SOAP
Society for Obstetric Anesthesia and Perinatology

2019 Sol Shnider, M.D. Obstetric Anesthesia Meeting

The premier review meeting for clinical obstetric anesthesia, established in 1976

March 14-17, 2019
Grand Hyatt Hotel on Union Square
San Francisco, California

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

American Society of Anesthesiologists™

SOAP
Society for Obstetric Anesthesia and Perinatology

Welcome to the SOAP 2019 Sol Shnider, M.D. Obstetric Anesthesia Meeting

On behalf of the leadership of the Society for Obstetric Anesthesia and Perinatology (SOAP), I would like to welcome you to the SOAP Sol Shnider 2019 Obstetric Anesthesia Meeting. This outstanding meeting has an extraordinarily rich history and an outstanding track record. The meeting was founded by Drs. Sol Shnider, Sam Hughes and Mark Rosen in 1976, and remains one of the premier refresher course programs for obstetric anesthesia in the world.

The goal for this meeting is to provide practical, high quality educational content for those who practice clinical obstetric anesthesia. We have carefully structured the program based on solicited feedback from practitioners and previous meeting attendees to cover all key aspects in the field of obstetric anesthesia in a clinically-focused program. The meeting presentations will be given by SOAP's best speakers and content experts, as well as accomplished obstetric anesthesiologists in the Bay Area.

I am proud to present what we hope for you will be a highly enriching program, a comprehensive update on current optimal practice, and a meaningful professional experience for all those that attend. I look forward to seeing and interacting with you at the SOAP Sol Shnider 2019 Obstetric Anesthesia Meeting.

Sincerely,

Brendan Carvalho MBBCh, FRCA
Chair, Program Committee
SOAP Sol Shnider 2019 Meeting

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Program Committee

Brendan Carvalho, M.B., B.Ch., FRCA
Program Chair
Stanford University School of Medicine

Pedram Aleshi, M.D.
University of California, San Francisco

Alexander Butwick, M.B., B.S., FRCA, M.S.
Stanford University School of Medicine

Jennifer Lucero, M.D., M.S.
University of California, San Francisco

Mark Rollins, M.D., Ph.D.
University of California, San Francisco

Faculty

Gillian Abir, M.B, Ch.B., FRCA
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Stanford University School of Medicine

Mark D. Rollins, M.D., Ph.D.
University of Utah

Katherine M. Seligman, M.D.
University of New Mexico

Caitlin D. Sutton, B.S., M.D.
Baylor College of Medicine

Andrea J. Traynor, M.D.
Stanford University School of Medicine

Lawrence C. Tsen, M.D.
Brigham & Women's Hospital

Exhibits Information

Exhibits will be open during the following times:

Friday, March 15, 2019:
7:00 - 8:00 a.m.
9:45 - 10:30 a.m.
3:15 - 4:00 p.m.

Saturday, March 16, 2019:
7:00 - 8:00 a.m.
9:45 - 10:30 a.m.
3:15 - 4:00 p.m.

Learning Objectives

At the conclusion of this learning activity, the participant will be able to answer these questions:

- Apply the latest medical, surgical and pharmacological advances in obstetrical hemorrhage management
- Integrate cutting-edge neuraxial techniques including programmed intermittent epidural bolus (PIEB) and dural puncture epidural (DPE) to optimize labor analgesia
- List the recent publications that will most impact your obstetric anesthesia practice
- Construct and implement an enhanced recovery after surgery (ERAS) program for cesarean delivery
- Evaluate point of care ultrasound to enhance your obstetric anesthesia care
- Implement the latest pre-eclampsia management and care bundles
- Identify how to prevent and treat side effects of neuraxial opioids
- Distinguish how to manage pregnant patients with chronic pain and opioid addiction
- Apply best practice for the management of post-dural puncture headaches
- Recognize how to provide optimal anesthesia for non-obstetric surgery during pregnancy and postpartum tubal ligation

Program Information

Jointly Provided by: American Society of Anesthesiologists; SOAP Society for Obstetric Anesthesia and Perinatology

Mission of SOAP
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.

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

MOCA®

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

The Maintenance of Certification in Anesthesiology Program® logo is a trademark of the American Board of Anesthesiology.

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

AANA Credits (Program offering Friday through Sunday)
This program has been prior approved by the American Association of Nurse Anesthetists for 17 Class A CE credits; Code Number 1036961; Expiration Date 3/17/2019.

Hands-on Ultrasound for the Obstetric Anesthesia Provider: Cardiac Ultrasound, Hemodynamic Exam, Pulmonary Evaluation, Ultrasound Guided TAP Blocks & Neuraxial Techniques and Basic Fetal Ultrasound
This program has been prior approved by the American Association of Nurse Anesthetists for 4.00 Class A CE credits; Code Number 1036960; Expiration Date 3/14/2019.

The American Society of Anesthesiologists designates this live activity for a maximum of *4 AMA PRA Category 1 Credits*™. Physicians should claim only the credit commensurate with the extent of their participation in the activity.

CEP Number
Provider approved by the California Board of Registered Nursing, Provider #CEP16975, for 17 Contact Hours.

Target Audience
This meeting is intended for specialists in anesthesiology to include anesthesiologists, nurse anesthetists, residents and fellows. Pediatricians, neonatologists, perinatologists, obstetricians, general practitioners, delivery room nurses, nurse midwives, and clinical pharmacologists may also find educational benefit. 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 meeting.

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

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 2019 Sol Shnider, M.D. Obstetric Anesthesia 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, and AAs or the equivalent. CE credit will be offered to CRNAs.

Evaluations
Electronic evaluations by questionnaire will address program content, presentations, and possible bias.

Special Needs Statement
The Society for Obstetric Anesthesia and Perinatology is committed to making its activities accessible to all individuals and fully complies 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 soap@soap.org.

Statement of Need
The SOAP Sol Shinder, M.D. Obstetric Anesthesia Meeting provides a forum devoted exclusively to obstetric anesthesia at which leaders in the field present recent clinical updates and other relevant clinical information.

Commercial Support Acknowledgement
This activity is supported by educational grants. A complete list of supporters will be available in the course syllabus.

Disclosure
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 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.

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

Disclosures

Each presenter is required to disclose the existence of any financial interest and/or other relationship(s) (e.g. employee, consultant, grant recipient/research support) he/she might have with a.) the manufacturer(s) of any commercial product(s) to be discussed during his/her presenation and/or b.) the commercial contributor(s) of the activity.

Planner/Faculty Disclosures

The following planning committee members and/or faculty have indicated that they have relevant financial relationships with commercial interests.

Alexander Butwick: Honoraria, Consulting

Ashraf Habib: Funded Research, Consulting, Honoraria

Brendan Carvalho: Funded Research

All other faculty, planners and staff have reported no relevant financial relationships with commercial interests.

Pre-Meeting Workshop

Thursday, March 14, 2019

SOAP is offering the Hands-on Ultrasound for the Obstetric Anesthesia Provider: Cardiac Ultrasound, Hemodynamic Exam, Pulmonary Evaluation, Ultrasound Guided TAP Blocks & Neuraxial Techniques and Basic Fetal Ultrasound Workshop the day before the full 2019 SOAP Sol Shnider, M.D. Obstetric Anesthesia Meeting begins.

Meeting attendees are encouraged to register for these events early. Please note that registration for the workshops requires a separate, additional fee from the full SOAP 2019 Sol Shnider, M.D. Obstetric Anesthesia Meeting registration.

Hands-on Ultrasound for the Obstetric Anesthesia Provider: Cardiac Ultrasound, Hemodynamic Exam, Pulmonary Evaluation, Ultrasound Guided TAP Blocks & Neuraxial Techniques and Basic Fetal Ultrasound

Co-Directors:
Kristine E. W. Breyer, MD and
Lindsey Huddleston, MD, PhD

1:00 p.m. – 5:00 p.m.

LOCATION
Grand Hyatt Hotel

Program Schedule

Thursday, March 14, 2019

1:00-5:00pm — **Workshops: Ultrasound**
Co-Directors: Kristine Breyer, M.D. & Lindsey Huddleston, M.D., Ph.D.

Friday, March 15, 2019

7:00 – 7:45 a.m. — **Registration and Continental Breakfast**

7:45 – 8:00 a.m. — **Opening Welcome**

Session I: Optimizing Labor Analgesia
Moderator: Alexander Butwick, M.B.,B.S., FRCA, M.S.

8:00 – 8:30 a.m. — **CSE, DPE, Epidural: Is there an Optimal Labor Analgesia Insertion Technique?**
Lawrence Tsen, M.D.

8:30 – 9:00 a.m. — **PIEB, CEI, PCEA: Is there an Optimal Labor Analgesic Maintenance Technique?**
Brendan Carvalho, M.B., B.Ch., FRCA

9:00 – 9:30 a.m. — **Alternatives to Neuraxial Analgesia for Labor Pain Management**
Jennifer M. Lucero, M.D., M.S.

9:30 – 9:45 a.m. — **Panel Discussion**

9:45 – 10:30 a.m. — **Coffee Break**

Session II: Comorbidities and High-Risk Patients
Moderator: Lawrence Tsen, M.D.

10:30 – 11:00 a.m. — **Management of Parturients with Cardiac Disease**
Ronald Pearl, M.D., Ph.D.

11:00 – 11:30 a.m. — **Latest on Pre-Eclampsia Management and Care Bundles**
Gillian Abir, M.B., Ch.B., FRCA

11:30 – 12:00 p.m. — **Anesthetic Management of Invasive Placental Disease**
John C. Markley, M.D., Ph.D

12:00 – 12:15 p.m. — **Coffee Break**

12:15 – 1:30 p.m. — **Lunch (hosted)**

Session III: Enhanced Recovery and Cesarean Anesthesia
Moderator: Brendan Carvalho, M.B., B.Ch., FRCA

1:30 – 2:00 p.m. — **Recommended ERAS Protocols for Cesarean Delivery**
Ashraf S. Habib, M.B.,B.Ch., M.Sc., M.S.N., FRCA

2:00 – 2:30 p.m. — **Setting up and Evaluation of a Successful ERAS Pathway for Cesarean Delivery**
Eric J. Hunt, M.D., Ph.D.

2:30 – 3:00 p.m. — **Regional Blocks for Cesarean Delivery Analgesia: TAP, QL and Beyond**
Pedram Aleshi, M.D.

3:00 – 3:15 p.m. — **Panel Discussion**

3:15 – 4:00 p.m. — **Coffee Break**

Session IV: Tips and Techniques
Moderator: Pamela D. Flood, M.D., M.A.

4:00 – 4:30 p.m. — **Trouble-Shooting Labor Epidurals and Failed Top-ups**
Jalal A. Nanji, B.Sc., M.D., FRCPC

4:30 – 5:00 p.m. — **Reducing Obstetric General Anesthesia: 10 Practical, Tested Tips**
Lawrence Tsen, M.D.

5:00 – 5:30 p.m. — **Preventing and Treating Side Effects of Neuraxial Opioids**
Ashraf S. Habib, M.B.,B.Ch., M.Sc., M.S.N., FRCA

5:30 – 5:45 p.m. — **Panel Discussion**

6:00 – 7:30 p.m. — **Reception**

Saturday March 16, 2019

7:00 – 8:00 a.m. — **Registration and Continental Breakfast**

Session V: Obstetric Anesthesia Safety Session
(ABA Part 2 MOCA Patient Safety Credit)
Moderator: Gillian Abir, M.B., Ch.B., FRCA

8:00 – 8:30 a.m. — **Current Evidence for the Prevention and Treatment of Spinal Hypotension**
Mark D. Rollins, M.D., Ph.D.

Program continued on next page

Program Schedule

Saturday March 16, 2019 *cont.*

8:30 – 9:00 a.m. **Pregnant Patient with Chronic Pain and Opioid Addiction**
Pamela D. Flood, M.D., M.A.

9:00 – 9:30 a.m. **OSA in the Parturient: Implications for Peri and Post-Operative Period**
Jeremy Collins, FRCA, M.B.,Ch.B.

9:30 – 9:45 a.m. **Panel Discussion**

9:45 – 10:30 a.m. **Coffee Break**

Session VI: New Developments and Concepts

Moderator: Jennifer M. Lucero, M.D., M.S.

10:30 – 10:55 a.m. **Point of Care Ultrasound in Obstetric Anesthesia**
Clemens M. Ortner, M.D., M.S., DESA

10:55 – 11:15 a.m. **Neuraxial Ultrasound: Practical Guide to Adoption**
Katherine M. Seligman, M.D.

11:15 – 12:00 p.m. **Sam Hughes Lecture: Obstetric Anesthesia Year in Review**
Ashraf S. Habib, M.B.,B.Ch., M.Sc., M.S.N., FRCA

12:00 – 12:15 p.m. **Panel Discussion**

12:15 – 1:30 p.m. **Lunch on your own**

Session VII: Obstetrical Hemorrhage Update

Moderator: Andrea Traynor

1:30 – 1:50 p.m. **Optimal Uterotonic Administration to Prevent and Treat Uterine Atony**
Lawrence Tsen, M.D.

1:50 – 2:10 p.m. **Obstetrical Management of Post-Partum Hemorrhage**
Maurice L. Druzin, M.D.

2:10 – 2:30 p.m. **Transfusion Practices for Obstetric Hemorrhage: What's the latest?**
Anil K Panigrahi, M.D., Ph.D.

2:30 – 2:50 p.m. **Pharmacological Management of Obstetric Hemorrhage**
Alexander Butwick, M.B.,B.S., FRCA, M.S.

2:50 – 3:15 p.m. **Panel Discussion**

3:15 – 4:00 p.m. **Coffee Break**

Session VIII: Clinical Conundrums in Obstetric Anesthesia

Moderator/Lead: Alexander Butwick, M.B.,B.S., FRCA, M.S.

4:00 – 5:30 p.m. **Expert Panel:** Lawrence Tsen, MD, Ashraf S. Habib, M.B.,B.Ch., M.Sc., M.S.N., FRCA, Edward T. Riley, M.D., Jennifer M. Lucero, M.D., M.S.

Sunday March 17, 2019

7:00 – 8:00 a.m. **Registration and Continental Breakfast**

Session IX: Management Updates Safety Session *(ABA Part 2 MOCA Patient Safety Credit)*

Moderator: Mark D. Rollins, M.D., Ph.D.

8:00 – 8:30 a.m. **Anesthesia for Non-Obstetric Surgery During Pregnancy**
Gillian Abir, M.B., Ch.B., FRCA

8:30 – 9:00 a.m. **Eating During Labor and the "Full Stomach" Pre and Post-Delivery**
Atisa B Britton, M.D.

9:00 – 9:30 a.m. **Post-Partum Tubal Ligation: Optimal Anesthetic Technique and Timing**
Andrea J. Traynor, M.D.

9:30 – 9:45 a.m. **Panel Discussion**

9:45 – 10:30 a.m. **Coffee Break**

Session X: Complications and Uncommon Occurrences

Moderator: Brendan Carvalho, M.B., B.Ch., FRCA

10:30 – 11:00 a.m. **Ethical Dilemmas in Obstetric Anesthesia**
Caitlin D. Sutton, B.S., M.D.

11:00 – 11:30 a.m. **Management of Postpartum Headaches**
Jessica Ansari, M.D.

11:30 – 12:00 a.m. **The Diagnosis and Management of Peripartum Neurologic Complications**
Mark D. Rollins, M.D., Ph.D.

12:00 – 12:15 p.m. **Panel Discussion**

12:15 p.m. **Adjourn**

The Society for Obstetric Anesthesia and Perinatology would like to thank the following supporters and exhibitors of the 2019 Sol Shnider, M.D. Obstetric Anesthesia Meeting:

Platinum Supporter

Gauss Surgical

Website: www.gausssurgical.com

Gauss Surgical is a medical technology company using Artificial Intelligence to make surgery and childbirth safer and more cost-effective. Gauss's flagship product, Triton, uses the iPad to monitor blood loss from digital images of sponges and canisters, with the goal of recognizing hemorrhage early, optimizing transfusion decisions, and assisting with sponge management. Triton has been adopted by a wide network of hospitals covering over 100,000 surgeries annually, and has been clinically proven to improve patient outcomes and reduce cost. Learn more at www.gausssurgical.com.

Gold Supporter

Rivanna

Website: http://rivannamedical.com

Accuro® by RIVANNA® is the world's first spinal navigation device designed to improve the safety, speed, and efficiency of epidural and spinal anesthesia. The revolutionary platform features BoneEnhance®, which visualization of bony versus soft tissue anatomy, and SpineNav3D™, which automates measurements of the spinal midline, epidural depth and trajectory. Accuro was engineered and commercialized by RIVANNA, an innovative medical device company headquartered in Charlottesville, VA. For anesthesia providers, certainty can be effortless with Accuro. For more information, visit rivannamedical.com.

Bronze Supporters

Cerus Corporation

Website: https://www.cerus.com

Cerus Corporation is a biomedical company focused in the field of blood safety. Cerus markets and sells the INTERCEPT Blood System for platelets and plasma in the United States and around the world. The INTERCEPT Blood System reduces the risk of transfusion-transmitted infections by inactivating a broad range of pathogens such as viruses, bacteria, parasites and leukocytes that may be present in donated blood products. The INTERCEPT red blood cell system is in clinical development.

Envision Physician Services

Website: https://www.evhc.net

Envision Physician Services is the nation's largest anesthesia services provider. With more than 780 service contracts in 48 states, our anesthesia group administers more than 2.6 million anesthetics a year. We are a clinician-centric, physician-led company at local, regional and national levels. We encourage, develop and recognize our clinical leaders, and we help physicians and advance practice providers focus on medicine, not its administrative burden. We invest in our clinicians, providing them with the tools, resources and technologies they need to deliver high-quality patient care, including quality and performance reporting, operational support and risk management resources.

WWW.IMD-INC.COM

International Medical Development

Website:
http://www.imd-inc.com

IMD, Inc. offers the famous Gertie Marx needle and full line of spinal and epidural needles for Labor and Delivery, Pediatric, Myelograms and Lumbar Puncture.

Needles range from 50mm to 215mm. CSE sets with 3.5/5"/6"/7" epidural needles are matched with Gertie Marx spinal Needle. We are proud to say we are NEVER on backorder.

IMD also has new Fenestrated Needle for Peripheral Nerve Block to be used for post-operative pain relief after total knee replacement with excellent results. This unique needle has multiple side ports giving exceptional distribution of anesthetic.

Universal Anesthesia Services

Universal Anesthesia is looking for anesthesiologists who like to practice OB Anesthesia, are compassionate and empathetic physicians. Universal Anesthesia is a privately owned anesthesia company in Louisville, Kentucky, which provides anesthesia services for Norton Healthcare at two locations: Norton downtown and Norton Women's and Children's Hospital. Norton offers inpatient and outpatient medical/surgical care, full diagnostic services and 24-hour emergency care for men, women and children. Labor and Delivery services include 33 labor and delivery rooms, 59 mother-baby rooms, 5 ORs on the Labor and Delivery units in addition to 16 rooms in the main OR and the lithotripsy unit. OB Emergency Departments care for 16+ weeks' gestation patients. 24/7 OB anesthesiologists, hospitalists and neonatologists provide support. Norton has been designated Blue Distinction Center + Maternity Care, 4-Star Kentucky Infants Safe and Strong (KISS) designation and has a 44 bed Level III Neonatal Intensive Care Unit. Obstetric Anesthesia Consultants is the company under the Universal Anesthesia umbrella providing OB Anesthesia Services to Norton Healthcare.

Program Slides

Friday, March 15, 2019

Session I: Optimizing Labor Analgesia

Moderator: Alexander Butwick, M.B.,B.S., FRCA, M.S.

CSE, DPE, Epidural: Is there an Optimal Labor Analgesia Insertion Technique?
Lawrence Tsen, M.D.

PIEB, CEI, PCEA: Is there an Optimal Labor Analgesic Maintenance Technique?
Brendan Carvalho, M.B., B.Ch., FRCA

Alternatives to Neuraxial Analgesia for Labor Pain Management
Jennifer M. Lucero, M.D., M.S.

The CSE, DPE, and Epidural Technique

Is there an Optimal Labour Analgesia Technique?

SOAP Sol Shnider
Obstetric Anesthesia Meeting,2019

Lawrence C. Tsen, MD
Director, Center for Reproductive Medicine, Department of Anesthesiology, Perioperative & Pain Medicine, Brigham & Women's Hospital
Associate Professor in Anaesthesia
Harvard Medical School

No Disclosures

"...from so simple a beginning, endless forms most beautiful and most wonderful have been and are being evolved"

Origin of the Species
Darwin

A Darwinian Adventure

1809

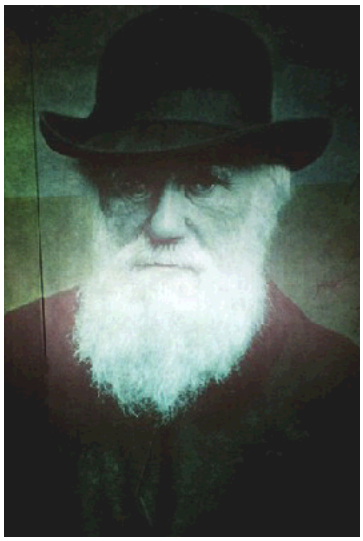
- Shrewsbury

1825

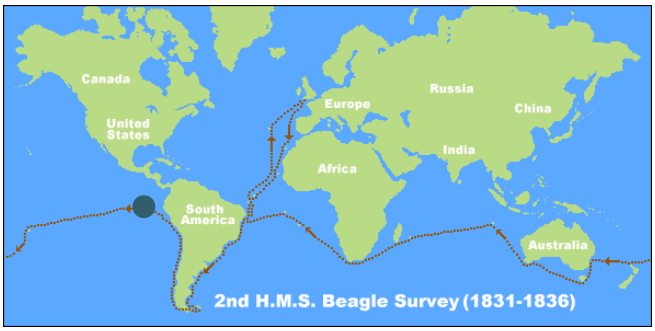
- Edinburgh
- Limb amputation
- Cambridge

1831

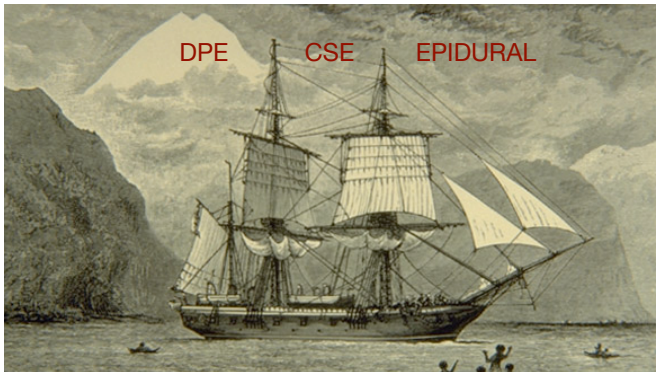
- HMS Beagle

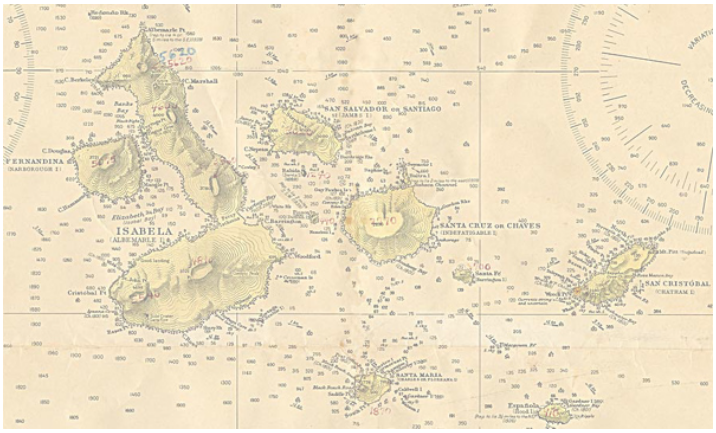


A Darwinian Adventure



A Darwinian Adventure





TECHNIQUES

Neuraxial Techniques

"Variability is not actually caused by man...but man can and does select the variations given to him by nature."

Origin of the Species
Darwin

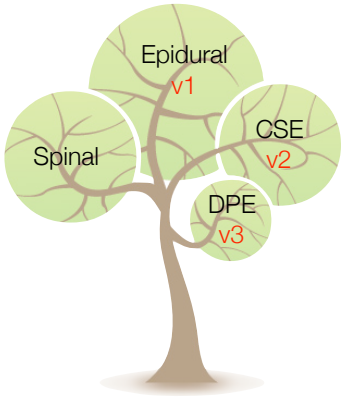
Neuraxial Techniques

"Ideal Technique"

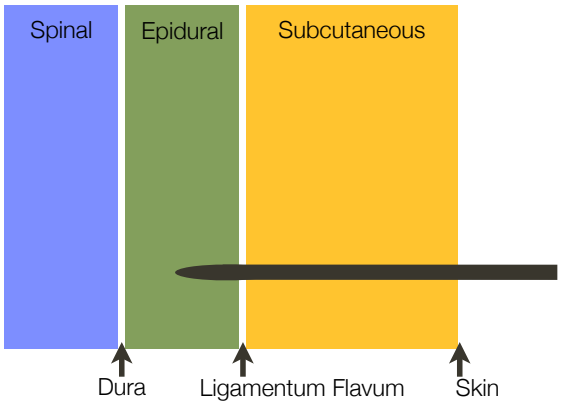
Quick Onset, Predictable Spread & Quality, Adjustable Depth & Duration, Minimal Motor Block, Minimal Maternal and Fetal Side Effects

Origin of the Species
Darwin

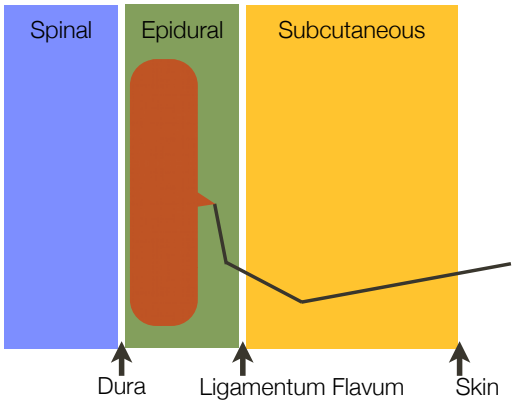
Neuraxial Techniques



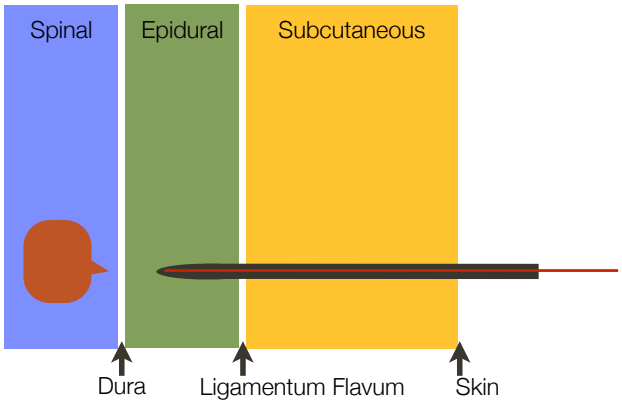
Epidural Technique



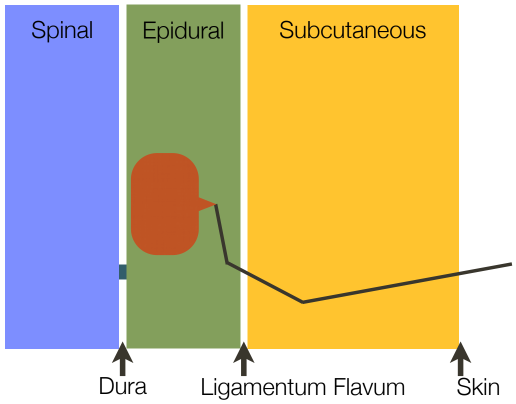
Epidural Technique



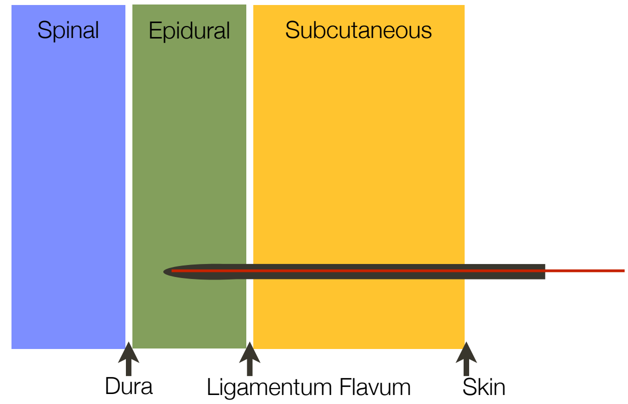
CSE Technique



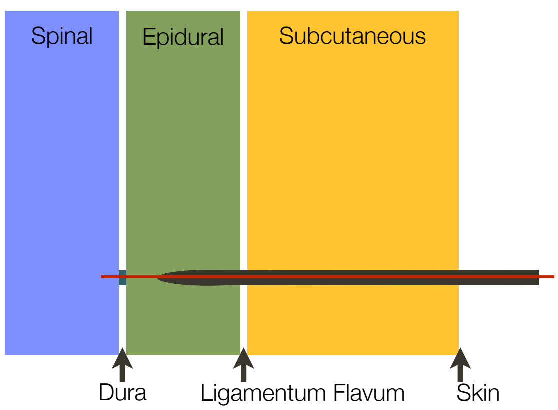
CSE Technique



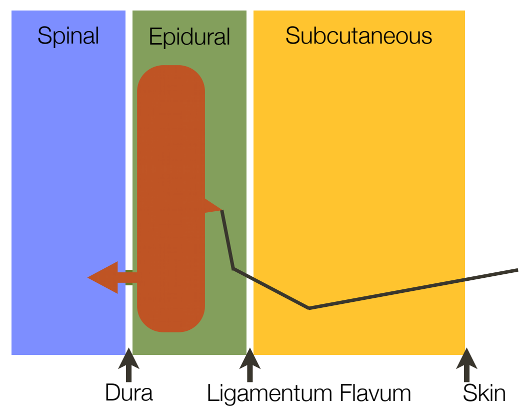
DPE Technique



DPE Technique



DPE Technique



DPE Technique

Study	Needle	Anesthetic	Effect
Thomas	27G	2% Lido 10 mL	No
Suzuki	26G	2% Mepiv 18 mL	Yes
Wilson	26G	0.125% Bup 12 mL	Yes
Cappiello, Tsen	25G	0.25% Bup 12 mL	Yes
Chau, Tsen	25G	0.125% Bup 20 mL	Yes
Chau, Tsen	25G	0.1% Bup 16 mL	Yes

Faster, Greater Sacral Spread
No Difference Hypotension, Highest Sensory or PDPH

Thomas J, et al. Anesth 2005; Suzuki N, et al. A&A 1996; Cappiello E, Tsen LC. A&A 2008; Chau A, Tsen LC. A&A 2017; Wilson SH, et al. A&A 2018

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Chau, Tsen	25G	0.125% Bup 20 mL	Yes
Chau, Tsen	25G	0.1% Bup 16 mL	Yes

No Difference Inadequate, Sacral, Bilateral
No Difference Hypotension, Highest Sensory or PDPH

Thomas J, et al. Anesth 2005; Suzuki N, et al. A&A 1996; Cappiello E, Tsen LC. A&A 2008; Chau A, Tsen LC. A&A 2017; Wilson SH, et al. A&A 2018

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Faster, Greater Sacral Spread, Bilateral
No Difference Hypotension, Highest Sensory or PDPH

Thomas J, et al. Anesth 2005; Suzuki N, et al. A&A 1996; Cappiello E, Tsen LC. A&A 2008; Chau A, Tsen LC. A&A 2017; Wilson SH, et al. A&A 2018

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Chau, Tsen	25G	0.125% Bup 20 mL	Yes
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Faster, Greater Sacral Spread, Bilateral
No Difference Hypotension, Highest Sensory or PDPH

Thomas J, et al. Anesth 2005; Suzuki N, et al. A&A 1996; Cappiello E, Tsen LC. A&A 2008; Chau A, Tsen LC. A&A 2017; Wilson SH, et al. A&A 2018

DPE Technique

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Cappiello, Tsen	25G	0.25% Bup 12 mL	Yes
Chau, Tsen	25G	0.125% Bup 20 mL	Yes
Chau, Tsen	25G	0.1% Bup 16 mL	Yes

Faster, 67% Increase in Adequate Analgesia
No Difference Hypotension, Highest Sensory or PDPH

Thomas J, et al. Anesth 2005; Suzuki N, et al. A&A 1996; Cappiello E, Tsen LC. A&A 2008; Chau A, Tsen LC. A&A 2017; Wilson SH, et al. A&A 2018

DPE Technique

Study	Needle	Anesthetic	Effect
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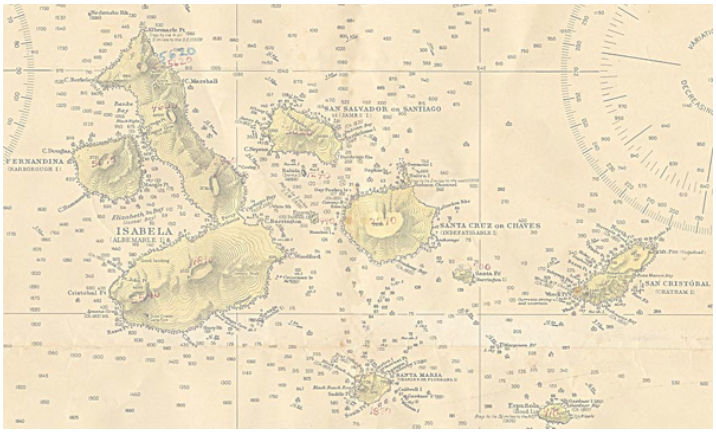
Suzuki	26G	2% Mepiv 18 mL	Yes
Wilson	26G	0.125% Bup 12 mL	Yes
Cappiello, Tsen	25G	0.25% Bup 12 mL	Yes
Chau, Tsen	25G	0.125% Bup 20 mL	Yes
Chau, Tsen	25G	0.1% Bup 16 mL	Yes

Faster, Greater Sacral Spread, Bilateral
No Difference Hypotxn, High Sensory, PDPH; CEI or PIEB

Thomas J, Anesth 2005; Suzuki N, et al. A&A 1996; Cappiello E,Tsen LC. A&A 2008 Chau A, Tsen LC. A&A 2017; Wilson SH, A&A 2018; Weale, Tsen, Chau SOAP 2018



ADVANTAGES

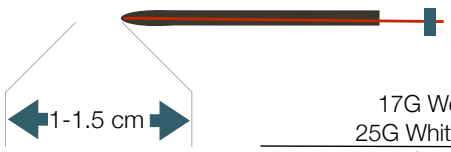
Technique Advantages

Characteristic	CSE	DPE	Epidural
Location Confirmation	X	X	

Cappiello E, O'Rourke N, Segal S, Tsen LC. Anes Analg 2008;107:1646-51
Chau A, Bibbo C, Huang CC, Elterman KG, Cappiello E, Tsen LC. Anesth Analg 2017

Location Confirmation

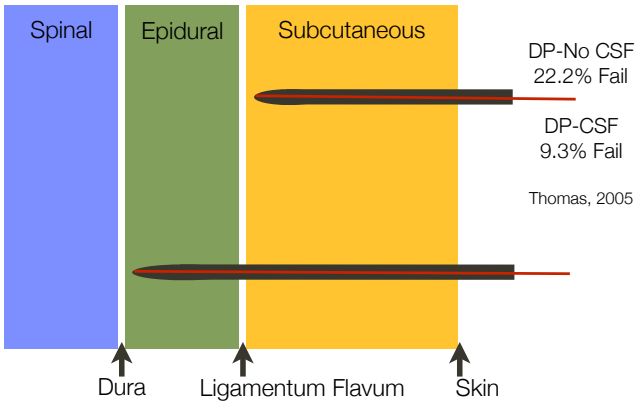
CSE + DPE Techniques



17G Weiss 8.5 cm
25G Whitacre 12 cm
difference (+hubs) 1.5 cm

17G Weiss 15 cm
25G Whitacre 18.5 cm
difference (+hubs) 1.5 cm

Location Confirmation



Technique Advantages

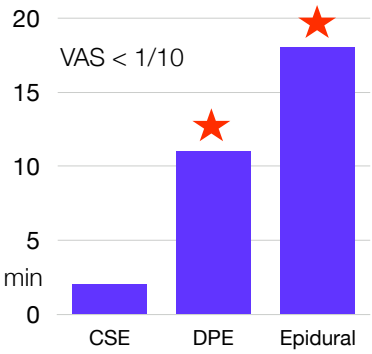
Characteristic	CSE	DPE	Epidural
Location Confirmation	X	X	
Onset	X	X	

Cappiello E, O'Rourke N, Segal S, Tsen LC. Anes Analg 2008;107:1646-51
Chau A, Bibbo C, Huang CC, Elterman KG, Cappiello E, Tsen LC. Anesth Analg 2017

Median Onset

Median Onset
CSE: 3-5 min
Epidural: 10-20 min

Thomas, Anesthesiology 2005
Norris, IJOA 2000;9:3-6
Eappen, IJOA 1998;7:220-5
Nageotte NEJM 1997;337:1715-9



Chau A, Bibbo C, Huang CC, Elterman KG, Cappiello E, Tsen LC. Anesth Analg 2017

Technique Advantages

Characteristic	CSE	DPE	Epidural
Location Confirmation	X	X	
Onset	X	X	
Sacral Spread	X	X	

Cappiello E, O'Rourke N, Segal S, Tsen LC. Anes Analg 2008;107:1646-51
Chau A, Bibbo C, Huang CC, Elterman KG, Cappiello E, Tsen LC. Anesth Analg 2017

Sacral Spread

	DPE/EPL			CSE/EPL		
				RR	95%CI	P
BS2 @ 10 min				2.54	1.69-3.80	<0.001
BS2 @ 20 min				1.60	1.26-2.03	<0.001
BS2 @ 30 min				1.18	1.01-1.30	0.034

Sacral Fibers Harder to Block
Nerve Roots-Larger in Diameter, Thicker Dura Mater
Spread-Farther from Epidural Catheter, Sacral Resistance

Chau A, Bibbo C, Huang CC, Elterman KG, Cappiello E, Tsen LC. Anesth Analg 2017

Sacral Spread

	DPE/EPL			CSE/EPL		
	RR	95%CI	P	RR	95%CI	P
BS2 @ 10 min	2.13	1.39-3.28	<0.001	2.54	1.69-3.80	<0.001
BS2 @ 20 min	1.60	1.26-2.03	<0.001	1.60	1.26-2.03	<0.001
BS2 @ 30 min	1.18	1.01-1.30	0.034	1.18	1.01-1.30	0.034

Sacral Fibers Harder to Block

Nerve Roots-Larger in Diameter, Thicker Dura Mater; Spread-Farther from Epidural Catheter, Sacral Resistance

Chau A, Bibbo C, Huang CC, Elterman KG, Cappiello E, Tsen LC. Anesth Analg 2017

Technique Advantages

Characteristic	CSE	DPE	Epidural
Location Confirmation	X	X	
Onset	X	X	
Sacral Spread	X	X	
Bilateral Spread	X	X	

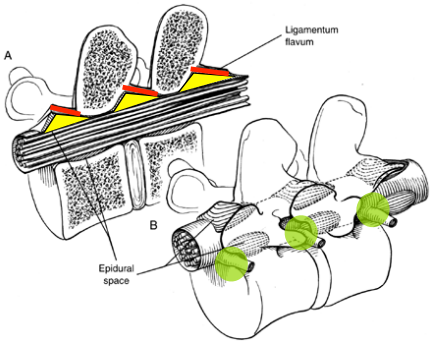
Cappiello E, O'Rourke N, Segal S, Tsen LC. Anes Analg 2008;107:1646-51
Chau A, Bibbo C, Huang CC, Elterman KG, Cappiello E, Tsen LC. Anesth Analg 2017

Bilateral Spread

Discontinuous, Heterogenous, Potential Space with Escape Routes

Harrison, BJA 1985; Blomberg, A&A 1986; Savolaine, Anesth 1988; Hogan, Anesth 1991, 1999; Collier Atlas Epiduralgrams

Patchy, One Sided: 5-8%



Pan PH, Bogard TD, Owen MD. IJOA 2004;13:227-233

Bilateral Spread

	DPE/EPL			CSE/EPL		
	RR	95%CI	P	RR	95%CI	P
BS2 @ 10 min	2.13	1.39-3.28	<0.001	2.54	1.69-3.80	<0.001
BS2 @ 20 min	1.60	1.26-2.03	<0.001	1.60	1.26-2.03	<0.001
BS2 @ 30 min	1.18	1.01-1.30	0.034	1.18	1.01-1.30	0.034

Chau A, Bibbo C, Huang CC, Elterman KG, Cappiello E, Tsen LC. Anesth Analg 2017

Technique Advantages

Characteristic	CSE	DPE	Epidural
Location Confirmation	X	X	
Onset	X	X	
Sacral Spread	X	X	
Bilateral Spread	X	X	
Tested Catheter		X	X

Cappiello E, O'Rourke N, Segal S, Tsen LC. Anes Analg 2008;107:1646-51
Chau A, Bibbo C, Huang CC, Elterman KG, Cappiello E, Tsen LC. Anesth Analg 2017

Tested Catheter

Failed Blocks	Epidural	CSE	Needle
Eappen n = 4240	13.1%	7.2%	25G
Norris n =1660	1.3%	0.2%	25G
Van de Velde n = 661/2075	3.18%	1.49%	27, 29G
Thomas n = 248	9.3%	8%	27G
Groden n = 1507/3980	3.9%	2.1%	27G
Booth n = 955/1440	11.6%	6.6%	27G

Eappen, IJOA 1998; Norris, IJOA 2000; Van de Velde, Anaesth Intens Care 2001
Thomas,Anesth 2005; Bauer,Tsen, IJOA 2012;Groden IJOA 2016;Booth Anesth 2016;

Technique Advantages

Characteristic	CSE	DPE	Epidural
Location Confirmation	X	X	
Onset	X	X	
Sacral Spread	X	X	
Bilateral Spread	X	X	
Tested Catheter		X	X
Progress of Labor	X	X (?)	

Cappiello E, O'Rourke N, Segal S, Tsen LC. Anes Analg 2008;107:1646-51
Chau A, Bibbo C, Huang CC, Elterman KG, Cappiello E, Tsen LC. Anesth Analg 2017

Progress of Labor

CSE vs Epidural; Bolus

- Lower instrumental delivery; Technique matters?

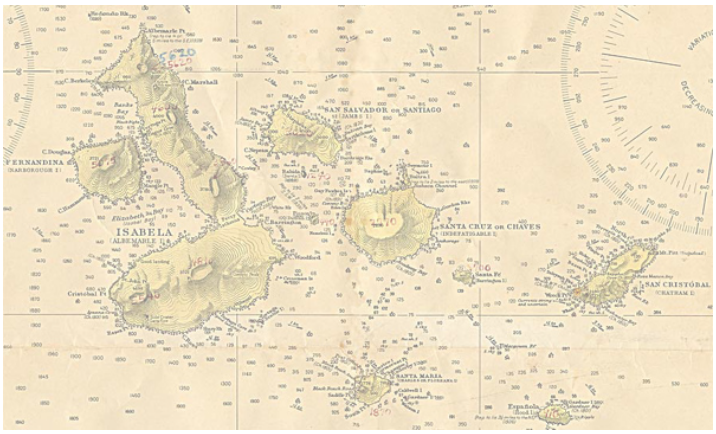
CSE vs Epidural; CEI

- 100 Nulliparous < 3 cm
- CSE: Shorter labor; Delivery 30 min faster

CSE vs Parenteral Opioids; CEI

- 750 Nulliparous < 4 cm
- CSE: Shorter labor; Delivery 80 min faster

Collis, Lancet 1995; Tsen, Anesthesiology 1999; Wong, NEJM 2005



DISADVANTAGES

Agents

"What a trifling difference must often determine which should survive...and which perish"

Darwin

Technique Disadvantages

Characteristic	CSE	DPE	Epidural
Fetal Bradycardia	X		

Cappiello E, O'Rourke N, Segal S, Tsen LC. Anes Analg 2008;107:1646-51
Chau A, Bibbo C, Huang CC, Elterman KG, Cappiello E, Tsen LC. Anesth Analg 2017

Fetal Bradycardia

	CSE	EPIDURAL	RR	NNH
FHR abnl	7.7%	6.7%	1.17	75
FHR brady	7.3%	4.8%	1.81	28
CS FHR	6%	7.8%	0.86	-87
CS Any	17%	16.6%	1.03	208
Apgar < 7	1%	0.9%	1.17	623

Mardirosoff: Meta-analysis: 24 Trials (n=3513) Intrathecal Opioids, BJOG 2002

Minimize Effect: Fentanyl (<50 mcg), Sufentanil (<7.5 mcg)

Van de Velde RAPM 2001, Fun Minerva Anestesiol 2008

	CSE	DPE	EPIDURAL
FHR decelerations	52.5%	45%	42.5%
NICHD I to II	32.5%	12.5%	12.5%

National Institute of Child Health and Human Development (NICHD) Classifications
Chau A, Bibbo C, Huang CC, Elterman KG, Cappiello E, Tsen LC. Anesth Analg 2017

Technique Disadvantages

Characteristic	CSE	DPE	Epidural
Fetal Bradycardia	X		
Uterine Hypertonus	X		

Cappiello E, O'Rourke N, Segal S, Tsen LC. Anes Analg 2008;107:1646-51
Chau A, Bibbo C, Huang CC, Elterman KG, Cappiello E, Tsen LC. Anesth Analg 2017

Uterine Hypertonus

	CSE	DPE	EPIDURAL
PRE UT/HT	5 (15%)	8 (20%)	8 (20%)
POST UT/HT	18 (45%)	4 (10%)	5 (12.5%)
Tocolysis	2 (5%)	0 (0%)	1 (2.5%)

1 Hour UT/UH: Uterine Tachysystole; Uterine Hypertonus

National Institute of Child Health and Human Development (NICHD) Classifications
Chau A, Bibbo C, Huang CC, Elterman KG, Cappiello E, Tsen LC. Anesth Analg 2017

Technique Disadvantages

Characteristic	CSE	DPE	Epidural
Fetal Bradycardia	X		
Uterine Hypertonus	X		
Workload	X		X

Cappiello E, O'Rourke N, Segal S, Tsen LC. Anes Analg 2008;107:1646-51
Chau A, Bibbo C, Huang CC, Elterman KG, Cappiello E, Tsen LC. Anesth Analg 2017

Workload

	CSE	DPE	EPIDURAL
NONE	20 (50%)	31 (77.5%)	20 (50%)
ONE or MORE	20 (50%)	9 (22.5%)	20 (50%)
TIME TO TOP-UP	132 ± 85	250 ± 163	207 ± 133
Catheter Manipulation	3 (7.5%)	2 (5%)	4 (10%)
Catheter Replacement	0 (0%)	0 (0%)	0 (0%)

Chau A, Bibbo C, Huang CC, Elterman KG, Cappiello E, Tsen LC. Anesth Analg 2017

Technique Disadvantages

Characteristic	CSE	DPE	Epidural
Fetal Bradycardia	X		
Uterine Hypertonus	X		
Workload	X		X
Adverse Events	X		

Cappiello E, O'Rourke N, Segal S, Tsen LC. Anes Analg 2008;107:1646-51
Chau A, Bibbo C, Huang CC, Elterman KG, Cappiello E, Tsen LC. Anesth Analg 2017

Adverse Events

	CSE	DPE	EPIDURAL
NAUSEA	1 (2.5%)	1 (2.5%)	4 (10%)
PRURITUS	27 (67.5%)	4 (10%)	4 (10%)
HYPOTENSION	13 (32.5%)	5 (12.5%)	5 (12.5%)

Chau A, Bibbo C, Huang CC, Elterman KG, Cappiello E, Tsen LC. Anesth Analg 2017

Technique Disadvantages

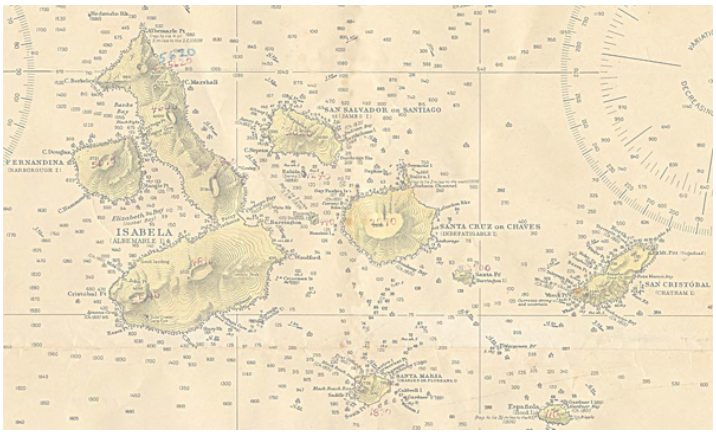
Characteristic	CSE	DPE	Epidural
Fetal Bradycardia	X		
Uterine Hypertonus	X		
Workload	X		X
Adverse Events	X		
High Spinal/ Motor Block			X
PDPH	X (?)	X (?)	

Cappiello E, O'Rourke N, Segal S, Tsen LC. Anes Analg 2008;107:1646-51
Chau A, Bibbo C, Huang CC, Elterman KG, Cappiello E, Tsen LC. Anesth Analg 2017

Adverse Events

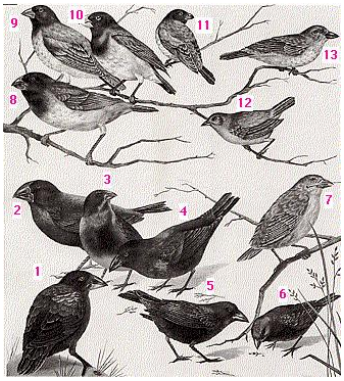
	CSE	DPE	EPIDURAL
HIGHEST LEVEL	T4 [T2-T6]	T4 [T2-T8]	T4 [T2-T8]
MOTOR BLOCKADE	3 (7.5%)	6 (15%)	15 (37.5%)
PDPH	0 (0%)	0 (0%)	0 (0%)

Chau A, Bibbo C, Huang CC, Elterman KG, Cappiello E, Tsen LC. Anesth Analg 2017



CONCLUSIONS

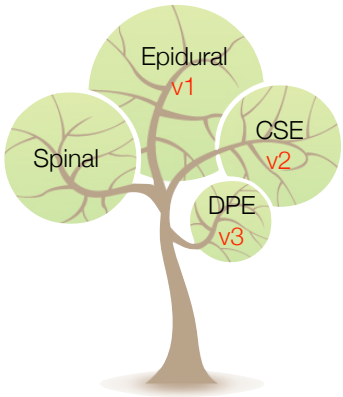
Optimal Neuraxial Technique?



"Natural selection is daily and hourly scrutinizing, rejecting those that are bad, preserving all that are good"

"We see nothing of these slow changes in progress, until the hand of time has marked the lapse of ages" Darwin

Neuraxial Techniques



+ 50 years

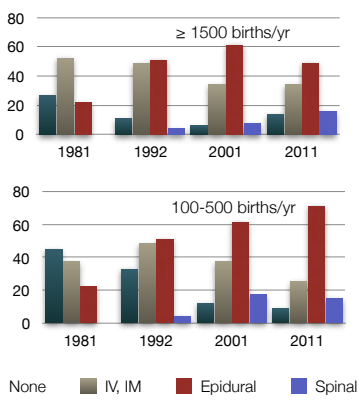
+ 40 years

+ 20 years

Neuraxial Techniques

Workforce Surveys

- 1300 hospitals in United States
- Geography
- #births: 3 strata



Gibbs et al. Anesthesiology 1986
Hawkins et al. Anesthesiology 1997
Bucklin et al. Anesthesiology 2005
Traynor et al. Anes Analg 2016

Technique Advantages

Characteristic	CSE	DPE	Epidural
Location Confirmation	X	X	
Onset	X	X	
Sacral Spread	X	X	
Bilateral Spread	X	X	
Tested Catheter		X	X
Progress of Labor	X	X (?)	

Cappiello E, O'Rourke N, Segal S, Tsen LC. Anes Analg 2008;107:1646-51
Chau A, Bibbo C, Huang CC, Elterman KG, Cappiello E, Tsen LC. Anesth Analg 2017

Technique Disadvantages

Characteristic	CSE	DPE	Epidural
Fetal Bradycardia	X		
Uterine Hypertonus	X		
Workload	X		X
Adverse Events	X		
High Spinal Motor Blockade			X
PDPH	X (?)	X (?)	

Cappiello E, O'Rourke N, Segal S, Tsen LC. Anes Analg 2008;107:1646-51
Chau A, Bibbo C, Huang CC, Elterman KG, Cappiello E, Tsen LC. Anesth Analg 2017

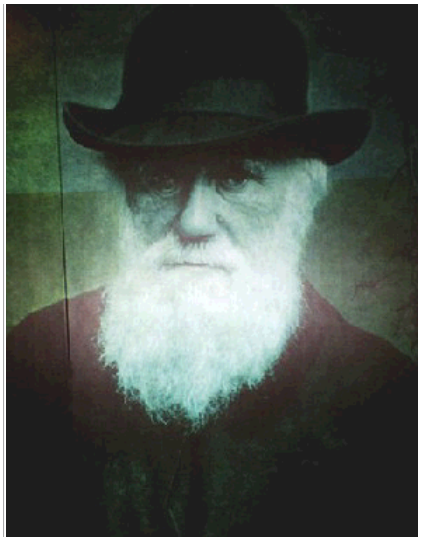
The CSE, DPE, and Epidural Technique

Is there an Optimal Labour Analgesia Technique?

SOAP Sol Shnider
Obstetric Anesthesia Meeting,2019

Lawrence C. Tsen, MD
Director, Center for Reproductive Medicine, Department of Anesthesiology, Perioperative & Pain Medicine, Brigham & Women's Hospital
Associate Professor in Anaesthesia
Harvard Medical School

Questions?



PIEB, CEI, PCEA: Is there an Optimal Labor Analgesic Maintenance Technique?

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Professor, Chief Obstetric Anesthesia Division
Stanford University School of Medicine
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Stanford Children's Health | Lucile Packard Children's Hospital Stanford

SOAP Society for Obstetric Anesthesia and Perinatology

Disclosures

No relevant financial relationships or funding to disclose

All investigational products and off-labeled use will be disclosed

Optimal Maintenance of Labor Neuraxial Analgesia
Lecture Outline

- **Patient-controlled epidural analgesia (PCEA)**
- **Programmed intermittent epidural boluses (PIEB)**
- **Local anesthetic solutions**
- **Epidural pump settings**

Labor Epidural Maintenance Techniques

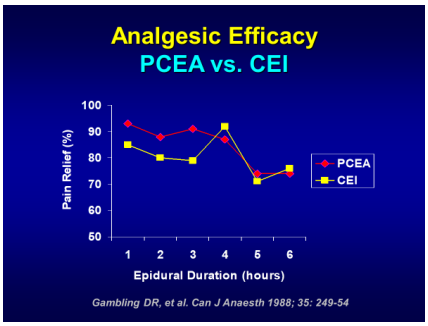
- 1930s **Epidural for Childbirth**
- 1970s Manually bolus epidural
- 1980s Continuous epidural infusion **CEI**
- 1988 Patient-controlled **PCEA**
- 2004 Programmed intermittent **PIEB**

Manual Intermittent Epidural Boluses

- Workload
- Drug errors / Sterility
- Analgesic delays
- Third party pain interpretation
- Over or under treatment

Continuous Epidural Infusion (CEI)

- Fewer manual boluses
- Less hypotension
- No analgesic control
- Doesn't adapt to labor pain or women's needs
- More local anesthetic use



PCEA vs. CEI

Halpern, Douglas (Eds) Evidence-Based Obstetric Anesthesia BMJ 2006

↓ **Local anesthetic use (24-45%)**

↓ **Motor block**

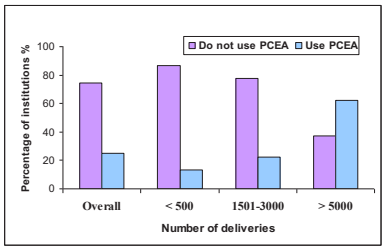
↑ **Analgesic, Maternal Satisfaction**
Control, autonomy, no analgesic delays
Less motor block

Workload: ↓19% in clinician top-ups

PCEA: Potential Safety Concerns

- **Local anesthetic overdose from excessive self-administration**
  - Poor understanding of the PCEA technique
  - Family member "trying to be helpful"
- **Literature and clinical experience: Labor PCEA is very safe**
- Potential harm with all techniques (CEI, manual boluses, PIEB)

Labor PCEA Usage



Carvalho. Int J Obstet Anesth. 2006;15(3):217-22

Background CEI with PCEA

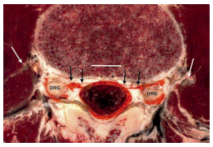
- **Improved labor pain relief**
- **↓ Clinician interventions**
- **↑ Local anesthetic consumption**
- Sleep uninterrupted
- Less active patient involvement

Halpern, Carvalho. Anesth Analg. 2009;108(3):921-8
ASA Practice Guidelines Anesthesiology 2007;106(4):843-63
Lim. Anesth Analg 2008;107,6:1968
Boselli E. Anesthesiology 2004;100:968
Bremerich DH. Int J Obstet Anesth 2005;14:114

CEI + PCEA

PIEB + PCEA

Programmed Intermittent Epidural Bolus (PIEB)
Automated Mandatory Bolus (AMB)

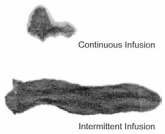


Most uniform spread:
- **Large volumes**
- **Correspondingly high injectate pressures**

Hogan Q. RAPM 2002;27:150-6

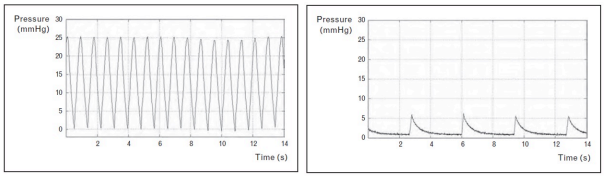
Dyed solution: 10.5 mL/h vs. 3.5 mL (delivered over 1 min) every 20 mins

Kaynar. Anesth Analg 1999;89:534



PIEB
10 ml every hour

CEI
10 ml/h



Stirparo S. Reg Anesth Pain Med 2012; 37:E1-E311

PIEB Mechanisms

- **Infusion rates office recruitment**
  - 1 orifice (<80 mL/h) → 3 orifices (>300 mL/h) [1]
- **Opioid bolus spinal effect**
  - Epidural fentanyl bolus 30 mcg vs. infusion (30 mcg/h) → segmental analgesia (leg>head) [2]

1. Fegley. Anesth Analg 2008;107:1079
2. Ginosar. Anesth Analg 2003;97:1428 –38

PIEB vs. CEI Spread

Porcine model; Extent of dye spread 1 ml bolus vs. 1 ml over 30 min

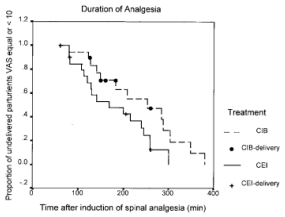
- **Infusion: 9 cm (3.1 levels)**
- **Bolus: 15 cm (5.5 levels)**

  Greater segmental spread
- **Injection pressure:** 314 mmHg (bolus) vs. 24 mmHg (infusion)

Mowat I. Br J Anaesth 2016; 116 (2): 277–81

PIEB vs. CEI

PIEB 5 ml q 60 min vs. CEI 5 ml/h
Ropivaine 0.1% + Fentanyl 2 mcg/ml

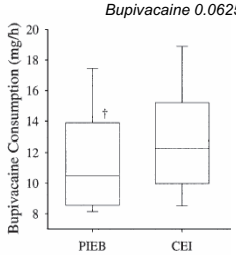


- **Longer duration of analgesia** (239 vs. 181 min)
- **Higher sensory block to cold**
- **Less labor pain**
- **No difference in blood pressure**

Chua, Sia. Can J Anaesth 2004;51:581–5

PIEB + PCEA vs. CEI + PCEA

PIEB 6 ml q 30 min vs. CEI 12 ml/h
Bupivacaine 0.0625% + Fentanyl 2 mcg/mL



- **Less bupivacaine consumption**
- **Fewer rescue boluses** (↓22%)
- **Higher maternal satisfaction**

Wong. Anesth Analg 2006; 102: 904-9

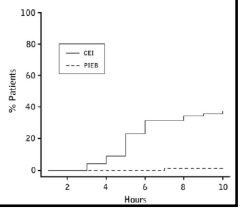
PIEB vs. CEI (+/- PCEA)

Meta-Analysis Data Outcomes	PIEB vs. CEI	P-value
Local Anesthetic Consumption	-1.2 mg/h	0.01
Maternal Satisfaction Scores	7.0 mm	<0.00001
Duration of 2nd Stage of Labor	-12 min	0.04
Mode of Delivery		
Cesarean Delivery	OR 0.87	0.54
Instrumented Delivery	OR 0.59	0.05
Anesthesia Interventions	OR 0.56	0.08

George RB. Anesth Analg 2013; 133-144

PIEB + PCEA vs. PCEA + CEI
Instrumented Delivery

- 145 patients; *Levobupivacaine 0.0625% + sufentanil 0.5 mcg/mL*
- *CEI (10 mL/h) vs. PIEB (10 mL q 1h)*
- *PCEA levobupivacaine 0.125%*
- PCEA boluses needed: 40% vs. 8%
- **Motor block: 37% CEI vs. 3% PIEB**
- **Instrumented delivery: 20% vs. 7%**



Capogna G. Anesth Analg 2011;113:826–31

PIEB/AMB vs. CEI

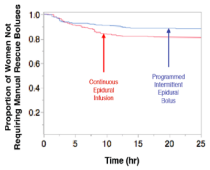
Cochrane Library
Cochrane Database of Systematic Reviews

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

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

CEI + PCEA → PIEB + PCEA
Clinical Practice Change

- *Bupivacaine 0.0625% + fentanyl 2 mcg/ml*
- *CEI 12 ml/h vs PIEB 9 ml q45 min*
- ↓ Clinician rescue boluses: 19 vs 12%
- ↓ Unilateral block: 5 vs. 2%
- ↓ Peak pain: 2 [0–5] vs. 0 [0–4]
- Similar obstetric outcomes



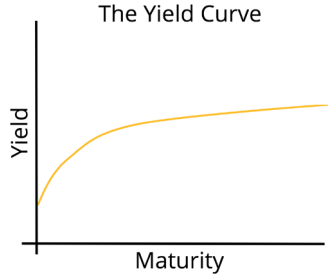
Piascik. Int J Obstet Anesth 2016;26:32-8

CEI + PCEA → PIEB + PCEA
Clinical Practice Change

- **UW:**
  - *Bupivacaine 0.0625% + fentanyl 2 mcg/ml*
  - *CEI 10 ml/h vs. PIEB 10 ml q 45, 45HF, 60 min*
  - PIEB (10 ml q 45 min) vs. CEI: ↓ physician bolus requests
- **Duke:**
  - *Bupivacaine 0.125% + fentanyl 2 mcg/mL*
  - *CEI 5 mL/h vs. PIEB 5 mL/60 min or 3 mL/30 min*
  - PIEB vs. CEI: ↑ PCEA attempts/given ratios

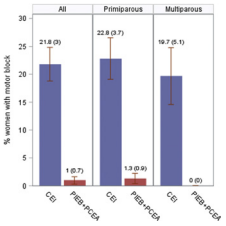
Delgado C. Curr Med Res Opin. 2018;34(4):649-656
Tien M. Curr Med Res Opin. 2016;32(8):1435–1440

The Yield Curve



Carvalho B, Riley ET. PIEB for Maintenance of Labor Analgesia: An Incremental Step Before the Next Paradigm Shift? Turk J Anaesthesiol Reanim. 2017; 45(2): 73-75

CEI → PIEB + PCEA
Clinical Practice Change



- CEI (ropivacaine 0.2% + fentanyl 2 mcg/ml) vs. PIEB + PCEA (ropivacaine 0.1% + fentanyl 2 mcg/ml)
- **Decreased ropivacaine use**
- **Less motor block** (31-fold difference)
- **Shorter 2nd stage of labor**

Bullingham. British J Anaesth 2018; 121(2): 432e437

SOAP Society for Obstetric Anesthesia and Perinatology

Centers of Excellence

- *Use of low concentration local anesthetic solutions. Ideally ≤0.1% bupivacaine or ≤0.15% ropivacaine
- *Use of neuraxial opioids (e.g. fentanyl or sufentanil) and/or other adjuvants (e.g. clonidine)
- *Patient controlled epidural analgesia (PCEA) and ideally background programmed intermittent epidural boluses (PIEB) utilized for the provision of neuraxial labor analgesia

SPECIAL ARTICLE

Implementation of Programmed Intermittent Epidural Bolus for the Maintenance of Labor Analgesia

Brendan Carvalho, MBBCh, FRCA, MDCH,* Ronald B. George, MD, FRCPC,† Benjamin Cobb,* Christine McKenzie, MD,* and Edward T. Riley, MD*

Programmed intermittent epidural bolus (PIEB) is an exciting new technology that has the potential to improve the maintenance of epidural labor analgesia. PIEB compared with a continuous epidural infusion (CEI) has the potential advantage of greater spread within the epidural space and therefore better sensory blockade. Studies have demonstrated a local anesthetic–sparing effect, fewer instrumental vaginal deliveries, less motor blockade, and improvements in maternal satisfaction with PIEB compared with CEI. However, the optimal PIEB regimen and pump settings remain unknown, and there are a number of logistical issues and practical considerations that should be considered when implementing PIEB. The PIEB bolus size and interval, PIEB start time delay period, and patient-controlled epidural analgesia bolus size and lockout time can influence the efficacy of PIEB used for epidural labor analgesia. Educating all members of the health care team is critical to the success of the technique. This review summarizes the role of PIEB for the maintenance of labor analgesia, outlines implementation strategies, suggests optimal settings, and presents potential limitations of the technique. (Anesth Analg 2016;123:965–71)

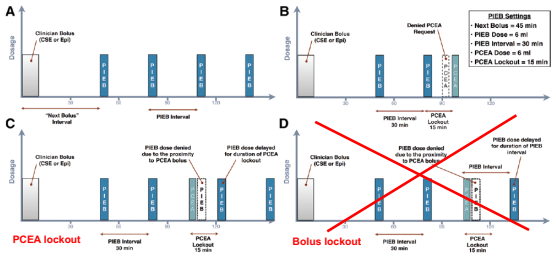
Carvalho. Anesth Analg. 2016;1123:965-71

Optimal PIEB + PCEA Settings

- Many recipes reported in literature
  - Bolus: 2-20 ml; lockout intervals: 5-60 min
- **PCEA settings**
  - No ideal settings
  - Larger less frequent boluses preferable
- **PIEB settings**
  - 10 mL bupivacaine 0.0625% + fentanyl 2 mcg/mL
  - Lockout ED90 ~40 min
  - Volume ED90 ~11 ml
  - 45% >T6, no motor block

Carvalho. Anesth Analg. 2016;1123:965-71
Halpern, Carvalho. Anesth Analg. 2009;108(3):921-8
Kanczuk ME. Anesth Analg 2017;124:537–41
Zakus. Anaesthesia 2018; 73, 459-465

PIEB and PCEA interactions

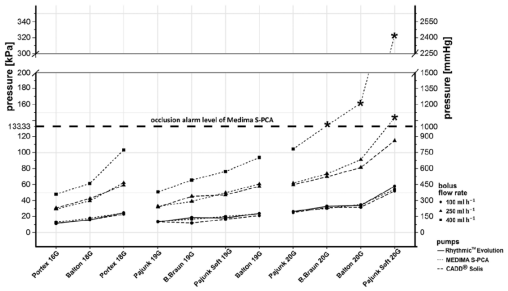


Carvalho. Anesth Analg. 2016;1123:965-71

PIEB Speed of Injection

- **In-vitro study:**[1]
  - Pressures by delivery speeds: 100, 175, 300, 400 mL/h
  - 2 single-orifice + 2 multi-orifice epidural catheters
  - Peak pressure ↑ with ↑ delivery speeds
- **Clinical efficacy:**[2]
  - 100 ml/h vs. 300 ml/h PIEB: No difference analgesia quality
- **Standard set (250 mL/h) → high-flow tubing (500 ml/h)**
- **Downstream occlusion alarms!**

Klumpner TT. J Clin Anesth. 2016; 34:6327
Lange. Anesthesiology 2018; 128:745-53



Krawczyk P. Anesth Analg July 17 2018, Ahead of Print doi: 10.1213/ANE.0000000000003650

PIEB: Potential Safety Concerns

- **Unwitnessed first bolus due to delay start of PIEB**
  - **Occlusion alarm**
  - **Respiratory depression (opioid bolus)**
  - **Hypotension (local anesthetic bolus)**
  - **Untested catheter (unrecognized intrathecal or intravascular)**

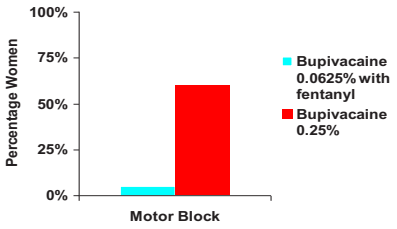
Betti F. AA Case Rep. 2017; 15;9(12):357-359
Carvalho. Anesth Analg. 2016;1123:965-71

- **Inopportune bolus timing**
  - Bolus during second stage labor in woman with motor block or difficulty pushing

Recommended Epidural Settings
Stanford University

- **Loading:**
  Epidural: 15 ml 0.125% bupivacaine + 10 mcg sufentanil
  CSE: 2.5 mg bupivacaine + 2.5 mcg sufentanil
- **Maintenance Solution:**
  0.0625% bupivacaine + 0.4 µg/ml sufentanil
- **PCEA + PIEB Settings:**
  - PIEB 9 ml every 45 min
  - 10 ml PCEA
  - 10 min lockout
  - Delay 30 min

Dilute Local Anesthetic Solutions
Reduce Motor Block



Chestnut. Anesthesiology 1988; 68: 754-9

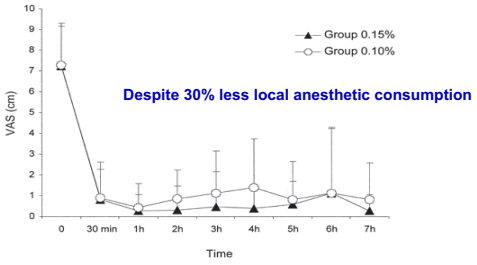
Light (≤ 0.1% Bupivacaine) vs. Heavy (> 0.1%) Meta-analysis:
Sultan. Can J Anaesth. 2013;60(9):840-54
↓ Assisted vaginal delivery
↓ Second stage duration, ↓ Motor blockade, ↑ Ambulation
No difference with analgesia

Low dose epidural vs. Non-epidural analgesia
Wang. Anesth Analg. 2017;124(5):1571-1580
Meta-analysis:
No difference assisted vaginal or cesarean delivery or duration of labor

Second Stage of Labor Duration: 400 patients
Epidural 0.08% ropivacaine + 0.4 mcg/mL sufentanil
Epidural 52 min vs. Saline 51 min
Spontaneous vaginal delivery rate similar (97% vs. 99%)

Shen. Obstet Gynecol 2017;130:1097–103

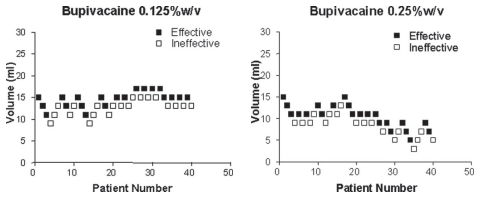
Dilute Local Anesthetic Solutions



Boselli E. Anesthesiology. 2004;100:968-72

Volume vs. Concentration

Lyons. Anesth Analg. 2007;104(2):412-5



MLAV = 14 mL (17 mg) **MLAV = 9 mL (23 mg)**

Equivalent analgesia with 25% dose reduction

Opioid + Local Anesthetics

- **↓ LA requirement by 2-4 fold**

Polley. Anesthesiology. 1998;89(3):626-32
Buyse. Int J Obstet Anesth. 2007;16(1):22-8

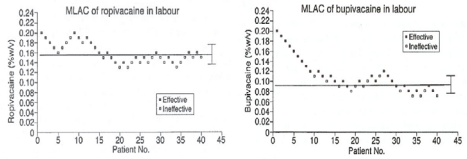
Fentanyl vs. Sufentanil

- **Fentanyl most popular option**
- **Many studies: Equivalent efficacy**
- **Sufentanil may be preferable** (↓ pain, ↓ LA use,↑ satisfaction, breastfeeding)[1-4]
- **↑ Cost, dosing errors with sufentanil**

1. Lilker S. JCA 2009; 21, 108–112
2. Cohen S. Can J Anaesth 1996;43:341-6
3. Le Guen H. J Clin Anesth 2001;13: 98-102
4. Beilin Y. Anesthesiology 2005;103:1211-7

Ropivacaine vs. Bupivacaine

Capogna. Br J Anaesth 1999; 82: 371-373
Polley. Anesthesiology 1999; 90:944-50
Buyse. Int J Obstet Anesth. 2007;16(1):22-8



MLAC potency ratios: 0.6 : 1.0
Ropivacaine is 40% less potent

Ropivacaine vs. Bupivacaine
PCEA Labor Analgesia

- **Systematic review; 11 studies**
- **Concentration range: 0.05% to 0.20%**
- **Labor analgesia similar**
- **Increased motor block with bupivacaine**
  (5 studies, most did not account for potency)
- "***Both ropivacaine and bupivacaine are well suited for PCEA in labor***"

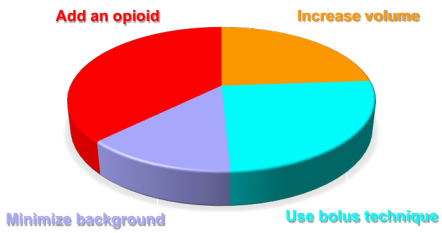
Halpern, Carvalho. Anesth Analg. 2009;108(3):921-8

Neuraxial Adjuvants
Clonidine and/or Neostigmine

- Modest analgesic effect
- ↓ LA use (~30%) and opioid use
- ↓ Breakthrough pain
- Maternal side-effects and fetal concerns
- Bolus (Clonidine 50-75 mcg, Neostigmine 500 mcg)
- Infusion (Clonidine 1-2 mcg/ml)

Van de Velde M. Int J Obstet Anesth 2009;18:207-14
Ross V. Anesth Analg 2009;109,2:524-31
Boogmans T. Eur J Anaesthesiol. 2014;31(4):190-6
Zhang N. J Obstet. Gynaecol. Res. 2015;41 (2): 214–221

Labor Epidural Primary Aim
Reduce Labor Epidural Local Anesthetic Use



Labor Epidural Analgesic Maintenance Techniques
Summary

- Modern neuraxial techniques provides excellent analgesia
- PCEA offers many advantages over CEI
- PCEA+PIEB more effective than PCEA+CEI
- Dilute local anesthetic epidural solutions facilitate effective analgesia with minimal obstetric effects
- Optimal settings PIEB + PCEA uncertain

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@carvalb

Epidural Labor Analgesia

- Overall rate neuraxial labor analgesia use:
  - 82% (>1500 deliveries/year)
  - 66% (<500) to 74% (500-1499)

Traynor. Anesth Analg 2016;122:1939–46

No Disclosures

OBJECTIVES

- Review Current Contraindications for Neuraxial Techniques
- Discuss Maternal Diseases for Consideration of Alternatives to Neuraxial
- Discuss the Evidence for Remifentanil and Fentanyl PCA
- Discuss and Review Nitrous Oxide

GOLD STANDARD: LABOR EPIDURAL

- Catheter based technique utilized in early 1930's
- Advances made in early 80's with use of local anesthetics and opioids
- Techniques advanced: CSE and patient-controlled pumps
- Widely used in the U.S. with some centers up to 80% laboring women
- Survey of Women epidurals are the most common form of labor analgesia

Listening to Mothers® III
Pregnancy and Birth

Survey Item	*LTM I* 2000-02	*LTM II* 2005	*LTM III* 2011-12
Base: all survey participants			
Had epidural or spinal analgesia for pain relief	63%	76%	67%
Had narcotics by intravenous drip for pain relief	30%	22%	16%
Used nitrous oxide for pain relief	2%	3%	6%
Used no pain medications	20%	14%	17%

Report of the Third National U.S. Survey of Women's Childbearing Experiences May 2013

CONTRAINDICATIONS TO EPIDURAL & SPINAL ANESTHESIA

- Patient Refusal or Inability to Cooperate
- Increased ICP from Mass Lesion
- Skin or Tissue Infection at Needle Placement Site
- Frank Coagulopathy
- Uncorrected Maternal Hypovolemia
- Inadequate Experience with Technique

Chestnut's Obstetric Anesthesia 2009, 4th Edition, pg. 431

32 y G3P0 at 35w0d who presents to OB Anesthesia clinic for history of spinal fusion (Mid Thoracic to Sacral Scar) in Florida at the age of 17

A) Offer Epidural

B) Offer her a Continuous Spinal

C) Offer her Nitrous

D) Offer her nothing and hope for the best

Labor Analgesia Consumption and Time to Neuraxial Catheter Placement in Women with a History of Surgical Correction for Scoliosis: A Case-Matched Study

Jeanette R. Bauchat, MD,* Robert J. McCarthy, PharmD,* Tyler R. Koski, MD,† and Cynthia A. Wong, MD*

- 41 women with surgical correction and 41 controls subjects requesting neuraxial labor analgesia
- Neuraxial failure occurred in 12% of women with spinal instrumentation and none in control
- Mean time to complete the procedure was 41% longer
- More redirects and more experienced proceduralist was required

October 2015 • Volume 121 • Number 4 www.anesthesia-analgesia.org

32 y G3P0 at 35w0d who presents to OB Anesthesia clinic for history of spinal fusion (Mid Thoracic to Sacral Scar) in Florida at the age of 17

- ***Initial epidural placement difficult for fellow and attending. No CSF with DPE and no level after testing. Decision made to replace epidural after discussing with patient***
- ***Pre-scanning with ultrasound revealed L- Harrington rod deep to scar and midline 2-3 cm lateral. Epidural placed easily with DPE and threaded easily***
- ***Repeat epidural placement functioned***
- ***Underwent cesarean delivery with functioning epidural***

38 y.o. G6P1 at 37w2d who presents to OB fellow clinic for hx of SLE presumed lupus nephritis & presumed ITP

- Pt has had a successful vaginal delivery in 2016 (due to thrombocytopenia was not a candidate for neuraxial but used nitrous and remifentanil)
- Her post partum course was complicated by severe thrombocytopenia, pre-eclampsia, and post-partum bleeding requiring transfusion
- During this pregnancy, she is on low dose plaquenil, 2-ASA per day
- Thrombocytopenia presumed to be immune-mediated complicated from her SLE, Goal plts > 50K

38 y.o. G6P1 at 37w2d who presents to OB fellow clinic for hx of SLE

presumed lupus nephritis & presumed ITP

A) Offer Epidural

B) Offer Opioid PCA

C) Offer her Nitrous

D) Offer her nothing and hope for the best

Neuraxial Techniques in Obstetric and Non-Obstetric Patients with Common Bleeding Diatheses

Systematic Review of 326 Neuraxial techniques on ITP patient
94 patient > 100k
204 patient had Plt count 75-100k
19 patient had Plt counts between 50-75k
9 patient Plts < 50k

No reports of hemorrhagic complications

Stephen Choi, MD*
Richard Brull, MD, FRCPC*†

(Anesth Analg 2009;109:648–60)

38 y.o. G6P1 at 37w2d who presents to OB fellow clinic for hx of SLE presumed lupus nephritis & presumed immune mediated thrombocytopenia

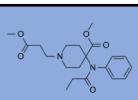
After discussion patient opted for a remifentanil PCA and delivered quickly without complication

Opioids

- Bind to specific receptors in CNS
- 4 major opioid receptors- mu (μ_1 and μ_2), kappa, delta, sigma
- Modulated through descending inhibitory pathway from periaqueductal gray matter to dorsal horn of spinal cord

Fentanyl

- High protein binding
- Lipid soluble
- No active metabolites when crossing the placenta
- Metabolized by the cytochrome P system via liver
- Reversed by naloxone
- Slows gastric emptying
- Respiratory depression
- Crosses placenta quickly to fetal F/M = .50



Remifentanil

- Ester structure
- Metabolized into inactive metabolite by non-specific esterases in plasma
- Metabolism allows for lack of accumulation
- Context sensitive half-life = 3.5 min, respiratory depression half-life = 2.5 min
- Rapid onset of analgesia = 30-60 sec; Peak at 2.5 min
- Crosses placenta and metabolized by placental and fetal nonspecific esterases
- F/M ratio = .50

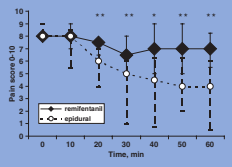
Labor PCA
Is it a viable Alternative to Labor Epidural?

Intravenous remifentanil vs. epidural levobupivacaine with fentanyl for pain relief in early labour: a randomised, controlled, double-blinded study

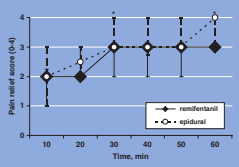
P. Volmanen[1], J. Sarvela[2], E. I. Akural[3], T. Raudaskoski[4], K. Korttila[2] and S. Alahuhta[3]
[1]Lapland Central Hospital, Rovaniemi, Finland, [2]Department of Anaesthesia and Intensive Care, Helsinki University Central Hospital, Helsinki, Finland, [3]Department of Anaesthesiology, University of Oulu, Oulu, Finland and [4]Department of Obstetrics and Gynaecology, University of Oulu, Oulu, Finland

Pain scores were lower in epidural group, which indicates epidural was superior for pain control
However, pain relief scores were no different between the groups

Pain Score - VAS



Pain Relief Score- PRS



Remifentanil and Labor:

Table 1. Summary of Remifentanil Studies for Labor Analgesia

	Remifentanil PCIA bolus dose	No.	Comparator group	Lockout interval (min)	Nitrous oxide used	Median or reduction in pain scores	Conversion to neuraxial analgesia
Blair et al.[14]	0.25–0.5 μg · kg^{-1} · min^{-1}	21	None	2	No	Median 50 mm	4 of 21
Thurlow et al.[16]	0.2 μg · kg^{-1} · min^{-1}	18	IM meperidine	2	Yes	Median 48 mm	7 of 18
Volmanen et al.[18]	0.4 μg · kg^{-1} · min^{-1}	20	Nitrous oxide	1		Reduction of 15 mm	Not reported
Blair et al.[15]	40 μg	20	PCIA meperidine	2	Yes	Median 64 mm	2 of 20
Volmanen et al.[13]	0.2–0.8 μg · kg^{-1} · min^{-1}	17	None	1	No	Reduction of 42 mm	Not reported
Evron et al.[17]	0.27–0.93 μg · kg^{-1} · min^{-1}	43	Meperidine infusion	3	No	Median 35 mm	4 of 43
Volikas et al.[12]	0.5 μg · kg^{-1} · min^{-1}	50	None	2	No	Mean 46 mm	5 of 50
Balki et al.[11]	0.25–1.0 μg · kg^{-1} · min^{-1} variable bolus + fixed IV infusion	10	0.25 μg · kg^{-1} · min^{-1} variable infusion + fixed IV bolus	2	No	Reduction of 56 mm vs 41 mm(variable bolus versus variable infusion)	1 of 20
Volmanen et al.[19]	0.3–0.7 μg · kg^{-1} · min^{-1}	24	Epidural	1	No	Median 73 mm	Not reported

All pain scores reported in millimeter (0–100 mm scale) for comparison between studies.
PCIA = patient-controlled IV analgesia.

Hinova et al. Systemic Remifentanil for Labor Analgesia. *Anesthesia & Analgesia*. 2009; 109(6): 1925-9.

VAS Scores: Remifentanil vs. Epidural

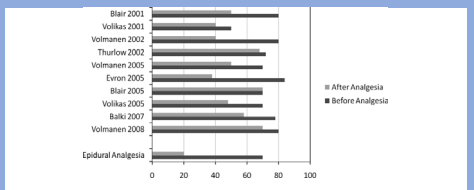


Fig. 1 Visual analogue scale (VAS, mm) scores for labour pain before and after initiation of epidural analgesia or remifentanil patient-controlled analgesia (PCA) in different studies. The VAS scores for epidural analgesia reflect what is usually reported in the literature.

Van de Velde, Controversy. Remifentanil patient-controlled analgesia should be routinely available for use in labor, International Journal Obstetric Anesthesia, 2008 October; 17(4):336-9

Remifentanil patient-controlled analgesia in labour: six-year audit of outcome data of the RemiPCA SAFE Network (2010–2015)

A.A. Melber,[a] Y. Jelting,[b] M. Huber,[c] D. Keller,[d] A. Dullenkopf,[e] T. Girard,[f] P. Kranke[b]
[a] *Department of Anaesthesiology, Spital Münsingen, Insel Gruppe AG, Münsingen, Switzerland*
[b] *Department of Anaesthesiology, University Hospital Würzburg, Würzburg, Germany*
[c] *Geographic Information Solutions and Database Management, Condesys Consulting GmbH, Rubigen, Switzerland*
[d] *Statistical Consultancy and Data Analysis, Statistik und Beratung, Kürnach, Germany*
[e] *Institute for Anaesthesia and Intensive Care Medicine, Spital Thurgau Frauenfeld, Frauenfeld, Switzerland*
[f] *Department of Anaesthesiology, University Hospital Basel, University of Basel, Switzerland*

- 5740 data sets No need for maternal ventilation or CPR
- Neonatal CPR *potentially* related to remi occurred in 0.3%
- Moderate rate of maternal hypoxia (O_2 sat <94% in ~25%)

RemiPCA SAFE Network (2010–2015). *Int J Obstet Anesth* (2019), https://doi.org/10.1016/j.ijoa.2018.12.004

Table 2 Changes to the standard operating procedure

	2010	2011	2012	2013	2014	2015
Recommended bolus dose [μg]	20–40	20–40	20–40	10–30[†]	10–30[†]	10–30[†]
Recommended SpO_2 threshold for supplemental oxygen	<92%	<92%	<92%	<92%	<94%	<94%[†]
Recommended interval between other opioids prior to PCA and start of PCA (h)	NA	NA	NA	>4	>4	>4[†]
Recommended time to stop PCA prior to cord clamping (min)	NA	NA	NA	>5–10	>5–10	>5–10[†]
Standardised documentation of severe incidents	NA	NA	yes	yes	yes	yes
RemiPCA Alert function (with detailed report)	NA	NA	NA	NA	yes	yes

[†]Mandatory guideline. NA: not applicable; PCA: patient-controlled analgesia; SpO_2: oxygen saturation.

Table 3 Maternal side effects

	2010	2011	2012	2013	2014	2015	Total
SpO_2 < 94%	56/423 (13.6%)	254/632 (40.2%)	239/762 (31.4%)	238/885 (26.9%)	322/1256 (25.6%)	306/1241 (24.7%)	1415/5189 (27.3%)
Sedation	97/435 (22.3%)	150/659 (22.8%)	231/798 (28.9%)	276/975 (28.3%)	371/1355 (27.4%)	309/1334 (23.2%)	1434/5556 (25.8%)
Nausea/Vomiting	89/435 (20.5%)	126/659 (19.1%)	160/798 (20.1%)	175/980 (17.9%)	185/1361 (13.6%)	206/1335 (15.4%)	941/5568 (16.9%)
Pruritus	20/435 (4.6%)	14/659 (2.1%)	20/786 (2.5%)	38/972 (3.9%)	33/1354 (2.4%)	31/1327 (2.3%)	156/5533 (2.8%)

Data are number/number of cases included (%). SpO_2: oxygen saturation.

Routinely Available Remifentanil?

- Retrospective study in Ireland performed in 2007
- In 2005 remifentanil PCA for labor analgesia was routinely available
- During the two year period:
  - 28% opted for remifentanil
  - 22% opted for epidural
- Conversion from remifentanil to epidural was 10%

Hill, D. Remifentanil patient-controlled analgesia should be routinely available for use in labor IJOA, (2009) 17, 336-342

Remifentanil vs Fentanyl

Remifentanil versus fentanyl for intravenous patient-controlled labour analgesia: an observational study

Rémifentanil versus fentanyl pour l'analgésie intraveineuse contrôlée par les patientes en travail: étude observationnelle

Radhika Marwah, MD · Samah Hassan, MD · Jose C. A. Carvalho, MD, PhD · Mrinalini Balki, MD

There is no difference in pain scores between Remifentanil and Fentanyl PCA, Both provide a moderate amount of pain relief. Pick your poison…

Remifentanil-more maternal oxygen desaturation

vs.

Fentanyl-associated with higher need for neonatal resuscitation

Labour pain with remifentanil patient-controlled analgesia versus epidural analgesia: a randomised equivalence trial

SLM Logtenberg,[a] K Oude Rengerink,[a] CJ Verhoeven,[b,c] LM Freeman,[d] ESA van den Akker,[e] MB Godfried,[f] E van Beek,[g] OWHM Borchert,[h] N Schuitemaker,[i] ECSM van Woerkens,[j] I Hostijn,[k] JM Middeldorp,[d] JA van der Post,[a] BW Mol[f]

N=408

Randomized Equivalence Trial

Remi-PCA vs Epidural Analgesia

Primary Outcome- satisfaction with pain relief measured hourly with VAS

Secondary Outcome-overall satisfaction with pain relief, Pain intensity scores during labor mode of delivery, and maternal and neonatal outcomes

Satisfaction with pain relief during labor with Remi-PCA and Epidural NOT Equivalent methods of labor analgesia.
Lower satisfaction with analgesia in Remi-PCA group
Higher pain intensity in the Remi-PCA group

Please cite this paper as: Logtenberg SLM, Oude Rengerink K, Verhoeven CJ, Freeman LM, van den Akker ESA, Godfried MB, van Beek E, Borchert OWHM, Schuitemaker N, van Woerkens ECSM, Hostijn I, Middeldorp JM, van der Post JA, Mol BW. Labour pain with remifentanil patient-controlled analgesia versus epidural analgesia: a randomised equivalence trial. BJOG 2016; DOI: 10.1111/1471-0528.14181.

Any Other Alternatives?

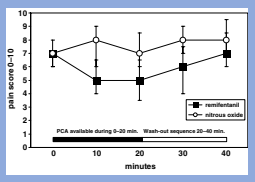
Nitrous oxide

Nitronox

- Patient breathes nitrous oxide and oxygen via tight face mask
  - Nitrous oxide better than opioid
  - Usually 50% nitrous oxide in 50% oxygen
  - Rapid onset, rapid elimination
  - Patient control
- Effective for some patients
- No ongoing dose during pushing

Comparison of remifentanil and nitrous oxide in labour analgesia

P. Volmanen[1], E. Akural[2], T. Raudaskoski[3], P. Ohtonen[4] and S. Alahuhta[2]
[1]*Department of Anaesthesia and Intensive Care, Lapland Central Hospital, Rovaniemi, Departments of* [2]*Anaesthesiology,* [3]*Obstetrics and Gynaecology, and* [4]*Surgery, University of Oulu, Oulu, Finland*



Remifentanil IVPCA provides better labor analgesia compared to nitrous oxide

A qualitative analysis of parturients' experiences using nitrous oxide for labor analgesia: It is not just about pain relief

Michael G. Richardson MD | Britany L. Raymond MD | Curtis L. Baysinger MD | Bradley T. Kook MD | David H. Chestnut MD

- Qualitative content analysis
- 6507 deliveries 2011-2014
- 12% used nitrous oxide
- Determinants of satisfaction more variable, than previously thought

Birth. 2019;46:97–104.

Satisfaction vs Analgesia

- 90% > 8 satisfaction scores
- 64% intermediate to low analgesia scores
- Women cited benefits of partial analgesia
- Partial analgesia allows for enhanced ability to cope with labor pain

Conclusions

- Epidural analgesia provides overall best pain relief in labor
- PCA opioid options exist, but with certain side effects
- Remifentanil an option for those who contraindicated to neuraxial
- Nitrous is an alternative, but pain scores higher than PCA-opioid
- Nitrous has a role in labor analgesia pain
- Nitrous does not require anesthesia provider to administer

Program Slides

Friday, March 15, 2019

Session II: Comorbidities and High-Risk Patients

Moderator: Lawrence Tsen, M.D.

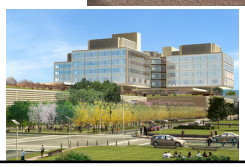
Management of Parturients with Cardiac Disease
Ronald Pearl, M.D., Ph.D.

Latest on Pre-Eclampsia Management and Care Bundles
Gillian Abir, M.B., Ch.B., FRCA

Anesthetic Management of Invasive Placental Disease
John C. Markley, M.D., Ph.D

Parturients with Cardiac Disease or Pulmonary Hypertension

Ronald Pearl, MD, PhD, FASA
Professor and Chair
Department of Anesthesiology
Stanford University
Rpearl@stanford.edu

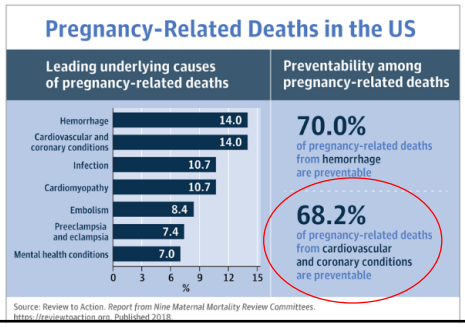


No financial disclosures

- Cardiac anesthesiologist
- Critical care physician
- Expert in pulmonary hypertension

Cardiovascular Disease

- 1-2% of parturients
- Leading cause of maternal mortality in the developed world
- Fetal morbidity (premature labor, IUGR, congenital anomalies)
- Fetal mortality



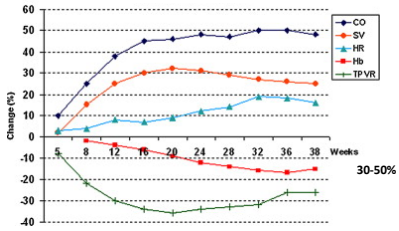
The 7 Steps to Success

- Recognition of the disorder
- Assessment of its severity
- Perioperative risk assessment
- Preoperative optimization of the patient
- Choice of anesthetic technique
- Choice of monitoring
- Treatment of decompensation

Heterogeneity of Cardiovascular Disease

- Anatomy
  - Cardiomyopathy, valvular disease, congenital heart disease without shunts, CHD with shunts, aortopathy, pulmonary hypertension
- Functional status
  - Maternal mortality 0.4% with NYHA I or II
  - Maternal mortality 6.8% with NYHA III or IV
- Arrhythmias

Cardiovascular Changes of Pregnancy



30-50% increase in blood volume

Ruys, Journal of Cardiology 2013; 61:107

Changes During Labor

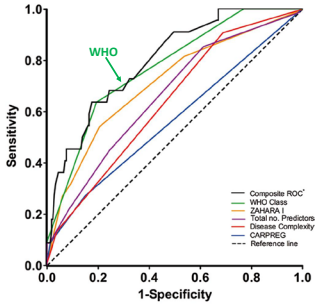
- Further increases in CO and SV with labor
- Contractions: Autotransfusion of 300-500 ml; 30-50% increase in CO
- Painful contractions: Increased SVR, increased PVR
- Valsalva: Decreased venous return
- After delivery, preload increases 30% due to relief of aortocaval compression and uterine autotransfusion; CO increases 50%; SVR increases over days

Interactions with Cardiovascular Disease

- Obstructive lesions (mitral stenosis, aortic stenosis, pulmonary hypertension)
  - Increased flow results in increased gradient
  - Tachycardia increases mitral gradient in MS
  - Decreased preload results in decreased cardiac output
- Shunting lesions (VSD, complex congenital heart disease)
  - Decreased SVR or increased PVR increases right-to-left shunt
  - Increased SVR or decreased PVR increases left-to-right shunt
- Aortopathy (Marfan syndrome, bicuspid aortic valve)
  - Hypertension results in aortic dissection or rupture
- Cardiomyopathy
  - Increased blood volume results in pulmonary edema
  - High incidence of arrhythmias
  - Need for increased cardiac output in pregnancy
  - ACEIs, ARBs, and aldosterone antagonists require discontinuation

Risk Assessment

- History, pathology, ECG, functional status, TTE, BNP, aortic diameter, arrhythmias
- Progression of disease during pregnancy
- Formal risk assessment systems
  - CARPREG
  - ZAHARA
  - WHO risk stratification model



Balci, Heart 2014; 100(17):1373

WHO Classification

Risk classification	Cardiac lesions
I – No detectable increased risk of maternal mortality and no or minimal increase in maternal morbidity	- Uncomplicated mild pulmonary stenosis - Ventricular septal defect - Patent ductus arteriosus - Mitral valve prolapse with no more than trivial mitral regurgitation - Successfully repaired simple lesions (atrial or ventricular septal defect, patent ductus arteriosus, anomalous pulmonary venous drainage) - Isolated ventricular extrasystoles and atrial ectopic beats
II – Small increased risk of maternal mortality or moderate increase in morbidity	- Unoperated atrial or ventricular septal defect - Repaired tetralogy of Fallot - Most arrhythmias
II–III – Depending on patient	- Hypertrophic cardiomyopathy - Native or tissue valvular heart disease not considered WHO I or IV - Repaired coarctation - Marfan syndrome without aortic dilatation - Bicuspid valve with aorta <45 mm - Mild ventricular impairment - Heart transplantation
III – Significantly increased risk of maternal mortality or severe morbidity, and expert cardiac and obstetric pre-pregnancy, antenatal, and postnatal care are required	- Mechanical valve - Systemic RV - Fontan circulation - Unrepaired cyanotic heart disease - Other complex congenital heart disease - Marfan syndrome with aorta 40–45 mm - Bicuspid aortic valve with aorta 45–50 mm
IV – Pregnancy is contraindicated	- Pulmonary hypertension - Eisenmenger syndrome - Systemic ventricular EF <30% - Systemic ventricular dysfunction with NYHA class III–IV - Severe mitral stenosis - Severe symptomatic aortic stenosis - Marfan syndrome with aorta >45 mm - Bicuspid aortic valve with aorta >50 mm - Native severe coarctation

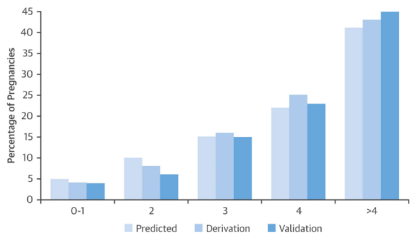
WHO Classification

- Class 1: Mitral valve prolapse with trivial MR, successfully repaired ASD
- Class 2: Unrepaired ASD; repaired tetralogy of Fallot
- Class 3: Cyanotic heart disease; Fontan circulation; mechanical valve; systemic right ventricle; bicuspid aortic valve with aorta 45-50 mm; Marfan with aorta 40-45 mm
- Class 4: Pulmonary hypertension; severe AS; Marfan syndrome with aorta > 45 mm; severe LV dysfunction

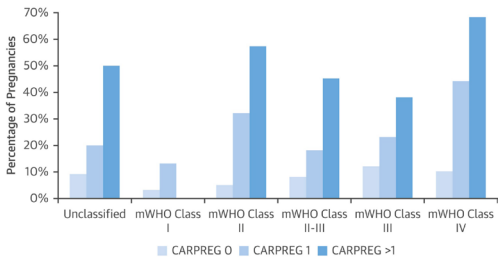
CARPREG II Risk Score

Predictor	Points
Prior cardiac events or arrhythmias	3
Baseline NHYA II-IV or cyanosis	3
Mechanical valve	3
Ventricular dysfunction	2
High risk left-sided valve disease/ LV outflow tract obstruction	2
Pulmonary hypertension	2
Coronary artery disease	2
High risk aortopathy	2
No prior cardiac intervention	1
Late pregnancy assessment	1

CARPREG II Risk Score



Incidence of Maternal Cardiac Events



The 7 Steps

- Recognition of the disorder
- Assessment of its severity
- Perioperative risk assessment
- Preoperative optimization of the patient
- Choice of anesthetic technique
- Choice of monitoring
- Treatment of decompensation

Multidisciplinary Planning

- Cardiologist
- Obstetrician/MFM
- Anesthesiologist
- Neonatologist
- Additional providers
- Consideration of intervention such as balloon valvuloplasty for MS/AS or medications for pulmonary hypertension

The 7 Steps

- Recognition of the disorder
- Assessment of its severity
- Perioperative risk assessment
- Preoperative optimization of the patient
- Choice of anesthetic technique (and of delivery)
- Choice of monitoring
- Treatment of decompensation

International Journal of Obstetric Anesthesia (2019) 37, 73-85
0959-289X/$ - see front matter © 2018 Elsevier Ltd. All rights reserved.
https://doi.org/10.1016/j.ijoa.2018.09.011

REVIEW ARTICLE

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Obstetric anesthesia management of the patient with cardiac disease

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[b]*Cardiovascular Division, John T. Milliken Department of Internal Medicine, Washington University School of Medicine, St. Louis, MO, USA*

ABSTRACT
Cardiovascular disease is the leading cause of maternal mortality in much of the developed world. Risk stratification models can predict which patients are at greatest risk for maternal or fetal morbidity or mortality. Particular cardiac diseases hold significant risk of mortality during pregnancy including pulmonary hypertension, aortic aneurysm, left ventricular outflow tract obstruction

Mitral Stenosis	(-) Because of relatively fixed preload to the LV, the heart may not be able to generate increased cardiac output and pulmonary edema will develop (-) Decreased oncotic pressure further increases risk of pulmonary edema (-)The increase in blood volume and heart rate in pregnancy increases left atrial pressure and may lead to atrial fibrillation and pulmonary edema	Normal heart rate (avoid tachycardia) → *Excellent labor analgesia* → *Continue beta blockade through labor and delivery* → *5-lead ECG monitoring for CD or labor* → *Avoid beta agonist agents (e.g. terbutaline)* Avoid Atrial fibrillation → *In new atrial fibrillation, cardioversion should be considered* → *In failed cardioversion and in cases with chronic atrial fibrillation, decrease rapid ventricular rate with medical treatment* Maintain normovolemia → *Strict monitoring of fluid balance* Prevent/ Monitor for pulmonary edema → *Careful fluid balance* → *Continuous pulse oximetry throughout labor and peripartum (including postpartum)* Manage pulmonary edema → *Consider diuresis* → *Administer supplemental oxygen* → *If necessary, consider intubation with PEEP and controlled ventilation* Postpartum monitoring → *Monitor for postpartum pulmonary edema*

ESC European Society of Cardiology
European Heart Journal (2018) 39, 3165–3241
doi:10.1093/eurheartj/ehy340

ESC GUIDELINES

2018 ESC Guidelines for the management of cardiovascular diseases during pregnancy

The Task Force for the Management of Cardiovascular Diseases during Pregnancy of the European Society of Cardiology (ESC)

Endorsed by: the International Society of Gender Medicine (IGM), the German Institute of Gender in Medicine (DGesGM), the European Society of Anaesthesiology (ESA), and the European Society of Gynecology (ESG)

Key Points

- Pregnancy not recommended in patients with pulmonary arterial hypertension, a systemic RV with decreased function, after Fontan operation, with dilated aorta, severe MS, or severely decreased LV ejection fraction
- Weight-based LMWH with anti-Xa monitoring rather than UFH
- WHO 2-3 or higher should be managed in specialized centers by a multidisciplinary team
- Induction of labor at 40 weeks
- Vaginal delivery recommended except for aggressive aortic pathology, acute intractable heart failure, severe pulmonary hypertension, or patients presenting in labor on oral anticoagulants

Method of Delivery

- Ruys, Heart 2015; 101:530
  - Analysis of ROPAC (Registry on Pregnancy and Cardiac Disease) registry
  - Compared planned vaginal delivery with planned Cesarean delivery
  - Similar perinatal mortality and Apgar scores
  - Planned section had decreased gestational age and birth weight
  - No difference in outcome with emergency vs. planned Cesarean

Method of Delivery

- Vaginal delivery in absence of obstetric indications
- "Cardiac vaginal delivery"
  - Avoids pushing
  - Requires forceps or vacuum-assisted delivery
- Cesarean delivery when pregnancy would have been contraindicated
  - Severe aortopathy
  - ?Severe pulmonary hypertension

The 7 Steps to Success

- Recognition of the disorder
- Assessment of its severity
- Perioperative risk assessment
- Preoperative optimization of the patient
- Choice of anesthetic technique
- Choice of monitoring
- Treatment of decompensation

Hemodynamic Goals

- Preload
- Afterload (SVR)
  - Blood pressure
- Contractility
- Heart rate
- Rhythm
- PVR
- Which are critical to the patient?
- Which are likely to change?

Interactions with Cardiovascular Disease

- Obstructive lesions (mitral stenosis, aortic stenosis, pulmonary hypertension)
  - Increased flow results in increased gradient
  - Tachycardia increases mitral gradient in MS
  - Decreased preload results in decreased cardiac output
- Shunting lesions (VSD, complex congenital heart disease)
  - Decreased SVR increases right-to-left shunt
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  - Hypertension results in aortic dissection or rupture
- Cardiomyopathy
  - Increased blood volume results in pulmonary edema
  - High incidence of arrhythmias
  - Need for increased cardiac output in pregnancy
  - ACEIs, ARBs, and aldosterone antagonists require discontinuation

Monitoring

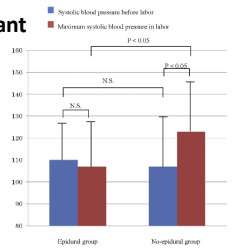
- 5-lead ECG
- NIBP ± arterial line
- Baseline TTE and availability if clinical change
- Fetal monitoring
- Consider CVP for drug administration and volume assessment
- Rarely PA catheter

Labor Analgesia

- Avoid painful labor: Increased HR, BP, CO, VO_2

Method of Delivery

- Epidural when BP control is important (aortopathy, cardiomyopathy, regurgitant lesions)



Tanaka, Taiwanese J Ob Gyn 2018; 57:190

Labor Analgesia

- Avoid painful labor: Increased HR, BP, CO, VO2
  - –Early analgesia
  - –Perineal coverage in later stages
- Epidural
- CSE with intrathecal opioid only
- LOR technique with no air in the syringe

Cesarean Delivery

- Neuraxial anesthesia (SAB, epidural, CSE)
  - – Decreased preload, decreased SVR
  - – Avoid rapid changes in hemodynamics
    - Slow epidural
    - CSE with low dose intrathecal bupivacaine (2.5 – 5 mg) and sequential epidural boluses
- General anesthesia
  - – Sympathetic response to intubation
    - Consider lidocaine plus fentanyl or remifentanil
    - Etomidate in potentially unstable patient
    - Consider TEE monitoring

Postpartum Period

- Increased preload and afterload
- Requires ICU monitoring

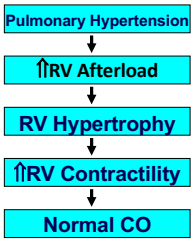
Drugs and Cardiovascular Disease

- Terbutaline and ritodrine: ↑inotropy/chronotropy, ↓SVR
- Oxytocin: ↑SVR
- PGF2-alpha: ↑PVR
- Methylergonovine: Coronary vasospasm, ↑PVR

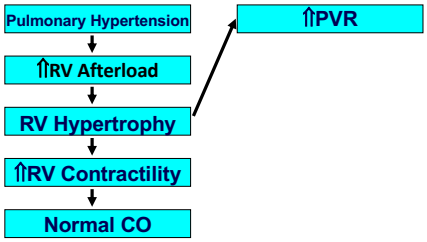
Pulmonary Hypertension

- One-third have a cardiac event
- 20% have a thromboembolic complication
- Half have premature delivery
- Increased fetal mortality
- Maternal mortality 25% but case series in specialized centers of 10-12%
- Neonatal mortality 1-4%; complications 18-30%

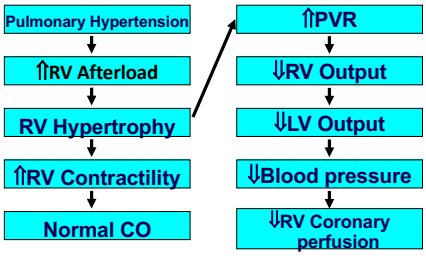
Compensated RV Failure



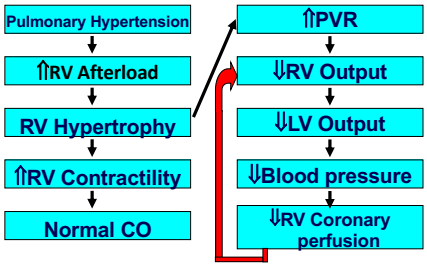
Compensated RV Failure



Decompensated RV Failure



Cycle of RV Failure



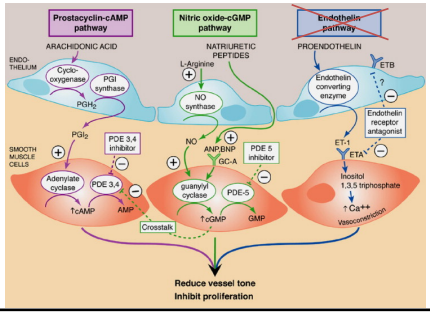
Risk of Surgery in Patients with Pulmonary Hypertension

- Depends on etiology of pulmonary hypertension, severity of pulmonary hypertension, and adequacy of compensatory mechanisms (RAP, CO, SvO_2, RV function, functional status)

The 7 Steps

- Recognition of pulmonary hypertension
- Assessment of severity of pulmonary hypertension
- Perioperative risk assessment
- Preoperative optimization of the patient
- Choice of anesthetic technique
- Choice of monitoring
- Treatment of decompensated pulmonary hypertension

Therapy of Pulmonary Hypertension



Pulmonary Hypertension

- Inhaled prostanoids
- Sildenafil
- Deliver at 34 weeks to avoid emergency situation
  - –?Cesarean delivery to avoid prolonged labor

The 7 Steps

- Recognition of pulmonary hypertension
- Assessment of severity of pulmonary hypertension
- Perioperative risk assessment
- Preoperative optimization of the patient
- Choice of anesthetic technique
- Choice of monitoring
- Treatment of decompensated pulmonary hypertension

Hemodynamic Goals in PH

- Maintain preload
- Maintain SVR (systemic afterload)
- Maintain contractility
- Maintain heart rate and sinus rhythm
- Avoid increased PVR

Anesthetic Techniques

- General anesthesia
  - ↓Preload, ↓afterload, ↓contractility
- Neuraxial blocks
  - ↓Sympathetic tone, ↓preload, ↓afterload
- Regional anesthesia
  - Ideal for peripheral procedures and for postoperative pain

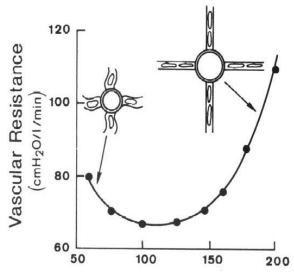
Induction Techniques

- Propofol: ↓preload, ↓afterload, ↓contractility
- Ketamine: ↑PVR
- Etomidate: Ideal agent

Maintenance of Anesthesia

- Nitrous oxide: ↑PVR
- High-dose narcotics: Hypercarbia with emergence
- Isoflurane/sevoflurane: ↓SVR
- Combined narcotic-volatile agent techniques work well
- Increasing role for dexmedetomidine
  - Avoid bradycardia

Ventilation and PVR



The 7 Steps

- Recognition of pulmonary hypertension
- Assessment of severity of pulmonary hypertension
- Perioperative risk assessment
- Preoperative optimization of the patient
- Choice of anesthetic technique
- Choice of monitoring
- Treatment of decompensated pulmonary hypertension

Intraoperative Monitoring

- Arterial catheter
- Intraoperative TEE
  - RV function, RV volume, LV volume
- Pulmonary artery catheter
  - Assess for progression of pulmonary hypertension
    - Guide surgical and anesthetic decision making
  - Treatment of systemic hypotension
  - Not used for wedge pressure measurement
    - Risk of pulmonary artery rupture

The 7 Steps

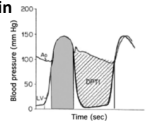
- Recognition of pulmonary hypertension
- Assessment of severity of pulmonary hypertension
- Perioperative risk assessment
- Preoperative optimization of the patient
- Choice of anesthetic technique
- Choice of monitoring
- Treatment of decompensated pulmonary hypertension

Treatment of RV Failure

- Molloy, Am Rev Respir Dis 1984; 130:870
  - Right ventricular failure model in dogs due to pulmonary hypertension from pulmonary embolism
  - Resuscitation with
    - Volume: 0% survival
    - Isoproterenol: 0% survival
    - Norepinephrine: 100% survival

Hypotension and RV Decompensation

- RV ischemia
  - RV coronary flow normally in systole and diastole; in pulmonary hypertension, only in diastole
  - Increased oxygen consumption
  - Cycle of ischemia and failure
- Role of the interventricular septum
  - High LV pressure normally pushes the septum towards the RV free wall, producing RV ejection



Etiologies of Hypotension

	CVP	PAP	CO
Decreased preload	↓↓	↓	↓
Decreased contractility	↑	↓	↓
Decreased SVR	→	→	↑ or →
Increased PVR	↑	↑	↓

Management of Hypotension

Is CVP decreased? Yes → Volume
↓No
Is PAP decreased? Yes → Inotropes
↓No
Are there reversible causes of increased PVR?
↓No ↓Yes
Is cardiac output decreased? Treatment
↓No ↓Yes
Systemic vasoconstrictors | Inotropes and/or Pulmonary vasodilators

Management of Hypotension

Is CVP decreased? Yes → Volume
↓No
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Management of Hypotension

Is CVP decreased? Yes → Volume
↓No
Is PAP decreased? Yes → Inotropes/
↓No Vasoconstrictors
Are there reversible causes of increased PVR?
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↓No ↓Yes
Systemic vasoconstrictors | Inotropes and/or Pulmonary vasodilators

Active Pulmonary Vasoconstriction

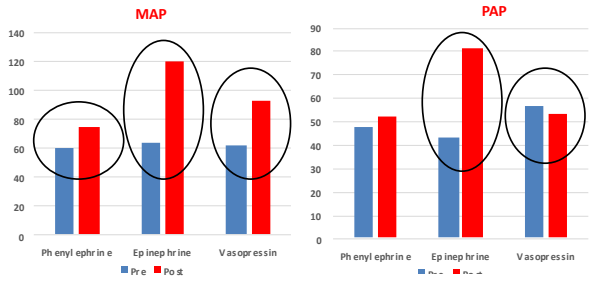
- Hypoxia
- Hypercarbia
- Acidosis
- Sympathetic tone

Management of Hypotension

Is CVP decreased? Yes → Volume
↓No
Is PAP decreased? Yes → Inotropes/
↓No Vasoconstrictors
Are there reversible causes of increased PVR?
↓No ↓Yes
Is cardiac output decreased? Treatment
↓No ↓Yes
Systemic vasoconstrictors Inotropes and/or Pulmonary vasodilators

Vasopressors in Pulmonary Hypertension

- Siehr, Pediatr Crit Care Med 2016; 17:428
  - 15 pediatric patients with pulmonary hypertension undergoing elective cardiac catheterization with general anesthesia
  - Received
    - Phenylephrine 1 mcg/kg (n = 5)
    - Epinephrine 1 mcg/kg (n = 5)
    - Vasopressin 0.03 U/kg over 5 minutes (n = 5)
  - Hemodynamic measurements at peak systemic pressure



MANAGEMENT OF HYPOTENSION

Is CVP decreased? Yes → Volume
↓No
Is PAP decreased? Yes → Inotropes/
↓No Vasoconstrictors
Are there reversible causes of increased PVR?
↓No ↓Yes
Is cardiac output decreased? Treatment
↓No ↓Yes
Systemic vasoconstrictors Inotropes and/or Pulmonary vasodilators

Inovasodilators

	Control	Milrinone (1 hour)	Milrinone (2 hours)
MPAP	34	28	27
CI	2.6	2.8	3.1
PVR	701	462	379
MAP	78	75	74

Wang, Adv Ther 2009; 26:46

MANAGEMENT OF HYPOTENSION

Is CVP decreased? Yes → Volume
↓No
Is PAP decreased? Yes → Inotropes
↓No
Are there reversible causes of increased PVR?
↓No ↓Yes
Is cardiac output decreased? Treatment
↓No ↓Yes
Systemic vasoconstrictors Pulmonary vasodilators

MANAGEMENT OF HYPOTENSION

Is CVP decreased? Yes → Volume
↓No
Is PAP decreased? Yes → Inotropes/ Vasoconstrictors
↓No
Are there reversible causes of increased PVR?
↓No ↓Yes
Is cardiac output decreased? Treatment
↓No ↓Yes
Systemic vasoconstrictors ~~Pulmonary~~ Inhaled vasodilators

Inhaled Vasodilators

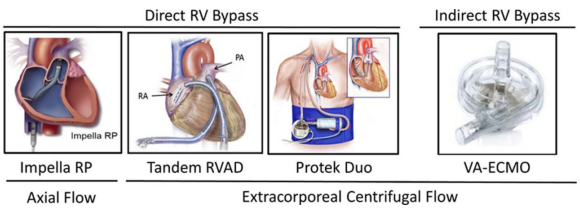
- Nitric oxide
- Epoprostenol (Flolan, Veletri)

Postoperative Management

- Most challenging aspect of the case
- Emergence issues
  - Dexmedetomidine
- Post-delivery pulmonary hypertensive crisis due to hormonal vasoconstriction
- ICU monitoring
- Continue chronic pulmonary vasodilator therapy throughout the perioperative period

When All Else Fails

- Right ventricular assist device (RVAD)
- V-A ECMO



The 7 Steps to Success

- Recognition of the disorder
- Assessment of its severity
- Perioperative risk assessment
- Preoperative optimization of the patient
- Choice of anesthetic technique
- Choice of monitoring
- Treatment of decompensation

- Call a friend: Rpearl@Stanford.edu


THANK YOU!
Rpearl@Stanford.edu

The Latest on Preeclampsia Management and Care Bundles

Dr Gillian Abir, MBChB, FRCA

Clinical Associate Professor
Department of Anesthesiology, Perioperative and Pain Medicine

STANFORD SCHOOL OF MEDICINE
Stanford University Medical Center

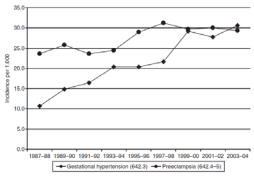
Disclosures

Nothing to declare

Objectives

- Compare current practice with best evidence to identify areas of improvement
- Discuss the role of the obstetric anesthesiologist in management planning for patients with preeclampsia
- Review the concept of care bundles and describe ways to incorporate them in your practice

Incidence



- Preeclampsia ↑ 25%
- Gestational HTN ↑ 186%
- Eclampsia ↓ 22%

3-6% of all pregnancies (US)

'Mild' PreE (1980 – 2010)

19%

322%

'Severe' PreE

Wallis et al. Am J Hypertens 2010;21:521-526
Ananth et al. BMJ 2013;347:f6564

Maternal morbidity

- ↑ Risk of CVS disease

RR: **HTN 3.7** after 14.1 yr (95% CI 2.7 – 5.05)

IHD 2.16 after 11.7 yr (95% CI 1.86 – 2.52)

CVA 1.81 after 10.4 yr (95% CI 1.45 – 2.27)

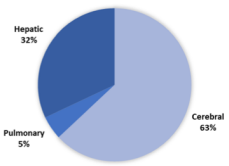
VTE 1.79 after 4.7 yr (95% CI 1.37 – 2.33)

- No associated ↑ risk of cancer

Bellamy et al. BMJ 2007;335(7627):974

Maternal mortality

Cause of death
(preeclampsia + eclampsia)



- RR of women dying within 12 months of delivery (preeclampsia/eclampsia vs. normotensive) = **5.1**
- Overall mortality RR = **1.49** after 14.5 yr

Bellamy et al. BMJ 2007;335(7627):974
Thornton et al. Am J Obstet Gynecol 2013;208:476.e1-5
CMACE Saving Mothers' Lives: reviewing maternal deaths to make motherhood safer: 2006–08. BJOG 2011;118(Suppl. 1):1–203

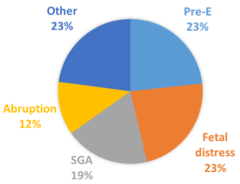
Seizure occurrence

▪ Antepartum	**25.1%**	
▪ During labor	**44.1%**	
▪ Postpartum	**26.3%**	Median PP day = **day 4** (range 1-55)
▪ Not specified	**4.5%**	

Thornton et al. Am J Obstet Gynecol 2013;208:476.e1-5

Neonatal morbidity + mortality

Medically indicated preterm delivery (<35 weeks)



Neonatal mortality rate

- 22.3/1000 - eclampsia
- 10.7/1000 - preeclampsia
- 7.9/1000 - normotensive

Ananth et al. AJOG 2006;195:1557-63
Thornton et al. Am J Obstet Gynecol 2013;208:476.e1-5

The American College of Obstetricians and Gynecologists
WOMEN'S HEALTH CARE PHYSICIANS

Royal College of Obstetricians and Gynaecologists

CMQCC
CALIFORNIA MATERNAL QUALITY CARE COLLABORATIVE

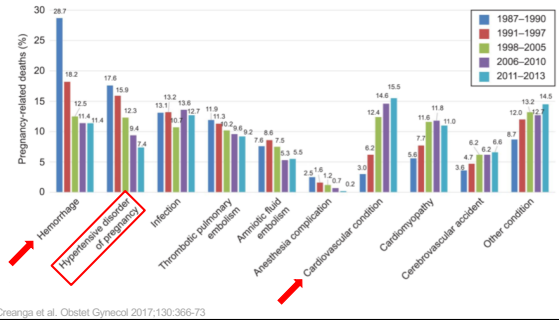
MBRRACE-UK
Mothers and Babies: Reducing Risk through Audits and Confidential Enquiries across the UK

THE SOCIETY OF OBSTETRICIANS AND GYNAECOLOGISTS OF CANADA

ACOG
THE AMERICAN CONGRESS OF OBSTETRICIANS AND GYNECOLOGISTS

The Royal Australian and New Zealand College of Obstetricians and Gynaecologists
Excellence in Women's Health

Cause-specific pregnancy-related mortality (US)



Creanga et al. Obstet Gynecol 2017;130:366-73

Classification

Hypertension in Pregnancy
Report of the American College of Obstetricians and Gynecologists' Task Force on Hypertension in Pregnancy

- Preeclampsia-eclampsia
- Chronic hypertension
- Chronic hypertension with superimposed PreE
- Gestational hypertension

Obstet Gynecol 2013;122:1122-31

Diagnostic criteria for preeclampsia

SBP ≥**160** or DBP ≥**110** mm Hg (min)
or
SBP ≥**140** or DBP ≥**90** mm Hg (4 h apart)

and

Proteinuria ≥**300 mg/24 h**
or
Prot/creat ≥**0.3**

and/or

1. Platelets **<100,000/μL**
2. Serum creatinine **>1.1 mg/dL or [x2]**
3. AST, ALT **x2**
4. Pulmonary edema
5. Cerebral or visual symptoms

Obstet Gynecol 2019;133:e1–25

Objectives

- Compare current practice with best evidence to identify areas of improvement
- Discuss the role of the obstetric anesthesiologist in management planning for patients with preeclampsia
- Review the concept of care bundles and describe ways to incorporate them in your practice

How we can help

- Anesthetic risk assessment
- Blood pressure control
- Fluid management
- Eclampsia prophylaxis
- Analgesia + anesthesia planning

The American College of Obstetricians and Gynecologists
WOMEN'S HEALTH CARE PHYSICIANS

COMMITTEE OPINION

Number 692 • April 2017 *(Replaces Committee Opinion No. 623, February 2015)*

Committee on Obstetric Practice

This Committee Opinion was developed by the American College of Obstetricians and Gynecologists' Committee on Obstetric Practice in collaboration with committee members Yasser Y. El-Sayed, MD, and Ann E. Borders, MD, MSc, MPH.

This document reflects emerging clinical and scientific advances as of the date issued and is subject to change. The information should not be construed as dictating an exclusive course of treatment or procedure to be followed.

Emergent Therapy for Acute-Onset, Severe Hypertension During Pregnancy and the Postpartum Period

Obstet Gynecol 2017;129:e90-5

Treatment for acute-onset, severe range hypertension

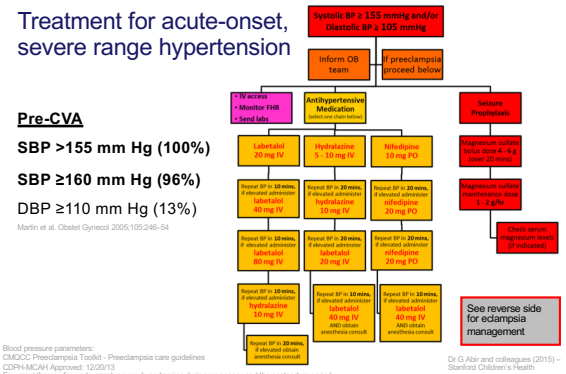
Pre-CVA

SBP >155 mm Hg (100%)

SBP ≥160 mm Hg (96%)

DBP ≥110 mm Hg (13%)

Martin et al. Obstet Gynecol 2005;105:246-54



Blood pressure parameters:
CMQCC Preeclampsia Toolkit - Preeclampsia care guidelines
CDPH-MCAH Approved: 12/20/13
Emergent therapy for acute-onset, severe hypertension during pregnancy and the postpartum period.
Committee Opinion No. 623, American College of Obstetricians and Gynecologists.
Obstet Gynecol 2015;125:521-5

Dr G Abir and colleagues (2015) – Stanford Children's Health

ACOG - 2nd line

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WOMEN'S HEALTH CARE PHYSICIANS

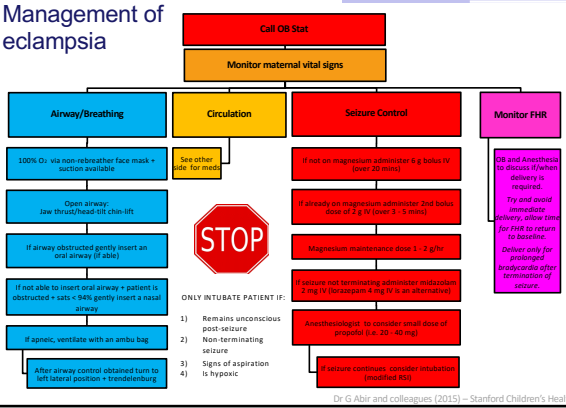
Esmolol infusion
or
Nicardipine infusion

Extreme emergency:

Sodium nitroprusside

Obstet Gynecol 2017;129:e90-5

Management of eclampsia



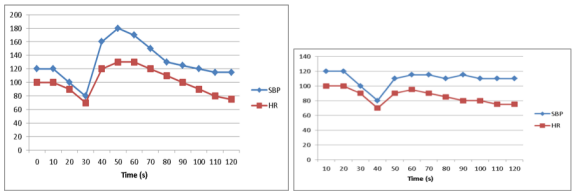
Dr G Abir and colleagues (2015) – Stanford Children's Health

RSI modification - Indications

- Preeclampsia
- Eclampsia
- Increased intracranial pressure:
  - Tumor
  - Hemorrhage
  - Hydrocephalus
  - Status epilepticus
  - Head injury
  - Meningoencephalitis
  - Cerebral edema
  - PRES

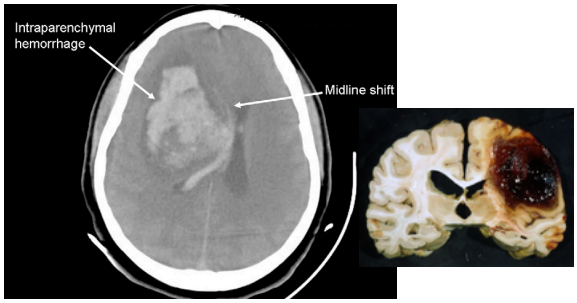
Cardiovascular changes at intubation

Unmodified | Modified



SBP = Systolic blood pressure (mm Hg)
HR = Heart rate (bpm)

Intracerebral hemorrhage



http://neuropathology-web.org/chapter2/chapter2cCerebralhemorrhage.html
Dangel AR et al. Eur J Obstet Gynecol Reprod Biol 2009;146 :232–33

FOCUSED REVIEWS IN OBSTETRIC ANESTHESIA

Prevention of Peri-Induction Hypertension in Preeclamptic Patients: A Focused Review

Melissa Pant, MD, Robert Fong, MD, and Barbara Scavone, MD

"It may be that a **combination of drugs** from different classes, along with a patient-specific dose of induction drug, **leads to optimal hemodynamic stability.**

Given their favorable pharmacologic profiles, wide availability, and predictability with few reports of serious maternal or fetal effects, **esmolol 1.5 mg/kg or NTG 2 mcg/kg, combined with propofol 2 mg/kg**, is used by the authors of this review, depending on maternal hemodynamic variables at the time of anesthesia induction."

Pant et al. Anesth Analg 2014;119:1350-6

RSI drugs

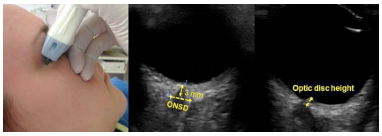
Modified — ***- Esmolol 1-2 mg/kg*** ***- Remifentanil 1 mcg/kg***

Induction agent	- Propofol
Muscle relaxant	- Succinylcholine
Maintenance	- O_2 + Volatile ± N_2O

Videolaryngoscopy???

Ocular Ultrasound

- Optic nerve sheath diameter >5.8 mm ► ↑ ICP
  (90% sensitivity, 84% specificity)
- Optic disc height ≥1 mm ► ↑ ICP
  (73% sensitivity, 100% specificity)



Simenc et al. Int J Obstet Anesth 2018;36:49-55

Preeclampsia with severe features vs. control group

	Optic nerve sheath diameter ≥5.8 mm		Optic disc height >1 mm	
	Severe preeclampsia (n=30)	Control (n=30)	**Severe preeclampsia (n=30)**	Control (n=30)
Antepartum	**13 (43%)***	0	**23 (77%)***	0
Day 1 postpartum	**13 (43%)***	0	**23 (77%)***	0
Day 4 postpartum	**3 (10%)***	0	**6 (20%)†**	0

* P<0.001
† P=0.66

Simenc et al. Int J Obstet Anesth 2018;36:49-55

Please note…

- **81 mg aspirin** (PreE prophylaxis)
  Neuraxial anesthesia not contraindicated
- **Magnesium infusion** (PreE with severe features)
  Continue infusion during cesarean delivery
- **NSAIDs**
  Safe use in postpartum patients with BP issues

Obstet Gynecol 2019;133:e1–25

Objectives

- Compare current practice with best evidence to identify areas of improvement
- Discuss the role of the obstetric anesthesiologist in management planning for patients with preeclampsia
- Review the concept of care bundles and describe ways to incorporate them in your practice

Care Bundles

"A patient safety bundle is a set of evidence-based guidelines, to be adapted for local circumstances, to optimally manage a medical condition and thus improve patient outcomes."

Bernstein et al. Obstet Gynecol 2017;130:347–57

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

PATIENT SAFETY BUNDLE **Hypertension**

CMQCC CALIFORNIA MATERNAL QUALITY CARE COLLABORATIVE

California Department of PublicHealth

CMQCC PREECLAMPSIA TOOLKIT
PREECLAMPSIA CARE GUIDELINES
CDPH-MCAH Approved: 12/20/13

Maternal Safety Bundle for Severe Hypertension in Pregnancy

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

PATIENT SAFETY BUNDLE **Hypertension**

- READINESS
- RECOGNITION & PREVENTION
- RESPONSE
- REPORTING/SYSTEMS LEARNING

Bernstein et al. Obstet Gynecol 2017;130:347–57
www.safehealthcareforeverywoman.org/patient-safety-bundles/severe-hypertension-in-pregnancy/

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

PATIENT SAFETY BUNDLE
Hypertension

READINESS

- Standard **diagnostic** criteria, monitoring + treatment
- Unit team **education**, reinforced with drills with debriefs
- Timely **triage**
- Rapid **access** to medications
- System plan for **escalation**

Bernstein et al. Obstet Gynecol 2017;130:347–57
www.safehealthcareforeverywoman.org/patient-safety-bundles/severe-hypertension-in-pregnancy/

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

PATIENT SAFETY BUNDLE
Hypertension

READINESS
RECOGNITION & PREVENTION

- Standard **protocol** and measurement of blood pressure + urine protein
- Standard **response** to MEWS
- Facility-wide standards for **educating women** on symptoms + signs

Bernstein et al. Obstet Gynecol 2017;130:347–57
www.safehealthcareforeverywoman.org/patient-safety-bundles/severe-hypertension-in-pregnancy/

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

PATIENT SAFETY BUNDLE
Hypertension

READINESS
RECOGNITION & PREVENTION
RESPONSE

- Facility-wide **standard protocols** with checklists + escalation protocols for management + treatment
- Minimum **requirements** for protocol
- **Support plan** for patients, families + staff for ICU admissions + serious complications

Bernstein et al. Obstet Gynecol 2017;130:347–57
www.safehealthcareforeverywoman.org/patient-safety-bundles/severe-hypertension-in-pregnancy/

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PATIENT SAFETY BUNDLE
Hypertension

READINESS
RECOGNITION & PREVENTION
RESPONSE
REPORTING/SYSTEMS LEARNING

- Establish a **culture** of huddles for high-risk patients + post-event team debrief
- **Multidisciplinary review** of all cases admitted to ICU for systems issues
- Monitor **outcomes** + process metrics

Bernstein et al. Obstet Gynecol 2017;130:347–57
www.safehealthcareforeverywoman.org/patient-safety-bundles/severe-hypertension-in-pregnancy/

In summary

- ✓ Current practice
- ✓ Role of the anesthesiologist
- ✓ Care bundles

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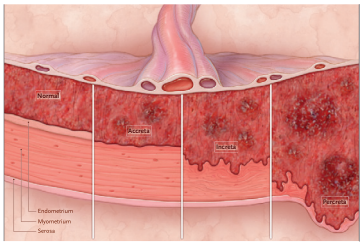
Anesthetic Management of Invasive Placental Disease

John C. Markley, MD, PhD
Department of Anesthesia and Perioperative Care
University of California San Francisco
Director of Obstetric Anesthesia, Zuckerberg San Francisco General

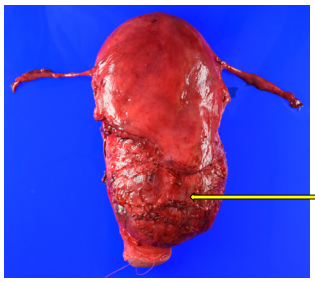
No Financial Disclosures

This presentation will address off-label use of medications

Placenta Accreta Spectrum (PAS)
aka Morbidly Adherent Placenta (MAP)
aka Invasive Placental Disease



Silver et al. *NEJM*. 2018



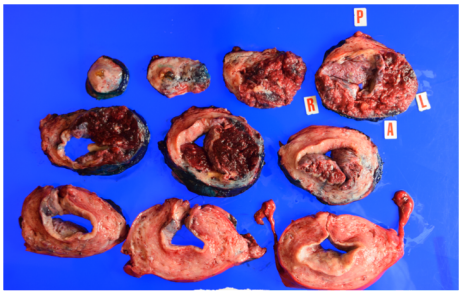
Bladder muscularis

Gross images courtesy of Dr. J. Rabban, UCSF Department of Pathology

Increta involving anterior (A), posterior (P), left (L), and right (R) lower uterine segments

Cervix

Fundus



Gross images courtesy of Dr. J. Rabban, UCSF Department of Pathology

Not all accretas are the same

(hence the term placenta accreta spectrum)

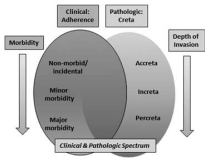
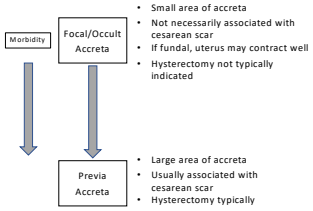


FIGURE 1. The spectrum of clinical and pathologic findings historically encompassed by the term "accreta."



- Small area of accreta
- Not necessarily associated with cesarean scar
- If fundal, uterus may contract well
- Hysterectomy not typically indicated

- Large area of accreta
- Usually associated with cesarean scar
- Hysterectomy typically indicated

Mullen et al. *Am J Perinatol*. 2018.
Carusi DA. *Clin Obstet Gynecol*. 2018.

Previa + Prior Cesarean Delivery → Accreta

- Risk of PAS increases with # of prior cesareans in the presence of previa

Table 4. Placenta Previa and Placenta Accreta by Number of Cesarean Deliveries

Cesarean Delivery	Previa	Previa*:Accreta† [n (%)]	No Previa‡:Accreta§ [n (%)]
First‖	398	13 (3.3)	2 (0.03)
Second	211	23 (11)	26 (0.2)
Third	72	29 (40)	7 (0.1)
Fourth	33	20 (61)	11 (0.8)
Fifth	6	4 (67)	2 (0.8)
≥ 6	3	2 (67)	4 (4.7)

* Percentage of accreta in women with placenta previa.
† Increased risk with increasing number of cesarean deliveries; $P < .001$.
‡ Percentage of accreta in women without placenta previa.
§ Primary cesarean.

Silver et al. *Obstet & Gynecol*, 2006.

Placenta Accreta Spectrum: Hemorrhage

- Because placenta is "stuck", a *gravid* hysterectomy may be needed.
- *Gravid* hysterectomy is ***not at all*** like a *Non-Gravid* hysterectomy
  - 700 vs. 50 mL/min blood flow
  - Many collateral vessels
  - Much larger organ
  - Open procedure
  - Fetus(es)

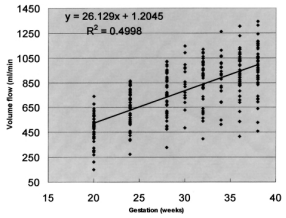


Fig 2. Changes in uterine artery blood volume flow with gestation.

Konje et al. *Am J Obstet Gynecol*. 2001.

Role of the Anesthesiologist in C-Hyst Planning

Opportunities for involvement of the Obstetric Anesthesia service

Box 1. Relevant Considerations for Case Optimization in Planned Placenta Accreta Spectrum

Preoperative
- Maximization of preoperative hemoglobin values
- Verification of specific timing of planned delivery
- Identification of exact location of delivery (surgical suite and its associated capabilities)
- Verification that necessary preoperative consultations have occurred
- Consideration of patient and family needs given temporary relocation to placenta accreta spectrum center of excellence

Intraoperative
- Verification of appropriate complement of surgical expertise involved or available, or both
- Intraoperative availability of resources to optimize each case
  - eg, Cell-saver, intraoperative point of care testing, adequate surgical trays, and necessary urologic equipment
- Verification of availability of related services as necessary (eg, interventional radiology)
- Coordination of blood bank with scheduling or timing of case

Postoperative
- Assurance that critical care services are engaged and available for postoperative care
- Identification of the need for identification of primary service responsible for postoperative care

Placenta Accreta. *ACOG Obstetric Care Consensus*. 2018.

Levels of Maternal Care

From ACOG: "Women with suspected PAS diagnosed in the antenatal period based on imaging or by clinical acumen should be delivered at a level III or IV center with considerable experience whenever possible to improve outcomes."

– Grade 1B; Strong recommendation, moderate-quality evidence.

Required Service	Level of Maternal Care				
	Birth Centers	Level I	Level II	Level III	Level IV
Anesthesia		Anesthesia services available	Anesthesia services available at all times Board-certified anesthesiologist with special training or experience in obstetrics, available for consultation	Anesthesia services available at all times Board-certified anesthesiologist with special training or experience in obstetrics is in charge of obstetric anesthesia services	Anesthesia services available at all times Board-certified anesthesiologist with special training or experience in obstetrics is in charge of obstetric anesthesia services

Placenta Accreta. *ACOG Obstetric Care Consensus*. 2018; Levels of Maternal Care. *ACOG Obstetric Care Consensus*. 2015.

Accreta Center of Excellence: Criteria

Box 1
Criteria for accreta referral center

1. Multidisciplinary team
   a. Experienced maternal–fetal medicine physician or obstetrician
   b. Imaging experts (ultrasound and MRI)
   c. Pelvic surgeon (ie, gynecologic oncology or urogynecology)
   d. Anesthesiologist (ie, obstetric anesthesia or cardiac anesthesia)
   e. Urologist
   f. Trauma surgeon or general surgeon
   g. Interventional radiologist
   h. Neonatologist
2. ICU and facilities
   a. Interventional radiology
      i. Capability within the operating suite—hybrid operating room
   b. Surgical or medical ICU
      i. 24-hour availability of intensive care specialists
   c. Neonatal ICU
      i. Gestational age appropriate for neonate
3. Blood services
   a. Massive transfusion capabilities
   b. Cell-saver and perfusionists
   c. Experience and access to alternative blood products
   d. Guidance of transfusion medicine specialists or blood bank pathologists

From Silver RM, Fox KA, Barton JR, et-al. Center of excellence for placenta accreta. Am J Obstet Gynecol. 2014. http://dx.doi.org/10.1016/j.ajog.2014.11.018; with permission.

Silver et al. *Obstet Gynecol Clin North Am*. 2015.

Obstetric Management of PAS

- Cesarean hysterectomy – typical treatment
- Conservative/Preservative management
  - Placental tissue removed, no hysterectomy
- Expectant management
  - Placenta remains in situ, no hysterectomy

"My doctor had to stick his entire arm in me and detach the placenta with his hand, scraping it away from my uterus with his fingernails"
– Kim Kardashian West
Hohman M. *People Magazine*, 1/3/2019

Placenta Accreta. *ACOG Obstetric Care Consensus*. 2018.
Fox et al. *AJOG*. 2015.

General Surgical Plan for PAS C-Hyst

- Delivery at 34-36 weeks
- +/- Preoperative ureteral stent placement
- +/- Arterial balloon catheters
- Low lithotomy vs. supine positioning
- Vertical midline vs. Pfannenstiel incision
- Hysterotomy site dependent on placenta position
- Delivery of neonate(s)
- Placenta left *in situ*
- Closure of hysterotomy
- Gravid hysterectomy
- +/- Cystoscopy
- +/- Arterial embolization
- +/- Intensive care unit

Silver et al. *Obstet Gynecol Clin North Am*. 2015.

Planning for the PAS Case

- Multidisciplinary team
  - Obstetrics
  - Obstetric Anesthesia
  - Perfusion Medicine (autologous blood salvage)
  - Neonatology
  - Gynecologic-Oncology
  - OB Nursing
  - Main OR Nursing
  - Anesthesia Technicians
  - Radiology
  - Interventional Radiology
  - Transfusion Medicine (Blood Bank)
  - General/Trauma Surgery
  - Urology
  - Critical Care

In an ***unplanned*** cesarean hysterectomy, these resources may need to be activated ***intraoperatively***.

PAS C-Hyst Perioperative Checklist

Antepartal Period
- Multidisciplinary meeting with maternal fetal medicine team and other specialty consultants
- Baseline blood laboratory studies drawn and reviewed
- Anesthesiology consult focused on comorbidities, obstetric history, and any lab abnormalities
- Additional periodic multidisciplinary meetings to formulate optimal delivery and surgical plan
- Contact scheduler and confirm booking of appropriate delivery location
- Notify IR, blood bank, NICU, and cell salvage technicians if applicable

Day Prior or Day of Surgery
- Review staging and location of adherent placenta
- Anti-D prophylaxis administered if appropriate
- Check fasting guidelines ordered and followed
- Confirm availability of specialty teams (eg, IR, gynecologic surgery, cell salvage, and OR nursing)
- Repeat examination of airway, heart, lungs, spine, and IV access sites
- Review laboratory studies (complete blood count, coagulation screen, electrolytes, liver function tests)
- Review any anticoagulation
- Confirm blood product availability
- Cross match 6 units PRBCs, 4 units FFP, 1 unit platelets, with additional units available
- Confirm consents for cesarean delivery, hysterectomy, blood products, and anesthetic plan
- Before entering OR, review (preprocedure timeout):
  - Surgical plan
  - Anesthetic plan (general or neuraxial with possible conversion to general anesthesia)
  - Plan for invasive monitoring (arterial line, central venous access, intraoperative cardiac echo)
  - Blood products present in OR
  - Neonatal isolette nearby and neonatal resuscitation team available
  - Rapid fluid/blood product infuser available

Intraoperative
- Aspiration prophylaxis
- Baseline vitals obtained, standard monitors placed
- Appropriate fluids, vasopressors, and airway equipment ready
- If applicable, spinal or epidural catheter insertion with test dose for epidural
- If applicable induction of general anesthesia with rapid sequence technique
- Additional IV access, arterial line, central venous access placed as appropriate
- Use of forced air warmer to maintain core temperature ≥ 36°C
- Placement of ureteral stents or arterial balloon catheters by other specialties if appropriate
- Preincision timeout
- Prophylactic antibiotic administration
- Maternal mean arterial pressure and heart rate maintained near baseline prior to delivery

After Delivery
- Possible conversion to general anesthesia (before potential for hemorrhage)
- Tranexamic acid administration
- Fluid administration and blood products guided by clinical judgment and laboratory studies
- Periodic laboratory studies (blood gas, complete blood count, coagulation/clotting studies)
- Remain in contact with blood bank to communicate transfusion needs
- Possible transport to IR suite or use of arterial balloons if appropriate
- Possible need to redose antibiotics

Case Completion
- Consider extubation (awake)
- Transport to surgical ICU
- Pain control orders in place
- Plan for VTE prophylaxis reviewed
- Debrief

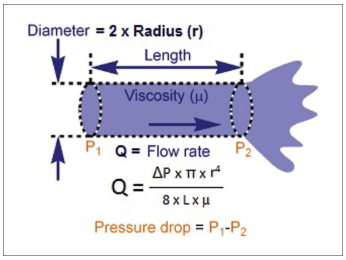
Warrick CM, Rollins MD. *Clin Obstet Gynecol*. 2018.

Transfusion Strategy

- Prepare for massive transfusion
  - Not necessarily needing the massive transfusion protocol (MTP)
- RBC:Plasma:Platelets
  - No equivalent of the randomized PROPPR trial done for *obstetric* hemorrhage
  - Higher Plasma:RBC ratio assoc. w/ decr. need for advanced interventional procedures
  - CMQCC recommends 6:4:1 or 4:4:1
- Aim for fibrinogen > ~250 mg/dL
  - Cryoprecipitate
  - Fibrinogen concentrate (RiaSTAP)

Pasquier et al. *A&A*. 2013; Holcomb et al. *JAMA*. 2015; Butwick et al. *Curr Opin Anaesthesiol*. 2015; CMQCC, 2015.

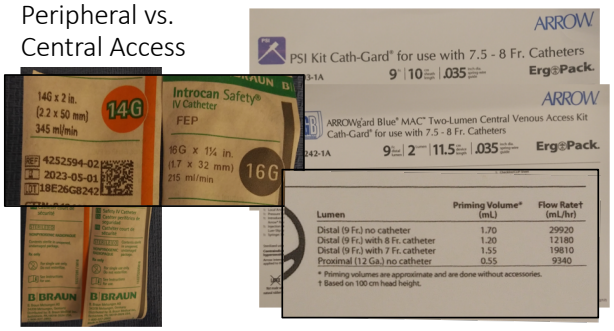
Vascular Access: Poiseuille Equation *c*. 1840



Greene N et al. *Int J Crit Illn Inj Sci*. 2012

Peripheral vs. Central Access

Peripheral vs. Central Access



"Exchange Set" means you can exchange a 20G catheter with this set.

www.teleflexvascular.com

Pressurized Flow Rates Through Different Catheters

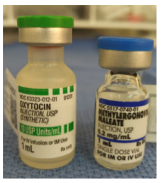
- Belmont rapid infuser
  - maximum rate 1000 mL/min
  - pressure limiter set to 300 mm Hg
  - extension tubing attached
- Massive Transfusion Products (PRBC:FFP 1:1)

Catheter	Flow (ml/min)	Pressure (mmHg)
Braun Introcan 18G	231	300
Braun Introcan 16G	458	300
Braun Introcan 14G	698	300
Arrow Two-lumen 14G Distal Port	255	300
Arrow Two-lumen 14G Proximal Port	205	300
Bard Trialysis 12G Distal Port	799	300
Bard Trialysis 12G Proximal Port	765	300
Arrow 7 Fr RIC	1000	287
Arrow 9 Fr PSI Kit	1000	287
Arrow 9 Fr MAC	1000	264
Control (No catheter)	1000	217

Milne A, Teng J, Vargas A, Collins A. *Unpublished results*. 2018.

Uterotonics During C-Hyst for PAS?

- No data to support their use *OR* non-use
- Controversy:
  - *PRO argument*
    Myometrial contraction will occlude blood vessels
  - *ANTI argument*
    Uterotonics will cause placental separation and lead to hemorrhage.
    Side effects of uterotonic agents.



Matsubara S. *Arch Gynecol Obstet*. 2012; Ngene et al. *Arch Gynecol Obstet*. 2013.

Anesthetic Modality Options for PAS

- Primary neuraxial anesthesia (NA)
  - What type of neuraxial?
  - Sedation plan?

- Primary general anesthesia (GA)
  - Place neuraxial for post-operative analgesia?

- NA to GA conversion after delivery
  - Electively after delivery?
  - Electively after hysterectomy confirmed?
  - Convert only if needed (non-elective)?

Comparison of Anesthesia Modalities

Anesthetic Modality	Pros	Cons
Neuraxial anesthesia (NA)	• Patient awake • Bonding/breastfeeding possible • Lower incidence of Apgar <7 • Possibly lower EBL • Reduced ICU admission	• Possible need for emergent conversion to GA • Inferior operative conditions • Intraoperative N/V • Possible need for supplemental sedation • Sympathectomy • Neuraxial in the setting of potential coagulopathy
General Anesthesia (GA)	• Airway secured • Controlled ventilation • Superior operative conditions	• Need to manipulate maternal airway • Fetal exposure to GA • Inferior post-op pain control/Higher incidence of chronic pain • Negative effect on bonding/breastfeeding • PONV • Higher incidence of Apgar <7 • Possibly higher EBL • If no PAS found at surgery, patient received GA unnecessarily • Higher ICU admission rate
NA-to-GA conversion after delivery	• Reduced fetal exposure to anesthetics • Patient can see/bond with neonate • Airway secured during resuscitation	• Need for airway securement at a non-ideal time • Neuraxial sympathectomy + GA induction at onset of hemodynamic instability

Warrick CM, Rollins MD. *Clin Obstet Gynecol.* 2018; Markley et al. *Anesth Analg.* 2018

ANESTHESIA AND ANALGESIA . . . *Current Researches* VOL. 49, NO. 2, MARCH-APRIL, 1970

Anesthetic Considerations in Cesarean Hysterectomy

DONALD R. LaPLATNEY, M.D.
JAMES A. O'LEARY, M.D.
Miami, Florida*

- *60 patients*
  - 18 spinal anesthesia
    - 4/18 failed
  - 6 epidural anesthesia
    - 3/6 failed
  - 36 general anesthesia

GYNECOLOGIC ONCOLOGY 5, 357–362 (1977)

Carcinoma *in Situ* of the Cervix in Pregnancy: Treatment with Primary Cesarean Hysterectomy

DAVID L. BARCLAY, M. D., DAVID M. FRUEH, M. D., AND BYRON L. HAWKS, M. D.
Department of Obstetrics and Gynecology, University of Arkansas for Medical Sciences, Little Rock, Arkansas 72201

Received May 10, 1977

- *32 patients*
  - No failure rate mentioned

patients received atropine as a drying agent, and spinal anesthesia was administered unless contraindicated. A vertical skin incision has been used in all of our patients; however, a low transverse incision is acceptable. In all patients, the

1168 October 1985 • SOUTHERN MEDICAL JOURNAL • Vol. 78, No. 10

Continuous Epidural Anesthesia for Elective Cesarean Hysterectomy

DAVID H. CHESTNUT, MD, and LLOYD F. REDICK, MD, Durham, NC

anesthesia throughout elective cesarean hysterectomy at this institution. There is an increasingly common desire among parturients to be awake and alert for cesarean delivery, and these patients should not be prohibited from choosing epidural anesthesia for elective cesarean hysterectomy, provided no other recognized contraindication to epidural anesthesia is present. Informed consent, however, should include recognition that some in-

- 25 patients epidural anesthesia
  - 7/25 failed

Anesthesia Modalities for Pathology-Confirmed PAS

Study	Type	N	% C-Hyst	% GA	% NA-only	% NA-to-GA
Lilker et al. *IJOA*, 2011	Retrospective	23	48	26	52	22
Kocaoglu et al. *Ginekol Pol*, 2012	Retrospective	28	61	86	7	7
Nguyen-Lu et al. *Can J Anesth*, 2016	Retrospective	50	72	12	62	26
Taylor et al. *IJOA*, 2017	Retrospective	40	60	5	53	43
Markley et al. *Anesth Analg*, 2018	Retrospective	81	93	9	68	23
Riveros-Perez et al. *Int J Gynaecol Obstet*, 2018	Retrospective	43	91	9	21	70

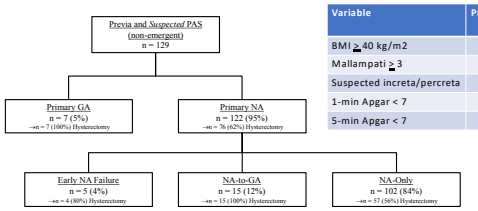
- No prospective studies.
- No consensus on a superior anesthesia modality.

Not Realistic to Plan Based on Path-Confirmed PAS

- Problem: When planning a case, the Obstetric Anesthesiologist is not given the patient's pathology results.
- Our plan relies on clinical and radiological *suspicion* for PAS.
- For example, what is your anesthesia plan for this scenario?
  - Clinical: "Current placenta previa with history of two prior cesarean deliveries."
  - Radiological findings: "Low suspicion for accreta."
    - Ultrasound – 54% sensitivity, 88% specificity
    - MRI – 77% sensitivity, 50% specificity
    - Ultrasound & MRI – 68% concordance

Bowman et al. *AJOG*. 2014, Riteau et al. *PLoS ONE*. 2014.

Anesthesia for *Suspected* PAS



Variable	Primary GA N = 7	Primary NA N = 122
BMI ≥ 40 kg/m2	1 (14%)	9 (7%)
Mallampati ≥ 3	2 (29%)	17 (14%)
Suspected increta/percreta	6 (86%)	29 (24%)
1-min Apgar < 7	4 (57%)	24 (20%)
5-min Apgar < 7	2 (29%)	9 (7%)

Adapted from Markley et al. *Anesth Analg*. 2018.

PAS C-Hyst: NA-Only vs. NA-to-GA

Outcome Variable	NA-Only N = 57	NA-to-GA N = 15	*P* Value
≥ 4 U PRBC	14 (25%)	9 (60%)	.01
Total products, U	2 (0-28)	8 (0-34)	0.03
Surgical duration, h	2.6 (1.0-5.6)	4.0 (2.0-6.3)	<.01
Postoperative Acuity*	2 (4%)	7 (47%)	<.001
Pathologic diagnosis			.10
No invasion	4 (7%)	0 (0%)	
Accreta	16 (29%)	1 (7%)	
Increta	20 (36%)	5 (33%)	
Percreta	16 (29%)	9 (60%)	

Data shown as n (%) or median (range).

* Need for ICU admission, arterial embolization, reoperation, or post-op transfusion of ≥ 3 U PRBC.

Table 3. Variables Associated With Postdelivery Conversion From NA to GA[a]

Variable	OR (95% CI)	aOR (95% CI)[b]
Uterine fibroids	4.82 (1.04–22.26)	3.84 (0.38–36.73)
≥3 prior CD	4.76 (1.30–17.49)	6.45 (1.12–45.03)
≥4 U PRBC intraoperative	4.61 (1.39–15.24)	1.31 (0.16–11.02)
Surgical duration (per 30-min time interval)	1.52 (1.17–1.99)	1.54 (1.01–2.42)

Abbreviations: aOR, adjusted odds ratio; CD, cesarean delivery; GA, general anesthesia; NA, neuraxial anesthesia; OR, odds ratio; PRBC, packed red blood cells; U, units.

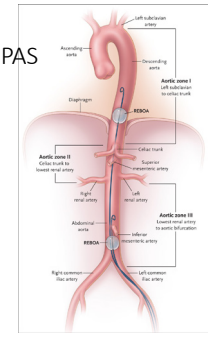
[a]Logistic regression models are controlled for body mass index and preoperative suspicion for increta or percreta.

[b]Reported as exact ORs.

Markley et al. *Anesth Analg*. 2018.

Resuscitative Endovascular Balloon Occlusion of the Aorta (REBOA) for PAS

- *Prophylaxis:* Meta-analysis of 4 studies
  - N = 128 control, N = 313 balloon
  - Balloon = -1.4 L EBL, -2.5 units transfused
  - 2 balloon-related complications
- *Treatment:* Largest case series: N = 36
  - Balloon placed for hemodynamically unstable severe PPH
  - All cases resulted in return of hemodynamic stability
  - 6 balloon-related complications
  - Of note, procedure performed by IR, but not with fluoroscopy



King DR et al. *NEJM*. 2019; Ordonez CA et al. *J Trauma Acute Care Surg*.2018; Stensaeth et al. *PLoS ONE*. 2017.

Conclusions

- ACOG strongly recommends that patients with suspected PAS be delivered at a Level III or IV Maternal Care institution
- The multi-disciplinary team approach is essential for successful outcomes
- No prospective trials exist comparing anesthesia modalities for cesarean delivery for PAS
- Primary neuraxial anesthesia may have advantages over primary general anesthesia including reduced fetal exposure to anesthetics
- Starting with neuraxial anesthesia may prevent the unnecessary general anesthetics in cases of false positive PAS or when a c-hyst was not performed
- It may be reasonable to reserve primary general anesthesia for patients with risk factors for difficult airway or increased surgical complexity.

Program Slides

Friday, March 15, 2019

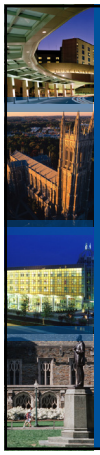
Session III: Enhanced Recovery and Cesarean Anesthesia

Moderator: Brendan Carvalho, M.B., B.Ch., FRCA

Recommended ERAS Protocols for Cesarean Delivery
Ashraf S. Habib, M.B.,B.Ch., M.Sc., M.S.N., FRCA

Setting up and Evaluation of a Successful ERAS Pathway for Cesarean Delivery
Eric J. Hunt, M.D., Ph.D.

Regional Blocks for Cesarean Delivery Analgesia: TAP, QL and Beyond
Pedram Aleshi, M.D.



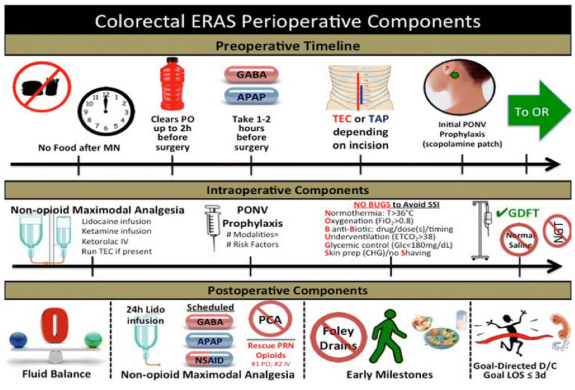
Duke Anesthesiology

Recommended ERAS Protocols for Cesarean Delivery

Ashraf S Habib, MBBCh, MSc, MHSc, FRCA
Professor of Anesthesiology
Professor in Obstetrics and Gynecology
Chief, Division of Women's Anesthesia

Disclosures

- **Research Support**
  - **Trevena Inc.**
  - **Pacira Pharmaceuticals**
  - **BioQ Pharma**
  - **Haylard Health**
- **Advisory Board**
  - **Trevena Inc**
  - **Health Decisions**



Objectives

- Identify Quality of Recovery Indicators following Cesarean Delivery
- Provide an Overview of essential elements of an ERAS protocol for CD
- Focus on the Anesthesiologist role in ERAS protocols

Quality of Recovery following CD

Pain

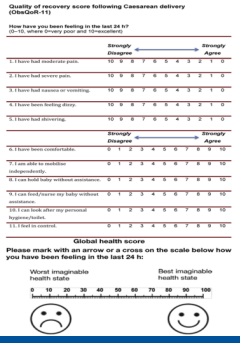
Nausea
Vomiting

Dizziness

Shivering

Breastfeeding
Holding Baby

Mobilizing
Personal hygiene
In control

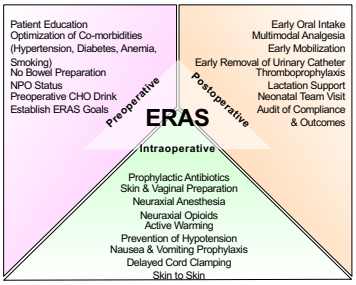


Ciechanowicz S. Br J Anaesth 2019;122: 69-78

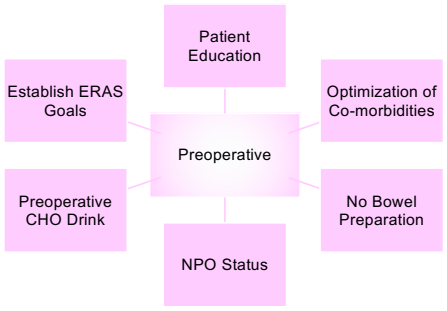
Objectives

- Identify Quality of Recovery Indicators following Cesarean Delivery
- Provide an Overview of essential elements of an ERAS protocol for CD
- Focus on the Anesthesiologist role in ERAS protocols

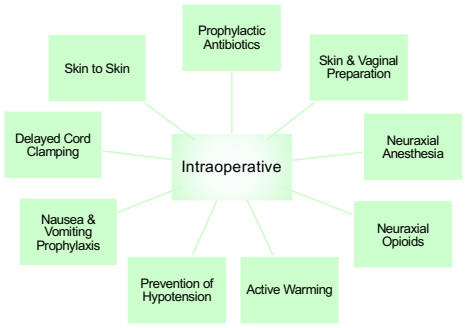
ERAS Multimodal Care Pathway



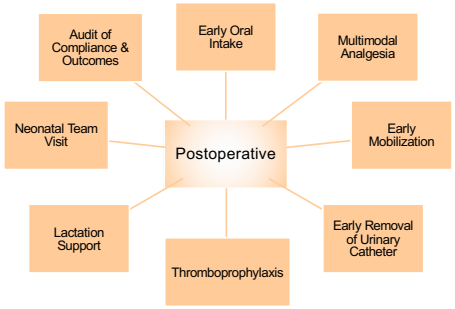
ERAS Multimodal Care Pathway
Preoperative



ERAS Multimodal Care Pathway
Intraoperative



ERAS Multimodal Care Pathway
Postoperative



Objectives

- Identify Quality of Recovery Indicators following Cesarean Delivery
- Provide an Overview of essential elements of an ERAS protocol for CD
- Focus on the Anesthesiologist role in ERAS protocols

Quality of Recovery following CD

Pain → Multimodal analgesia

Nausea / Vomiting → IONV/PONV prophylaxis; Opioid sparing strategies

Dizziness → Prevention of hypotension; Non-sedating agents

Shivering → Prevention of hypothermia

Breastfeeding / Holding Baby → Skin to skin; Adequate analgesia; Breastfeeding support

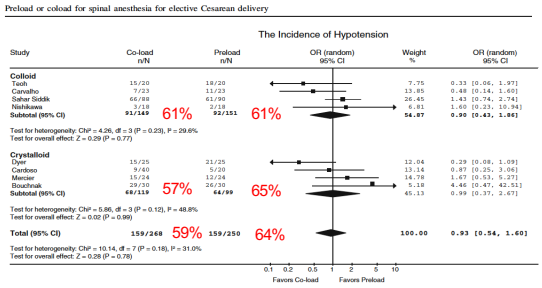
Mobilizing / Personal hygiene / In control → Adequate Analgesia; Patient Education

Anesthesiologist Role

- Prevention of hypotension
- Prevention of hypothermia
- Nausea and vomiting prophylaxis
- Postoperative analgesia

Duke Anesthesiology

Fluids for Spinal Induced Hypotension

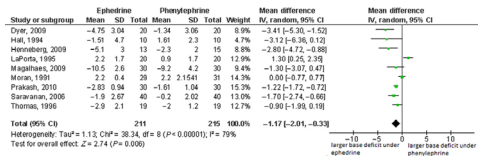


Banerjee A. Can J Anesth 2010;57:24-31

Duke Anesthesiology

Phenylephrine vs. Ephedrine

Neonatal Base Excess



Veeser M. Acta Anaesthesiol Scand 2012;56:810-16

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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

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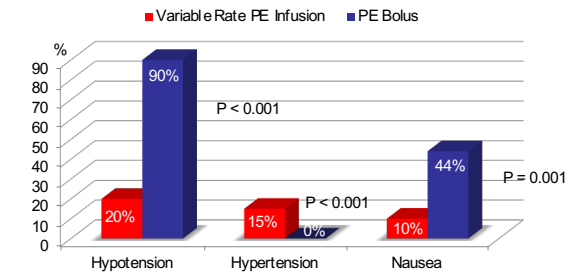
Prophylactic Phenylephrine Infusion



Median number of interventions: 0 vs. 3, p < 0.001

Siddik-Sayyid S. Anesth Analg 2014;118:611-8

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Anesthesiologist Role

- Prevention of hypotension
- Prevention of hypothermia
- Nausea and vomiting prophylaxis
- Postoperative analgesia

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Impact of Hypothermia

- Increased blood loss
- Increased wound infection
- Myocardial ischemia
- Prolonged drug action
- Prolonged recovery and hospital stay/ increased costs

Frank SM. JAMA 1997;277;1127-34. Kurz A. NEJM 1996; 334;1209-15
Schmied H. Lancet 1996;347;289-92. Lenhardt R. Anesthesiology 1997;87:1318-23

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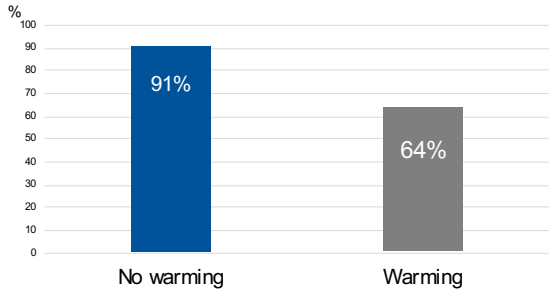
Incidence of Hypothermia



Cobb B. Anesth Analg 2016;122:1490-7

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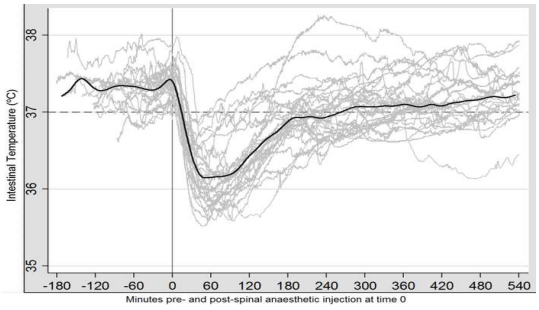
Magnitude and Duration of Temperature Drop



du Toit. Anesth Analg 2018;126:190-195

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Active Warming

Outcome (n studies)	MD, RR or SMD (95% CI)
End of surgery temperature (10)	0.43 (0.27, 0.59)
Shivering (12)	0.58 (0.43, 0.79)
Thermal Comfort (4)	0.90 (0.36, 1.45)
Hypothermia (5)	0.66 (0.50, 0.87)
Umbilical artery pH (3)	0.02 (0.00, 0.05)

Sultan P. Br J Anaesth 2015;115:500-10

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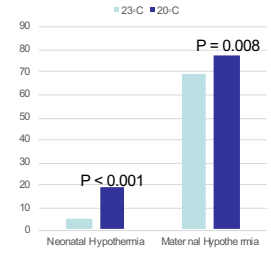
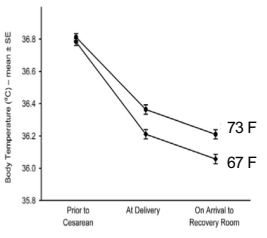
OR Ambient Temperature

Neonatal and Maternal Hypothermia



Maternal Temperature



Duryea EL. Am J Obstet Gynecol 2016; 214: 505.e1-505.e7

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Anesthesiologist Role

- Prevention of hypotension
- Prevention of hypothermia
- Nausea and vomiting prophylaxis
- Postoperative analgesia

Duke Anesthesiology

Prevention of IONV

- **Anesthetic factors:**
  - Prevention of hypotension (PE Infusion)
  - Good quality block (ITF)
    - RR (95% CI) = 0.41 (0.24. 0.70), NNT = 6.5
  - Combination Antiemetics
    - Metoclopramide + ondansetron
      - 23% vs. 49% with placebo
- **Surgical factors:** Exteriorization and irrigation

Ngan Kee W. Br J Anaesth 2004;92:469-74 Mannulang TR. Anesth Analg 2000; 90:1162-6
Uppal V. Anesth Analg 2019 (Epub ahead of print) Habib AS. Obstet Gynecol 2013;101:615-23

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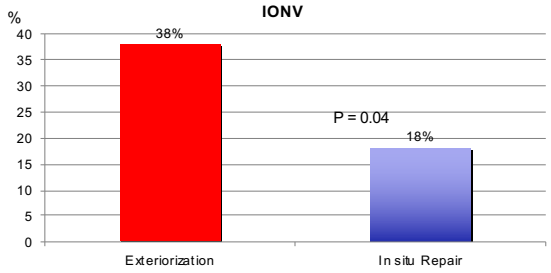
Exteriorization of the Uterus and IONV



Siddiqui M. Obstet Gynecol 2007;110:570-5

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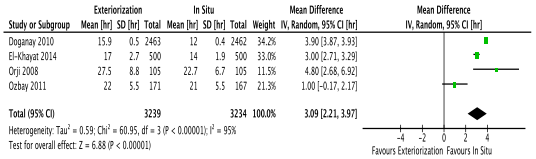
Exteriorization of the Uterus and Bowel Function

Return of bowel function



Zaphiratos V. Can J Anesth 2015;62:1209-20

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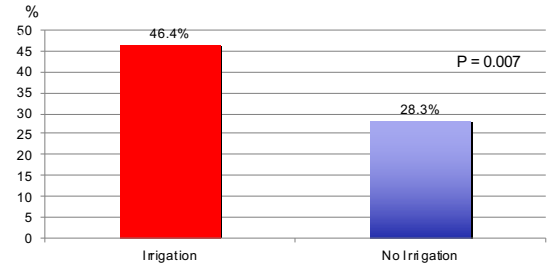
Intra-abdominal Irrigation and IONV



ION:RR: 1.68, 95% CI:1.36–2.06
IOV: RR: 1.70, 95% CI: 1.28–2.25

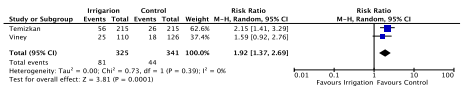
Viney R. Obstet Gynecol 2012;119:1106-11
Eke AC. J Matern Fetal Neonatal Med 2016;29:1588-94

Duke Anesthesiology

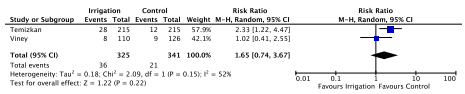
Intra-abdominal saline irrigation at cesarean section: a systematic review and meta-analysis

Ahizechukwu Chigoziem Eke[1], Ghadear Hussein Shukr[2], Tina Taissir Chaalan[2], Sereen Khaled Nashif[2], and George Uchenna Eleje[3]

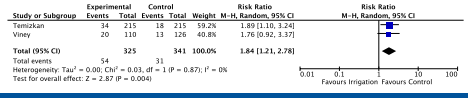
Postoperative Nausea



Postoperative Vomiting



Need for Rescue Antiemetics



Eke AC. J Matern Fetal Neonatal Med 2016;29:1588-94

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Prevention of PONV

- **Combination Antiemetic Therapy**
- **Analgesia**
  - Dose of ITM
  - Opioid sparing techniques

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Anesthesiologist Role

- Prevention of hypotension
- Prevention of hypothermia
- Nausea and vomiting prophylaxis
- Postoperative analgesia

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Modalities for Post-Cesarean Analgesia

- **Opioids**
- **Systemic Adjuncts**
- **Local Anesthetic Techniques**
- **Neuraxial Adjuncts**

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Neuraxial vs. Parenteral Opioids

- **Meta-analysis (10 studies):**
  - ↑ time to first analgesia
  - ↓ pain scores
  - ↑ pruritus (RR=2.7) and nausea (RR=2)
  - ↑ sedation with parenteral opioids

Bonnet MP. Eur J Pain 2010;14:894.e1-894. e9

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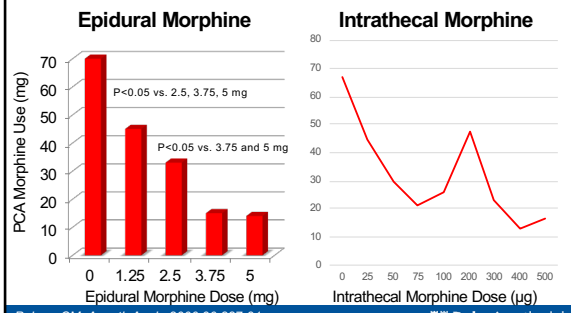
Dose Response of Neuraxial Morphine



Palmer CM. Anesth Analg 2000;90:887-91
Palmer CM. Anesthesiology 1999;90:437-44

Duke Anesthesiology

ITM Dose and Pruritus/PONV

Table 4. Summary of Maternal Secondary Outcomes

Outcomes	No. studies	No. patients (low dose, high dose)	MD/OR	MD/OR (95% CI)	P	I^2	NNT/NNH
Pain scores at 12 h	2	74, 72	MD	2.54 (−2.55 to 7.63)	0.33	0	NA
Pain scores at 24 h	1	18, 19	MD	1.00 (−2.50 to 4.50)	0.58	NA	NA
Pruritus	8	228, 192	OR	0.34 (0.20 to 0.59)	0.0001	0	5.9
Severe pruritus	5	156, 131	OR	0.32 (0.16 to 0.61)	0.0006	0	7.0
Vomiting	7	180, 138	OR	0.38 (0.19 to 0.75)	0.005	0.03	7.7
Nausea or vomiting	7	196, 174	OR	0.44 (0.27 to 0.73)	0.002	0	8.3
Antiemetics	2	79, 75	OR	0.69 (0.32 to 1.45)	0.33	0	NA

CI = confidence interval; MD = weighted mean difference; NA = not applicable; NNH = numbers needed to harm; NNT = numbers needed to treat; OR = odds ratio.

Sultan P. Anesth Analg 2016; 123:154-64

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Modalities for Post-Cesarean Analgesia

- Opioids
- **Systemic Adjuncts**
- Local Anaesthetic Techniques
- Neuraxial Adjuncts

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Combination of NSAIDs and Acetaminophen

- Combination > acetaminophen alone in 85% of studies
- Combination > NSAIDs alone in 64% of studies
- Pain scores reduced by 35%/37% over acetaminophen/ NSAIDs
- Analgesic needs reduced by 39%/31% over acetaminophen/NSAIDs

Ong CKS. Anesth Analg 2010;10:1170-9

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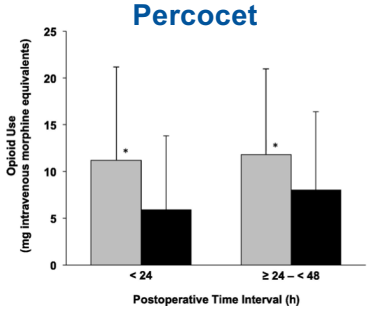
Scheduled Acetaminophen vs. PRN Percocet



Need for opioids: 83% vs. 72%, P = 0.03
Lower pain scores first 24 h

Valentine AR. Int J Obstet Anesth 2015;24:210-16

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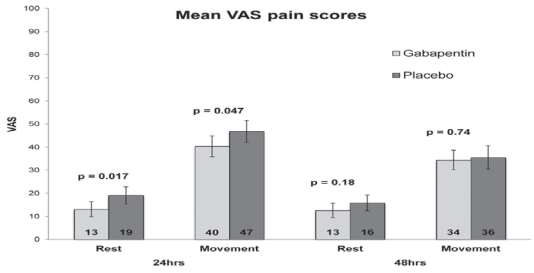
Gabapentin



Sedation: 55% vs. 38%, P = 0.03
Severe Sedation: 8% vs. 2%, P = 0.02

Monks DT. Anesthesiology 2015;123:320-6

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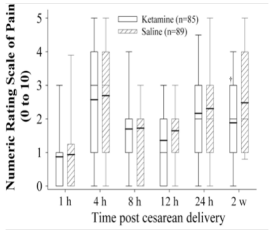
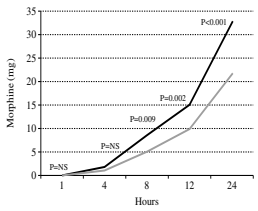
Ketamine

10 mg IV following Delivery

0.5mg/kg IM followed by 2 µg/kg/min for 12 h





Bauchat JR. Int J Obstet Anesth 2011;20: 3-9
Suppa E. Minerva Anesthesiol 2012;78:774-81

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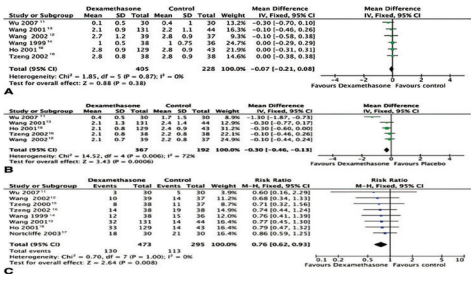
Dexamethasone

Early Pain (0-4 h)

Late Pain (24 h)

Need for rescue analgesics



Allen TK. Anesth Analg 2012;114:813-22

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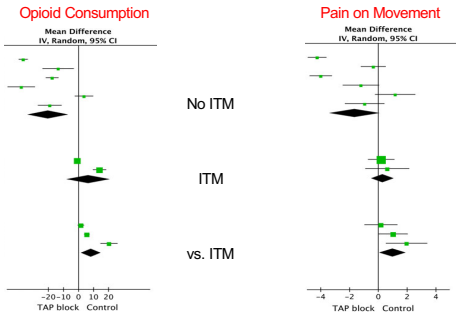
Modalities for Post-Cesarean Analgesia

- Opioids
- Systemic Adjuncts
- **Local Anesthetic Techniques**
- Neuraxial Adjuncts

Duke Anesthesiology

TAP Block



Mishriky BM. Can J Anesth 2012;59:766-78

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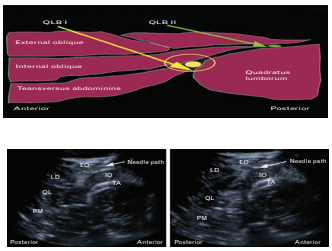
Quadratus Lumborum Block



Blanco R. Eur J Anaesthesiol 2015;32:812-8
Blanco R. Reg Anesth Pain Med 2016;41:757-62

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Modalities for Post-Cesarean Analgesia

- Opioids
- Systemic Adjuncts
- Local Anesthetic Techniques
- **Neuraxial Adjuncts**

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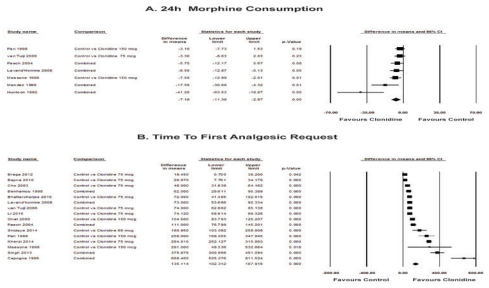
Neuraxial Clonidine



Allen TK. Br J Anaesth 2018;120:228-240

Duke Anesthesiology

Duke ERAS Protocol

Before Hospital Arrival	Only apple juice or Gatorade up to 12 oz 2 hours before hospital arrival *Please note time* No solid food after midnight
Preoperative	Aspiration/Antiemetic prophylaxis: IV famotidine 20 mg + Metoclopramide 10 mg before OR Order recovery food IVF LR @ 120mL/h

Duke Anesthesiology

Duke ERAS Protocol

Intraoperative	Normothermia: OR temp > 20°C (68°F), Fluid Warmer, forced air warmer Spinal/CSE with bupivacaine 12mg + F 15mcg + M 100-150mcg Antiemetic: Dexamethasone 4mg prior to incision, Ondansetron 4mg after delivery Promethazine PRN Pain: Neuraxial opioids. PR Acetaminophen 975mg and Ketorolac 15mg unless contraindicated. Fluid management: Co-load with 1000-2000 cc + 1:1 for EBL or clinically dictated (Goal= 2-3L unless fluid restriction needed) Oxytocin: 18 U/h Gentle cesarean: Assist with clear drapes, mark skin-to-skin time	
PACU	"Fast-track" must be approved by OB team and Anes team at hand-off Fast track: Sips/chips for first < 30 mins. Clears ad lib > 30 mins Eat food > 60 mins	IV lock Oxycodone 5-10mg q4 hour PRN Promethazine, Haloperidol, Diphenhydramine PRN Nalbuphine 2.5mg q4 PRN

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Duke ERAS Protocol

Postop	Ketorolac 15mg for 24 hours -> Ibuprofen 600mg q6h and Discontinue IV Acetaminophen 975mg q6 hours Oxycodone 5-10mg q4 PRN breakthrough Ondansetron 4mg PRN Nalbuphine 2.5mg q4 PRN Remove Foley at 6 h
Opioid Dependent Parturient	Consider: Epidural for postoperative analgesia TAP Block Neuraxial Clonidine Gabapentin Ketamine
Post-discharge Opioids	15 tablets oxycodone 5 mg

Duke Anesthesiology

SOAP 2019 Sol Shnider, M.D. Obstetric Anesthesia Meeting
Friday, March 15, 2019

Setting Up & Evaluation of a Successful ERAS Pathway for 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. Recognize how *implementing an ERAS pathway for cesarean delivery requires multidisciplinary coordination between anesthesia, obstetrics, neonatology, perinatology, and nursing.*
2. Appreciate the importance of *developing documentation that tracks adoption of pathway steps and results.*
3. Understand the effect of *an ERAS pathway for cesarean delivery on opioids usage.*

Kaiser Permanente Northern California

4.1 Million Members

The Permanente Medical Group, multidisciplinary physician led established 1948

- 9,000 Physicians
- 16,000 Nurses
- ~43,000 deliveries in 2019
- ~11,000 Cesarean deliveries
- 15 Hospitals with maternity services

24 X 7 OB coverage in house at each hospital:

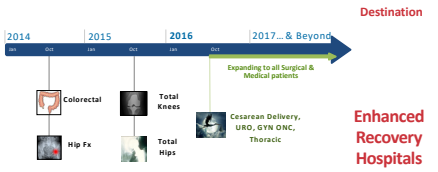
- Two anesthesia providers: one exclusively dedicated to OB, at least one anesthesiologist in house
- Obstetrician and surgical assist
- Midwifery care in 14 of the 15 hospitals

Enhanced Recovery after Cesarean Delivery: Initial Efforts

Obstetric Anesthesia Chiefs/Directors
Represent all 15 maternity hospitals in system
Mission: evidence-based practice, standardize care, &
coordinate patient centered care improvement with the perinatal care team.

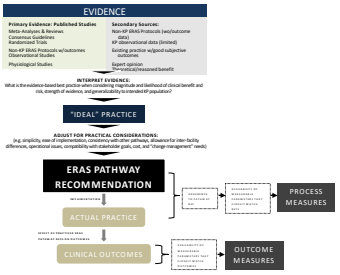
Difficulty with initial efforts
Created pathway for preop, intraop & post partum care, however,
-Difficult to coordinate with OB, perinatology, neonatology…
-Challenged to rein in variation in anesthesia care
-Impossible to coordinate with nursing without order sets.
-No documentation tools.

Enhanced Recovery After Cesarean Delivery fell into regionwide plan



Integrate Cesarean care with other regional objectives.

Framework for Creating Pathway Recommendations & Metrics



ERAS for Cesarean Delivery Recourses

Increasingly robust literature regarding ERAS in general, as well as ERAS for Cesarean delivery.
Anesthesia literature
Obstetric literature
Perioperative Surgical Home for Cesarean Delivery

ERAS Society Recommendations


Special Reports ajog.org

Guidelines for Antenatal and Preoperative care in Cesarean Delivery: Enhanced Recovery After Surgery Society Recommendations (Part 1)

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Part 1 focuses on **Antenatal and Preoperative care** (AJOG 2018; 219: 523-32)
Part 2 focuses on **Intraoperative** care (AJOG 2018; 219: 533–44)

Recommended ERAS protocols for Cesarean delivery


F1000Research

REVIEW

Enhanced recovery after cesarean delivery [version 1; referees: 2 approved]

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Excellent resource on Cesarean ERAS with additional details regarding anesthetic considerations.

Developing a Cesarean ERAS Pathway

Develop your ERAS pathway from literature reviews and expert opinion.
Reviews describe many dimensions of enhanced recovery goals that have the most value to your practice.
ERAS for cesarean delivery must engage the continuum of care
- **Preconception** outreach with comorbidity mitigation including weight management,
- **Antepartum care** involving education, diet, exercise, diabetes management
- **Intrapartum** care including the anesthetic
- **Postpartum inpatient &**
  outpatient care

Multidisciplinary perinatal team develops ERAS consensus.

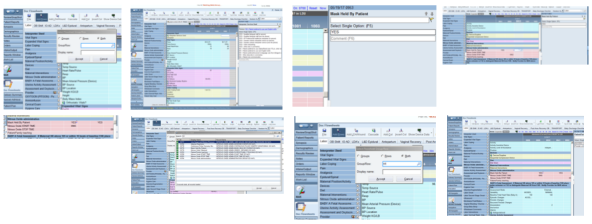
Obstetrician and anesthesia leaders and hospital administration align
Obstetrician
Midwife
L&D nursing
PACU nursing
Postpartum nursing
Anesthesia
Pediatrics
Neonatology and perinatology

Tracking ERAS implementation

Engage IT early in the process
- Track implementation using the electronic medical record (EMR)
- Process measures
- Outcome measures
- Define discrete data fields,
  - **nurse** documentation, and
  - **anesthesia if** record is part of the EMR
  - Pharmacy (MAR)
- Coding associated with delivery including **elective** vs **non-elective**

Nursing Documentation Challenges

IT can develop as many new discrete data fields as your Cesarean ERAS team requests. However, smart IT design is essential for success.
In this example, a single nursing documentation required opening eight windows.



Invest in Cesarean ERAS education

Change is not easy.

Enhanced recovery requires the perinatal team to adopt new protocols and procedures to support the new pathway.

ERAS "champions" socialize the concept then introduce specific ERAS elements.

- Presentations to perinatal staff
  - Nurse education time
  - Department wide presentations with expectations for each team

Overcoming resistance to Cesarean ERAS

Overcoming resistance of anesthesia providers

- "I trained with Sol Shnider, and when I trained, we did it …"

Counter by presenting cesarean ERAS anesthesia protocols in the context of

- Evidenced based medicine
- Improved care experience
- Opioid sparing
- and
- Sol Shnider, Gertie Marx, Gerald Ostheimer…practiced, and taught, cutting-edge evidence-based anesthesia, not decades behind the time.

Align Cesarean Order-sets to Support ERAS

ERAS requires new protocols, supported by updated order-sets
Multimodal analgesia (MMA) is a cornerstone of ERAS

- Supported by orders that assure around the clock dosing
- Prevent accidental overdosing

Anesthesia orders must align with obstetrician orders

- Preop
- PACU orders for MMA, PRN opioids, diet
- Anesthesia neuraxial opioid orders with MMA and
  - PRN non-combined PO opioids

Potentially Controversial Cesarean ERAS protocols

Additional time may be required to get agreement on protocol involving:
Carbohydrate drink
Skin-to-skin in operating room
Active warming throughout delivery
Evidence based Pitocin dosing
Evidence based neuraxial opioid dosing
Avoiding exteriorization of the uterus
Pressor infusion to maintain maternal blood pressure
Avoiding prescription of PRN PO opioids with analgesia additives, eg prescribe oxycodone rather than oxycodone combined with acetaminophen

Data not tracked by process or outcome measure requires chart audits to verify compliance with protocol

If the anesthesia record is not integrated into the EMR, check

- Opioid dosing
- Pitocin dosing
- Pressor infusion
- Verify that acetaminophen and NSAID are not being administered in both the OR and PACU

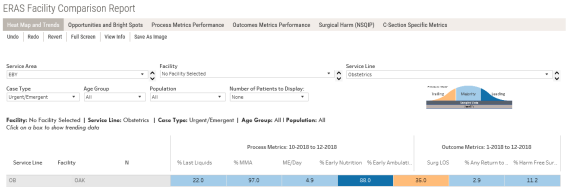
Tracking Implementation of Cesarean ERAS

A product of IT involvement and Administrative resolve.

Monthly reports

Each facility has an ERAS champion who provides feedback to leaders and frontline staff.

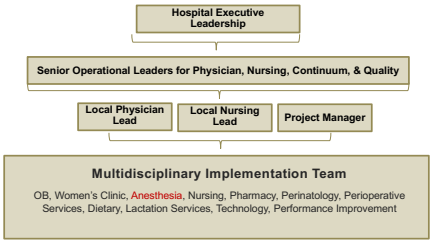
Cesarean ERAS intramural reports



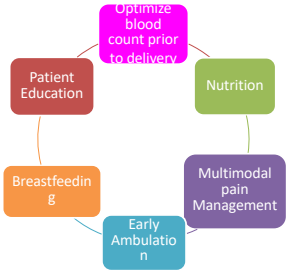
Current process and outcome data is shared for every facility

Performance is benchmarked relative to all hospitals in the region.

Local Infrastructure to Rollout OB Enhanced Recovery



Enhanced Recovery after Cesarean Delivery



What's New for OB Anesthesia?

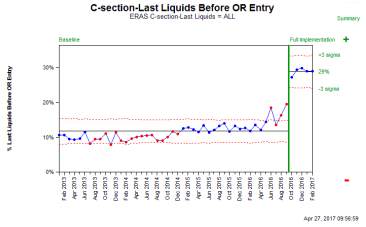
- Guideline-based NPO Instruction
- Active warming
- Neuraxial anesthesia guidelines
- Prevention of hypotension
- Multimodal Analgesia
- Intraoperative skin to skin neurobehavioral support
- Standard PONV/Aspiration Prophylaxis
- Optimize uterotonic administration
- Support Early Nutrition and ambulation

Feedback at Pilot sites

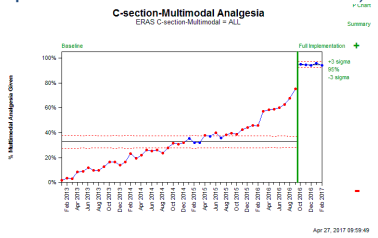
1. RN feedback: "*Patients reach their **goal of comfort while decreasing opioid usage***"
2. Lactation Consultant stated that "*Patients are more **alert and retaining more of what we teach***"
3. OB and CNM feedback: patients are **more alert, engaged with recovery process**
4. Anesthesia feedback: 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…

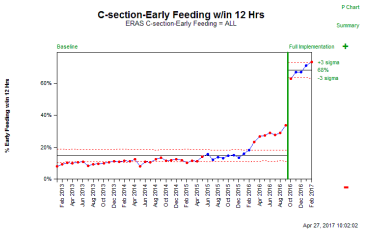
Enhanced Recovery after Cesarean Delivery: Provides women with preoperative fluids and nutritional support.



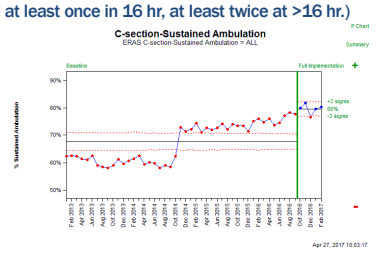
Enhanced Recovery after Cesarean Delivery: Provides multimodal analgesia for post Cesarean analgesia (IV acetaminophen and ketorolac was administered after OR)



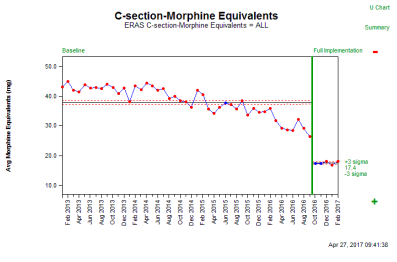
Enhanced Recovery after Cesarean Delivery: Improved nutritional support for mothers after delivery. (Meal eaten within 12 hr of OR departure.)



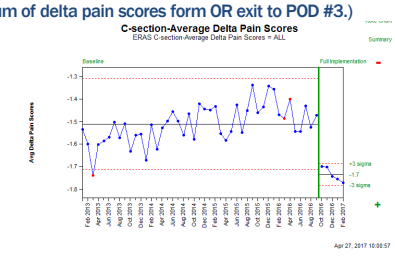
Enhanced Recovery after Cesarean Delivery: Increased sustained ambulation after delivery. (Ambulated at least once in 16 hr, at least twice at >16 hr.)



Enhanced Recovery after Cesarean Delivery: Reduced opioid use by 50%.

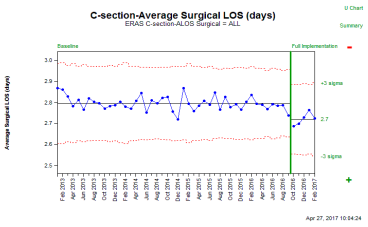


Enhanced Recovery after Cesarean Delivery: Reduced pain scores while simultaneously reducing opioid use. (Sum of delta pain scores form OR exit to POD #3.)

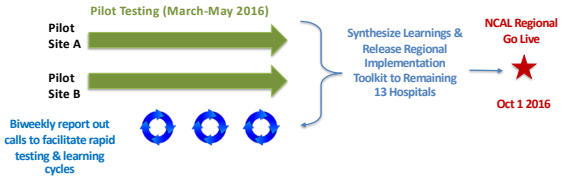


Enhanced Recovery after Cesarean Delivery: Has little impact on the length of stay.

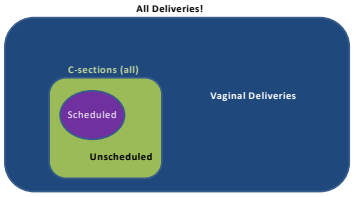
(Days from OR arrival to discharge.)



Enhanced Recovery after Cesarean Delivery Pilot at 2 hospitals



Obstetric Enhanced Recovery pathways are now incorporated in the care plan for all maternity patients!



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Steps to set-up & evaluate ERAS for Cesarean delivery

1. Ally with obstetric leaders.
2. Develop support from medical group and hospital administration.
3. Form a multidisciplinary group of *nursing, obstetrics, neonatology, perinatology, and anesthesia to develop agreement on ERAS steps.*
4. Harness the electronic medical record to track process and outcome measures.
5. Invest in your staff through education, feedback and reinforcement.
6. Follow your measures to continuously improve care and prevent drift.
7. Celebrate your results with patients, staff and your **administrative sponsors.**

REGIONAL ANESTHESIA BLOCKS FOR CESAREAN DELIVERY ANALGESIA: TAP, QL AND BEYOND

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UCSF

SOAP SOL SHNIDER MEETING, MARCH 2019

DISCLOSURES

OBJECTIVES

- Gold standard for post-cesarean analgesia
- Regional anesthesia techniques for providing post-cesarean analgesia
- Landmark and sono-anatomy, nuts and bolts of performing TAP, Quadratus Lumborum (QL) and Erector Spinae Plane (ESP) blocks

POST CESAREAN DELIVERY PAIN

- Incisional/pelvic/visceral pain after cesarean
- Persistent pain reported from 1% to 18% based on studies
- At least 13,000 patients/year in the US
- Risk Factors:
  - Post-operative pain, genetics, history of chronic pain
  - Psychological risk factors include anxiety, depression, catastrophizing pain
  - Sleep deprivation and stress

Carvalho B., Butwick A. Best Pract Res Clin Anaesthesiol. 2017

CONSEQUENCES OF PERSISTENT PAIN

- Chronic pain/opioid tolerance, dependence and addiction
- Societal costs of opioid prescriptions
- Depression/anxiety
- Disability/impaired quality of life
- Impaired maternal-neonatal bonding, decreased breast feeding

THE GOLD STANDARD

- Neuraxial opioids
  - Intrathecal morphine 100-150mcg
  - Epidural morphine 2-3mg
- Both help with postop pain
- Reduce opioid consumption
- Neuraxial fentanyl helps with intraop analgesia
- NSAIDs and acetaminophen scheduled around the clock

Dahl et al. Anesthesiology, 1999

WHEN TO USE REGIONAL ANESTHESIA

- Absence of neuraxial block
  - Cesarean under GA without neuraxial access
  - Contraindications to neuraxial anesthesia
- High risk patients
  - Chronic pain
  - Opioid dependent/tolerant/addiction
- High pain levels despite use of neuraxial opioids

REGIONAL ANESTHESIA OPTIONS

- Transversus abdominis plane block (TAP)
- Quadratus lumborum block (QL)
  - At least 4 different types of QL blocks
- Erector spinae block (ESP)

TOPIC COVERED FOR EACH BLOCK

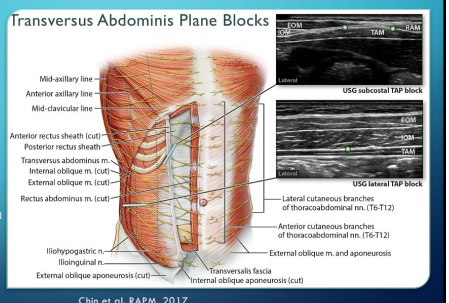
- Level of difficulty
- Advantages/disadvantages
- Area of coverage
- Scanning technique
- What to inject
- Tips and trouble shooting

TRANSVERSUS ABDOMINIS PLANE (TAP) BLOCK

- Level of difficulty: basic to intermediate depending on body habitus
- Advantages
  - Easiest of 3 blocks to perform
  - Good sono-anatomy landmarks
  - Can be performed supine
- Disadvantages
  - No visceral coverage

TAP BLOCK COVERAGE

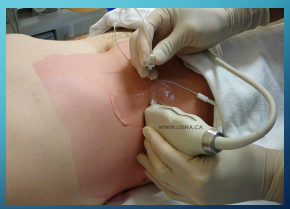
- Terminal branches of the anterior rami of T10-L1 innervating skin, muscle, and peritoneum
- Covers ipsilateral infra-umbilical abdominal wall



Chin et al. RAPM, 2017

TAP SCANNING/BLOCK TECHNIQUE

- Probe placed in transverse position in the mid-axillary line between iliac crest and costal margin
- Skin, subcut/adipose tissue, external oblique, internal oblique, transversus abdominis muscle, peritoneum
- 5-10cm needle inserted in the anterior axillary line/in-plane approach
- Local anesthetic injected between internal oblique and transversus abdominis muscle



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TAP
INJECTATE

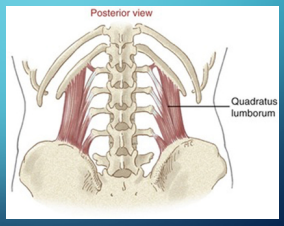
- Typically 20-40ml, 0.25-0.5% bupivacaine or ropivacaine bilaterally
- Larger volume helps spread of local anesthetic
- May need to use lower concentrations to keep total dose acceptable in smaller patients
- Liposomal bupivacaine is now FDA approved for TAP blocks (cost v. benefit)
- Can only combine liposomal bupivacaine with isotonic solutions and bupivacaine

TAP
TIPS AND TROUBLE SHOOTING

- As probe is moved posteriorly, transversus abdominis muscle ends into transversalis fascia (3 muscle layers to 2 muscle layers)
- The nerves travel deep to the fascial plane between the internal oblique and transversus abdominis muscle (when in doubt, inject into TAM rather than IOM)
- T6-T9 nerves enter the plane more medially, so TAP will not reliably cover above the umbilicus. (Subcostal TAP can cover above the umbilicus, or QL block)

QUADRATUS LUMBORUM BLOCK

- Quadratus lumborum muscle
  - Posterior abdominal wall
  - "Drape" between 12th rib and iliac crest
  - Medial connections to transverse processes of L1-L4



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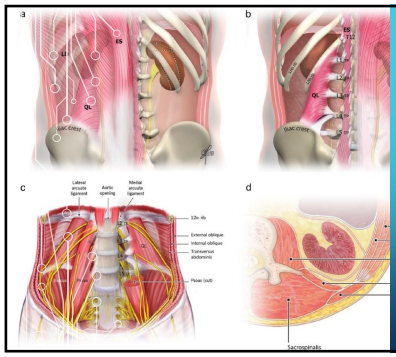
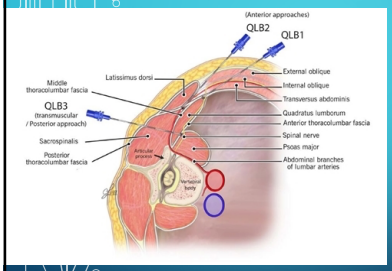


QUADRATUS LUMBORUM BLOCK

Elsharkaway, H. ASRA News Volume 15, Issue 4, pp. 34-40 (November, 2015).



QUADRATUS LUMBORUM BLOCK

Elsharkaway, H. ASRA News Volume 15, Issue 4, pp. 34-40 (November, 2015).

QUADRATUS LUMBORUM BLOCK

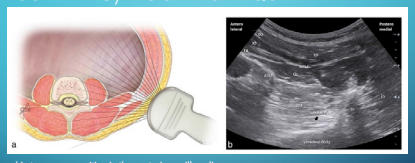
- Level of difficulty: Intermediate to advanced depending on body habitus
- Advantages
  - QLB 1 can be done supine in most patients, may need a bump under the hip
  - QLB 1 easier than QLB 2 and QLB 3
  - Some visceral pain coverage
- Disadvantages
  - Technically challenging to image and block with QLB 2 and QLB 3
  - Lateral positioning needed for QLB 3
  - Not recommended for novice ultrasound practitioners
  - Close to kidneys/paranephric fat

QL BLOCK COVERAGE

- T6-L1 skin incisions
- Abdominal wall and viscera
- Works though connection of thoracolumbar fascia into the paravertebral space
- More dermatomal coverage compared to TAP block with same volume of injectate

Elsharkaway, H. ASRA News, Volume 15, Issue 4, pp. 34-40 (November 2015).

QLB 1 SCANNING/BLOCK TECHNIQUE

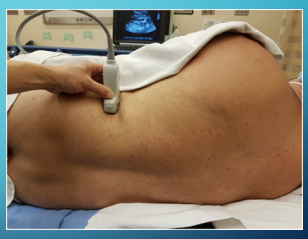


- Probe placed in transverse position in the posterior-axillary line
- Skin, subcut/adipose tissue, external oblique, internal oblique, transversus abdominis muscle, quadratus lumborum muscle
- 5-10cm needle inserted in the mid- axillary line/in-plane approach
- Local anesthetic injected lateral to the QL deep to transversus abdominis muscle and superficial to transversalis fascia

Elsharkaway, H. ASRA News, Volume 15, Issue 4, pp. 34-40 (November 2015).

QLB 2 SCANNING/BLOCK TECHNIQUE

- Probe placed in transverse position in the post-axillary line
- Skin, subcut/adipose tissue, external oblique, transversus abdominis muscle, QL muscle, psoas major, erector spinae muscles
- 5-10cm needle inserted in the mid-axillary line/in-plane approach
- Local anesthetic injected between QL muscle and erector spinae/latissimus muscles (posterior to QL muscle)



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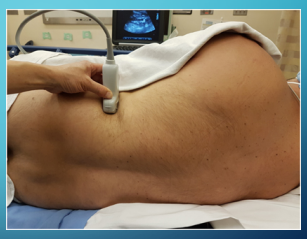
QLB 3 SCANNING/BLOCK TECHNIQUE

- Probe placed in transverse position in the post-axillary line
- Skin, subcut/adipose tissue, external oblique, transversus abdominis muscle, QL muscle, psoas major, erector spinae muscles
- 5-10cm needle inserted posteriorly/in-plane approach
- Local anesthetic injected between QL muscle and psoas muscle (anterior to QL muscle)



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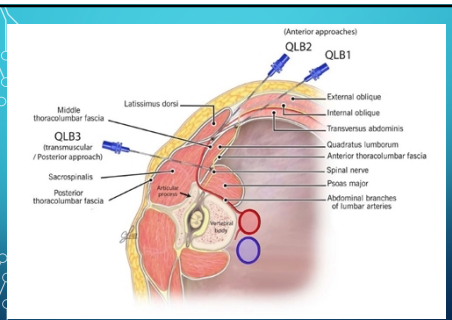

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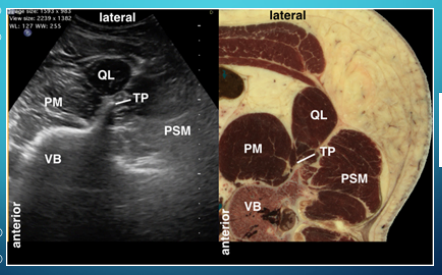

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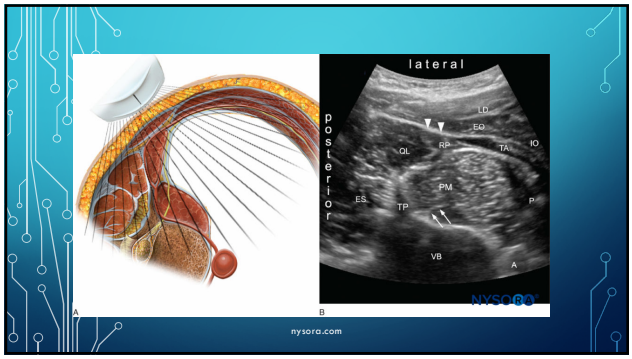


QUADRATUS LUMBORUM INJECTATE

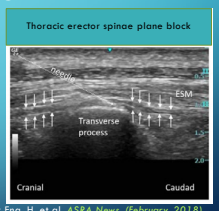
- Typically 20-40ml, 0.25-0.5% bupivacaine or ropivacaine bilaterally
- Larger volume helps spread of local anesthetic
- May need to use lower concentrations to keep total dose acceptable in smaller patients

QUADRATUS LUMBORUM TIPS AND TROUBLE SHOOTING

- For QL1 block, avoid injecting into retroperitoneal space/perinephric fat, injectate is placed superficial to the transversalis fascia
- For QL2 block, it's important to inject between QL and erector spinae muscles
- For QL3 block, injection must be done deep to the QL muscle, between QL muscle and the psoas muscle. Injection into the psoas muscle can block the lumbar plexus and cause more significant lower extremity weakness.
- There is conflicting evidence if QL blocks cause lower extremity weakness

ERECTOR SPINAE PLANE BLOCK

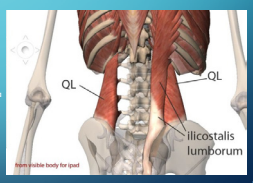
- Erector spinae muscles
  - 3 muscles
    - Iliocostalis, longissimus, spinalis
  - Erector spinae plane is the plane between the erector spinae muscles and transverse processes



Cruz Eng, H. et al. ASRA News. (February, 2018).

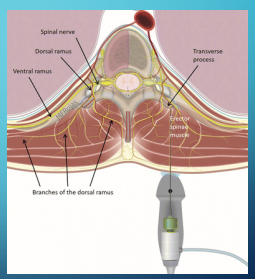
ERECTOR SPINAE PLANE BLOCK

- Level of difficulty: Intermediate
- Advantages
  - Extensive cephalad and caudad coverage
  - Bones are easy to visualize on ultrasound
  - Can easily thread a catheter for prolonged analgesia
- Disadvantages
  - Patient positioning (lateral, sitting or prone)
  - Needle visualization may be hard
  - Single shot injection does not last very long



ESP BLOCK COVERAGE

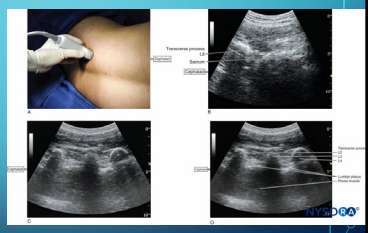
- Diffusion of local anesthetic to ipsilateral ventral and dorsal rami of thoracic and lumbar region, innervating skin, muscle, peritoneum, visceral organs
- Extensive spread up and down the spine



Melivn et al. Can J Anaesth, 2018

ESP BLOCK SCANNING/BLOCK TECHNIQUE

- Probe placed in parasagittal position, 4cm away from midline
- Sacrum, L5, L4 visualized
- 5-10cm needle inserted in-plane, cephalad or caudad until it touches transverse process
- Local anesthetic injected deep to the erector spinae muscles, between erector spinae muscle and transverse process



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- Larger volume helps spread of local anesthetic
- May need to use lower concentrations to keep total dose acceptable in smaller patients
- For catheter technique, can use 0.2% ropivacaine or bupivacaine
- Use programmed-intermittent-bolus (PIB) if available on your pumps

ESP BLOCK TIPS AND TROUBLE SHOOTING

- Make sure the needle is touching the bone when injecting
- If you encounter high pressure, you may not be fully under the erector spinae muscles, can walk cephalad or caudad on the transverse process
- In some patients, it's hard to detect a level but they are usually pretty comfortable

GOLD STANDARD FOR POST-CESAREAN ANALGESIA IS NEURAXIAL OPIOIDS

ALTERNATIVE TECHNIQUES:

- TRANSVERSUS ABDOMINIS PLANE BLOCK
- QUADRATUS LUMBORUM BLOCK
- ERECTOR SPINAE PLANE BLOCK

THANK YOU

Thanks to all the experts/artists/illustrators for making all the amazing images and cartoons available for our learning.

Program Slides

Friday, March 15, 2019

Session IV: Tips and Techniques

Moderator: Pamela D. Flood, M.D., M.A.

Trouble-Shooting Labor Epidurals and Failed Top-ups
Jalal A. Nanji, B.Sc., M.D., FRCPC

Reducing Obstetric General Anesthesia: 10 Practical, Tested Tips
Lawrence Tsen, M.D.

Preventing and Treating Side Effects of Neuraxial Opioids
Ashraf S. Habib, M.B.,B.Ch., M.Sc., M.S.N., FRCA

Troubleshooting Labour Epidurals & Failed Top-ups

2019 Sol Shnider M.D. Obstetric Anesthesia Meeting
Mar 15, 2019

Jalal A. Nanji, MD, FRCPC

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Faculty/Presenter Disclosure

Relationships with financial interests: None

Objectives

At the end of this lecture, attendees will be able to:

1. Identify common causes of inadequate neuraxial analgesia
2. Discuss risk factors for failed conversion of neuraxial analgesia to surgical anesthesia (e.g. for cesarean delivery)
3. Develop a systematic approach in order to troubleshoot an ineffective labour epidural

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Defining the Problem

1. Never gets comfortable, *vs.*
2. Previously comfortable but now in pain during labour, *vs.*
3. Experiences pain during cesarean delivery (CD) with *in situ* epidural catheter (+/- comfortable during labour)

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Statistics

- Retrospective review of > 12,000 cases of obstetric neuraxial analgesia/anesthesia (> 19,000 deliveries)
- Overall failure rate of 12%
- 5.6% required direct replacement
  - 1.5% required multiple replacements
- 98.8% reported adequate labour analgesia

Pan PH, et al. Int J Obstet Anesth. 2004;13:227-33.

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A Word on Prevention…

- Prevention is the cure!
- Optimize insertion, initiation, and maintenance to best avoid issues later on
- Consider early replacement if issues persist despite corrective attempts
- "Plant the seed" during consent process AND if issues arise later during maintenance

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Why Do Epidural Catheters Fail?

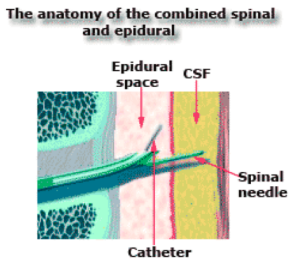
1. Inadequate Initiation
2. Inadequate Maintenance
3. Incorrect Catheter Location
   A. Initial Placement
   B. Subsequent Migration

Inadequate Initiation

- Need adequate volumes of epidural solution (usually dilute LA + opioid) to establish epidural block
- Traditional epidural may never "catch up" in patient with advanced and/or rapidly-progressing labour
  - Consider CSE in these cases for quicker onset
  - Will also help improve sacral coverage

Arendt K and Segal S. Rev Obstet Gynecol. 2008;1:49-55.

Combined Spinal-Epidural (CSE)



http://www.anaesthesiauk.com/article.aspx?articleid=100132

CSE vs. Epidural for Labour

- Quicker onset of pain relief
- Better subsequent analgesia
  - Sacral coverage
  - Bilateral coverage
  - Fewer boluses/top-ups
  - Fewer catheter failures (despite the myth of the "untested epidural")

Collis R, et al. Lancet. 1995;345:1413-6.
Simmons SW, et al. Cochrane Database Syst Rev. 2012;10:CD003401.
Gambling D, et al. Anesth Analg. 2013;116:636-43.
Heesen M, et al. Anaesthesia. 2014;69:64-71.
Niesen AD, et al. Clin Perinatol. 2013;40:373-84.

Catheter Failures

- 2395 neuraxial procedures for labour
- Failures: 6.6% (CSE) vs. 11.6% (epidural)
- More failed catheters recognized within ½ hour:
  - 48% (CSE) vs. 31% (epidural)

Booth JM, et al. Anesthesiology. 2016;125:516-24.

Failed Blocks: CSE vs. Epidural

- Catheter placed despite no CSF obtained during CSE
  - Replacement rate 29% (vs. 4% if CSF obtained)
- Failed top-up for Cesarean after labour
  - OR 5.5 epidural vs. CSE

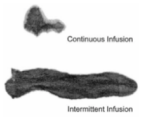
Grondin LS, et al. Anesthesiology. 2009;111:165-72.
Lee S, et al. Anesth Analg. 2009;108:252-4.

Inadequate Maintenance

- Optimal maintenance technique is a background regimen (either continuous infusion [CEI] or intermittent bolus [PIEB]) with a patient-controlled epidural analgesia (PCEA) option

Programmed Intermittent Epidural Bolus (PIEB)

- Instead of giving the "background" as a slow-infusion, why not give it as a bolus as well?
- Models of spread
  - Large volumes
  - Concomitant high injectate pressures
  - E.g. 10.5 mL/h vs. 3.5 mL q20 minutes (each delivered over 1 minute)



Hogan Q, et al. Reg Anesth Pain Med. 2002;27:150-6.
Kaynar AM, et al. Anesth Analg. 1999;89:534.

PIEB vs. CEI

Meta-Analysis Data Outcomes	PIEB vs. CEI	P-value
Local Anesthetic Consumption	-1.2 mg/h	0.01
Maternal Satisfaction Scores	7.0 mm	<0.00001
Duration of 2nd Stage of Labor	-12 min	0.04
Mode of Delivery		
Cesarean Delivery	OR 0.87	0.54
Instrumented Delivery	OR 0.59	0.05
Anesthesia Interventions	OR 0.56	0.08

George RB, et al. Anesth Analg. 2013;116:133-44.

Incorrect Catheter Location

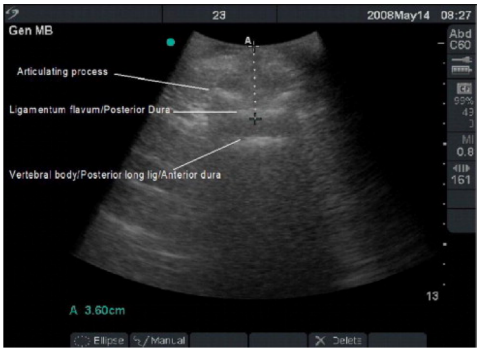
- Initial Placement
  - Subcutaneous (complete block failure)
  - Subdural (variable presentation)
  - Intrathecal
  - Intravascular (stiff catheters)
- Subsequent Migration
  - Neural foramina (if > 5 cm into epidural space)
  - Intrathecal/Subdural
  - Subcutaneous (especially obese patients)
  - Intravascular

Beilin Y, et al. Anesth Analg. 1995;81:301-4.
Pan PH, et al. Int J Obstet Anesth. 2004;13:227-33.

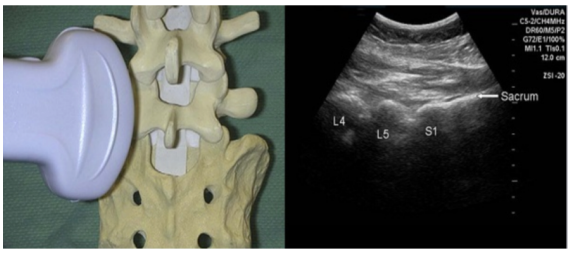
Ultrasound Assistance

- Accurate identification of interspace
- Establishment of midline
- Estimation of depth to epidural space
- Determination of optimal interspace and insertion point
- Angulation of epidural needle between spinous processes
- Benefits may not apply to experienced providers or patients with easily palpable landmarks

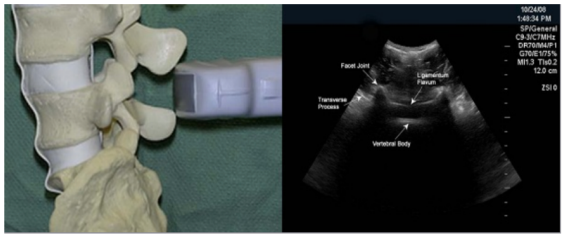
Margarido CB, et al. Can J Anaesth. 2011;58:262-6.
Perlas A, et al. Reg Anesth Pain Med. 2016;41:251.
Arzola C, et al. Eur J Anaesthesiol. 2015;32:499-505.



Vallejo MC, et al. Int J Obstet Anesth. 2010;19:373-8.



http://pie.med.utoronto.ca/OBAnesthesia/OBAnesthesia_content/OBA_spinalUltrasound_module.html



http://pie.med.utoronto.ca/OBAnesthesia/OBAnesthesia_content/OBA_spinalUltrasound_module.html

Ultrasound vs. Palpation/Landmarking

- Reduced technical failure (RR 0.51)
- Less traumatic procedure (RR 0.27)
- Reduced needle punctures and redirections
- Shorter procedure time (but increased setup time!)
- Decreased block failures
- Higher satisfaction
- Better analgesia

Perlas A, et al. Reg Anesth Pain Med. 2016;41:251.
Shaikh F, et al. Br Med J. 2013;346:f1720.
Grau T, et al. J Clin Anesth. 2002;14:169-75.
Vallejo M, et al. Int J Obstet Anesth. 2010;19:373-8.

Preventing Migration of Catheter

- Optimal amount of catheter in epidural space 4-5 cm at most (beyond tip of epidural needle)
- Higher incidence of subcutaneous migration if $\leq$ 3 cm left in epidural space, unilateral block if > 5 cm
- In obese patients, consider having patient sit upright (i.e. not "slouched" or to lie lateral prior to taping/fixating

Hamilton CL, et al. Anesthesiology. 1997;86:778-84.

Changes in Position

	Obese Habitus n = 46	Normal Habitus n = 206
Change FLEX to LAT (cm)	1.27 ± 0.77*	0.75 ± 0.49
Distance to ES (cm)	5.3 ± 0.84*	4.2 ± 0.71

Values are mean ± SD.
* $P < 0.05$.
FLEX = flexed; LAT = lateral; ES = epidural space.

Hamilton CL, et al. Anesthesiology. 1997;86:778-84.

Technical Factors

- LOR technique with Air vs. Saline (debatable)
- Multi-orifice epidural catheter vs. single orifice
- Catheter with flexible tip vs. stiff tip

Arendt K and Segal S. Rev Obstet Gynecol. 2008;1:49-55.

Miscellaneous

- Patient expectations
- Bands/septae in epidural space?
  - Dorsal Median Connective Tissue Band (DMCTB)
  - May just be an artifact of how the space was studied

Hogan QH. Anesthesiology. 1991;75:767-75.

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Approach to Inadequate Labour Analgesia

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Initial Assessment

- Examine the patient!
  - Catheter site
  - Testing of motor + sensory blockade
  - Review recent OB examination:
    - Cervical dilatation
    - Station
    - Bladder (full vs. empty)
    - Position of presenting part (e.g. occiput posterior, occiput transverse)

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Next Steps

- Assess response to bolus administration of epidural solution
  - May elect to use a higher concentration of local anesthetic
  - Consider addition of supplemental epidural opioid

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Clinician "Top-up"

- Generally successful (~70% of cases)
- Larger volume of dilute (e.g. 10 mL of 0.125% bupivacaine) or smaller volume of more concentrated (e.g. 5 mL of 0.25%) local anesthetic can be considered
  - Depends on whether spread or density is required

Beilin Y, et al. Anesthesiology. 1998;88:1502-6.

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Catheter Manipulation

- Sterile withdrawal of catheter 1-2 cm +/- additional clinician top-up dose can improve analgesia in 77% of cases
  - Especially if block is unilateral to begin with
- Useful to use a clear dressing to compare initial documented insertion depth with current catheter location
- Securement devices may prevent migration > 2 cm of labour epidurals

Beilin Y, et al. Anesthesiology. 1998;88:1502-6.
Odor PM, et al. Anaesthesia. 2016;71:298-305.

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Expectation Management

- Not the patient's fault!
- Pressure/tightening is normal during contractions if epidural is working
- Significant pain is NOT normal prior to 2nd stage
- This process starts with consent prior to procedure
  - Explanation of failure rate and risk of needing to redo block

Catheter Replacement

- If more than 2 clinician top-ups are required and inadequate analgesia persists, replace the epidural catheter
- Consider performing a CSE in this case
  - Does NOT increase risk of unrecognized catheter failure
    - Actually reduced risk of failure
  - Quick-onset respite for patient with unexpected breakthrough pain
  - Confirmation of epidural space by obtaining CSF through spinal needle
    - More likely to thread catheter into a midline position

Booth JM, et al. Anesthesiology. 2016;125:516-24.

Conversion to Surgical Anesthesia

- Active management of labour epidurals is important for successful conversion
- Attempting to use an inadequately-functioning catheter risks both failure (and need for general anesthesia) as well as toxicity/high spinal

Bauer ME and Mhyre JM. Anesth Analg. 2016;123:1074-6.

Risk Factors

- Increasing number of clinician boluses (OR = 3.2)
- Urgency of delivery (OR = 40.4)
- Care by non-obstetric anesthesiologist (OR = 4.6)

Bauer ME, et al. Int J Obstet Anesth. 2012;21:294-309.

Sage Advice

- Every time you enter a patient room, ask yourself:
  - Is the catheter functioning like it's in the epidural space?
  - Do you have confidence in being able to use it for cesarean delivery?
- If the answer to either of these questions is no…
  - DO SOMETHING about it!

Summary

- Prevention is the cure!
- Epidurals can fail for myriad reasons
- Certain interventions during initiation and/or maintenance of a labour epidural can improve analgesic success
- Inadequate analgesia can usually be fixed with simple manoeuvres


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SOAP
Society for Obstetric Anesthesia and Perinatology

Reducing General Anesthesia for Cesarean Delivery: 10 Practical Tested Tips!

SOAP Sol Shnider
OB Anesthesia Meeting, 2019

Lawrence C. Tsen, MD
Associate Professor in Anaesthesia, Harvard Medical School
Director of Anesthesia, Center for Reproductive Medicine,
Department of Anesthesiology, Perioperative and Pain Medicine
Associate Director, Center for Professionalism and Peer Support
Brigham & Women's Hospital

A Fable

A Fable

The Grasshopper's summer was squandered with singing,
Now without a morsel, found winter most stinging.
Off he went to the house of the Ant, his neighbor,
To ask for a meager share of the fruits of her labor.
Alas, he discovered, after an arduous journey
through blinding ice and heavy snow,
A sign, tacked firmly to her door:

"Wintering in Maui…
with all of my dough".

Reducing GA for Cesarean: Learning Objectives

Upon Completion of this Learning Activity, Participants Should Be Able To:

Appropriate?

Not Possible?

Tips!

No Disclosures-

Reducing GA for Cesarean: Learning Objectives

Upon Completion of this Learning Activity, Participants Should Be Able To:

Appropriate?

Not Possible?

Tips!

No Disclosures-

Reducing GA for Cesarean: Appropriate?

- 38 yo, G3P0 at 36 weeks, 5'4", 280#, (BMI 48.1), MP IV
  - Preeclampsia (BP 168/88), gDiabetes, gThrombocytopenia (Plt 98)
  - Anterior Placenta Previa
  - Surgical History: Cholecystectomy, Appendectomy, Jaw Reconstruction
- Fetus: Large for Gestational Age

Reducing GA for Cesarean: Appropriate?

38 yo, G3P0 at 36 wks, 5'4", 280#, (BMI 48.1), MP IV

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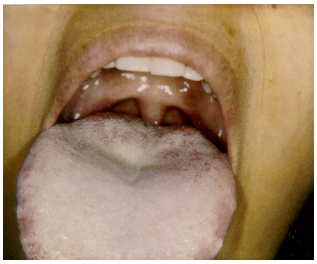
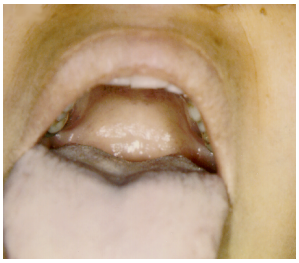
- Anterior Placenta Previa
- Fetus: Large for Gestational Age

Maternal Airway Changes

Capillary Engorgement

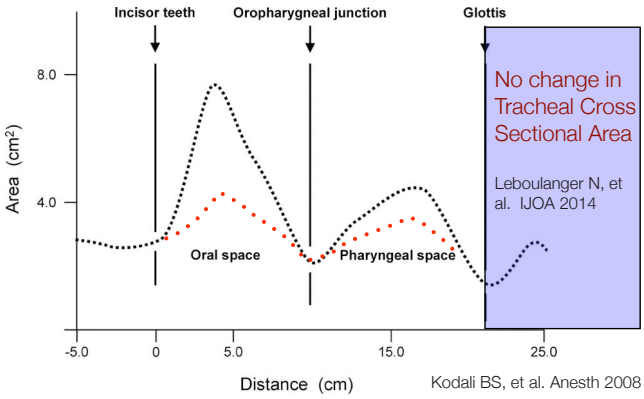
- Increased Class IV, Facial Edema & Swollen Tongue
- Further Engorgement with Labor and Active Pushing





Pinkington et al., BJA 1995; Rocke et al., Anesth 1992; Kodali et al., Anesth 2008

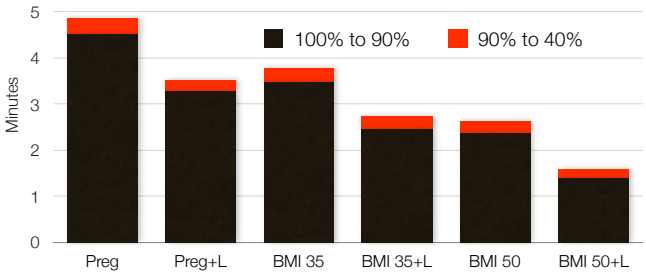
Maternal Airway Changes



Kodali BS, et al. Anesth 2008

Maternal Thoracic & Respiratory Changes

- Increased Thoracic Chest Diameter/Breast Mass
- Faster Desaturation (FRC -30%, O2 Demand +60%)



McClelland SH et al. Anaesthesia 2009

Maternal Gastrointestinal Changes

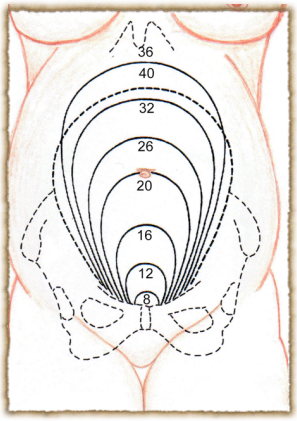
Uterine Encroachment

- Anatomic Stomach Compression

Hormonal Changes

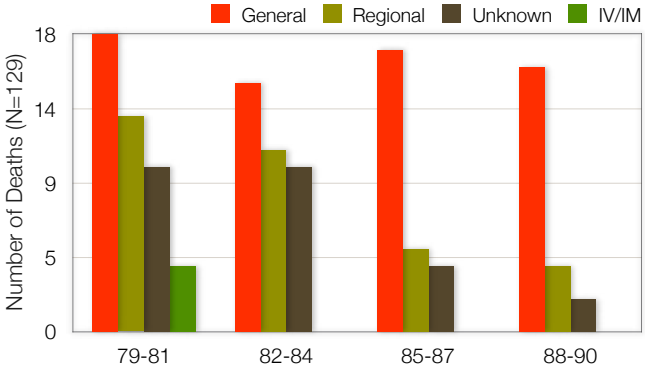
- LES Sphincter Tone

Gastric Emptying



Wong et al., A&A 2007
Nimmo et al., Lancet 1975

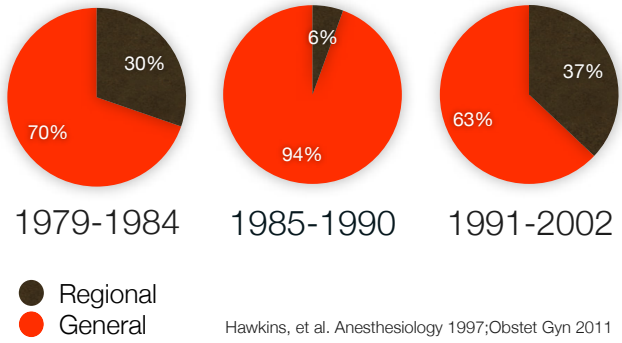
Maternal Mortality Higher with GA



Hawkins, et al. Anesthesiology 1997;86:277-84

Maternal Mortality Higher with GA

Case fatality ratio 2.3:1 to 16.7:1 to 1.7:1

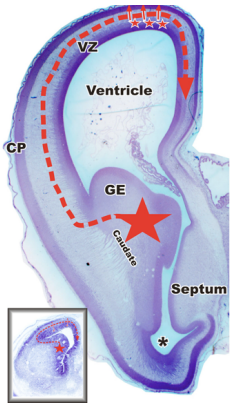


Hawkins, et al. Anesthesiology 1997;Obstet Gyn 2011

Fetal Morbidity Worse with GA

Emergent	Design	UA pH	Agpar <8	Intubation
Gale '82	R			GA worse
Marx '84	P		GA worse	
Ong '89	R		GA worse	GA worse
Elective	**Design**	**UA pH <7.20**	**Apgar**	**Ventilation**
Evans '89	R	RA worse	GA worse	
Dick '92	P	GA worse	RA worse	GA worse
Ratcliffe '93	R		GA worse	
Roberts '95	R	RA worse	GA worse	GA worse
Mueller '97	R	RA worse	RA worse	GA worse
Sendag '99	R	RA worse	RA worse	
Kolatat '99	P	GA worse	GA worse	

Fetal Morbidity Worse with GA



- Neural Stem/Progenitor Cells (NPCs)
- Neuron Creation, Migration, Differentiation, Synapsis Formation, Reorganization
- GABA agonism
  NMDA antagonism

Jevtovic-Todorovic V, J Neurosci 2003
Soriano S, Anesthesiology 2005
Palanisamy A, et al. Anesthesiology 2011

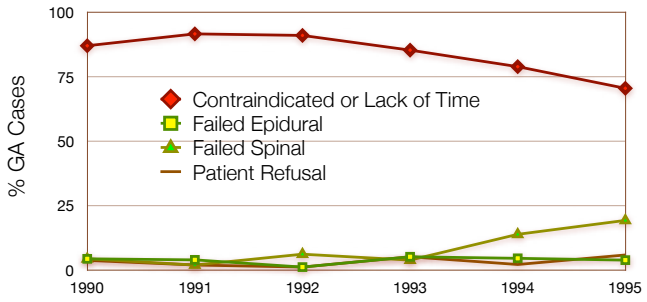
Reducing GA for Cesarean: Not Possible?

Co-Morbidities

Time

Reducing GA for Cesarean: Not Possible?

Lack of Time/Contraindications/Refusal?



Tsen et al. Int J Obstet Anesth 1998

Time: Decision to Incision

Time: Decision to Incision

30 minutes: ACOG, RCOG, ACP, ISOG, CNCC

ACOG Standards for Obstetric Services, 6th edition 1988
ACOG + AAP Guidelines for Perinatal Care, 2nd edition 1988

Time: Decision to Incision

30 minutes: ACOG, RCOG, ACP, ISOG, CNCC

20 minutes: GSGO

ACOG Standards for Obstetric Services, 6th edition 1988
ACOG + AAP Guidelines for Perinatal Care, 2nd edition 1988

Time: Decision to Incision

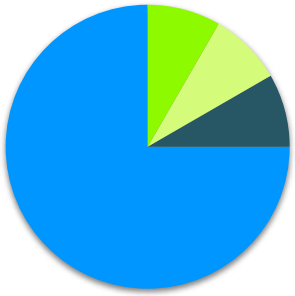
30 minutes: ACOG, RCOG, ACP, ISOG, CNCC

20 minutes: GSGO

15 minutes: ACOG High Risk

ACOG Standards for Obstetric Services, 6th edition 1988
ACOG + AAP Guidelines for Perinatal Care, 2nd edition 1988

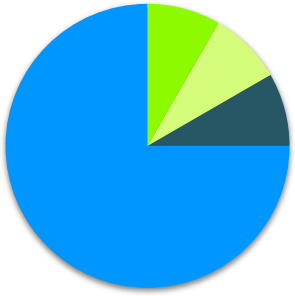
Time: Decision to Incision



15 minutes?

Obstetric Decision

Time: Decision to Incision



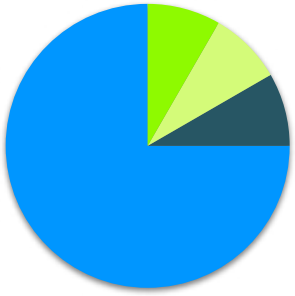
15 minutes?

Obstetric Decision

↓

Anesthesia Contact

Time: Decision to Incision



15 minutes?

Obstetric Decision

↓

Anesthesia Contact

↓

Anesthesia Provision

Time: Decision to Incision

15 minutes?

Obstetric Decision

↓

Anesthesia Contact

↓

Anesthesia Provision

↓

Incision

Time: Decision to Incision

5 minutes:

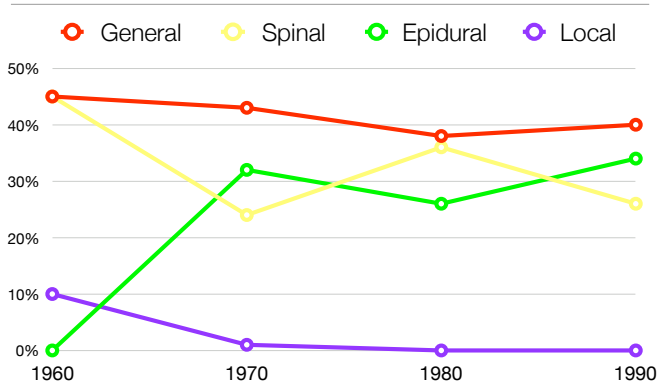
Complete Fetal Anoxia

- Maternal Cardiac Arrest
- Total Placental Abruption
- Complete Cord Prolapse
- Uterine Rupture

Lipman S, Tsen L, et al. SOAP Consensus Statement on Cardiac Arrest. A&A 2014

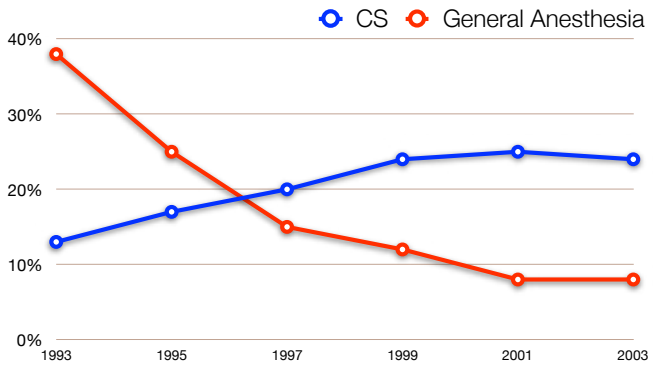
Reducing GA for Cesarean: Tips

Anesthesia Selection for Cesarean Delivery



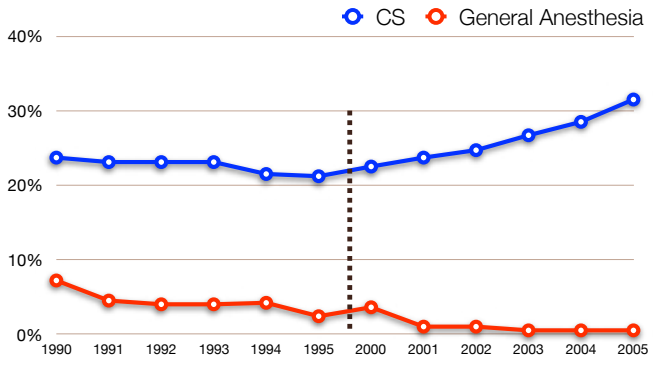
Chang LY, Tsen LC. Anesth Analg 2013

Incidence of Cesarean and Obstetric GA



Rahman et al., Anaesthesia 2005

Incidence of Cesarean and Obstetric GA



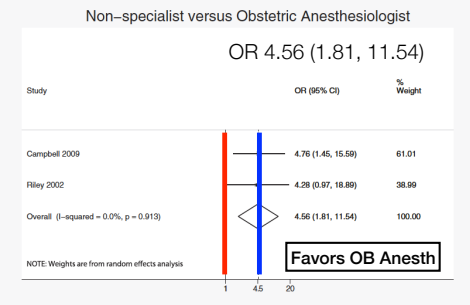
Tsen L et al. IJOA 1998; Palanisamy A, Tsen LC Anesth Analg 2011

Tip #1: Develop a "Core Team" with QA/QI

Uncommon, Unlikely, but a Possible Goal?

Shared Mental Models, Expectations

Similar Methods, Management Styles



Bauer ME, Tsen LC, Mhyre JM, et al. IJOA 2012; 21:294-309
Chau A, Tsen LC. Anesth Analg 2017

Tip #2: Institute "High Risk" Consult System-Need

Optimizes significant disease

Creates a multispecialty plan: BACH

Establishes expectations by patient and providers

Allays anxiety in patient (and provider!)

Generates referrals & revenue (n = 519;7.8%)

Creates stakeholder in perioperative medical home

Reduces maternal mortality (CMACE-counsel/referral)

Bharwani F, MacArthur A. CJA 2013; Butwick AJ, Carvalho B, IJOA 2007
Cooper GM et al. BJA 2005; Tsen LC, et al. Anesth Analg 2002

Tip #2: Institute "High Risk" Consult System-Value

Antenatal Mandatory

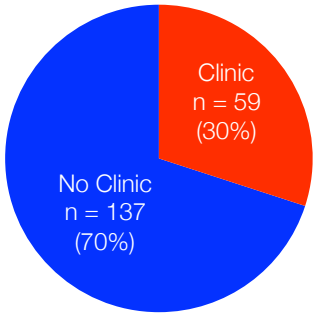
- France-'98, 8th Month

Antenatal Recommended

- UK

Antenatal Significant Dz

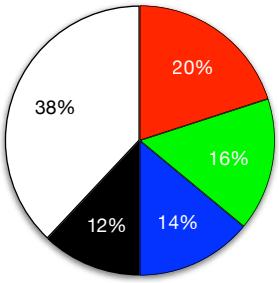
- USA, Belgium



Rai et al. IJOA 2005; Bulletin Officiel Sante, 1998; Acta Anaesth Belg, 2003; ASA Guidelines: Anesthesiology 2007; Butwick AJ, et al. IJOA 2007

Tip #2: Institute "High Risk" Consult System-Value

- 1357 pts = 7% of deliveries
  25% of deliveries = high risk
- 53% > 1 major disorder
  52% nulliparous
- Increased referrals over time



Bharwani F, Macarthur A. CJA 2014;61:282-3; Butwick AJ, Carvalho B, IJOA 2007

Tip #2: Institute "High Risk" Consult System-How

- Distribute Guidelines
- On Call "Clinic" in Triage
- Hours 9:00 am-2:00 pm
- Send Consult Note + Bill
- Audit Cases/Remind

BWH Anesthesia Clinic
612 Patients/2.5 yrs
Average: 2 pts/wk

30% Management Change
Request Consultant
Order Test
Request Outside Info
Review Novel Info

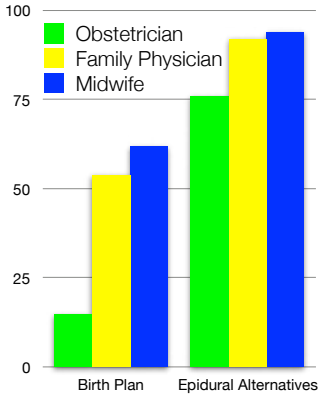
Moffit D, Tsen LC, Farber M: SOAP Abstracts 2016

Tip #3: Mandate Ability to see all Parturients

Tip #3: Mandate Ability to see all Parturients

- Parturient Birth Plans

The Gold Standard Natural Child Birth: Midwife-Attended, Home Birth, Intervention-Free (No IV, Epidural or CS)



Reime B et al. BJOG 2004;111:1388-93
Malacrida C, et al. Health 2014;18:41-59

Tip #3: Mandate Ability to see all Parturients-How

Patient Room Visit

- Coordinate with other Providers: Introduction/Timing
- Respect Patient/OB Wishes and Relationship
- Don't "SELL" the Epidural Technique

Emphasize Safety for Mother and Baby

Remind OB the value of Early Consult, High Risk Clinic

Tip #4: Deputize an "Early Warning System"

- Obstetricians, Nurses, and Unit Clerks
- "Head's up" on Physiology/Anatomy, including Airway

OB	Pre	Post	P
Airway	59%	60%	NS
Consult	47%	50%	NS

- Providers influence Timing and Patient's Selection of Analgesia/Anesthesia, as well as Delivery Mode

Gaiser RR et al. Obstet Gynecol 1999;93:648-52

Tip #4: Deputize an "Early Warning System"

Joint Board Rounds

- 10 am/10 pm
- All Providers

Goal: Information/Safety

Benefit: Names, Hierarchy, Norms (& Outliers), Rationale & Respect, Teamwork KSA's

Teamwork Knowledge, Skills, and Attributes

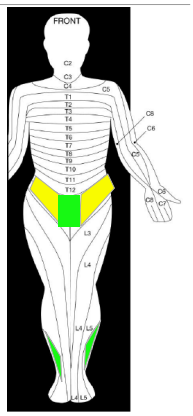
Shared Mental Models
Team Leadership
Team Orientation
Mutual Performance
Backup Behavior
Mutual Trust
Adaptability
Closed Communication

Chau A, Vijjeswarapu MA, Hickey M, Acker D, Tsen LC:Anesth Analg 2017

Tip #5: Insert "Early Epidural" Catheters

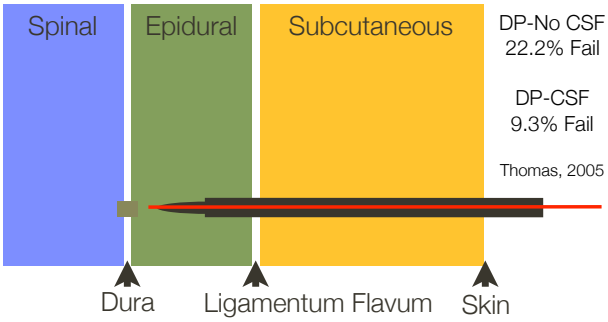
- Before Requested or Required
- Consider Dural Puncture Epidural (DPE) Technique
- Dose Epidural Catheter (5-6 mL)
- Test Sensory Band

Obstetric Anesthesia Guidelines Update Task Force, **2016**



Tip #5: Insert "Early Epidural" Catheters

Dural Puncture Epidural (DPE) Technique



Tip #5: Insert "Early Epidural" Catheters

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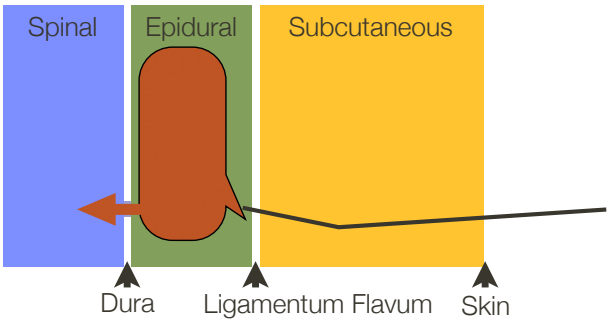
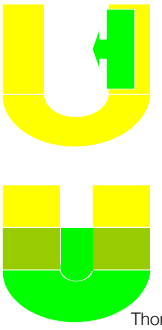


Tip #5: Insert "Early Epidural" Catheters

Dural Puncture Epidural (DPE) Technique



Thomas	2005	27G	No
Suzuki	1996	26G	Yes
Wilson	2018	26G	Yes
Cappiello, Tsen	2008	25G	Yes
Chau, Tsen	2017	25G	Yes

- Greater Bilateral and Sacral Block
- Faster Onset
- No Higher Sensory Spread
- No FHR Brady or PDPH

Thomas J, Anesthesiology 2005; Cappiello E, Tsen LC. A&A 2008
Suzuki N et al. 1995; Chau A, Tsen LC. A&A 2017, Wilson SH. A&A 2018

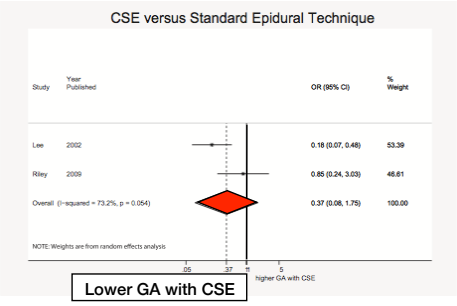
Tip #5: Insert "Early Epidural" Catheters

Characteristic	CSE	DPE	Epidural
Location Confirmation	X	X	
Onset	X	X	
Sacral Spread	X	X	
Bilateral Spread	X	X	
Tested Catheter		X	X
Progress of Labor	X	X (?)	

Cappiello E, O'Rourke N, Segal S, Tsen LC. Anes Analg 2008;107:1646-51
Chau A, Tsen LC. Anesth Analg 2017

Tip #6: Confirm "Functional" Epidural Catheter

Does the Initial Technique matter? **MAYBE**



Bauer, Kountanis, Tsen, Greenfield, Mhyre: IJOA 2012

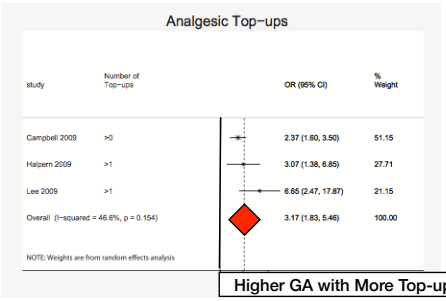
Tip #6: Confirm "Functional" Epidural Catheter

Failed Blocks	Epidural	CSE	Needle
Eappen n=4240	13.1%	7.2%	25G
Norris n=1660	1.3%	0.2%	25G
van de Velde	3.1%	1.5%	27G, 29G
Thomas n=248	9.3%	8%	27G

Bauer, Tsen, Mhyre. IJOA 2012; Thomas, Anesth 2005
Van de Velde, Anaesth Intens Care 2001; Norris, IJOA 2000; Eappen, IJOA 1998

Tip #6: Confirm "Functional" Epidural Catheter

Does the number of Top-up's matter? **YES**



Adequate Analgesia?

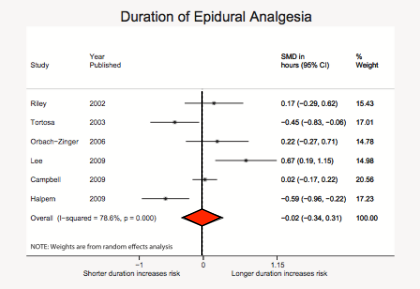
Patchy?

Increasing Local +Opioid

Bauer, Kountanis, Tsen, Greenfield, Mhyre: IJOA 2012

Tip #6: Confirm "Functional" Epidural Catheter

Does the Duration of epidural analgesia matter? **NO**



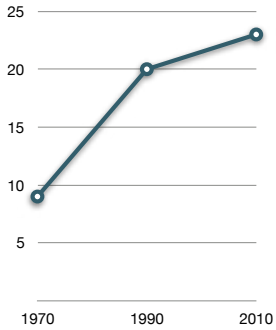
Bauer, Kountanis, Tsen, Greenfield, Mhyre: IJOA 2012

Tip #7: Reaffirm No "Emergent" Cesarean

Emergent Cesarean = 23%

Acidosis with Decelerations

- Initially Normal to Late: 115 Minutes
- Initially Normal to Variable: 145 Minutes



CDC, National Center for Vital Statistics; Fleisher AJOG 1982

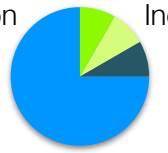
Tip #8: Implement "Fastest" Anesthesia Combo

General or Spinal

Obstetric Decision
↓
Transport to Room
↓
Anesthesia Provision
↓
Incision

Epidural In-Situ

Obstetric Decision
↓
Anesthesia Provision
↓
Incision



Tip #8: Implement "Fastest" Anesthesia Combo

Study	Agent	Time	Comment
Gaiser, IJOA 1998;7:27-31	Chloro 3% + Bicarb	3.1 min	Extension T4
	Lido 1.5% + Bicarb	4.4 min	Extension T4
Lam, Anaes 2001;56:790-4	Lido 2% + Epi+Bicarb	5.2 min	Extension T6
	Lido 2% + Epi	9.7 min	Extension T6

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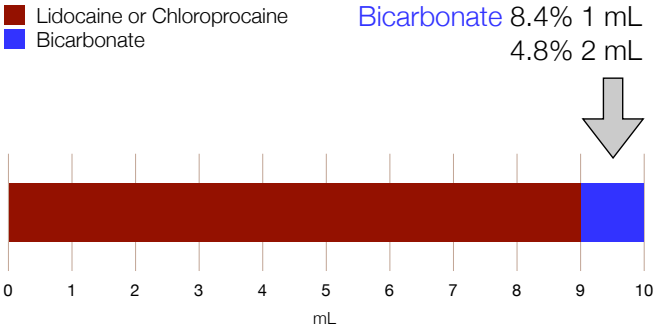
Tip #8: Implement "Fastest" Anesthesia Combo



Peterfreund, Datta, Ostheimer. Reg Anesth 1989

Tip #9: Affirm "Neuraxial Technique" Commitment

- 6393 Cesarean/8 years (2005-2013)
- 851 General Anesthetics
- Not just Emergent Cases

Anesthesia Technique	Start to Cut
General Anesthesia	5 (3-11) min
Spinal	20 (16-28) min
Epidural in Situ	22 (18-24) min
General Anesthesia + Prior Neuraxial Attempt	26 (18-35) min

Heinrich et al. J Obstet Gyn Res 2015

Tip #9: Affirm "Neuraxial Technique" Commitment

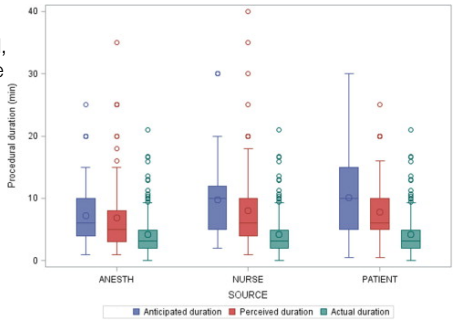
Epidural Technique:
Anticipated, Perceived, Actual Technique Time

Placement Duration
4.2 ± 3.5 min

7% > 10 min; 21 min

Placement to Comfort
12.6 ± 8 min

Total Time to Comfort
16.8 ± 11.5 min



Clark A, Holck B, Mahoney B, Farber MK, Liu X, Tsen LC: IJOA 2015

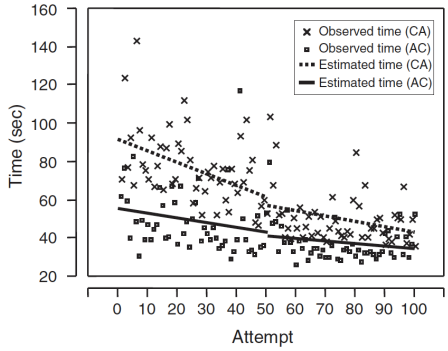
Tip #9: Affirm "Neuraxial Technique" Commitment

Epidural Technique
1200 Placements
12 Attendings/Fellows

Placement: SQ Local
Needle to Epidural
Needle Removal

Placement Duration
53.2 (51.2-55.5) sec

99% Comfort at
30 min



Carabuena JM, Mitani AM, Xiaoxia L, Kodali BS, Tsen LC: A&A 2013

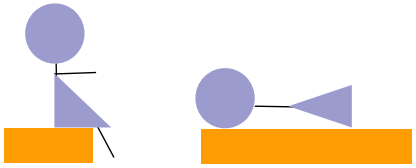
Tip #9: Affirm "Neuraxial Technique" Commitment

Are you faster than converting epidural analgesia?

Study	Agent	Time	Comment
Gaiser, IJOA 1998;7:27-31	Chloro 3% + Bicarb	3.1 min	Extension T4
	Lido 1.5% + Bicarb	4.4 min	Extension T4
Lam, Anaes 2001;56:790-4	Lido 2% + Epi+Bicarb	5.2 min	Extension T6
	Lido 2% + Epi	9.7 min	Extension T6

Tip #9: Affirm "Neuraxial Technique" Commitment

Are you facile with a lateral placement?



What about difficult spinal placements? (10-14%)

Tsen LC. Int J Obstet Anesth 2008
Sprung J, et al. Anesth Analg 1999; Chien I, et al. T JMS 2003

Tip #10: Trouble-Shoot Neuraxial Technique

Scenario #1

- Urgent Cesarean, Patchy Labor Epidural

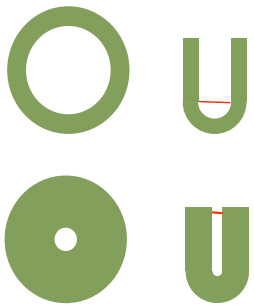
Solution

- Examine Epidural Analgesia History
- Give 6-10 mL Bolus Epidural Local Anesthetic
- Consider Spinal (Reduced Dose?)

Tip #10: Trouble-Shoot Neuraxial Technique

Epidural Space Fills…

- Compresses Dural Sac
- Makes Spinal Difficult
- Spreads Spinal Higher
- Dural Puncture Assists



Griffiths et al., Br J Anaesth 1993
Lee et al., Spine 2001
Higuchi et al., Anesthesiology 2005

Tip #10: Trouble-Shoot Neuraxial Technique

Scenario #2:

- Urgent Cesarean, Spinal Failed

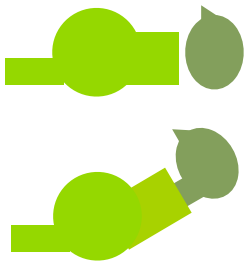
Solution

- Consider Repeat Spinal (Reduced Dose?)
  - Initial: bupivacaine 12-15 mg, fentanyl 10-20 µg (T8)
  - Repeat: bupivacaine 10 mg, fentanyl 10-20 µg (T3)
- Consider Continuous Spinal Catheter

Dadarkar/Vadhera et al. Anesthesiology 2002;96:suppl 1
Stocks, GM; Wilson MJ. Pro-Con. IJOA 2005;14(1):53-7

Tip #10: Trouble-Shoot Neuraxial Technique

- Head-Up Positioning (Semi-Fowler's)
- Limit Cephalad Spread
- Spinal Bupivacaine: Mobile up to 45 min



Tip #10: Trouble-Shoot Neuraxial Technique

Scenario #3: Urgent Cesarean, Intraop Pain

Solution

- Consider Epidural Options
  - Somatic: Chloroprocaine or Lidocaine (+ Bicarb)
  - Viceral: Sufentanil/Fentanyl 20-50% to 5-10%
- Consider Analgesia/Anesthesia
  - IV: Ketamine + Midazolam; Induction GA
  - Inhaled: 50% Nitrous

Dahlgren et al. Anesth Analg 1997; Ginosar et al. Anesth Analg 2003

Reducing GA for Cesarean: Summary

Appropriate	Not Possible?	Tips

Reducing GA for Cesarean: Summary

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Preventing and Treating Side Effects of Neuraxial Opioids

Ashraf S Habib, MBBCh, MSc, MHSc, FRCA
Professor of Anesthesiology
Professor in Obstetrics and Gynecology
Chief, Division of Women's Anesthesia

Disclosures

- **Research Support**
  - Trevena Inc.
  - Pacira Pharmaceuticals
  - BioQ Pharma
  - Haylard Health
- **Advisory Board**
  - Trevena Inc
  - Health Decisions

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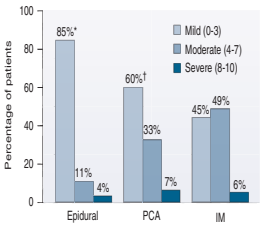
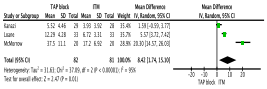
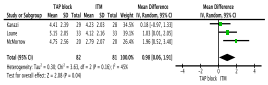
Neuraxial Opioids



Opioid consumption TAP block vs. ITM



Pain scores TAP block vs. ITM



Epidural vs. parenteral opioids

Harrison DM. Anesthesiology 1988; 68: 454-7
Mishriky BM. Can J Anesth 2012;59:766-78

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Side Effects of Neuraxial Opioids

- Pruritus (40-90%)
- PONV (30-50%)
- Respiratory Depression (0-0.9%)
- Urinary Retention (22-58%)
- Hypothermia (6-7%)

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Patient Preferences for Anesthesia Outcomes Associated with CD

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;101:1182-7

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Objectives

- Risk factors
- Prophylaxis
- Treatment
- Monitoring

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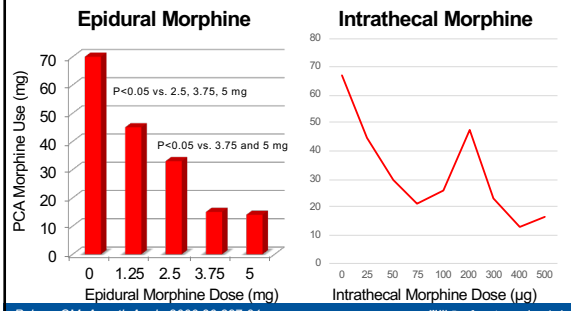
Dose Response of Neuraxial Morphine



Palmer CM. Anesth Analg 2000;90:887-91
Palmer CM. Anesthesiology 1999;90:437-44

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ITM Dose and Pruritus/PONV

Table 4. Summary of Maternal Secondary Outcomes

Outcomes	No. studies	No. patients (low dose, high dose)	MD/OR	MD/OR (95% CI)	P	I^2	NNT/NNH
Pain scores at 12 h	2	74, 72	MD	2.54 (−2.55 to 7.63)	0.33	0	NA
Pain scores at 24 h	1	18, 19	MD	1.00 (−2.50 to 4.50)	0.58	NA	NA
Pruritus	8	228, 192	OR	0.34 (0.20 to 0.59)	0.0001	0	5.9
Severe pruritus	5	156, 131	OR	0.32 (0.16 to 0.61)	0.0006	0	7.0
Vomiting	7	180, 138	OR	0.38 (0.19 to 0.75)	0.005	0.03	7.7
Nausea or vomiting	7	196, 174	OR	0.44 (0.27 to 0.73)	0.002	0	8.3
Antiemetics	2	79, 75	OR	0.69 (0.32 to 1.45)	0.33	0	NA

CI = confidence interval; MD = weighted mean difference; NA = not applicable; NNH = numbers needed to harm; NNT = numbers needed to treat; OR = odds ratio.

Sultan P. Anesth Analg 2016; 123: 154-64

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PRURITUS

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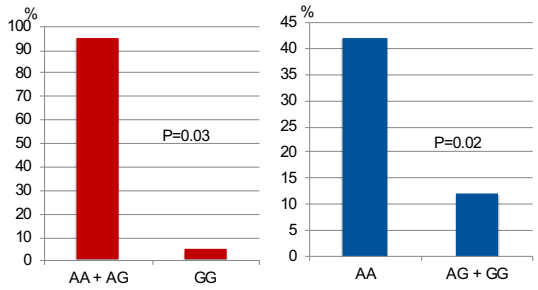
OPRM Polymorphism and Pruritus



Tsai FF. Acta Anaesthesiol Scand 2010; 54:1265-1269
Wong CA. Int J Obstet Anesthesiol 2010;19:246-253

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Other Risk Factors for Pruritus

- Epinephrine
- Pregnancy
- Spinal administration

Szarvas S. J Clin Anesth 2003;15:234–9
Reich A. Clin Exp Dermatol 2010;35-2-6
Krajnik M. J Pain Symptom Manage 2001;21:151-68

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Pruritus

- NOT histamine release
- **Possible mechanisms:**
  - μ receptors
  - Itch center (Trigeminal nucleus)
  - Dorsal or ventral horn neurons
  - Other (D_2, $5HT_3$, GABA, Glycine, PG)

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Prophylaxis Against Pruritus

- Opioid Receptor Antagonists
- Antihistamines
- $5HT_3$ RAs
- Dexamethasone
- Other

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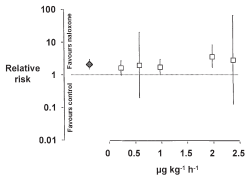
Prophylaxis Against Pruritus
Opioid Antagonists

- **Naloxone:**
  - Single dose not effective (0.4 mg SC)
  - Continuous infusion effective (50-100 µg/h)
  - NNT 3.5 (0.25-2.4 µg/kg/h)



Lockington PF. Anaesthesia 2007;62:672-6 Luthman JA. Int J Obstet Anesth 1992;1:191-4
Kendrick WD. Anesth Analg 1996;82: 641-7 Kjellberg F. Eur J Anesthesiol 2001;18:346-57

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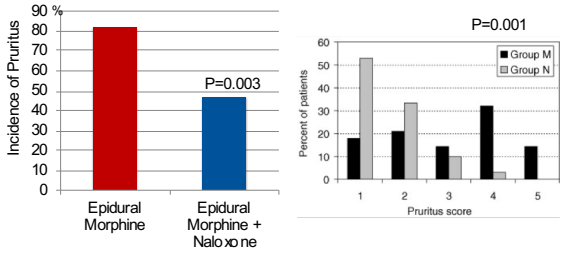
Prophylaxis Against Pruritus
Opioid Antagonists

Epidural Naloxone Infusion following Epidural Morphine (4 mg bolus + 6 mg infusion)



Jeon Y. Int J Obstet Anesth 2005;14:22-25

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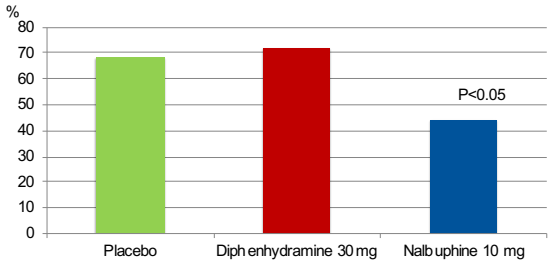
Prophylaxis Against Pruritus
Opioid Antagonists



Epidural morphine 1.5 mg every 12h

Liao CC. Chang Gung Med J 2011; 34: 172-8

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Prophylaxis Against Pruritus
$5HT_3$ Receptor Antagonists

Study or Subgroup	5HT3RA Events	Total	Placebo Events	Total	Weight	Risk Ratio M-H, Random, 95% CI
Yeh (31)	5	20	17	20	3.2%	0.29 [0.13, 0.64]
Yazigi (30)	38	50	41	50	21.1%	0.93 [0.76, 1.14]
Charuluxananan (26)	105	120	56	60	30.9%	0.94 [0.85, 1.03]
Siddik-Sayyid (29)	72	84	39	45	26.5%	0.99 [0.86, 1.14]
Sarvela (28)	48	58	22	29	18.4%	1.09 [0.86, 1.38]
Total (95% CI)		332		204	100.0%	0.94 [0.81, 1.09]
Total events	268		175			

Heterogeneity: Tau² = 0.02; Chi² = 11.46, df = 4 (P = 0.02); I² = 65%
Test for overall effect: Z = 0.83 (P = 0.41)

Risk Ratio M-H, Random, 95% CI
0.01 0.1 1 10 100
Favors 5HT3RA Favors placebo

Need for treatment for pruritus: NNT =13

George RB. Anesth Analg 2009;109:174-82

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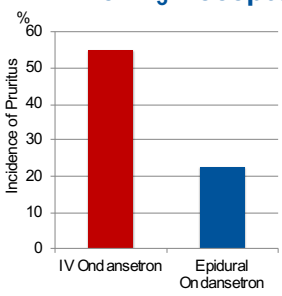
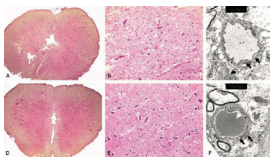
Prophylaxis Against Pruritus
$5HT_3$ Receptor Antagonists





Han DW. Acta Obstet Gynecol Scand 2007;86: 683-7

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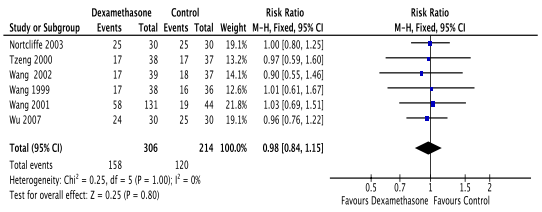
Prophylaxis Against Pruritus Dexamethasone



Allen TK. Anesth Analg 2012;114:813-22

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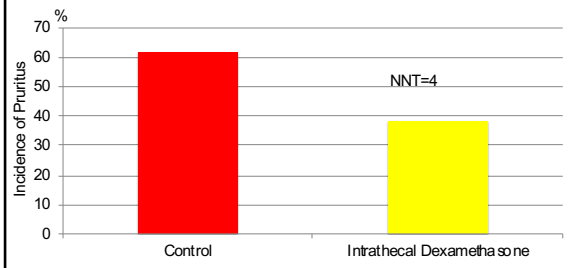
Prophylaxis Against Pruritus Intrathecal Dexamethasone



Abdel-Aleem M. Int J Gynaecol Obstet 2012;116:158-61

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Other Prophylactic Therapies

- Droperidol (1.25-2.5 mg, epidural 1.25-5 mg)
- Propofol (20 mg)
- Alizapride (50-100 mg)
- NSAIDs

Horta ML. Br J Anaesth 2003;91:287–9
Horta ML. Reg Anesth 1993;18:118–20
Lee L. Anaesthesia 2004; 59:876-80
Horta ML. Br J Anaesth 2006;96:796-800
Brião FF. Rev Bras Anestesiol 2015;14:137-8
Samimi S. Fam Reprod Health 2011;2:35–9

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Treatment of Pruritus

- Opioid Antagonists
- $5HT_3$ Receptor Antagonists
- Antihistamines
- Propofol

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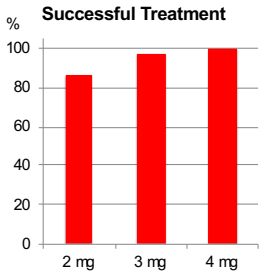
Treatment of Pruritus Opioid Antagonists

- **Nalbuphine**
  - 2-5 mg (optimal dose 2-3 mg)
  - More effective than:
    - Propofol 10 mg
    - Diphenhydramine 25-50 mg
- **Butorphanol**
  - 1 mg followed by 0.2 mg/h



Charuluxananan S. Anesth Analg 2001;93:162-5
Alhashemi JA. Can J Anaesth 1997;44:1060-5
Wu Z. J Anesth 2012; 26: 752-7
Somrat C. J Obstet Gynaecol Res 1999;25:209-13
Cohen S. Anesth Analg 1992;75:747-52

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Treatment of Pruritus $5HT_3$ Receptor Antagonists

Ondansetron 4 mg vs. Placebo

- More effective (80 % vs. 36 % success)
- Not effective (no difference in pruritus scores before or after treatment)

Ondansetron 4mg vs. other agents

- Less effective than pentazocine (96.1% vs. 80.8 %)
- As effective as diphenhydramine 25 mg (70 % success with both agents)

Charuluxananan S. Reg Anesth Pain Med 2000;25:535-9
Siddik-Sayyid SM. Acta Anaesthesiol Scand 2010; 54:764-9
Tamadee D. Anesth Analg 2009;109:1606-11
Kung AT. Int J Obstet Anesthesiol 2014;23:222-6

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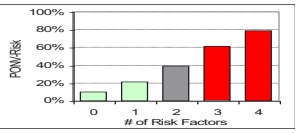
PONV

Duke Anesthesiology

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

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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

Habib AS. Obstet Gynecol 2013;121:615-23
George RB. Can J Anesth 2018;65:254-62

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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. ASA Meeting 2015:A3033

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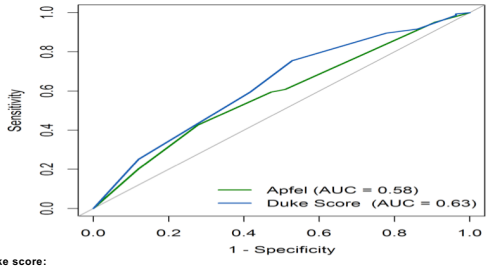
Apfel Score vs. Duke Score



Duke score:
1 point: history of PONV after CD or history of morning sickness
1 point: Non-smoker during pregnancy
1 point: never smoked

Anderson R. SOAP Meeting 2016

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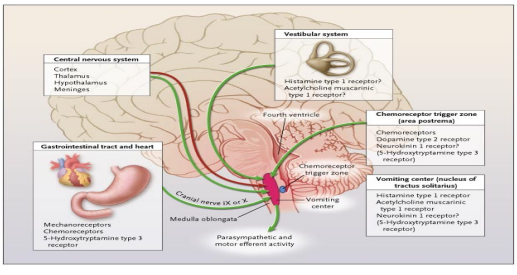
Antiemetics



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Interventions for Preventing NV During CD Under Regional Anesthesia

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;(9):CD007579

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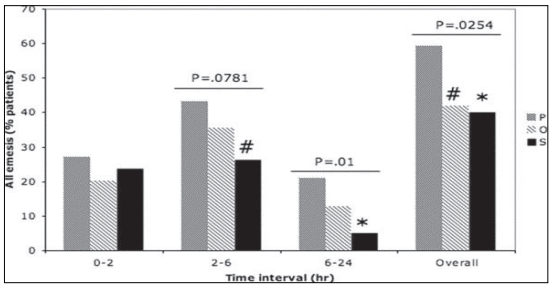
PONV Prophylaxis Scopolamine



Harnett M. Anesth Analg 2007;105:764-9

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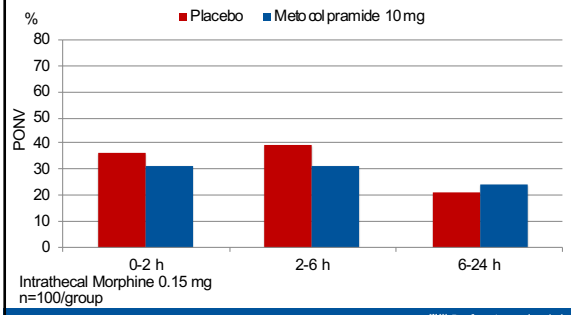
PONV Prophylaxis Metoclopramide



Habib AS. Obstet Gynecol 2013;101:615-23

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Interventions for Preventing NV During CD Under Regional Anesthesia

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;(9):CD007579

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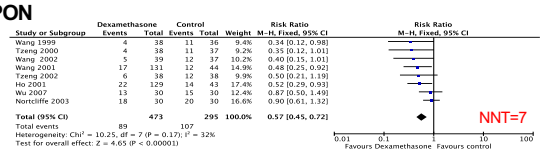
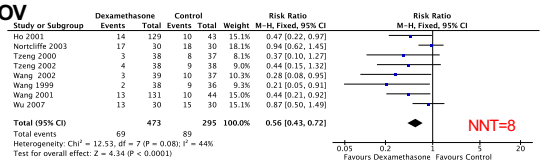
PONV Prophylaxis Dexamethasone

PON



POV



Allen TK. Anesth Analg 2012;114:813-22

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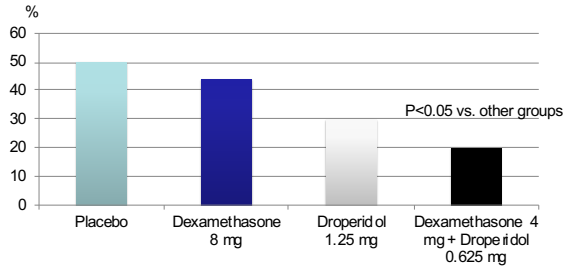
PONV Prophylaxis Combination Antiemetic Therapy



Wu JI. Int J Obstet Anesth 2007;16:122-7

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Treatment of Established PONV

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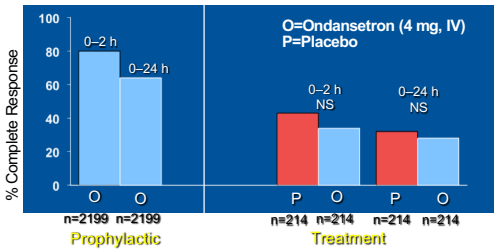
Ondansetron Retreatment Study

Not Significantly Different From Placebo



Kovac AL. J Clin Anesth 1998;11:453–459

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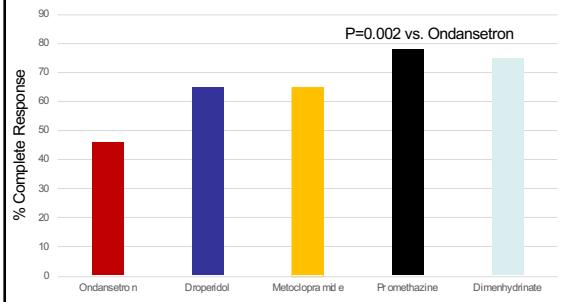
Rescue Following Failure of Ondansetron Prophylaxis



Habib AS. J Clin Anesth 2005;17:62-65

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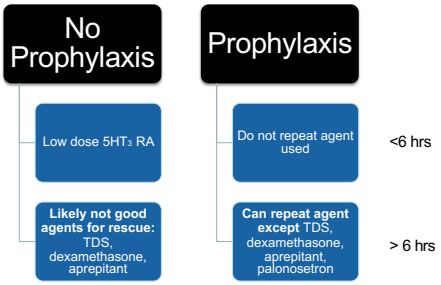
Treatment of established PONV



Gan TJ. Anesth Analg 2014;118:85-113

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Respiratory Depression

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Respiratory Depression

- Early (30-90 min), late (6-18 h)
- 0-0.9%
- Clinically significant respiratory depression:
  - 78 studies (n = 18,455)
  - All doses: 5.96-8.67 per 10,000 cases
  - Contemporary doses:1.08-1.63 per 10,000 cases

Kafer ER. Anesthesiology 1983; 58:418-27 Palmer CM. Anesthesiology 1991; 74: 1153-5
Noble DW. Br J Anaesth 1991; 66: 645-50 Carvalho B. Anesth Analg 2008: 107: 956-61
Sharawi N.Anesth Analg 2019;127:1385-95

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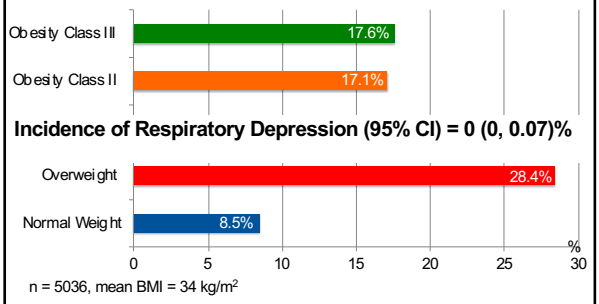
Respiratory Depression



Crowgey T. Anesth Analg 2013;117:1368-70

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ASA Practice Guidelines

- Identification of high risk patients
- Minimum effective dose
- **Monitoring**
  - Morphine: Every hour for 12 h and then ever 2 h for 12 h
  - Fentanyl: Minimum of 2 h

ASA Taskforce on neuraxial opioids. Anesthesiology 2016;124:535–552

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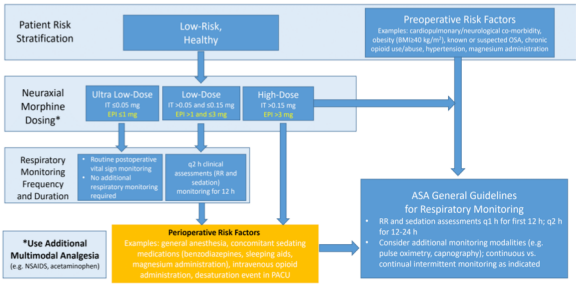
SOAP Consensus Statement



Bauchat J. Submitted for publication

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Urinary Retention

- Impact on detrusor contractility and the urgency to void
- Lack of consensus on definition
- Limited data (22-58%)

Evron S. Pain 1985;23:135-44
Liang CC. J Obstet Gynaecol Res 2010;36:991-5

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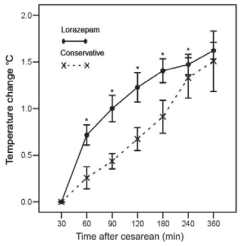
Hypothermia

- Hypothermia with diaphoresis and feeling hot
- Not responsive to active warming
- Persists for about 6 hrs
- Lorazepam and naloxone



Hess P. Int J Obstet Anesth 2005;14:279-83 Sayyid S. Reg Anesth Pain Med 2003;28:140-3
Harkouk H. Ann Fr Anesth Reanim 2013;32:53-5

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Conclusions

- Pruritus and PONV common after neuraxial opioid administration
- Respiratory depression rare
- Minimal effective dose of neuraxial morphine

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Conclusions

- **Pruritus**
  - Naloxone 0.25 µg/kg/h
  - Nalbuphine 2.5 mg
- **PONV**
  - 5 HT_3 RAs
  - Dexamethasone
  - Anticholinergics
  - Antihistaminergics
  - Combination Antiemetics

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Program Slides

Saturday, March 16, 2019

Session V: Obstetric Anesthesia Safety Session

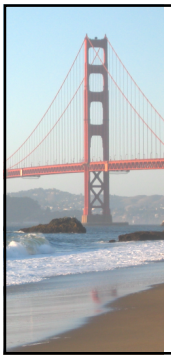
(ABA Part 2 MOCA Patient Safety Credit)

Moderator: Gillian Abir, M.B., Ch.B., FRCA

Current Evidence for the Prevention and Treatment of Spinal Hypotension
Mark D. Rollins, M.D., Ph.D.

Pregnant Patient with Chronic Pain and Opioid Addiction
Pamela D. Flood, M.D., M.A.

OSA in the Parturient: Implications for Peri and Post-Operative Period
Jeremy Collins, FRCA, M.B.,Ch.B.



Current Evidence for the Prevention & Treatment of Spinal Hypotension

Sol Shnider
Obstetric Anesthesia Conference
March 16, 2019

Mark Rollins, MD, PhD
Professor & Director Obstetric Anesthesia
University of Utah
Department of Anesthesiology

No Disclosures

Objectives

Participants should be able to discuss the impact of the following to prevent & treat spinal hypotension:

- Fluid Management
- Vasopressors
- Uterine Displacement

Definition of Hypotension

Two most common definitions…

1) A decrease below 80% of baseline

OR

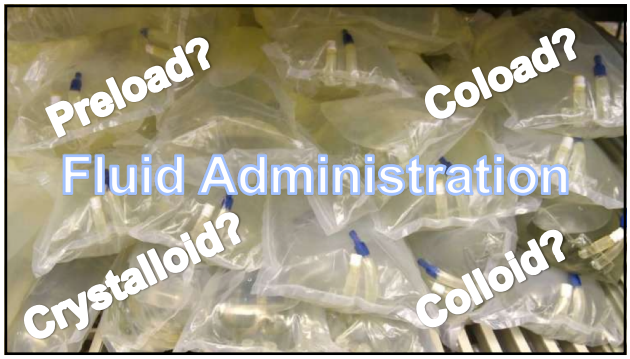
2) Either a blood pressure below 100mmHg or a decrease below 80% of baseline

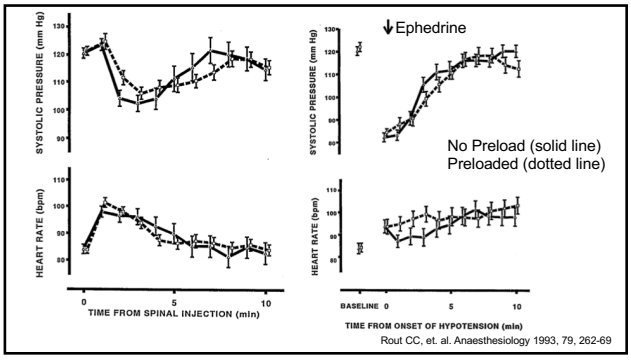
Klohr S, et al. Acta Anaesthesiol Scand 2010; 54: 909–921

Why The Concern?

- Maternal
  - Nausea and vomiting
  - Dizziness
- Fetal
  - Acidosis
  - Bradycardia

Kinsella SM, et. al. Anaesthesia 2018, 73, 71–92
Corke BC, et al. Anaesthesia 1982; 37: 658–62.
Ngan Kee et al. BJA 2004, 92 (4): 469-74





Rout CC, et. al. Anaesthesiology 1993, 79, 262-69

IV Coload?

1) 2004 study by Dyer et al. noted benefit of coload over preload

2) 2010 Meta-analysis by Banerjee et al. found no benefit of coload over preload

3) 2012 Analysis suggests may be some minimal benefit with vasopressor use

4) 2017 Meta-analysis by Ni et al. suggests benefit of colading over preload

1) Dyer RA et al. Anaesthesia and Intensive Care 2004; 32: 351–7
2) Banerjee A et al. Canadian Journal of Anesthesia 2010; 57:24–31
3) Mercier FJ et al. Current Opinion in Anaesthesiology 2012; 25: 286–91.
4) Ni HF et al. Biomed Res Int. 2017

Minerva Anestesiol. 2015 Sep;81(9):1019-30. Epub 2014 Dec 11.

Colloids versus crystalloids in the prevention of hypotension induced by spinal anesthesia in elective cesarean section. A systematic review and meta-analysis.

Ripollés Melchor J[1], Espinosa Á, Martínez Hurtado E, Casans Francés R, Navarro Pérez R, Abad Gurumeta A, Calvo Vecino JM.

A significant decrease in hypotension associated with spinal anesthesia was observed with the use of colloids compared to crystalloids

(RR [95% CI] 0.70 [0.53-0.92], P=0.01)

EPHEDrine 5 mg/ml Date_____ Time_____ Int._____

Phenylephrine 100 mcg/ml Date_____ Time_____ Int._____

Norepinephrine_____mg/ml Date_____ Time_____ Int._____

Vasopressors

Prophylactic Ephedrine Preceding Spinal Analgesia for Cesarean Section

BRETT B. GUTSCHE, M.D.*

Hypotension frequently occurs in parturients undergoing cesarean section with high subarachnoid block, due to decreased cardiac output from inferior vena caval compression by the gravid uterus, compounded by vasodilatation and bradycardia.[1] In normotensive parturients systolic blood pressures below 100 torr are associated with fetal bradycardia, indicating fetal distress *in utero*[2] as well as indicating neonatal depression at birth.[3] ceived little attention. The purpose of this study was to determine the need for and effects of prophylactic im administration of ephedrine when both left uterine displacement and maternal hydration are employed. Results indicated that left uterine displacement and maternal hydration alone were not sufficient, and that addition of prophylactic im administration of ephedrine was efficacious.

Gutsche BB. Anesthesiology. 1976 Oct;45(4):462-5.

Anesthesiology 2009; 111:506–12

Placental Transfer and Fetal Metabolic Effects of Phenylephrine and Ephedrine during Spinal Anesthesia for Cesarean Delivery

Warwick D. Ngan Kee, M.B.Ch.B., M.D., F.A.N.Z.C.A., F.H.K.A.M., Kim S. Khaw, M.B.B.S., F.R.C.A., F.H.K.A.M.,† Perpetua E. Tan, B.Sc., M.Phil.,‡ Floria F. Ng, R.N., B.A.Sc.,§ Manoj K. Karmakar, M.B.B.S., F.R.C.A., F.H.K.A.M.†*

Results:

Lower umbilical artery or umbilical vein pH with ephedrine

Greater umbilical cord lactate, glucose, epinephrine with ephedrine

Placental transfer was greater with ephedrine (1.13 vs 0.17)

1) Ephedrine crosses the placenta to a greater extent and undergoes less early metabolism / redistribution

2) The overall effect of vasopressors on fetal oxygen supply and demand favors phenylephrine

Editorial View:

Richard M. Smiley, M.D., Ph.D., Division of Obstetric Anesthesia, Department of Anesthesiology, PH-5, College of Physicians & Surgeons of Columbia University, New York, New York. rms7@columbia.edu

Anesthesiology 2009; 111:470–2

Burden of Proof

" …the evidence now is sufficient for a change in attitude and practice to be strongly encouraged."

"The weight of the evidence has now equaled the burden of proof, and our clinical burden should be to incorporate the evidence into our routine practice."

Infusion vs Bolus Dosing?

Less hypotension and less nausea and vomiting with a phenylephrine infusion compared to bolus dosing

1) Ngan Kee WD, et al. Anesth Analg 2004;98(3):815-21.
2) das Neves JF, et al. Rev Bras Anestesiol 2010;60(4):391-8.
3) Allen TK, et al. Anesth Analg 2010;111(5): 1221-9.
4) Siddik-Sayyid SM, et al. Anesth Analg 2014;118(3):611-8.
5) George RB, et al. Can J Anesth/ 2018 65:254–262

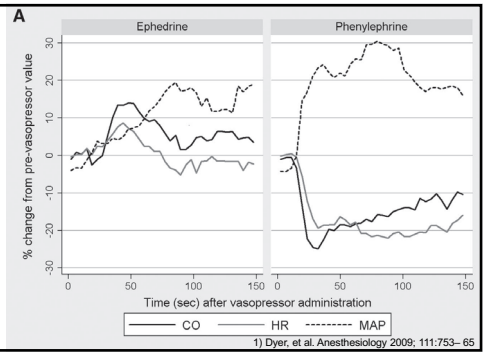
Optimal Infusion Rate?

A 25 - 50 mcg/min infusion rate may be a preferable starting point for prophylactic phenylephrine compared with an initial infusion of 100 mcg/min

1) Butwick AJ, et al. BJA 114 (2): 183–6 (2015)
2)) Allen TK, et al. Anesth Analg 2010;111: 1221-9.
3) Stewart A, et al. Anesth Analg 2010; 111: 1230–7

Cardiovascular Effects

10 mg Ephed. vs 80mcg Phenyl



1) Dyer, et al. Anesthesiology 2009; 111:753– 65

Randomized Double-blinded Comparison of Norepinephrine and Phenylephrine for Maintenance of Blood Pressure during Spinal Anesthesia for Cesarean Delivery

(Anesthesiology 2015; 122:736-45)

Warwick D. Ngan Kee, M.B.Ch.B., M.D., F.A.N.Z.C.A., F.H.K.A.M., Shara W. Y. Lee, B.Sc.(Hons.), M.Sc., Ph.D., Floria F. Ng, R.N., B.A.Sc., Perpetua E. Tan, B.Sc., M.Phil., Kim S. Khaw, M.B.B.S., M.D., F.R.C.A., F.H.K.A.M.

"norepinephrine was effective for maintaining blood pressure and was associated with greater heart rate and cardiac output compared with phenylephrine"

Obstetric Anesthesiology
Section Editor: Jill M. Mhyre

Prophylactic Norepinephrine Infusion for Preventing Hypotension During Spinal Anesthesia for Cesarean Delivery

Anesth Analg 2018;126:1989–94)

Warwick D. Ngan Kee, MD, FANZCA, FHKCA,* Shara W. Y. Lee, PhD,† Floria F. Ng, RN, BASc,* and Kim S. Khaw, MD, FRCA, FHKCA*

An open-label randomized controlled clinical trial for comparison of continuous phenylephrine versus norepinephrine infusion in prevention of spinal hypotension during cesarean delivery

IJOA 2017. 29: 18-25

M.C. Vallejo,[a] A.F. Attaallah,[a] O.M. Elzamzamy,[a] D.T. Cifarelli,[a] A.L. Phelps,[b] G.R. Hobbs,[a] R.E. Shapiro,[a] P. Ranganathan[a]

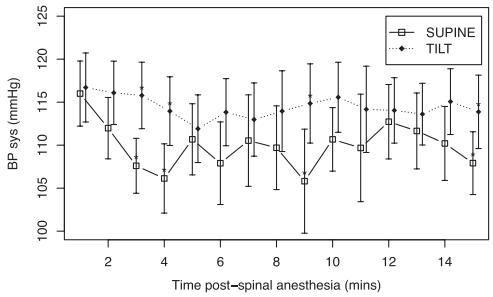
Is LUD Beneficial?

Left Lateral Table Tilt for Elective Cesarean Delivery under Spinal Anesthesia Has No Effect on Neonatal Acid–Base Status

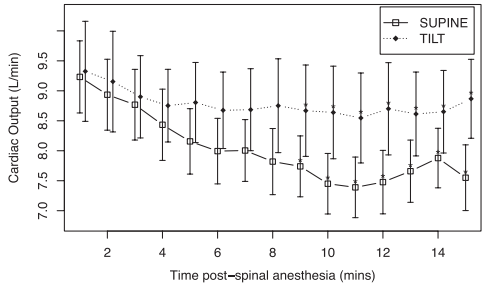
A Randomized Controlled Trial

(Anesthesiology 2017; 127:241-9)

Allison J. Lee, M.D., Ruth Landau, M.D., James L. Mattingly, C.R.N.A., Margaret M. Meenan, C.R.N.A., Beatriz Corradini, M.Sc., Shuang Wang, Ph.D., Stephanie R. Goodman, M.D., Richard M. Smiley, M.D., Ph.D.



Lee et al. Anesthesiology 2017; 127:241-9



Lee et al. Anesthesiology 2017; 127:241-9

Anaesthesia 2018, 73, 71–92 doi:10.1111/anae.14080

Guidelines

International consensus statement on the management of hypotension with vasopressors during caesarean section under spinal anaesthesia

S. M. Kinsella,[1] B. Carvalho,[2] R. A. Dyer,[3] R. Fernando,[4] N. McDonnell,[5] F. J. Mercier,[6] A. Palanisamy,[7] A. T. H. Sia,[8] M. Van de Velde[9,10], A. Vercueil[11] and the Consensus Statement Collaborators

Recommendations

1) Hypotension following spinal or combined spinal-epidural anesthesia at caesarean section causes both maternal and fetal/neonatal adverse effects.

2 Hypotension is frequent and vasopressors should be used routinely and preferably prophylactically.

Kinsella SM, et al. Anaesthesia 2018, 73, 71–92.

Recommendations

3) Alpha-agonist drugs are the most appropriate agents to treat or prevent hypotension following spinal anaesthesia. Although drugs with some beta activity may have the best profile phenylephrine is currently recommended due to the amount of supporting data.

4) Left lateral uterine displacement and intravenous colloid preloading or crystalloid coloading, should be used in addition to vasopressors.

Kinsella SM, et al. Anaesthesia 2018, 73, 71–92.

Recommendations

5) The aim should be to maintain systolic arterial pressure (SAP) at ≥ 90% of an accurate baseline obtained before spinal anesthesia, and avoid a decrease to < 80% baseline. We recommend a variable rate prophylactic infusion of phenylephrine using a syringe pump. This should be started at 25–50 mcg/min immediately after the intrathecal injection, and titrated to blood pressure and pulse rate.

Kinsella SM, et al. Anaesthesia 2018, 73, 71–92.

Recommendations

6) Maternal HR can be used as a surrogate for CO if the latter is not being monitored; both tachycardia and bradycardia should be avoided.

7) When using an alpha-agonist as the first-line vasopressor, ephedrine is suitable to manage SAP < 90% of baseline combined with a low heart rate. For bradycardia with hypotension, an anticholinergic drug may be required. Epinephrine should be used for circulatory collapse.

Kinsella SM, et al. Anaesthesia 2018, 73, 71–92.

Pregnant Patient with Chronic Pain and Opioid Use Disorder

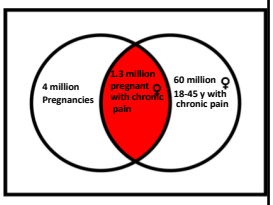
Pamela Flood, MD, MA
Professor of Anesthesiology,
Perioperative and Pain Medicine
Stanford University

Chronic Pain in Pregnancy

As if that is not complicated enough!

Pain is Common – Pregnancy is Common

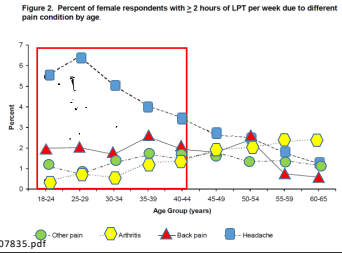
- 4 million term pregnancies each year in the United States
- 25% of young adults 20-44 report chronic pain that interferes with their life
- Twice as common in women (33%)
- ***Any chronic pain syndrome that occurs in young women can superimposed upon pregnancy***



http://www.cdc.gov/nchs/fastats/births.htm
2010 US Census

Pain Conditions Common in Young Women

- > 2 hours lost productive time per week
- **Headache** most common **5%**
- **Back pain 2%**
- **Arthritis 1.5%**
- **Other 1%**
  - Fibromyalgia
  - Pelvic Pain



www.fda.gov/downloads/Drugs/NewsEvents/UCM307835.pdf

Impact of Pregnancy on Chronic Pain

- **Some Conditions Get Worse:**
  - Low back Pain 2% before pregnancy, 60% of pregnant women report low back pain during pregnancy
  - 20% of pregnant women report pelvic girdle pain during pregnancy, 50% is treated with medication
- **Some Conditions Improve (but have exacerbations after delivery):**
  - Headache
  - Autoimmune arthritis
  - Multiple Sclerosis

Interventions for preventing and treating low-back and pelvic pain during pregnancy. *Cochrane Database of Systematic Reviews* 2015, Issue 9. Art. No.: CD001139.
Curr Neurol Neurosci Rep (2016) 16: 40
Neurotherapeutics. 2017 Oct;14(4):974-984

Preparation is key for women with chronic pain and analgesic use

- Any chronic pain syndrome that occurs in young women can superimposed upon pregnancy
- Pre-conceptual counseling about expected Impact of pregnancy on pain condition and safe treatment
- Prehab:
  - **Pharmacology**
    - Woman with childbearing potential merits a discussion about reproductive plans
    - Reduce opioids
    - Limited interventions are possible during pregnancy
      - No fluoroscopy
      - Limited steroids
      - Can do some blocks with ultrasound
  - **Physical therapy**: maximization of core strength and weight loss
  - **Pain psychology**: maximize coping skills
- Preparation is key but… Unanticipated Pregnancy ~ 50% (in women who do not abuse drugs)

Heil SH, Jones HE, Arria A, et al. Unintended pregnancy in opioid abusing women. J Subst Abuse Treat 2011;40:199-202

Common Comorbidities

- Depression
- Anxiety
  - May have had difficulty with previous procedures and providers
  - Often feel negatively judged
- Sleep disorders
- Hyperalgesia – Difficult IV placement
- Allodynia- tourniquet is painful
- Good time to gain trust

Principles of Chronic Pain Management: Biopsychosocial Model

- **Medications – Buprenorphine Induction**
- **Procedures**
  - Ultrasound guided injections
  - Acupuncture
- **Physical Therapy**
  - Core strengthening
  - Yoga for flexibility
- **Pain psychology**
  - Coping skills
  - Biofeedback
  - Cognitive Behavioral therapy
  - Mindfulness Meditation

Back Pain in Pregnancy: Management

2% before pregnancy

60% during pregnancy

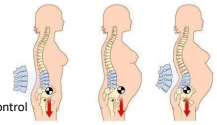
Post Partum prevalence is 25%

Relapse rate is high in subsequent pregnancies

Back Pain in Pregnancy and After:

etiology for onset of chronic back pain in young women?

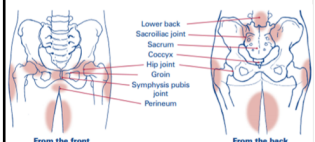
- **Risk Factors**
  - Increased Weight
  - History of low back pain
  - Low Job Satisfaction
- **Etiology**
  - Increased lumbar lordosis
  - Inefficient neuromuscular control



Pennick V[1], Liddle SD. Interventions for preventing and treating pelvic and back pain in pregnancy. Cochrane Database Syst Rev. 2013

Back Pain in Pregnancy

- **Management**
  - Acetaminophen
  - Topical Analgesic Patches
    - Capsaicin
    - Menthol salicylate
    - lidocaine
  - TENS (better than exercise or acetaminophen)
  - Any land based exercise
    - Pain -0.64(-1.03 to -0.25) SD
    - Functional disability -0.56 (-0.89 to -0.23) SD
  - Music Based Relaxation
  - No evidence for pelvic support belt



Pelvic Girdle and Lumbar Pain

- The joints in the pelvis are held together by thick ligaments and normally don't allow much motion.
  - Sacroiliac and Pubic Symphysis
- Increasing estrogen and progesterone soften ligaments and allow a greater degree of motion as early as the first trimester
- During the second and third trimester the growing fetus results in increased lordosis and widening of the hips increasing pelvic girdle and lumbar pain

Ultrasound guided Injections

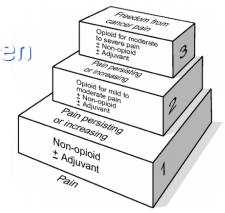
- Trigger point injections
- Occipital nerve blocks
- Facet joints
- Sacroiliac joints
- Injections during pregnancy to facilitate physical therapy

The elephant in the room

Are drugs commonly used for pain conditions safe in pregnancy and during lactation?

The ladder During Pregnancy: Acetaminophen and Non-Steroidals

WHO Guidelines in Pregnancy?



NSAIDS and Acetaminophen: teratogenicity

Table 1 Data on teratogenic risk with some common mild analgesics

Drug	Authors	Source of data	Number exposed	Risk estimate (95 % CI)	Comment
Acetaminophen	Thulstrup et al. [19]	Prescription	58	0.70 (0.1–5.5)	
	Rebordosa et al. [20]	DNBC	88,142	1.01 (0.93–1.08)	Increased risk for Q18.8
	Källén [21]	SMBR	66,300	1.04 (1.00–1.09)	
Acetyl salicylic acid	Heinonen et al. [2]	CPP	14,864	1.01 (0.93–1.09)	
	Källén [21]	SMBR	8371	0.94 (0.83–1.06)	
NSAID	Nielsen et al. [22]	Prescription	1106	1.27 (0.93–1.75)	
	Ericson and Källén [23]	SMBR	2557	1.04 (0.94–1.29)	Increased risk for cardiac defects
	Ofori et al. [24]	Case-control prescriptions	1056	2.21 (1.72–2.85)	Septal cardiac defects dominate
	Källén [21]	SMBR	16,723	1.06 (0.98–1.16)	Increased risks for CL(P), cardiac defects, kidney malformations
	Bérard and Kori [8]	Case-control, prescriptions	3941 cases	1.20 (1.06–1.56)	Migraineurs
	Nezvalová-Henriksen et al. [26]	MoBa	6511	0.9 (0.7–1.2)	Borderline risk increase for cardiac defects

CPP Collaborative Perinatal Project, *DNBC* Danish National Birth Cohort, *MoBa* Norwegian Mother and Child Study, *SMBR* Swedish Medical Birth Register, *Q18.8* neck and face malformations, *CL(P)* cleft lip with/without cleft palate

Acetaminophen: OK

Aspirin: OK

Non-Steroidal Anti-inflammatory- Not OK

Summary: NSAIDS and Acetaminophen During Pregnancy

- Aspiring OK
- Acetaminophen likely OK
- Non-steroidals
  - Risk of miscarriage first trimester
  - Multiple studies suggest small increase in risk of cardiac defects
  - Risk of closure of the ductus arteriosus third trimester

Commonly Used Drugs During Pregnancy: Drugs for Migraine

Occurs in 5% of women and commonly recurs post-partum

Migraine

- History of migraine is associated with an increased risk of pregnancy complications
  - preeclampsia,
  - low birthweight infants,
  - ischemic stroke
  - Myocardial infarction
  - DVT
  - PE

Curr Neurol Neurosci Rep (2016) 16: 40

Migraine Treatment Options in Pregnancy

- Non-pharmacological
  - Behavioral (relaxation, cognitive behavioral, biofeedback, stress management)
  - Lifestyle (sleep hygiene, regular meals)
  - Mind-body (meditation, yoga)
  - Dietary (limit caffeine, hydrate, avoid known food triggers)
- Ablative Drugs -Triptans
- Procedures
  - Physical therapy
  - Acupuncture
  - Nerve blocks
  - ?Botox

Ablative drugs for migraine: Teratogenicity

Table 3 Data on teratogenic risks for drugs used for migraine

Drug	Authors	Source of data	Number exposed	Risk estimate (95 % CI)	Comment
Ergots					
Ergotamine	Ács et al. [38]	HCCSCA	13 cases, 17 controls	1.3 (0.3–2.7)	3 cases of spina bifida
	Källén et al. [39]	SMBR	388	0.82 (0.49–1.36)	
Dehydro-ergotamine	Källén et al. [39]	SMBR	135	0.78 (0.25–1.81)	
	Bérard and Kori [25]	Case-control, prescriptions	5 cases, 48 controls	0.97 (0.22–4.28)	
Triptans					
Sumatriptan	Cunnington et al. [40]	Pregnancy register	413	–	4.8 % malformed
Any triptan	Nezvalová-Henriksen et al. [41]	MoBa	1387	1.0 (0.7–1.3)	653 with sumatriptan
Any triptan	Källén et al. [39]	SMBR	2777	0.97 (0.81–1.16)	
Sumatriptan	Källén et al. [39]	SMBR	2257	0.99 (0.91–1.21)	
Zolmitriptan	Källén et al. [39]	SMBR	362	0.76 (0.43–1.35)	
Any triptan	Bérard and Kori [25]	Case-control prescription	18 cases, 121 controls	1.49 (0.89–2.52)	
Any triptan	Nezvalová-Henriksen et al. [26]	NMBR prescription	1210	1.13 (0.91–1.50)	415 with sumatriptan

HCCSCA Hungarian Case-Control Surveillance of Congenital Abnormalities, *MoBa* Norwegian Mother and Child Study, *NMBR* Norwegian Medical Birth Registry, *SMBR* Swedish Medical Birth Register

Concerns about blood pressure

Many studies, very clean but most cases with sumatriptan

Other ablatives for Migraine in Pregnancy

- Ondansetron new concerns – case control study found increase risk of clefts with ondansetron, conflicting findings from 2 birth registries
- Butalbital (barbiturate with caffeine, acetaminophen asprine +/- codeine)– medication overuse headache, fatal withdrawal syndromes. Historically considered safe but may have association with cardiac defects

Holland S, Silberstein SD, Freitag F, Dodick DW, Argoff C, Ashman E. Evidence-based guideline update: NSAIDs and other complementary treatments for episodic migraine prevention in adults: report of the Quality Standards Subcommittee of the American Academy of Neurology and the American Headache Society. Neurology. 2012;78(17):1346–53.

Prophylactic Drugs for Migraine

- Magnesium dietary supplement 200-500 mg at night
- Topiramate used in epilepsy may or may not have a higher risk than no treatment
- Propranolol, nadolol, metoprolol betablockers have been used safely for hypertension
- Gabapentin – No increased risk has been found in several registries

Newer-Generation Antiepileptic Drugs and the Risk of Major Birth Defects. JAMA, May 18, 2011—Vol 305, No. 19 ©2011

Summary: Migraine Management

- Triptans are likely safe, the best data is with sumatriptan
- Migraine prophylactics
  - Start with the more familiar in pregnancy
    - Magnesium citrate
    - Beta blockers
- Emphasis on lifestyle changes

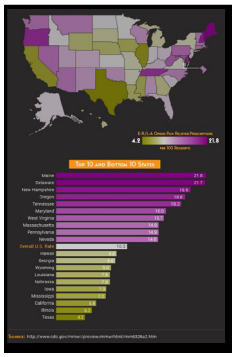
Ephross SA, Sinclair SM. Final results from the 16-year sumatriptan,naratriptan, and treximet pregnancy registry. Headache.2014;54(7):1158–72.

Opioid Use in Pregnancy

Opioid Use is Common – Pregnancy is Common

- 4 million term pregnancies each year in the United States
- Private Insurance 28% of women of reproductive age filled an opioid prescription
- Medicaid 39 % of women of reproductive age filled an opioid prescription
- Opioid use increased from 1 to 6/1000 births between 2000 - 2006
- ***All pregnant women should be screened for opioid use at first prenatal visit***

JAAPA. 2019 Mar;32(3):20-24. Opioid use disorder during pregnancy: An overview.
Carter LC1, Read MA, Read L, Nicholas JS, Schmidt E.



Long Acting Opioids Prescribed by State

- The likelihood of your patient being on chronic opioids depends on where you practice (2012 data)
- This is decreasing due to regulation and increased consciousness, but still very common
- For your state up to 2015: https://ppsg-chart.medicine.wisc.edu/

Kallen, Drugs (2016) 76:915–924

Are Opiates Teratogenic?

Analgesics During Pregnancy 919

Table 2 Data on teratogenic risks with some opiates and opioids

Drug	Authors	Source of data	Number exposed	Risk estimate (95 % CI)	Comment
Narcotic analgesics	Heinonen et al. [2]	CPP	1564	0.96 (0.72–1.27)	
Codeine	Heinonen et al. [2]	CPP	563	1.08 (0.87–1.66)	
	Nezvalová-Henriksen et al. [34]	MoBa	1693	0.8 (0.5–1.1)	
	Källén and Reis [35]	SMBR	2655	1.42 (1.15–1.76)	Non-significantly increased risk for cardiovascular defects
Dextropropoxyphene	Heinonen et al. [2]	CPP	686	1.04 (0.69–1.55)	
	Källén and Reis [35]	SMBR	3256	1.05 (0.86–1.27)	
Tramadol	Källén and Reis [35]	SMBR	1603	1.25 (0.98–1.03)	Increased risk for cardiac septum defect and PEQ
Other synthetic opioids than tramadol and dextropropoxyphene	Källén and Reis [35]	SMBR	382	1.30 (0.71–2.58)	Increased risk for cardiovascular defect, OR = 2.94 (1.18–6.06)
Other natural opiates than codeine	Källén and Reis [35]	SMBR	556	1.17 (0.71–1.93)	No increased risk of cardiovascular defects, OR = 0.86 (0.23–2.19)

CPP Collaborative Perinatal Project, *MoBa* Norwegian Mother and Child Study, *SMBR* Swedish Medical Birth Register, *PEQ* pes equino-varus, *OR* odds ratio

Small signal for risk with Synthetic Opioids

Are there neurodevelopmental risks? Is it the chicken or the egg?

In this case, It's the chicken

- Opioids
  - Prenatal exposure is associated with developmental delay
  - only when the infants are raised by the opioid using mother
  - Not when fostered with non-opioid using parents

Baldacchino A, Arbuckle K, Petrie DJ, McCowan C. Neurobehavioral consequences of chronic intrauterine opioid exposure in infants and preschool children: a systematic review and metaanalysis. BMC Psychiatry 2014; 14:104.
Sithisarn T, Granger DT, Bada HS. Consequences of prenatal substance use. Int J Adolesc Med Health. 2012;24:105–12.

Summary: Opioid Prescription During Pregnancy

- Avoid synthetic opioids during the first trimester
- Opioids should be weaned before conception or (?) during the second trimester
  - Increase in incidence of miscarriage if withdrawal in the first trimester
  - Increase in preterm birth if withdrawal in the third trimester
- Avoid codeine during lactation
  - Codeine is a prodrug metabolized to morphine
  - The amount and rate of metabolism is highly variable from none to producing very high fast peaks
  - Neonatal deaths have been attributed to mismatch between ultrarapid metabolizing moms and slow and infants with immature morphine metabolism

Opioid Use Disorder - MAT

Opioid Use Disorder MAT

- **Methadone –** gold standard since 1974 ,
  - Daily dispensing with psychological support
    86% of women need dose increase during pregnancy, and many need split dose
  - Dose reduction after 6 weeks
  - No increase in NAS (neonatal abstinence syndrome)

JAAPA. 2019 Mar;32(3):20-24. Opioid use disorder during pregnancy: An overview.
Carter LC1, Read MA, Read L, Nicholas JS, Schmidt E.

MAT

- **Buprenorphine**
  - Fewer preterm births
  - Lower risk or NAS
  - Can be prescribed in the office weekly or biweekly (4-32 mg)
  - Ceiling effect ?
  - Increased adherence
  - New long acting forms
    - Monthly injection
    - Implantable

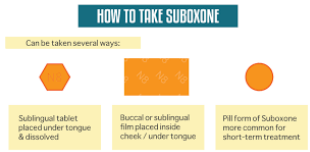
Sublocade

Probuphine no more than 8mg/day

Am Fam Physician. 2018 May 15;97(10):668-670. Implantable Buprenorphine (Probuphine) for Maintenance Treatment of Opioid Use Disorder. Goodbar NH1, Hanlon KE1.

MAT

- **Buprenorphine – Naloxone (Suboxone)**
  - Cannot be injected
  - No difference in outcome betv buprenorphine or methadone
  - ? Lower APGAR scores



Probuphine no more than 8mg/day

Am Fam Physician. 2018 May 15;97(10):668-670. Implantable Buprenorphine (Probuphine) for Maintenance Treatment of Opioid Use Disorder. Goodbar NH1, Hanlon KE1.

Buprenorphine and Analgesia

Anesthesiologist

- **Partial Agonist – binds tightly**
  - Regional analgesia
  - Other analgesics
  - Low doses <2 mg can be overcome by a full agonist

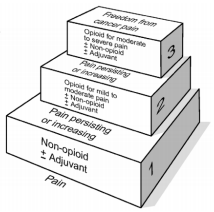
Am Fam Physician. 2018 May 15;97(10):668-670. Implantable Buprenorphine (Probuphine) for Maintenance Treatment of Opioid Use Disorder. Goodbar NH1, Hanlon KE1.

Management of Labor and Delivery

- Re assure –
  - Patients with chronic pain may fear the impact of vaginal delivery or surgery
  - They may be hyperalgesic
  - Patients taking pain medications may have had adverse experience medical personnel who judge their use of medication during pregnancy
- Opioids need to be continued even with regional analgesia
  - Need to prevent withdrawal
  - Pre delivery daily requirement should be given in divided doses for pain patients and usually split dose for methadone
- Emphasize regional analgesia whenever possible
  - It is the one treatment that a patient won't be tolerant to
- Consider adjuvant analgesics
  - additive or synergistic when opiates are used

Postpartum Management for the Chronic Pain Patient – Opioid Tolerant

- Hyperalgesia
  - Chronic pain patients, even if not taking opioids may have higher sensitivity to pain, plan enhanced pain care in advance
  - Regional analgesia is a mainstay and should be continued as long as possible, even in the setting of vaginal delivery
  - Consider other adjuvants
- Tolerance
  - Baseline daily dose is a minimum and increased opioids and other adjuvant medications are required
  - >100 MED difficult



OK to Breast Feed? – YES!

- Consider this excerpt from ***The American Academy of Pediatrics*** *Clinical Report:*
- "Many mothers are inappropriately advised to discontinue breastfeeding or avoid taking essential medications because of fears of adverse effects on their infants. This cautious approach may be unnecessary in many cases, because only a small proportion of medications are contraindicated in breastfeeding mothers or associated with adverse effects on their infants."

You can use your:

Knowledge of pharmacology

Understanding of maternal and fetal physiology

Human kindness

OSA in the Parturient
Implications for Peri- and Postoperative Period

Jeremy Collins MB ChB FRCA
Clinical Associate Professor, Stanford University

SOAP

Stanford MEDICINE

No conflicts of interest

Local OSA guideline?

Anaesth Intensive Care 2009; 37: 697-699

Editorials

Preoperative screening for obstructive sleep apnoea – are we losing sleep over nothing?

Limited enthusiasm for diagnosis and treatment

- Limited number of studies showing merits of intervention
- Limitation of sleep medicine referrals
- Limited patient compliance with treatment
- Expense of Dx and Mx in an uninsured population

Natl Vital Stat Rep. 2016;65:1–11.

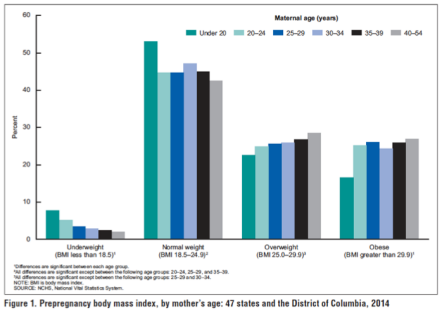
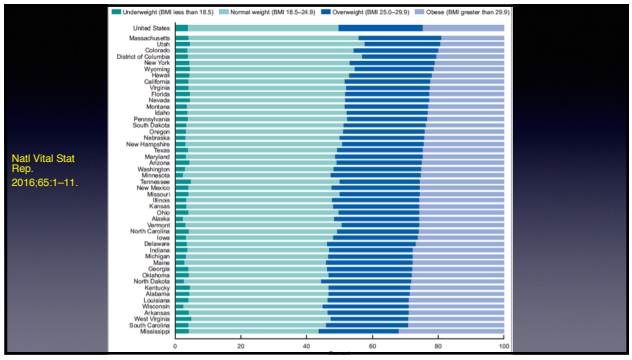


Figure 1. Prepregnancy body mass index, by mother's age: 47 states and the District of Columbia, 2014



Natl Vital Stat Rep. 2016;65:1–11.

Sleep disordered breathing

ORIGINAL ARTICLE

Risk factors for sleep-disordered breathing in pregnancy

Grace W Pien,[1,2,3] Allan I Pack,[1,2] Nicholas Jackson,[1] Greg Maislin,[1] George A Macones,[4] Richard J Schwab[1,2,3]

- OSA in 10% in first trimester
- OSA in 26% in third trimester
- Risk factors are BMI, gestational wt gain and maternal age

Pein. Thorax. 2014;69:371–377

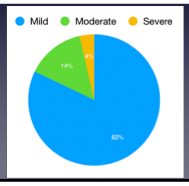
Sleep disordered breathing

ORIGINAL ARTICLE

Risk factors for sleep-disordered breathing in pregnancy

Grace W Pien,[1,2,3] Allan I Pack,[1,2] Nicholas Jackson,[1] Greg Maislin,[1] George A Macones,[4] Richard J Schwab[1,2,3]

- 26% OSA in third trimester



Pein. Thorax. 2014;69:371–377

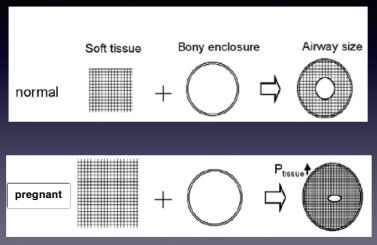
Pregnancy and OSA

\+

hyperemia

FRC

02 consumption



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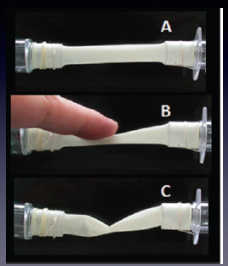
ventilation

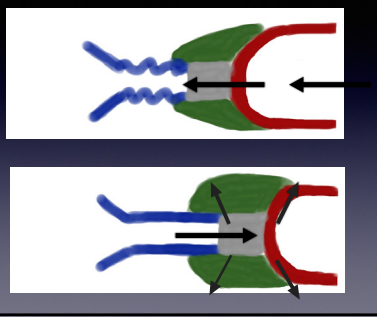
side-sleeping

Distant effect of visceral obesity



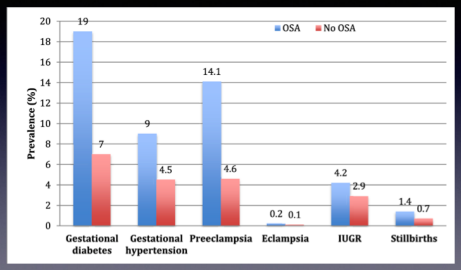
Isono Respirology 2012

Distant effect of visceral obesity



- Waist circumference: strong correlation with OSA
- Reduced activity of genioglossus with increased lung volume

Obstructive sleep apnea in pregnancy is associated with adverse maternal outcomes: a national cohort



G. Bourjeily et al. / Sleep Medicine 38 (2017) 50-57

RESEARCH www.AJOG.org

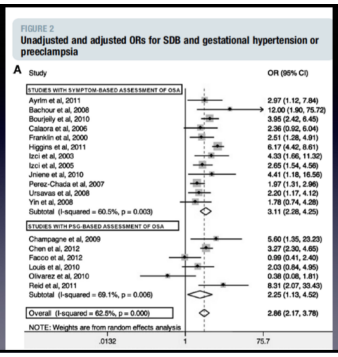
OBSTETRICS

Maternal sleep-disordered breathing and adverse pregnancy outcomes: a systematic review and metaanalysis

Sushmita Pamidi, MD; Lancelot M. Pinto, MD, MSc; Isabelle Marc, MD; Andrea Benedetti, PhD; Kevin Schwartzman, MD, MPH; R. John Kimoff, MD

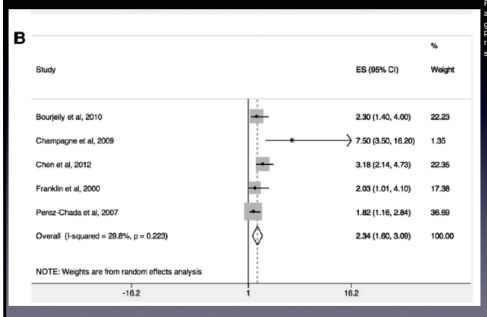
Pamidi S, Pinto LM, Marc I, et al. Maternal sleep-disordered breathing and adverse pregnancy outcomes: a systematic review and metaanalysis. Am J Obstet Gynecol 2014;210:52.e1-14.

OR ~ 2.5-3.5



Forest plots showing A, unadjusted and B, adjusted ORs for SDB and gestational hypertension or preeclampsia. Weights are from random-effects analysis and are shown by gray-shaded boxe

Pamidi S, Pinto LM, Marc I, et al. Maternal sleep-disordered breathing and adverse pregnancy outcomes: a systematic review and metaanalysis. Am J Obstet Gynecol 2014;210:52.e1-14.



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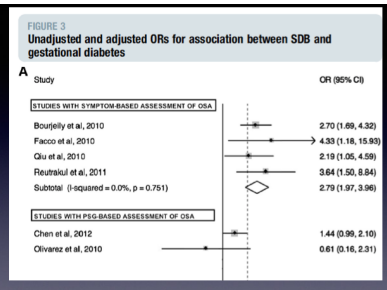
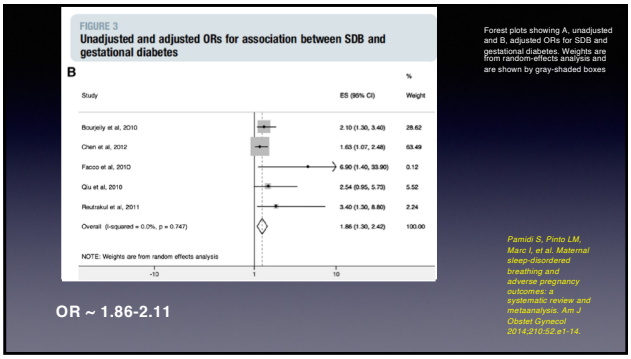


Forest plots showing A, unadjusted and B, adjusted ORs for SDB and gestational diabetes. Weights are from random-effects analysis and are shown by gray-shaded boxes

OR ~ 1.86-2.11

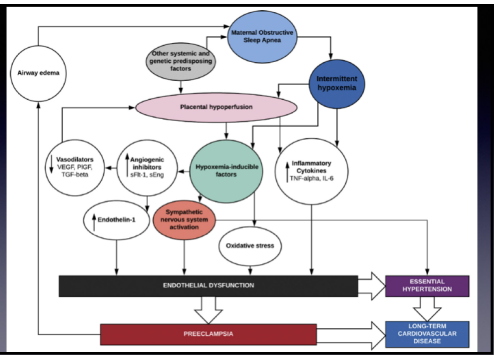
Pamidi S, Pinto LM, Marc I, et al. Maternal sleep-disordered breathing and adverse pregnancy outcomes: a systematic review and metaanalysis. Am J Obstet Gynecol 2014;210:52.e1-14.



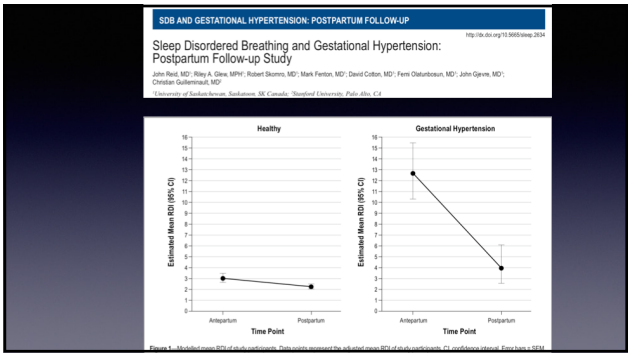
OR ~ 1.86-2.11

Pamidi S, Pinto LM, Marc I, et al. Maternal sleep-disordered breathing and adverse pregnancy outcomes: a systematic review and metaanalysis. Am J Obstet Gynecol 2014;210:52.e1-14.

Hypertensive disorders of pregnancy and OSA



J.E. Dominguez et al. / Sleep Medicine Reviews 42 (2018) 37-46



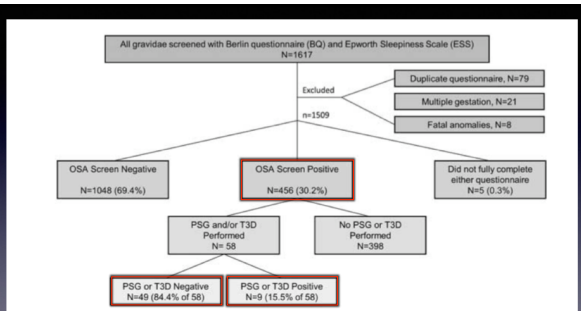
Diagnosis of OSA in pregnancy

- **Men**: excessive daytime sleepiness
- **Women**: fatigue, insomnia, tension

Screening questionnaires for OSA in pregnancy

- STOP-BANG (age>50, NC, gender)
- EPWORTH
- BERLIN
- Sensitivity/specificity: **35% / 63%**

Specificity improved by adding serum bicarbonate >28mmol/L



KM Anthony et al Journal of Perinatology (2014), 587 – 593

Home sleep studies

wait time

inconvenient

Expense

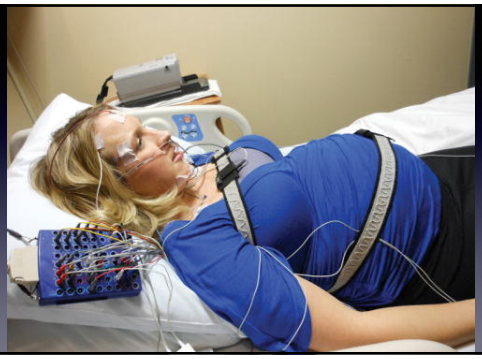
Traditional Model	Home Testing Model
Clinical sleep evaluation	Clinical sleep evaluation
In-laboratory PSG	Home portable monitor
In-laboratory CPAP titration	Home APAP titration
CPAP prescription (optimal pressure from in-laboratory titration)	CPAP prescription (based on 90th percentile APAP pressure)

available

convenient

inexpensive

Cooksey JA et al. Chest 2016; 149(4):1074-1081



Portable home monitors

WatchPAT

Correlates with PSG (r=0.889)

Apnea Risk Evaluation System monitor

Cooksey JA et al. Chest 2016; 149(4):1074-1081

Screening: clinical judgement

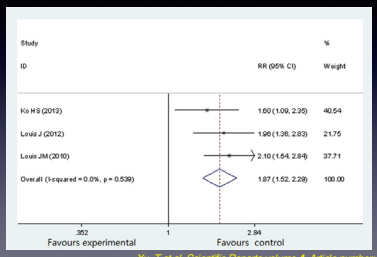
- Morbid obesity
- Neck Circumference > 40cm
- H/O difficult airway
- CHTN or GHTN
- Loud snoring
- Observed apneas
- daytime somnolence

>

referral

OSA increases risk for Cesarean delivery

Forest plots of the association between OSA and cesarean delivery



Xu, T et al. Scientific Reports volume 4, Article number: 6982 (2014)

Peri-operative management guidelines for OSA in the parturient

Peri-operative management guidelines for OSA in the parturient

- Suspect and optimize early
- CPAP
- Position
- (Mandibular advancement devices)
- (Weight loss & sleep surgery)
- Opioids and multimodal analgesia

SPECIAL ARTICLES

Practice Guidelines for the Perioperative Management of Patients with Obstructive Sleep Apnea

An Updated Report by the American Society of Anesthesiologists Task Force on Perioperative Management of Patients with Obstructive Sleep Apnea

Consensus driven
vs
evidence driven
guidelines

SPECIAL ARTICLES

Practice Guidelines for the Perioperative Management of Patients with Obstructive Sleep Apnea

An Updated Report by the American Society of Anesthesiologists Task Force on Perioperative Management of Patients with Obstructive Sleep Apnea

- similar consideration as for surgical patients - optimize early
- CPAP machines should be used during admissions
- studies of bariatric patients suggest CPAP mitigates effect of opioids on OSA

Section Editor: David Hillman

Preoperatively Screened Obstructive Sleep Apnea Is Associated With Worse Postoperative Outcomes Than Previously Diagnosed Obstructive Sleep Apnea

Ana Fernandez-Bustamante, MD, PhD,* Karsten Bartels, MD,* Claudia Clavijo, MD,* Benjamin K. Scott, MD,* Rachel Kacmar, MD,* Kenneth Bullard, BS,* Angela F. D. Moss, MS,† William Henderson, PhD,† Elizabeth Juarez-Colunga, PhD,† and Leslie Jameson, MD*

- Adverse respiratory events ?
- Respiratory interventions ?
- Hospital stay ?

- **diagnosis on DOS associated with more interventions and longer stay**

Anesth Analg 2017;125:593–602

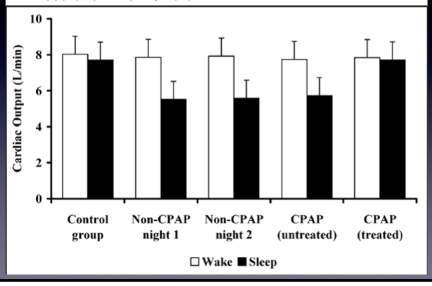
CPAP - safe

- dry mouth
- aerophagia
- rhinitis
- skin abrasions

Reduced Nocturnal Cardiac Output Associated with Preeclampsia is Minimized with the Use of Nocturnal Nasal CPAP

Diane M. Blyton, MSc[1,2], Colin E. Sullivan, PhD[1], Natalie Edwards, PhD[1]

[1]The University of Sydney; [2]Royal Prince Alfred Hospital, Sydney

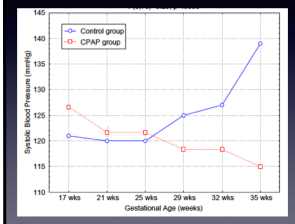


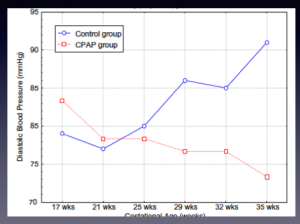
SLEEP 2004;27(1): 79-84.

SLEEP MEDICINE

Original article

Pre-eclampsia and nasal CPAP: Part 2. Hypertension during pregnancy, chronic snoring, and early nasal CPAP intervention



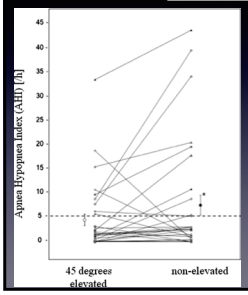


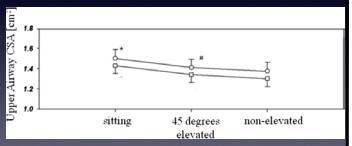
Poyares D, et al. Pre-eclampsia and nasal CPAP: part 2 Hypertension during pregnancy, chronic snoring, and early nasal CPAP intervention. SleepMed. 2007;9:15-21

Positioning

Elevated Upper Body Position Improves Pregnancy-Related OSA Without Impairing Sleep Quality or Sleep Architecture Early After Delivery

Sebastian Zaremba, MD; Noemi Mueller, Cand Med; Anne M. Hasselg, MD; Christina H. Shin, BA; Stefanie Jung, MD;





CHEST 2015; 148 (4): 936 - 944

Elevated Upper Body Position Improves Pregnancy-Related OSA Without Impairing Sleep Quality or Sleep Architecture Early After Delivery

Sebastian Zaremba, MD; Noemi Mueller, Cand Med; Anne M. Hasselg, MD; Christina H. Shin, BA; Stefanie Jung, MD;

- AHI supine : **7.7**±2.2/h
- AHI 45° elevation: **4.5**±1.4/h
- CSA upper airway supine: **1.35**±0.1㎠
- CSA upper airway 45° elevation: **1.54**±0.1㎠

CHEST 2015; 148 (4): 936 - 944

SPECIAL ARTICLES

Practice Guidelines for the Perioperative Management of Patients with Obstructive Sleep Apnea

An Updated Report by the American Society of Anesthesiologists Task Force on Perioperative Management of Patients with Obstructive Sleep Apnea

- avoid sedating anti-emetics, sleeping aids, sedatives
- judicious use of systemic opioids
- multi-modal analgesic regimes
- Sp02 monitoring - oxygen prn until return to baseline
- CPAP during sleep periods

Challenge

OPIOIDS!

Respiratory effects of opioids

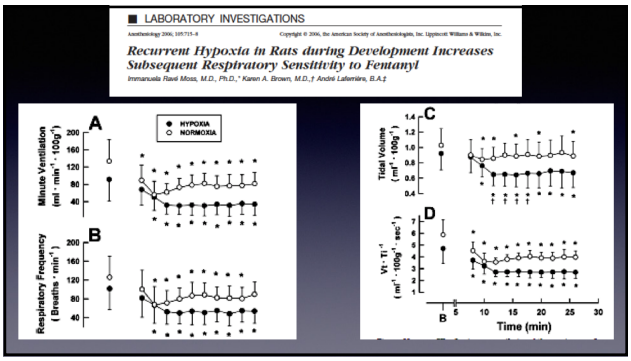
- Reduced airway tone
- Reduced central drive
- Less response to hypoxia
- Change in sleep architecture

Challenges

- Common
- Pk/PD in obesity more complex
- Heterogenous nature of obese population
- Limited resources for postoperative observation
- Associated co-morbdities

Adequate pain control

- Early ambulation offsets risk of DVT
- Increased satisfaction
- Maintenance of lung volumes



MO + OSA

- More uncertainty in dosing
- Greater sensitivity to opioid
- Greater level of hypoxia as a result of those effects

Transcranial Magnetic stimulation

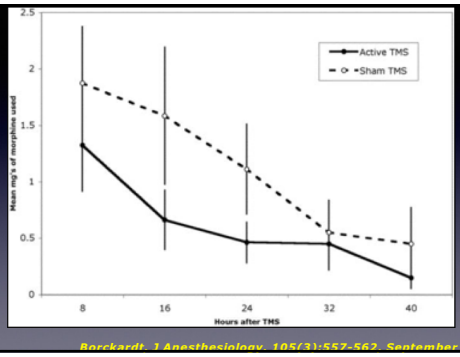
PAIN AND REGIONAL ANESTHESIA

Anesthesiology 2006; 105:557–62

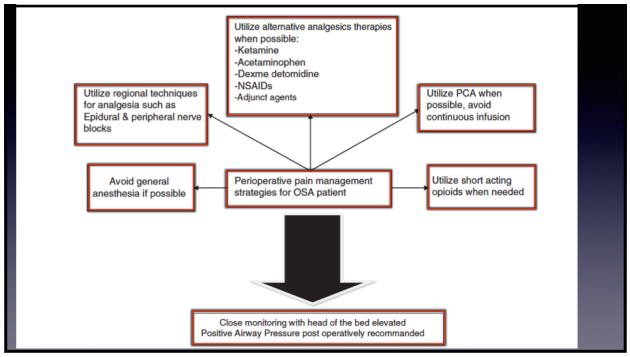
Postoperative Left Prefrontal Repetitive Transcranial Magnetic Stimulation Reduces Patient-controlled Analgesia Use

Jeffrey J. Borckardt, Ph.D.,* Mitchel Weinstein, M.D.,† Scott T. Reeves, M.D.,‡ F. Andrew Kozel, M.D.,§ Ziad Nahas, M.D.,‖ Arthur R. Smith, M.D.,† T. Karl Byrne, M.D.,# Katherine Morgan, M.D.,** Mark S. George, M.D.††

- 20 gastric bypass patients
- randomized to sham or 20 min session of rTMS
- mix of open and closed surgery
- measured morphine consumption via PCA



Borckardt, J Anesthesiology, 105(3):557-562, September 2006



Obesity Surgery, **17**, 920-925

Treatment with Lavender Aromatherapy in the Post-Anesthesia Care Unit reduces Opioid Requirements of Morbidly Obese Patients Undergoing Laparoscopic Adjustable Gastric Banding

Thank you

Program Slides

Saturday, March 16, 2019

Session VI: New Developments and Concepts

Moderator: Jennifer M. Lucero, M.D., M.S.

Point of Care Ultrasound in Obstetric Anesthesia
Clemens M. Ortner, M.D., M.S., DESA

Neuraxial Ultrasound: Practical Guide to Adoption
Katherine M. Seligman, M.D.

Sam Hughes Lecture: Obstetric Anesthesia Year in Review
Ashraf S. Habib, M.B.,B.Ch., M.Sc., M.S.N., FRCA

SOAP Society for Obstetric Anesthesia and Perinatology

Stanford MEDICINE

Point-of-Care Ultrasound in Obstetric Anesthesiology

CLEMENS M. ORTNER, MD, MSC, DESA
CLINICAL ASSISTANT PROFESSOR
DEPARTMENT OF ANESTHESIOLOGY, PERIOPERATIVE AND PAIN MEDICINE
STANFORD UNIVERSITY SCHOOL OF MEDICINE

Conflict of interest: none

residents' review

Beyond Tuohy Needles and Emesis Basins:
A Case for Focused Cardiac Ultrasound Training in Obstetric Anesthesiology

Brian Tolly, M.D. ASA Monitor 02 2017, Vol.81, 62-63.

www.asamonitor.org

Case #1

- 38 yo G2P1,
- 48hrs post D&E
- Fever (Chorioamnitis?)
- **Severe dyspnea**

residents' review

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www.asamonitor.org

Case #1

- SaO_2 88%
- HR 140 bpm
- NIBP ?
- **PANIC** in the room
- OBGYN resident staring at ECG

DD: Sepsis? Occult hemorrhage? PE? Heart failure?

residents' review

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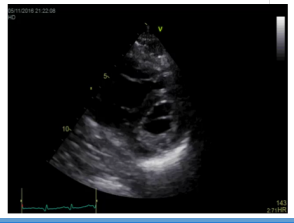

residents' review

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www.asamonitor.org

Case #1

- Stopped fluids
- Transfer SICU (within 30 min)
- iv Enoxaparin
- IR for catheter directed Thrombolysis (within 6hrs)

„Why wasn't it being used more widely in OBA?"

Learning Objectives:

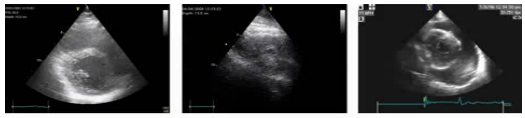
- Definition & Goals oft Focused Cardiac Ultrasound
- Applications of Lung Ultrasound in Obstetric Anesthesiology
- Ocular Sonography in Preeclampsia
- Gastric Ultrasound in the Obstetric Patient

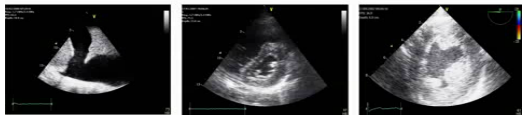
Focused Cardiac Ultrasound (FOCUS)

1. Why is this patient hypotensive?
2. Might this patient benefit from fluid loading?
3. Is major LV-dysfunction responsible for the shock state?

Expert Consensus Statement, ASE 2013
Position Paper, FOCUS, ESC 2014
International EBM-Recommendation, ASE 2014

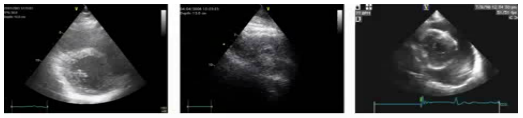
LV failure | Hypovolemia | Tamponade

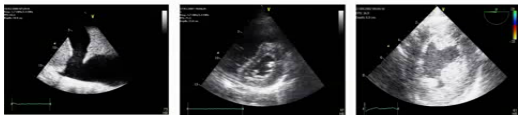




Pleural effusion | Pulmonary embolus | LV hypertrophy

Inotropes | Fluids | Drain





Drain | Embolectomy | ????

Focused Cardiac Ultrasound (FOCUS)

- Rapid
- Bedside
- At Point of Care
- Repeatable

Expert Consensus Statement, ASE 2013
Position Paper, FOCUS, ESC 2014
International EBM-Recommendation, ASE 2014

Focused Cardiac Ultrasound (FOCUS)

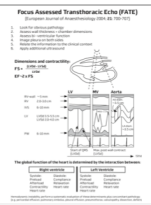
- Rapid
- Bedside
- At Point of Care
- Repeatable

➔ **Targeted diagnostic test (Yes/No)**

Expert Consensus Statement, ASE 2013
Position Paper, FOCUS, ESC 2014
International EBM-Recommendation, ASE 2014

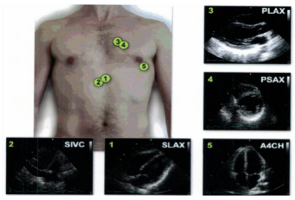
FOCUS Diagnostic Targets:

1. LV-Dimension / systolic function
2. RV-systolic Function
3. Volume Status
4. Pericardial Effusion
5. Gross signs of chronic cardiac Dx
6. Gross valvular Dx



Holm JM, FATE, Anesth.& Analg, 2012; 115,-1029-1032
International EBM-Recommendation, ASE 2014

FOCUS: How is it done ?



Via G; Int. EBM Recommendations on FoCUs; JASE 2014, 27/16: 683

FOCUS: How is it done in OB ?

Anatomic changes in Pregnancy:

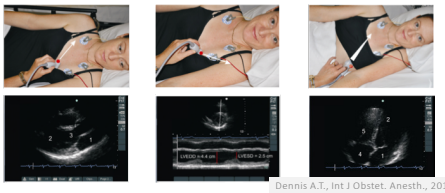
- Anterior and left displacement of the heart
- Elevated diaphragm
- Partial left lateral tilt (LUD)

➔**IDEAL for parasternal and apical views**

Dennis A.T., Int J Obstet. Anesth., 2011; 20,160-158
Dennis A.T. Abstract SOAP, 2010

FOCUS: How is it done in OB ?

„Rapid obstetric screening echocardiography: **ROSE-Scan**"



Dennis A.T., Int J Obstet. Anesth., 2011; 20,160-158
Dennis A.T. PhD Thesis, 2010

Can you do a Focused-Scan?

Novice / Non-cardiologist diagnose hypotension 2/2:

- Systolic dysfunction [1,3,4,5]
- Significant hypovolemia [1,3]
- RV-failure [1]
- Pericardial effusion/Tamponade [1,2]
- Gross valvular pathology [1,4]
- LVH [1,4]

84-95% level of agreement to level II/III specialist

[1]Frederikson, Scand.J. Trauma Resc.&EM,2013, 21:83
[2]Mandavia, Ann Emerg Med 2001; 38:377-83
[3]Mjolstad, Fam Pract 2012: 29: 534-40
[4]Croft Echocardiography 2006:23: 439-46
[5] Razi, JASE 2011; 24: 1319-24

Intensive Care Med (2011) 37:1077–1083
DOI 10.1007/s00134-011-2246-9

EXPERT PANEL

Expert Round Table on Ultrasound in ICU

International expert statement on training standards for critical care ultrasonography

1. Minimum 10hr lectures + image based training
2. ≈ **30 TTEs under supervison** (milestone achievement)
3. Didacted cases / interactive image interpretation
4. Logbook
5. Special Competence in Critical Care Echocardiography Exam (CCEeXAM: www.echoboards.org)

US-guided management of acute breathlesness

Case #2

- 31yo G2P1 @ 36wks
- PMH: moderate to severe Asthma, ASD II
- Previous uncomplicated pregnancy
- Now dyspnea on minimal exertion
- Admitted on L&D with SOB
- Started on duonebs + diuresis

US-guided management of acute breathlesness

Case #2

- Initial improvement of symptoms,
- IOL for PreE and severe features
- Dyspnea + expiratory wheezing with labor
- Oliguria, plasma creatinine ↑
- OB: „**Is this related to hypovolemia** or **worsening PreE?**"
- Fluid bolus?
- Cardiology: Yes
- Pulmonology: No
- CXR ordered

US-guided management of acute breathlesness

Case #2

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- Oliguria, plasma creatinine ↑
- OB: fluid bolus?
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.....and then came Paul.....

Lung-ultrasound as a diagnostic test

Pathology	Sensitivity	Specificity
Interstitial Edema[1]	93%	93%
Alveolar consolidation[2]	90%	98%
Pleural Effusion[3]	94%	97%
Pneumothorax[4]	95%	94%

[1]Lichtenstein, Am J Respir Crit Care Med 1997; 156:1640-1646
[2]Lichtenstein, Intensive Care Med 2004; 30: 276 – 281
[3]Lichtenstein, Intensive Care Med 1999; 25: 955-958
[4]Lichtenstein, Intensive Care Med 2000; 26: 1434-1440

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Lung-US is superior to conventional CXR !

[1]Lichtenstein, Am J Respir Crit Care Med 1997; 156:1640-1646
[2]Lichtenstein, Intensive Care Med 2004; 30: 276 – 281
[3]Lichtenstein, Intensive Care Med 1999; 25: 955-958
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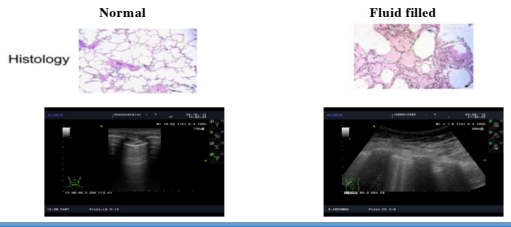
Experimental evidence to Lung ultrasound



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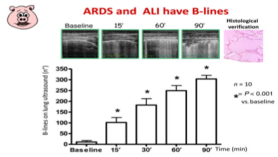
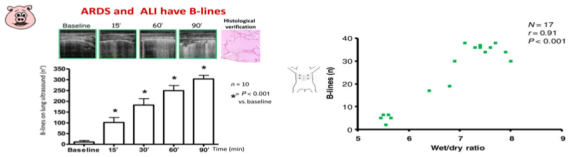


- # B-lines increase with progressing ALI
- Before PaO_2/FiO_2↓

Gargani L., Crit Care Med 2007; 35:2769–2774)

Experimental evidence to Lung ultrasound



- # B-lines increase with progressing ALI
- Before PaO_2/FiO_2↓
- # B-lines correlate with wet-dry ratio

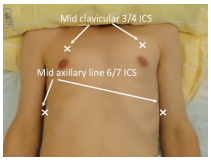
Gargani L., Crit Care Med 2007; 35:2769–2774)

Jambrik S., US in Med. & Biol.,2010, Vol. 36(12), 2004–10,

Lung-US: Short Learning Curve

1 hr training module[1] sufficient to train physicians with/without US-experience to recognize:

- Normal Lungs
- Pulmonary edema
- Pneumothorax



[1]Noble V.E., BMC Medical Education 2009; 9: 3

Lung-US is normal in healthy pregnancy

150 women at 36-38 gest. weeks:

- n=0 Interstitial pulmonary syndrome (B-pattern)
- n=0 alveolar consolidation
- n=0 pleural effusion
- n=0 pneumothorax

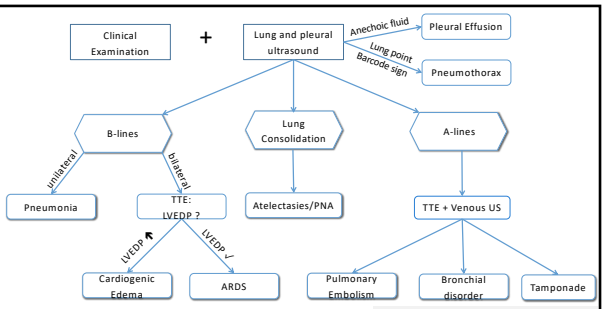
Arbeid E., Gynecol. & Obst. Investigation, 2017; 82: 398-403
Macias P., Abstract SOAP 2019

US-guided management of acute breathlesness

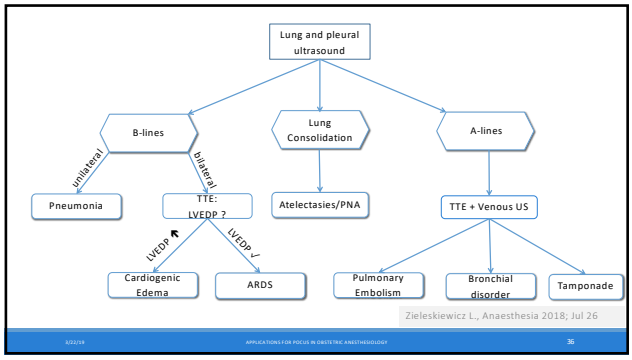
Case #2

- Initial improvement of symptoms,
- Dyspnea + expiratory wheezing with labor
- Oliguria, plasma [illegible]
- OB: fluid bolus?
- Cardiology: Yes
- Pulmonolgy: No
- CXR ordered

.....and then came Paul.....



Zieleskiewicz L., Anaesthesia 2018; Jul 26


Lung and pleural ultrasound
B-lines
Lung Consolidation
A-lines
unilateral
bilateral
Pneumonia
TTE: LVEDP ?
Atelectasies/PNA
TTE + Venous US
LVEDP ↑
LVEDP ↓
Cardiogenic Edema
ARDS
Pulmonary Embolism
Bronchial disorder
Tamponade
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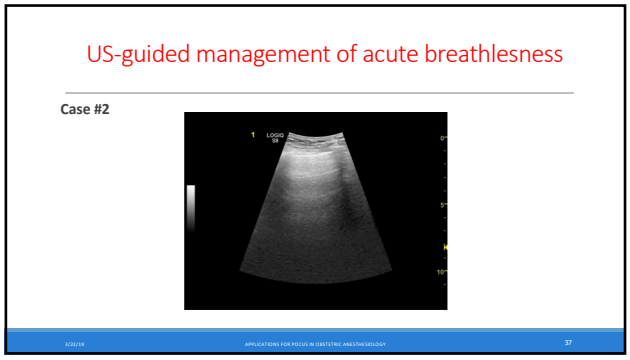
APPLICATIONS FOR FOCUS IN OBSTETRIC ANESTHESIOLOGY
36


US-guided management of acute breathlessness
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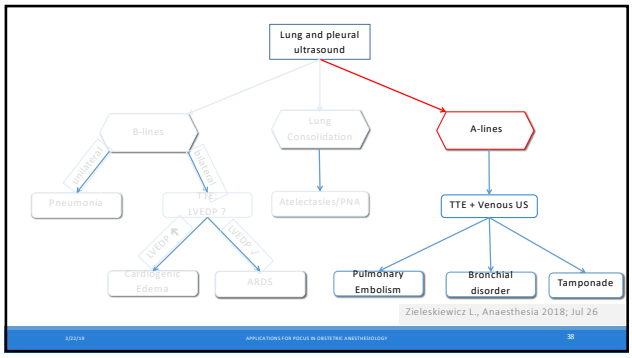
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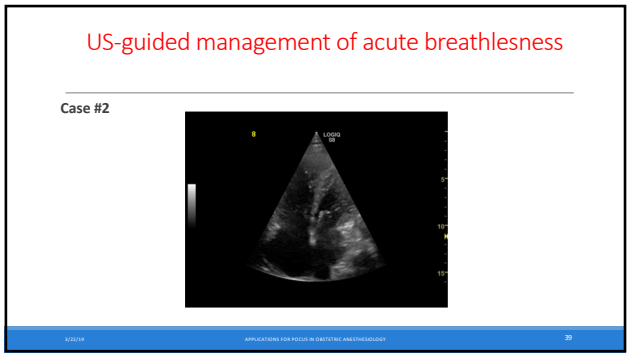
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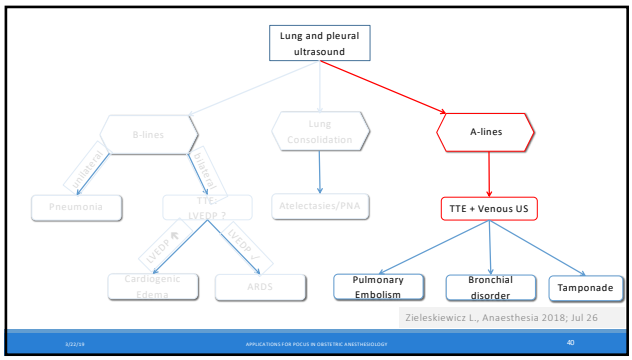
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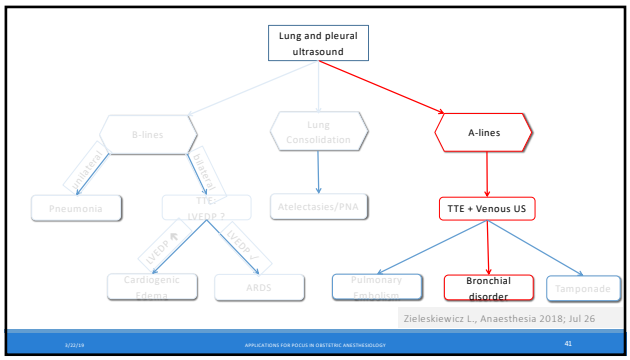
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41

Lung-Ultrasound and Preeclampsia

- 25[1,2] % Interstitial pulmonary syndrome present in severe preeclampsia
- 19[1]-20[2] % raised LVEDP on TTE
- B-pattern on Lung-US is associated with raised LVEDP on TTE[1,2]
- (Sensitivity 80-100 %, Specificity 80-85%)

[1] Zieleskiewicz L., Anesthesiology 2014; 120: 906-14
[2] Ortner CM, Anesth & Analg. 2018; Sept. 10

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➔ **A-pattern on Lung-US excludes raised LVEDP**

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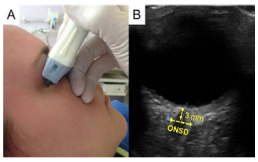
[2] Ortner CM, Anesth & Analg. 2018; Sept. 10

Ocular Sonography in Preeclampsia



Ultrasonographic measurement of the **Optic Nerve Sheath Diameter (ONSD)**

ONSD measurement to detect raised ICP:

- ONSD Cut–off: 4.8 – 5.9 mm [1-3]
- Sensitivity 90% [95 % C.I. (0,80 – 0.95)][1]
- Specificity 85% [95 % C.I. (0.73 – 0.930)][1]
- ROC = 0.938 [(2)]

[1] Dubourg J, Intensive Care Med. (2011) 37: 1059-1068
[2] Robba C, Intensive Care Med. (2018) 44: 1284-1294
[3] Ohle R, J. oft US in Med. (2014) 34: 1285-1294

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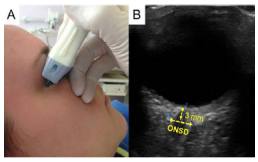

Ultrasonographic measurement of the **Optic Nerve Sheath Diameter (ONSD)**

Incidence of raised ONSD in Preeclampsia: 19-43%

Cut-off: 5.8mm[1]

- [1] Early and late onset dx +/- SF: 5/26 **(19 %)**
- [2] Late onset dx + SF: 28/95 **(27%)**
- [3] Early and late onset dx + SF: 13/30 **(43%)**
- Back to normal (4.5mm) post partum day 4
- ONSD normal in ALL healthy controls

[1] Dubost C, Anesthesiology (2012) 116: 1066-71
[2] Ortner CM, Anesth & Analg. 2018; Sept. 10
[3] Simenc GB, IJOA (2018) 36: 49-55

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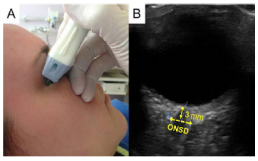

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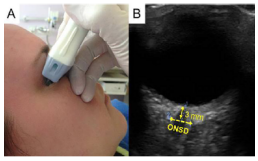

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Ocular Sonography in Preeclampsia

Challenges in Interpretation:

- No correlation with neurologic symptoms (HA, visual disturbances)
- No comparisons to direct or indirect ICP-measurements
- MRI studies in PreE showing focal swelling only (incidence: 0 -14.5 %)[1-3]
- Imaging artefarcts? (Lamina cribrosa or Optic disc edema)[4-6]
- Sign of disease severity?

[1] Morris MC, Obstet. Gynecol (1997), 89(4): 561-8
[2] Matsuda H, J Perinat Med (2005), 33(3): 199-205
[3] Osmanagaoglu MA, Aust J OB Gyn (2005),45(5): 384-90
[4] Blehar DJ, J Ultrasound Med (2008) 27(3): 407-11
[5] Copetti R, Intensive Care Med (2009) 35(8):1488-9
[6] Teisman NA, J Ultrasound Med (2012) 31(1):130-1

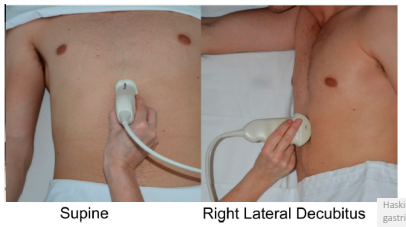
Gastric Ultrasound in Obstetrics

Case #3

- 34yo G3P2 @ 37wks, ho CDx1 (failed spinal)
- PMH: healthy, BMI 38, Scoliosis
- Pregnancy complicated by ITP (Plts 70 G/l)
- Now contracting q 10-15min, Cervix @ 3cm
- OBGYN wants to proceed
- Coffee+cream and Cornflakes 5-1/2hrs ago

➔ **Wait?** Proceed? How?

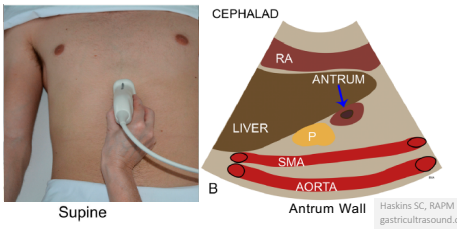
Gastric Ultrasound



Supine Right Lateral Decubitus

Haskins SC, RAPM 2018,(43):1-10
gastricultrasound.org

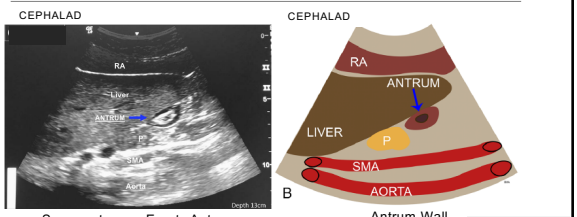
Gastric Ultrasound



Supine Antrum Wall

Haskins SC, RAPM 2018,(43):1-10
gastricultrasound.org

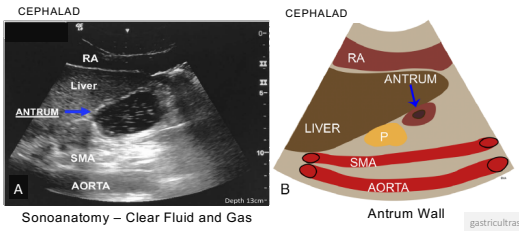
Gastric Ultrasound



Sonoanatomy – Empty Antrum Antrum Wall

gastricultrasound.org

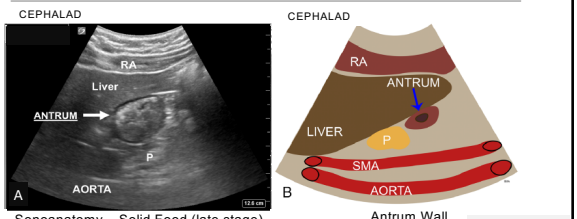
Gastric Ultrasound



Sonoanatomy – Clear Fluid and Gas Antrum Wall

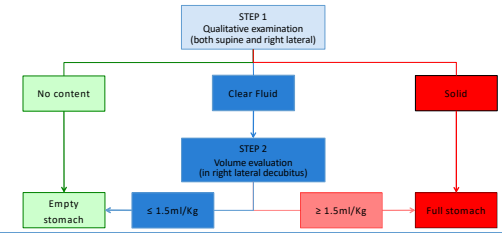
gastricultrasound.org

Gastric Ultrasound



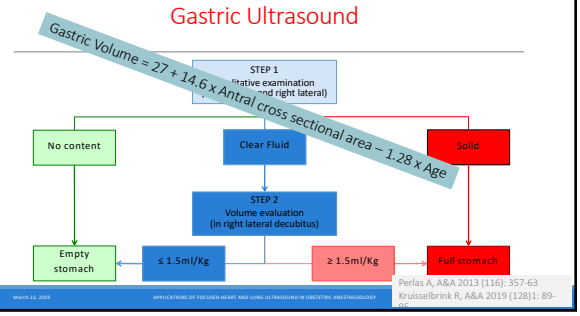
gastricultrasound.org

Gastric Ultrasound

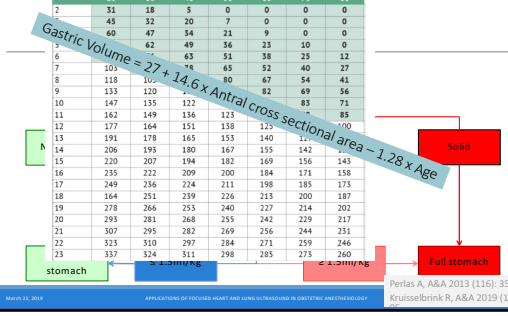


Kruisselbrink R, A&A 2019 (128)1: 89-

Gastric Ultrasound



Perlas A, A&A 2013 (116): 357-63
Kruisselbrink R, A&A 2019 (128)1: 89-



Right lat CSA	Age(y) 20	30	40	50	60	70	80
2	31	18	5	0	0	0	0
	45	32	20	7	0	0	0
	60	47	34	21	9	0	0
5		62	49	36	23	10	0
6			63	51	38	25	12
7	103			65	52	40	27
8	118	10		80	67	54	41
9	133	120			82	69	56
10	147	135	122			83	71
11	162	149	136	123			85
12	177	164	151	138	125		100
13	191	178	165	153	140	127	
14	206	193	180	167	155	142	
15	220	207	194	182	169	156	143
16	235	222	209	200	184	171	158
17	249	236	224	211	198	185	173
18	164	251	239	226	213	200	187
19	278	266	253	240	227	214	202
20	293	281	268	255	242	229	217
21	307	295	282	269	256	244	231
22	323	310	297	284	271	259	246
23	337	324	311	298	285	273	260

Perlas A, A&A 2013 (116): 357-63
Kruisselbrink R, A&A 2019 (128)1: 89-

Gastric Ultrasound in Obstetrics

- Gastric ultrasound more challenging, but feasible (83-96%) [1-3]
- Right lateral (RL) positioning not well tolerated [4]
- Gastric emptying in obstetric women may be delayed (light meals) [2,5]
- Traditional Gastric Volume formula not validated in obstetric population
- Variety of antral area cut-offs (SR, RL-position) to predict 1.5ml/kg (large 95% C.I.) [1,3,7]

[1] Arzola C, BJA 2014; (113):1018-23
[2] Barboni E, Minerva A. 2016; (82): 543-9
[3] Zieleskiewicz L, BJA 2016; (117) 2: 198-205
[4] Desgranges FP, IJOA 2018; (35): 116-117
[5] Hakak S, IJOA 2018; (34): 15-20
[6] Bouvet L, Anesthesiology 2012 (114):1086-92
[7] Roukhomovsky M, EJA 2019 (35): 379-389

Gastric Ultrasound in Obstetrics

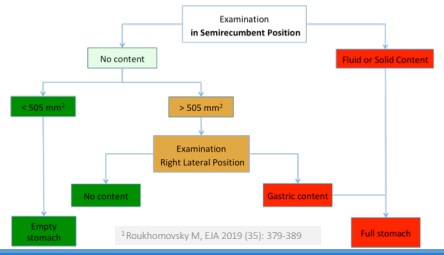
Validation Study in Obstetric Women:

- N = 34 women, third trimester
- Gastric volume measured in MRI and compared to Gastric-US
- Composite scale using 505mm^2 antral CSA in semirecumbent position to predict 1.5ml/kg

Sensitivity: 89% (95% CI: 51-99) **Specificity: 87% (95% CI: 59-98)**
NPV: 93% (95% CI: 64-99) **PPV: 80% (95% CI: 44-96)**

[1] Roukhomovsky M, EJA 2019 (35): 379-389

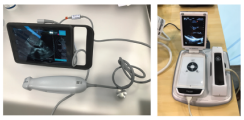
Gastric Ultrasound in Obstetrics



[1] Roukhomovsky M, EJA 2019 (35): 379-389

The Future of POCUS

- 1 transducer = function of 13 piezzo electric probes!
- Costs go down (2000 $?/ Transducer)
- Artificial intelligence for imaging acquisition
- Images interpreted via telemedicine



Conclusion: Consensus Statement

„...the **use of FOCUS** for the evaluation of hemodynamic instability of uncertain or suspected cardiac ethiology meets **Class I recommendation** according to American and European Guidelines..."

Frankel H.L., „Guidelines for appropriate use of Cardiac Ultrasonography", Critical Care Medicine, 2016, 44/6: 1206-26

SOAP Society for Obstetric Anesthesia and Perinatology

UNM SCHOOL of MEDICINE

Neuraxial Ultrasound: Practical Guide to Adoption

Katherine M Seligman, MD
Assistant Professor, University of New Mexico

Disclosures

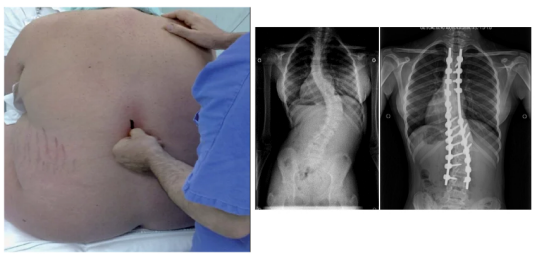
- No Financial Disclosures
- Researched/Published on Rivanna-Accuro

Content Outline

- Benefits of Neuraxial Ultrasound
- Machine Types & Equipment
- Neuraxial Anatomy
- Scanning Technique
- How to implement

Content Outline

- **Benefits of Neuraxial Ultrasound**
- Machine Types & Equipment
- Neuraxial Anatomy
- Scanning Technique
- How to implement



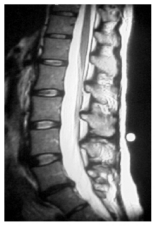
Benefits of Neuraxial Ultrasound

- Midline Identification
- Accurate identification of lumbar interspaces
- Increased success rates
- Identification of angle of entry
- Accurate estimation of depth to epidural space
- Decreased time to access neuraxial space

Ability of anaesthetists to identify a marked lumbar interspace

C. R. Broadbent,[1] W. B. Maxwell,[1] R. Ferrie,[1] D. J. Wilson,[2] M. Gawne-Cain[3] and R. Russell[4]

- 100 Patients, level assessed in flexed lateral & sitting position
- MRI assessed where the marker was placed
- Experienced providers appropriately identified the correct interspace by palpation alone 29% of the time
- In 51% of cases, marker was one or more levels higher than predicted



Ultrasound Assessment of the Vertebral Level of the Intercristal Line in Pregnancy

Allison J. Lee, MD,* J. Sudharma Ranasinghe, MD,* Jules Marie Chehade, MD,* Kris Arheart, EdD,† Bruce S. Saltzman, MD,* Donald H. Penning, MD, MS, FRCP,* and David J. Birnbach, MD, MPH*

- 51 term pregnant patients
  - 2 experience anesthesiologists palpated "intercristal line"
  - 3rd anesthesiologist ultrasound for vertebral level
- Only 14% agreement between palpation & ultrasound
- Palpation One level higher than estimate - 23%
- Palpation more than one level higher- 25%

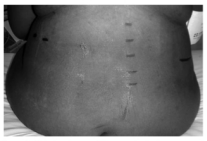


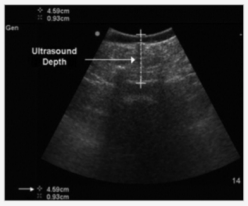
Figure 4. Clinical estimates of iliac crest level, when uncovered, shown to be at the L2 vertebral level in this patient. The iliac crest level by ultrasound was found to be at L3-4.

Obstetric Anesthesia: Research Report

Ultrasound Using the Transverse Approach to the Lumbar Spine Provides Reliable Landmarks for Labor Epidurals

Arzola, Cristian MD; Davies, Sharon MD; Rofaeel, Ayman MD; Carvalho, Jose C. A. MD, PhD Author Information
Section Editor(s): Bimbach, David J.

- 61 pregnant patients enrolled
- Curved Array probe identified midline, intervertebral space & estimate depth (UD) to epidural space
- Needle depth (ND) at loss of resistance was recorded
- Results
  - UD estimate within mean 0.68cm
  - 91.8% success at ultrasound identified insertion point
  - 1st pass success rate 73.8% (no redirects)



J Clin Monit Comput (2015) 29:573–577
DOI 10.1007/s10877-014-9634-y

ORIGINAL RESEARCH

Pre-puncture ultrasound guided epidural insertion before vaginal delivery

Mahmoud Nassar · Ibrahim A. Abdelazim

- 110 Randomized to Palpation vs. Ultrasound before CSE
- 67.27% 1st pass success in Ultrasound vs. 40% Palpation
- Ultrasound Group
  - Decreased Punctures/Attempts (1.2 vs. 2.3)
  - Decreased Redirects (1.4 vs. 2.8)
- Palpation Group
  - 2 accidental dural punctures in palpation
- Mean time to identify puncture site longer in ultrasound group (9.1min vs. 6.2min)

SPECIAL ARTICLE

Lumbar Neuraxial Ultrasound for Spinal and Epidural Anesthesia
A Systematic Review and Meta-Analysis

Anahi Perlas, MD, FRCPC,† Luis E. Chaparro, MD,‡ and Ki Jinn Chin, MD, FRCPC*†*

- Systemic Review including 31 studies
- Ultrasound depth estimates to epidural space correlate well with needle depth
- Ultrasound resulted in increased success and ease of performance
  - Pooled data showed a 79% reduction in the risk of failed lumbar puncture
- Neuraxial ultrasound reduced risk of traumatic procedure

Ultrasound Imaging Facilitates Spinal Anesthesia in Adults with Difficult Surface Anatomic Landmarks

Ki Jinn Chin, F.R.C.P.C.,* Anahi Perlas, F.R.C.P.C.,† Vincent Chan, F.R.C.P.C.,‡ Danielle Brown-Shreves, M.B.B.S.,§ Arkadiy Koshkin, M.D.,§ Vandana Vaishnav, F.C.A.R.C.S.I.‖

- 120 Ortho pts. undergoing spinal anesthesia
  - BMI > 35 and poorly palpable spinous process
  - Previous Spine surgery
  - Severe lumbar scoliosis
- Results
  - First attempt success 65% in US vs. 32% in palpation
  - Significantly decreased # of needle insertions
  - Significantly decreased # of needle passes

Content Outline

- Benefits of Neuraxial Ultrasound
- **Machine Types & Equipment**
- Neuraxial Anatomy
- Scanning Technique
- How to implement

Equipment Needed

- Ultrasound (Portable or Consul)
- Curvilinear Probe
- Ultrasound Gel
- Marking Pen

Ultrasound Equipment

- Traditional Consul
- Low Frequency (2-5MHz) Curved Probe

Portable Ultrasound

Accuro

Lumify

Clarius

Butterfly IQ

Content Outline

- Benefits of Neuraxial Ultrasound
- Machine Types & Equipment
- **Neuraxial Anatomy**
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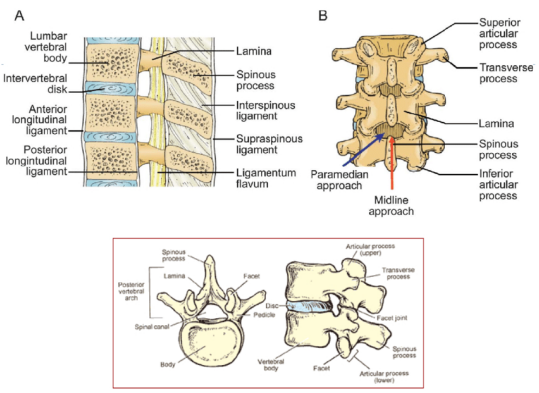
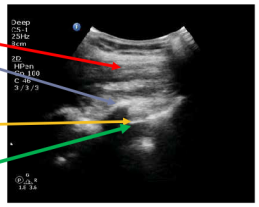


Ultrasound Anatomy

- What can you see on ultrasound
  - Soft Tissue
  - Bone – Bright white with dropout
  - Ligament – Bright white
  - Dura- Moderate white signal



Content Outline

- Benefits of Neuraxial Ultrasound
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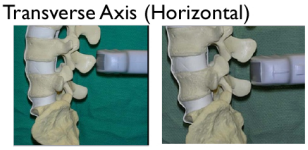
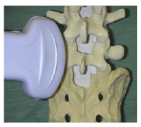
Pre-Procedural Scanning

- Transverse Axis (Horizontal)

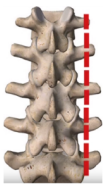


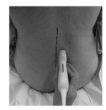
- Sagital Axis (Longitudinal)

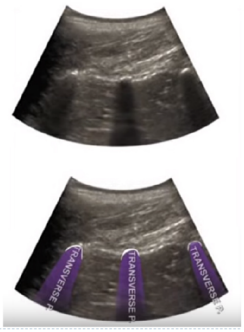


http://pie.med.utoronto.ca/OBAnesthesia/OBAnesthesia_content/OBA_spinalUltrasound_module.html

Sagittal Plane- Transverse Process

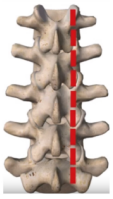


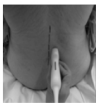


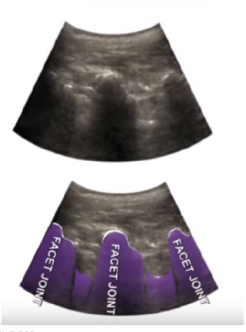


Escolar VR. Lumbar Spine Sonoanatomy - https://www.youtube.com/watch?v=JgBbsPV5QDc

Sagittal Plane – Facet Joint

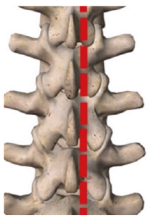


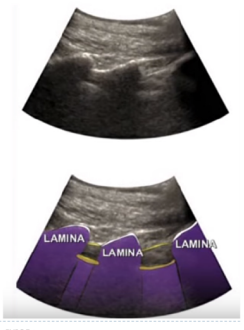




Escolar VR. Lumbar Spine Sonoanatomy - https://www.youtube.com/watch?v=JgBbsPV5QDc

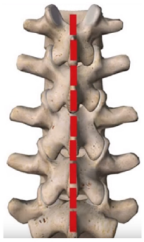
Sagittal Plane- Lamina

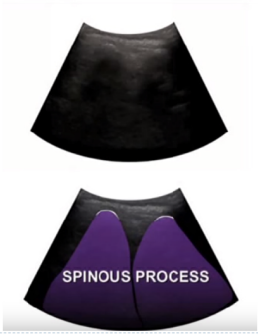




Escolar VR. Lumbar Spine Sonoanatomy - https://www.youtube.com/watch?v=JgBbsPV5QDc

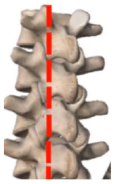
Sagittal Plane – Spinous Process

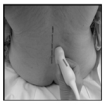


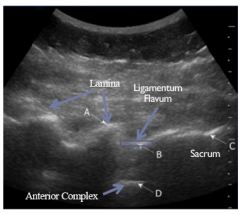


- Escolar VR. Lumbar Spine Sonoanatomy - https://www.youtube.com/watch?v=JgBbsPV5QDc

Parasagittal Oblique







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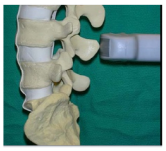
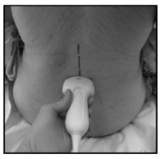
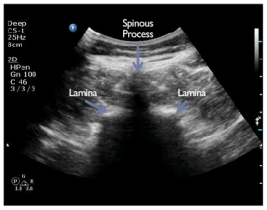
Transverse Midline – Spinous Process

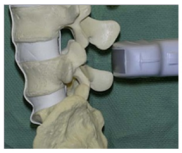


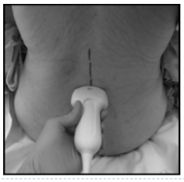


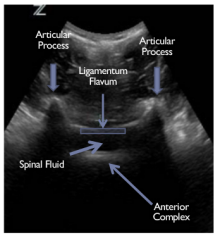


- http://pie.med.utoronto.ca/OBAnesthesia/OBAnesthesia_content/OBA_spinalUltrasound_module.html

Transverse Midline - Interlaminar

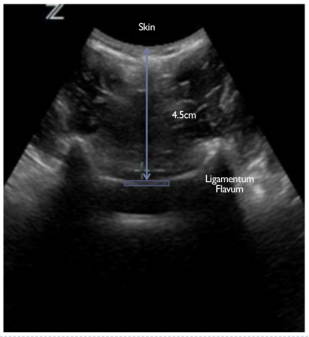






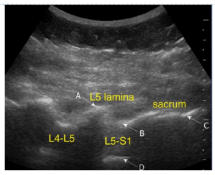
- http://pie.med.utoronto.ca/OBAnesthesia/OBAnesthesia_content/OBA_spinalUltrasound_module.html

Transverse Midline- Epidural Depth

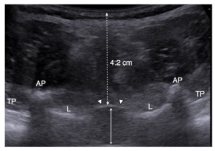


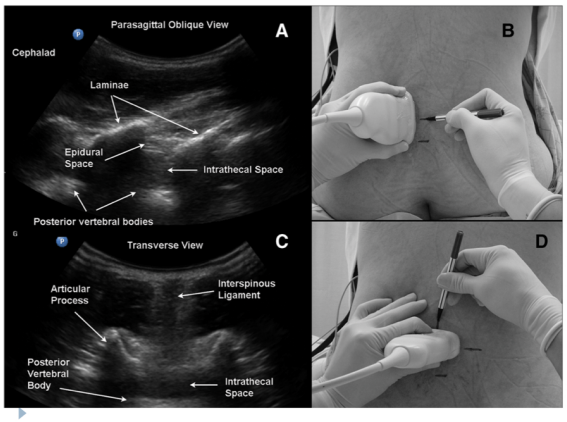
Scanning Steps

- Parasagital Oblique
  - Start at Sacrum & Scan Up to Identify Interspace
  - Identify & Mark: L3/4, L4/5, L5/S1



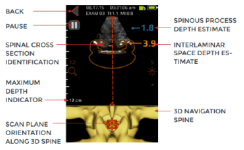
- Transverse Midline
  - Identify Midline Interlaminar View
    - Adjust probe for correct angle and rotation
    - Mark Midline
  - Estimate Depth to Epidural Space



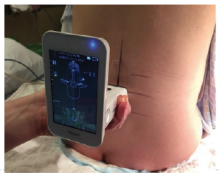


Novell Handheld Ultrasound

- Accuro
  - Automated Bony landmark identification
  - Automated estimated Depth to epidural space
  - Small & Portable



- Decreased time to spinal placement compared to landmark technique (Powlovich et al.)
- Estimated depth to Epidural space within 6.6mm (Seligman et al)



Practical Application

- Learning curve can be steep
  - Scan normal to familiarize yourself to anatomy
  - Practice without time pressure
- Use what you have
  - Curvilinear probe
  - Marking Pen
  - Ultrasound Gel
- Handheld Ultrasounds are portable & convenient

Thank You

- Email:
  - kseligman@salud.unm.edu

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The 2019 Sam Hughes Lecture: Obstetric Anesthesia Year in Review

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Disclosures

- **Research Support**
  - Pacira Pharmaceuticals, Inc
  - BioQ Pharma
  - Haylard Health
  - Trevena, Inc
- **Advisory Board**
  - Trevena, Inc
  - Health Decisions

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Literature Search

- **Table of contents of major journals**
  - Obstetric anesthesia
  - Obstetrics
  - Perinatology
  - Health services research
- **Search engines**
- **Media sources**

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Subject

First Author. Journal year; volume: pages

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- Maternal Mortality
- Maternal Morbidity
- Cesarean Delivery & Postpartum Pain
- Labor Analgesia
- Global Health

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Maternal Mortality in the USA

2011-2013

- **Observational Study**
  - CDC Pregnancy Mortality Surveillance System
- 2,009 pregnancy related deaths (death of a woman while pregnant or within 1 year of pregnancy termination)
- **Pregnancy Related Mortality Ratio**
  - 17:100,000 live births

Creanga AA. Obstet Gynecol 2017;130:366-373

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Maternal Mortality in the USA
2011-2013

- **Age**
  - 30% of pregnancy related deaths among women ≥ 35 years old
- **Race**
  - Non-Hispanic black women had 3.4 times higher risk of death than non-Hispanic white women
- **Obesity**
  - 1:6 women who died were obese

Creanga AA. Obstet Gynecol 2017;130:366-373

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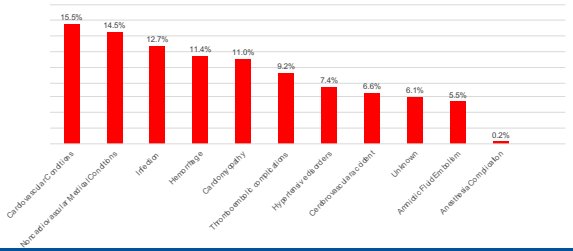
Maternal Mortality in the USA 2011-2013
Causes of Pregnancy Related Deaths



Creanga AA. Obstet Gynecol 2017;130:366-373

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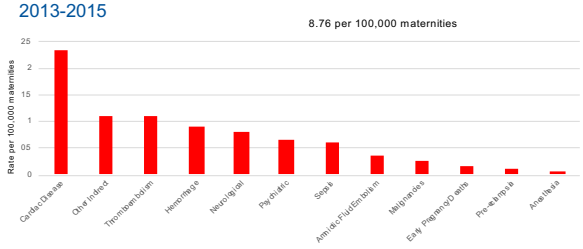
Maternal Mortality in the UK
2013-2015



Knight M. Saving Lives, Improving Mother's Care 2017

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Maternal Cardiovascular Mortality in Illinois
2002-2011

- **Retrospective Study**
  - Pregnancy related deaths in Illinois from 2002 to 2011
  - 140/636 (22.2%) died of cardiovascular causes (8.2:100,000 live births)
- **Aims**
  - Estimate the role of specific CV diseases, examine demographics and estimate preventable mortality

Briller J. Obstet Gynecol 2017;129:819-826

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Maternal Cardiovascular Mortality in Illinois
Causes

Cause of Death	Number (%)
Cardiomyopathy	39 (27.9%)
Stroke	32 (22.9%)
Hypertension	18 (12.9%)
Arrhythmias	15 (10.7%)
Coronary Artery Disease	13 (9.3%)
Valvular Heart Disease	6 (4.3%)
Aortic Dissection	4 (2.9%)
Congenital Heart Disease	4 (2.9%)

Briller J. Obstet Gynecol 2017;129:819-826

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Maternal Cardiovascular Mortality in Illinois
Demographics, Timing & Preventability

- **Age** (vs. 20-29 years old)
  - 30-39 years old: RR 1.67
  - > 40 years old: RR 3.78
- **Time of Death**
  - Antepartum: 13.2%
  - 0-6 days: 29.4%
  - 7-42 days: 21.1%
  - 43-365 days: 34.6%
- **28.1% Preventable**
  - **Patient Factors**
    - Non-compliance
    - Smoking
    - Obesity
  - **Healthcare Provider Factors**
    - Incomplete/delayed treatment
    - No referral

Briller J. Obstet Gynecol 2017;129:819-826

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- Maternal Mortality
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Maternal Morbidity

- Cardiovascular disease
- Hemorrhage
- Pre-eclampsia
- Cardiac arrest

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Bromocriptine for Peripartum Cardiomyopathy

RCT

- **Background**
  - ***Pathophysiology:*** High levels of prolactin and the production of a cleaved 16kDa N-terminal fragment of prolactin
- **RCT** (n = 63)
  - Short-term (1 week, 2.5 mg, 7 days) or long-term (8 weeks: 5 mg for 2 weeks followed by 2.5 mg for 6 weeks) + standard heart failure therapy
- **Primary Outcome:** LVEF change from baseline to 6 months

Hilfiker-Kleiner D. Eur Heart J 2017;38:2671-2679

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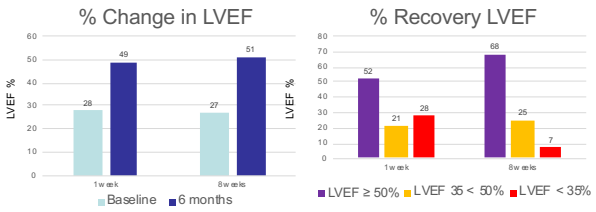
Bromocriptine for Peripartum Cardiomyopathy

Results



Hilfiker-Kleiner D. Eur Heart J 2017;38:2671-2679

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Maternal Morbidity

- Cardiovascular disease
- Hemorrhage
- Pre-eclampsia
- Cardiac arrest

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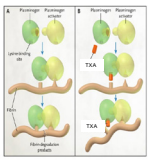
Tranexamic Acid for Postpartum Hemorrhage

What we know

- Tranexamic acid (TXA) reduces surgical blood loss
- **CRASH-2 Trial:** TXA reduced death due to bleeding (early treatment within 3 h)
- In 2012, WHO recommended TXA for PPH



Ker k. BMJ 2012;344:e3054
CRASH-2 Collaborators. Lancet 2010;376:23–32

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Tranexamic Acid for Postpartum Hemorrhage
The WOMAN Trial - Design

- **RCT (n = 20,021, 193 hospitals, 21 countries)**
  - Women with PPH received 1 gram TXA or placebo
  - Second dose: bleeding continued after 30 min or restarted within 24 h
- **Primary Outcome:** Death from all causes or hysterectomy within 42 days of randomization
- **Sample Size:** 15,000 → 20,000

WOMAN Trial Collaborators. Lancet 2017;389:2105-2116

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Tranexamic Acid for Postpartum Hemorrhage
The WOMAN Trial - Results

	TXA (n = 10,036)	Placebo (n = 9,985)	RR (95% CI)	P value
Death or Hysterectomy	534 (5.3%)	546 (5.6%)	0.97 (0.87, 1.09)	0.65
Death due to Bleeding	**155 (1.5%)**	**191 (1.9%)**	**0.81 (0.65, 1.00)**	**0.045**

- **Death due to bleeding by time since delivery**
  - < 3 hrs: RR (95% CI) = 0.69 (0.53, 0.90)
  - > 3 hrs: RR (95 % CI) = 1.07 (0.76, 1.51)
- Reduction in laparotomy due to bleeding (0.8% vs. 1.3%, p = 0.002)
- No difference in thrombo-embolic events (0.3% both groups)

WOMAN Trial Collaborators. Lancet 2017;389:2105-2116

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ROTEM Guided Fibrinogen Concentrate for PPH
OBS2 Study - Design

- **Background**
  - Fibrinogen higher in pregnancy, low fibrinogen associated with massive PPH
- **RCT (n = 55)**
  - PPH 1000-1500 ml, Fibtem A5 ≤ 15 mm
  - Fibrinogen concentrate or placebo (target Fibtem A5 > 22 mm)
- **Primary Endpoint**: Number of allogeneic blood products

Collins PW. Br J Anaesth 2017;119:411-421

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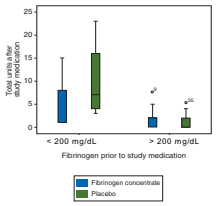
ROTEM Guided Fibrinogen Concentrate for PPH
OBS2 Study - Results

	Fibrinogen Concentrate (n = 28)	Placebo (n = 27)	Adjusted Incidence Rate Ratio (95% CI)
Allogeneic Blood Products units	**58**	**75**	**0.72 (0.30, 1.70)**
RBC units	37	38	0.53 (0.13, 2.16)



Collins PW. Br J Anaesth 2017;119:411-421

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Safety Bundles and Hemorrhage Morbidity
State Quality Collaborative

- **Background**
  - The California Maternal Quality Care Collaborative (CMQCC)
    - Developed obstetric hemorrhage tool kit
    - Established the California Partnership for Maternal Safety Collaborative
- **Quality Improvement, Before-After Model**
  - Baseline (01/2011-12/2014), Post-intervention (10/2015-03/2016)
- **Primary Outcome:** Severe maternal morbidity in patients with obstetric hemorrhage

Main EK. Am J Obstet Gynecol 2017;216:298.e1-298.e11

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Safety Bundles and Hemorrhage Morbidity
State Quality Collaborative

	N	BEFORE morbidity/100 cases	AFTER morbidity/100 cases	Reduction in Morbidity
Hospitals in CMQCC CPMS (256,541 annual births)	99	22.7	18.0	20.8%
Hospitals not in collaborative (81,089 annual births)	48	28.6	28.1	1.2%

- All hospital types improved at similar rates

Main EK. Am J Obstet Gynecol 2017;216:298.e1-298.e11

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Maternal Morbidity

- Cardiovascular disease
- Hemorrhage
- Pre-eclampsia
- Cardiac arrest

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Association between OSA and Pre-eclampsia

What we know

- **OSA is a risk factor for hypertensive disorders of pregnancy (HDP) and gestational diabetes (GDM)**
  - Cross-sectional and retrospective studies
    - Self reported symptoms
    - Inadequate adjustment for BMI
  - Small prospective observational cohorts
    - Conflicting results
- **OSA could be a modifiable risk factor**

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Association between OSA and Pre-eclampsia

Study Design

- **Prospective Cohort Study** (n = 3705)
  - Nulliparous women enrolled at 6-13 6/7 weeks
  - Level 3 Home Sleep Test at 6-15 weeks and 22-31 weeks (results blinded)
- **Primary Outcome:** Pre-eclampsia (PE)
- **Secondary Outcomes:** HDP and GDM

Facco FL. Obstet Gynecol 2017;129:31-41

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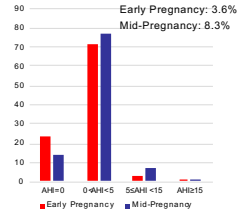
Association between OSA and Pre-eclampsia

Results



- **HDP: 13.1% (PE: 6%), GDM: 4.1%**

	Early Pregnancy aOR (95% CI)	Mid-pregnancy aOR (95% CI)
Pre-eclampsia	**1.94 (1.07, 3.51)**	**1.95 (1.18, 3.23)**
HDP	1.46 (0.91, 2.32)	1.73 (1.19, 2.52)
GDM	3.47 (1.95, 6.19)	2.79 (1.63, 4.77)

OR adjusted for age, BMI, chronic hypertension and gestational weight gain

Facco FL. Obstet Gynecol 2017;129:31-41

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Bundle on Severe Hypertension

Pregnancy and Postpartum

Readiness (Every Unit)	• Diagnostic criteria/monitoring/Escalation • Education/ access to medications/ triaging
Recognition and Prevention (Every Patient)	• Protocols for BP and urine protein assessment • Response to EWS/ patient education
Response (Every case)	• Standard protocols/checklists/escalation policies • Support plan for serious complications
Reporting and Systems Learning (Every Unit)	• Culture of huddles/Debriefs • Multidisciplinary reviews

Bernstein PS. Anesth Analg 2017;125:540-7, Obstet Gynecol 2017;130:347-357. *J Midwifery Womens Health* 2017:62:493-501. *J Obstet Gynecol Neonatal Nurs* 2017:302843

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Maternal Morbidity

- Cardiovascular disease
- Hemorrhage
- Pre-eclampsia
- Cardiac arrest

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Cardiac Arrest in Pregnancy (CAPS) Study
Incidence and Outcomes (2011-2014)

- **Prospective Descriptive Study**
  - Cardiac arrest and perimortem cesarean delivery (PMCD)
- 66 cardiac arrests (2011-2014): 1:36,000 during pregnancy
- **Survival:** Mothers: 58%, babies: 71%
- **Median (range) time to PMCD (n = 49)**
  - Survived [median (IQR)]: 3 (0-39) vs. died: 12 (0-67) min, p=0.01

Beckett VA. BJOG 2017;124:1374-1381

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Cardiac Arrest in Pregnancy (CAPS) Study
Causes

	Survived (n = 37)	Died (n = 22)
Anesthetic cause	17	0
AFE	5	9
Hypovolemia	5	8
Thromboembolic	1	10
Hypoxia	4	0
Cardiac cause	5	1
Vessel bleed/rupture	0	6
Intracerebral bleed	0	3
Other	2	5
Aortic dissection	0	2
Cardiomyopathy	0	2

- **Anesthetic Causes**
  - **12/17 obese**
    - Intubation problems (3)
    - CVS collapse post epidural top up (3)
    - Total spinal after de novo spinal (10)
    - Other causes (1)

Beckett VA. BJOG 2017;124:1374-1381

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- Maternal Mortality
- Maternal Morbidity
- **Cesarean Delivery & Postpartum Pain**
- **Labor Analgesia**
- **Global Health**

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Opioid Prescription and Use after Cesarean

- Leftover opioid could be diverted, abused or accidentally ingested
- Little information on patterns of opioid prescription and use after cesarean delivery
- Sparse data on pain resolution and functional recovery

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Recovery after Nulliparous Birth
Analgesia and Functional Recovery

- **Prospective Observational Study** (n = 213)
  - Nulliparous women attempting vaginal delivery
- **Primary Outcome**
  - Time to pain- and opioid-free functional recovery
    - Functional recovery to pre-delivery level
    - First of 5 days of no pain
    - First of 5 days of no opioid use

Komatsu R. Anesthesiology 2017;127:684-694

Duke Anesthesiology

Recovery after Nulliparous Birth
Analgesia and Functional Recovery

- 3,343 daily calls attempted (48% success rate), 134/213 completed the study
- **Opioid Use:** 31% (Vaginal Delivery), 91% (Cesarean Delivery)

	Vaginal Delivery (n = 99)	Cesarean Delivery (n = 35)	P value
Time to pain and opioid-free functional recovery	**19 (3-77)**	**27 (10-85)**	**0.0003**
Time to opioid cessation	0 (0-14)	9 (0-39)	< 0.0001

Data are median (range)

Komatsu R. Anesthesiology 2017;127:684-694

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Opioid Prescription and Use after Cesarean
Survey

- **Phone Survey (n = 720):** 2 weeks after CD at 6 academic centers
- 85.4% filled opioid prescription (higher pain scores)
- Median dispensed: 40, consumed: 20 tablets, 95.3% did not dispose of opioids

Pills Dispensed	Pills Consumed [Median (IQR)]	Satisfied/ Very Satisfied	Pain Scores [Median (IQR)]	Need for Refills	Side Effects
≤ 30	15 (5-24)	84%	4 (3-5)	5.9%	47%
31-40	20 (10-32)	84%	4 (2-5)	5.0%	62%
≥ 40	32 (14-50)	81%	4 (2-5)	5.8%	71%

Bateman BT. Obstet Gynecol 2017;130:29-35

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Opioid Prescription and Use after Cesarean
Survey

- **Survey (n = 179)**
  - Phone or email survey on day 1 and 2 weeks after discharge following CD
- 83% used opioids, median dispensed 30 (8-84), median use 8 days
- 75% had unused tablets, median 10 tablets, 93% did not dispose of opioids

	Top Opioid Quartile (n = 44)	Average Opioid Quartile (n = 135)	RR/OR (99% CI)
Public Insurance	66%	46%	1.45 (1.09, 1.92)
Smoking	18%	5%	3.51 (1.35, 9.12)
In hospital median morphine mg equivalents/h	1.6 mg	1 mg	2.59 (1.61, 4.17)

Osmundson SS. Obstet Gynecol 2017;130:36-41

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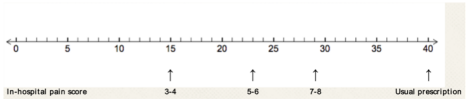
Opioid Prescription and Use after Cesarean
Shared Decision Making

- **Shared Decision Making Session (n = 50)**
  - Anticipated patterns of pain
  - Expected outpatient opioid use
  - Risks and benefits of analgesics
  - How to dispose and refill opioids



Prabhu M. Obstet Gynecol 2017;130:42-46

Duke Anesthesiology

Opioid Prescription and Use after Cesarean
Shared Decision Making

Outcome	Median or %
Oxycodone tablets chosen	**20**
Oxycodone tablets used	15
Need for refills	8%
Plan to dispose of opioids	67%
Satisfied or very satisfied	90%

Prabhu M. Obstet Gynecol 2017;130:42-46

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Patient Choice for Intrathecal Morphine Dose
Does it Reflect Opioid Consumption?

- **Background**
  - Significant inter-individual in pain and preferences
  - One size fits all approach
- **RCT (n = 120)**
  - Randomized to perceived choice or no choice
  - All randomized to 100 or 200 µg intrathecal morphine
- **Primary Aim:** Is patient's choice for intrathecal morphine dose reflective of pain and postoperative opioid analgesic use?

Carvalho B. Br J Anaesth 2017;118:762-771

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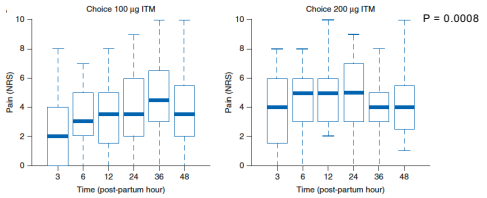
Patient Choice for Intrathecal Morphine Dose
Does it Reflect Opioid Consumption?



Median opioid consumption: 16 mg
Need for rescue antiemetics: 20%

Median opioid consumption: 25 mg
Need for rescue antiemetics: 9%

Carvalho B. Br J Anaesth 2017;118:762-771

Duke Anesthesiology

Left Lateral Tilt for Elective Cesarean Delivery

Effect on Neonatal Acid-Base Status

- **Background**
  - Earlier studies suggested better neonatal clinical and acid base status with left lateral tilt
  - Improved BP control with phenylephrine infusion and fluid co-load
- **RCT (n = 100)**
  - 15 degrees left table tilt or horizontal position, BMI ≤ 40 kg/m^2
- **Primary Outcome:** Umbilical artery base excess

Lee A. Anesthesiology 2017;127:241-249

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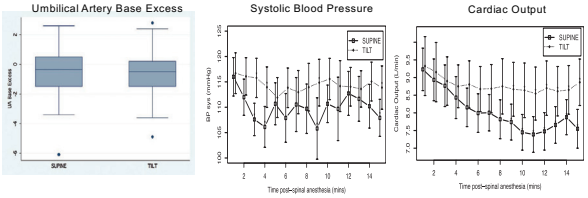
Left Lateral Tilt for Elective Cesarean Delivery

Effect on Neonatal Acid-Base Status



- ? Generalizability to obesity, non-reassuring fetal heart tones, emergency CD, utero-placental insufficiency

Lee A. Anesthesiology 2017;127:241-249

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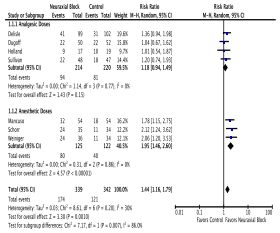
Spinal Bupivacaine Dose and Success of ECV

What we know

- **Neuraxial Techniques**
  - Increase ECV success (58% vs. 43%)
  - Lower CD rate (46% vs. 55%)



Lee HC. Am J Obstet Gynecol 2008;199:e1–8, Lavoie A. Can J Anesth 2010;57:408–14
Magro-Malosso ER. Am J Obstet Gynecol 2016;215:276–86

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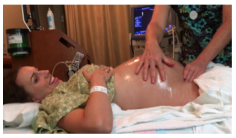
Spinal Bupivacaine Dose and Success of ECV

RCT

- **RCT (n = 239)**
  - CSE with 4 doses of isobaric bupivacaine (2.5, 5, 7.5 and 10 mg) + fentanyl 15 µg
  - Patient, obstetrician, research nurse blinded
- **Primary Outcome:** ECV success

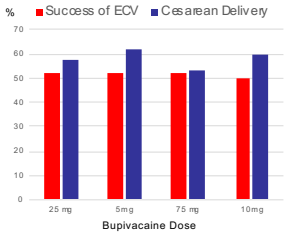


Chalifoux LA. Anesthesiology 2017;127:625-632

Duke Anesthesiology

Spinal Bupivacaine Dose and Success of ECV

Results



- Higher sensory level with 7.5 and 10 mg
- More hypotension with 5, 7.5 and 10 mg
- More pain with 2.5 mg vs. 7.5 and 10 mg but no difference in satisfaction
- Delayed discharge with 7.5-10 mg
  - 77 min for 7.5, 106 min for 10 mg vs. 2.5 mg
  - 56 min for 7.5 mg, 85 min for 10 mg vs. 5 mg

Chalifoux LA. Anesthesiology 2017;127:625-632

Duke Anesthesiology

- Maternal Mortality
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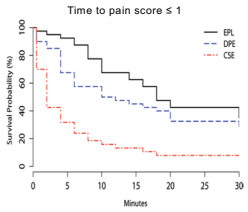
Dural Puncture Epidural Technique
Study Design

- **Background**
  - DPE with 25-26 G Whitacre needle improved sacral spread and reduced asymmetric block but no benefit with 27 G needle
- **RCT (n = 120): EPL vs. DPE vs. CSE**
  - EPL/DPE: 20 ml bupivacaine 0.125%
  - CSE: bupivacaine 1.7 mg with fentanyl 17 µg
  - PCEA + CEI: bupivacaine 0.125 % + fentanyl 2 µg/ml
- **Primary Outcome:** Time to pain score ≤ 1 between DPE and EPL

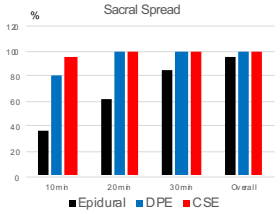
Chau A. Anesth Analg 2017;124:560-569

Duke Anesthesiology

Dural Puncture Epidural Technique
Onset Time and Sacral Spread



DPE: 11 min vs. EPL: 18 min, p = 0.21
DPE: 11 min vs. CSE: 2 min, p < 0.0001



Chau A. Anesth Analg 2017;124:560-569

Duke Anesthesiology

Dural Puncture Epidural Technique
Block Characteristics and Side Effects

	Epidural (n = 40)	DPE (n = 40)	CSE (n = 40)
Asymmetric block	52.5%*	10%	10%
Physician top-ups	50%*	22.5%	50%*
Pruritus	10%	10%	67.5%*
Hypotension	12.5%	12.5%	32.5%*
Tachysystole/hypertonus	12.5%	10%	45%*
Category I-II FHR	12.5%	12.5%	32.5%*
Cesarean Delivery	27.5 %	10%	5%

* P<0.05 vs. DPE

Chau A. Anesth Analg 2017;124:560-569

Duke Anesthesiology

Epidural Analgesia during Second Stage
What we know

- Epidural analgesia may be associated with prolonged second stage and increased instrumental deliveries
- Some obstetric providers request discontinuation of epidural analgesia during second stage of labor

Duke Anesthesiology

Epidural Analgesia during Second Stage
Study Design

- **RCT (n = 400)**
  - Healthy nulliparous women in spontaneous labor
  - Ropivacaine 0.08% + Sufentanil 0.4 µg/ml (CEI + PCEA)
  - Second stage
    - Randomized to same solution or saline at 8 ml/h
- **Primary Outcome**
  - Duration of the second stage of labor

Shen X. Obstet Gynecol 2017;130:1097-1103

Duke Anesthesiology

Epidural Analgesia during Second Stage
Results

	Saline (n = 200)	Ropivacaine (n = 200)	P value
Duration of 2nd Stage (min)	**51 ± 25**	**52 ± 27**	**0.52**
Cesarean Delivery	0 (0%)	2 (1%)	0.50
Forceps	2 (1%)	5 (2.5%)	0.25
Episiotomy	64 (32%)	70 (35%)	0.52
Satisfaction Score <8/10	61 (30.5%)	32 (16%)	< 0.001

Shen X. Obstet Gynecol 2017;130:1097-1103

Duke Anesthesiology

Impact of Epidural Fentanyl on Breastfeeding

What we know

- Synergistic effect between local anesthetics and opioids
- **Conflicting Data**
  - **Beilin:** *Epidural fentanyl > 150 µg:* more likely to stop breastfeeding at 6 weeks + low neonatal behavioral scores
  - **Wilson:** *Labor epidural analgesia (+/- epidural fentanyl):* No impact on initiation or duration of breastfeeding
  - **French:** No definitive conclusions

Beilin Y. Anesthesiology 2005;103:1211–7 *French CA. J Hum Lact 2016;32:507–20*
Wilson MJ. Anaesthesia 2010;65:145–53

Duke Anesthesiology

Impact of Epidural Fentanyl on Breastfeeding

Study Design

- **RCT (n = 305)**
  - Women > 38 weeks (with prior breastfeeding success) randomized to CEI + PCEA with:
    - Bupivacaine 1 mg/ml + Fentanyl 0 µg/ml
    - Bupivacaine 0.8 mg/ml + Fentanyl 1 µg/ml
    - Bupivacaine 0.625 mg/ml + Fentanyl 2 µg/ml
- **Primary Outcome:** Breastfeeding at 6 weeks

Lee AI. Anesthesiology 2017;127:614-624

Duke Anesthesiology

Impact of Epidural Fentanyl on Breastfeeding

Results

	Bupivacaine 0.1% + Fentanyl 0 µg/ml (n = 111)	Bupivacaine 0.08% + Fentanyl 1 µg/ml (n = 109)	Bupivacaine 0.0625% + Fentanyl 2 µg/ml (n = 112)
Breastfeeding at 6 weeks	**97%**	**98%**	**94%**
Breastfeeding at 3 months	94%	96%	88%
LATCH score	8.5 (8-9)	8 (8-9)	9 (8-9)

- Only 18% exposed to cumulative fentanyl dose > 150 µg (CSE + short labor)

Lee AI. Anesthesiology 2017;127:614-624

Duke Anesthesiology

- Maternal Mortality
- Maternal Morbidity
- Cesarean Delivery & Postpartum Pain
- Labor Analgesia
- **Global Health**

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Global Health

Impact and Cost-Effectiveness

- **Background**
  - 5 year partnership between Kybele and Ghana health service
- **Cost Effectiveness Analysis**
  - Incremental cost effectiveness ratio (ICER)
- **Results**
  - Maternal mortality ratio decreased by 22% (236 deaths averted)
  - Still birth decreased by 52% (129 still births averted)
  - ICER: $ 158 (95% CI: 129, 195)

Goodman DM. PLoS One 2017;12:e0180929

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Things to do..

- Incorporate TXA as an adjunct in your transfusion protocol
- Use bromocriptine for women with peripartum cardiomyopathy
- Institute safety bundles on your unit
- Educate, reduce and individualize post-discharge opioid prescriptions
- Consider (and study) DPE for labor analgesia
- Use neuraxial techniques to facilitate ECV
- Get Involved/ support Global Health

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Extraordinary care through a unique culture of innovation, education, research, and professional growth.

Program Slides

Saturday, March 16, 2019

Session VII: Obstetrical Hemorrhage Update

Moderator: Andrea Traynor

Optimal Uterotonic Administration to Prevent and Treat Uterine Atony
Lawrence Tsen, M.D.

Obstetrical Management of Post-Partum Hemorrhage
Maurice L. Druzin, M.D.

Transfusion Practices for Obstetric Hemorrhage: What's the latest?
Anil K Panigrahi, M.D., Ph.D.

Pharmacological Management of Obstetric Hemorrhage
Alexander Butwick, M.B.,B.S., FRCA, M.S.

Optimizing Uterotonic Agent Administration to Prevent and Treat Uterine Atony

SOAP Sol Shnider
Obstetric Anesthesia Meeting, 2019

Lawrence C. Tsen, MD
Department of Anesthesiology, Perioperative and Pain Medicine
Director of Anesthesia, Center for Reproductive Medicine
Associate Director, Center for Professionalism and Peer Support
Brigham & Women's Hospital
Associate Professor in Anaesthesia, Harvard Medical School

Uterotonic Agents: Learning Objectives

Upon Completion of this Learning Activity, Participants Should Be Able To:

- Evaluate the role of oxytocin and alternative uterotonic agents in promoting uterine tone
- Investigate the mechanisms by which uterine tone is augmented
- Identify an algorithm to optimize uterotonic agent use to prevent and treat uterine atony

Optimizing Uterotonic Agent Use

- THEORY
- INVESTIGATION
- NEWS FLASH

No Disclosures

Optimizing Uterotonic Agent Use

- THEORY
- INVESTIGATION
- NEWS FLASH

Theory: Uterotonic Agent Use is Variable

Alternative Uterotonic Agent Use

Patterns of Alternative Uterotonic Agents

Premier Database: 2,180,916 Deliveries
Mixed effects, logistic regression
Patient and hospital characteristics

Frequency

Mean: **7.1%** (IQR 5.2-10.8%)
Range: 1.7% (0.12%) to 25% (1.28%)

Use not explained by: patient or hospital characteristics, delivery mode, medical or obstetric conditions, or year

Bateman B, Tsen LC, Liu J, Butwick AJ, Huybrechts KF. Patterns of second-line uterotonic use in large sample of hospitalizations for childbirth in the United States: 2007-2011. Anesth Analg 2014 Dec; 119(6):1344-9

1. METHERGINE
   - Methylergonovine Maleate 0.2 mg IM
2. HEMABATE
   - Carboprost Tromethamine 0.25 mg IM
3. Cytotec
   - Misoprostol 800 -1000 mcg Rectal or 600 mcg Buccal

Investigation: Pharmacology

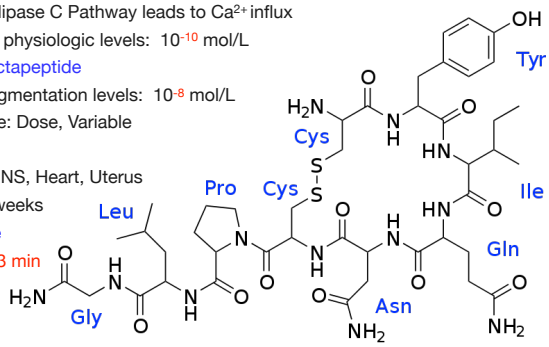
Oxytocin

Natural Nonapeptide
- Synthesized Hypothalamus, Secreted Posterior Pituitary
- Phospholipase C Pathway leads to Ca^{2+} influx
- Pregnant physiologic levels: 10^{-10} mol/L

Synthetic Octapeptide
- Labor augmentation levels: 10^{-8} mol/L
- Response: Dose, Variable

Receptors
- Breast, CNS, Heart, Uterus
- 20 & 30 weeks

Oxytocinase
- $t_{1/2}$ = 3 min



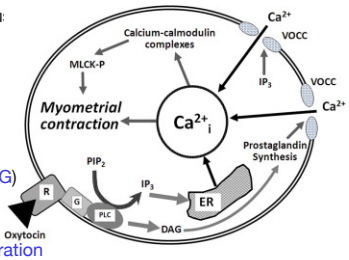
Mechanism: Oxytocin

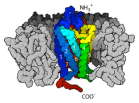
30x increase (8x sensitivity) with gestational age

200x increase in myometrium; numerou
few lower segment and cervical

4 Mechanisms for Uterine Contractility
- Inosital Triphosphate (InsP3; Ca^{2+})
- Voltage Gated Depolarization (Ca^{2+})
- Mitogen-activated Protein Kinase (PG)
- Rho-kinase Protein Kinase (PG)

Contraction: Frequency, Amplitude, Duration





Vrachnis N, et al. Int J Endocrinology 2011
Joyce KRS, et al. Reprod Sci 2009;16:501-8
Magalhaes J et al. Reprod Sci 2009;16:510-8
Robinson CR, et al. Am J Obstet Gynecol 2003;188:497-502

Oxytocin Receptors

Desensitization with continuous oxytocin exposure
- Occurs via: Phosphorylation, Internalization, Alteration of mRNA levels
- Lasts for hours to days
- Time and Concentration Dependent

Study	Model	Time	Concentration
Joyce	Rat	1 hrs	10^{-8} mol/L
Robinson	Human	3 hrs	10^{-8} mol/L
Phaneuf	Human	4, 6 hrs	10^{-8} mol/L

Vrachnis N, et al. Int J Endocrinology 2011
Joyce KRS, et al. Reprod Sci 2009;16:501-8
Phaneuf S, et al. Hum Reprod Update 1998;4:625-33
Robinson CR, et al. Am J Obstet Gynecol 2003;188:497-502

Methylergonovine (Methergine)

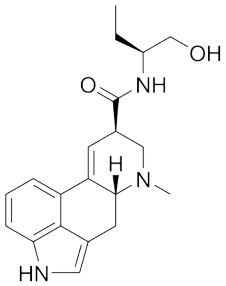
Natural Ergot Alkaloid
- Fungus on Rye, Morning Glory
- Chemically similar to LSD

Receptors
- Uterus, Blood Vessels
- 5-HT2a Serotonin
- Dopaminergic, Alpha Adrenergic

Bioavailability (IM = 78%)

Hepatic Metabolism and Excretion

Contraindicated
- Hypertension, Preeclampsia
- HIV+ protease inhibitors



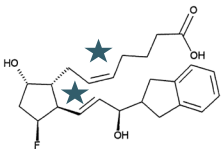
Carboprost (Hemabate) + Misoprostol (Cytotec)

Natural Prostaglandins
- Synthesized in Most Tissues and Organs
- Nucleated cells produce from arachidonic acid
- All contain 20 Carbon Atoms + 5 Carbon Ring
- Letter (Ring Structure) + Number (Double Bonds)

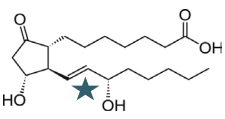
Synthetic Prostaglandins
- F2a and E2, Corey, 1969: Japan Prize 1989
- Aspirin inhibit Synthesis, 1971: Nobel Prize 1982

Receptors
- Platelets, Endothelium, Uterus, Mast Cells
- Platelet Aggregation, Vasodilation, Inflammation

Paracrine (local active), Autocrine (on cell of synthesis)
- $t_{1/2}$ = short



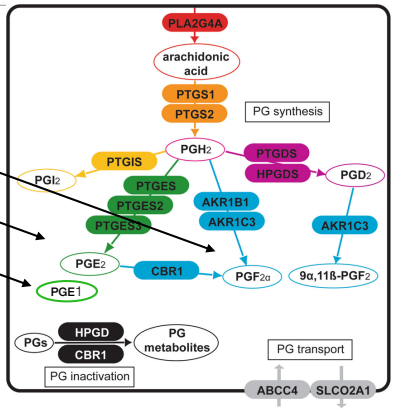
Hemabate (PGF2a)



Misoprostol (PGE1)

Carboprost (Hemabate) + Misoprostol (Cytotec)

- Carboprost (Hemabate)
- Dinoprostone (Cervidil)
- Misoprostol (Cytotec)



News Flash: Algorithm for Uterotonic Agent Use

A Stepwise, Standardized Algorithm

Specific guidance

- Laboring & Non-Laboring Women

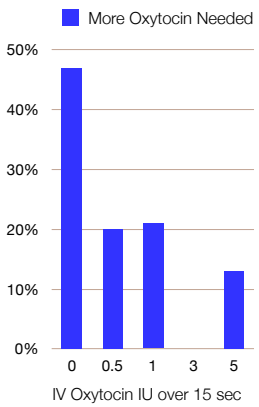
Emphasis

- Avoid Large & Rapid Bolus Doses
- Initial Infusion + Maintenance
- Early Consideration of Alternatives

Rescue Options

- Methylergonovine Maleate 0.2 mg IM
- Carboprost Tromethamine 0.25 mg IM
- Misoprostol 800 -1000 mcg Rectal

Investigation: Oxytocin is Overdosed



Uterine Tone/Blood Loss Ceiling Effect

- 5 IU = 10, 15, 20 IU
- Dosed 1U/min

ED90 Labor Arrest Cesarean

- Oxytocin 9.8 ± 6.3 hrs (10.3 ± 8.2 mIU/min)
- 0.5 IU/mL initial; up/down increments
- Dosed over 30 secs
- 2.99 IU

ED90 Elective Cesarean

- 0.35 IU
  - Dosed over 30 secs

Sarna MC, et al. Anesth Analg 1997;84:753-6
Carvalho JCA, et al. AJOG 2004;104:1005-1010
Balki M, et al. Ob Gyn 2006;107:45-50
Butwick AJ, et al. BJA 2010; 104:3338-43

News Flash: Algorithm for Uterotonic Agent Use

"RULE OF THREES"

- 3 IU Oxytocin Load/30 secs
- 3 minute intervals
- 3 total doses (Load + 2 Rescue)
  - 3 IU/hr maintenance (30 IU/L at 100 mL/hr)
- 3 pharmacologic options

LOADING

- Non-Laboring < 1 IU (ED90 = 0.35 IU)
- Laboring 3 IU (ED90 = 2.99 IU)

MAINTENANCE 2.4 IU/hr

- 0.04 IU/min (20 IU/L at 120 mL/hr) x 8 hrs
- 0.08 IU/min (40 IU/L at 125 mL/hr)

Tsen LC, Balki M. Int J Obstet Anesth. 2010 Jul;19(3):243-5.

Kovacheva VP, Soens MA, Tsen LC. Anesthesiology 2015;123:92-100

News Flash: Algorithm for Uterotonic Agent Use

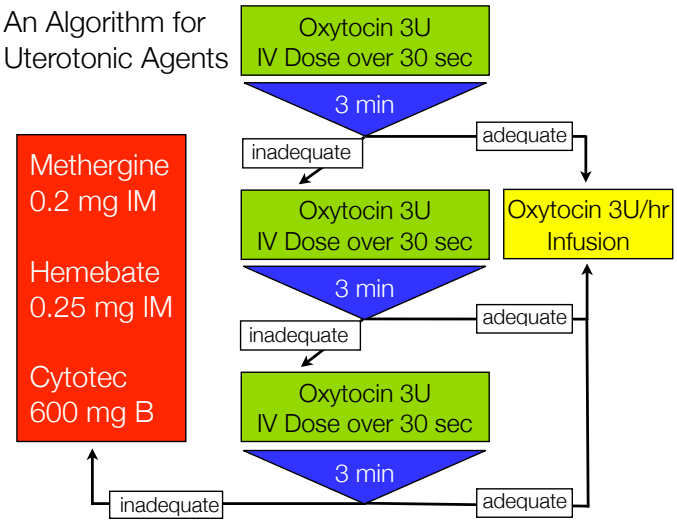
OXYTOCIN "RULE OF THREES"

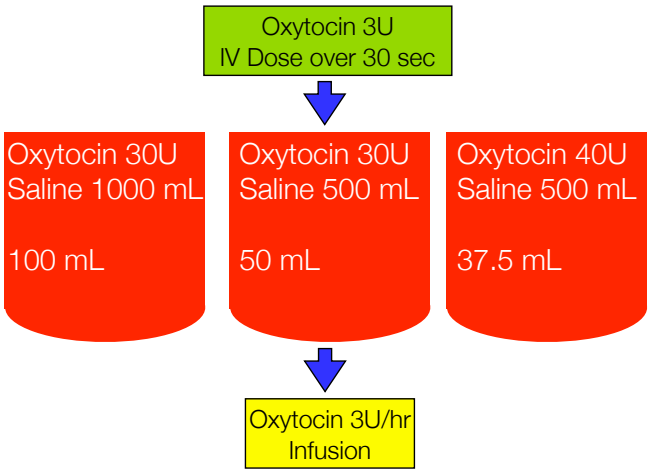
- 3 IU Oxytocin Load/ 30 secs
- 3 minute intervals
- 3 total doses (Load + 2 Rescue)
- 3 IU/hr maintenance (30 IU/L at 100 mL/hr)
- 3 pharmacologic options

1. METHERGINE
   - Methylergonovine Maleate 0.2 mg IM
   - Ergot Derivative
   - Avoid if Hypertension/Eclampsia
   - 20 min interval; repeat to 1 mg
2. HEMABATE
   - Carboprost Tromethamine 0.25 mg IM
   - Prostaglandin F2alpha
   - Avoid if Asthma?
   - 1.5-3.5 hr intervals; total 12 mg, 2 days
   - 20 min interval; repeat to 1 mg
3. Cytotec
   - Misoprostol 800 -1000 mcg Rectal or 600 mcg Buccal
   - Prostaglandin E1 Analog
   - FDA for NSAID Gastric Ulcer Reduction
   - Terminal Half-life 20-40 min

Balki M, et al. Reprod Sci 2010; 17:269-77
Tsen LC, Balki M. IJOA 2010;19:243-5
Balki M, Tsen LC. Int Anesth Clinics 2014

An Algorithm for Uterotonic Agents





News Flash: An Algorithm for Uterotonic Use

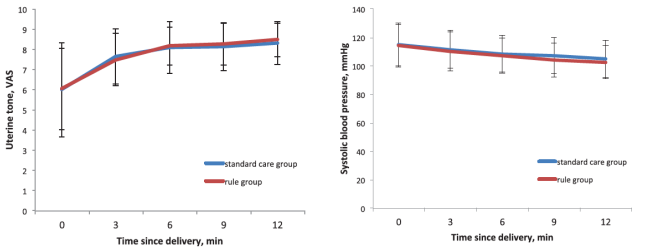
Oxytocin (3IU) + Saline (wide open)
oxytocin 3 IU in 3 mL

Saline (3 mL) + Oxytocin (wide open)
oxytocin 30 IU in 500 mL

mean, 4.0 IU

Uterine Tone at 3, 6, 9, & 12 min

mean, 8.4 IU



Kovacheva VP, Soens MA, Tsen LC. Anesthesiology 2015; 123:92-100

Summary: Optimizing Uterotonic Agent Use

THEORY

- Uterotonic Agent Use is Variable?

INVESTIGATION

- Mechanisms Assist **Overdosed!**

NEWS FLASH

- Avoid "rapid IV push" doses
- Rule of Three's
- 3 IU doses, 3 min, 3 doses, 3 IU maintenance
- Limit reliance on single agent

Questions

SOAP

2019 Sol Shnider, MD

Saturday, March 16, 2019

Obstetrical Management of Post Partum Hemorrhage

Maurice L. Druzin, MD
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Department of Obstetrics and Gynecology
Division of Maternal-Fetal Medicine
Stanford University School of Medicine
Lucile Packard Children's Hospital Stanford

I have no financial disclosures

REFERENCES

- Up-To-Date – January 2018
- Contemporary OBGYN, March 13, 2018
- ACOG Practice Bulletin, Number 183, October 2017 – Postpartum Hemorrhage
- Obstetrics and Gynecology, Vol. 130, No. 4, October 2017
- California Maternal Quality Care Collaborative (CMQCC) – Postpartum Hemorrhage, 2.0, Toolkit, 2015
- Global Outreach Mobile Obstetrics Medical Simulation (GO MOMS)

www.gomomsgogyns.com

World Health Organization (WHO), 2012

Learning Objectives

1. *To outline a stepwise obstetrical approach to post-partum hemorrhage.*
2. *To describe minimally invasive techniques to address post-partum hemorrhage.*
3. *To describe surgical interventions for control of post-partum hemorrhage.*

Executive Summary - WHO 2012

- Postpartum Hemorrhage **(PPH)** is commonly defined as a blood loss **of 500 ml or more within 24 hours after birth.**
- **EBL of > 500 mL an "alert line"**
- **> 1000 mL an "action line"(Severe PPH)**
- PPH is the **leading cause of maternal mortality in low-income countries** and the primary cause of nearly **one quarter of all maternal deaths globally**.
- Most deaths resulting from PPH occur during the first 24 hours after birth.
- The majority of these could be avoided through the use of **prophylactic uterotonics during the third stage** of labour and by **timely and appropriate management.**

DEFINITION ACOG 2017

Maternal hemorrhage, *defined as:*

A cumulative blood loss of greater than or equal to 1,000 ml

OR

Blood loss accompanied by signs or symptoms of hypovolemia;

within 24 hours after the birth process

MORBIDITY FROM HEMORRHAGE

Hemorrhage that leads to blood transfusion is the leading cause of ***severe maternal morbidity*** *in the United States closely followed by disseminated intravascular coagulation.*

In the United States, the rate of postpartum hemorrhage increased ***26%*** *between 1994 and 2006 primarily because of increased rates of* ***atony****.*

MORBIDITY

Additional important secondary sequelae from hemorrhage exist and include:

- ✓*Adult respiratory distress syndrome****(ARDS)***
- ✓*Shock*
- ✓*Disseminated Intravascular Coagulation****(DIC)***
- ✓*Acute renal failure****(ARF) (AKI)***
- ✓*Loss of fertility*
- ✓*Pituitary necrosis (Sheehan syndrome)*

MORBIDITY FROM HEMORRHAGE

In contrast, ***maternal mortality*** *from postpartum obstetric hemorrhage has* ***decreased*** *since the late 1980s and accounted for slightly more than 10% of maternal mortalities (approximately 1.7 deaths per 100,000 live births) in 2009.*

This observed decrease in mortality is associated with ***increasing rates of transfusion and peripartum hysterectomy.***

Teamwork!!!!

- Obstetrics+Nursing+ Anesthesiology
- Mutual respect
- Huddle early and often
- Closed loop communication

Example of Risk Assessment Tool

Low Risk	Medium Risk	High Risk
Singleton Pregnancy	Prior Cesarean or uterine surgery	Previa, accrete, increta, percreta
Less than four previous deliveries	More than four previous deliveries	Hematocrit <30
Unscarred uterus	Multiple gestation	Bleeding at admission
Absence of postpartum hemorrhage history	Large uterine fibroids	Known coagulation defect
	Chorioamnionitis	History of postpartum hemorrhage
	Magnesium sulfate use	Abnormal vital signs (tachycardia and hypotension)
	Prolonged use of Oxytocin	

Modified from Lyndon A, Lagrew D, Shields L, Main E, Cape V, editors. Improving health care response to obstetric hemorrhage version 2.0. A California Quality Improvement Toolkit. Stanford (CA); California Maternal Quality Care Collaborative; Sacramento (CA); California Department of Public Health; 2015.

Box 1.
Etiology of Postpartum Hemorrhage

Box 1. Etiology of Postpartum Hemorrhage

Primary:
- Uterine atony
- Lacerations
- Retained placenta
- Abnormally adherent placenta (accreta)
- Defects of coagulation (eg, disseminated intravascular coagulation)*
- Uterine inversion

Secondary:
- Subinvolution of the placental site
- Retained products of conception
- Infection
- Inherited coagulation defects (eg, factor deficiency such as von Willebrand)

*These include inherited coagulation defects as well as acute coagulopathies that may develop from events such as amniotic fluid embolism, placental abruption, or severe preeclampsia.

Table 1. Antenatal and Intrapartum Risk Factors for Postpartum Hemorrhage

Etiology	Primary Problem	Risk Factors, Signs
Abnormalities of uterine contraction—atony	Atonic uterus	Prolonged use of oxytocin High parity Chorioamnionitis General anesthesia
	Over-distended uterus	Twins or multiple gestation Polyhydramnios Macrosomia
	Fibroid uterus	Multiple uterine fibroids
	Uterine inversion	Excessive umbilical cord traction Short umbilical cord Fundal implantation of the placenta
Genital tract trauma	Episiotomy Cervical, vaginal, and perineal lacerations Uterine rupture	Operative vaginal delivery Precipitous delivery TOLAC
Retained placental tissue	Retained placenta Placenta accreta	Succenturiate placenta Previous uterine surgery Incomplete placenta at delivery
Abnormalities of coagulation	Preeclampsia Inherited clotting factor deficiency (von Willebrand, hemophilia) Severe infection Amniotic fluid embolism Excessive crystalloid replacement Therapeutic anticoagulation	Abnormal bruising Petechia Fetal death Placental abruption Fever, sepsis Hemorrhage Current thromboembolism treatment

Modified from New South Wales Ministry of Health. Maternity—prevention, early recognition and management of postpartum haemorrhage (PPH). Policy Directive. North Sydney: NSW Ministry of Health; 2010. Available at: http://www1.health.nsw.gov.au/pds/ActivePDSDocuments/PD2010_064.pdf. Retrieved July 24, 2017. Copyright 2017.

Ref: ACOG Practice Bulletin 183, October 2017

Maternal Early Warning Criteria

FIGURE 1
Maternal early warning criteria

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

Early warning system proposed by National Partnership for Maternal Safety.
BP, blood pressure.
Arora. Triggers, bundles, protocols, and checklists for obstetric safety. Am J Obstet Gynecol 2016.

Quantification of Blood Loss: QBL

DENIAL leads to DELAY

Quantitative Blood Loss (QBL): Vaginal Birth

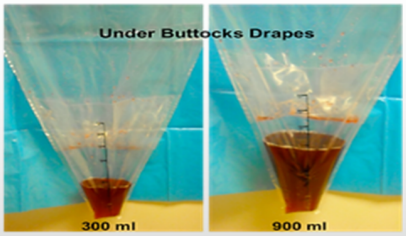
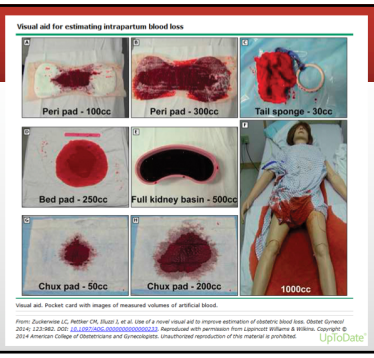
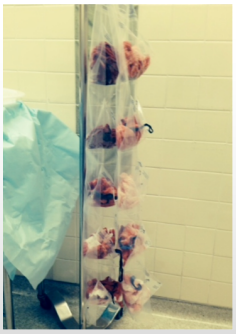


Photo courtesy of Bev VanderVal, CNS and used with permission





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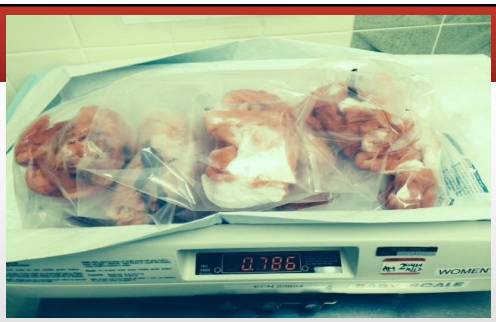


Photo courtesy of Jennifer McNulty, MD and used with permission

Uterine Atony
Most frequent cause of PPH

Risk Factors

- Advanced age
- Multiparity
- Chorioamnionitis
- $MgSO_4$
- Oxytocin
- Uterine Overdistension
- Abnormal labor

BIMANUAL COMPRESSION

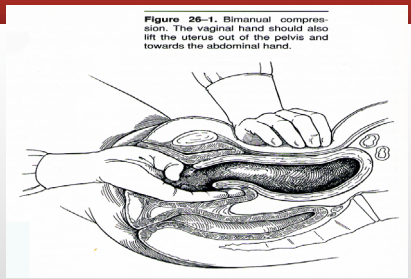
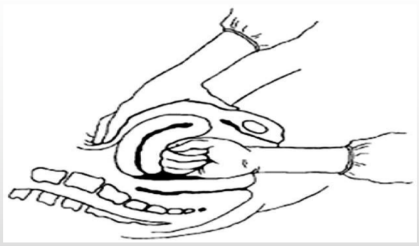


Figure 26–1. Bimanual compression. The vaginal hand should also lift the uterus out of the pelvis and towards the abdominal hand.

Ref: Hankins, Clark, Cunningham, Gilstrap Operative Obstetrics, 1995. Page 486

Bimanual Uterine Massage



2016 SIM2 Camp

Blood Loss: > 500 ml Vaginal > 1000 ml CS

- Increase IV rate (LR): Increase Oxytocin
- Methergine 0.2 mg IM (if not hypertensive)
- Consider TXA
- Continue fundal massage; Empty bladder, Keep Warm
- Administer O2 to maintain Sat > 95%
- Rule out retained POC, laceration or hematoma
- Order Type and Crossmatch 2 Units PRBC's if not already done

Blood Loss: > 1000 - 1500 ml or greater

- CALL FOR EXTRA HELP
- Hemabate 250 mcg IM
- Misoprostol 800-1000 mcg PR
- Tranexamic Acid within 3 hours
- To OR (if not there);
- Activate Massive Hemorrhage Protocol
- TRANSFUSE AGGRESSIVELY
- RBC:FFP:Plts 6:4:1 or 4:4:1

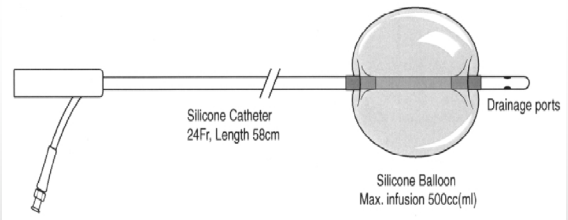
Management of Uterine Atony if Bimanual Compression fails

- Tamponade/Packing
- Uterine Artery Ligation
- B- Lynch Suture – (Brace)
- Hypogastric Artery (internal iliac) Ligation
- Hysterectomy
  - Supracervical
  - Total
- Angiography
- Mast suit

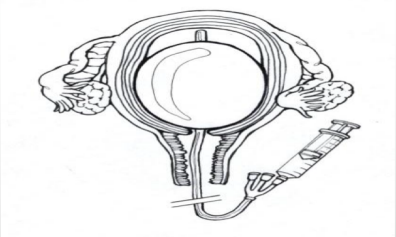
Table 4. Tamponade Techniques for Postpartum Hemorrhage

Technique	Comment
Commercially available intrauterine balloon tamponade devices	Inserted transcervically or through cesarean incision; has an exit port for blood drainage
- Bakri Balloon	Inflated with 300–500 mL of saline
- ebb uterine tamponade system	Double Balloon: maximum recommended fill volumes are 750 mL for the uterine balloon and 300 mL for the vaginal balloon.
Foley catheter	Insert one or more 60 mL bulbs and fill with 60 mL of saline.
Uterine packing	4-inch gauze, can be soaked with 5,000 units of thrombin in 5 mL of saline then insert from one cornua to the other with ring forceps.

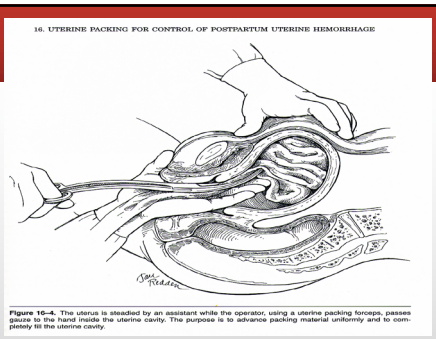
Ref: ACOG Practice Bulletin #183, October 2017, Replaces Practice Bulletin 76, October 2006



Uterine Tamponade



2016 SIM2 Camp

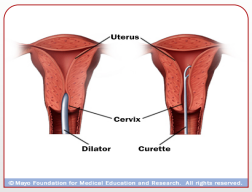


Surgical Management

Table 3. Surgical Management of Postpartum Hemorrhage

Technique	Comment
Uterine curettage	
Uterine artery ligation	Bilateral; also can ligate uteroovarian vessels
B-Lynch suture	
Hypogastric artery ligation	Less successful than earlier thought; difficult technique; generally reserved for practitioners experienced in the procedure
Repair of rupture	
Hysterectomy	

UTERINE CURETTAGE



UTERINE ARTERY LIGATION— "O'LEARY STITCH"

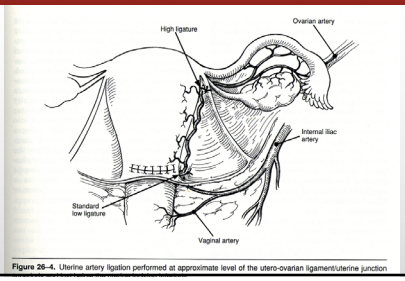


Figure 26–4. Uterine artery ligation performed at approximate level of the utero-ovarian ligament/uterine junction

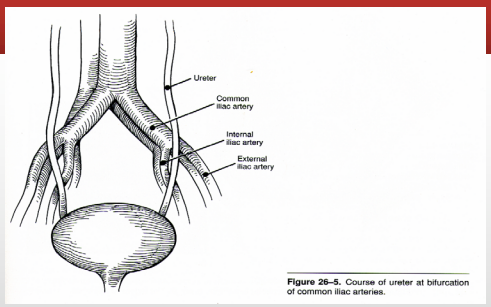


Figure 26–5. Course of ureter at bifurcation of common iliac arteries.

Perform B-Lynch within an hour

- Among 211 women treated with B-Lynch sutures
- Hysterectomy rate was **16% if done within 1 hour of delivery**
- Hysterectomy rate was **42% with a delay of 2-6 hours**
-

Move along a plan!

Ref: Kayem G, Kurinczuk JJ, Alfirevic Z, et al. Uterine compression sutures for the management of severe postpartum hemorrhage. *Obstet Gynecol.* Jan 2011;117(1):14-20.

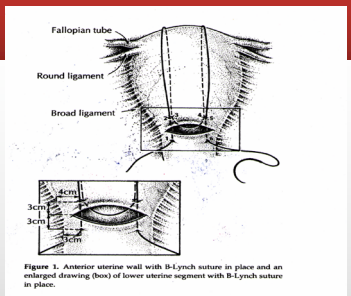


Figure 1. Anterior uterine wall with B-Lynch suture in place and an enlarged drawing (box) of lower uterine segment with B-Lynch suture in place.

Ref: B-Lynch C, Coker A, Lawal AH, Abu J, Cowen MJ. The B-Lynch surgical technique for the control of massive postpartum haemorrhage: An alternative to hysterectomy? Five cases reported. Br J Obstet Gynaecol 1997;104:372-5

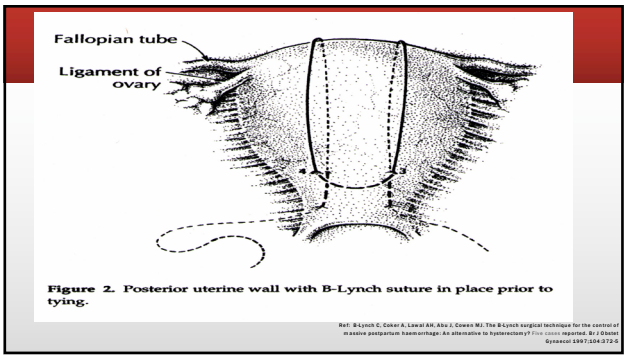


Figure 2. Posterior uterine wall with B-Lynch suture in place prior to tying.

Ref: B-Lynch C, Coker A, Lawal AH, Abu J, Cowen MJ. The B-Lynch surgical technique for the control of massive postpartum haemorrhage: An alternative to hysterectomy? Five cases reported. Br J Obstet Gynaecol 1997;104:372-5

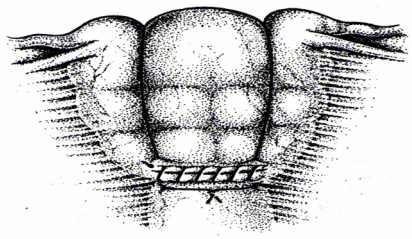


Figure 3. Compressed uterus with the hysterotomy incision closed and the B-Lynch suture in place.

B-Lynch C, Coker A, Lawal AH, Abu J, Cowen MJ. The B-Lynch surgical technique for the control of massive postpartum haemorrhage: An alternative to hysterectomy? Five cases reported. Br J Obstet Gynaecol 1997;104:372-5

Hemostatic Suturing Technique for Uterine Bleeding During Cesarean Delivery

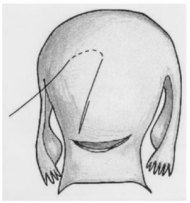


Figure 1. Hemostatic multiple square suture method.

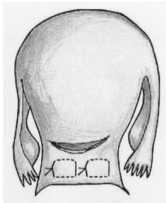


Figure 3. Bleeding because of placenta previa or accreta.

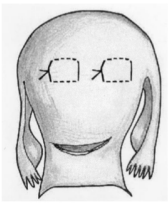


Figure 2. Bleeding because of uterine atony or placenta accreta.

Ref: Cho, Jun, Lee – Hemostatic Suturing Technique for Uterine

Uterine Sandwich Technique

Figure 2: Intrauterine balloon placement with Foley's Catheter.

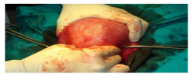


Figure 3: Manual compression of uterus before applying UCS, reduces the overall size of the uterus, prior to application of uterine compression sutures.

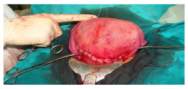


Figure 4: Uterine compression sutures being placed using the modified Hayman's Technique.

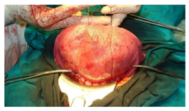


Figure 5: Two loops of compression sutures, placed on either side of the uterus.

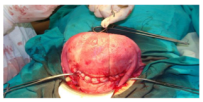


Figure 6: The two loops of sutures tied at the fundus to prevent slippage.

Ref: Dhillon, Dhilloon – Use of Comb. Methd to control PPH. Int'l Jour of Rep, 2018 July;7(7):2753-2758

American Journal of OBGYN

RESIDENTS' PAPERS www.AJOG.org

The uterine sandwich for persistent uterine atony: combining the B-Lynch compression suture and an intrauterine Bakri balloon

Wendy L. Nelson, MD; John M. O'Brien, MD

OBJECTIVE: The objective of the study was to evaluate the effectiveness of a combination of surgical interventions for control of postpartum hemorrhage.

STUDY DESIGN: At cesarean delivery, patients with persistent bleeding from uterine atony after the administration of oxytonics were treated with the placement of a B-Lynch suture. When the B-Lynch failed, subsequent placement of an intrauterine Bakri balloon followed. This combination is termed the uterine sandwich.

RESULTS: The uterine sandwich was successful for all 5 patients undergoing this approach. The median nadir hematocrit was 21.1% (range 20.1% to 28%). The balloon was in place for a median duration of 11hours (range10-24 hours). The median volume infused into the balloon was 100 mL (range 60- 250 mL). No complications were observed.

CONCLUSION: Placing an intrauterine Bakri balloon in conjunction with the B-Lynch uterine compression suture was successful in treating uterine atony.

Key words: compression suture, intrauterine balloon, postpartum hemorrhage

American Journal of OBGYN

RESEARCH www.AJOG.org

OBSTETRICS

The combination of intrauterine balloon tamponade and the B-Lynch procedure for the treatment of severe postpartum hemorrhage

Anke Diemert, MD; Gerhard Ortmeyer, MD; Bettina Hellwitz, MD; Manuela Lotz, MD; Thierry Sonville, MD; Peter Glosemeyer, MD; Werner Diehl, MD; Kurt Hecher, MD

OBJECTIVE: To evaluate intrauterine balloon tamponade with or without B-Lynch sutures in avoiding postpartum hysterectomy in cases with severe postpartum hemorrhage.

STUDY DESIGN: Retrospective analysis using all women delivering between January 2005 and July 2010 in our center. Prevention of hysterectomy was the main outcome studied.

RESULTS: Twenty-four cases of severe postpartum hemorrhage occurred in which medical treatment alone failed. In 20 cases, the Bakri balloon was the first choice to stop hemorrhage. Sixty percent (n = 12) of these were successfully treated with the balloon alone, 30% (n = 6) with the balloon and the B-Lynch suture. Therefore, 90% (n = 18) were successfully treated with the balloon as part of the treatment. The balloon tamponade was not successful in 2 cases. Four cases were treated with emergency hysterectomy a priori.

CONCLUSION: The Bakri balloon with or without B-Lynch sutures in a stepwise approach is an effective option for the treatment of severe PPH.

Key words: Bakri balloon, B-Lynch, postpartum hemorrhage

Cite this article as: Diemert A, Ortmeyer G, Hollwitz B, et al. The combination of intrauterine balloon tamponade and the B-Lynch procedure for the treatment of severe postpartum hemorrhage. Am J Obstet Gynecol 2012;206:65.e1-4.

ACOG SHORT RESEARCH REPORT

Application of uterine compression suture in association with intrauterine balloon tamponade ('uterine sandwich') for postpartum hemorrhage

WAI YOONG[1], ALEXANDRA RIDOUT[1], MARIA MEMTSA[1], ANDREAS STAVROULIS[1], MERNOOSH AREF-ADIB[1], ZEUDI RAMSAY-MARCELLE[1] & ABIODUN FAKOKUNDE[1]

[1]Department of Obstetrics and Gynecology, North Middlesex University Hospital, and [2]University College London Medical School, London, UK

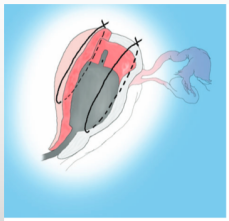


Figure 1. 'Uterine sandwich' technique combining Hayman external compression suture with intrauterine Bakri balloon tamponade (Yoong and Abernethy 2011).

Table 1. Demographic data of 11 patients who underwent the 'uterine sandwich' technique.

Patient	Age (years)	Ethnicity	Mode of delivery	Parity	Risk factor	Gestational age (weeks)	Suture	Estimated blood loss (ml)	Bakri balloon volume (ml)	Units of blood transfused	FU (months)
1	16	Black African	Emergency CS	0	PP	36	B-Lynch	2400	280	4	3
2	33	Black African	Elective CS	4	PP, previous uterine rupture	36	B-Lynch	1000	350	0	12
3	18	Eastern European	Normal vaginal delivery	0	–	42	Hayman	2700	300	8	3
4	27	Black African	Elective CS	0	PP	39	Hayman	750	200	0	32
5	36	Eastern European	Elective CS	3	PP	36	Hayman	2000	300	3	3
6	40	White Caucasian	Elective CS	1	PP, accreta	37	Hayman	4000	200	9 (ICS)	18
7	31	White Caucasian	Elective CS	1	PP	37	Hayman	1500	200	2 (ICS)	6
8	36	Black African	Elective CS	0	PP	36	Hayman	1500	200	0 (ICS)	12
9	27	Turkish	Elective CS	1	PP	37	Hayman	4500	300	6	3
10	26	Somalian	Elective CS	0	PP	37	Hayman	950	150	0 (ICS)	6
11	30	White Caucasian	Elective CS	0	PP	38	Hayman	2000	200	2 (ICS)	6

Abbreviations: CS, cesarean section; ICS, intraoperative cell salvage; PP, placenta previa.

Ref: Yoong, Ridout, Memtsa et al. Acta OBGYN Scand 2012;91:147-151

Hypogastric Artery LIGATION

- Performed much less frequently than in the past.
- Purpose is to diminish pulse pressure of blood flow via internal iliac (hypogastric vessels).
- Practitioners are less familiar with this technique, and the procedure has been found to be considerably less successful than previously thought.

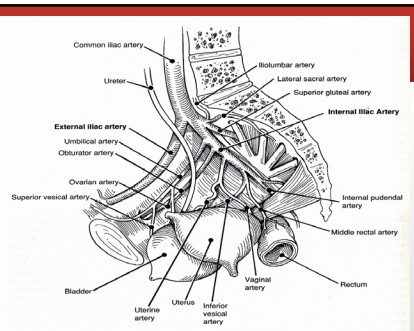


Figure 26–8. The internal iliac (hypogastric) artery.

Ref: Hankins, Clark, Cunningham, Gilstrap Operative Obstetrics, 1995, Page 487

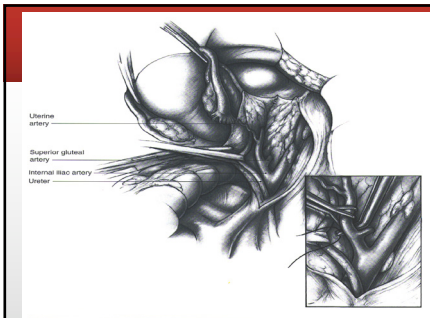


Figure 26–9. A. The retroperitoneal space has been opened, the ureter retracted medially, and the hypogastric artery exposed. B. The hypogastric artery is elevated with a large Babcock clamp and the suture is passed beneath the artery.

Ref: Hankins, Clark, Cunningham, Gilstrap Operative Obstetrics, 1995, Page 486

HYSTERECTOMY

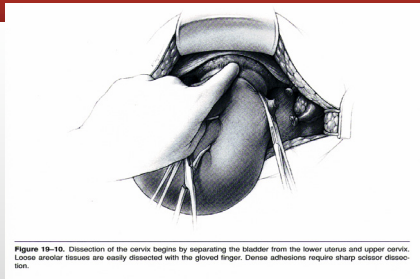


Figure 19–10. Dissection of the cervix begins by separating the bladder from the lower uterus and upper cervix. Loose areolar tissues are easily dissected with the gloved finger. Dense adhesions require sharp scissor dissection.

Ref: Hankins, Clark, Cunningham, Gilstrap Operative Obstetrics, 1995, Page 347

Summary of Recommendations and Conclusions

- All obstetric care facilities should have guidelines for **the routine administration of uterotonics in the immediate postpartum period.**
- Uterotonic agents should be the **first-line** treatment for postpartum hemorrhage caused by uterine atony.
- The **specific agent** selected, outside of recognized contraindications, is at the health care provider's **discretion** because none has been shown to have greater efficacy than others for the treatment of uterine atony.

Summary of Recommendations and Conclusions

- When uterotonics and **bimanual compression** techniques **fail** to adequately control postpartum hemorrhage, **prompt escalation** to other interventions (such as **tamponade or surgical techniques**) and escalation of intensity of care and support personnel are indicated.
- Given the mortality reduction findings, **Tranexamic acid within 3 hours should be considered** in the setting of obstetric hemorrhage when **initial medical therapy fails.**
- Obstetrician–gynecologists and other obstetric care providers should work with their institutions to ensure the existence of a:

1) **designated multidisciplinary response team,**

2) staged postpartum hemorrhage **protocol** that includes guidelines for **escalation of care, and**

- **3) functioning massive transfusion protocol.**

Summary of Recommendations and Conclusions

- Management of postpartum hemorrhage should use a **multidisciplinary** and multifaceted approach that involves:
  - **maintaining hemodynamic stability**
  - while **simultaneously** identifying and treating the cause of blood loss.
- Generally, in the treatment of postpartum hemorrhage, less invasive methods should be used initially if possible, but if unsuccessful, preservation of life may require more **aggressive** interventions including **hysterectomy.**
- **When a massive transfusion protocol is needed, fixed ratios of packed red blood cells, fresh frozen plasma, and platelets should be used.**

DO NOT DENY THE DIAGNOSIS OF PPH
DO NOT DELAY TREATMENT OF PPH

DENIAL **DELAY**

FIGURE 1
Maternal early warning criteria

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

Early warning system proposed by National Partnership for Maternal Safety.
BP, blood pressure.
Arora. Triggers, bundles, protocols, and checklists for obstetric safety. Am J Obstet Gynecol 2016.

Thank You

Transfusion Practices for Obstetric Hemorrhage: What's the latest?

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Clinical Assistant Professor
Departments of Anesthesiology, Perioperative and Pain Medicine and Pathology, Division of Transfusion Medicine

STANFORD ANESTHESIA

Disclosures

- None

Obstetric Hemorrhage

- Over 11% of US maternal deaths
- 27% of maternal deaths worldwide[1]
- Higher rates in developing countries[1]
  - 16% developed countries
- Majority due to postpartum hemorrhage (PPH)
- Increasing incidence of PPH
  - ~25% from 1995 to 2004[2]

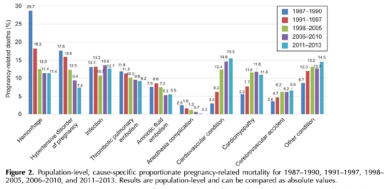
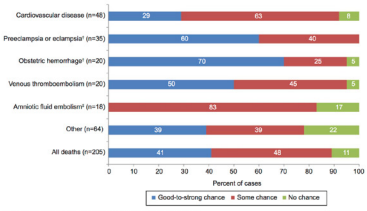


Figure 2. Population-level, cause-specific proportionate pregnancy-related mortality for 1987–1990, 1991–1997, 1998–2005, 2006–2010, and 2011–2013. Results are population-level and can be compared as absolute values.
Creanga, AA, et al. Obstet Gynecol. 2017 Aug;130(2):366-373.

1. Say L, et al. Lancet Glob Health. 2014 Jun;2(6):e323-33
2. Bateman BT, et al. Anesth Analg. 2010 May 1;110(5):1368-73

Treatable Cause of Maternal Mortality



Main, EK, et al. Obstet Gynecol. 2015 Apr;125(4):938-47

- Highest number of preventable maternal deaths
  - California: 70%[1]
  - North Carolina: 93%[2]
- Most common preventable provider factors[3]
  - Delay in diagnosis
  - Delay in treatment
  - Failure to identify high-risk patients

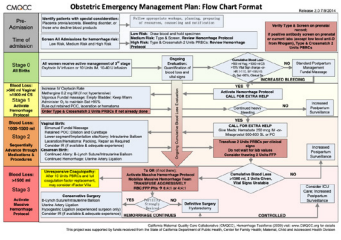
1. Main EK, et al. Obstet Gynecol. 2015 Apr;125(4):938-47
2. Borg CJ, et al. Obstet Gynecol. 2005 Dec;106(6):1228-34
3. Geller SE, et al. Am J Obstet Gynecol. 2014 Dec;211(6):658

Outline

- Risk Assessment and Pretransfusion Testing
- Recommendations for Massive Transfusion
- Patient Blood Management in Obstetrics

Obstetric Hemorrhage Safety Bundle

- Equipment for managing obstetric emergencies
  - Hemorrhage Cart with Procedural Instructions (balloons, compression stiches)
  - Rapid access to hemorrhage medications (kit or equivalent)
  - Establish a response team
- Unit-standard obstetric hemorrhage protocol
  - Staged-based system of escalating interventions
  - Uterotonic medications
  - Massive transfusion protocols
  - Invasive procedures



STANFORD ANESTHESIA

Risk Assessment

Low (Clot only)	Medium (Type and Screen)	High (Type & Crossmatch)
No previous uterine incision	Prior cesarean birth(s) or uterine surgery	Placenta previa, low lying placenta
Singleton pregnancy	Multiple gestation	Suspected placenta accreta, percreta, increta
≤4 previous vaginal births	>4 previous vaginal births	Hematocrit <30 AND other risk factors
No known bleeding disorder	Chorioamnionitis	Platelets <100,000
No history of PPH	History of previous PPH	Active bleeding (greater than show) on admit
	Large uterine fibroids	Known coagulopathy

Pre-transfusion testing strategy should be standardized to facility conditions depending on blood bank resources, speed of testing, and availability of blood products.

CMQCC. www.cmqcc.org/resources-tool-kits/toolkits/ob-hemorrhage-toolkit

STANFORD ANESTHESIA

Pretransfusion Testing

- Incidence of PPH requiring transfusion[1, 2]
  - Low risk group: 2.1% and 0.8%
  - Medium risk group: 4.5% and 2.0%
  - High risk group: 22.6% and 7.3%
- Suggests type and screen is unnecessary in low and medium risk groups
- Type and screen sufficient in high risk group
  - If electronic cross-matching available and antibody screen negative
- In event of unexpected large volume hemorrhage without type and screen
  - Provide uncrossmatched Type O= RBCs
  - Extremely low risk of hemolysis
  - No higher risk of RBC alloimmunization

Turn Around Time for Red Blood Cell (RBC) Issue to the Operating Room

Pre-transfusion testing status	Blood product order	Time to complete RBC issue process and send blood to OR location using the pneumatic tube system
Type & Screen completed Blood type verification completed	RBCs ordered prior to surgery date	5 min.
Type & Screen completed Blood type verification completed	RBCs not ordered prior to surgery date Orders added on surgery day or during procedure	15 min.
Type & Screen completed *Test Pending:* Blood Type verification	RBCs ordered prior to surgery date	15 min. after blood type verification specimen is received and test completed
Type & Screen ordered when patient arrives in pre-op on day of surgery	RBCs ordered with Type & Screen	Undetermined period of time if Screen is POSITIVE
Type & Screen ordered when patient arrives in pre-op on day of surgery	RBCs ordered with Type & Screen	60 minutes from receipt of specimen in TS if Screen is NEGATIVE

1. Wu, E, et al. J Matern Fetal Neonatal Med. 2015 Jan;28(1):71-6
2. Dilla AJ, et al. Obstet Gynecol. 2013 Jul;122(1):120-6

STANFORD ANESTHESIA

Electronic Crossmatch

- "ABO-Rh typing alone results in a 99.8% chance of a compatible transfusion, the addition of an antibody screen increases the safety to 99.94%, and a crossmatch increases this to 99.95%."
  Miller's Anesthesia, Chapter 61, 1830-1867.e6
- Negative Antibody Screen
  - Out of 10,899 transfusions with negative Ab screen (Heddle, et. al. Br J Haematol. 1992)
    - 168 (1.5%) has positive X-match
    - 27 (0.25%) were true positives
    - No clinical or serologic evidence of hemolysis
- Electronic/Computer crossmatch
  - Ensures ABO compatibility (similar to immediate spin crossmatch)
  - Only used if patient has a negative antibody screen & no history of alloantibodies
  - Requires two consistent ABO/RhD blood types (blood type verification)
  - Greatly improves turn-around time
- Perform serologic (Coombs) crossmatch in select cases
  - Presence or history of RBC alloantibodies

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Multiple RBC Alloantibodies

- Time to prepare RBC units depends on the specificity and number of alloantibodies
  - If the antigen is of high prevalence in the general population, then it is more difficult to find compatible units
- Prior preparation is key
  - Provide transfusion service advanced notice (24-48 hrs) in order to locate and crossmatch RBC units
  - Consider adjuncts
    - Cell salvage
    - Uterine artery embolization
    - Hysterectomy

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Insufficient Supply of Compatible RBC Units

- Supporting OB hemorrhage
  - Number of antigen-negative crossmatch-compatible units may be limiting
  - Should not withhold RBC transfusion
  - Issue "least incompatible" RBC units
    - If 2 antibodies present, issue units which do not express the antigen corresponding to the more clinically significant antibody
- If transfusion of incompatible RBC units anticipated
  - Consult with transfusion medicine, hematology, MFM
  - Methylprednisone 1 mg/kg/day + IVIG 1g/kg/day x 3 days prior to procedure[1]

1. Grifols, JR, et al. Transfus Apher Sci. 2009 Apr;40(2):105-7

STANFORD ANESTHESIA

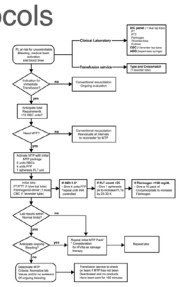
Outline

- Risk Assessment and Pretransfusion Testing
- Recommendations for Massive Transfusion
- Patient Blood Management in Obstetrics

STANFORD ANESTHESIA

Massive Transfusion Protocols

- Massive Transfusion
  - 10 or more RBC units in 24 hours
  - More than 4 RBC units in 1 hour with anticipation of continued need for transfusion
  - Replacement of >50% of blood volume within 3 hours
- MTPs designed to facilitate administration of blood early in resuscitation
  - Pre-defined ratio
  - Avoid excessive crystalloid
  - Prevent dilutional coagulopathy
  - Transfuse plasma and platelets empirically without waiting for laboratory testing



Burtlow, M et al. Transfusion. 2007 Sep;47(9):1564-72.

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Benefits of MTPs

Table 5. Blood Component Charges*

Blood Component	Charge, $	Pre-MTP Charges, $	Post-MTP Charges, $	Savings, $
PRBCs	450	8280	4725	1485
Fresh frozen plasma	120	570	375	360
Platelets	600	2280	990	1920
Cryoprecipitate, 10 pooled units	150	120	450	-75
rFVIIa, 4.8-mg vial	4500	689	1570	-1181
rFVIIa, 2.4-mg vial	2550	139	153	-24
Total		10 873	8263	2710

Table 4. Mortality Rates Between Cohorts

Variable	Pre-MTP	Post-MTP	p Value
Patients, n	40	37	
Deaths, n	18	7	
Mortality, %	45	19	0.02*

*Statistically significant; p ≤ 0.05.
MTP, massive transfusion protocol.

- Improved outcomes[1]
- Reduction in multiorgan failure and infection[2]
- Reduction blood product use and cost[3]
- Decreased mortality[4]

1. Nunez, TC, et al. J Trauma. 2010 Jun;68(6):1486-505
2. Cotton, BA, et al. J Trauma. 2009 Jan;66(1):41-8
3. O'Keefe, T et al. Arch Surg. 2008 Jul;143(7):686-90
4. Riskin, DJ, et al. J Am Coll Surg. 2009 Aug;209(2):198-205

STANFORD ANESTHESIA

MTP for Obstetric Hemorrhage

- Obstetric Hemorrhage Protocols universally endorsed
  - The Joint Commission, ACOG and the Society of Maternal Fetal Medicine[1]
- Guidelines lack detail about Massive Transfusion Protocols availability
  - Recommended by RANZCOG, NPMS, and an international expert panel[2]
- 93% of US academic obstetric anesthesia units have a MTP available[3]

1. Shields, LE, et al. Am J Obstet Gynecol. 2015 Mar;212(3):272-280
2. Shaylor, R, et al. Anesth Analg. 2017 Jan;124(1):216-232
3. Kacmar, RM, et al. Anesth Analg. 2014 Oct;119(4):906-10

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RBC : Plasma Ratios

- Inconsistency among obstetric societies on MTP composition
  - ACOG recommend fixed product ratios (1:1)[1]
    - "What is more important than the actual ratio is that there is a specific protocol for multicomponent therapy in place at each institution."
  - RCOG[2]

    Transfusion of FFP

    If no haemostatic results are available and bleeding is continuing, then, after 4 units of RBCs, FFP should be infused at a dose of 12–15 ml/kg until haemostatic test results are known.
- Recommendations based upon trauma literature

1. Committee on Practice Bulletins-Obstetrics. Obstet Gynecol. 2017 Oct;130(4):e168-e186
2. Mavrides E, et al. BJOG 2016;124:e106-e149

STANFORD ANESTHESIA

PROMMTT Data – Early Plasma

- Early plasma transfusion – within first 3-6 blood units and within 2.5 hrs of admission

TABLE 2. Adjusted Odds Ratios (95% Confidence Intervals) Associating In-Hospital Mortality With Early Plasma and Platelet Transfusion Status at Entry to the Analysis Cohort*

Plasma and Platelets at Entry	6-h Mortality	24-h Mortality	30-d Mortality
At least 1 U plasma	0.37 (0.19–0.73) $p = 0.004$	0.47 (0.27–0.84) $p = 0.01$	0.44 (0.27–0.73) $p = 0.002$
At least 1 U platelets	0.49 (0.09–2.60) $p = 0.402$	1.37 (0.44–4.24) $p = 0.582$	1.26 (0.42–3.74) $p = 0.678$

*A total of 619 patients entered into this analysis cohort having received 3 U to 6 U of blood products (including RBCs) within 2.5 hours of admission. Odds ratios are adjusted for the cumulative sum of unit blood products transfused at entry, ISS, entry time interval, age, bleeding sites (head, chest, and limb) and center differences as a random intercept in the multilevel logistic models.[25]

del Junco, DJ, et al. J Trauma Acute Care Surg. 2013 Jul;75(1 Suppl 1):S24-30

- Decreased 6-hour mortality with increased ratios of:
  - Plasma : RBCs (adjusted HR= 0.31; 95% CI, 0.16-0.58)
  - Platelets : RBCs (adjusted HR= 0.55; 95% CI, 0.31-0.98)
  - when hemorrhagic death predominated
  - Patients with ratios less than 1:2 were 3 to 4 times more likely to die than patients with ratios of 1:1 or higher

Holcomb, JB, et al. JAMA Surg. 2013 Feb;148(2):127-36

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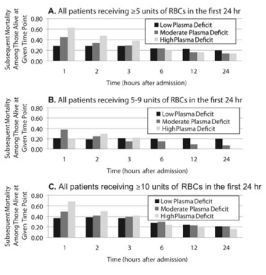
Plasma Deficit

- Adult trauma admissions receiving >5 RBC units during the first 24 hours (n=438)
- Correlation of survival with RBC and plasma use by hour; ratio and plasma deficit
- Mortality associated with worse plasma deficit during the first 2 hours of resuscitation
  - p < 0.001 at 1 hr and p < 0.01 at 2 hr



de Biasi et al., Transfusion. 2011 Sep;51(9):1925-32

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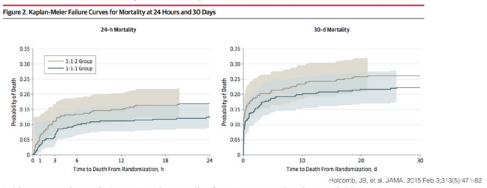
PROPPR Trial

- 1:1:1 vs. 1:1:2 ratio of plasma, platelets, and red blood cells



Holcomb, JB, et al. JAMA. 2015 Feb 3;313(5):471-82

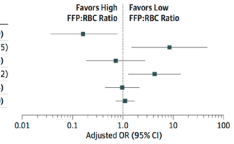
- Improved hemostasis and decreased mortality from exsanguination at 24 hours
  - Difference, −5.4% [95% CI, −10.4% to −0.5%], P = .03
- No increase in immune-mediated complications in the the 1:1:1 group
  - Infection, sepsis, acute respiratory distress syndrome, and multi-organ failure
  - Suggests relative safety of higher dose plasma transfusion

STANFORD ANESTHESIA

MTPs in Non-Trauma Hemorrhage

Figure. Adjusted Odds Ratio (OR) for Death

Surgical Service	No. of Patients	Adjusted OR (95% CI)
Vascular surgery	78	0.16 (0.03-0.79)
Medicine	76	8.48 (1.50-47.75)
Trauma surgery	99	0.63 (0.17-2.35)
General surgery	86	4.27 (1.28-14.22)
Cardiac surgery	272	0.98 (0.45-2.14)
All patients without trauma	767	1.10 (0.72-1.70)



- No difference in 30 day survival between high (1 FFP to 0.9 RBC) and low (1 FFP to 3 RBC) plasma groups (27% vs 22%; P = .16)

Mesar, T, et al. JAMA Surg. 2017 Jun 1;152(6):574-580.

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MTPs in Non-Trauma Hemorrhage

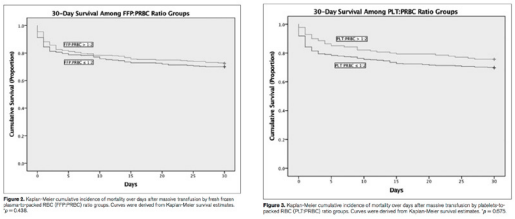


Figure 3. Kaplan-Meier cumulative incidence of mortality over days after massive transfusion by fresh frozen plasma-to-packed RBC (FFP:PRBC) ratio groups. Curves were derived from Kaplan-Meier survival estimates. $\chi = 0.436$.

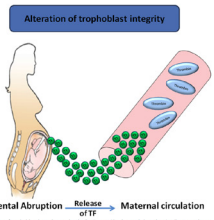
Figure 3. Kaplan-Meier cumulative incidence of mortality over days after massive transfusion by platelets-to-packed RBC (PLT:PRBC) ratio groups. Curves were derived from Kaplan-Meier survival estimates. $\chi = 0.0875$.

- No survival benefit to higher ratios of plasma or platelets to RBC
  - Adjusted for age, baseline plt count, Hct, INR, and APACHE II score

Etchill, EW, et al. Crit Care Med. 2017 Aug;45(8):1311-1316.

STANFORD ANESTHESIA

Coagulopathy Varies Based on the Cause of PPH



Disruption of trophoblast integrity, as classically observed in placental abruption, leading to a release of a large amount of tissue factor in maternal circulation. This can activate the coagulation cascade and propagate an inflammatory response that can easily become systemic leading to uncontrolled thrombin generation and subsequent development of DIC.

Exac. Disseminated intravascular coagulation in pregnancy. Am J Obstet Gynecol 2015.

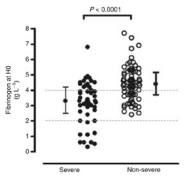
- Uterine atony[1,2]
  - May not develop significant coagulopathy even with large volume blood loss
  - EBL 1-1.5L from uterine atony, surgical trauma, adherent placenta[3]
    - Average fibrinogen 3.9 g/L; normal PT, PTT >98%
  - Delayed or failed hemorrhage control
    - Dilutional coagulopathy can evolve
- Placental abruption/separation[4]
  - Release of large quantities of TF into maternal circulation
  - Local hypoxia and hypovolemia upregulate endothelial TF expression
  - Increased risk of development of DIC

1. Allard, S, et al. Br J Haematol. 2014 Jan 164(2):177-88
2. Collis, R, and Guasch, E. Best Pract Res Clin Anaesthesiol. 2017 Mar;31(1):107-124
3. Collins, PW, et al. Blood. 2014 Sep 11;124(15):1727-36
4. Erez, O, et al. Am J Obstet Gynecol. 2015 Oct;213(4):452-63

STANFORD ANESTHESIA

Hypofibrinogenemia During PPH

- Predictive of progression to severe PPH
  - Prospective, multicenter, observational study (n = 128)[1]
    - Fibrinogen >4 g/L had NPV of 79% (68-89%)
    - Fibrinogen <2 g/L had PPV of 100% (71-100%)
  - Prospective analysis of 738 women with PPH after vaginal delivery[2]
    - Progress to severe PPH – average fibrinogen 3.4 g/l vs 4.2 g/L
    - Fibrinogen 2-3 g/L : adjusted OR 1.90 (1.16-3.09)
    - Fibrinogen <2 g/L: adjusted OR 11.99 (2.56-56.06)
  - Prospective multicenter analysis of 239 patients with PPH[3]
    - Fibrinogen measured 4 hr after the start of PPH
    - Fibrinogen <2 g/L independent predictor of progression requiring invasive procedure



1. Charbit B, et al. J Thromb Haemost. 2007 Feb;5(2):266-73
2. Cortet, M, et al. Br J Anaesth. 2012 Jun;108(6):984-9
3. Gayat E, et al. Intensive Care Med. 2011 Nov;37(11):1816-25

STANFORD ANESTHESIA

Target Fibrinogen Level

- American Society of Anesthesiologists[1]
  - Fibrinogen concentration < 0.8-1.0 g/L in the presence of excessive bleeding
  - Treatment may be indicated at higher concentrations in actively bleeding obstetric patients
- European Task Force for Advanced Bleeding Care in Trauma[2]
  - Treat when fibrinogen level < 1.5-2.0 g/L
- European Society of Anaesthesiology[3]
  - Fibrinogen concentration < 1.5-2 g/L is considered as hypofibrinogenemia in acquired coagulopathy and is associated with increased bleeding risk
  - Recommend treatment in bleeding patients
- Royal College of Obstetricians and Gynaecologists[4]
  - A plasma fibrinogen level of greater than 2 g/L should be maintained during ongoing PPH
  - Cryoprecipitate should be used for fibrinogen replacement
- Not mentioned by ACOG[5] or SCOG[6]

1. ASA Task Force on Perioperative Blood Management, *Anesthesiology.* 2015
2. Rossaint, *Crit Care.* 2016
3. Kozek-Langenecker, *Eur J Anaesthesiol.* 2017
4. Mavrides E, et al. BJOG 2016;124:e106–e149
5. Committee on Practice Bulletins-Obstetrics. Obstet Gynecol. 2017 Oct;130(4):e168-e186
6. Leduc, D, et al. J Obstet Gynaecol Can. 2009;31:980–993

STANFORD ANESTHESIA

Outline

- Risk Assessment and Pretransfusion Testing
- Recommendations for Massive Transfusion
- Patient Blood Management in Obstetrics

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Consequences of Transfusion

- Risks of transfusion[1]
  - Transmissible infectious disease
  - Transfusion reactions
  - Exposure to unknown risks (Zika, vCJD)
  - Potential effects of immunomodulation
  - Increased morbidity and mortality[2]
- MT for PPH associated with high morbidity[3]
  - Prospective cross-sectional study conducted through the UK Obstetric Surveillance System (UKOSS)
  - Any pregnant woman ≥20 weeks of gestation receiving ≥8 RBC units within 24 hours of giving birth (n=181)
  - Median EBL – 6L
  - 82% transferred to ICU; 45% underwent hysterectomy; 28% developed significant morbidities (respiratory failure and cardiac complications)
- Small volume transfusion associated with poorer outcomes[4]
  - 1069 of 14989 women with obstetric hemorrhage receiving a transfusion of 1-2 RBC units
  - More likely to experience
    - Severe maternal morbidity (RR 7·0)
    - Admitted to ICU (RR 2·1)
    - Length of stay >5 days (RR 2·0)

1. Goodnough LT and Shander A. Anesthesiology. 2012 Jun;116(6):1367-76
2. Glance, LG. et al. Anesthesiology. 2011 Feb;114(2):283-92
3. Green, L. et al. BJOG. 2018 Dec;123(13):2164-2170
4. Patterson, JA. et al. Vox Sang. 2018 Oct;113(7):679-685

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Patient Blood Management

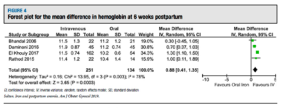
	Optimize erythropoiesis	Minimize blood loss	Manage anemia
PREoperative	• Identify, evaluate, and treat underlying anemia • Preoperative autologous blood donation • Consider erythropoiesis stimulating agents (ESA) if nutritional anemias ruled out/treated • Refer for further evaluation if necessary	• Identify and manage bleeding risk (past/family history) • Review medications (antiplatelet, anticoagulation therapy) • Minimize iatrogenic blood loss • Procedure planning and rehearsal	• Compare estimated blood loss with patient-specific tolerable blood loss • Assess/optimize patient's physiologic reserve (e.g., pulmonary and cardiac function) • Formulate patient-specific management plan using appropriate blood conservation modalities to manage anemia
INTRAoperative	• Time surgery with optimization of erythrocyte mass (note: unmanaged anemia is a contraindication for elective surgery)	• Meticulous hemostasis and surgical techniques • Blood-sparing surgical techniques • Anesthetic blood conserving strategies • Acute normovolemic hemodilution • Cell salvage/reinfusion • Pharmacologic/hemostatic agents	• Optimize cardiac output • Optimize ventilation and oxygenation • Evidence-based transfusion strategies
POSTOperative	• Manage nutritional/correctable anemia (e.g., avoid folate deficiency, iron-restricted erythropoiesis) • ESA therapy if appropriate • Be aware of drug interactions that can cause anemia (e.g., ACE inhibitor)	• Monitor and manage bleeding • Maintain normothermia (unless hypothermia indicated) • Autologous blood salvage • Minimize iatrogenic blood loss • Hemostasis/anticoagulation management • Be aware of adverse effects of medications (e.g., acquired vitamin K deficiency)	• Maximize oxygen delivery • Minimize oxygen consumption • Avoid/treat infections promptly • Evidence-based transfusion strategies

Goodnough LT and Shander A. Anesthesiology. 2012 Jun;116(6):1367-76.

STANFORD ANESTHESIA

PBM – Anemia Treatment

- WHO estimates that over 1/3 of pregnant women are anemic (Hgb <11 g/dL)[1]
- Most cases due to iron deficiency



- IV iron better tolerated and more efficacious than oral iron for post-PPH anemia[2]
  - Higher hemoglobin at 6 weeks
  - Decreased constipation and dyspepsia

1. Breymann, C and Auerbach, M. Hematology Am Soc Hematol Educ Program. 2017 Dec 8;2017(1):152-159
2. Sultan, P. et al. Am J Obstet Gynecol. 2018 Dec 19. pii: S0002-9378(18)32236-9

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PBM – Cell Salvage

- No problems with amniotic fluid contamination given improved filtering techniques
- Endorsed by ACOG[1] (for cesarean delivery) and RCOG[2]
- SALVO Trial[3]
  - Cell salvage vs standard care in c/s among women at risk of hemorrhage
  - N= 2990
  - No statistically significant difference in allogeneic blood transfusion rates (2.5% versus 3.5%)
  - Increased maternal exposure to fetal blood using cell salvage
    - Ensure prophylaxis for RhD alloimmunization
  - For routine c/s, more costly than standard care[4]
    - Mean difference £83 per patient
    - £8252 per transfusion avoided for cell salvage compared with standard care
- Does not account for cost from morbidity and mortality risk associated with allogeneic blood transfusion
- Can be useful in patients with preexisting alloantibodies and limited allogeneic blood

1. Committee on Practice Bulletins-Obstetrics. Obstet Gynaecol. 2017 Oct;130(4):e168-e186
2. Leduc, D. et al. J Obstet Gynaecol Can. 2009;31:980-993
3. Khan, KS. et al. PLoS Med. 2017 Dec 19;14(12):e1002471
4. McLoughlin, C. et al. BMJ Open. 2019 Feb 19;9(2):e022352

STANFORD ANESTHESIA

PBM – POC Testing and Pharmacologic Therapy

- Viscoelastic testing for early identification of coagulopathy
  - Detecting hypofibrinogenemia[1]
    - Decrease in FIBTEM amplitude - 100% sensitivity and 85-88% specificity to detect fibrinogen concentration < 1.5 g/L
  - Predicting progression to severe PPH[2]
    - FIBTEM an independent predictor for progression to bleeds >2500 mL
  - Decreasing blood product use[3]
    - ROTEM algorithm based on the EXTEM clot time (CT) and A5 the FIBTEM test decreased number of blood products transfused and number of patients requiring >5 RBC units
- Pharmacologic Therapy
  - Tranexamic acid
  - Fibrinogen concentrate
  - rFVIIa

1. Hulsoud, C. et al. Thromb Haemost. 2009 Apr;101(4):755-61
2. Collins, PW. et al. Blood. 2014 Sep 11;124(11):1727-36
3. Mallaiah S. et al. Anaesthesia. 2015 Feb;70(2):166-75

Conclusions

- Type and Screen is sufficient for women at high risk of PPH
  - When electronic cross-matching available
- In patients with RBC alloantibodies, extra time is required to obtain and prepare cross-match compatible blood
  - Time required is dependent on number and specificity of antibodies
- Massive Transfusion Protocols should be available to all units treating patients with potential PPH
  - The optimal ratio of RBC : plasma units when treating PPH is unclear
- Hypofibrinogenemia is strong predictor of severe PPH
  - Studies are ongoing to determine the efficacy of early fibrinogen replacement
- Patient Blood Management initiatives should be employed as part of routine obstetric care to avoid allogeneic blood transfusion and its associated morbidity and mortality risk

Definitions of Postpartum Hemorrhage

Organization	PPH Definition
World Health Organization[1]	• Blood loss ≥500 mL within 24 hours after birth. • Severe PPH: Blood loss ≥1000 mL within 24 hours after birth.
American College of Obstetricians and Gynecologists[2]	• Cumulative blood loss ≥1000 mL or blood loss accompanied by signs or symptoms of hypovolemia within 24 hours after the birth process (includes intrapartum loss) regardless of route of delivery.

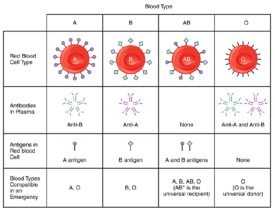
Royal College of Obstetricians and Gynaecologists[3]	• Minor PPH: 500 to 1000 mL
	• Major PPH: >1000 mL
	  • Moderate: 1001 to 2000 mL
	  • Severe: >2000 mL

Society of Obstetricians and Gynaecologists of Canada[4]	• Any amount of bleeding that threatens the patient's hemodynamic stability.
California Maternal Quality Care Collaborative[5]	• Stage 0: All women in labor or recently delivered. • Stage 1: Blood loss >500 mL after vaginal or >1000 mL after cesarean delivery; or vital sign changes >15%; or heart rate ≥110 beats/minute, blood pressure ≤85/45 mmHg, O_2 saturation <95%. • Stage 2: Continued bleeding with total blood loss <1500 mL. • Stage 3: Total blood loss >1500 mL or ≥2 units pRBC transfused or unstable vital signs or suspicion of DIC.

1. WHO recommendations for the prevention and treatment of postpartum haemorrhage. Geneva: World Health Organization; 2012
2. ACOG Practice Bulletin No. 183: Obstet Gynecol. 2017 Oct;130(4):e168-e186
3. Green-top Guideline No. 52 BJOG. 2017 Apr; 124(3):e106-e149
4. Leduc D, et al. J Obstet Gynaecol Can. 2009 Oct;31(10):980-993
5. CMQCC. www.cmqcc.org/resources-tool-kits/toolkits/ob-hemorrhage-toolkit

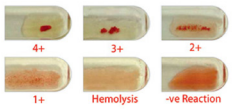
Transfusing Crossmatch-Compatible Blood

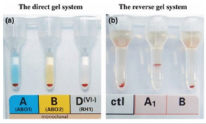
- What is required?
  - ABO & RhD Type
    - Second confirmatory specimen (Blood Type Verification)
  - Completed RBC alloantibody screen
    - Does not assess presence of "naturally occurring" anti-A and anti-B isohemagglutinins
  - If RBC alloantibodies present, they must be identified – takes time!



Type and Screen

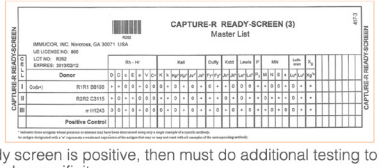
- 2 separate diagnostic tests
- Type – Determine ABO and RhD blood type
  - Forward type = Incubate patient RBCs with known reagent antibodies (anti-A, anti-B, anti-RhD)
  - Reverse type = Incubate patient serum with known reagent RBCs (A, B)





RBC Antibody Screen

- Commercially prepared Group O screening cells (ignore anti-A and -B)
- Typed for 18 antigens required by FDA
  - D, C, E, c, e, M, N, S, s, P1, Le^a, Le^b, K, k, Fy^a, Fy^b, Jk^a, and Jk^b

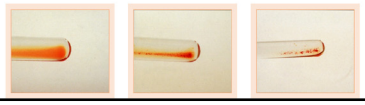


- If antibody screen is positive, then must do additional testing to identify the antibody specificity

Preparing RBC for Transfusion

Requires RBC Crossmatch

- Test patient serum with a cell suspension from a donor RBC unit
- Complete Indirect Antiglobulin Testing crossmatch
  - Involves 37°C incubation and includes anti-human globulin or "Coombs reagent"
- Identifies if the patient has detectable antibody(ies) to antigen(s) present on a donor RBC's
- Positive reaction indicates an incompatible unit and that unit should not be transfused



STANFORD ANESTHESIA

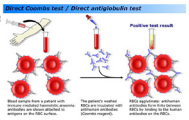
Acute Hemolytic Transfusion Reactions

- Usually occur during or within 24 hours of transfusion
  - Can be intra- or extravascular
  - Intravascular hemolysis more severe and usually associated with ABO incompatibility
    - Anti-A, anti-B antibodies are IgM and can fix complement
- Signs and symptoms
  - Fever and chills
    - Most common presenting symptom (> 80%)
  - Back or infusion site pain
  - Hypotension/shock
  - Hemoglobinuria (may be first indication of hemolysis in anesthetized patients)
  - DIC/increased bleeding (also important in anesthetized patients)
  - Sense of "impending doom"

STANFORD ANESTHESIA

AHTR Management

- Stop the transfusion!
  - Main indicator of survival of an acute HTR is the amount of incompatible blood infused.
- Initiate Transfusion Reaction Workup (Call Transfusion Service)
  - Clerical check
    - Transfusion Service and bedside check to ensure correct unit sent to patient
  - Visible hemoglobinemia check
    - Spin EDTA blood sample and inspect serum for free hemoglobin
    - Most sensitive test for hemolysis (2.5 to 5mL), but not specific
  - Repeat ABO testing
    - Test recipient and blood unit (for RBCs)
  - Direct Antiglobulin Test
    - Determine whether antibody and/or complement is bound to patient's RBCs



- IV hydration and diuresis (maintain UOP >1ml/kg/hr)
- Observe for DIC
- Consider exchange transfusion for high volume incompatible transfusion

Disclosures

- Consulting / Honoraria:
- Instrumentation Laboratory, Cerus Corporation

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TRANEXAMIC ACID (TXA)

FIBRINOGEN CONCENTRATE

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TXA & Postpartum Hemorrhage

- Treatment
- Prevention

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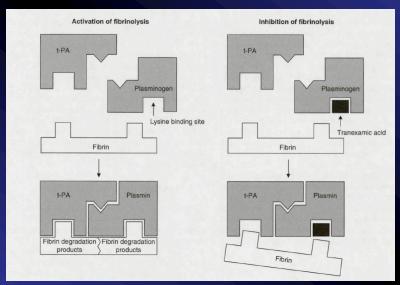
How does TXA work?



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Does TXA TREATMENT Improve Outcomes?

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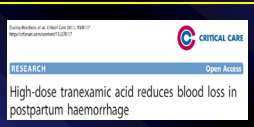
TXA and PPH


CRITICAL CARE

RESEARCH Open Access

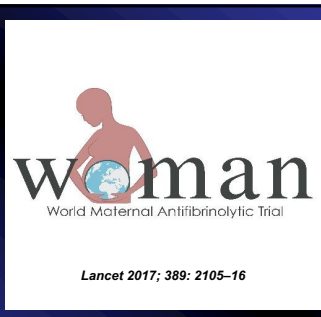
High-dose tranexamic acid reduces blood loss in postpartum haemorrhage

Policy of high-dose tranexamic acid for treating postpartum hemorrhage after vaginal delivery

4g TXA + 1 g / hr infusion vs. placebo

- Intermediate quality studies
- Low sample sizes
- Inconsistent results: ↓ / ↔ estimated blood loss with TXA

Ducloy-Bouthors. Critical Care 2011,15:R117 *Bouet. Mat Fetal Med 2016; 29: 1617 - 1622*



Lancet 2017; 389: 2105–16

BIG STUDY

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Effect of early tranexamic acid administration on mortality, hysterectomy, and other morbidities in women with post-partum haemorrhage (WOMAN): an international, randomised, double-blind, placebo-controlled trial

WOMAN Trial Collaborators*

oa

- N = 20,000
- Randomized: TXA (1 – 2 g) vs. placebo
- Primary outcome = Death from PPH

@aljabut *Lancet 2017; 389: 2105–16* #SolShnider2019

Effect of early tranexamic acid administration on mortality, hysterectomy, and other morbidities in women with post-partum haemorrhage (WOMAN): an international, randomised, double-blind, placebo-controlled trial

WOMAN Trial Collaborators*

oa

Death from:	Tranexamic acid group (n=10 036)	Placebo group (n=9985)	RR (95% CI)	p value (two-sided)
Bleeding	155 (1·5%)	191 (1·9 %)	0·81 (0·65–1·00)	0·045

TRANSFUSIONS:

54% TXA vs. 54% placebo

Among those transfused:
No diff mean number of blood units transfused

Each group: 0.3% Thromboembolism (P=0.6)

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RESEARCH ARTICLE

The effect of tranexamic acid on blood loss and maternal outcome in the treatment of persistent postpartum hemorrhage: A nationwide retrospective cohort study

N = 1261 – severe PPH

	Early TXA	Late / No TXA	aOR (95% CI)
Maternal Morbidity	8.1%	9.8%	0.9 (0.7 - 1.3)

Gillisen A. PloS ONE 2017;12: e0187555.

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Updated WHO Recommendation on Tranexamic Acid for the Treatment of Postpartum Haemorrhage

Highlights and Key Messages from the World Health Organization's 2017 Global Recommendation

October 2017 www.mcsprogram.org

WHO 2017 TXA Recommendation (updated)	Use TXA **in all cases of PPH, regardless of whether the bleeding is due to genital tract trauma or other causes.**	Use TXA **within 3 hours and as early as possible after onset of PPH. Do not initiate TXA more than 3 hours after birth,** unless being used for bleeding that restarts within 24 hours of completing the first dose (see dosing).	Fixed dose of **1 g in 10 mL (100 mg/mL) IV at 1 mL per minute (i.e., administered over 10 minutes)** **Second dose** of 1 g IV **if bleeding continues after 30 minutes or if bleeding restarts within 24 hours of completing the first dose**

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TXA – Should I use it?

- Reasonable option:
  - Prehospital care / Limited resources
- Therapeutic adjunct
- New PPH algorithms → TXA

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Does TXA PROPHYLAXIS Prevent PPH?

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Does tranexamic acid prevent postpartum haemorrhage? A systematic review of randomised controlled trials

K Ker, H Shakur, I Roberts

Main results We found 26 trials including a total of 4191 women. Examination of the trial reports raised concerns about the quality of the data. Eight trial reports contained identical or similar text and there were important data inconsistencies in several trials. Two trials did not have ethics committee approval. Meta-analysis of baseline variables suggested that randomisation was inadequate in many trials.

Conclusions There is no reliable evidence that TXA prevents postpartum haemorrhage during childbirth. Many of the trials conducted to date are small, low quality and contain serious flaws.

BJOG 2016;123:1745–1752.

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The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

Tranexamic Acid for the Prevention of Blood Loss after Vaginal Delivery

N = 3891

	TXA	Placebo	RR (95% CI)
PPH	8.1%	9.8%	0.8 (0.7-1.0)

Sentilhes L. NEJM 2018;379:731-42

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Final Word of Caution

Neurologic Injury / Death – Intrathecal Injection [1-4]

1. Patel S Anesth Analg 2015; 121: 1570-7
2. Hatch DM Int J Obstet Anesth 2016; 26: 71-5
3. APSF Newsletter 2010; 25 (1): 9
4. Roy A. SEAJCRR 2015; 4: 1910-6

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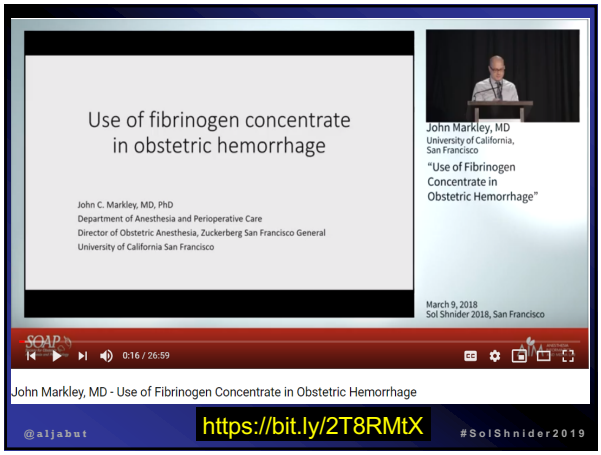
Fibrinogen Concentrate & Postpartum Hemorrhage



John Markley, MD - Use of Fibrinogen Concentrate in Obstetric Hemorrhage

https://bit.ly/2T8RMtX

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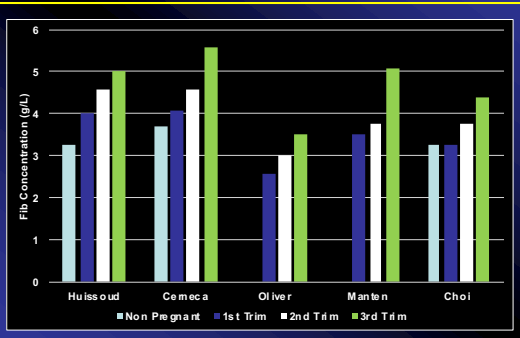
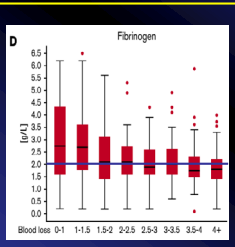
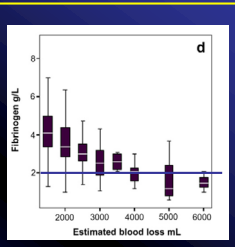
Fibrinogen and Pregnancy



@aljabut *Butwick. Int J Obstet Anesth 2013; 22: 87-91* #SolShnider2019

Fibrinogen Levels and Blood Loss





Gillissen. Blood Adv 2018; 2: 2433-2442

De Lloyd. Int J Obstet Anesth 2011; 20: 135–141

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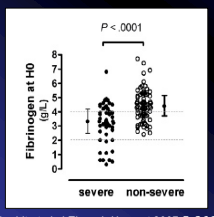
Fibrinogen & Severe Blood Loss Progression



Charbit et al. J Thromb Hemost 2007;5:266-73

Fibrinogen < 200 mg/dl = 100% PPV

→ progression to severe PPH

- **Fibrinogen < 200 mg/dl:**
  - **2.7 – 12 fold ↑ risk: Worsening blood loss or morbidity [1-2]**
  - **Transfusion = 100% PPV [3]**

1. *Cortet. Brit J Anaesth 2012; 108:984 – 989*
2. *Gayat. Intensive Care Med 2011; 37: 1816 – 25.*
3. *Collins. Blood 2014; 124: 1727 – 36*

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Are Outcomes Improved After Treating a Low Fibrinogen Level?

What is the Best Product for Fibrinogen Supplementation?

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Fibrinogen Containing Products

Product	Fibrinogen Concentration (g / L)	Volume	Amount to ↑ fibrinogen by 100 mg / dl?
FFP	1 – 3	1 unit = 250 ml	4 units *
Cryoprecipitate	3 - 30	2 pools (10 single units) = 400 ml	2 pools
Fibrinogen Concentrate	20	1 g = 50 ml	2 – 3 g

*Nascimento Anesth Analg 2014; Nascimento Brit J Anaesth 2014; Levy Anesth Analg 2012; Bell Int J Obstet Anesth 2010; Collins Brit J Anaesth 2014**

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Fibrinogen Concentrate

- Sterile,
- Preservative-free
- Lyophilized fibrinogen concentrate

- Each Vial: 900 – 1300 mg fibrinogen
- Dilute in 50 ml Sterile Water

- Give IV
- Not exceed 5 ml / min

Pre-emptive treatment with fibrinogen concentrate for postpartum haemorrhage: randomized controlled trial†

A. J. Wikkelsø[1*], H. M. Edwards[2], A. Afshari[3], J. Stensballe[4], J. Langhoff-Roos[5], C. Albrechtsen[3], K. Ekelund[3], G. Hanke[3], E. L. Secher[3], H. F. Sharif[5], L. M. Pedersen[6], A. Troelstrup[6], J. Lauenborg[7], A. U. Mitchell[1], L. Fuhrmann[1], J. Svare[3], M. G. Madsen[8], B. Badker[8], A. M. Møller[1] and FIB-PPH trial group

Brit J Anaesth 2017; 114 : 623–33

2g RiaSTAP vs. Placebo

	RiaSTAP (n=123)	Placebo (n=121)	P
EBL at inclusion (ml)	1493 (489)	1426 (463)	-
Baseline fibrinogen (g/L)	4.5 (1.1)	4.5 (1.3)	NS
Postpartum RBC transfusion	20%	22%	0.9
RBC transfusion within 4 hrs	3%	8%	0.37

Viscoelastometric-guided early fibrinogen concentrate replacement during postpartum haemorrhage: OBS2, a double-blind randomized controlled trial

P. W. Collins[1,*], R. Cannings-John[2], D. Bruynseels[3], S. Mallaiah[4], J. Dick[5], C. Elton[6], A. D. Weeks[7], J. Sanders[8], N. Aawar[2], J. Townson[2], K. Hood[2], J. E. Hall[9] and R. E. Collis[3] on behalf the OBS2 study team†

Brit J Anaesth 2017; 119 : 411–21

RiaSTAP (weight based dose) vs. Placebo:
Severe PPH with FIBtem A5≤15 mm

	RiaSTAP (n=28)	Placebo (n=27)	P
Blood loss at study drug delivery	1950 [1500 – 2280}	2000 [1700 – 2500]	-
Transfusion Rate	53%	55%	0.9
Number of units	1 [0 – 2]	1 [0 – 2]	0.45
Blood loss within 24 hr of study medication	225 [100 – 341]	300 [60 – 800]	0.6

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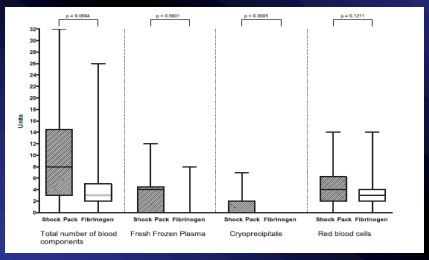
Introduction of an algorithm for ROTEM-guided fibrinogen concentrate administration in major obstetric haemorrhage

S. Mallaiah,[1] P. Barclay,[1] I. Harrod,[2] C. Chevannes[1] and A. Bhalla[2]

Shock Pack vs. Shock Pack with Fib Conc + ROTEM



Anaesthesia 2015; 70: 166-75

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Suggestions for Use

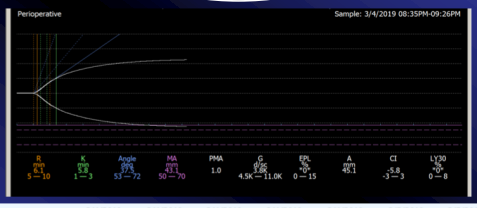
MAJOR ACTIVE BLEEDING

- Fibrinogen ≤ 250 mg / dl
- ROTEM: FibTEM A5 ≤ 10 mm
- TEG: Alpha Angle < 45 °
- *Probably* if no lab / POC value

Repeat labs / POC q 20 – 30 mins

Start with 1 – 2 g RiaSTAP

ABRUPTIONS!!



	3/4/2019 1700	3/4/2019 1823	3/4/2019 2005	3/4/2019 2026	3/4/2019 2140	3/5/2019 0122	3/5/2019 0501
COAGULATION							
D-Dimer	>20.00 *	>20.00 *		>20.00 *	>20.00 *	>20.00 *	
Fibrinogen	<30 *	<30 *		68 *	134	245	
INR	4.7 *	4.7 *		1.7 *	1.5 *	1.3 *	1.2 *
Part Thromboplastin	59.1 *	54.9 *		40.8 *	39.5 *	32.9 *	31.4 *
Prothrombin Time	42.4 *	42.1 *		19.5 *	17.5 *	15.5	14.9

McNamara Int J Obstet Anesth 2015; Green Br J Haematol 2016; Collis Anaesthesia 2015; Collins Blood 2014; Thachil Blood Rev 2009; Levi Thromb Res 2013.

What Are We Doing?

OB Stat	• OB Anesthesia Attending / Fellow / Resident • MFM Attending / SWC Attending / OB Chief Resident • Charge Nurse • If severe PPH (stage 3) – GYN Onc / Trauma / Gen Surgery
All patients: Atony Prophylaxis	• Atony prophylaxis: IV pitocin (for c/section: 1-2 u; cumulative max dose = 5 u over 3-4 mins) + pitocin infusion for maintaining adequate tone • Fundal massage • Measure blood loss – gravimetric + volumetric
STAGE 1 Bleed+ AND >500 ml VD or >1000 mL CS	• Large bore IV x 2 • CBC / PT / PTT / INR / Fibrinogen +/- POCT (TEG or ROTEM) • 100% O_2 (non-rebreather facemask) • 2nd line uterotonic (methergine; hemabate; misoprostol)
STAGE 2 Bleed+ AND EBL ≤1500 mL	• Activate MTP or use T&Cd blood if immediately available • Move to OR if PPH post vaginal delivery – repair tear; D&C; IUBT; embolization • Transfuse (fixed ratio of RBC:FFP:Plt or goal-directed using labs/POCT) + Belmont • Consider early arterial line + ABG • Surgical intervention if c/section (inspect broad lig; B Lynch; IUBT; Embolization)
STAGE 3 Bleed+ AND EBL >1500 mL	• Transfuse (fixed ratio RBC:FFP:Plt or goal-directed using labs/POCT) + Belmont • Watch for acidosis / hypocalcemia / hyperkalemia • Avoid hypothermia (use active warming) • Surgical intervention (laparotomy; B Lynch; UA ligation; hysterectomy)

Pharmacological Adjuncts:
- Fibrinogen concentrate (1-2g IV)
- Tranexamic acid (1 g IV bolus over 10 min; if bleed+ after 30 min, then give 1g IV over 8h)

Many Thanks

Email = ajbut@stanford.edu
@ aljabut
https://www.facebook.com/obstetricanesthesia

Program Slides

Saturday, March 16, 2019

Session VIII: Clinical Conundrums in Obstetric Anesthesia

Moderator/Lead: Alexander Butwick, M.B.,B.S., FRCA, M.S.

Expert Panel: Lawrence Tsen, MD; Ashraf S. Habib, M.B.,B.Ch., M.Sc., M.S.N., FRCA; Edward T. Riley, M.D.; Jennifer M. Lucero, M.D., M.S.

#SOLSHNIDER2019

Clinical Conundrums in Obstetric Anesthesia

ALEXANDER BUTWICK MBBS, FRCA, MS
ASSOCIATE PROFESSOR
DEPARTMENT OF ANESTHESIOLOGY, PERIOPERATIVE, AND PAIN MEDICINE
STANFORD UNIVERSITY SCHOOL OF MEDICINE

@aljabut

Disclosures

- Thank you Dr. Katie Arendt MD (Mayo Clinic)

The EXPERTS

- Lawrence Tsen (Brigham and Women's)
- Ashraf Habib (Duke)
- Edward Riley (Stanford)
- Jennifer Lucero (UCSF)

Guided walk

- Case presentation
- At least 2 courses of action
- Audience vote

Case 1: ThrombocytoPAINia

- 30 y/o G1P0 – 39 weeks
- Admitted Spontaneous Labor
- BMI 40
- Gestational Thrombocytopenia – PLT count today = 50 x 10^9 / L
- She's requesting an epidural – no prior anesthesia consultation

Case 1: ThrombocytoPAINia

What do you do?
1. Perform an Epidural
2. Not Perform an Epidural

Risk of epidural hematoma – Thrombocytopenic patients

- PLT count <100,000 + neuraxial block [1]
  - Systematic Review – 951 patients
  - MPOG – 573 patients

Table 5. Neuraxial Techniques in Thrombocytopenic Parturients Reported from Systematic Review Case Series Combined with Multicenter Perioperative Outcomes Group Data

	Systematic Review Data			MPOG Data Combined with Systematic Review Data		
Platelet Range, mm^{-3}	n (%)	Frequency of Epidural Hematoma Requiring Surgical Decompression	95% CI for Risk of Epidural Hematoma, %	n (%)	Frequency of Epidural Hematoma Requiring Surgical Decompression	95% CI for Risk of Epidural Hematoma, %
0–49,000	12 (1)	0	0–25	27 (2)	0	0–11
50,000–69,000	53 (6)	0	0–6	89 (6)	0	0–3
70,000–100,000	764 (80)	0	0–0.4	1,286 (84)	0	0–0.2
Total	951 (100)	0		1,524 (100)	0	

MPOG = Multicenter Perioperative Outcomes Group.

1. Lee Anesthesiology 2017

Case 1: ThrombocytoPAINia

- **Epidural @ 3cm**
- **Ob performs ARM → pain is getting worse**
- **3 epidural top-ups**
- **Pt still c/o right-sided pain**
- **OB calls c/section for failure to progress (7cm); fetal trace 'ok'**
- **Epidural top-up: 20 ml 2% lidocaine + epi + bicarb**

  – inadequate block (T7 – Left; L1 – Right)

Case 1: ThrombocytoPAINia

What do you do?
- Take out catheter & do another block
- GA
- MAC

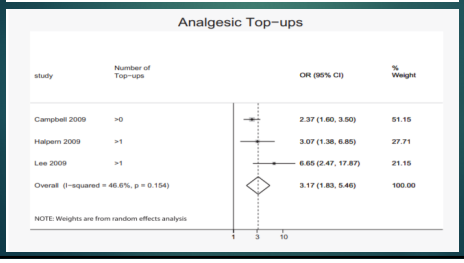
International Journal of Obstetric Anesthesia (2012) 21, 294–309
0959-289X/$ - see front matter © 2012 Elsevier Ltd. All rights reserved.
http://dx.doi.org/10.1016/j.ijoa.2012.05.007

ORIGINAL ARTICLE

ELSEVIER
www.obstetanesthesia.com

Risk factors for failed conversion of labor epidural analgesia to cesarean delivery anesthesia: a systematic review and meta-analysis of observational trials

M.E. Bauer,[a] J.A. Kountanis,[a] L.C. Tsen,[b] M.L. Greenfield,[a] J.M. Mhyre[a]
[a] Department of Anesthesiology, University of Michigan Health System, Ann Arbor, MI, USA
[b] Department of Anesthesiology, Brigham and Women's Hospital, Boston, MA, USA



Case #2: They're Grrrrreeeattt!

25y/o G6P5 at 40 wks

- Spont ROM 2 hrs ago, breech position, 1 prior CS
- Cervix unchanged from clinic
- Non-painful regular contractions
- **OB wants to go to Cesarean now**

Case #2: They're Grrrrreeeattt!

AUDIENCE VOTE:
It is 9pm at night and this patient ate a bowl of Frosted Flakes at 8pm.

Do you delay this case for 6 to 8 hours & do the Cesarean between 2 - 4am?
YES
NO

Case #2: They're Grrrrreeeattt!

Practice Guidelines for Obstetric Anesthesia

*An Updated Report by the American Society of Anesthesiologists Task Force on Obstetric Anesthesia and the Society for Obstetric Anesthesia and Perinatology**

- Solid foods should be avoided in laboring patients
- The patient undergoing elective surgery:

  Fasting period for solids = 6 to 8hrs; depending on the type of food ingested (e.g., fat content)

Anesthesiology 2016; 124:270-300

Practice Guidelines for Preoperative Fasting and the Use of Pharmacologic Agents to Reduce the Risk of Pulmonary Aspiration: Application to Healthy Patients Undergoing Elective Procedures

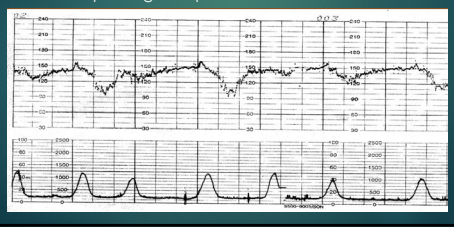
An Updated Report by the American Society of Anesthesiologists Committee on Standards and Practice Parameters

- A light meal or nonhuman milk up to 6 hrs before elective procedures requiring general anesthesia, regional anesthesia, or procedural sedation and analgesia.
- Additional fasting time (e.g., ≥8 hrs) [for] fried foods, fatty foods, or meat
- Since nonhuman milk is similar to solids in gastric emptying time, consider the amount ingested when determining an appropriate fasting period.

Anesthesiology 2017; 126: 376-393

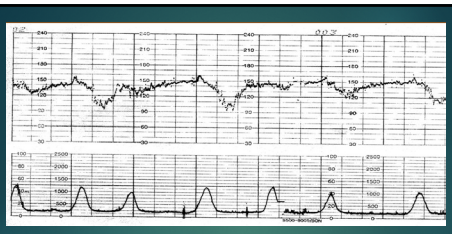
Case #3: Oooo….the strip!

- 32y/o G2P1 at 38wks underwent IOL and labor augmentation with oxytocin.
- ARM – 1 hr ago
- Pain now 10/10; cervix: 7cm
- Now requesting an epidural



Case #3: Oooo….the strip!

What do you do?
1. **Place an epidural**
2. **Place a CSE**
3. **Place a DPE**
4. **Not place any block & use alternate analgesia e.g., IV PCA**



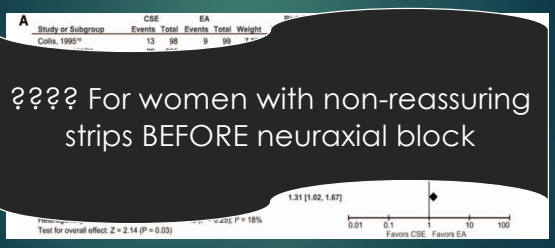
LATE DECELERATION: NICHD Workshop on Electronic Fetal Monitoring

- Symmetrical gradual decrease and return of FHR assoc with uterine contraction
- A gradual FHR decrease: onset - the FHR nadir ≥30 secs
- Nadir of the deceleration after the peak of the contraction
- In most cases, the onset, nadir, and recovery of the deceleration occur after the beginning, peak, and ending of the contraction, respectively.

JOGNN, 37, 510-515; 2008

Case #3: Oooo….the strip!

- CSE vs epidural analgesia: 17 studies; n= 3947
- RR = 1.31, 95% CI:1.02–1.67, nonreassuring FHR



???? For women with non-reassuring strips BEFORE neuraxial block

Hatter. Anesth Analg 2016;123:955–64

Case #4: I could do with a laugh

26y/o G1P0; 40 wks gestation

- Presents with spontaneous labor
- BMI 25; healthy with a reassuring airway exam
- She is requesting pain relief

Case #4: I could do with a laugh

- The patient requests nitrous oxide labor analgesia.
- The patient's nurse is reviewing the protocol for administration.

Case #4: I could do with a laugh

AUDIENCE VOTE:
Do you believe that your anesthesia department should be an integral part of the protocol for administration of nitrous oxide to laboring women?
YES
NO

Case #4: I could do with a laugh

- **Nitrous oxide: less effective than epidural labor analgesia** [1]
- **Side-effects: nausea, vomiting, dizziness, drowsiness** [1]
- **Satisfaction ?** [1]

	Nitrous use among laboring women	Conversion rate to neuraxial analgesia
Sutton (Stanford)[2]	3%	63%
Richardson (Vanderbilt) [3]	19%	40%

1. Anesth Analg 2014. 118: 153-167
2. J Clin Anesth 2017. 40: 40-45
3. Anesth Analg 2017; 124: 548-553

Case #4: I could do with a laugh

She is done with the nitrous and she and her Doula are now requesting a remifentanil PCA.

Case #4: I could do with a laugh

Do you offer this patient a remifentanil PCA?

Audience Vote:
- ❑ Yes, I would offer her a remifentanil PCA.
- ❑ No, I would **not** offer her a remifentanil PCA.

Remifentanil Labor Analgesia

Melber AA. **Remifentanil patient-controlled analgesia (PCA) in labour –in the eye of the storm.** Anaesthesia 2019, 74, 277–279 (Editorial)

Wilson MJ. **Intravenous remifentanil patient-controlled analgesia versus intramuscular pethidine for pain relief in labour (RESPITE): an open-label, multicentre, randomised controlled trial.** Lancet 2018. 392: 662-72

Weibel S. **Patient-controlled analgesia with remifentanil versus alternative analgesic methods for pain relief in labour.** Cochrane Database of Systematic Reviews 2017, Issue 4. CD011989

Freeman LM. **Patient controlled analgesia with remifentanil versus epidural analgesia in labour: randomised multicentre equivalence trial.** BMJ 2015; 350: h846

Case #4: I could do with a laugh

She is done with the nitrous and the remifentanil and now requests **real** analgesia.

You have heard from a colleague that Dural Puncture Epidurals (DPE) are now considered better than epidurals or CSEs.

Do you perform a DPE for this patient?

Case #4: I could do with a laugh

Audience Vote:

- ❑ Yes, I would perform a DPE.
- ❑ No, I would perform an epidural.
- ❑ No, I would perform a CSE.

Case #4: I could do with a laugh

She is now postpartum and is requesting a postpartum tubal ligation. It is 10pm and the plan is to schedule the procedure at 8am the next morning

Do you pull the epidural, or utilize it the next morning for the tubal ligation?

Case #4: I could do with a laugh

Audience Vote:

- ❑ I would leave the catheter in tonight and utilize it the following morning for the PPTL.
- ❑ I would pull the catheter out tonight and perform a single shot spinal tomorrow morning.
- ❑ I would pull the catheter out tonight and do a GA tomorrow morning.

Anesthesia for Tubal Ligations

- **Survey: 26 US Fellowship Directors** [1]
  - **58% keep epidural catheter for tubal**
  - **If no epidural, 96% - single-shot spinal**
- **Failed Epidural top-up rates: 12-26%** [1-2]
- **RFs for failure: poor patient satisfaction; increased delivery-reactivation time; top-ups during labor** [2]

1. McKensie. J Clin Anesth. 2017; 43:39-46
2. Powell. J Clin Anesth 2016; 35: 221-4.

Case #5: A quickie

- G1P0: SVD 2 hr ago with an epidural.
- RN took the epidural catheter out after delivery.
- Now has a retained placenta
- OB calls – patient uncomfortable; placenta 'not coming out'
- Asks if you can give 'some sedation' in the labor room to 'try again'….'it won't take long ☺'

Case #5: A quickie

What do you do?
1. Say yes – give sedation
2. Say no – offer an alternative

Case #5. A quickie

- You say no.
- OB not happy as another patient in labor (9cm)
- You want to do the case in the OR

Case #5: A quickie

What do you do?
1. Spinal
2. Epidural
3. CSE
4. MAC
5. GA

Case #5. A 'not-so' quickie

- You do a spinal
- OB is 'tugging hard' on the placenta but 'thinks it's coming……'
- BP dropping; HR increasing
- Blood loss is 'estimated' ~ 1 L / 5 min
- What next?

Program Slides

Sunday, March 17, 2019

Session IX: Management Updates Safety Session

(ABA Part 2 MOCA Patient Safety Credit)

Moderator: Mark D. Rollins, M.D., Ph.D.

Anesthesia for Non-Obstetric Surgery During Pregnancy
Gillian Abir, M.B., Ch.B., FRCA

Eating During Labor and the "Full Stomach" Pre and Post-Delivery
Atisa B Britton, M.D.

Post-Partum Tubal Ligation: Optimal Anesthetic Technique and Timing
Andrea J. Traynor, M.D.

Non-obstetric Surgery during Pregnancy

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STANFORD UNIVERSITY SCHOOL OF MEDICINE, CALIFORNIA, USA

Disclosures

I have no disclosures

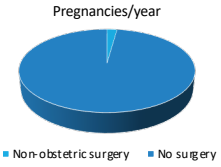
Learning Objectives

- Describe **when, where** and **how to perform** a safe anesthetic for non-obstetric surgery
- List maternal and fetal **risks**
- Summarize **drug** administration during pregnancy
- Evaluate the importance of a **multidisciplinary team**

Incidence

- Approximately 4M births/year (US)

➢ **Up to 88,000 (2.2%) non-obstetric surgery during pregnancy cases/year (US)**



www.cdc.gov/nchs/fastats/births.htm
Brodsky et al. Am J Obstet Gynecol. 1980;138:1165-7

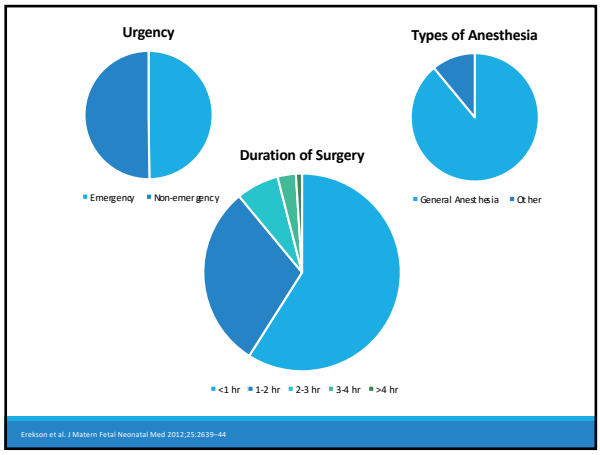
Outline

- **Types of surgery**
- When and where to perform surgery?
- Maternal and fetal risks
- Operative considerations

Types of Surgery

Procedure	%
Appendectomy	**44**
Open	37
Laparoscopic	63
Cholecystectomy	**22**
Open	10
Laparoscopic	90
Intraperitoneal procedures	11
Open	81
Laparoscopic	19
Breast procedures	8
Other (vascular, cardiac, neck)	6
Musculoskeletal procedures	6
Skin, incision + drainage	3

Erekson et al. J Matern Fetal Neonatal Med. 2012;25:2639–44



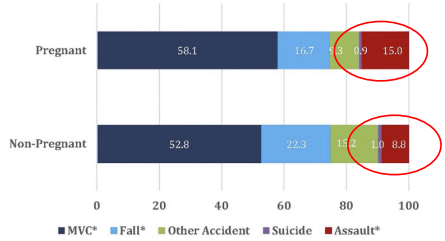
Erekson et al. J Matern Fetal Neonatal Med 2012;25:2639–44

Trauma….

- 3rd leading cause of death for all ages/sex/race
- **Leading** cause of death in **all women <40 yr**
- **Leading non-obstetric cause** of maternal mortality
- Complicates **6-7%** of all pregnancies

www.cdc.gov/nchs/fastats/leading-causes-of-death.htm

Mechanism of Trauma



Women and girls of reproductive age
*Statistically significant difference between pregnant and non-pregnant women (p<0.001)

Deshpande et al. Am J Obstet Gynecol. 2017;217:590.e1-590

Trauma Pregnancy-related Mortality Rate

- Pregnant **trauma** victims: **1.6x** ↑ mortality (p<0.001)
- **Violent** trauma (vs. non-violent): **3.14x** ↑ mortality (p=0.03)

Violent	Non-violent
Assault	Traffic accidents
Homicide	Falls
Rape	Other
Domestic violence	
Suicide	

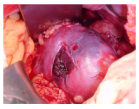
Deshpande et al. Am J Obstet Gynecol. 2017;217:590.e1-590

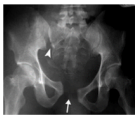
Compared to Non-pregnant Women, Pregnant Women:

Sustain violent trauma	15.9% vs. 9.8% (p<0.001)
Lower Injury Severity Score	**8.9 vs. 10.9 (p<0.001)**
Dead on arrival	aRR 2.33 (P<0.001)
Undergo surgery	aRR 0.70 (p<0.001)
Transfer to another facility	aRR 1.72 (P<0.001)
Die during hospital course	**aRR 1.79 (p=0.004)**

Deshpande et al. Am J Obstet Gynecol. 2017;217:590.e1-590

Why?





- **Physiological** changes in pregnancy
- Challenging physical **examination**
- **Imaging** modalities not fully utilized
- Systems-level factors:
  - Limited ER physician **experience**
  - **Lack** of on-call obstetric services
  - Limited management **protocols** (if any)

➢ **70%** more likely to be **transferred to another facility**
➢ **30%** less likely to go to the **OR**

Deshpande et al. Am J Obstet Gynecol. 2017;217:590.e1-590

Outline

- Types of surgery
- **When and where to perform surgery?**
- Maternal and fetal risks
- Operative considerations

The American College of Obstetricians and Gynecologists | American Society of Anesthesiologists

COMMITTEE OPINION

Number 696 • April 2017 (Replaces Committee Opinion Number 474, February 2011)

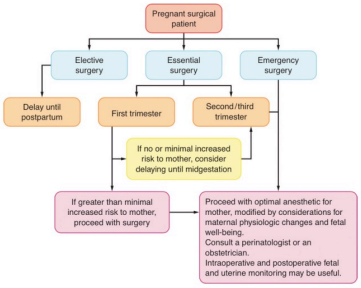
Committee on Obstetric Practice
American Society of Anesthesiologists

Non-obstetric Surgery during Pregnancy

- A pregnant woman should never be denied indicated surgery, regardless of trimester
- Elective surgery should be postponed until after delivery
- If possible, non-urgent surgery should be performed in the 2nd trimester, when preterm contractions and spontaneous abortion are least likely

Obstet Gynecol. 2017;129:777-8

Decision-making Algorithm



Upadya et al. Indian J of Anaesth. 2016;60:234-41

Which Trimester?

Risk of teratogenicity → 1st trimester

2nd trimester

3rd trimester ← Risk of preterm delivery

Logistics

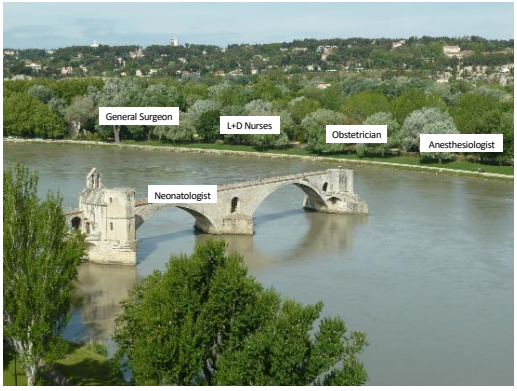
"Think about every possible eventuality ....and then think some more!"

Personnel

- OB team/L+D nurse for *monitoring*
- OB team for *surgery*
- NICU team
- Intensivist

OR equipment

- Uterotonic/lytic medications
- Wedge (LUD)
- Fetal monitor
- Cesarean delivery instruments
- Neonatal resuscitation equipment (multiples?)



Logistics…

PACU

- Fetal monitoring
- Maternal monitoring
- Post-op orders

Patient disposition

- L+D
- Surgical ward
- ICU

Guidelines

Outline

- Types of surgery
- When and where to perform surgery?
- **Maternal and fetal risks**
- Operative considerations

What is the patient thinking….?

- Will the drugs **affect** my baby?
- Will I **loose** my baby?
- Will it affect my ability to **breastfeed**?
- What if I **don't** go ahead with the surgery?

…and what will *your* answers be?

Maternal Risk Increased?

2539 pregnant women matched 1:1 with non-pregnant women undergoing general surgery

- Overall morbidity: **No significant difference**
  - **6.6%** in pregnant women vs. **7.4%** in non-pregnant women (p=0.30)
- 30-day mortality: **No significant difference**
  - **0.4%** in pregnant women vs. **0.3%** in non-pregnant women (p=0.82)

Moore et al. AMA Surg. 2015;150:637-43

30-day Major Postoperative Complications after Non-obstetric Surgery

Predictor	aOR (95% CI)	P value
Age (per 5 yr increase)	1.32 (1.13, 1.53)	<0.001
Preoperative systemic infection	2.30 (1.48, 3.58)	<0.001
New York Heart Class III or IV	3.77 (1.62, 8.81)	0.002
Ventilator dependency	6.72 (1.84, 24.5)	0.004
Functional status (dependent/partially dependent for ADLs)	3.34 (1.48, 7.52)	0.004
Previous procedure (within 30 days)	2.01 (0.84, 4.81)	0.12
Operative time:		
<1 h	1 (reference)	<0.001
1-2 h	3.33 (2.05, 5.39)	0.011
2-3 h	2.66 (1.25, 5.66)	0.008
3-4 h	3.95 (1.44, 10.8)	0.010
>4 h	5.80 (1.53, 22.0)	-

Erekson et al. J Matern Fetal Neonatal Med. 2012;25:2639–44

Maternal Consequences: Physiological

Respiratory:

- ↑ incidence of difficult + failed intubation
- FRC ↓ 20% (↓ 30% if supine)
- Oxygen consumption ↑ 20%

Blood constituents:

- Hypercoaguable
- ↓ platelets
- ↑ fibrinogen

Cardiovascular:

- CO ↑ 50%
- Supine position: CO ↓ 10-20%
- Blood volume ↑ 45%

Reactive NST = Good uterine perfusion = Proxy for maternal status ✓

Chestnut's Obstetric Anesthesia: Principles and Practice. 5th Ed, 2014.

Maternal Consequences: Pharmacodynamics

Physiological effects ✓

- Induction agents (propofol): **Dose ↓ 35%**
- Volatiles (sevo/isoflurane): **MAC ↓ 40%**
- DMR (succinylcholine): **↓ Sensitivity**
- NDMR (aminosteroids): **↑ Sensitivity**
- Vasopressors (phenylephrine): **↓ Sensitivity**

Chestnut's Obstetric Anesthesia: Principles and Practice. 5th Ed, 2014.

Maternal Consequences: Airway

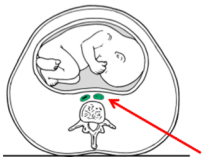
Physiological effects ✓
Pharmacodynamics ✓
Airway

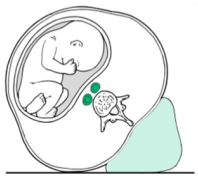
- ETT vs. LMA?
- ↑ risk of aspiration after 18-20 gestation?
- May have dyspepsia/GERD <18 weeks – Ask!
- "*Probably safe* in healthy, selected patients when managed by experienced LMA users"

Han et al. Can J Anesth. 2001;48:1117-21

Maternal Consequences: LUD

Physiological effects ✓
Pharmacodynamics ✓
Airway ✓
LUD





Maternal Consequences: Consent

Physiological effects ✓
Pharmacodynamics ✓
Airway ✓
LUD ✓

Consent for intraoperative CS (if viable)?

Fetal Consequences

- Risk of **fetal loss**
  - 2% simple appendicitis vs.
    6% complicated appendicitis (p<0.05)
  - Laparoscopic vs. open appendectomy = OR 2.31
- Risk of **pre-term labor**
  - 'Considerable risk' within first week post-appendectomy
- Risk of **pre-term delivery**
  - 4% simple appendicitis vs.
    11% complicated appendicitis (p<0.05)

McGory et al. J Am Coll Surg. 2007;205:534–40
Kort et al. Surg Gynecol Obstet. 1993;177:371-6

Teratogenicity Studies

Prospective studies are impractical

Current data taken from:

1) Studies of the reproductive effects of anesthetic agents in small animals
2) Epidemiologic surveys of operating room personnel constantly exposed to sub-anesthetic concentrations of inhalation agents
3) Studies of pregnancy-outcome in women who have undergone surgery while pregnant

Chapter 17, Chestnut's Obstetric Anesthesia: Principles and Practice. 5th Ed, 2014.

Teratogenicity = *Any significant postnatal change in **function** or **form** in an offspring after prenatal treatment*

Drug factors

- Dose
- Duration
- Timing of exposure
- Genetic predisposition

Non-drug factors

- Hypoxia
- Hypercarbia
- Stress/anxiety
- Temperature abnormalities
- Carbohydrate metabolism

Chestnut's Obstetric Anesthesia: Principles and Practice. 5th Ed, 2014.

Drug Categories

- FDA Pregnancy categories: A, B, C, D, X
- Benzodiazepines?
- Nitrous oxide?

➢ *Anesthetic drugs are **not proven as known teratogens***

➢ *Many agents have been used with **no demonstrable difference in maternal and fetal outcomes***

Chestnut's Obstetric Anesthesia: Principles and Practice. 5th Ed, 2014.

Fetal Monitoring

When?
- Pre-op/intra-op/postoperatively

Type?
- Intermittent/continuous

Interpretation?
- OB/L+D nurse?

Consequences?
- Ready to act?
- OB team immediately available
- Equipment readily available

Perioperative Fetal Monitoring

COMMITTEE OPINION

- **If previable** - ascertain FHR by Doppler before and after the procedure
- **If viable*** - as a minimum obtain electronic FHR and contraction monitoring before and after the procedure
- Intraoperative electronic FHR monitoring may be appropriate when all of the following apply:
  - (i) The fetus is **viable**
  - (ii) It is **physically possible** to perform intraoperative electronic fetal monitoring
  - (iii) A health care provider with obstetric surgery privileges is **available and willing to intervene** during the surgical procedure for fetal indications
  - (iv) When possible, the woman has given **informed consent** to emergency cesarean delivery
  - (v) The nature of the planned surgery will allow the **safe interruption or alteration** of the procedure to provide access to perform emergency delivery

*A viable fetus is defined as ≥24 + 0 weeks gestation

Obstet Gynecol. 2017;129:777-8

Outline

- Types of surgery
- When and where to perform surgery?
- Maternal and fetal risks
- **Operative considerations**

Operative Considerations

Maintain maternal and fetal homeostasis:

- Oxygenation
- Carbon dioxide + acid-base balance
- Temperature
- Uteroplacental perfusion (fetal monitoring)

- Cautious positioning
- Cautious surgical techniques
  (insufflation pressures 10-15 mm Hg)
- Treat pre-term labor
  (no need for prophylactic treatment)

Pearl et al. www.sages.org

In Summary

- ✓ Described when, where and how to perform a safe anesthetic for non-obstetric surgery
- ✓ Listed maternal and fetal risks
- ✓ Summarized drug administration during pregnancy
- ✓ Evaluated the importance of multidisciplinary team planning

gabir@stanford.edu

Eating During Labor and the "Full Stomach" Pre and Post Delivery

Atisa Britton, MD
Assistant Clinical Professor
UCSF Department of Anesthesia and Perioperative Care
SOAP 2019 Sol Shnider Meeting

Disclosures

I have no conflicts of interest in relation to this presentation.

Overview

- Gastroesophageal anatomic and physiologic changes in pregnancy
- Data on pulmonary aspiration rates during labor and delivery
- Recommendations from professional organizations on oral intake during labor
- Data on anesthesia for surgical abortions
  → Pregnancy aspiration risk
- Data on anesthesia for PPTL and postpartum physiologic changes
  → Postpartum aspiration risk

Objective

Provide data on peripartum aspiration risk to aide in the development of an informed anesthetic plan for pregnant and postpartum patients

Physiological changes of pregnancy and postpartum period

↓

Concern for increased risk of perioperative pulmonary aspiration

↓

Potential for serious morbidity and mortality

Box 30-1
Anatomic and Physiologic Risk Factors for Airway Complications during Pregnancy

- Airway edema
- Decreased functional residual capacity
- Increased oxygen consumption
- Weight gain
- Breast enlargement
- Full dentition
- Decreased lower esophageal sphincter tone
- Delayed gastric emptying in labor

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TABLE 2-7 Changes in Gastrointestinal Physiology during Pregnancy*

Parameter	Trimester			Labor	Postpartum (18 h)
	FIRST	SECOND	THIRD		
Barrier pressure†	Decreased	Decreased	Decreased	Decreased	?
Gastric emptying	No change	No change	No change	Delayed	No change
Gastric acid secretion	No change	No change	No change	?	?
Proportion of women with gastric volume > 25 mL	No change	No change	No change	Increased	No change
Proportion of women with gastric pH < 2.5	No change	No change	No change	No change	No change

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Gastric acid secretion	No change	No change	No change	?	?
Proportion of women with gastric volume > 25 mL	No change	No change	No change	Increased	No change
Proportion of women with gastric pH < 2.5	No change	No change	No change	No change	No change

*Chestnut, D. Chestnut's Obstetric Anesthesia: Principles and Practice. Fifth edition. Philadelphia, PA: Elsevier/Saunders, 2014.

TABLE 2-7 Changes in Gastrointestinal Physiology during Pregnancy*

Parameter	Trimester			Labor	Postpartum (18 h)
	FIRST	SECOND	THIRD		
Barrier pressure†	Decreased	Decreased	Decreased	Decreased	?
Gastric emptying	No change	No change	No change	Delayed	No change
Gastric acid secretion	No change	No change	No change	?	?
Proportion of women with gastric volume > 25 mL	No change	No change	No change	Increased	No change
Proportion of women with gastric pH < 2.5	No change	No change	No change	No change	No change

*Chestnut, D. Chestnut's Obstetric Anesthesia: Principles and Practice. Fifth edition. Philadelphia, PA: Elsevier/Saunders, 2014.

Peripartum LES: Anatomy & Physiology

- Decreased tone of lower esophageal high pressure zone (LEHPZ)
  - → Intraabdominal segment of the esophagus displaced into the thorax
  - → Progestin
- LEHPZ returns to prepregnancy levels at 1 – 4 weeks postpartum

*Chestnut, D. Chestnut's Obstetric Anesthesia: Principles and Practice. Fifth edition. Philadelphia, PA: Elsevier/Saunders, 2014.

Gastroesophageal Reflux Disease (GERD)

- 30-50% incidence of GERD during pregnancy
  - 80% regurgitation with no heartburn
- Prevalence of GERD
  - First trimester: 10%
  - Second trimester: 40%
  - Third trimester: 55%

*Chestnut, D. Chestnut's Obstetric Anesthesia: Principles and Practice. Fifth edition. Philadelphia, PA: Elsevier/Saunders, 2014.

Risk Factors for GERD during Pregnancy

- Gestational age
- GERD prepregnancy
- Multiparity

*Chestnut, D. Chestnut's Obstetric Anesthesia: Principles and Practice. Fifth edition. Philadelphia, PA: Elsevier/Saunders, 2014.

Risk Factors for GERD

- Gestational age
- GERD prepregnancy
- Multiparity
- ~~Weight gain~~

*Chestnut, D. Chestnut's Obstetric Anesthesia: Principles and Practice. Fifth edition. Philadelphia, PA: Elsevier/Saunders, 2014.

Eating During Labor

THE ASPIRATION OF STOMACH CONTENTS INTO THE LUNGS DURING OBSTETRIC ANESTHESIA*

CURTIS L. MENDELSON, M.D., NEW YORK, N. Y.
(From the Department of Obstetrics and Gynecology, Cornell University Medical College and New York Hospital)

Mendelson. Am J Obstet Gynecol. 1946 Aug;52:191-205.

THE ASPIRATION OF STOMACH CONTENTS INTO THE LUNGS DURING OBSTETRIC ANESTHESIA*

CURTIS L. MENDELSON, M.D., NEW YORK, N. Y.
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Summary

Sixty-six cases of aspiration of stomach contents into the lungs during obstetric anesthesia are analyzed. The incidence of this complication is 0.15 per cent in 44,016 pregnancies at the New York Lying-In Hospital from 1932 to 1945.

Aspiration

Aspiration was recorded as having definitely occurred in the delivery room in 68 per cent. In 32 per cent this complication went unrecognized until later. The character of the aspirated material in the 45 recorded cases was liquid in 40 and solid in five.

Mortality

The two deaths in the series were due to suffocation from complete obstruction by solid undigested food. Both patients had recently ingested a full meal; one eight hours previously, the other six hours previously. Autopsy obtained in the latter case revealed complete obstruction of the major respiratory passages by solid food particles.

Mendelson. Am J Obstet Gynecol. 1946 Aug;52:191-205.

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(From the Department of Obstetrics and Gynecology, Cornell University Medical College and New York Hospital)

Conclusions

7. Aspiration of stomach contents into the lungs is preventable. The dangers of this complication as an obstetric hazard may be avoided by: (a) withholding oral feeding during labor and substituting parenteral administration where necessary; (b) wider use of local anesthesia where indicated and feasible; (c) alkalinization of, and emptying the stomach contents prior to the administration of a general anesthetic; (d) competent administration of general anesthesia with full appreciation of the dangers of aspiration during induction and recovery; (e) adequate delivery-room equipment, including transparent anesthetic masks, tiltable delivery table, suction, laryngoscope, and bronchoscope; and (f) differential diagnosis between the two syndromes described, and prompt institution of suitable therapy.

Mendelson. Am J Obstet Gynecol. 1946 Aug;52:191-205.

THE ASPIRATION OF STOMACH CONTENTS INTO THE LUNGS DURING OBSTETRIC ANESTHESIA*

CURTIS L. MENDELSON, M.D., NEW YORK, N. Y.
(From the Department of Obstetrics and Gynecology, Cornell University Medical College and New York Hospital)

TABLE I. ANALYSIS OF 66 CASES OF ASPIRATION

Prolonged labor,	30 hours or over	9	or 14%
Type of delivery,	Normal spontaneous	29	44%
	Cesarean section	14	21%
	Operative other	23	35%
Anesthesia,	Gas, oxygen, ether	66	100%
Aspiration,	Recorded at delivery	45	68%
	solid	5	
	liquid	40	
	Subsequently diagnosed	21	32%
	Obstructive reaction	6	8%
	suffocation	3	
	massive collapse	2	
	Asthmatic-like reaction	61	92%
	Recorded	55	83%
Cyanosis,	Pulse over 110 per minute	66	100%
Tachycardia,	Respirations over 30 per minute	66	100%
Dyspnea,	Diffuse	15	23%
Chest pathology,	Right only	51	77%
	Left only	0	0%
Morbidity,	Febrile	20	30%
	chest	8	
	pneumonia	6	
	abscess	2	
	other	12	
Chemotherapy,	Sulfonamides	14	21%
	Penicillin	3	5%
	Both	2	3%
Deaths,	Immediate	2	3%
	Later	0	0%

Mendelson. Am J Obstet Gynecol. 1946 Aug;52:191-205.

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Mendelson. Am J Obstet Gynecol. 1946 Aug;52:191-205.

J Clin Anesth. 1998 Sep;10(6):449-51.

Oral intake policies on labor and delivery: a national survey.

Hawkins JL[1], Gibbs CP, Martin-Salvaj G, Orleans M, Beaty B.
Author information

Abstract

STUDY OBJECTIVE: To examine current policies on oral intake during labor among hospitals throughout the United States.

DESIGN AND SETTING: Anonymous questionnaire survey distributed to the directors of anesthesia and obstetrics departments of 740 hospitals. Completed surveys were then grouped by number of deliveries performed each year.

MEASUREMENTS AND MAIN RESULTS: A total of 2,265 surveys were distributed. Of that number, 902 (33% response rate) surveys, representing 740 U.S. hospitals, were returned. Of the surveys returned, 419 surveys were received from obstetricians and 401 surveys were received from anesthesiologists. Oral intake during labor is limited primarily to clear liquids, although hospitals with fewer deliveries allow significantly more oral intake during latent phase than do hospitals with larger services. Allowing nonclear liquids or solid foods is uncommon in either phase of labor, regardless of hospital size.

CONCLUSIONS: The results give an indication of oral intake policies used by labor and delivery units in the United States, and they may be helpful for obstetric services that are in the process of developing their own policies.

Table 1. Hospital Policy on Oral Intake during Labor

Stratum (deliveries/year)	I: ≥1,500 (Percent of responses)	II: 500–1,499 (Percent of responses)	III: <500 (Percent of responses)	Average (Percent of responses)
Latent phase of labor				
a. Nothing by mouth	9*	7*	3	6
b. Ice and/or sips of clear liquids	68*	65*	56	63
c. Unlimited clear liquids	18*	25	29	25
d. Non-clear liquids	2	3	4	3
e. Food permitted	6*	6*	13	8
Active phase of labor				
a. Nothing by mouth	24*	19*	13	18
b. Ice and/or sips of clear liquids	74	73	75	74
c. Unlimited clear liquids	6	8	11	8
d. Non-clear liquids	0	0	0	0
e. Food permitted	0	0	1	0

Note: Percentages may not add to 100% because some respondents checked more than one response.
Using Stratum III as the reference *significantly different at $p < 0.05$.

Hawkins et al. J Clin Anesth. 1998 Sep;10(6):449-51

Eur J Obstet Gynecol Reprod Biol. 1998 May;78(1):37-40.

Aspects of food and fluid intake during labour. Policies of midwives and obstetricians in The Netherlands.

Scheepers HC[1], Essed GG, Brouns F.

Table 1. Policy of midwives and obstetricians regarding food and fluid-intake during normal labour

	Midwives		Obstetricians	
	n	%	n	%
No defined policy	2	5		
Defined policy	12	28	6	27
Restriction to water only	8	20	3	13.5
Light food allowed	4	8	3	13.5
Policy based on preference of women in labour	26	67	16	73

Eur J Obstet Gynecol Reprod Biol. 1998 May;78(1):37-40.

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Am J Obstet Gynecol. 2016 May;214(5):592-6. doi: 10.1016/j.ajog.2016.01.166. Epub 2016 Jan 23.

Restriction of oral intake during labor: whither are we bound?

Sperling JD[1], Dahlke JD[2], Sibai BM[3].
Author information

Abstract

In 1946, Dr Curtis Mendelson suggested that aspiration during general anesthesia for delivery was avoidable by restricting oral intake during labor. This suggestion proved influential, and restriction of oral intake in labor became the norm. These limitations may contribute to fear and feelings of intimidation among parturients. Modern obstetrics, especially in the setting of advances in obstetric anesthesia, does not mirror the clinical landscape of Mendelson; hence, one is left to question if his findings remain relevant or if they should inform current recommendations. The use of general anesthesia at time of cesarean delivery has seen a remarkable decline with increased use of effective neuraxial analgesia as the standard of care in modern obstetric anesthesia. While the American College of Obstetricians and Gynecologists now endorses clear liquids during labor, current recommendations continue to suggest that solid food intake should be avoided. Recent evidence from a systematic review involving 3130 women in active labor suggests that oral intake should not be restricted in women at low risk of complications, given there were no identified benefits or harms of a liberal diet. Aspiration and other adverse maternal outcomes may be unrelated to oral intake in labor and as such, qualitative measures such as patient satisfaction should be paramount. It is time to reassess the impact of oral intake restriction during labor given the minimal risk of aspiration during labor in the setting of modern obstetric anesthesia practices.

L&D Pulmonary Aspiration Rates

- OB Anesthesia Closed Claims: 4.2% (prior to 1990) to 0.46% (1990-2003)
- McDonnell 2008 Study: 0.4%
- SOAP Serious Complications Registry 2014 (>300,000 deliveries, >250,000 neuraxial anesthetics, >5,000 GAs): No aspiration events

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- SOAP Serious Complications Registry 2014 (>300,000 deliveries, >250,000 neuraxial anesthetics, >5,000 GAs): No aspiration events

- Decreased use of GA (increased use of neuraxial anesthesia)
- Aspiration prevention measures
- Improvements in airway management

Distribution of Maternal Cardiac Arrests (n = 4,843), the Nationwide Inpatient Sample 1998–2011

	Potential Proximate Etiology of Maternal Cardiac Arrest, N (%)	Cause-specific Cardiac Arrest Frequency per 1,000 Women with Each Condition	Survival to Hospital Discharge, * N (%)
Postpartum hemorrhage	1,349 (27.9)	0.8	739 (55.1)
Antepartum hemorrhage	813 (16.8)	0.9	433 (53.2)
Heart failure	645 (13.3)	15.6	458 (71.1)
Amniotic fluid embolism	645 (13.3)	252.7	337 (52.5)
Sepsis	544 (11.2)	2.1	256 (46.9)
Anesthesia complication	379 (7.8)	29.5	310 (81.9)
Aspiration pneumonitis	346 (7.1)	20.3	287 (82.9)
Venous thrombo embolism	346 (7.1)	43.9	144 (41.5)
Eclampsia	296 (6.1)	6.2	226 (76.5)
Puerperal	212 (4.4)	13.6	85 (40.0)

Wong et al. Anesthesiology. 2014 Apr;120(4):810-8.

Gastric Ultrasound

Aust N Z J Obstet Gynaecol. 2013 Aug;53(4):369-74. doi: 10.1111/ajo.12079. Epub 2013 Apr 4.

Maternal outcomes in women supplemented with a high-protein drink in labour.

Valleio MC[1], Cobb BT, Steen TL, Singh S, Phelps AL.

Author information

Abstract

BACKGROUND: Because of the potential aspiration risk, oral intake is restricted during labour.

AIMS: To determine whether high-protein drink supplementation in labour decreases nausea and emesis and promotes patient satisfaction.

MATERIALS AND METHODS: The study was registered with www.clinicaltrials.gov (NCT01414478). Labouring women were randomised into two groups: Group P received a high-protein drink (325 mL) with ice chips/water PRN; and Group C served as control and received only ice chips/water PRN (Study 1). Incidences of nausea and emesis were measured hourly until delivery and at 1 h postdelivery. Patient satisfaction was measured the following day. A secondary aim was to evaluate the rate of gastric emptying (½) in women who ingested either 325 mL of a high-protein drink or ice chips/water (Study 2) using ultrasound.

RESULTS: In Study 1, 150 women were recruited (Group P = 75; Group C = 75). There were no differences in the overall incidences of nausea (P = 0.14), emesis (P = 0.15) or in the incidences at the measured time periods (MANOVA, P > 0.05). Median patient satisfaction scores were higher in Group P than in Group C (P = 0.007). In Study 2, 18 additional patients (Group PG = 9; Group CG = 9) were analysed to determine US gastric emptying ½ rates (PG : 25.56 ± 15.90 min [95% CI: 15.17 - 35.94] compared with CG : 20.00 ± 8.70 min [95% CI: 14.34 - 25.66], P = 0.19).

CONCLUSION: In labour, patient satisfaction is improved with high-protein drink supplementation compared with ice chips/water with comparable gastric emptying rates.

Anesthesia. 2016 Nov;71(11):1284-1290. doi: 10.1111/anae.13605. Epub 2016 Aug 26.

Changes in qualitative and quantitative ultrasound assessment of the gastric antrum before and after elective caesarean section in term pregnant women: a prospective cohort study.

Rouget C[1], Chassard D[1,2], Bonnard C[1], Poo M[1], Desgranges FP[1], Bouvet L[3,4].

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Anesth Analg. 2015 Sep;121(3):752-8. doi: 10.1213/ANE.0000000000000818.

Bedside Gastric Ultrasonography in Term Pregnant Women Before Elective Cesarean Delivery: A Prospective Cohort Study.

Arzola C[1], Perlas A, Siddiqui NT, Carvalho JC.

Anesthesiology. 2016 Nov;71(11):1284-1290. doi: 10.1111/anae.13605. Epub 2016 Aug 26.

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Arzola C[1], Pertes A, Siddiqui NT, Carvalho JC.

Eur J Anaesthesiol. 2018 May;35(5):379-389. doi: 10.1097/EJA.0000000000000749.

Ultrasound examination of the antrum to predict gastric content volume in the third trimester of pregnancy as assessed by MRI: A prospective cohort study.

Roukhomovsky M[1], Zieleskiewicz L, Diaz A, Guibaud L, Chaumoitre K, Desgranges FP, Leone M, Chassard D, Bouvet L; AzuRea, CARE/Echo Collaborative Networks.

Br J Anaesth. 2016 Aug;117(2):198-205. doi: 10.1093/bja/aew171.

Ultrasonographic measurement of antral area for estimating gastric fluid volume in parturients.

Zieleskiewicz L[1], Boghossian MC[1], Delmas AC[1], Jay L[2], Bourgoin A[1], Carcopino X[3], Poirier M[1], Cogniat B[2], Stewart A[4], Chassard D[2], Leone M[5], Bouvet L[1]; AzuRea and CARE/Echo Collaborative Networks.

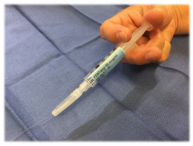
Anesthesiology. 2018 Mar;73(3):295-303. doi: 10.1111/anae.14131. Epub 2017 Dec 19.

Gastric ultrasound in the third trimester of pregnancy: a randomised controlled trial to develop a predictive model of volume assessment.

Arzola C[1], Pertes A[2], Siddiqui NT[1], Downey K[3], Ye XY[4], Carvalho JCA[5].

Neuraxial Opioids and Gastric Emptying

- Although some controversy exists, there is evidence that gastric emptying is delayed in the presence of epidural or intrathecal opioids [1-4]



1. Kelly et al. Anesth Analg. 1997 Oct;85(4):934-6.
2. Porter et al. Anaesthesia. 1997 Dec;52(12):1151-6.
3. Wright et al. Br J Anaesth. 1992 Mar;68(3):248-51.
4. Zimmermann et al. Anesth Analg. 1994 Mar;78(3):543-6.

BMJ. 2009 Mar 24;338:b784. doi: 10.1136/bmj.b784.

Effect of food intake during labour on obstetric outcome: randomised controlled trial.

O'Sullivan G[1], Liu B, Hart D, Seed P, Shennan A.

- 2426 nulliparous, non-diabetic women at term, with a singleton cephalic presenting fetus & in labor with a cervical dilation of < 6 cm
- Consumption of a light diet or water during labor
- Primary outcome: NSVD rate

BMJ. 2009 Mar 24;338:b784. doi: 10.1136/bmj.b784.

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O'Sullivan G[1], Liu B, Hart D, Seed P, Shennan A.

- Other outcomes:
  - Duration of labor
  - Need for augmentation of labor
  - Instrumental and cesarean delivery rates
  - Incidence of vomiting
  - Neonatal outcomes (1 and 5 minute Apgars, NICU or special care baby unit admissions)

BMJ. 2009 Mar 24;338:b784. doi: 10.1136/bmj.b784.

Effect of food intake during labour on obstetric outcome: randomised controlled trial.

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- Results: No differences in any of the outcome measures
- Conclusion: Consumption of a light diet during labor did not influence obstetric or neonatal outcomes in participants

TABLE 2
Recommendations of professional organizations on restriction of oral intake during Labor

Organization	Recommendation	Strength of recommendation
American College of Nurse-Midwives[30]	Self-determination regarding oral intake encouraged for women at low risk for aspiration.	Not provided
American Congress of Obstetricians and Gynecologists, American Society of Anesthesiologists Task Force on Obstetric Anesthesia[3]	Clear liquids for women at low risk for aspiration. Small amounts of clear liquids up to 2 hours before anesthesia for women with no complications.	Not provided
World Health Organization (WHO)[4]	Noninterference with desire for food or liquid intake without reason.	Not provided
Cochrane Review[2]	Since evidence shows no benefits or harms, there is no justification for the restriction of fluids and food in labor for women at low risk of complications.	Not provided
Royal College of Obstetricians and Gynaecologists: NICE Clinical Guideline[10]	Women may eat a light diet in established labor unless they have received opioids or they develop risk factors that make a general anesthesia more likely.	Not provided
Society of Obstetricians and Gynaecologists of Canada[31]	A woman in active labor should be offered a light or liquid diet according to her preference.	Not provided
The Royal Australian and New Zealand College of Obstetricians and Gynaecologists	Women should be encouraged to only have clear fluids and light diet in the active phase of labor.	Not provided

Sperling. Restriction of oral intake during labor: Whither are we bound? Am J Obstet Gynecol 2016.

ACOG **COMMITTEE OPINION**

Number 441 • September 2009

Oral Intake During Labor

Committee on Obstetric Practice

This document reflects emerging clinical and scientific advances as of the date issued and is subject to change. The information should not be construed as dictating an exclusive course of treatment or procedure to be followed.

Reaffirmed 2017

ABSTRACT: There is insufficient evidence to address the safety of any particular fasting period for solids in obstetric patients. Expert opinion supports that patients undergoing either elective cesarean delivery or elective postpartum tubal ligation should undergo a fasting period of 6–8 hours. Adherence to a predetermined fasting period before nonelective surgical procedures (ie, cesarean delivery) is not possible. Therefore, solid foods should be avoided in laboring patients.

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PRACTICE PARAMETERS

Practice Guidelines for Obstetric Anesthesia

*An Updated Report by the American Society of Anesthesiologists Task Force on Obstetric Anesthesia and the Society for Obstetric Anesthesia and Perinatology**

Anesthesiology, V 124 • No 2 February 2016

Recommendations for Aspiration Prevention††

Clear Liquids.

- The oral intake of moderate amounts of clear liquids may be allowed for uncomplicated laboring patients.
- The uncomplicated patient undergoing elective surgery may have clear liquids up to 2 h before induction of anesthesia.

Recommendations for Aspiration Prevention††

Clear Liquids.

- Examples of clear liquids include, but are not limited to, water, fruit juices without pulp, carbonated beverages, clear tea, black coffee, and sports drinks.
- The volume of liquid ingested is less important than the presence of particulate matter in the liquid ingested.

Recommendations for Aspiration Prevention††

Clear Liquids.

- Laboring patients with additional risk factors for aspiration (*e.g.*, morbid obesity, diabetes mellitus, and difficult airway) or patients at increased risk for operative delivery (*e.g.*, nonreassuring fetal heart rate pattern) may have further restrictions of oral intake, determined on a case-by-case basis.

Recommendations for Aspiration Prevention††

Solids.

- Solid foods should be avoided in laboring patients.

Recommendations for Aspiration Prevention††

Solids.

- The patient undergoing elective surgery (*e.g.*, scheduled cesarean delivery or postpartum tubal ligation) should undergo a fasting period for solids of 6 to 8 h depending on the type of food ingested (*e.g.*, fat content).‡‡

Key Points: Eating During Labor

- Divergent recommendations amongst professional organizations worldwide
- Controversy based on low incidence of aspiration + high morbidity
- Evidence shows that eating during labor does not affect obstetric and neonatal outcomes

The "Full Stomach" Pre and Post Delivery

Anesthesia and Aspiration Risk During and After Pregnancy

- No consensus
- No guidelines

"Full Stomach" *Pre* Delivery

Conditions that increase risk of aspiration during induction of anesthesia

Full stomach – nonfasted, emergency surgery or trauma
Pregnancy after 12 to 20 weeks gestation (gestational age for increased risk is controversial)
Symptomatic gastroesophageal reflux
Diabetic or other gastroparesis
Hiatal hernia
Gastric outlet obstruction
Esophageal pathology
Bowel obstruction
Increased intra-abdominal pressure – ascites, abdominal mass

Obstet Gynecol. 2018 Jul;132(1):171-178. doi: 10.1097/AOG.0000000000002692.

Safety of Deep Sedation Without Intubation for Second-Trimester Dilation and Evacuation.

Aksel S[1], Lang L, Steinauer JE, Drey EA, Lederle L, Sokoloff A, Carlisle AS.

Author Information

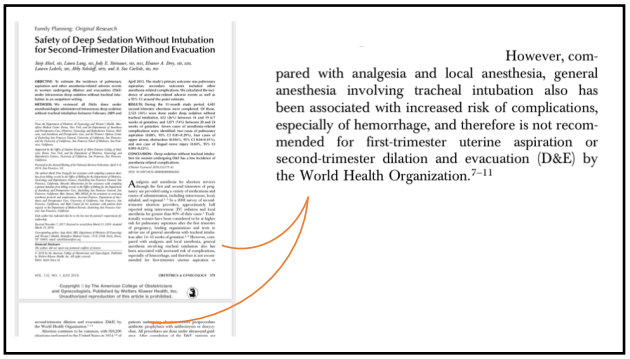
Abstract

OBJECTIVE: To estimate the incidence of pulmonary aspiration and other anesthesia-related adverse events in women undergoing dilation and evacuation (D&E) under intravenous deep sedation without tracheal intubation in an outpatient setting.

METHODS: We reviewed all D&Es done under anesthesiologist-administered intravenous deep sedation without tracheal intubation between February 2009 and April 2013. The study's primary outcome was pulmonary aspiration; secondary outcomes included other anesthesia-related complications. We calculated the incidence of anesthesia-related adverse events as well as a 95% CI around the point estimate.

RESULTS: During the 51-month study period, 4,481 second-trimester abortions were completed. Of these, 2,523 (56%) were done under deep sedation without tracheal intubation, 652 (26%) between 14 and 19 6/7 weeks of gestation, and 1,871 (74%) between 20 and 24 weeks of gestation. Seven cases of anesthesia-related complications were identified: two cases of pulmonary aspiration (0.08%, 95% CI 0.01-0.29%), four cases of upper airway obstruction (0.016%, 95% CI 0.04-0.41%), and one case of lingual nerve injury (0.04%, 95% CI 0.001-0.22%).

CONCLUSION: Deep sedation without tracheal intubation for women undergoing D&E has a low incidence of anesthesia-related complications.



Safety of Deep Sedation Without Intubation for Second-Trimester Dilation and Evacuation

However, compared with analgesia and local anesthesia, general anesthesia involving tracheal intubation also has been associated with increased risk of complications, especially of hemorrhage, and therefore is not recommended for first-trimester uterine aspiration or second-trimester dilation and evacuation (D&E) by the World Health Organization.[7–11]

Study	Sample size	Second trimester patients	Incidence of Aspiration
The safety of deep sedation without intubation for abortion in the outpatient setting Dean et al. J Clin Anesth. 2011	62,125	11,039 (17.8%) 6,752 (10.6%) ≥ 15 wks gestation	None
Intravenous Sedation Without Intubation and the Risk of Anesthesia Complications for Obese and Non-Obese Women Undergoing Surgical Abortion: A Retrospective Cohort Study Gokhale et a. Anesth Analg. 2016	5,579	1,707 (30.6%) 851 (15.3%) were ≥17 wks gestation	None
Deep sedation without intubation during second trimester surgical termination in an inpatient hospital setting Mancuso et al. Contraception. 2017	313	313 (100%) ≥ 16 wks gestation	None

Chloroprocaine Spinal Anesthesia: Back to the Future?

Kenneth Drasner, MD

Department of Anesthesia and Perioperative Care, San Francisco General Hospital, San Francisco, California

Potential Benefits:

- Decreased aspiration risk
- Easy/quick administration
- Decreased recovery time

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Chloroprocaine Spinal Anesthesia: Back to the Future?

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Department of Anesthesia and Perioperative Care, San Francisco General Hospital, San Francisco, California

Potential Risks:

- Neurologic complications / TNS

Summary: "Full Stomach" *Pre* Delivery

- Decreased LES tone as early as the first trimester
- Prevalence of GERD increases dramatically in the second trimester
- Current data shows low incidence of aspiration events in second late trimester abortions performed under deep sedation without intubation
- Major limitation: No prospective data!

"Full Stomach" *Post* Delivery

Int J Obstet Anesth. 2005 Apr;14(2):90-5.

A prospective observational study of the use of the Proseal laryngeal mask airway for postpartum tubal ligation.

Evans NR[1], Sikwero JJ, Bennett PJ, James MF, Dyer RA.

Author information

Abstract

BACKGROUND: Though controversial, the risk of pulmonary aspiration during general anaesthesia in the immediate postpartum period appears low. The efficacy of the Proseal laryngeal mask airway was studied prospectively in a group of patients undergoing postpartum tubal ligation.

METHODS: The Proseal laryngeal mask airway was employed for airway management in 90 fasted patients undergoing tubal ligation via minilaparotomy at least 8 h after normal vaginal delivery (mean 36.5, range 8-96 h). Gastric volume and pH were measured, using aspiration through a gastric tube.

RESULT: Proseal laryngeal mask airway insertion was successful in all patients, requiring one attempt in 75 patients (83%). The median (range) leak pressure was 35 (23-40) cmH2O. Twenty-two patients (25%) had a leak pressure of 40 cmH2O or greater. Gastric tube placement was successful in all patients, described as easy in 79 (87%), and difficult in 11 (13%). The mean initial volume of gastric aspirate was 10.7 (0-64) mL and the final volume 15.6 (0-71) mL. The mean pH of the gastric aspirate was 2.6 (1.2-6.6). There were no incidents of suspected fluid regurgitation or aspiration, but two patients required intubation during surgery. Ten patients (11.1%) complained of sore throat in the recovery room, nine of which were described as mild. All patients reported being satisfied with their anaesthesia.

CONCLUSION: The Proseal laryngeal mask airway provides an effective airway for general anaesthesia in fasted patients undergoing tubal ligation from 8 h after normal vaginal delivery. While the safety of an unprotected airway in this population remains uncertain, this study suggested a low risk of regurgitation, especially in the first 24 h post partum.

Risk Factors for Postpartum Aspiration

- Gastric emptying
- Gastric volume and pH
- Gastroesophageal reflux

Postpartum Gastric Emptying

Paracetamol Absorption Test

Gin et al:

- Day 1 and day 3, 6 weeks – No delay

Whitehead et al:

- 2 hours - Delay
- 18-24 hours, 24-48 hours - No delay

Nimmo et al:

- 2-5 days - No delay

Postpartum Gastric Emptying

Applied Potential Tomography

Sandhar et al:

- 37-40 weeks gestation
- 2-3 days postpartum
- 6 weeks postpartum

} No delay

Epigastric impedance

O'Sullivan et al:

- 60 minutes – No delay

Postpartum Gastric pH and Volume

- No difference in intragastric pH and volume of postpartum women compared to nonpregnant women
  - *Blouw et al*: Mean time to delivery 19.5 hours
  - *Lam et al*: 9 to 120 hours postpartum

Postpartum Gastroesophageal Reflux

- *Vanner and Goodman*: Significant decrease in gastroesophageal reflux by the second day after delivery

Summary: "Full Stomach" *Post* Delivery

- Most studies show no delay in gastric emptying starting at 24 hours
- Reflux is decreased starting at 48 hours
- LEHPZ returns to prepregnancy levels within 1-4 weeks postpartum
- No difference in gastric acid secretion (remains highly acidic)

Aspiration Prophylaxis

- Metoclopramide:
  - Increases lower esophageal sphincter tone
  - Enhances gastric emptying
- Antacids and H2-receptor antagonists
  - Increases gastric pH

Take Away Points

- Peripartum pulmonary aspiration is rare

  …likely too rare to be used as a primary outcome for RCTs
- Peripartum aspiration results in significant maternal morbidity
- LES tone and difficult intubation are major risk factors for aspiration during pregnancy and the immediate postpartum period (+ delayed gastric emptying during labor)

Take Away Points

- ACOG and ASA recommend avoiding solid foods during labor
- Pregnancy induced physiologic and anatomic changes can help guide the anesthetic plan
- Utilizing neuraxial anesthesia (avoiding GA) is the most effective way to reduce the risk of aspiration
- **Need more reliable data informing an evidence-based approach to anesthesia care for pregnant and postpartum women!**

Thank You

Postpartum Tubal Ligation

Andrea J. Traynor, M.D.
Clinical Associate Professor
Obstetric Anesthesiology Fellowship Director
Stanford University School of Medicine

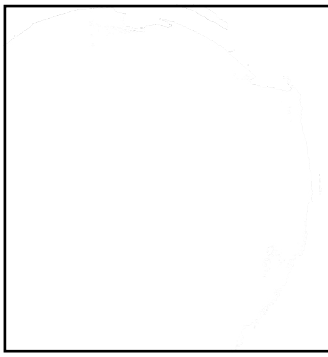
Stanford MEDICINE

Disclosures

Nothing to disclose

Except…..

I'm passionate about this topic!



Why this is important

Decision Making Process

Barriers to Care

Anesthetic Technique

Tubal Ligation

One of the most effective methods of birth control

Failure rate = 6/1000

2nd most commonly used method of birth control

Postpartum Tubal Ligation
Request Completion Rate = 31-56%

Why?

Richardson MG. Anesth Analg 2018;126:1225–31

Unfulfilled Requests

709 Patients

324 (46%) did not receive procedure

121 (37%) - No consent

21 (6.5%) - OR availability

Predominantly African American, Latino, unemployed, unmarried, insured by Medicaid

Zite N, et. Al. *Contraception*. 2006;73:404–407.

Why??

What's the issue with consent?

Consent for Tubal Ligation

Almost half of pregnancy care = Medicaid

Medicaid Title XIX Consent Form – signed, in chart

Over age 18-21, mentally competent

>30 days, not more than 180 days

No Consent = No Tubal

What about patients with co-existing disease?

Complications of Tubal Ligation

Large Swiss study >5000 patients = zero deaths

Complications <0.5%

- Intraabdominal injury, fever, hemorrhage (0.27%), thromboembolic events

Huber AW, Eur J Obstet Gynecol Reprod Biol. 2007;134:105–109.

Complications of Repeat Pregnancy in Sick Patients

Maternal Mortality (CDC) = 23.8 per 100,000

Severe Maternal Morbidity = 144/10,000 delivery hospitalizations (2014)

Racial and ethnic disparities – African Americans most at risk

Interpregnancy interval <18 months increases the risk of:

- Small for Gestational Age
- Preterm Birth
- Low Birth Weight

CDC.gov, accessed 3/16/2019
Richardson MG. Anesth Analg 2018;126:1225–31

Consequences of Unintended Pregnancies

Poor Quality Maternal Child Relationships

Higher rates of Developmental Delay

Adverse effects on maternal mental health

Richardson MG. Anesth Analg 2018;126:1225–31

Staff and OR Availability

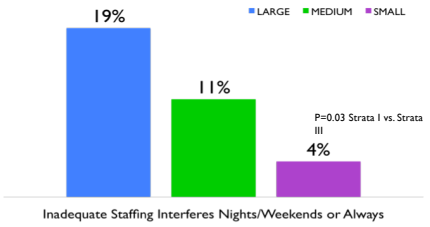
Hospitals Offering PPTL

Stratum I: 85%
Stratum II: 90%
Stratum III: 87%

How often does inadequate staffing interfere with tubal ligation?

Traynor AJ, et. Al. Anesth Analg 2016;122:1939–46

Staff and OR Availability



Traynor AJ, et. Al. Anesth Analg 2016;122:1939–46

1460 Women Delivered

429 Requested PPTL

269 (69%) Received the Procedure

133 (31%) Did not

Those who did not were given similar methods of birth control

Pregnancies within a year?

Thurman AR, Janecek T. Obstet Gynecol. 2010 Nov;116(5):1071-7.

47% pregnant within one year

Thurman AR, Janecek T. Obstet Gynecol. 2010 Nov;116(5):1071-7.

Complications of Repeat Pregnancy in Sick Patients

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Richardson MG. Anesth Analg 2018;126:1225–31

Consequences of Unintended Pregnancy

2010 – 138,853 Medicaid Funded Sterilizations

53% of requests unfulfilled

29,013 unintended pregnancies in the US

Cost of a Medicaid Birth 2010 = $12,744

$371,000,000

Borrero S, et Al. *Contraception*. 2013;88:691–696.

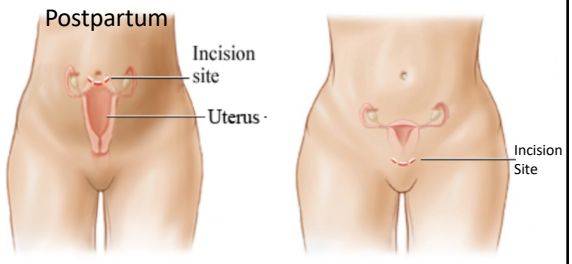
ACOG Committee Opinion #530: Access to Postpartum Sterilization

Committee for Healthcare for Underserved Women

"Given the consequences of a missed procedure and the limited time frame in which it may be performed, **postpartum sterilization should be considered an urgent surgical procedure."**

The American College of Obstetricians and Gynecologists' Committee on Health Care for Underserved Women. Access to postpartum sterilization. Available at: http://www.acog. org/Resources-And-Publications/Committee-Opinions/Committee-on-Health-Care-for-Underserved-Women/Access- to-Postpartum-Sterilization. Accessed March 22, 2017.

How Post Partum Tubal Ligation is Done



Anesthetic Technique

Should I use the epidural?

Success rates 67-90%

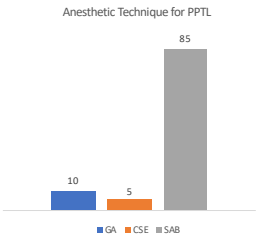
Anesthetic Technique

Single center, 2 years, retrospective

202 patients requesting PPTL

131 - Labor Epidural/CSE (65%)

62 - No reactivation attempted



McKenzie C, et. Al. J Clin Anesth 2017 (43) 39-43

Anesthetic Technique

Reactivation Attempt – 53%, n=69
Successful - 74%, n= 51

Time since INSERTION of catheter more correlated with success

Reactivation - attempted within the 24 hours post-placement, ideally within 8 hours of placement or delivery

McKenzie C, et. Al. J Clin Anesth 2017 (43) 39-43

Anesthetic Technique

Survey: 26 Fellowship Directors from SOAP

44% - Immediately after delivery

44% - > 2h after delivery

McKenzie C, et. Al. J Clin Anesth 2017 (43) 39-43

Epidural Anesthesia

50% left epidurals in place for PPTL after delivery

70% dosed epidurals if <24 hours

23% "rarely or never used epidurals"

McKenzie C, et. Al. J Clin Anesth 2017 (43) 39-43

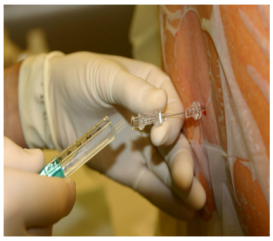
Spinal Anesthesia

Preferred technique no epidural in situ

Bupivacaine 10-12.5mg (48%)

Fentanyl (88%)

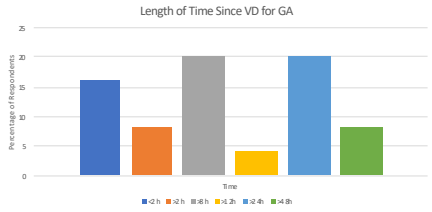
T4-T6 level



McKenzie C, et. Al. J Clin Anesth 2017 (43) 39-43

General Anesthesia

How long after uncomplicated delivery are you willing to provide GA for PPTL?



McKenzie C, et. Al. J Clin Anesth 2017 (43) 39-43

General Anesthesia

Respondents saying that GA was "rarely or never used" = 24%

General Anesthesia

- ProSeal LMA
- 90 Patients undergoing PPTL
- Overall success rate = 100%
- 83% on first attempt
- 3 patients required intubation

Evans NR. IJOA 2005 (14) 90-95

What about aspiration risk?

General Anesthesia

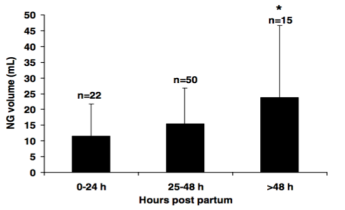


Fig. 2 The relationship between gastric volume and time post partum. *$P = 0.009$ vs. 0-24 h; $P = 0.04$ vs. 25-48 h.

Evans NR. IJOA 2005 (14) 90-95

General Anesthesia

- Zero Cases of Aspiration
- All Patients Satisfied with Anesthesia

Evans NR. IJOA 2005 (14) 90-95

What I do

I love Tubal Ligations!
I will do them anytime….during the day, during the night, on the weekend…
I will do them with an epidural or a spinal, or a CSE, or even a GA if its preferred by she…
I love Tubal Ligations!

What I do

Reactivate Epidural

- Patient worried about repeat procedure
- If interval is short and it worked well for labor

Spinal Anesthesia

1.5ml bupivacaine with fentanyl 15mcg
Aim for T6 level

General Anesthesia

- Normal body habitus = LMA
- Obese = ETT

Obstetric Anesthesiology
Section Editor: Jill M. Mhyre
NARRATIVE REVIEW ARTICLE

CME **Postpartum Tubal Sterilization: Making the Case for Urgency**

Michael G. Richardson, MD,* Sarah J. Hall, MD, PhD,† and Lisa C. Zuckerwise, MD*

The parturient who requests postpartum sterilization has given consideration to and has made decisions regarding this aspect of her medical care long before her delivery. She arrives at parturition expecting the postpartum procedure to be performed as intended. The American Congress of Obstetricians and Gynecologists has reaffirmed its opinion that postpartum sterilization is an urgent procedure, owing to the safety and superior effectiveness of tubal sterilization via minilaparotomy in the immediate postpartum period, and the adverse consequences for mothers, babies, and society when the procedure is not actualized as desired and intended. In contrast, recent practice guidelines for obstetric anesthesia address anesthetic procedural aspects and short-term safety but overlook the long-term complications and considerations associated with failure to perform postpartum sterilization as planned. In practice, procedure completion rates are strikingly low, reportedly ranging from 31% to 52%. Reasons for failure to complete abound and include inadequate resources or inavailability of necessary personnel; obstetrician reluctance due to concerns for patient regret in younger women or medical comorbidities; barriers related to provision of obstetric care in a religiously affiliated hospital, or incomplete, improperly completed, or unavailable original federal consent forms among Medicaid-insured women. The federal requirement to wait 30 days after signing informed consent, and to retain the original signed document to be physically verified at time of the procedure, serves as a significant source of health care disparity for Medicaid-dependent mothers. This article reviews these larger issues of maternal health and comprehensive maternal care to broaden the anesthesiologist's appreciation of major benefits and potential risks of postpartum sterilization, including long-term effects, to promote an evidence-based, informed, and proactive role in delivering equitable, safe, and optimal care for these patients. (Anesth Analg 2018;126:1225–31)

Journal of Clinical Anesthesia 43 (2017) 39–46
Contents lists available at ScienceDirect
Journal of Clinical Anesthesia
ELSEVIER

Original Contribution

Postpartum tubal ligation: A retrospective review of anesthetic management at a single institution and a practice survey of academic institutions

Christine McKenzie [a,1], Seden Akdagli [b], Gillian Abir [c], Brendan Carvalho [c,*]

[a] Department of Anesthesiology, UNC Medical Center, 101 Manning Drive, Chapel Hill, NC 27516, United States
[b] Department of Anesthesiology, SUNY Downstate Medical Center, 450 Clarkson Avenue, Brooklyn, NY 11203, United States
[c] Department of Anesthesiology, Perioperative and Pain Medicine, Stanford University School of Medicine, 300 Pasteur Drive, Stanford, CA 94305, United States

Thank You

SOAP

Brendan Carvalho

Fellows

Program Slides

Sunday, March 17, 2019

Session X: Complications and Uncommon Occurrences

Moderator: Brendan Carvalho, M.B., B.Ch., FRCA

Ethical Dilemmas in Obstetric Anesthesia
Caitlin D. Sutton, B.S., M.D.

Management of Postpartum Headaches
Jessica Ansari, M.D.

The Diagnosis and Management of Peripartum Neurologic Complications
Mark D. Rollins, M.D., Ph.D.

Make Good Choices!

A Primer on Confidently Navigating Ethical Dilemmas in OB Anesthesia

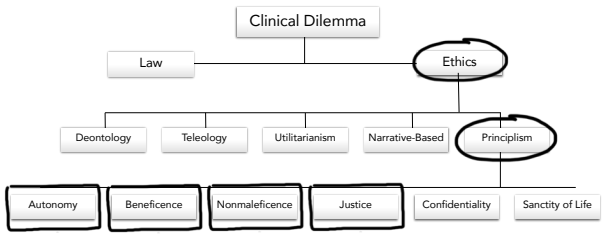
Caitlin Sutton, MD
Texas Children's Hospital · Baylor College of Medicine
Sol Shnider 2019, San Francisco, California

Disclosures

Today we will focus on…

- Ethics fundamentals: What's the most important principle?
- No consent: What now?
- Ethical policy-making: Who gets what?
- Standards of disclosure: What do we need to tell?

Principlism: An Ethical Framework



Beauchamp T, Childress J: Principles of Biomedical Ethics. 1994.

Principlism in Practice

Steps for Ethics Work-Up

1. Define dilemma and alternative courses of action
2. Identify relevant principles
3. Evaluate from the perspective of each principle
4. Prioritize the principles*

Dilemma 1: Lost in Translation

- Patient arrives to L&D alone
- Speaks no English
- Repeated late decels seen on monitor
- Stat CD called
- IV in place, labs and maternal VS WNL

How do you proceed?

Dilemma 1: Lost in Translation

Steps for Ethics Work-Up

1. Define dilemma and alternative courses of action
2. Identify relevant principles
3. Evaluate from the perspective of each principle
4. Prioritize the principles*

Is Autonomy Always #1?

Prima facie principle:

- When competing principles have a stronger argument
- When infringing on the principle of autonomy is the least restrictive
- When infringing on the principle of autonomy protects the competing principles

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.

OB Anesthesia: It's Complicated!

1. Multiple stakeholders: mom, fetus → baby, other parent
2. Impact of pain on decision-making
3. Significant baseline misinformation
4. Strong societal & cultural influence

Dilemma 2: Wait… These new spinal kits don't come with bupivacaine?

- Monday morning after vacation
- Email from pharmacy: bupivacaine supply running low
- Supplier reports bupivacaine is on backorder, and unclear on when more will be available

How do you implement an ethical policy?

Ethics & Drug Shortages: Policy Making

Steps for Ethics Work-Up

1. Define dilemma and alternative courses of action
2. Identify relevant principles
3. Evaluate from the perspective of each principle
4. Prioritize the principles*

Arch Intern Med. 2012;172(19):1494-1499.

Dilemma 3: Should I tell the patient I'm using isobaric bupivacaine?

- New policy has been implemented
- Scheduled and urgent cesareans get isobaric bupivacaine
- Hyperbaric bupivacaine reserved for stat cesarean deliveries

What do you need to tell the patient?

Ethics & Drug Shortages: Patient Care

Steps for Ethics Work-Up

1. Define dilemma and alternative courses of action
2. Identify relevant principles
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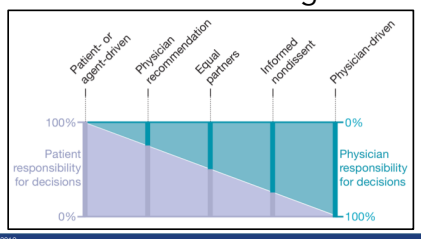
Arch Intern Med. 2012;172(19):1494-1499.

Autonomy, Paternalism & Shared Decision-Making



Kon AA, JAMA 2010.

What risks do we need to tell?

Reasonable Person Standard:
What a reasonable person would want to know
Professional Practice Standard:
What a reasonable physician would say

Broaddus, B. Anesth Analg 2011;112:912-5.
Jackson et al. Can J Anaesth 2000; 47:1068.
Landau, R. IJOA 2006;15:301-305.
Paech, M. Anaesth Int Care 2006;34,2:147-9.
Pattee et al. Can J Anaesth 1997; 44:918.

What risks do we need to tell?

Section Editor: Franklin Dexter

Survey of the National Drug Shortage Effect on Anesthesia and Patient Safety: A Patient Perspective

Ivan Kai-Hsiang Hsia, MD,* Franklin Dexter, MD, PhD,† Ilana Logvinov, RN, MSN, CCRP,‡ Nikola Tankosic, MD,§ Harish Ramakrishna, MD, FACC,§ and Sorin J. Brull, MD, FCARCSI (Hon)‖

BACKGROUND: There are few data on patients' desire to be informed of drug shortages before elective surgery. We surveyed patients who had previously undergone laparoscopic cholecystectomy for their opinions.
METHODS: Nine hundred forty-nine Mayo Clinic patients were invited to participate in the survey. The postal survey posed a hypothetical surgical scenario and requested answers regarding the desire to be informed and to postpone scheduled surgery because of neostigmine shortage. Comparison was made with Canadian patients from a hospital in Ontario.
RESULTS: Most of the 256 respondents wanted "to be told by the anesthesia doctor about the neostigmine shortage" if there were "slight differences" in side effects between the drug combinations (P < 0.0001). The percentage of patients wanting to know was 76.2% (95% confidence interval, 70.5%-81.3%). Secondary analyses tested the validity and reliability of the survey. With each increase in the differences in substituted drug's side effects, there was a progressive increase in the patients' desire for information (P < 0.0001; 73.2%, 76.2%, and 95.7% of 246, 256, and 253 respondents, respectively) and preference for delaying surgery (P < 0.0001; 33.6%, 39.4%, and 80.9% of 238, 246, and 241 respondents, respectively). There was no association with respondents' sex (P = 0.19), age (P = 0.76), educational level (P = 0.39), or country (United States versus Canada) (P = 0.67).
CONCLUSIONS: The majority (>50%) of surveyed patients want to be informed of drug shortages that might affect their care. (Anesth Analg 2015;121:502-6)

Hsia et al. Anesth Analg 2015;121:502-6.

What risks do we need to tell?

Subjective Patient Standard:
What does *this* patient want to know?

Broaddus, B. Anesth Analg 2011;112:912-5.
Jackson et al. Can J Anaesth 2000; 47:1068.
Landau, R. IJOA 2006;15:301-305.
Pattee et al. Can J Anaesth 1997; 44:918.

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Landau, R. IJOA 2006;15:301-305.
Paech, M. Anaesth Int Care 2006;34,2:147-9.
Pattee et al. Can J Anaesth 1997; 44:918.
Ciortea. J Civ L Stud 2018; 191-2.

Summary

- Using principlism to resolve ethical dilemmas in OB anesthesia
- Autonomy: Often (but not always) the top priority
- Shared Decision-Making: Different situations call for different models
- Standards of Disclosure: Aim for subjective patient standard

Management of **Postpartum Headache**

JESSICA ANSARI, MD
CLINICAL INSTRUCTOR OF ANESTHESIOLOGY, PERIOPERATIVE AND PAIN MEDICINE

Stanford University

Disclosures

- None

Stanford University

Overview

- **Incidence and DDx for postpartum headaches**
- **Discuss post dural puncture headache**
- **Review the evidence for epidural blood patch**
- **Review the evidence for other treatments for post dural puncture headache**
- **Review the evidence for preventive measures in case of wet tap**

Stanford University

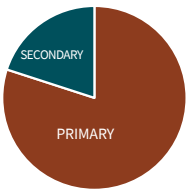
Acute Postpartum headache

- Very common!
- 30-40% incidence in the first days to weeks after delivery in prospective studies

Stanford University

Postpartum Headache*

- 80-90% are **primary**, non-dangerous headaches
  - Tension type headaches
  - Migraines
- Only about 10% are **secondary**
  - Post dural puncture headache
  - Analgesic or caffeine rebound
  - Preeclampsia related
  - Intracranial HTN
  - Cerebral venous sinus thrombosis
  - Brain tumor
  - Other ischemic or hemorrhagic

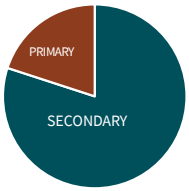


O'Neal. Headaches complicating pregnancy and the postpartum period. BMJ Practical Neurology. 2017

Stanford University

A quick note on the previous slide

- In patients **seeking care for postpartum headache,** the majority (75% in a recent study) are actually secondary headaches
  - Post dural puncture headache
  - Preeclampsia spectrum headaches
  - Bad stuff (bleeds, tumors, etc)
  - Recurrence of migraines



Vgontzas et al. A Hospital Based Retrospective Study of Acute Postpartum Headache Headache. 15 February 2018.

Stanford University

Red flags that warrant careful evaluation

- Hypertension
- Neurological deficits (other than tinnitus and/or muffled hearing)
- Unusually severe or “thunderclap” headaches
- Headaches that worsen when lying down or awaken the patient from sleep
- Loss of previously positional nature of a post dural puncture headache

IMAGING

Stanford University

Post Dural Puncture Headache (PDPH)

- Headache that occurs within 5 days of a neuraxial procedure
- Usually orthostatic (worse upon sitting or standing)
- More than 50% will also have
  - Neck pain or stiffness
  - Photophobia
  - Tinnitus or hypoacusis
  - Nausea

Van de Velde. Ten years of experience with accidental dural puncture and post-dural puncture headache in a tertiary obstetric anaesthesia department. IJOA, 17 (2008)

Stanford University

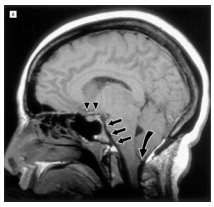
Post Dural Puncture Headache (PDPH)

Occurs when rate leakage is greater than CSF production (0.35ml/min)

Headaches associated with low spinal fluid pressure. Headache. 1990;30(3):122.

Stanford University

Why the headache? CSF hypotension



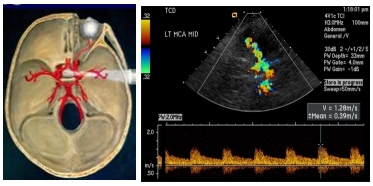
Brain sags in the upright position and stretches the pain sensitive dura, cranial nerves, veins, and sinuses

Kunkle EC, Ray BS, Wolff HG.. Arch Neurol 1949; 49: 323

Stanford University

Why the headache? Compensatory Vasodilation

- Increased cerebral blood flow shown by doppler of middle cerebral artery
- Some cerebral vasoconstrictors offer temporary symptomatic relief (Caffeine, triptans)



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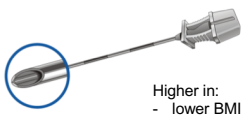
Post Dural Puncture Headache (PDPH)

- When do we see it?
  - Unintended puncture with large bore epidural needle



= 50-80%

Higher in:
- lower BMI
- vaginal delivery (compared to Cesarean)
- Long secomd stage

Headaches associated with low spinal fluid pressure.Headache. 1990;30(3):122.

J. Metzner et al. / Best Practice & Research Clinical Anaesthesiology 25 (2011) 263–276

Stanford University

Post Dural Puncture Headache (PDPH)

- When do we see it?
  - Intentional dural puncture with a 25-27g pencil point needle (spinal for Cesarean, eg)

= 1%

Headaches associated with low spinal fluid pressure.Headache. 1990;30(3):122.
J. Metzner et al. / Best Practice & Research Clinical Anaesthesiology 25 (2011) 263–276

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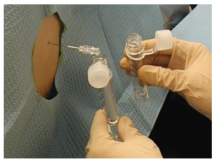
Post Dural Puncture Headache (PDPH)

- When do we see it?
  - Spinal tap (lumbar puncture) with a 20-22g cutting needle



= 10-30%

Larger bore, cutting needle

Headaches associated with low spinal fluid pressure.Headache. 1990;30(3):122.
J. Metzner et al. / Best Practice & Research Clinical Anaesthesiology 25 (2011) 263–276

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Not benign, and not necessarily self-limited

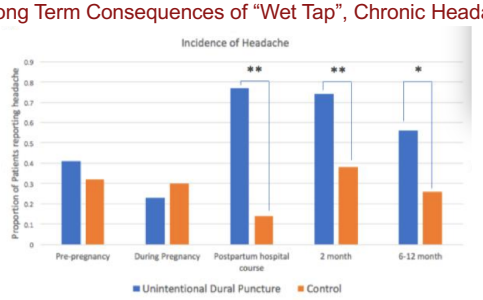
- Limits interaction between mother and infant
- May impact breastfeeding success
- Increased hospital length of stay
- Emergency department visits
- Decreased patient satisfaction
- Lawsuits
- Rare severe sequelae: subdural hematoma and venous sinus thrombosis
- Can be associated with chronic headache and back pain

Anesth Analg. 2012 Jul;115(1):124-32
Best Practice & Research Clinical Anaesthesiology 25 (2011) 263–276
Can J Anesth. 1998;45:6–9

Stanford University

16

Long Term Consequences of "Wet Tap", Chronic Headache



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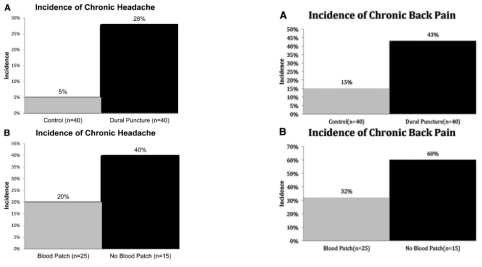
17

Long Term Consequences (1 year) of "Wet Tap" Chronic Headache, Chronic Back ache

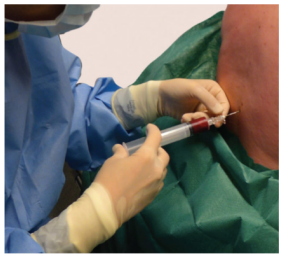


Webb. Anesth Analg 2012;115:124–32

Stanford University

Treatment: Gold standard, the epidural blood patch

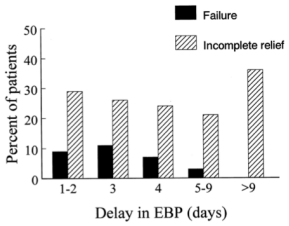
- Sterile injection of 10-30mL of the patient's blood into the epidural space
- Mechanism:
  - Clot over defect in meninges
  - "Pressure patch" pushes CSF cephalad for immediate relief



Stanford University

When Should I do It?

- There is benefit to delay about 24h
- It depends upon the degree of pain
- Practical considerations regarding patient discharge

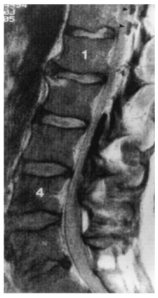


Anesthesiology 8 2001, Vol.95, 334-339

Stanford University

Which level?

- An MRI study using 20 mL blood
  - Spreads 3.5 levels above
  - Spreads 1 level below the site of injection
- **Attempt to perform below or at level of previous dural puncture**

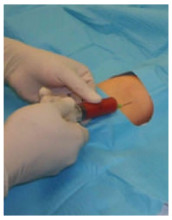


Anesthesiology 1986 64:820-822

Stanford University

How Much Blood Should I Use?

- 121 patients randomized to:
  - 15 mL blood
    - 61% partial relief, 10% complete relief
    - All patients got intended amount
  - 20 mL blood
    - 73% partial relief, 32% complete
    - 81% got intended amount
  - 30 mL blood
    - 67% partial relief, 26% complete
    - Only 54% got intended amount
- Rationale for 20mL as the "sweet spot"

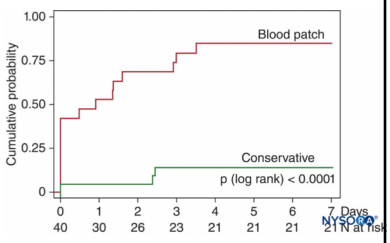


Anesth Analg. 2011 Jul;113(1):126-33, Pain Pract. 2017 Sep;17(7):956-960

Stanford University

Blood Patch Efficacy – it works

- Patients with PDPH after spinal with a 20g cutting needle
- Over 80% of the "conservative treatment" group still have headache at 7 days



Van Kooten. Epidural blood patch in post dural puncture headache: a randomised, observer-blind, controlled clinical trial. " J Neurol Neurosurg Psychiatry. 2008.

Stanford University

Risks and Side Effects

- Pain at injection site
  - 25% experience aching in back, buttocks, or legs
- Neck pain, vagal symptoms (transient bradycardia)
- Repeat unintentional dural puncture
  - Worsening headache if recognized
  - Arachnoiditis if blood injected intrathecally

Anesthesiology 8 2001, Vol.95, 334-339

Stanford University

Treatment: "Conservative management"

- No evidence for bed rest, abdominal binders, or hydration other than symptom palliation
- Not practical for new mothers

Stanford University

Treatment: Caffeine or theophylline

- Mechanism: cerebral vasoconstriction
- In studies, temporary but no prolonged benefit
  - No statistically significant difference in need for blood patch
- Contraindicated in preeclampsia
- Case reports of precipitating seizures

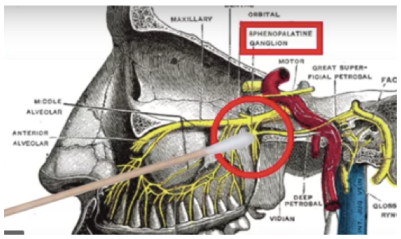
Ona. Drug therapy for treating post-dural puncture headache. 2015 Cochrane

Treatment: Other systemic therapies

- Corticosteroids
  - No benefit to single dose cosyntropin in one small RCT
  - Possible benefit for repeated dosing of hydrocortisone
  - Downside: side effects
- Gabapentin or pregabalin
  - Small studies suggest benefit
- Triptan medications
  - No prolonged benefit in one small RCT
- Neostigmine and atropine

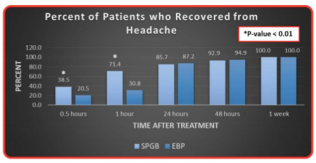
Ona. Drug therapy for treating post-dural puncture headache. 2015 Cochrane

Treatment: Sphenopalatine Ganglion Block



Sphenopalatine Ganglion (SPG) block

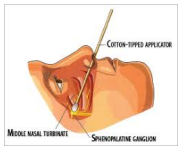
- Retrospective study of patients who received SPG block (42) compared to epidural blood patch (39)
- Better early relief and no difference long term with SPG block



Cohen. Topical Sphenopalatine Ganglion Block Compared With Epidural Blood Patch for Postdural Puncture Headache Management in Postpartum Patients: A Retrospective Review. BMJ Regional Anesthesia and Pain Medicine. 2018.

Sphenopalatine Ganglion Block

1.Soak a long 10 cm cotton-tipped applicator in local anesthetic
2. With the patient's head in a sniffing position, insert the soaked cotton-tipped applicator into the nose
3.Apply firm and steady pressure (similar to the insertion of nasal packing) along the superior border of the middle turbinate until you meet resistance at the posterior wall of the nasopharynx. At this point, the local anesthetic should contact the SPG and anesthetize the ganglion
4.Leave the cotton-tipped applicator in place for 5-10 minutes, after which the patient should experience significant improvement or resolution of their headache



Anesth Analg. 2017 Apr;124(4):1219-1228

The Wet Tap scenario: Can I prevent the headache?

While ***you*** may or may not develop a headache, ***I*** certainly have one!

Prevention: Not worth forcing bed rest

- No evidence to support the common practice of recommending bed rest and aggressive hydration in the prevention of PDPH.

Stanford University

Prevention: Low hanging fruit

- Replace some CSF volume with the sterile LOR saline
  - One small study (n = 43), immediate injection of 10 mL saline through the epidural needle substantially reduced the incidence of PDPH (32%, compared with 62% in a matched control group) and decreased need for EBP (p = 0.004).
- Consider replacing stylet prior to removing needle
  - May prevent a "wicking strand" of arachnoid from coming out

Strupp. Incidence of post lumbar puncture syndrome reduced by reinserting the stylet. 1998
Kuczkowski. Decrease in the incidence of post-dural puncture headache: Maintaining CSF volume. 2003

Stanford University

Prevention: Intrathecal catheters

Meta analysis of 9 studies:
- May not decrease incidence of PDPH
  - (RR 0.82, CI 0.67-1.1)
- Do decrease need for blood patch
  - (RR 0.64, CI 0.49-0.84)
- Need to be left >24hours

Risk / benefit depends on institution and patient factors
- Difficulty of placing block
- Comfort with intrathecal dosing
- Anticipated time to delivery

Heesen . Insertion of an intrathecal catheter following accidental dural puncture: A meta-analysis. IJOA. 2013

Stanford University

Prevention: Prophylactic blood patch

- Mixed depending on study design
- Best study by Scavone et al (prospective, randomized, double blind)
  - 64 parturients
    - 56% of prophylactic EBP group get PDPH
    - 56% of sham EBP group get PDPH
    - Trend toward less need for blood patches in the prophylactic group
    - Shorter duration of headache in prophylactic group (5 -> 2 days)
- Most have moved away from prophylactic blood patch
  - Evidence isn't great
  - Unnecessary treatment of some women who wouldn't get a headache

Scavone. Efficacy of a prophylactic epidural blood patch in preventing post dural puncture headache in parturients after inadvertent dural puncture. Anesthesiology 2004

Stanford University

Prevention: Cosyntropin

- ACTH analog
- Mechanism unknown: possibly
  - increases CSF production
  - decreases inflammation
  - acts on opioid receptors
- RCT data: 1mg cosyntropin compared to placebo for prophylaxis
  - 69% PDPH in control group
    - 30% needed EBP
  - 33% PDPH in cosyntropin group
    - 11% needed EBP

Hakim. Cosyntropin for prophylaxis against postdural puncture headache after accidental dural puncture. Anesthesiology 2010

Stanford University

Summary

- Postpartum headaches are common and generally benign
- Women seeking help for headaches generally require treatment for:
  - Post dural puncture headache (most common)
  - Preeclampsia-related headache
  - Migraine disorder recurrence
  - Other bad stuff that requires imaging
- Watch for:
  - HTN
  - focal neurological deficits
  - "thunderclap" symptoms
  - Nonpostural headaches

Stanford University

Summary

- Postdural puncture headaches
  - Are not necessarily benign
  - Are linked to long term headache and back pain

Stanford University

Summary

- Treatment should be offered to women with post dural puncture headache
  - Blood patch is the gold standard
  - Sphenopalatine ganglion block promising for:
    - Milder headache / spinal associated headache
    - Helping patient wait 24h for blood patch
    - Patients who refuse blood patch
  - Bed rest, caffeine, and hydration are *not* evidence based or recommended substitutes

Stanford University

Summary

- If you have a wet tap with an epidural needle:
  - Counsel the patient and follow carefully postpartum
    - 50-80% will develop headache, usually in 24-48 hours
    - Introduce the concept of blood patch so it sounds less crazy
  - Consider flushing 10mL sterile saline intrathecally
  - Possible small benefit to intrathecal catheter
    - Use your judgement given the patient and your institution
  - No great evidence for prophylactic blood patch
  - Consider one dose of cosyntropin after delivery, especially if blood patch may prove very difficult

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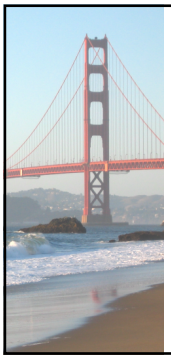

The Diagnosis and Management of Peripartum Neurologic Complications

Sol Shnider

Obstetric Anesthesia Conference

March 17, 2019

Mark Rollins, MD, PhD
Professor & Director Obstetric Anesthesia
University of Utah
Department of Anesthesiology

No Disclosures

Objectives

REVIEW

1) **Incidence and Diagnosis of Neurologic Injury**
2) **Risk Factors and Prevention**
3) **Management of the Neurologic Deficit**

Obstetric Neurologic Injuries

Anesthesia:

- Needle/catheter trauma
- Intraneural injection
- Ischemic / neurotoxic
- Bleeding / hematoma
- Infection

Childbirth:

- Fetal descent
- Positioning
- Operative delivery
- Cesarean section
- Ischemic injury

Incidence of Epidural Hematoma, Infection, and Neurologic Injury in Obstetric Patients with Epidural Analgesia/Anesthesia

Wilhelm Ruppen, M.D., Sheena Derry, M.A.,† Henry McQuay, D.M.,‡ R. Andrew Moore, D.Sc.§*

Anesthesiology, August 2006

1.37 million women receiving labor epidurals:

- Deep epidural infections — 1 in 145,000
- Epidural Hematoma — 1 in 168,000
- Persistent Neurologic Injury — 1 in 240,000
- Transient Neurologic Injury — 1 in 6,700

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.

Anesthesiology, June 2014

Serious Complication	Totals	Incidence	95% CI	Anesthesia Related	Incidence	95% CI
Maternal death	30	1:10,250	1:7,180, 1:15,192	0		
Cardiac arrest	43†	1:7,151	1:5,319, 1:9,615	2	1:128,398	1:35,544, 1:1,060,218
Myocardial infarction	2	1:153,748	1:42,562, 1:1,269,541	2	1:128,398	1:35,544, 1:1,060,218
Epidural abscess/meningitis	4			4	1:62,866	1:25,074, 1:235,620
Epidural hematoma	1			1	1:251,463	1:46,090, 1:10,142,861
Serious neurologic injury	27	1:11,389	1:7,828, 1:17,281	7	1:35,923	1:17,805, 1:91,244
Aspiration	0			0		
Failed intubation	10			10	1:533	1:290, 1:971
High neuraxial block	58			58‡	1:4,336	1:3,356, 1:5,587
Anaphylaxis	5§	1:61,499	1:26,353, 1:189,403	0		
Respiratory arrest in labor suite	25	1:8,455	1:5,714, 1:12,500	16	1:10,042	1:6,172, 1:16,131
Unrecognized spinal catheter	14			14	1:15,435	1:9,176, 1:25,634
Total	157‖	1:1,959	1:1,675, 1:2,294	85#	1:3,021	1:2,443, 1:3,782

Serious Complications Related to Obstetric Anesthesia

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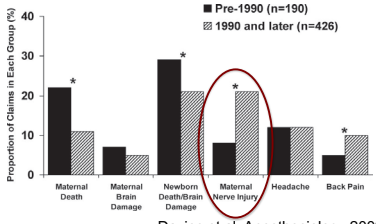
Robert D'Angelo, M.D., Richard M. Smiley, M.D., Ph.D., Edward T. Riley, M.D., Scott Segal, M.D., M.H.C.M.

Anesthesiology, June 2014

257,000 obstetric anesthetics:

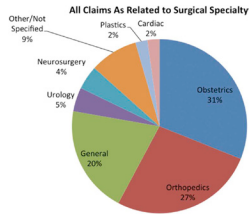
- Epidural Abscess/Meningitis 1 in 63,000
- Epidural Hematoma 1 in 251,000
- Serious Neurologic Injury 1 in 11,000
- Anesthesia Neurologic Injury 1 in 36,000

Injuries in Obstetric Anesthesia Closed Claims



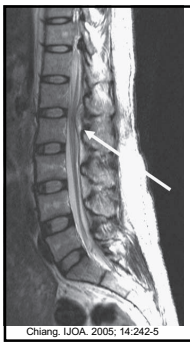
Davies et al. Anesthesiology 2009; 110(1): 131-9

Injuries in Obstetric Anesthesia Closed Claims



Contributing factor category	Present in percent of claims (n)
Technical knowledge/performance	88.9 (40)
Documentation error/missing	35.6 (16)
Delayed specialist consultation	20 (9)
Patient comorbidity (non-neurologic)	20 (9)
Pre-existing injury/radiculopathy	17.8 (8)
Bleeding/coagulopathy	11.1 (5)
Delayed/missed diagnosis	6.7 (3)
Surgical trauma	6.7 (3)

Huang H et al. Journal of Clinical Anesthesia 57 (2019) 66–71

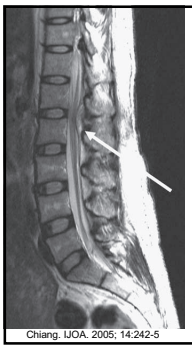


Chiang. IJOA. 2005; 14:242-5

Transient Neurologic Symptoms

• Signs & Symptoms

- Pain of buttocks & thighs with possible radiation to the lower extremities.
- May start a few hours after a spinal anesthetic and may last as long as 10 days.
- Exclusively a pain syndrome: no associated weakness or loss of bowel or bladder function.
- Typically will resolve within 10 days



Chiang. IJOA. 2005; 14:242-5

Epidural Abscess

Rate (0.6-2.6/100,000)[1]

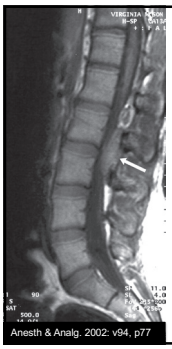
• Signs & Symptoms

- Presents 4 to 10 days postpartum
- Backache & localized tenderness
- Most common organism *Staph aureus*
- Fever, headache, neck stiffness

• Suspicion

- MRI w/ gadolinium
- Antibiotics & surgical decompression

1) Chambers DJ, et al. 2016. Anaesthesia & Intensive Care Medicine 17(8):372



Anesth & Analg. 2002: v94, p77

Epidural Hematoma

Rate (1.3- 1.8/100,000)[1]

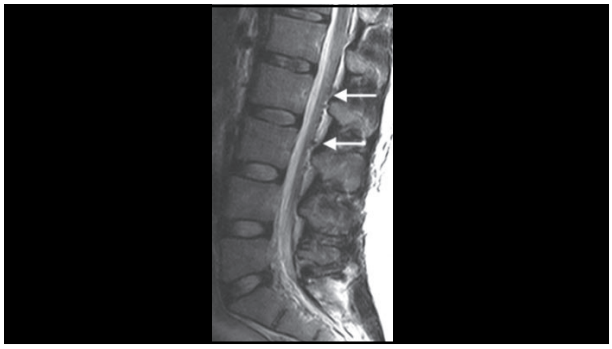
• Signs & Symptoms

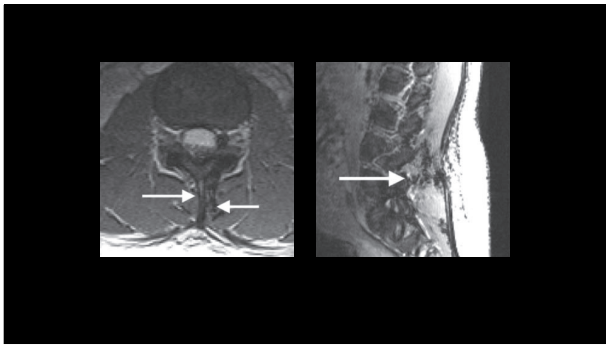
- Acute back and radicular pain
- Lower limb numbness & weakness
- Urinary and bowel dysfunction

• Suspicion

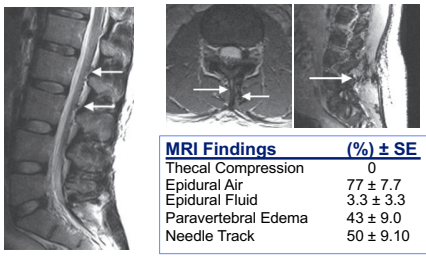
- Immediate MRI & Neuro consult
- Minimize time to decompression

1) Chambers DJ, et al. 2016. Anaesthesia & Intensive Care Medicine 17(8):372





MRI after Neuraxial Analgesia



MRI Findings	(%) ± SE
Thecal Compression	0
Epidural Air	77 ± 7.7
Epidural Fluid	3.3 ± 3.3
Paravertebral Edema	43 ± 9.0
Needle Track	50 ± 9.10

Horlocker T, et al. Anesth Analg 2010; 110:233-7

Obstetric Anesthesia Neurologic Injuries

Direct Trauma and Injury

Single root neuropathy (0.75-3.7 / 10,000) [1,2]

Radicular injuries often w/ pain or paresthesias [3]

Damage to conus medullaris from spinal/CSE [4]

Neurotoxicity from wrong drug or high concentration

1) Scott DB, et al. BJA 1990; 64:537-41
2) Scott DB, et al. IJOA 1995; 4:133-9
3) Auroy Y, et al. Anesthesiology 1197; 87:479-86
4)Reynolds F, et al. Anaesthesia 2001; 56:238-47

Obstetric Anesthesia Neurologic Injuries

Prevention

- Thorough Pre-procedure H&P
- Stop needle advancement if pain
- Inject or place catheter only if pain resolved
- If pain persists or reoccurs with injection then resite
- Use of low lumbar puncture site
- Double check drug and dosage
- Aseptic technique wash hands, wear hat & mask

Wong CA. Reg Anesth Pain Med 2004; 29:341-51

Neurologic Injuries Intrinsic to Childbirth

Reported incidence ranges between 1 to 92 in 10,000 (approaching 1%)

Symptoms improve or resolve in vast majority

Median duration 6 – 8 weeks

Wong CA. Best Practice & Research Clinical OB & Gyn 2010; 24:367-81

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Childbirth Risk Factors for Neurologic Injury

- **Prolonged Second Stage of Labor**
- **Nulliparous**
- ? Degree of Neuraxial Labor Analgesia
- ? Positioning / Time in Lithotomy Position
- ? Operative delivery
- ? Malpresentation

Wong CA. Reg Anesth Pain Med 2004; 29:341-51
Haller G. et al. Acta Anaesthesiologica Scandinavica 2017; 61:1203–14

Intrinsic Nerve Injury

Nerve	Roots	Sensory Deficit	Motor Deficit
Lateral Fem Cutaneous	L2-L3	Anterolateral Thigh	None
Femoral	L2-L4 (posterior)	Anteromedial Thigh Medial Calf & Medial Foot	Hip Flexion & Knee Extension Patellar Reflex
Obturator	L2-L4 (anterior)	Medial Thigh Medial Knee	Hip Adduction
Lumbosacral Plexus*	L1-S4	Lateral Leg Dorsum Foot	Foot Dorsiflexion & Eversion Hip Extension & Abduction
Sciatic	L4-S3	Buttocks & Posterior Thigh Lateral Leg & Dorsum Foot	Knee Flexion
Peroneal	L4-S2	Anteriolateral Leg Dorsum Foot & Toes	Foot Dorsiflexion & Eversion
Posterior Tibial	L4-S3	Sole of Foot	Foot Plantar Flexion & Inversion

* Peroneal components most common but may be more extensive with additional neural components injured

Tsen LC. Int Anesthesiol Clin. 2002;40(4):67-88.
Wong CA. Reg Anesth Pain Med 2004; 29:341-51

Lateral Femoral Cutaneous

Postpartum rate of 4 / 1000[1]

Compression under the inguinal ligament

- Sensory deficit along anterolateral aspect of thigh
- Risk with prolonged hip flexion or pressure at waist
- Purely sensory nerve

1) Wong CA. Obstet Gynecol 2003; 101:279

Femoral Nerve

Postpartum rate of 3 / 1,000[1]

Compression under inguinal ligament

- Partial hip flexion and weakness of knee extension
- Diminished patellar reflex
- Hyperesthesia over anteriomedial thigh & medial calf
- Risk with flexion, abduction, external rotation thigh
- Retractor can compress against pelvic wall (C/S)

1) Wong CA. Obstet Gynecol 2003; 101:279

Obturator Nerve

- Fetal / retractor compression on pelvic wall
- Lithotomy position affects obturator canal

- Weakness of hip adduction and internal rotation
- Sensory loss at groin and medial leg
- Abnormal wide gait with leg circumduction

Lumbosacral Plexus Injury

Compression on pelvic wall by fetal head, forceps, or retractors during C/S

- 75% unilateral & 25% bilateral
- Can affect quadriceps, hip adduction, hip flexion
- Foot drop and inversion
- Can resemble pure root or peripheral nerve lesion
- Often multiple root levels
- Risk with large fetus, malpresentation, small pelvis

Sciatic Nerve

- (L4/S2) Peroneal
- (L4/S3) Tibial

Stretch injury with lithotomy and improper leg extension & external hip rotation

- Also misplaced gluteal injections
- Sensory loss lower 2/3 lateral leg
- Sensory loss dorsum of foot
- Weak knee flexion and possible foot drop

Peroneal Nerve

External compression at fibular head

- Weak foot dorsiflexion and eversion
- Sensory loss lower 2/3 lateral leg
- Sensory loss dorsum of foot and toes
- Stirrups, poles, side rails, hand over lateral knee

Foot Drop Differential

Differential	L5 Root	Lumbar Plexus	Sciatic	Peroneal
Ankle Inversion	Weak	Weak	Normal / Weak	Normal
Ankle Jerk	Normal (except S1)	Normal (except S1)	Normal / Weak	Normal
Plantar Flexion	Normal	Normal	Normal / Weak	Normal
Toe Flexion	Weak	Weak	Normal / Weak	Normal
Sensory Loss	L5 Dermatome	Poor Demarked (often Big Toe)	Dorsum Foot Lateral 2/3 Leg	Dorsum Foot Lateral 2/3 Leg
Pain	Common Radicular	Common Can be radicular	Can be severe	Rare

Tsen LC. Int Anesthesiol Clin. 2002;40(4):67-88.
Wong CA. Reg Anesth Pain Med 2004; 29:341-51

Assessment following Neurologic Injury

- H & P including details of labor & delivery
- Assessment neurologic deficits and pain / back pain
- Onset, progression and dermatomal vs. peripheral
- Sensory and motor tone of paraspinous muscles
- Deep palpation of spinous process
- Consider neurologist consultation (EMG and NCS?)
- Consider physical therapist referral

Medicolegal Implications

- Nerve injury was leading cause of claims
- Effective communication between providers, patients & families helps prevent lawsuits
- Most pregnant women want to know possible complications of neuraxial anesthesia (even rare)
- Consider separate consent for neuraxial labor analgesia

Summary

- Serious & permanent neurologic complications are rare
- Intrinsic childbirth injuries may be near 1%
- Prompt recognition, diagnosis & treatment are needed to prevent serious injury
- Effective communication with patients and other providers is essential

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