spinal Cord Injury in Pregnancy

Presenting Author: Bridget R Sullivan MD
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Ray Paschall MD - Vanderbilt University Medical Center - Nashville, TN
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Limited literature exists concerning the management of paturients suffering acute spinal cord injury. This case report presents the management of a parturient who suffered an acute spinal cord transection.

A 34-year-old G5P4 Spanish speaking female at 26+5/7 weeks presented following head-on MVC. Upon arrival both mother and fetus were hemodynamically stable. ATLS protocol was initiated by the emergency room staff with a primary survey including fetal ultrasound by OB/GYN staff which was reassuring and negative for abruption. Her injuries were significant for hemopneumothorax and complete spinal cord transection at the T4-T5 level. Large bore peripheral access was obtained bilaterally in addition to an arterial line for hemodynamic monitoring. A phenylephrine infusion was started to maintain spinal cord perfusion.

After multidisciplinary discussion, it was decided that Stat Cesarean Delivery would be reserved for maternal cardiac arrest. Continuing the pregnancy was the goal. Scheduled spine stabilization was made for the next available operating slot.

Multiple evaluations were made to assess for occult abruption and labs drawn per usual protocol which were consistently negative for abruption. Fetal monitoring was performed pre-operatively. She was taken to the operating room for prone T3-T8 posterior spinal fusion. Supplies for emergency Cesarean Delivery were immediately available in the operating room. Following rapid sequence induction of general anesthesia and prone positioning, a lumbar epidural catheter was placed under fluoroscopy due to concern for precipitation of pre-term labor in addition to autonomic hyperreflexia. Surgical course was otherwise uneventful and patient was transferred to the ICU intubated on norepinephrine drip. Fetal heart tones were checked post-operatively, which were within normal limits.

On POD#2, she was no longer requiring hemodynamic support and met extubation criteria. Cesarean Delivery indications were broadened and continuous external fetal monitoring was initiated. She was transferred to an outpatient rehabilitation center on hospital day #15, with weekly visits to the OB Clinic for NSTs. She was admitted several more times in her prenatal course for urinary tract infection and C. Difficile colitis. She was eventually admitted in preterm labor at 35 weeks and was monitored on the inpatient unit until she began labor induction at 37 weeks gestation. She displayed no signs or symptoms of autonomic hyperreflexia throughout her pregnancy. A lumbar labor epidural was placed prior to the start of induction in the seated position without issue. She had a successful vaginal delivery and bilateral tubal ligation was performed. She was transferred back to the rehabilitation facility on PPD #5 when she was meeting all post-partum goals.

Abstract #:SUN-73

Management of postpartum hemorrhage (PPH) and disseminated intravascular coagulation (DIC) in a parturient with DTGA – another factor to consider

Presenting Author: Jean Marie Carabuena MD
Presenting Author's Institution: Brigham and Women's Hospital - Boston, MA
Co-Author: Karishma Patel Bhangare MD - Brigham and Women's Hospital - Boston, MA

Background: Patients with congenital heart disease are at increased risk of obstetric complications, including PPH.1 Safety bundles provide recommendations for blood management in obstetric hemorrhage.2 We report the use of prothrombin complex concentrates (PCC) in the treatment of refractory DIC.

Case: A 32-year-old G2P1 with DTGA was s/p elective CS (breech) 2 years prior without complication. She had a neonatal atrial switch procedure and insertion of a pacemaker 16 years prior to this pregnancy. Her systemic right ventricle had borderline depressed function. She was admitted for TOLAC of an intrauterine fetal demise at 38 weeks. Hours into labor with epidural analgesia, she became hypotensive and was treated with fluids and phenylephrine. Hypotension recurred as labor progressed. With suspicion of chorioamnionitis and early sepsis, delivery was assisted with forceps. Immediately post Stage 3, she had hemorrhage with progressive hypotension and tachycardia. The hemorrhage protocol was activated. She was transferred to the OR for laceration repair (eventual laparotomy) and resuscitation. This included crystalloid, over 20 liters of banked blood products (PRBC, FFP, cryoprecipitate, platelets) and fibrinogen concentrate. Despite ongoing resuscitation, she continued to massively exsanguinate. PCC was administered at a dose of 50U/Kg. Almost immediately, her ability to form clot dramatically improved. Exposure revealed uterine rupture from the previous hysterotomy extending to the uterine artery. A hysterectomy was performed. Estimated blood loss was 12-15 liters. She was brought to the ICU intubated and in stable condition with good hemostasis.

Discussion: The presence of a hemorrhage protocol with adequate blood bank personnel was vital in resuscitation. There is no recommendation on the use of PCC in obstetric hemorrhage. PCC is a combination of factors II, VII, IX, X (increasing the generation of thrombin), protein C and protein S (preventing excessive clot). Arterial thrombosis, however, is a potential risk.3 The utility of PCC for PPH and DIC has not been reported. In weighing the risk benefit in this case, it proved to be an important factor to consider. This case demonstrates the importance of obstetric hemorrhage protocols, the need for effective communication between a number of teams (Fig), and consideration of PCC in refractory DIC.

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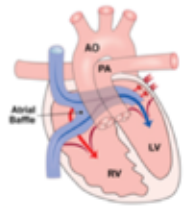

ACHD cardiologist
Nursing team
Neonatologist
Surgical technician
General/GYN surgeon
Blood bank team
Interventional radiologist
Transport team
ICU team
Respiratory specialist
Psychological support

ROLES in POSTPARTUM HEMORRHAGE

OBSTETRICIAN	ANESTHESIOLOGIST
RESUSCITATION	**RESUSCITATION**
Determine and control the source of bleeding	Intravenous access
DIFFERENTIAL and TREATMENT	Circulatory support
Lacerations (repair)	Transfusion of blood products
Sepsis(antibiotics)	Keep patient warm
DIC (transfusion)	Clarify degree of hemostasis
Uterine rupture (surgical)	**GENERAL ANESTHESIA**
Atony (uterotonics, Bakri)	Ensure comfort
Accreta (surgical)	**INVASIVE MONITORING**
Abruption (transfusion)	Arterial line
SURGICAL ASSISTANCE	Central line
Determine need for hysterectomy/exploratory laparotomy and assistance from general/GYN surgeon	**POSTOPERATIVE INTENSIVE CARE**
	Airway support
	Fluid balance
	Circulatory support

Figure: Teams and services involved in the care of patients with adult congenital heart disease (ACHD) and the role of the obstetrician and anesthesiologist in PPH.

Abstract #:SUN-74

Point-of-Care Ultrasound for Obstetric Anesthesia Care: Case Report

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Co-Author: Ping Li MD - Brigham and Women's Hospital - Boston, MA
Suneetha Medhu MD - Brigham and Women's Hospital - Boston, MA

Background: Ultrasound has been used widely as a point-of-care imaging modality for clinical care. We report a parturient who had lumbar surgery history arrived for consultation for anesthesia care for her upcoming delivery.

Case report: A 36-year-old G2P0 woman was referred by her obstetrician to the obstetric anesthesia consult at 29w5d gestation. She reported that she had a history of herniated lumbar disk and underwent a very complex lumbar spine operation 10 years ago in the midwest. She could not recall the detailed hospital name. In 2015, at age of 34, she had been through an abdominal myomectomy operation under general anesthesia. On examination, there were no obvious abnormalities of airway, lungs, cardiac and lower extremities, except for a skin scar on her lower back.

We used ultrasound to examine her lumbar spine. Bilateral Harrington rods were identified on bilateral L4-L5-S1 levels, which cleared her mid and upper lumbar spine for potential neuraxial approach for her upper coming labor and delivery.

For completion of medical documentation, a medical record release request was sent out for her past medical record. Upon multiple search and telephone calls, we identified the hospital where she received her past medical care. The old record indicated that she has ungenerative disk disease with complex posterior lumbar interbody fusion L4-S1 with fresh frozen femoral allograft and infusion. An old CT lumbar scan was received which showed the Harrington rods were inserted from the level of L4 to the level of S1. We counsel the patient for potential neuraxial anesthesia/analgesia.

Discussion: In parturient with spinal surgery in lumbosacral region, neuraxial analgesia and/or anesthesia should still be considered. Although cross cut image may not always show rods clearly, sagittal images usually can easily identify the screws and give the long axis of the rods. The patient is estimated to be induced on March 17, 2017. We will report our analgesia/ anesthesia experience on her at the SOAP meeting.

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Figure 1. CT scan (left) and lumbar ultrasound (right)

Abstract #:SUN-75

Cesarean Delivery 40 Days after STEMI with PCI and Drug Eluting Stent Placement

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Introduction: Acute myocardial infarction is a rare event during pregnancy, with an estimated incidence of one in 16,000 pregnancies. Cardiovascular changes associated with pregnancy, labor, and delivery may precipitate myocardial ischemia. Parturients with recent myocardial infraction require careful anesthetic and physiological management of labor and delivery in order to avoid further ischemia and myocardial decompensation.

Case Description: A 28 year-old primiparous woman at 34+6 weeks gestation presented with chest pain. Her past medical history was significant for osteogenesis imperfecta and a previous right coronary artery dissection requiring three cardiac stents six years earlier. Her examination revealed EKG changes, elevated troponins, and new echocardiographic wall motion abnormality consistent with STEMI. Angiography revealed an acute dissection of the LAD coronary artery and a drug eluting stent was placed by interventional cardiology. Once stable, the patient was discharged on dual antiplatelet therapy. Coordination between cardiology, maternal fetal medicine, and anesthesiology physicians resulted in a plan for a scheduled induction of labor four weeks after cardiac stenting. A lumbar MRI was performed revealing anatomy favorable for lumbar epidural placement. The patient was instructed to stop clopidogrel seven days before the scheduled induction.

Upon planned presentation, the patient's interval medical history was reviewed and continuous hemodynamic monitoring, including an arterial line, was initiated. Labor analgesia was achieved with a carefully titrated lumbar epidural with planned passive second stage of labor with assisted vaginal delivery in order to reduce maternal cardiac stress. However, due to arrest of fetal descent, a cesarean delivery was performed in a controlled manner under epidural anesthesia, producing a vigorous female infant with APGARs of 9/9. The patient tolerated the procedure well without any cardiac events and had an unremarkable postpartum course.

Discussion: Due to the rare nature of peripartum myocardial infarction and variable patient characteristics, there is no consensus on the optimal method of delivery for these cases. Both vaginal and cesarean deliveries are reported in the literature and each has its theoretical advantages. In this case, cesarean delivery was indicated due to fetal malposition and arrest of descent and was safely performed in a controlled manner via epidural anesthesia.

The successful management of this patient was ultimately the result of a multidisciplinary approach with close collaboration between obstetricians, cardiologists, and anesthesiologists.