OB Anesthesia Panel

A case-based discussion of important obstetric anesthesia topics

Rachel Kacmar, MD, Anne Lavoie, MD and Joy Hawkins, MD

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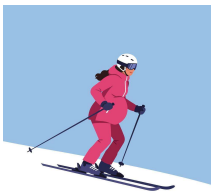

Disclosures

NONE

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Panel Learning Objectives

- Use a case-based approach to integrate evidence-based practice for common challenges in obstetric anesthesia.
- Implement effective management strategies for complex patients with co-existing disease on L&D.
- Evaluate and manage peripartum women experiencing obstetric emergencies.

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Case # 1

- A 38 y/o G3P2 is at 31 weeks gestation. She has a history of a DVT when on oral contraceptive medication 6 years ago between her first and second pregnancies. During her second and the current pregnancies she has taken prophylactic anticoagulation. Her current medication regimen is enoxaparin 40 mg daily (every 24 hours).
- She has been referred to your obstetric anesthesia team for an antenatal anesthetic consultation because of her anticoagulation. Both her previous deliveries were vaginal and uncomplicated, however she was only able to have an epidural with the first due to taking her enoxaparin right before she went into labor with her second child.
- She is otherwise healthy but is anxious that her anticoagulation will again prevent her from receiving neuraxial analgesia during labor and delivery.

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STANDARDS AND PRACTICE PARAMETERS

Statement on Antenatal Anesthesiology Consultation

Developed by: Committee on Obstetric Anesthesia
Original Approval: October 15, 2025

https://www.asahq.org/standards-and-practice-parameters/statement-on-antenatal-anesthesiology-consultation

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Why antenatal consultations?

- US has **highest maternal mortality** ratio of any high-income country.
- **80%** (or more) of pregnancy-related deaths may be **preventable**
- ACOG recommends anesthesia consultations in the antenatal period for the highest-risk parturients

https://www.cdc.gov/maternal-mortality/php/data-research/index.html

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Indications for consultation

- Not your average pregnant patient…or even most of the complicated ones!
- ACOG has recommendations, new ASA Statement also has them
  - These categories/ examples help your obstetric providers know who to refer

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Consultation Structure

Location

Telehealth v. In-person

Staffing/ Personnel

Timing/ Frequency

Telemed J E Health 2020;26(8):967-72. Am J Perinatol 2020;37(8):800-808. Curr Opin Anaesthesiol 2011;24(4):459-62. J Clin Anesth 2016;33:460-8.

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Benefits of antenatal consultations

Quality and Safety:	Health System:
• Improved patient outcomes (maternal and fetal) • Enhanced patient experience • Reduced racial and ethnic disparities • Reduced maternal morbidity and mortality	• Decreased complications and readmissions → improved resource utilization • Improved operating room and L&D efficiency • Increased revenue from bundled payments*

Statement on Anesthesiologists' Role in Reducing Maternal Mortality and Severe Maternal Morbidity 2022. Statement on Reducing Maternal Peripartum Racial and Ethnic Disparities in Anesthesia Care 2021. Br J Anaesth 2023;131(5):937-946. BMJ Open 2022;12(5):e054206.

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Funding and Billing Considerations

FUNDING
- Hospital or other sources of funding may be needed
- Can use success of pre-anesthesia clinics for main OR patients to justify improved outcomes and support

DOCUMENTATION FOR BILLING
- Eligible for payment BUT significant variations exist by payor, legislative and regulatory agencies
- Consult note must have
  - Expanded problem-focused history
  - Expanded problem-focused examination
  - Explanation of medical decision making and need for on-going management** of complex medical issues

Distinguishing Between a Pre-Anesthesia Evaluation and a Separately Reportable Evaluation and Management Service. ASA Committee on Economics 2023. J Clin Med. Apr 29 2025;14(9)doi:10.3390 .

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Billing Considerations Con't

BILLING
- **Work with your billing department to ensure appropriate codes**
- In-person likely different than telehealth

IN-PERSON	TELEHEALTH
"Evaluation and Management (E/M) Codes" that cover medical consultation	Require note with specifics of telehealth modality
e.g. CPT codes 99242-99245	e.g. CPT code 99202 (straightforward decision making), 99203 (moderate complexity of decision making) with modifier 95 for telehealth
	Audio-only consultations can be billed under 98008 - 98015.

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Our Case Continues…

- Following your consultation, the patient's pregnancy proceeds uneventfully.
- However, at her 36 week appointment, ultrasound reveals that the fetus is in breech position and the patient is counseled about the possibility of an external cephalic version (ECV).
- After this discussion she agrees to proceed with ECV and is scheduled for this procedure at 37 weeks and 2 days EGA.
- She presents to your labor and delivery unit for this scheduled procedure…

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STANDARDS AND PRACTICE PARAMETERS

Statement on Anesthesia Management and Support for External Cephalic Version

Developed by: Committee on Obstetric Anesthesia
Original Approval: October 15, 2025

https://www.asahq.org/standards-and-practice-parameters/statement-on-anesthesia-management-and-support-for-external-cephalic-version

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Why ECV and why are we involved?

- ECV recommended by ACOG as a strategy to decrease the rate of cesarean delivery
- Neuraxial analgesia/ anesthesia INCREASES SUCCESS of ECV and vaginal delivery
  - Success of ECV (baby turns ☺) - RR 1.37 (95% CI 1.19 - 1.58)
  - Vaginal delivery - RR 1.23 (95% CI 1.03-1.47)
- Cost effective!
  - 17 C/D prevented for every 100 ECVs attempted

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ACOG
The American College of Obstetricians and Gynecologists

INTERIM UPDATE
2020

ACOG PRACTICE BULLETIN

Clinical Management Guidelines for Obstetrician–Gynecologists

NUMBER 221 *(Replaces Practice Bulletin No. 161, February 2016)*

Committee on Practice Bulletins—Obstetrics. This Practice Bulletin was developed by the Committee on Practice Bulletins—Obstetrics in collaboration with Gayle Olson Koutrouvelis, MD.

INTERIM UPDATE: This Practice Bulletin is updated as highlighted to reflect a limited, focused change in the evidence regarding external cephalic version in women with a previous cesarean birth and the evidence on the inverse relationship between hospital cesarean birth rate and successful external cephalic version. In addition, there is a new Level B recommendation for the consideration of the use of neuraxial analgesia in combination with tocolytic therapy to increase external cephalic version success rate.

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Important Details

- Where?
  - Location varies by facility/ patient but must allow for access to resources for emergency CD
- When?
  - At/ after 37 weeks EGA
  - NPO status should follow ASA Guidelines for an elective procedure
- Who?
  - While the anesthesia team might not be involved in all ECV, the team must be aware they are happening to ensure availability of a team in the case of an emergency CD.

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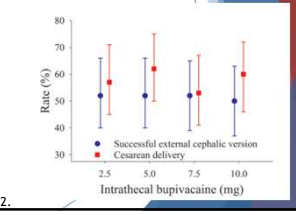
Anesthetic Management for ECV

- Neuraxial techniques increase success of ECV!
- No *standard* technique (I prefer CSE because it can be converted for C/D) but spinal and CSE are probably most common choices
- *NO* difference in success with higher doses (i.e. anesthetic) compared to lower doses of bupivacaine

Effect of Intrathecal Bupivacaine Dose on the Success of External Cephalic Version for Breech Presentation

A Prospective, Randomized, Blinded Clinical Trial

Laurie A. Chaillou, M.D., Jeanette R. Blauchut, M.D, M.S., Nicole Higgins, M.D., Paloma Toledo, M.D., M.P.H., Feyce M. Peralta, M.D., Jason Farrar, M.D., Susan E. Gerber, M.D., M.P.H., Robert J. McCarthy, Pharm.D., John T. Sullivan, M.D., M.B.A.



Anesthesiology. 2017 Oct;127(4):625-632.

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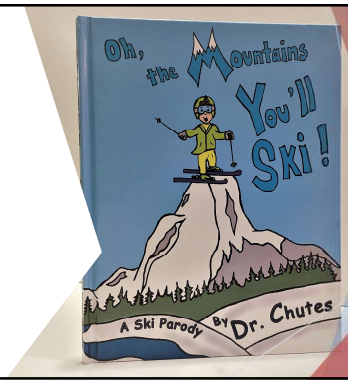
Questions/ Discussion



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OBSTETRIC ANESTHESIA PANEL: CASE PRESENTATION #2

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CASE 2

- A 38 y/o G1P0 at 38.5 wks EGA is undergoing induction of labor. A labor epidural was placed about 13 hours ago and the patient has progressed to 5 cm cervical dilation (last check about 3 hours ago).
- Initially the FHR tracing was Category 1, however the nurse calls to tell you that over the past 45 minutes there have been several late decelerations and the obstetric team is concerned that the patient will require a cesarean delivery if there is no progress in her labor.
- When you check on the patient she reports that her epidural is mainly working on the left side and has seemed less effective over the past hour or so.

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The Retrievals

- Susan Burton NYT, 2023 & 2025

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The Retrievals

- Scandal = Fentanyl
- Real issue : How easily women's pain was ignored
  - Pain was not recognized
  - Women's testimony was not believed
  - The system failed to respond
- Season 2 focuses on pain during cesarean delivery

"This is not only a pain problem, it's a credibility problem of women's lived pain"

Susan Burton NYT, 2023 & 2025

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Review Article

Inadequate neuraxial anaesthesia in patients undergoing elective caesarean section: a systematic review

Table 1 Prevalence of different types of inadequate neuraxial anaesthesia in elective section settings. Values are presented as percentage of patients (95%CI) and number of patients.

	Spinal	Epidural de-novo	Combined spinal–epidural
Studies	32	17	9
Patients	1842	765	890
Supplement type (95%CI); n			
Intravenous opioids	6.6 (5.5–7.8%) (121 patients)	6.4 (4.7–8.5%) (49 patients)	1.9 (1.1–3.1%) (17 patients)
Epidural top-up	-	7.2 (5.4–9.4%) (55 patients)	2.9 (1.9–4.3%)* (26 patients)
General anaesthesia	0 (0.0–0.2%) (0 patients)	0.3 (0.0–0.9%) (2 patients)	0 (0.0–0.4%) (0 patients)
Other	4.3 (3.4–5.4%) (80 patients)	16.5 (13.7–19.6%) (126 patients)	3.8 (2.6–5.3%) (34 patients)

*Patients who underwent non-elective caesarean section via epidural top-up, who then had further epidural top-up as a supplement due to neuraxial inadequacy.

44 RCT n = 3500, ED95% AL, 14.6%, epidural 30% adjustments 30.3% CI95% 26.5-34.5%)

Patel Anaesthesia 2022

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Epidural fentanyl and Caesarean section: when should fentanyl be given?

Terrance W. Breen MD FRCPC, James A. Janzen MD FRCPC

Correspondence

Epidural fentanyl and C-section

Had the authors studied a larger sample population, provided the trends reported in their paper continued, and if a summary statistic was generated for the total intraoperative analgesic supplements given, it is likely that the authors' conclusion would have been quite different. This paper should not discourage clinicians from employing a very useful technique, the administration of a lipid-soluble narcotic during initiation of epidural blockade for Caesarean section to enhance intraoperative anaesthesia.

delivery compared to giving it after, the benefit is small.

Terrance W. Breen MD FRCPC
James A. Janzen MD FRCPC
Department of Anaesthesia
Foothills Hospital
University of Calgary

REFERENCE
1 *Breen TW, Janzen JA.* Epidural fentanyl and Caesarean section: when should fentanyl be given? Can J Anaesth 1992; 39: 317–22.

CAN J ANAESTH 1993 / 40: 8 / pp 796–803

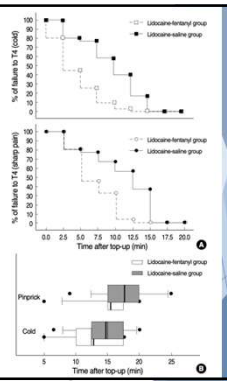
CJA 1992

24

Table 4. Intraoperative side effects

Side effects	Lidocaine-fentanyl group (n=31)	Lidocaine-saline group (n=30)	P
Visceral pain	2 (6.5%)	11 (36.7%)	0.015
Rescue for visceral pain			
Epidural lidocaine	2 (6.5%)	11 (36.7%)	0.012
Fentanyl IV	0 (0%)	4 (13.4%)	NS
Hypotension	4 (12.9%)	2 (6.7%)	NS
Nausea	2 (6.5%)	8 (26.7%)	0.032
Vomiting	3 (9.7%)	5 (16.7%)	NS
Pruritus	3 (9.7%)	1 (3.4%)	NS
Shivering	4 (12.9%)	3 (10.0%)	NS

Data are number of patients (%).
There are more patients who complained of intraoperative visceral pain and were treated with additional epidural lidocaine in the lidocaine-saline group than the lidocaine-fentanyl group.
NS, not significant.



Hong JY J Korean Med Sci. 2010

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Pain during cesarean delivery : meta-analysis & systematic review

- 34 Études 21 RCT 13 non-RCT n = 11 351
  - 1◦ Incidence
  - 2nd Incidence per type of neuraxial technique
- Pain during & linked with cesarean delivery (self reported)
- Grouped incidence = 17%
  - Epidural > CSE > Spinal
- **Epidural 33% CI95 17-54%**
  - Spinal 14% CI95 10-20%

Charles *et al.* Anesthesiology 2025

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Prospective study : incidence of intrapartum pain during cesarean delivery

- Multicentric prospective study
  - n = 3 693 patients North America (SOAP-CHUM)
  - 1◦ Incidence of intrapartum pain during cesarean delivery
  - 2nd Incidence of intrapartum pain during cesarean delivery per technique
- Global incidence 7.6 %
  - **Higher with epidural13.6%**
  - Median pain score: NRS 6/10

O'Carroll *et al.* Anesthesiology 2025

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Higher risk population

- Intrapatum cesarean delivery
- **Retrospective study EPI 33% IC95 17-54%**[1]
- **Prospective study EPI 13.6% IC95 11.1-15.5%**[2]

1. Charles *et al.* Anesthesiology 2025
2. O'Carroll *et al.* Anesthesiology 2025

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« First thing first »

« In the absence of a medical contraindication, maternal request is a sufficient medical indication for pain relief during labor.»

Obstet Gynecol 2004

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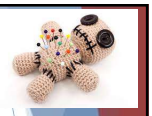
Labor pain



- Among the highest scores on the McGill Pain Questionnaire
  - Amputation of a digit
- Great variability
- Psychologic aspect (anticipation, preparation)
- Biologic aspect : inflammatory mediators

Melzack Pain 1984

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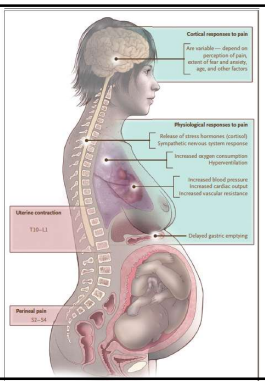

Visceral pain
1st stage T10-L1

Somatic pain
2nd stage S2-S4

Physiologic response to pain = stress

N Engl J Med 2010

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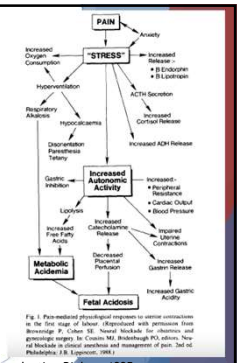
Physiologic response to labor pain

- Neuroendocrine cascade
  - O2 consumption
  - Hyperventilation
  - Respiratory alcalosis
  - 3-5 x plasmatic catecholamine
  - Gastric emptying
  - ↓ Uterine perfusion
  - Uterine contraction alteration (Wong NEJM 2005)



Brownridge European Journal of Obstetrics and Gynecology and Reproductive Biology 1995

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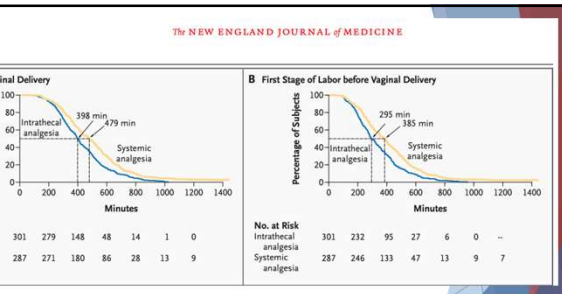

A Mean time difference = 81 minutes CI95 -123 à -28 P<0.001
B Mean time difference = 90 minutes CI95 -123 à -135 P<0.001

Wong NEJM 2005

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Epidural as a treatment

- Effective pain relief is associated with a reduction in circulating catecholamines and attenuation of the adrenergic stress response.
- "Early neuraxial analgesia is recommended to reduce the maternal stress response inherent to labor."

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Epidural and reduction of severe maternal morbidity

Table 2 | Observed events and adjusted relative risks for all outcomes for whole cohort

	Crude event rate							
	All pregnancies (n=567 216)		No epidural analgesia (n=442 192)		Epidural analgesia (n=125 024)		Adjusted relative risk* (95% CI)	P value
	No	% (95% CI)	No	% (95% CI)	No	% (95% CI)		
No epidural analgesia (reference group)	–	–	–	–	–	–	1.00	
SMM	2412	0.43 (0.41 to 0.44)	1885	0.43 (0.41 to 0.45)	527	0.42 (0.39 to 0.46)	0.65 (0.50 to 0.85)	0.001
SMM+critical care admission	927	0.16 (0.15 to 0.17)	750	0.17 (0.16 to 0.18)	177	0.14 (0.12 to 0.16)	0.46 (0.29 to 0.73)	0.001
Respiratory morbidity	241	0.04 (0.04 to 0.05)	200	0.05 (0.04 to 0.05)	41	0.03 (0.02 to 0.04)	0.42 (0.16 to 1.15)	0.09

CI=confidence interval, SMM=severe maternal morbidity.
*Adjusted for maternal height, weight, ethnicity, Scottish index of multiple deprivation, gestation at birth, comorbidity before labour using Bateman index weighted score (restricted to period of 180 days preconception to day before delivery), parity, induction of labour, previous caesarean (before period used for Bateman index), year of birth, smoking in pregnancy, and type of delivery unit.

Severe maternal morbidities = ≥ 1 of 21 entities (CDC) ad 42 days PP
e.g. SCA, Eclampsia, hysterectomy
16 dx et 5 procedures

Kearns BMJ 2024

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Severe maternal morbidity (CDC)

SMM type and indicators
Procedure
Blood transfusion
Hysterectomy
Ventilation
Conversion of cardiac rhythm
Temporary tracheostomy
Condition
Disseminated intravascular coagulation
Acute renal failure
Eclampsia
Sepsis
Adult respiratory distress syndrome
Pulmonary edema or acute heart failure
Shock
Air and thrombotic embolism
Puerperal cerebrovascular disorders
Sickle cell disease with crisis
Cardiac arrest or ventricular fibrillation
Severe anesthesia complications
Amniotic fluid embolism
Acute myocardial infarction
Aneurysm
Heart failure or arrest during surgery

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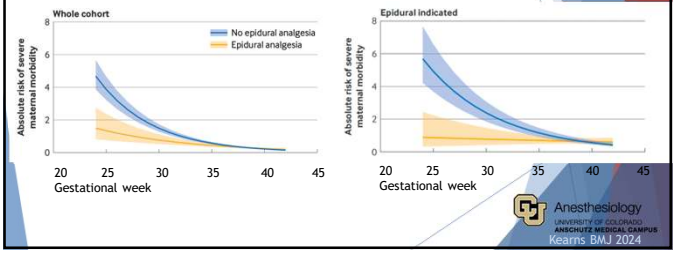
More SMM reduction if medical indication



Anesthesiology
UNIVERSITY OF COLORADO ANSCHUTZ MEDICAL CAMPUS

Kearns BMJ 2024

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EDITORIAL

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

Melissa E. Bauer, DO,* and Jill M. Mhyre, MD†

Society for Obstetric Anesthesia and Perinatology

Section Editor: Jill M. Mhyre

NARRATIVE REVIEW ARTICLE

CME **Failure to Extend Epidural Labor Analgesia for Cesarean Delivery Anesthesia: A Focused Review**

Suzanne K. W. Mankowitz, MD,* Antonio Gonzalez Fiol, MD,† and Richard Smiley, MD, PhD*

Extension of epidural labor analgesia for cesarean delivery anesthesia may fail. There are a number of factors associated with labor epidural catheter failure. This focused review discusses these associations and anesthetic options when faced with inadequate surgical epidural anesthesia for cesarean delivery. (Anesth Analg 2016;123:1174–80)

CRASH

Anesth Analg 2016

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Risk Factors for Failed Conversion

- Systematic review and meta-analysis
  - 13 trials, n = 8628, 1994-2011
- Evaluation of 7 risk factors
  - **Enhanced urgency for CD (OR 40.43)**
  - **Non-obstetric anesthesia provider (OR 4.56)**
  - **Top-ups (OR 3.17)**
  - Higher BMI
  - Longer duration of labor epidural
  - Use of epidural versus CSE
  - Cervical dilation at the time of epidural placement

Bauer Int J Obstet Anesth 2012

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Risk Factors for Failed Conversion

- **Enhanced urgency for CD (OR 40.43)**
- **Non-obstetric anesthesia provider (OR 4.56)**
- **Top-ups (OR 3.17)**

Bauer Int J Obstet Anesth 2012

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Enhanced urgency for CD (OR 40.43)

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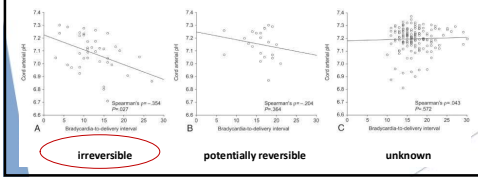
Obstet Gynecol 2009;114:1023–8

Urgent Cesarean Delivery for Fetal Bradycardia

Tak Yeung Leung, MRCOG, MD, Pui Wah Chung, MRCOG, Michael Scott Rogers, FRCOG, MD, Daljit Singh Sahota, PhD, Terence Tzu-Hsi Lao, FRCOG, MD, and Tony Kwok Hung Chung, FRCOG, MD

Table 1. List of Conditions and Number of Cases Categorized Into Irreversible Causes, Potentially Reversible Causes, and Unknown Cause for Fetal Bradycardia

Condition	Number of Cases (%)
Irreversible conditions	39 (16.6)
Placental abruption	9 (3.8)
Cord prolapse	21 (8.9)
Uterine rupture	0 (0)
Preeclampsia	3 (1.3)
Failed instrumental delivery	6 (2.6)
Potentially reversible conditions	22 (9.4)
Iatrogenic uterine hyperstimulation	13 (5.6)
Hypotension after epidural anesthesia	5 (2.1)
After external cephalic version (without abruption)	4 (1.7)
Aortocaval compression	0 (0)
Unknown cause for fetal bradycardia	174 (74.0)



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Royal College (UK) Recommendations

- Conversion under genaral anesthesia
  - < 1% Elective cesarean delivery (CD)
  - < 5% Urgent CD
- Evaluation of FHR in OR

Purva Royal College of Anesthetist 2012

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Table 3:

Adverse events in the 466,014 cesarean deliveries without a recorded clinical indication for general anesthesia in the State Inpatient Database for New York 2003-2014.

	Neuraxial anesthesia (N = 439,583)	General anesthesia (N = 26,431)	Crude OR (95% CI)	P-value [a]	Adjusted OR [b] (95% CI)	P-value [a]
Death or cardiac arrest (missing = 2)	27 (0.6 per 10,000)	_c	_c	0.096	2.44 (0.67-8.93)	0.18
Anesthesia-related complications	2540 (57.8 per 10,000)	217 (82.1 per 10,000)	1.42 (1.24-1.64)	< 0.001	1.62 (1.37-1.92)	< 0.001
Severe anesthesia-related complications [d] (missing = 2)	118 (2.7 per 10,000)	18 (6.8 per 10,000)	2.54 (1.55-4.17)	< 0.001	2.86 (1.58-5.19)	< 0.001
Surgical site infections	2812 (64.0 per 10,000)	342 (129.4 per 10,000)	2.04 (1.83-2.28)	< 0.001	1.74 (1.47-2.06)	< 0.001
Venous thromboembolic events	311 (7.1 per 10,000)	31 (11.7 per 10,000)	1.66 (1.15-2.40)	0.009	1.92 (1.23-2.97)	0.004

Abbreviations: CI: confidence interval; OR: odds ratio.

Results are expressed as count (per 10,000 of discharges with neuraxial or general anesthesia).

[a] The P-value for statistical significance is 0.01.

[b] Adjustment using propensity score weighting

[c] Because of Healthcare Cost and Utilization Project data use agreement restrictions on small cell size, the number of observed cases and exact proportions are not presented.

[d] Complications associated with death, cardiac arrest, severe organ dysfunction, or hospital stay ≥ 99th percentile (7 days)

Guglielminotti Anesthesiology 2019

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Non-obstetric anesthesia provider (OR 4.56)

- Not necessarily related to technical skill
- **ACTIVE MANAGEMENT**
  - Comfort with early recognition of neuraxial failure or inadequate analgesia
  - Low threshold for replacing a suboptimal epidural catheter
  - Emphasis on quality of analgesia

Mankowits Anesth Analg 2016

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Active management of the epidural catheter

- Routine sensory level monitoring using cold stimulation (ice test) every 1-2 hours
- Assessment of motor block using the Bromage scale
- Pain evaluation with a numeric rating scale or visual analog scale
- Continuous communication with the obstetric team and the patient

Mankowits Anesth Analg 2016

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Active management of the epidural catheter

- ↑ Satisfaction & quality of care
- Less breakthrough pain
- Less failed conversion
  - Early detection of sub-optimal epidural catheter
  - Early replacement

Mankowits Anesth Analg 2016

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Ideal practice

- Retrospective study, Brigham, 6y, 8000-10000 deliveries/y, 2000-2005
  - Versus 10 years period1990-1995
- ↑ CD rate 24-32%
- ↓ GA0.5-1% vs. 4.5%
  - 85.7% emergency
- Failed neuraxial technique
  - Epidural 4.6%. vs 8.4%
  - Spinal 2.3% vs 4%
- Algorithms
- Active management
  - Aggressive replacement strategy
  - Prophylactic epidural (high risk patients)

Palanisamy Int J Obstet Anesth 2011

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Top-ups (OR 3.17)

- Predictor of failed conversion = suboptimal analgesia[1]
- Dystocia = abnormal labor = increase risk of CD[2]

1. Bauer ME Int J Obstet Anesth 2012
2. McKenzie Int J Obstet Anesth 2016

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Impact study

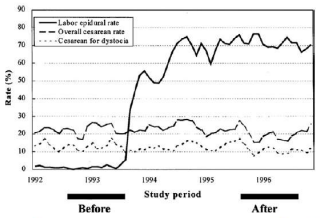

Figure 1 Impact study: epidural analgesia use during labor and cesarean delivery rates both overall and for dystocia among nulliparous women, 1992-96. Reprinted with permission from Zhang et al.[3]

- Segal S *et al.*, Am J Obstet Gynecol 2000
- Meta-analysis
  - 9 impact studies
  - n ≈ 40 000
  - CD rate idem

50

Initiation Epidural vs DPE vs CSE

- No impact on obstetrical and fetal outcomes
- CSE FASTER, CSE & DPE DENSER = better analgesia
- Different profile of adverse effects
  - Epidural : lateralisation, suboptimal analgesia
  - IT : Pruritus, hypotension, abnormal FHR (ZERO impact on major outcomes)
- No evidence that CSE reduces the risk of failed conversion
  - 1 retrospective study n = 1025, but CSE was the norm

51

Breakthrough pain

Table 2 Analysis of the Percentage Within Each Group That Experienced Breakthrough Pain Necessitating an Additional Provider-Administered Bolus Following Neuraxial Analgesia. Values Are Presented as Number of Patients (%)

BTP requests for provider bolus	Patients, No. (%)			aOR (95% CI)		
	Group EA (n = 42)	Group DPE (n = 44)	Group CSE (n = 45)	DPE vs EA	CSE vs EA	CSE vs DPE
Any unadjusted	20 (47.6)	13 (29.5)	10 (22.1)	0.46 (0.19–1.11)[a]	0.31 (0.12–0.79)[a,b]	0.68 (0.26–1.77)[a]
Any adjusted[c]	20 (47.6)	13 (29.5)	10 (22.1)	0.43 (0.16–1.09)	0.29 (0.10–0.78)[b]	0.66 (0.24–1.74)

Notes: [a]P = 0.013. [b]Data are unadjusted OR (95% CI). [c]Values were adjusted for age, Gestational age, Cervical dilation, American Society of Anesthesiologists physical status, body mass index, and Numeric Rating Scale pain score at request for neuraxial analgesia.
Abbreviations: EA, epidural anesthesia; DPE, dural puncture epidural; CSE, combined spinal-epidural; BTP, breakthrough pain; OR, odds ratio; CI, confidence interval.

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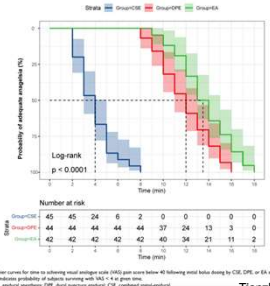
Onset of analgesia



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Outcomes IDEM (maternal, obstetrical & fetal)

Table 4 Labor Outcomes. Values Are Presented as Median (IQR [Range]), Mean (SD), or Number of Patients (%)

	Group EA (n = 42)	Group DPE (n = 44)	Group CSE (n = 45)	*P* Value
Stage of labor duration (min)				
First stage labor duration	451.7 (129.4)	461.4 (121.4)	454.4 (130.1)	0.935
Second stage labor duration	62.1 (18.3)	60.5 (20.5)	62.9 (17.9)	0.825
Third stage labor duration	8 (6–9 [5–12])	7 (6–9 [5–12])	8 (7–9 [4–13])	0.621
Apgar score				
≤7 at 1 min	2 (4.8)	1 (2.3)	1 (2.2)	0.737
≤7 at 5 min	0	0	0	NA
≤7 at 10 min	0	0	0	NA
UABGA				
pH	7.2 (0.1)	7.2 (0.1)	7.2 (0.1)	0.490
PaCO2 (mmol/L)	51.1 (5.4)	49.6 (6.8)	49.7 (6.2)	0.441
PaO2 (mmol/L)	20.5 (5.6)	21.5 (6.4)	21.7 (5.2)	0.617
Weight of newborn (g)	3398 (317)	3383 (343)	3384 (392)	0.978
Mode of delivery (%)				0.895
Spontaneous vaginal	40 (80.9)	42 (91.3)	44 (93.6)	
Operative vaginal	2 (4.4)	2 (4.3)	1 (2.1)	
Adverse effects, (%)				
Postpartum headache	0	0	2	0.329
Nausea	4 (9.5)	5 (11.4)	7 (15.6)	0.671
Vomiting	0	0	0	NA
Pruritus	2 (4.8)	1 (2.3)	5 (11.1)	0.241
Shivering	0	0	0	NA
Hypotension	2 (4.8)	3 (6.8)	4 (8.9)	0.749
Lower limb numbness	2(4.8)	2(4.5)	7 (15.6)	0.146
Urinary retention	0	0	0	NA
Fetal heart rate decelerations, (%)				
Early	3 (7.1)	4 (9.1)	2 (4.4)	0.699
Late	4 (9.5)	3 (6.8)	4 (8.9)	0.928
Variable	2 (4.8)	3 (6.8)	5 (11.1)	0.398

Abbreviations: EA, epidural anesthesia; DPE, dural puncture epidural; CSE, combined spinal-epidural; UABGA, umbilical arterial blood gas analysis.

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ESAIC focused guidelines for the management of the failing epidural during labour epidural analgesia

- Meta-analysis & systematic review
- 56 articles (classification for quality & bias)
- 2 evidence-based recommendations
  - Expertise intiation + F/U anesthesiologist
  - Decision making
- Consensus

Brogly N Eur J Anaesthesiol 2025

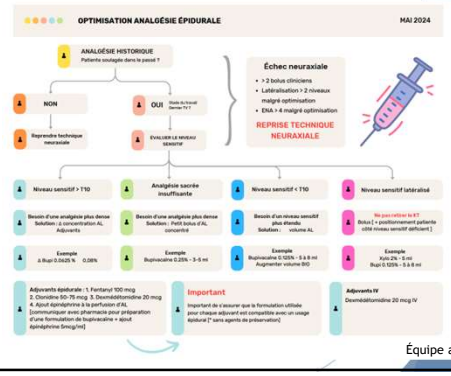
55

ESAIC focused guidelines for the management of the failing epidural during labour epidural analgesia

- Catheter replacement
  - « Earlier the better »
- Technique after failed catheter
  - CSE/DPE
  - Single shot spinal (high risk if bupivacaine > 7.5 mg)
- Algorithms for failed conversion

Brogly N Eur J Anaesthesiol 2025

56



Équipe anesthesie OB CHUM

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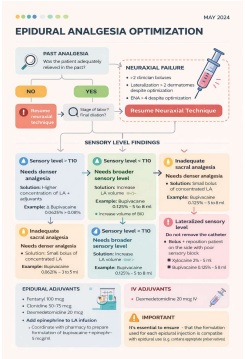

Generated by ChatGPT 2026

58

Resume Neuraxial Technique

- CSE & DPE
- Avantages
- Faster
- Denser
- IT dose for quicker labor

Bauer Anesth Analg 2016
Brogly N Eur J Anaesthesiol 2025

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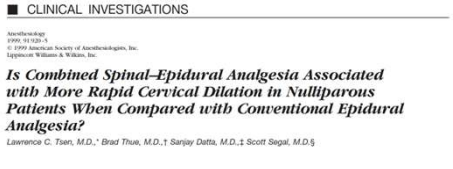
Physiologic or selection bias?


CLINICAL INVESTIGATIONS

Is Combined Spinal–Epidural Analgesia Associated with More Rapid Cervical Dilation in Nulliparous Patients When Compared with Conventional Epidural Analgesia?

Lawrence C. Tsen, M.D.,* Brad Thue, M.D.,† Sanjay Datta, M.D.,‡ Scott Segal, M.D.§

60

Table 1. Progress of Labor

	Combined Spinal–Epidural	Epidural
Onset of labor to analgesia (h)	10.0 ± 5.2	11.6 ± 8.9
Analgesia to full cervical dilation (h)	3.8 ± 2.6	5.1 ± 2.6*
Full cervical dilation to delivery (h)	1.8 ± 1.2	2.2 ± 1.5
Initial cervical dilation rate (cm/h)†	2.1 ± 2.1	1.0 ± 1.0*
Mean cervical dilation rate‡	2.3 ± 2.6	1.3 ± 0.7*
Mode of delivery (%)		
Spontaneous vaginal	68	66
Instrumental vaginal	16	16
Cesarean section	16	18

Times and cervical dilation rates are shown as mean ± SD.

* $P < 0.05$ for difference between analgesic groups (see text for statistical details).

† Initial cervical dilation rate = (first cervical examination after analgesia − last cervical examination before analgesia)/time between examinations.

‡ Mean cervical dilation rate = (10 − last cervical examination before analgesia)/time between examinations.

Tsen Anesthesiology 1999

61

Table 1. Progress of Labor

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‡ Mean cervical dilation rate = (10 − last cervical examination before analgesia)/time between examinations.

Tsen Anesthesiology 1999

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Manipulating the catheter

Lateralized sensory level

Do not remove the catheter

- **Bolus** + reposition patient on the side with poor sensory block
  - Xylocaine 2% – 5 ml
  - Bupivacaine 0.125% – 5 8 ml

63

Why obstetric epidurals fail: a study of epidurograms

C. B. Collier

Department of Anaesthetics, Royal Hospital for Women, Paddington, New South Wales, Australia

SUMMARY. In a study of the factors involved in the occasional failure of continuous obstetric epidural blockade, contrast injections through epidural catheters and radiographic screening were undertaken in 35 postpartum patients. The two major causes of inadequate block were found to be transforaminal escape of the catheter tip, and persistent unilateral block associated with an obstructive barrier in the epidural space. Recommendations for overcoming these problems are discussed.

Collier C.B. Int J Obstet Anesth 1996

64

Why Obstetric Epidurals Fail: a Study of Epidurograms

- 2 majors causes of inadequate block
  - Transforaminal escape of the catheter tip
    - Sanchez et al. 7% if insertion of 12.5 cm
  - Obstructive barrier → persistent unilateral block
    - Complex and compartmentalized
    - Epidural fat, midline pedicle, dorsal midline septum

Collier Int J Obstet Anesth 1996

65

Transforaminal escape

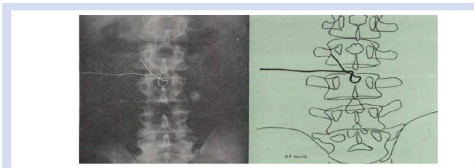

Fig 2 Epidural catheter exhibiting through the transforaminal passage; reproduced from Hehre and colleagues with permission.[17]

Hermanides J. Br J Anaesth 2012

66

Anesthesiology
1998; 88:1502–6
© 1998 American Society of Anesthesiologists, Inc.
Lippincott-Raven Publishers

Treatment of Incomplete Analgesia after Placement of an Epidural Catheter and Administration of Local Anesthetic for Women in Labor

Yaakov Beilin, M.D.,* Jeffrey Zahn, M.D.,† Howard H. Bernstein, M.D.,‡ Barbara Zucker-Pinchoff, M.D.,§ Wendy J. Zenzen,|| B.S., Lewis A. Andres, B.A.#

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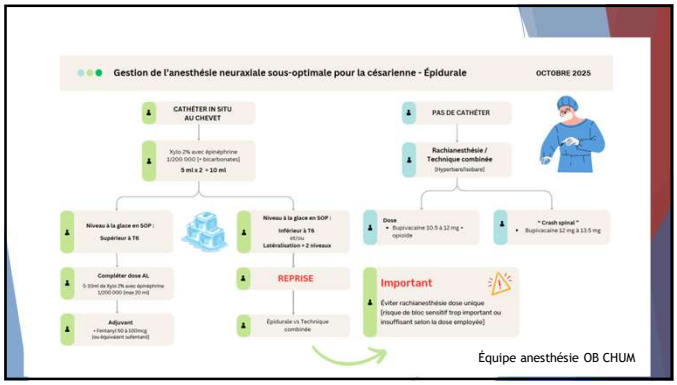
Table 2. Treatment Success Rates in Each Group

Cathéters rigides	Local Anesthetic Only	Catheter Manipulation
Number of patients	39	39
Success after initial intervention	29/39 (74%)	30/39 (77%)
Number of patients requiring 2nd intervention	10	7*
Pain score before 2nd intervention		
0	n = 29	n = 30
1	n = 0	n = 0
2 or 3	n = 4	n = 4
4 or 5	n = 3	n = 1
6 or 7	n = 2	n = 4
8	n = 1	n = 0
9	n = 0	n = 1
10	n = 0	n = 0
Success after 2nd intervention	10/10 (100%)	7/7 (100%)
Replaced catheters	0	1

* Two patients were not studied due to investigator error.

Beilin Y Anesthesiology 1998

68



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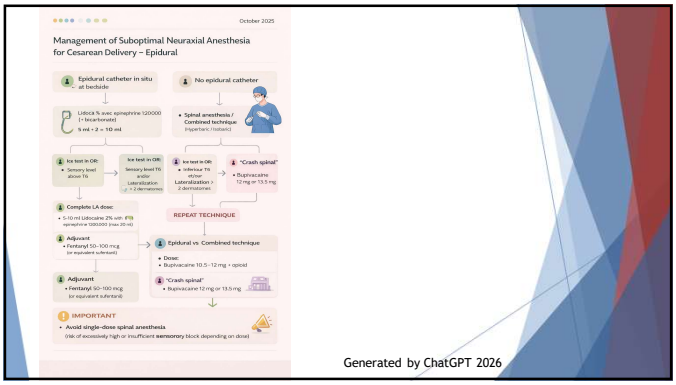

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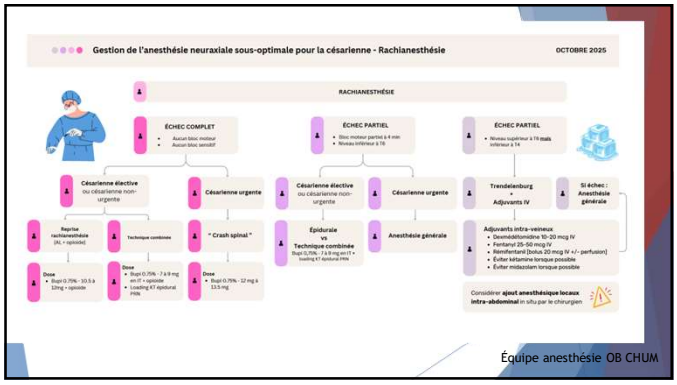

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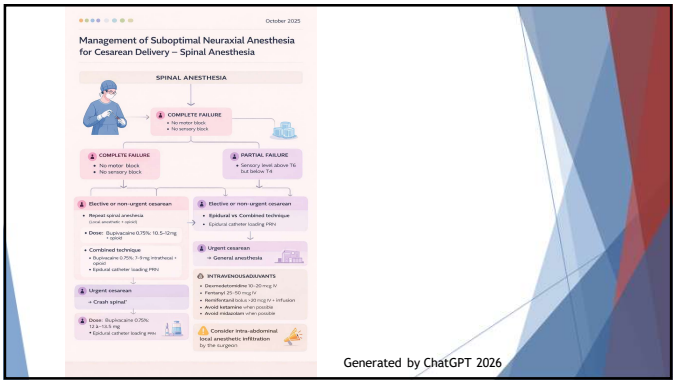

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Ultrasound

EDITORIAL

Preprocedure Ultrasonography Before Initiating a Neuraxial Anesthetic Procedure

Cristian Arzola, MD, MSc

"Excellence is an art won by training and habituation. We are what we repeatedly do. Excellence, then, is not an act but a habit."

—Aristotle

Anesth Analg 2017

73

Central role of the anesthesiologist

Personality

- Multitasker
- Effective communicator and active listener
- Resilient
- Collaborative team member and unifier
- Systems thinker
- Decision-maker
  - Able to prioritize
  - Able to make trade-offs and compromises

Expertise

Conroy J.M. Anesth Analg 2022

74

QUESTIONS & DISCUSSION

75

OBSTETRIC ANESTHESIA PANEL: CASE PRESENTATION #3

Anesthesiology

76

Case 3: GOALS & OBJECTIVES

At the conclusion of this case-based activity, participants will be able to:

1. Identify options to anticipate and control intraoperative pain during cesarean delivery, including shared decision-making with the patient.
2. Internalize management strategies for conversion to general anesthesia including airway management.
3. Apply knowledge of risk stratification, preparation and diagnosis of postpartum hemorrhage during cesarean delivery.

77

CASE #3

You arrive at work in the morning to take over covering L&D. At sign-out you receive report on a G1 who has been laboring with an epidural overnight but has not progressed for several hours despite increasing doses of oxytocin. She is now having non-reassuring FHT and the OB team decides to move to delivery by cesarean for failure to progress and fetal intolerance of labor.

In reviewing her record, you note she received 3 epidural top-ups overnight with a note that she obtained good relief after each one.

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OB ANESTHESIA PANEL: CASE #3

You arrive at work in the morning to take over coverage on L&D. At sign-out you receive report on a G1 who has been laboring overnight with an epidural but has not progressed for several hours, despite increasing doses of oxytocin. She is now having non-reassuring FHT and the OB team decides to move to delivery by cesarean for failure to progress and fetal intolerance of labor.

In reviewing her record, you note she received 3 epidural top-ups overnight with a note that she obtained relief after each one.

79

OB ANESTHESIA PANEL: CASE #3 (cont.)

When you meet her in the labor room, she appears exhausted but comfortable. The oxytocin is off after late decelerations became more frequent.

On arrival to the operating room, you dose the epidural catheter incrementally with 20 ml 2% lidocaine with epinephrine + 100 mcg fentanyl while placing monitors and administering the antibiotics (cefazolin 2 gm and azithromycin 500 mg). The Allis clamp test is negative, and her husband is now seated next to you. A few minutes after skin incision she complains of pain.

80

IS PAIN DURING ANESTHESIA *REALLY* AN ISSUE?

A meta-analysis included 34 studies on pain during neuraxial:

- The pooled incidence of intraoperative pain was 17%.
- Spinal anesthesia had the lowest incidence of intraop pain (14%), while epidural top-up had the highest (33%).

Anesthesiology 2025;143:156

An international prospective cohort study of 3693 patients was completed over 8 weeks to determine the incidence of intraoperative pain:

- The overall incidence was 8%; 4% with spinal, 9% with CSE, and 12% with epidural top-up anesthesia.
- The median pain score was 6. 10% of these patients were dissatisfied with how the anesthesia team managed their pain.

Anesthesiology 2026;144:(O'Connell)

81

PAIN DURING CESAREAN IN THE UK

92% of cesareans in the UK are done using neuraxial, and intraop pain is *the most common* successful negligence claim.

- 360 cases of pain during C/S from NHS Litigation Authority
- 50% had sub-standard consent, i.e. possible pain and options.
- Failure to document the events and the anesthesiologist's thought processes in the chart was frequent.
- In 42%, C/S was allowed to start despite inadequate block.
- Despite the obvious lack of adequate intraoperative anesthesia, there was a delay or a complete refusal to convert to general anesthesia.
- "Pain is whatever the person experiencing it says it is."

Anaesthesia 2018; 73: 223

82

PAIN DURING CESAREAN IN THE UK (*cont.*)

- Ms. C recalled testing by placing an ice cube on her abdomen and asking her if it was numb. She said it was not and she could feel it. The doctor seemed surprised and said "I doubt you can". When the operation started, she could feel hands inside and was crying with pain. She kept thinking to herself that it would be over soon.
- The nurse was outside the OR when she heard screams and shouting. Inside she found Ms. D screaming and crying on the OR table while surgery was underway. The anesthesiologist said that he had checked the block and was convinced that she had a good block. She was not offered or given a general anesthetic.

83

The Retrievals is an award-winning podcast that investigates how women's pain, especially during medical procedures like fertility treatments (egg retrievals) and C-sections, is often dismissed or minimized by the medical

The Retrievals
Serial
★ 4.6 (10K) · TRUE CRIME · SERIES

C-sections are the most frequently performed major surgeries in the world. So why do so many patients feel severe pain during them? Season 2 of the award-winning podcast "The Retrievals" is an ... MORE

▶ Season 2 Trailer

84

GUIDELINES TO MANAGE PAIN DURING CESAREAN

The ASA COBA published the "*Statement on Pain During Cesarean Delivery*" with practical advice & best practices. An estimated 15% of patients experience pain during cesarean → medicolegal consequences per the ASA Closed Claims Project.

- Preoperative assessment: risk factors and consent
- Minimizing risk of inadequate block: techniques, drugs, doses
- Supplementing inadequate neuraxial: variety of options
- Conversion to GETA and conduct of the anesthetic
- Follow-up, referral and QI metrics: communicate & acknowledge her experience.

https://www.asahq.org/standards-and-practice-parameters/statement-on-pain-during-cesarean-delivery

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HOW SHOULD WE MANGE INTRAOP PAIN?

- Check in often and empower the patient to report pain at any time.
- If a patient reports pain, believe and validate, troubleshoot, and communicate what you are planning. Use shared decision-making.
- Have the obstetricians pause while you attempt treatment:

1) Epidural catheter: 10-20 ml 3% 2-chloroprocaine
2) Intravenous: fentanyl, ketamine, dexmedetomidine, i.e. analgesics.
3) Inhaled: 50-70% high-flow nitrous oxide from the machine
4) Intra-abdominal 2-chloroprocaine 30 ml

- If unsuccessful, be prepared to convert to GA immediately while reassuring the patient of their safety and the baby's.
- Continue to inform the surgeons of the situation and your plan for conversion to general anesthesia.

86

BUT IS GENERAL ANESTHESIA SAFE?

Cochrane Database 004350: There is no evidence from this review to show that regional anesthesia is superior to general in terms of major maternal or neonatal outcomes.

- *However*, GETA may ↑ risk of hemorrhage, SSI and VTE.
- Neonates may have lower initial Apgar scores and ↑ risk of respiratory complications.
- Mothers have amnesia for the delivery, less effective pain control, impaired breast-feeding success, and cannot do skin-to-skin ("golden hour") time immediately after delivery.
- Some studies have shown ↑ risk of postpartum depression.

87

IS GETA ASSOCIATED WITH PP DEPRESSION?

A review of 326K cesarean deliveries followed patients for one year postpartum for readmission, clinic visit or ED visit.

- Overall, 6% received GETA compared to 94% neuraxial.
- Use of GETA was associated with a 38% ↑ risk of postpartum depression requiring hospitalization.
- GETA also had a 45% ↑ risk of suicidality.
- When GETA is used for cesarean, consider a postpartum debrief with the patient, especially if they screen + for PPD.

Anesth Analg 2025;141:618

88

WHAT ABOUT DIFFICULT OR FAILED INTUBATION?

Review of MPOG data on almost 15,000 intubations during general anesthesia for cesarean between 2004 and 2019:

- 1:49 were difficult intubations either based on the view in 88% or based on requiring ≥ 3 attempts in 16%.
- 1:808 were failed intubations, defined as any attempt without successful ETT placement. All 18 were rescued using a supraglottic airway with 1 arrest but no deaths.
- Risk factors: MP 3 or 4, BMI ≥ 40, and maternal age ≥ 35.

Anesthesiology 2022; 136: 697-708

89

AIRWAY MANAGEMENT FOR GETA ON L&D

A QI project tracked 3 steps that can optimize airway management in obstetric patients:

1. Use of video-laryngoscopy for all obstetric general anesthetics led to 94% first-pass success and 100% overall.
2. Use of low-flow nasal oxygen during apnea & laryngoscopy maintained saturations in 90% vs 48% without oxygen.
3. Patient positioning in a ramped 20-30 degree head-up position improves FRC and the view at laryngoscopy.
4. Use of a checklist and team training is supportive.

Eur J Anaesthesiol 2023;40:826

90

IS GENERAL ANESTHESIA SAFE FOR NEONATES?

Neonatal outcomes influence the choice of anesthesia for cesarean, with neuraxial assumed to be safer.

- Meta analysis of 36 RCTs with 3456 neonates compared neuraxial to general anesthesia for cesarean.
- Apgar scores at 1 & 5 minutes were slightly lower with GA (mean difference at 1 min = 0.58 points and at 5 min = 0.09).
- No differences between anesthetics after the immediate newborn period and no difference in NICU admissions.
- If GA is indicated due to maternal co-morbidities, fetal emergencies or patient request, it is safe for the neonate.

Anesthesiology 2025; 144:325

91

GENERAL ANESTHESIA FOR CESAREAN: HOW TO

1. Call for help while drawing up your induction agents.
2. Position the patient with HOB 20-30 degrees elevated.
3. Pre-oxygenate to an end-tidal oxygen ≥ 0.8 with a tight mask fit.
4. Perform rapid sequence induction: adequate dose of hypnotic + succinylcholine or high-dose rocuronium and cricoid pressure.
5. Control hemodynamics as needed for stable BP and HR.
6. Use video laryngoscopy, a 7 mm ETT, & confirm end-tidal CO_2.
7. Maintain anesthesia with 1.0 MAC (end-tidal) volatile until delivery followed by 0.5 MAC + nitrous oxide and opioids or TIVA to reduce the risk of uterine atony. Be aware of the risk for recall.
8. Have a plan for postoperative pain management.

92

GENERAL ANESTHESIA: ACCIDENTAL AWARENESS

Awareness in obstetric patients may be as high as 1:256.

- 3115 obstetric patients were interviewed after GETA and 12 had accidental awareness.
- 58% were distressed, 42% felt paralyzed, 17% had pain.
- 75% of the episodes of awareness occurred during induction or emergence. Use adequate doses at induction!
- Direct postoperative questioning should be done to elicit accidental awareness after cesarean using GETA.

Anaesthesia 2021; 15385

93

FOLLOW-UP AFTER FAILED NEURAXIAL

- Use the postoperative visit to obtain patient feedback and to provide your explanation of the events. Transparency is key!
- Document the patient's experience of pain in your record, your thinking at the time, and actions you took to address it.
- Refer the patient to an appropriate professional for follow-up after any significant adverse experience. This situation is an independent variable for development of PTSD.
- In your practice, audit the percentage of patients who receive systemic analgesia or require general anesthesia during cesarean delivery performed under neuraxial.
- Seek opportunities for changes in practice or for education.

94

ANESTHESIA & CHILDBIRTH-RELATED PTSD

Several anesthetic-related complications during delivery are risk factors for developing or exacerbating PTSD:

- Failed spinal/epidural anesthesia with pain requiring rescue medications or conversion to general anesthesia.
- Accidental awareness during general anesthesia.
- Severe postoperative nausea & vomiting.
- Traumatic needle insertion causing pain during neuraxial procedures.
- "Wet tap" followed by severe PDPH.
- We *must* practice trauma-informed care: close & frequent communication, allowing patients control when possible, and using medications if desired.

Anesth Analg 2024;139:1156

95

"Childbirth persists in women's minds, often vividly, for a lifetime. More than that, its significance can affect their sense of self, their relationships with their children, their partners, their future ability to interact with healthcare services, their physical and emotional well-being and more. Positive effects are also deeply felt by many women. How a woman feels during birth, and crucially how she is treated, is important for her wellbeing in the long term."

Schiller R. Why human rights in childbirth matter, 2

96

OB ANESTHESIA PANEL: CASE #3 (cont.)

The patient is safely off to sleep, her husband has been escorted out of the operating room, and you continue settling into your case that is now being done under general anesthesia. Delivery is completed and the oxytocin infusion is started.

Within a few minutes, the obstetrician tells you the uterine tone is poor and asks if the oxytocin is running (it is) and what other uterotonics are in the room. Should you have anticipated this? How do you begin preparing for a possible postpartum hemorrhage?

97

BLOOD LOSS AND INDICATION FOR CESAREAN

What are the effects of indication for cesarean delivery on QBL?

- Based on 4881 cases performed at a large academic hospital.
- Mean QBL for <u>all</u> cesarean deliveries was 792 ml.
- **The highest blood loss occurred during CD for arrest of labor.**
- QBL during intrapartum cesarean was greater than 1500 ml in 18% of primary and 13% of repeat CD (i.e. attempted VBAC).
- Lowest blood loss was in elective repeat CD or for fetal malposition (breech).

Am J Obstet Gynecol 2025;232:478

98

DIFFERENCES IN OXYTOCIN DOSING

Do parturients exposed to oxytocin during labor require ↑ oxytocin after delivery to achieve satisfactory tone? **YES.**

- Oxytocin ED_{90} was 3x higher if the patient had received oxytocin in labor (for induction or augmentation) versus those without prior labor (i.e., elective cesarean).
- 34% of laboring women also required other uterotonic agents, versus only 8% of non-laboring, scheduled C/S.
- Exposure > 12 hours had ↑ risk of hemorrhage (OR 1.52)

Anesth Analg 2015;121:159

99

PROPHYLACTIC ADDITIONAL UTEROTONIC?

Patients having intrapartum cesarean after laboring are at ↑ risk of PPH. Would prophylactic methylergonovine improve atony?

- 160 patients were randomized to receive routine oxytocin infusion + methylergonovine <u>*or*</u> oxytocin + saline at delivery.
- Only 20% of the methergine group required additional uterotonics vs 55% in the placebo group, RR 0.4.
- Other improved outcomes with M: 80% had good uterine tone (vs 41%), ↓ incidence of PPH (35% vs 59%), lower mean QBL (967 ml vs 1315 ml), and fewer blood transfusions (5% vs 23%).
- Consider prophylaxis for other high-risk indications?

Obstet Gynecol 2022;140:181

100

ACOG COMMITTEE OPINION: *QUANTITATIVE BLOOD LOSS IN OBSTETRIC HEMORRHAGE* (2025)

PPH accounts for 11% of maternal deaths in the U.S. and ~80% are preventable due to delayed recognition and treatment.

- Quantitative methods are more accurate than visual. Especially when blood loss is high, EBL underestimates actual blood loss.
- Current data do not support any one method of quantifying blood loss as superior to another. Protocols should be developed by the multi-disciplinary team on L&D.
- Begin measuring QBL at delivery and continue an ongoing tally of blood loss, visible to the team, until stable postpartum.

Obstet Gynecol 2017;130:e168 (reaffirmed 202

101

OB ANESTHESIA PANEL: CASE #3 (cont.)

The QBL quickly passes 1000 ml and you proceed to redose her cefazolin 2 grams, place another large-bore IV, and draw labs. What lab studies besides a CBC will influence your management of this postpartum hemorrhage?

What other preparations should you be making? What other consults or services – besides your own colleagues - might you want to notify if this hemorrhage progresses and the current management is not effective?

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FIBRINOGEN LEVEL PREDICTS SEVERITY OF PPH

- Bottom line: If fibrinogen is ≤ 2 g/L, there is a positive predictive value of 100% that she will develop severe PPH.
- Even in the early stages of PPH, a low fibrinogen level predicts severe hemorrhage, defined as transfusion ≥ 4 PRBC and/or Hgb fall greater than 4 g/dL.
- Replace fibrinogen to keep > 3 g/L. Remember that FFP has only 2.0 g/L, but cryoprecipitate has 3.8 g/L, and fibrinogen concentrate contains about 1 g/vial.

Int J Obstet Anesth 2013; 22: 87

103

CALCIUM LEVEL PREDICTS SEVERITY OF PPH

Is ionized calcium level associated with severity of PPH? YES.

- 436 patients had calcium levels drawn at the onset of PPH.
- 52% who went on to have severe PPH were hypocalcemic and ↓ calcium was associated with more severe PPH.
- Only 11% were hypocalcemic in the group who did not have severe PPH,
- Calcium and fibrinogen were the *only* variables that were independently associated with risk of severe bleeding.

Br J Anaesth 2021; 126: 1022

104

CALCIUM RX MAY PREVENT PPH

Women with at least 2 risk factors for PPH during their CD were randomized to receive 1 gm calcium chloride or placebo.

- Administered over 10 minutes after cord clamping.
- Uterine atony occurred in only 20% of CaCl recipients versus 50% of placebo recipients (RR 0.38).
- Peak ionized calcium was normal after 1 gm, and the CaCl was tolerated well by recipients via peripheral IV.
- 1 gm CaCl = 3 gm Ca gluconate. Onset times were the same and both declined by half within 30 minutes.

J Clin Anesth 2022; 110796 / Anesthesiology 2025;142:121

105

OTHER RESOURCES TO MOBILIZE IF AVAILABLE

1. Activate the massive transfusion protocol (MTP). Know what resources it provides besides blood products.
2. Cell salvage is recommended – not contraindicated - in OB cases when large-volume blood loss (> 10% of blood volume) is anticipated, the patient refuses blood products, and/or when there is difficulty with cross-matching.
   - Use leukocyte depletion filters (5-50 µm).
   - Take precautions against Rh isoimmunization.
   - Routine use is not cost-effective or recommended.
3. If you need an embolization or REBOA placement, is Interventional Radiology in-house or on call from home?

106

OBSTETRIC HEMORRHAGE & LIABILITY

When the ASA Closed Claims Project reviewed claims related to hemorrhage in all types of surgeries, they found:

- OB cases accounted for 30% of the hemorrhage claims vs only 13% of all claims in the database. L&D over-represented!
- Mortality was high: 77% vs 27% of non-hemorrhage claims.
- Payments made were high: $607K vs. $276K overall.
- Substandard care was found in 55% vs. only 38% of all claims.
- Themes in OB: lack of timely diagnosis & delayed transfusion.

Anesthesiology 2014; 121: 450

107

QUESTIONS & DISCUSSION

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OBSTETRIC ANESTHESIA PANEL: CASE PRESENTATION #4

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Case # 4

- A 38 y/o G6P5 with h/o 4 previous cesarean deliveries presents for a repeat C/D at 34.6 wks EGA. During her 4th C/D (about 18 months ago) she had extensive adhesive disease and suffered a PPH of 3500 mL for which she received 2 units PRBC.
- At ~ 20 weeks in this pregnancy she was diagnosed with placenta previa and suspected placenta accreta spectrum based on U/S and MRI findings. There is no suspected placental invasion to structures outside of the uterus.
- The plan is for delivery on L&D with gyn-onc backup available from the main OR.

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Learning Objectives – Case 4

- Describe risk factors for placenta accreta spectrum and strategies to minimize PAS-related morbidity and mortality.
- Discuss pros and cons of different strategies for treating severe obstetric hemorrhage.
- Explain reasoning for and principles of aggressive post-dural puncture headache management.

111

Hemorrhage-related maternal mortality

- **Pregnancy-Related Deaths Due to Hemorrhage: Pregnancy Mortality Surveillance System, 2012–2019** (Obstet Gynecol 2024;144(2):252-255.)
  - Overall mortality rate 1.94 per 100,000 live births
  - Rupture ectopic pregnancy 22.9% of deaths
  - Postpartum hemorrhage 21.2% of deaths
- **Trends in Maternal Mortality From Obstetric Hemorrhage in France: 15 Years of Confidential Enquiry Into Maternal Deaths** (Anesth Analg 2024;139(6):1170-80.
  - Compared hemorrhage-related MMR 2001-2003 v. 2013-15
  - **MMR decreased** from 2.3 (2001-2003) to 0.8 (2013-2015) per 100,000 live births
    - Increased hemodynamic monitoring, increased use of vasopressors, earlier and more frequent transfusion
  - **BUT 88% of hemorrhage-related deaths were preventable**

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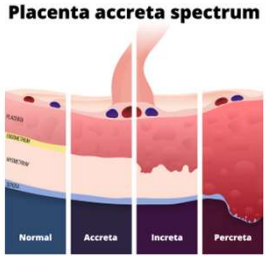
PAS - Basics

- **Incidence** → 0.17% (1:588 pregnancies)
- Incidence is **increasing**
- **Etiology** → Abnormal trophoblast invasion v. trophoblast attachment to abnormal uterine endometrium



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PAS- Preparation

- Risk factors:
  - ***Placenta previa + history of C/D***
  - H/o other uterine surgeries/ ablations/ IVF
- Risk stratification
  - Based on risk factors, imaging (U/S and MRI) and presumed depth of invasion
  - Deeper invasion = Higher risk

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PAS – Delivery Planning

Contemporary Innovations

- Characteristics of PAS referral centers:
  - Coordination by a program champion or champions
  - Membership from all involved specialties
  - Capability for 24/7 mobilization of PAS surgical team
  - Interdisciplinary treatment planning meetings or formalized communication
  - Standardized evidence-based approaches to PAS diagnosis, staging, and management.
- Standardized intraoperative staging and pathologic classification based on visible appearance of the placenta, remodeled uterus, and surrounding maternal structures
- Peer Support Networks and Care Navigators

- Multidisciplinary team
  - OB/ MFM
  - Gyn Onc
  - Anesthesiology
  - Other surgical specialties prn
- L&D (lower risk) v. Main OR (higher risk)

Obstet Gynecol 2023;142(1):31-50.

115

PAS – Intraoperative Management

- Access, access, access – venous and arterial
  - Risk for significant PPH
- Anesthetic technique → Neuraxial v. GA v. Combo
  - NO RIGHT ANSWER!
- Likely cesarean hysterectomy with high risk for bleeding
  - Usually midline vertical incision
  - Rare conservative management or planned delayed hysterectomy
- Prophylactic interventions (uterine stents, iliac balloons) are largely out of favor

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Case 4 Con't

- The bleeding…happens…

117

TXA for PPH

The effect of tranexamic acid on postpartum bleeding in women with moderate and severe anaemia (WOMAN-2): an international, randomised, double-blind, placebo-controlled trial

The WOMAN-2 Trial Collaborators*

- International, randomized, double-blind, placebo-controlled trial in 34 hospitals in 4 countries (Nigeria, Pakistan, Tanzania, Zambia)
- Women who had VD randomized to 1 gram TXA (7580 patients) or placebo (7488 patients) within 15 min of umbilical cord clamping
- **NO difference in risk of PPH** (RR 1.05, 95% CI 0.94-1.19)

- This in addition to other studies → **NO evidence to support routine *prophylactic* use of TXA after either VD or CD**
- In high-resource settings TXA should be used as an adjunctive component of multimodal PPH *treatment* strategy (after failed 1st-line therapy of oxytocin and a second-line uterotonic)

***Lancet* 2024; 404: 1645–56. Curr Opin Ob Gyn 2024;36(2):88-97.**

118

Viscoelastic assays in PPH

- Can be used to facilitate targeted/ goal-directed transfusion during PPH
  - Observational data → above associated with decreased use of blood products and decreased hemorrhage-related morbidity compared to fixed-ratio strategies

AJOG 2024;230(3S):S1089-S1106.

119

Calcium : cheap new uterotonic?

- 2004 Calcium & uterine contractility
- 2015 negative study small dose Ca2+ (vasopressors, volume, SV)
- 2021 Low ionized calcium & PPH
- 2025 1 g Calcium gluconate
  - Less second line uterotonics for intrapartum CD (tonus idem)

Editorial IJOA 2025

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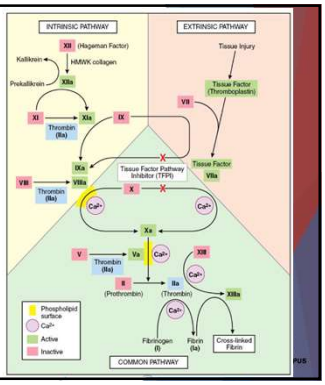
Calcium



121

Calcium

- Calcium chloride 1 g = calcium gluconate 3 g

Ansari Anesthesiology 2025

122

Calcium for high risk cesarean delivery, intrapartum CD

- RCT, blinded, n = 120
- 1g calcium chloride vs. placebo after cord clamp
- 1º blood loss
  - NS 200 mL
- Sub-group with uterine atony
- Meaningful reduction of blood loss

Ansari Obstet Gynecol. 2024

123

ÉTAPE 1 Saignement ≥ 1000 mL et persistant → déclenchement protocole HPP

•Pertes sanguines •Liste de vérification •Sonde urinaire en place •Exploration vaginale (trauma?)	**Causes?** ↳ 4 « T »: • tonus • trauma • tissue • thrombine **NB** Inversion utérine: 1.AG et relaxation 2.utérotoniques → **Éviter CIVD**	**Causes?** ↳ 4 « T »: • tonus • trauma • tissue • thrombine **NB** Inversion utérine: 1.AG et relaxation 2.utérotoniques → **Éviter CIVD** Acide tranexamique ↳ bolus 1 g IV en 10 min, puis 1 g/h si saignement actif 2e IV avec labo : (Hémocue, Hb, plt, INR, fibrinogène gazA ou gazV complet) ↳ **Correction précoce du fibrinogène** Éviter triade: • hypothermie • hypoCa2+ • acidose * Calcium 1 g IV si Ca2+ ionisé < 1,0	Appeler pour aviser des labos en stat Nouveau-né et accompagnant hors de la SOP Aviser la banque de sang **8413** et commander produits sanguins prn	Labo en stat

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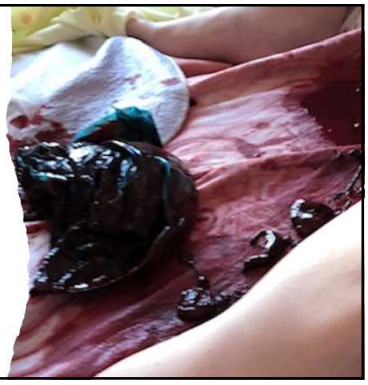
Clinical cases

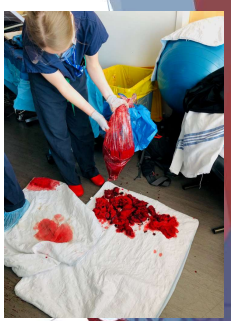
"Because obstetric is fantastic"



125

Twins delivery uterine atony after 3 minutes EBL > 2.5 L

- TONUS
- TONUS
- TONUS
- **UTEROTONICS**
- TXA
- Calcium chloride
- Cryo.



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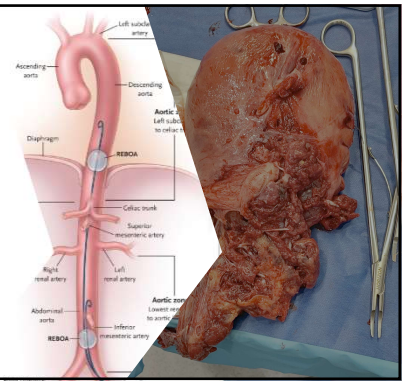
Placenta Accreta Spectrum (PAS)



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Reboa® « Resuscitative Endovascular Balloon Occlusion of the Aorta »

- Studies different IR modalities (n = 1,811 across 69 studies)*
  - Primary objective: efficacy and safety (primary outcome: blood loss)
- n = 1,395 (77%) interventional radiology cases
  - Placenta accreta: 587 (42%)
  - Placenta increta: 254 (18%)
  - Placenta percreta: 313 (22%)

* Modalities included:
- •Balloon inflation in arteries (BIA): 460 (33%)
- •Common iliac arteries
- •Internal iliac arteries
- •Uterine arteries

Shahin Y. European Radiology 2018

128

Intra-aortic balloon occlusion (IAB)

- Reduced blood loss: -1,391.7 mL (95% CI -2,153 to -630 mL)
- Improved surgical visualization
- Reduced hysterectomy rates
- No significant complications reported

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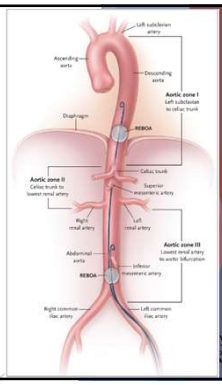
Aortic endovascular clamp

- Aortic Zone 3
- 100% of percreta at the CHUM (dx antepartum)
- Hybrid room & multidisciplinary



Nakajima K World Journal of Emergency Surgery 2019

130

Severe post partum hemorrhage (PPH)

- CSE-AROM-Hypoxemia + distress
- Stat CD under GA : stable & lucid
- CD nothing to report
- DIC
  - Vasopressors high doses and volume responsive
  - 7 Cryo
  - 16 RBC
  - 3 Platelets
  - 11 FFP
  - + TXA, Ca+, BIC
  - Mechanical ventilation

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Amiotic fluid emboli (AFE) C1 esterase inhibitor (Berinert®)

- Role of bradykinin in the anaphylactoid reaction
- In response to the question, *"How did you think of measuring bradykinin?"*

Dr. GE Rivard May 2025

Robillard J. AJOG 2005

132

Quite simply, when I observed the severity of the bleeding, I suspected a significant contribution from plasmin-mediated fibrinolysis. I knew that plasmin activates factor XII, leading to the generation of factor XIIa, which in turn activates prekallikrein into kallikrein. Kallikrein then cleaves high-molecular-weight kininogen, resulting in the production of bradykinin.

Bradykinin, through its binding to B2 receptors on endothelial cells, stimulates the generation of nitric oxide via the citrulline-arginine pathway, leading to vasodilation and increased capillary permeability, and consequently hypotension.

In addition, I was aware that bradykinin inhibits uterine contractility, which provided a physiologically coherent explanation for the combination of refractory bleeding, vasodilation, and uterine atony observed in this patient.

Dr. GE Rivard May 2025

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Team work

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Conditions associated with massive transfusion

- PAS aOR 18.5
  - (CI95% 14.7-23.3)
- DPPNI aOR 14.6
  - (CI95% 11.2-19.0)
- Severe preeclampsia aOR 10.4
  - (CI95% 7.7-14.2)

DIC early and severe = RARE

AFE = RARE

Mhyre et al. Obstet Gynecol 2013

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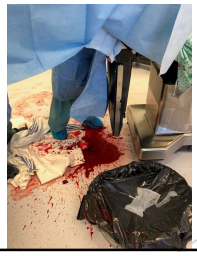
Most common cause of DIC = uncontrolled surgical bleeding



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The Use of Postpartum Hemorrhage Protocols in United States Academic Obstetric Anesthesia Units

Rachel M. Kacmar, MD,* Jill M. Mhyre, MD,† Barbara M. Scavone, MD,‡ Andrea J. Fuller, MD,§ and Paloma Toledo, MD, MPH*

- Recommendations → Implementation of a PPH protocol
  - 20% of academic centers do not have a PPH protocol in place
  - Institutional delivery volume is the strongest predictor *(≥2,300 deliveries per year*
- *The Joint Commission on the Accreditation of Healthcare Organizations*
- *Saving Mothers' Lives*
- *National Partnership for Maternal Safe*

Kacmar Anesth Analg 2014

137

Case 4 Con't

- On PPD 3, you receive a call that the patient now c/o a severe postural headache. Upon questioning, she reports significant neck pressure/ stiffness, a headache that is much worse upon standing and a fullness in her ears with muffled hearing. She is struggling with breast feeding due to pain when she is upright.
- Despite no frank "wet tap" when the neuraxial block was placed for her cesarean hysterectomy a few days ago, you are highly suspicious for a post-dural puncture headache and recommend proceeding with an epidural blood patch for definitive therapy.

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Post-Dural Puncture Headache (PDPH)

- Definition → HA attributed to low CSF pressure occurring within 5 days of a lumbar puncture
  - Older definitions included the classic postural component
- May make diagnosis based on clinical presentation, history and exam
- BUT…not all patients will have the same presenting symptoms and a high index of suspicion is needed in patients with HA and known accidental dural punctures

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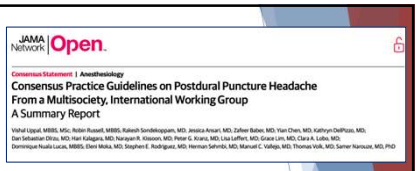
PDPH Practice Guidelines 2023/ 2024


JAMA Network Open.

Consensus Statement | Anesthesiology

Consensus Practice Guidelines on Postdural Puncture Headache From a Multisociety, International Working Group A Summary Report

- Contributions from ASRA, ESRA, SOAP, OAA, ASSR, AIHS
- 50 recommendations total regarding PDPH
  - Risk factors
  - Prevention
  - Diagnosis
  - Management


Regional Anesthesia & Pain Medicine — Original research

Evidence-based clinical practice guidelines on postdural puncture headache: a consensus report from a multisociety international working group

Vishal Uppal, Robin Russell, Rakesh V Sondekoppam, Jessica Ansari, Zafeer Babel, Yian Chen, Kathryn DelPizzo, Dan Sebastian Dirzu, Hari Kalagara, Narayan R Kissoon, Peter G Kranz, Lisa Leffert, Grace Lim, Clara Lobo, Dominique Nuala Lucas, Eleni Moka, Stephen E Rodriguez, Herman Sehmbi, Manuel C Vallejo, Thomas Volk, Samer Narouze

Reg Anesth Pain Med 2024;49(7):471–501. JAMA Netw Open 2023;6(8):e2325387

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Recommendations

A High level of certainty B Moderate level of certainty

- A — Routine use of non-cutting spinal needles for LP for all populations is recommended.
- A — If using a cutting needle for LP, the use of a narrower gauge needle is recommended to reduce the risk of PDPH.
- B — Regular multimodal analgesia including acetaminophen and NSAIDs should be offered to all patients with PDPH (if not contraindicated).
- B — Focal neurological deficits, visual changes, alterations in consciousness, or seizures, especially in the postpartum period, should prompt neuroimaging to evaluate alternative diagnoses.
- B — When PDPH is refractory to conservative therapy and impairs activities of daily living, an EBP should be considered to treat headache and other neurological sequelae of intracranial hypotension.
- B — When the site of dural puncture is known, an EBP should be performed ideally at, or one space below, this level.
- B — Strict aseptic technique should be observed in both collection and injection of autologous blood.
- A — Informed consent for an EBP should include the potential for repeat dural puncture, backache, and neurological complications.
- B — To minimize complications, blood should be injected slowly and incrementally. If the patient develops significant backache or headache (e.g., pressure paresthesia), injection of blood should be stopped and resumed based on the clinical judgment if symptoms resolve.
- B — Before discharge, information regarding PDPH sequelae should be conveyed to patients with arrangements for appropriate follow-up and contact information with their anesthesia provider and other health care providers.
- B — Follow-up with patients who experience PDPH should be continued until headache resolves.
- B — Urgent neuroimaging and referral to an appropriate specialist should be performed for any PDPH patient with worsening symptoms despite an EBP, new focal neurologic symptoms, or a change in the nature of headache.

Reg Anesth Pain Med 2024;49(7):471–501

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Evidence-based clinical practice guidelines on the risk, prevention, and diagnosis of postdural puncture headaches (PDPH)

- While a PDPH may be "self-limiting", timely treatment is paramount!

Treatment
- Regular multimodal analgesia, including acetaminophen and NSAIDs
- Caffeine in the first 24h of symptoms

Epidural Blood Patch (EBP)
- An EBP should be offered if PDPH doesn't respond to conservative therapy and impairs daily living activities

An EBP should be performed:
- Using a strict aseptic technique
- With informed consent on potential risks
- 15-20 ml blood injected slowly and incrementally and stop if headache or backache develops

Procedural Interventions
- Evidence does not support routine use of sphenopalatine ganglion blocks
- Greater occipital nerve block can help in certain cases of PDPH.* However, headaches may return, requiring an EBP

*PDPH following lumbar puncture with narrow gauge spinal needle (22 G or smaller)

Complications & Follow-up
- Inform the patient about PDPH sequelae and contact information
- Arrange appropriate follow-up until the headache resolves
  - Inform primary care and other physicians about management
  - Refer to appropriate specialist and neuroimaging if worsening headache, new neurological symptoms/deficits or change in headache

Reg Anesth Pain Med 2024;49(7):471–501

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PDPH - ASA Statement

STANDARDS AND PRACTICE PARAMETERS

Statement on Post-Dural Puncture Headache Management

Committee of Origin: Obstetric Anesthesia

(Approved by the ASA House of Delegates on October 13, 2021)

Key Points

- PDPH needs to be evaluated and diagnosed when symptomatic
- Mild symptoms may be managed conservatively whereas with severe symptoms, an EBP should be offered
- A second EBP may be offered if the clinical history is clearly UDP related; other causes of HA need to be considered in the differential diagnosis
- Post discharge, a telephone follow-up is essential with appropriate documentation in the medical record
- PDPH education should be provided to the parturient along with long-term follow-up for those with persistent headache

https://www.asahq.org/standards-and-practice-parameters/statement-on-post-dural-puncture-headache-management

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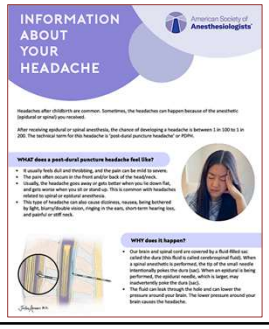
PDPH – ASA Member Resources


INFORMATION ABOUT YOUR HEADACHE

American Society of Anesthesiologists

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QUESTIONS & DISCUSSION

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