



Cardiac Lecture #8: Obstetric Anesthesia and L&D Considerations

June 6, 2023



Updates



- Next Maternal Webinar August 1st
Topic: GaPQC Cardiac Resources Review & EHR Integration of the CVD Risk Assessment
- Q2 2023 HTN and Cardiac Data Submission – DUE July 31st
- Sustainability Survey's



SIMULATION AND DRILLS FOR PATIENT SAFETY

OBSTETRIC IN-SITU DRILL PROGRAM MANUAL ►



PRACTICING FOR PATIENTS SIMULATIONS PREPARATION CHECKLIST ►



SAMPLE CASE SCENARIOS

📄 HYPERTENSION CASE
SCENARIO 1

📄 HYPERTENSION CASE
SCENARIO 2

📄 HYPERTENSION CASE
SCENARIO 3

📄 HEMMORHAGE CASE
SCENARIO 1

📄 HEMMORHAGE CASE
SCENARIO 2

📄 HEMMORHAGE CASE
SCENARIO 3



📄 HYPERTENSION SCENARIO TRAINING AIDS

📄 FETAL HEART RATE TONES TRAINING AIDS

📄 HEMORRHAGE SCENARIOS VISUAL AIDS

📄 ADDITIONAL HEMORRHAGE CASE SCENARIOS

SAMPLE CASE VIDEOS

📺 SEVERE HYPERTENSION CASE
1

📺 SEVERE HYPERTENSION CASE
2

📺 SEVERE HYPERTENSION CASE
3

📺 OBSTETRIC HEMORRHAGE -
REQUIRING UTERINE
TAMPONADE

📺 OBSTETRIC HEMORRHAGE -
REQUIRING UTEROTONICS

📺 OBSTETRIC HEMORRHAGE
WITH RETAINED PRODUCTS



TEAM REVIEW AND DEBRIEFING

- 📄 SEVERE HYPERTENSION FORM
- 📄 OBSTETRIC HEMORRHAGE FORM

TEAM BASED COMMUNICATION TRAINING

- 📄 TEAM STEPPS



PROTOCOL CHANGE FORM AND IMPLEMENTATION ACTION PLAN

- 📄 IN-SITU DRILLS FACILITY PROTOCOL CHANGE FORM
- 📄 PRACTICING FOR PATIENTS IMPLEMENTATION ACTION PLAN

PRACTICING FOR PATIENTS PRESENTATIONS

- 📄 PRACTICING FOR PATIENTS PRESENTATION FOR STAFF (PPT)
- 📄 PRACTICING FOR PATIENTS PRESENTATION FOR LEADERSHIP (PPT)



Key Driver Diagram: Maternal Cardiac Conditions

GOAL:

To reduce severe morbidity & mortality related to maternal cardiac conditions in Georgia.

SMART AIM:

By 02/6/2026, **National Wear Red Day**, to reduce harm related to existing and pregnancy related cardiac conditions through the 4th trimester by **20%**.

Key Drivers

Readiness: EVERY UNIT - Implementation of standard processes for optimal care of cardiac conditions in pregnancy and post-partum.

Recognition & Prevention: EVERY PATIENT - Screening and early diagnosis of cardiac conditions in pregnancy and post-partum.

Response: EVERY UNIT - Care management for every pregnant or postpartum woman with cardiac conditions in pregnancy and post-partum.

Reporting/System Learning: EVERY UNIT - Foster a culture of safety and improvement for care of women with cardiac conditions in pregnancy and post-partum.

Respectful, Equitable, and Supportive Care — EVERY UNIT/PROVIDER/TEAM MEMBER - Inclusion of the patient as part of the multidisciplinary care team.

INTERVENTIONS

- ☐ Train all obstetric care providers to perform a basic Cardiac Conditions Screen.
- ☐ Establish a protocol for rapid identification of potential pregnancy-related cardiac conditions in all practice settings to which pregnant and postpartum people may present.
- ☐ Develop a patient education plan based on the pregnant and postpartum person's risk of cardiac conditions.
- ☐ **Establish a multidisciplinary "Pregnancy Heart Team" or consultants appropriate to their facility's designated Maternal Level of Care to design coordinated clinical pathways for people experiencing cardiac conditions in pregnancy and the postpartum period. S1**
- ☐ Establish coordination of appropriate consultation, co-management and/or transfer to appropriate level of maternal or newborn care.
- ☐ Develop trauma-informed protocols and training to address health care team member biases to enhance quality of care
- ☐ Develop and maintain a set of referral resources and communication pathways between obstetric providers, community-based organizations, and state and public health agencies to enhance quality of care. *

- ☐ Obtain a focused pregnancy and cardiac history in all care settings, including emergency department, urgent care, and primary care.
- ☐ **In all care environments assess and document if a patient presenting is pregnant or has been pregnant within the past year. S2**
- ☐ Assess if escalating warning signs for an imminent cardiac event are present.
- ☐ Utilize standardized cardiac risk assessment tools to identify and stratify risk.
- ☐ Conduct a risk-appropriate work-up for cardiac conditions to establish diagnosis and implement the initial management plan.

- ☐ Facility-wide standard protocols with checklists and escalation policies for management of **cardiac symptoms**.
- ☐ Facility-wide standard protocols with checklists and escalation policies for management of people **with known or suspected cardiac conditions**.
- ☐ Coordinate transitions of care including the discharge from the birthing facility to home and transition from postpartum care to ongoing primary and specialty care.
- ☐ Offer reproductive life planning discussions and resources, including access to a full range of contraceptive options in accordance with safe therapeutic regimens. *
- ☐ **Provide patient education focused on general life-threatening postpartum complications and early warning signs, including instructions of who to notify if they have concerns, and time and date of a scheduled postpartum visit. S3**

- ☐ For pregnant and postpartum people at high risk for a cardiac event, establish a culture of multidisciplinary planning, admission huddles and post-event debriefs.
 - ☐ **Perform multidisciplinary reviews of serious complications (e.g., ICU admissions for other than observation) to identify systems issues. S4**
 - ☐ Monitor outcomes and process data related to cardiac conditions, with disaggregation by race and ethnicity due to known disparities in rates of cardiac conditions experienced by Black and Indigenous pregnant and postpartum people.
- Process Measures – 1-5**

- ☐ Screen for structural and social drivers of health that might impact clinical recommendations or treatment plans and provide linkage to resources that align with the pregnant or postpartum person's health literacy, cultural needs, and language proficiency.
- ☐ Engage in open, transparent, and empathetic communication with pregnant and postpartum people and their identified support network to understand diagnoses, options, and treatment plans.
- ☐ **Include each pregnant or postpartum person and their identified support network as respected members of and contributors to the multidisciplinary care team. *S5**



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Obstetric Anesthesiology

ERICA M. JOHNSON, MD

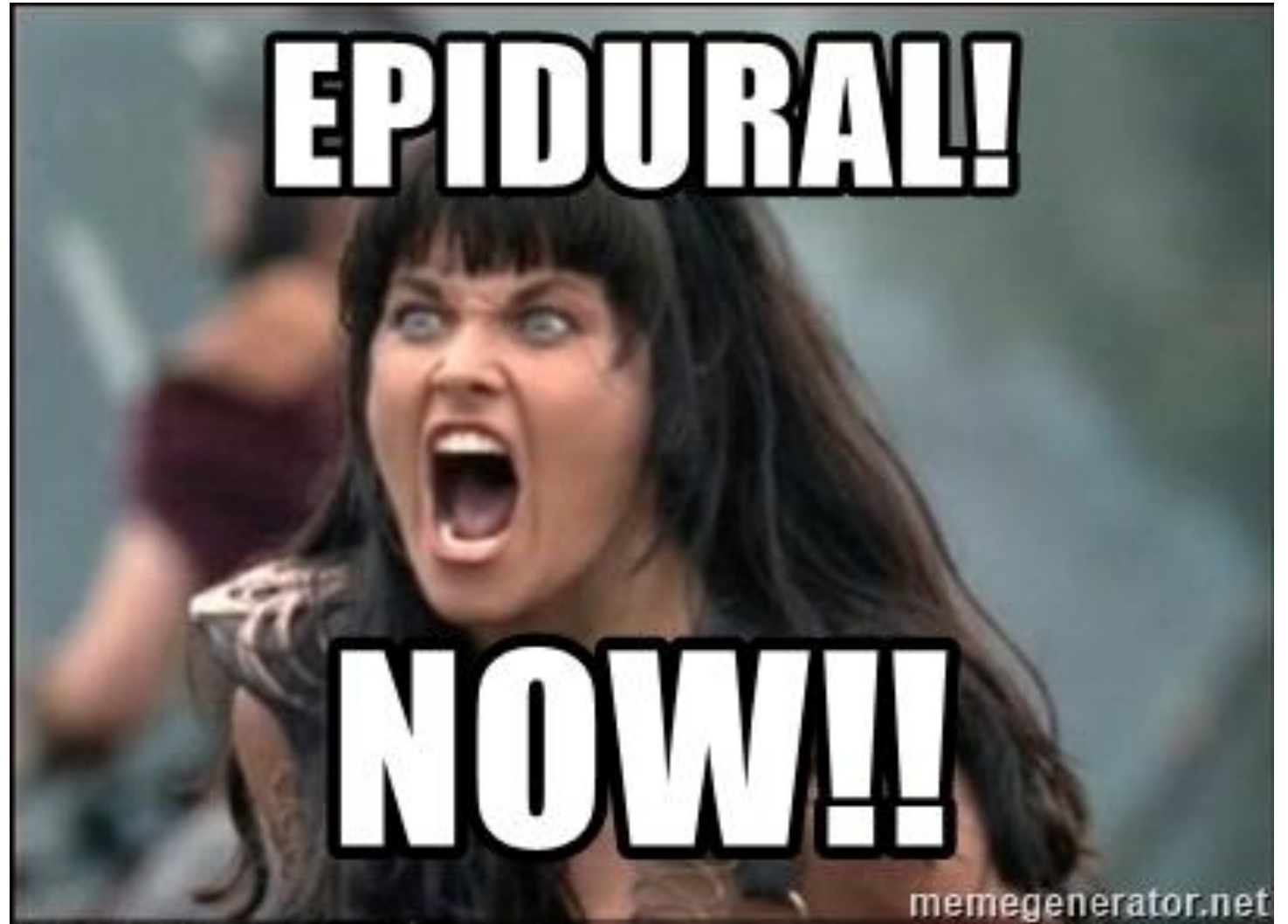
JUNE 6, 2023

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OUTLINE

- What is Obstetric Anesthesiology?
- Labor Analgesia and Indications for Cardiac Patients
- Anesthesia for C-Sections
- High Risk Obstetric Anesthesiology Consult

Epidural
Doctors!!





- Obstetric anesthesiology is the body of anesthesiology knowledge and practice that relates to the anesthetic care of women during pregnancy.
- Obstetric anesthesiologists are specialized anesthesiologists who have expertise in maternal and neonatal physiology, as well as in regional anesthesia. These anesthesiologists are involved in the care of parturients during the entire duration of their pregnancy.
- Obstetric anesthesiologists are involved with in vitro fertilization, anesthesia for cerclage placements, nonobstetric surgery for the pregnant patient, fetal surgery, postpartum procedures, and of course, anesthesia for labor and cesarean deliveries.





BULLETIN OF ANESTHESIA HISTORY



VOLUME 23, NUMBER 2

APRIL, 2005

The Religious Objections and Military Opposition to Anesthetics, 1846–1848*

By George A. Siveroni, M.D.
Department of Anesthesiology
University of Alabama School of Medicine at Birmingham

This article won third place in the 2004 AHA Resident Essay Contest Award.

More than half a century before the anesthetic first published in the medical literature, on March 30, 1843, Crawford W. Long administered a diethyl ether for the excision of a neck cyst on a patient in Jefferson, Georgia.¹ On October 16, 1846, William Thomas Green Morton, 1819–1898, used sulphuric ether to anes-

thetize Scottish obstetrician James Young Simpson and American Army military surgeon John Pomeroy. Each, after seeing the effects of anesthesia on the suffering of surgical patients, came to a very different conclusion. Their subsequent work and writings on the direct and indirect uses of the most volatile anesthetic ether entered

Genesis 3:16 - ".....The Lord God said to the woman, I will greatly increase your pain when you give birth. You will be in pain when you have children. You will long for your husband. And he will rule over you....."

Edinburgh in 1840, he was a popular lecturer on medical topics predominantly, but had expertise in archaeology as well. He was said to be the best obstetrician in Scotland² and in 1847, the year of his great fame, he was named one of Her Majesty's Physicians in Scotland.³ Simpson lived in a society immersed



John
Snow



Queen
Victoria



James
Young
Simpson



- *Simpson JY. Notes on the employment of the inhalation of sulphuric ether in the practice of midwifery. *Monthly J Med Sci* 1847-8;7:721-8.
- *Simpson JY. On a new anaesthetic agent, more efficient than sulphuric ether. *Lancet* 1847;ii:549-550.
- *Simpson JY. Answer to the religious objections advanced against the employment of anaesthetic agents in midwifery and surgery. Edinburgh: Sutherland & Knox. 1847.

After learning of the use of chloroform by Queen Victoria at the birth of Prince Leopold, *The Lancet* in an editorial challenged the accuracy of the information, and then condemned the Queen's physicians and Dr. John Snow (although not by name) for even considering anesthesia.
<http://www.ph.utah.edu/ajph/chron/1847-ed04Chloroform.html>



Cite



Share



Favorites

MATERNAL MORTALITY AND SEVERE MATERNAL MORBIDITY

The Role of the Anesthesiologist in Preventing Severe Maternal Morbidity and Mortality

McQUAID, EMILY MD*; LEFFERT, LISA R. MD*; BATEMAN, BRIAN T. MD, MSc^{†,‡}

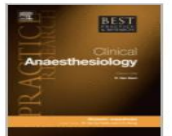
[Author Information](#) ☺

Clinical Obstetrics and Gynecology 61(2):p 372-386, June 2018. | DOI: 10.1097/GRF.0000000000000350



Best Practice & Research Clinical Anaesthesiology

Volume 31, Issue 1, March 2017, Pages 91-105



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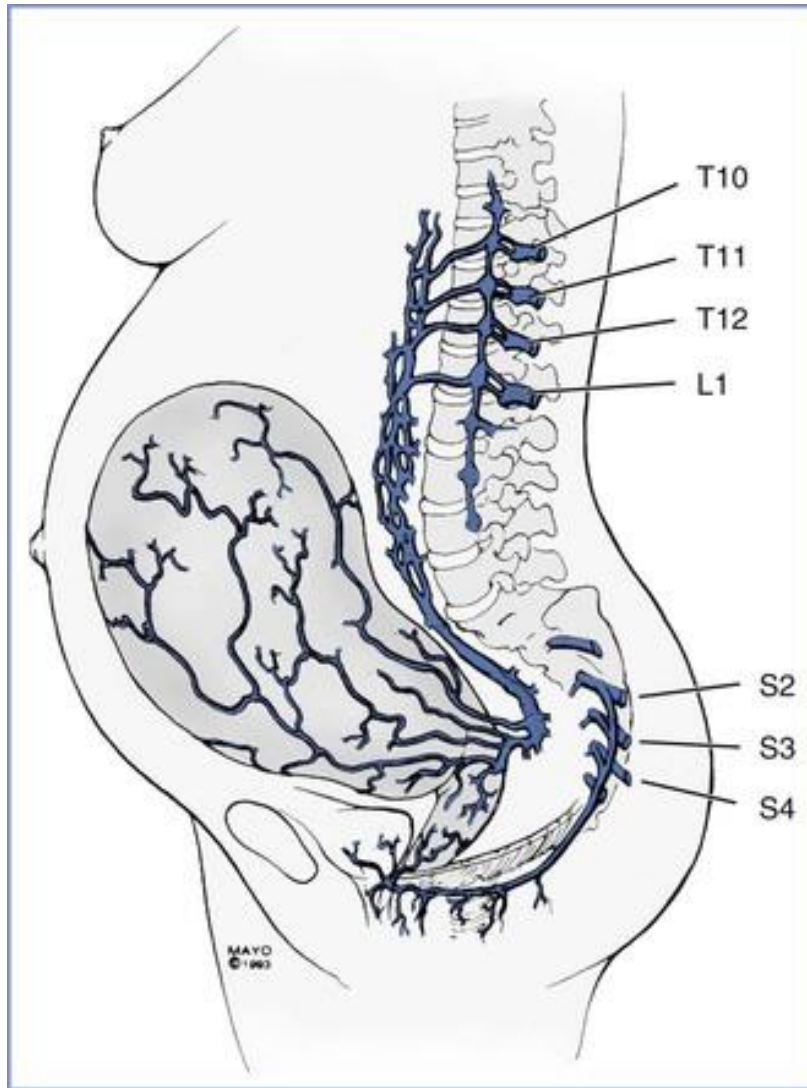
Maternal mortality and the role of the obstetric anesthesiologist

Gillian Abir MBChB, FRCA (Clinical Associate Professor)^a

Jill Mhyre MD (The Dola S Thompson Professor)^b

Labor Analgesia

- Labor Pain
- Physiology
- Timing of Epidural Placement
- Criteria for epidural placement
- Neuraxial Options



The Physiology of Pain in Labor

- **1st stage of labor** – mostly visceral
 - Dilation of the **cervix** and distention of the **lower uterine segment**
 - Dull, aching and poorly localized
 - Slow conducting, visceral C fibers, enter spinal cord at T10 to L1
- **2nd stage of labor** – mostly somatic
 - Distention of the **pelvic floor, vagina and perineum**
 - Sharp, severe and well localized
 - Rapidly conducting A-delta fibers, enter spinal cord at S2 to S4

Why Labor Epidurals for Pain Management?



[Cochrane Database Syst Rev.](#) 2018; 2018(5): CD000331.

PMCID: PMC6494646

Published online 2018 May 21. doi: [10.1002/14651858.CD000331.pub4](https://doi.org/10.1002/14651858.CD000331.pub4)

PMID: [29781504](https://pubmed.ncbi.nlm.nih.gov/29781504/)

Epidural versus non-epidural or no analgesia for pain management in labour

Monitoring Editor: [Millicent Anim-Somuah](#),[✉] [Rebecca MD Smyth](#), [Allan M Cyna](#), [Anna Cuthbert](#), and Cochrane Pregnancy and Childbirth Group

Contraindications

ABSOLUTE

- Patient REFUSAL
- Bacteremia
- Local infection at the site of puncture
- Hemorrhagic diathesis or therapeutic coagulation
- Increased intracranial pressure

The NEW ENGLAND JOURNAL *of* MEDICINE

ESTABLISHED IN 1812

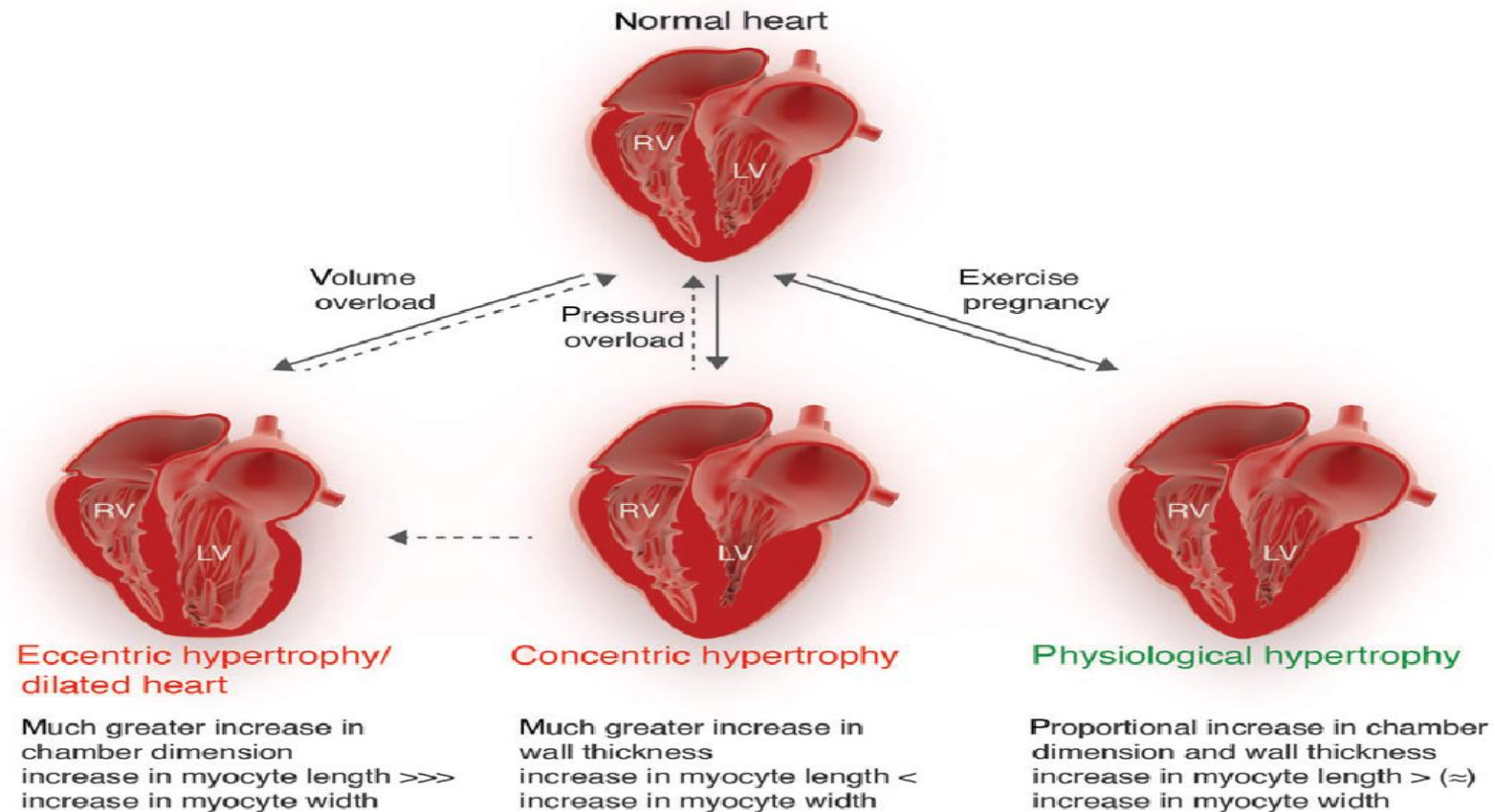
FEBRUARY 17, 2005

VOL. 352 NO. 7

The Risk of Cesarean Delivery with Neuraxial Analgesia Given Early versus Late in Labor

Cynthia A. Wong, M.D., Barbara M. Scavone, M.D., Alan M. Peaceman, M.D., Robert J. McCarthy, Pharm.D.,
John T. Sullivan, M.D., Nathaniel T. Diaz, M.D., Edward Yaghmour, M.D., R-Jay L. Marcus, M.D.,
Saadia S. Sherwani, M.D., Michelle T. Sproviero, M.D., Meltem Yilmaz, M.D., Roshani Patel, R.N.,
Carmen Robles, R.N., and Sharon Grouper, B.S.

Obstetric Anesthesia for Cardiac Patients



ANESTHESIOLOGY

Obstetric Anesthesia and Heart Disease: Practical Clinical Considerations

Marie-Louise Meng, M.D., Katherine W. Arendt, M.D.

ANESTHESIOLOGY 2021; 135:164–83

ABSTRACT

Maternal morbidity and mortality as a result of cardiac disease is increasing in the United States. Safe management of pregnancy in women with heart disease requires appropriate anesthetic, cardiac, and obstetric care. The anesthesiologist should risk stratify pregnant patients based upon cardiac disease etiology and severity in order to determine the appropriate type of hospital and location within the hospital for delivery and anesthetic management. Increased intrapartum hemodynamic monitoring may be necessary and neuraxial analgesia and anesthesia is typically appropriate. The anesthesiologist should anticipate obstetric and cardiac emergencies such as emergency cesarean delivery, postpartum hemorrhage, and peripartum arrhythmias. This clinical review answers practical questions for the obstetric anesthesiologist and the nonsubspecialist anesthesiologist who regularly practices obstetric anesthesiology.

Cardiac patients

- **Risk Stratify**
- **Plan for Hemodynamic monitoring**
- **Neuraxial analgesia/anesthesia Contraindications**
- **Anticipate Emergencies**

Risk Stratify

Range of Diagnosis-

- CHD, aortic dz, valvular heart dz
- Cardiomyopathy, HF, CAD, ACS, HTN,
- Pulm HTN, endocarditis, arrhythmias

Preload Dependent?

- $CO = HR * SV$

Afterload

- Systemic Vasc Resistance (SVR)

Table 1. Modified World Health Organization Classification of Cardiovascular Disease in Pregnancy^{1,2}

Risk Classification	Cardiac Lesions
Class I No detectable increased risk of maternal mortality and no or minimal increase in maternal morbidity	<ul style="list-style-type: none"> • 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 extra-systoles and atrial ectopic beats
Class II Small increased risk of maternal mortality or moderate increase in morbidity	<ul style="list-style-type: none"> • Unrepaired atrial or ventricular septal defect • Repaired tetralogy of Fallot • Most arrhythmias • Hypertrophic cardiomyopathy
Class II–III Moderate increased risk of maternal mortality or morbidity	<ul style="list-style-type: none"> • Native or tissue valvular heart disease not considered Modified World Health organization I or IV • Repaired coarctation • Marfan syndrome without aortic dilatation • Bicuspid valve with aorta <45 mm • Mild ventricular impairment • Heart transplantation • Mechanical valve
Class III Significantly increased risk of maternal mortality or severe morbidity, and expert cardiac and obstetric prepregnancy, antenatal, and postnatal care are required	<ul style="list-style-type: none"> • Systemic right ventricle • 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 • Pulmonary hypertension • Eisenmenger syndrome • Systemic ventricular ejection fraction <30% • Systemic ventricular dysfunction with New York Heart Association class III–IV • Severe mitral stenosis or symptomatic aortic stenosis • Marfan syndrome with aorta >45 mm • Bicuspid aortic valve with aorta >50 mm • Native severe coarctation • Previous peripartum cardiomyopathy with any residual impairment of ventricular function
Class IV Pregnancy is highly discouraged	

Table 2. Maternal Levels of Care³

Level	Title	Maternal Health	Hospital Capabilities	Anesthesia Staffing	Modified World Health Organization Patients*
Birth center	Birth center	Low risk	Not applicable	None	None
Level I	Basic care	Low to moderate risk	Limited obstetric ultrasound Blood bank	Anesthesia provider readily available at all times	Modified World Health Organization class I
Level II	Specialty care	Moderate to high risk	Computed tomography scanning/magnetic resonance imaging Maternal echocardiogram Nonobstetric ultrasound	Anesthesiologist readily available at all times	Modified World Health Organization class I or II
Level III	Subspecialty care	More complex maternal, obstetric and fetal conditions	Interventional radiology In-house capability of all blood components	Board-certified anesthesiologist physically present at all times	Modified World Health Organization class I or II, some III
Level IV	Regional perinatal health center	Most complex maternal conditions	ICU care with Maternal Fetal Medicine comanagement Cardiovascular surgery, ECMO, and transplant capabilities	Board-certified anesthesiologist with obstetric anesthesia fellowship or experience in obstetric anesthesia physically present at all times	Modified World Health Organization class I, II, III, or IV


*The addition of the Modified World Health Organization classifications into the Maternal Levels of Care is an extrapolation based upon Drs. Meng and Arendt's experience, and is not a direct recommendation from the American College of Obstetricians and Gynecologists, Society of Maternal–Fetal Medicine, or Modified World Health Organization.

ECMO, extracorporeal membrane oxygenator; ICU, intensive care unit.

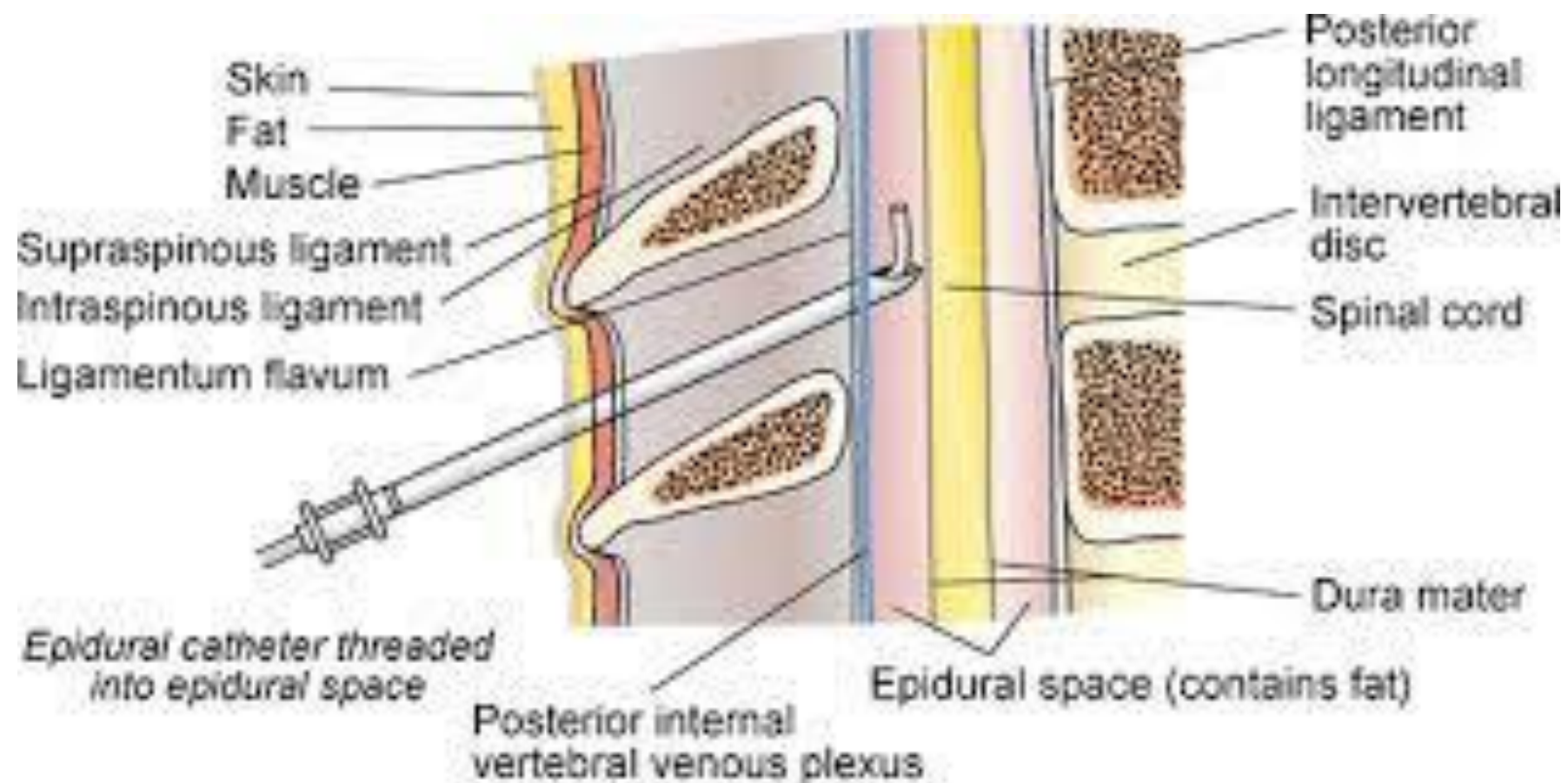
Hemodynamic Monitoring/ Neuraxial Contraindications

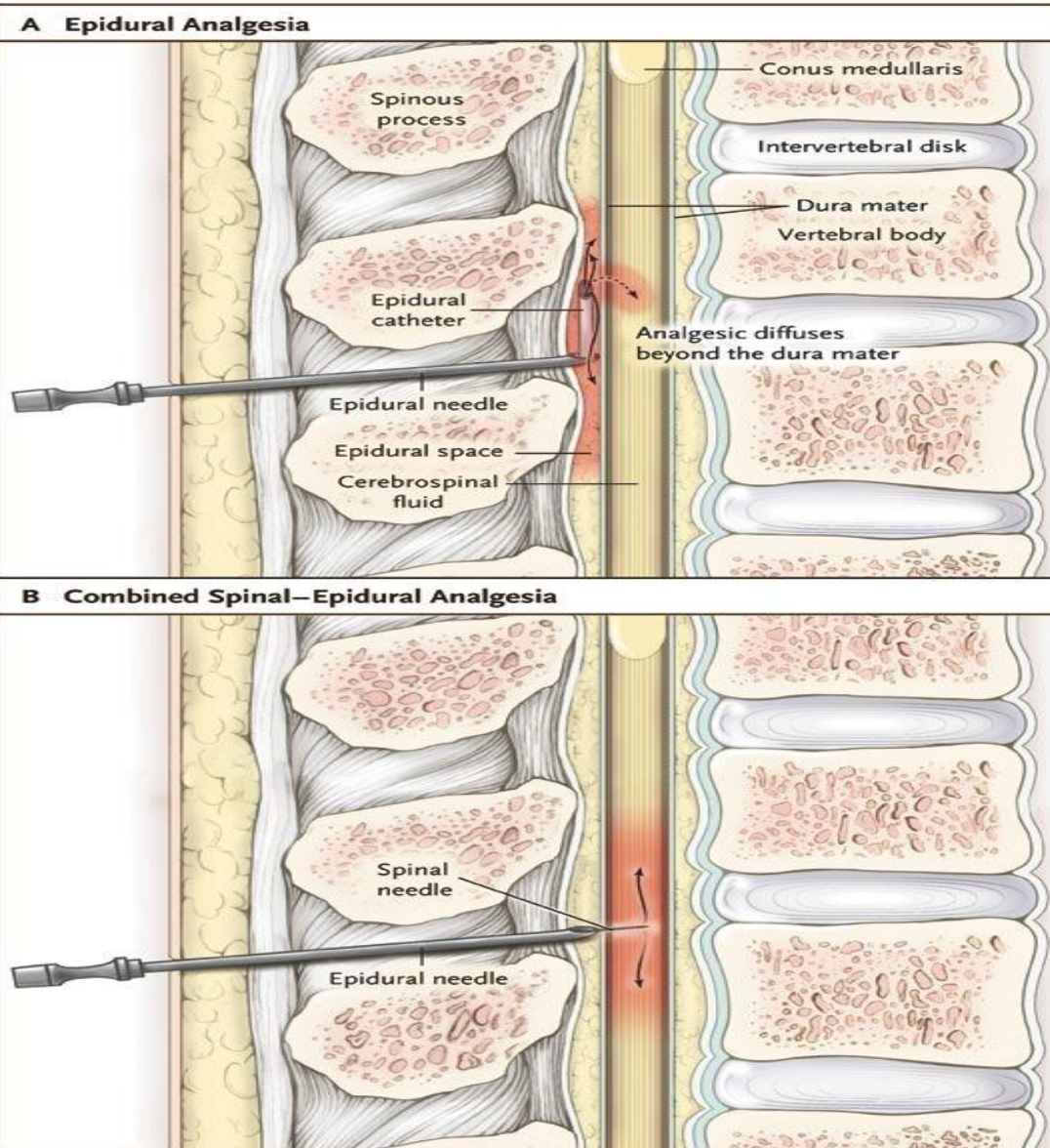
Type of Cardiac Condition

- Cardiomyopathy with preserved Ejection Fraction (EF) vs reduced EF
 - Recent Transthoracic echo/ POCUS
 - Invasive arterial Blood Pressure
 - Large bore IV access, vasopressor/inotropes
- Tachyarrhythmias-atrial fibrillation, Supraventricular tachycardia
 - Anticoagulation-planned cessation (heparin vs lovenox)
 - Beta-blockers, anti-arrhythmia medications
 - Telemetry
- Prior Valve replacements
 - Anticoagulation-warfarin->heparin (planned cessation)
- Chronic HTN/Pre-Eclampsia
 - PreEclampsia with Severe Features consider invasive BP monitoring

ANTICOAGULATION GUIDELINES FOR NEURAXIAL PROCEDURES Guidelines to Minimize Risk Spinal Hematoma with Neuraxial Procedures			
 STANFORD SCHOOL OF MEDICINE <i>Stanford University Medical Center</i>	Minimum time between last dose of anticoagulant & spinal injection or catheter placement * longer in CRI/AKI	Use of Antithrombotic Agents in Patients with Indwelling Neuraxial Catheters	Minimum time between spinal injection or catheter removal & next dose of anticoagulant
TRADITIONAL ANTICOAGULANTS			
Warfarin	when INR < 1.5	CONTRAINDICATED	2 hours
Heparin full dose IV	when aPTT < 40. Check after holding 2 hours	Indwelling catheter OK	1 hour
Heparin minidose (5000 Units) SQ BID	No contraindication		
Heparin minidose (5000 Units) SQ TID	when aPTT < 40 or 6 hours after last dose		
Heparin full dose (>5000 Units) SQ bid or TID	when aPTT <40 or 6 hours after last dose		
Fondaparinux (Arixtra) <2.5mg SQ qd (prophylaxis)	36-42 hours	CONTRAINDICATED	6-12 hours
Fondaparinux (Arixtra) 5-10mg SQ qd (full dose)	Contraindicated		24 hours
Enoxaparin (Lovenox) 1mg/kg SQ bid; 1.5mg/kg SQ qd (full dose)	24 hours*		
Enoxaparin (Lovenox) 40mg SQ qd (prophylaxis)	12 hours*		6-8 hours
DIRECT THROMBIN INHIBITORS			
Argatroban	unknown or when DTI assay < 40 or aPTT < 40	CONTRAINDICATED while catheter in place	unknown
Bivalirudin (Angiomax)			
Lepirudin (Refludan)			
Dabigatran (Pradaxa)			
	7 days		
ORAL ANTIPLATELET AGENTS			
Aspirin/NSAIDS	May be given, No time restrictions		
Clopidogrel (Plavix)	7 days	CONTRAINDICATED while catheter in place	2 hours
Prasugrel (Effient)			
Ticlopidine (Ticlid)	14 days		
GP IIB/IIIA INHIBITORS			
Abciximab (Reopro)	48 hours	CONTRAINDICATED while catheter in place	2 hours
Eptifibatide (Integrilin)	8 hours*		
Tirofiban (Aggrastat)	8 hours*		
THROMBOLYTIC AGENTS			
Alteplase (TPA) Full dose for stroke, MI, etc	10 days	CONTRAINDICATED while catheter in place	10 days
Alteplase (TPA) 2mg dose for catheter clearance	May be given, No time restrictions (maximum dose 4mg/24 hrs)		
NEW AGENTS			
Apixaban (Eliquis)	unknown for neuraxial procedures but hold 48 hours for surgery		

Date 3/28/2013





Labor Epidurals for Cardiac Patients

Varying Degrees of Sympathectomy!!

EARLY

SLOW

LOW

"Epidurals"

- Traditional Epidural
 - Pro-slow and controlled sympathectomy
- Combined-Spinal Epidural
 - Different variations
 - Quick onset, superior analgesia
 - More hemodynamic instability associated with intrathecal injections
- Dural Puncture Epidural
 - Combination of 2 prior
 - Dense sacral nerve root coverage

Planning for Emergencies

Surgical Anesthesia (C-section)

ELECTIVE

- Spinal Anesthesia
- Epidural
- Combined-Spinal Epidural
- Dural Puncture Epidural

NON-ELECTIVE

- Urgent
- Stat/Emergency
- General Anesthesia

Intrapartum C-Section

Attending: Is the Epidural Working?

Resident: I think so?!!!....



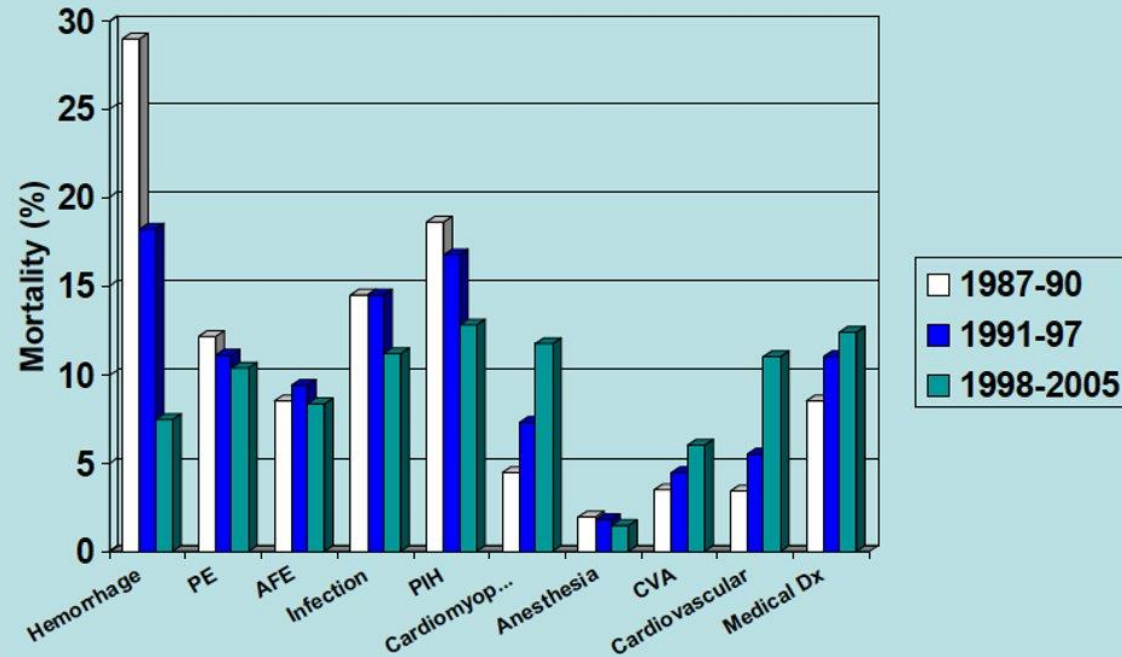
FASTEST

Slowest



Chloroprocaine. Lidocaine. Bupivacaine. Ropivacaine.

Cause of Death: 1987 - 2005



Berg CJ, et al. Obstet Gynecol 2010;116:1302-1309.

General Anesthesia

Pregnant Airway

- Incidence of failed intubation 8x that in non-pregnant women
 - Independent risk factors: older age, increasing BMI, pre-eclampsia
 - Anesthesia related death is the 7th leading cause of maternal mortality->failed intubation most common cause
- Anatomy:
 - Mucosal hyperemia of oral & nasal pharynx, larynx, and trachea, angioedema
 - Pre-existing anatomical deformity
 - Obesity, coexisting diseases involving the airway
- Intubation Technique:
 - Positioning (HELP)
 - Laryngeal BURP maneuver (backward, upward, to the right pressure)
 - Smaller laryngoscope handles
 - Smaller endotracheal tubes 6.5->7.0mm



General Anesthesia (Cont'd)

Maternal Concerns

- Serious Adverse Events related to induction of General Anesthesia (respiratory compromise, cardiac arrest)
- Failed intubation
- Cerebrovascular injury from severe HTN response to intubation in women with comorbidities (severe preE, cerebral aneurysms)
- Severe Hypoxia (Decreased FRC) and resp depression after emergence
- Death
- Post-Partum Hemorrhage, increased uterine atony
- Increased and persistent pain (inability to have neuraxial opioids)
- Increased Infection
- VTE
- Decreased "bonding" and family experience

Fetal Concerns

- Respiratory Depression with delivery, APGAR<7 at 5min
- Increased NICU admissions
- Concern about long-term neurodevelopmental outcomes
- Decreased Breast-feeding success
- 2019 Meta-analysis (RSS)

High Risk ANE Consult

- 21yo F G1P0 at 10 wks gestational age. Scheduled for medically indicated termination. Pt increasingly SOB with minimal activity.
- PMH –CHF with reduced EF (5-10%) 2months prior
- Defibrillator in place
- Cardiology team dispo'd to hospice
- BMI 58
- OSA-no CPAP

Table 3. Anesthetic Care Steps for Pregnant Women with Known Cardiovascular Disease**Predelivery Consultation with the Anesthesiology Service**

1. Summarize cardiovascular, obstetric, and anesthesia history and risk factors
2. Cardiac history should focus on:
 - a. Previous surgeries, echocardiograms, electrocardiograms, Holter monitors, stress tests, heart catheterization, *etc.*
 - b. Previous or current episodes of heart failure
 - c. Intracardiac shunting and cyanosis
 - d. Previous arrhythmias
 - e. Left heart obstructive lesions
 - f. Left and right heart function
3. Risk stratify according to the Modified World Health Organization criteria
4. Participate in multidisciplinary planning of labor and delivery
5. With obstetric team, plan appropriate delivery location according to maternal levels of care
6. Partner with pregnancy heart team* for anticoagulation regimen to optimize ability to perform neuraxial techniques
7. Clarify in the consultation note plan for pacemaker or defibrillator (keep automatic implantable cardioverter defibrillator “on” during labor or cesarean delivery)
8. Clarify in the consultation notes which obstetric drugs could cause hemodynamic instability (see table 5)
9. Partner with pregnancy heart team* to clarify in the consultation notes postdelivery plans for monitoring

Trial of Labor

1. Besides standard labor monitoring, also consider monitoring with:
 - a. Pulse oximetry with a wave form
 - b. Five-lead electrocardiography if at risk for tachyarrhythmia or cardiac ischemia
 - c. Intraarterial blood pressure monitoring if at risk for hemodynamic instability with induction of neuraxial or general anesthesia
2. Initiate neuraxial analgesia early in labor (unless contraindication)
3. Do not use a routine preepidural fluid bolus in patients at risk for pulmonary edema
4. Consider modifying epidural test dose to minimize the risk of high spinal or intravascular epinephrine
5. Monitor for hypotension closely during induction of neuraxial labor analgesia and treat with goal-directed fluids and vasopressors (*e.g.*, phenylephrine, norepinephrine, and ephedrine) to maintain normal blood pressure
6. Readily replace suboptimal epidural catheter
7. Keep epidural block dense enough throughout labor such that it eliminates pain and catecholamine release, facilitates operative vaginal delivery, and can quickly be converted to a surgical block in the event of an obstetric emergency

Cesarean Delivery

1. Low threshold to monitor with intraarterial blood pressure
2. Perform neuraxial anesthesia if no contraindications (choose epidural, sequential combined spinal epidural, or single-shot spinal based upon presumed tolerance of sympathectomy)
3. Titrate vasopressor infusion (*e.g.*, phenylephrine or norepinephrine) to maintain blood pressure
4. Titrate oxytocin on an infusion pump

Postpartum

1. Titrate oxytocin on an infusion pump
2. Monitor for postpartum hemorrhage and treat rapidly
3. In most cardiovascular patients, risks of methylergonovine and carboprost may outweigh the benefits of these uterotonic medications (see table 5)
4. More intense monitoring postpartum (*e.g.*, five-lead electrocardiographic monitoring, continuous pulse oximetry) may be indicated in patients with Modified World Health Organization class III or IV lesions, or those who experience obstetric or cardiac complications during labor or delivery. This may require intensive care or step-down unit admission.

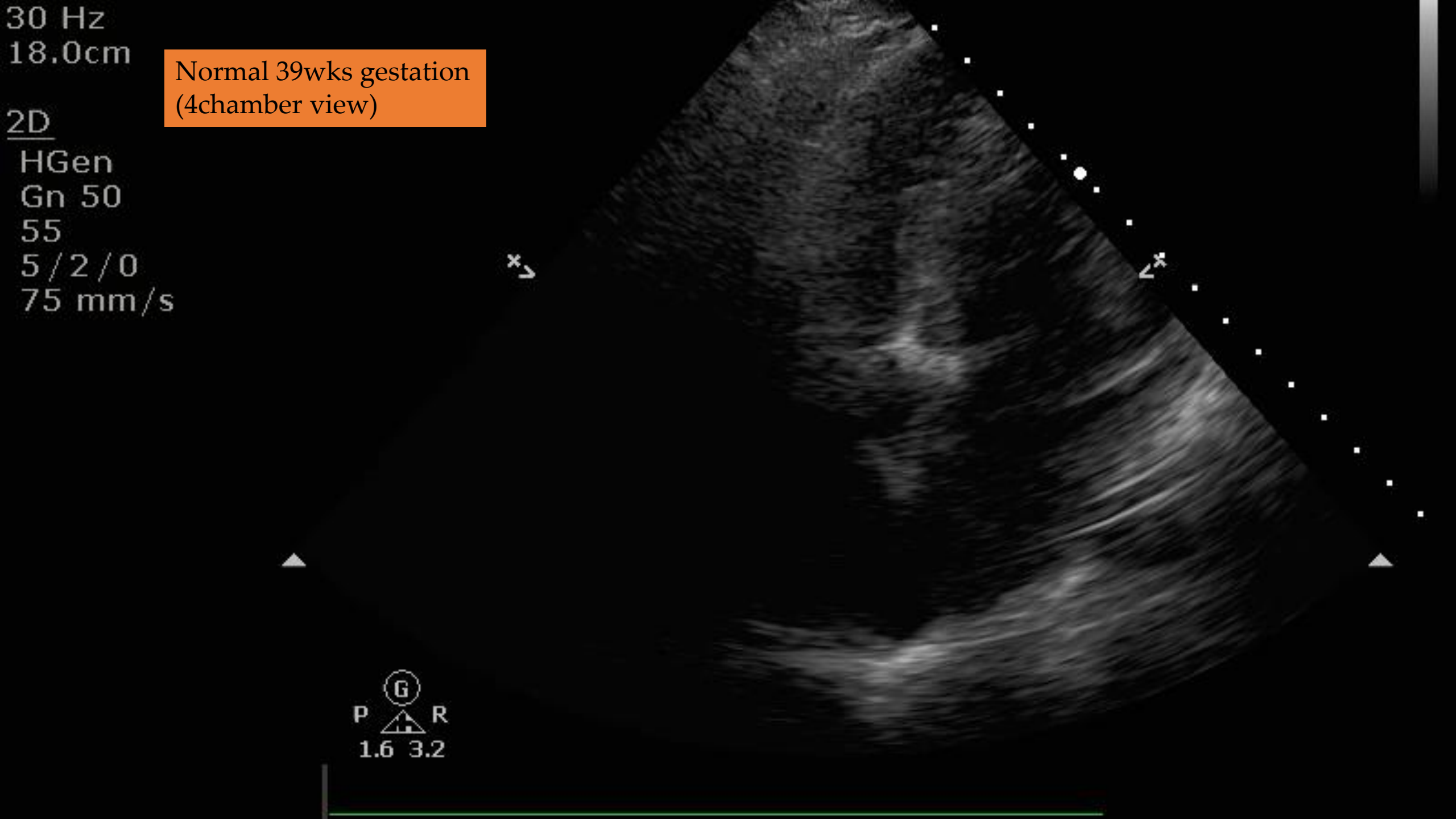
30 Hz
18.0cm

Normal 39wks gestation
(4chamber view)

2D

HGen
Gn 50
55
5 / 2 / 0
75 mm/s

G
P R
1.6 3.2



CARDIAC S4

S4-2

34 Hz

15.0cm

Normal 39wks gestation
(parasternal short axis)

2D

HGen

Gn 50

55

5 / 2 / 0

75 mm/s



FR 61Hz
20cm

2D
62%
C 50
P Med
HPen

SUPINE
NAUSEA

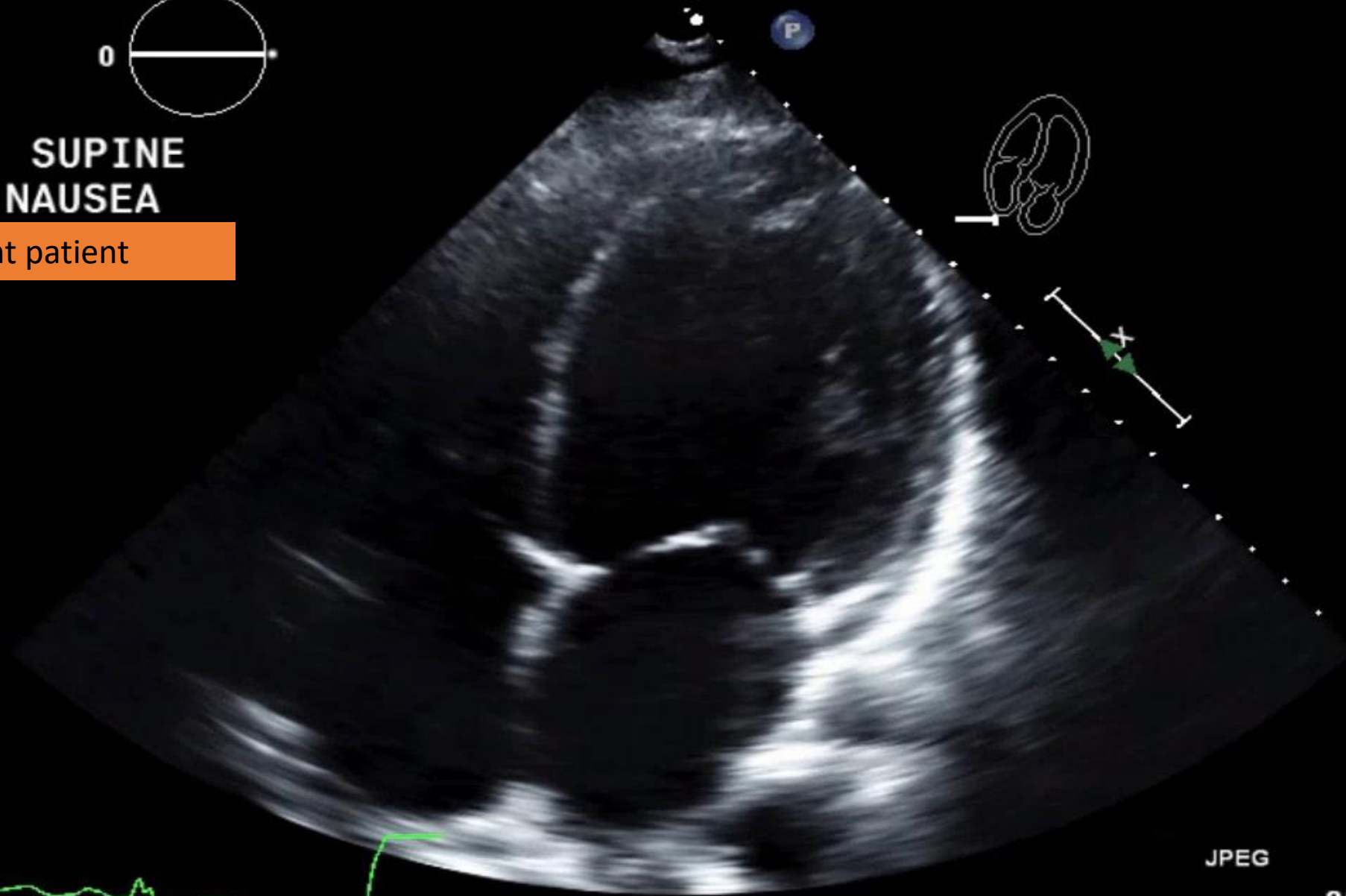
Our current patient

G
P 1.3 R 2.6

M3

JPEG

85 bpm



TIS 0.4

CARDIAC S4

S4-2

20.0cm

+ TR Max PG	35.6 mmHg
RA Pressure	15 mmHg
RVSP	50.6 mmHg

2D

HGen

Gn 50

55

5/2/0



Our current patient
(mild-mod pulm HTN)



Color

2.5 MHz

Gn 60

4/5/0

Filtr High

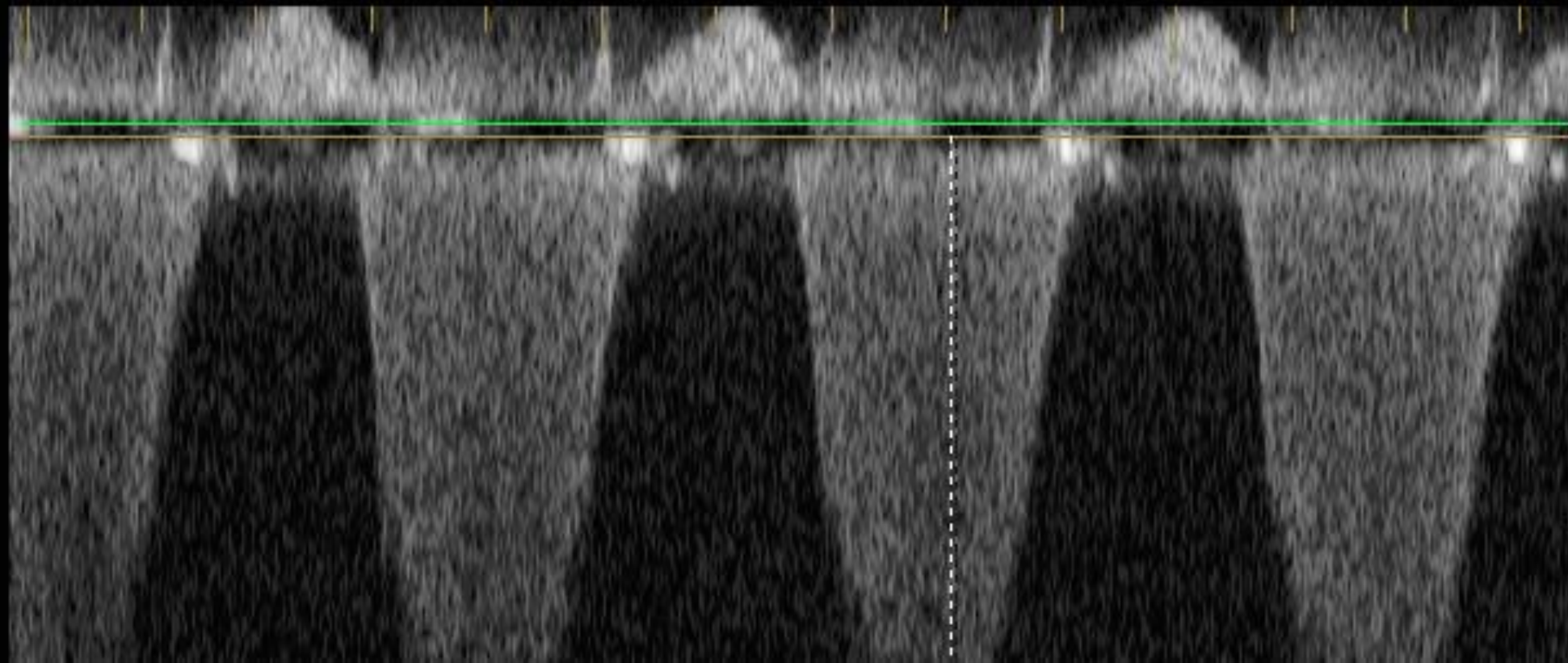
CW

1.7 MHz

Gn 66

11.8 cm

Angle 00



Plan?!

- Preop: Extensive counseling
 - Multidisciplinary approach-MFM, Family Planning, cardiology, anesthesiology
- Intraop
 - Defibrillator remains active
 - Arterial line for beat to beat BP guidance
 - Monitored Anesthesia Care (MAC) vs neuraxial
 - Avoid oversedation/ hypercapnia (exacerbate Pulm HTN/Right heart failure)
 - Required vasopressor support
 - Low dose single shot spinal (Sacral-> T10 level, minimal sympathectomy)
 - Modified supine/ lithotomy position (inability to lie flat)
- Postop
 - ICU transfer for advance hemodynamic monitoring
 - Required vasopressor support for ~24hrs

High Risk ANE Consult

- 23yo G2P0010 with a history of congenital mitral dysplasia who was scheduled for a primary cesarean section (CS) at 35wks.
- The patient had no cardiac complications until she reached 11wk gestational age at which time she was hospitalized for significant volume overload and NYHA class IV symptoms.
- She was found to have severe functional mitral stenosis of her MMV that was significantly undersized for her current body surface area. Serial transthoracic echocardiograms revealed worsening mitral stenosis with a mean gradient of 25mmHg, moderate pulmonary hypertension (RVSP 40-45mmHg) and NYHA class II-III symptoms with preserved left ventricular ejection fraction 55-60%.

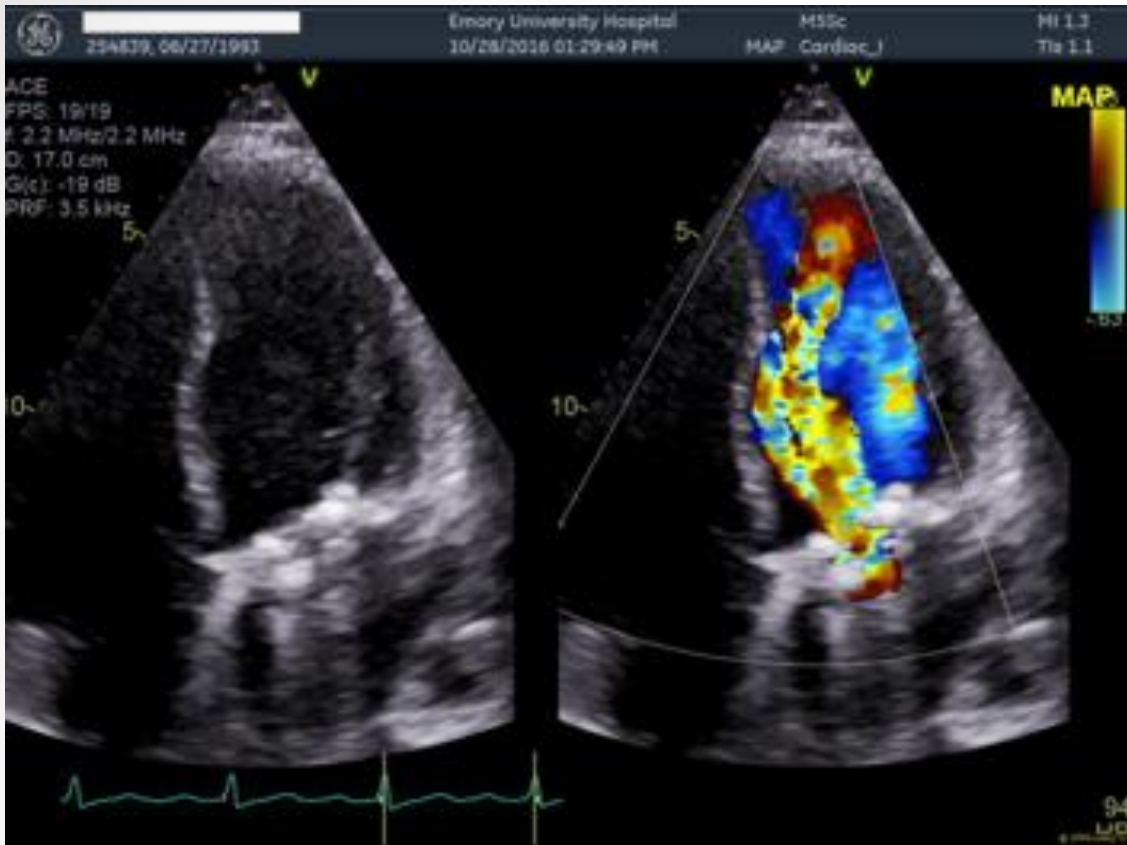


Figure 1: TTE at 24 wks reveals undersized MMV in place causing “functional” mitral stenosis with significant turbulent flow seen on doppler.



Figure 2: (TTE, 24wks) Continuous wave doppler reveals the severely elevated mean pressure gradient 27mmHg across the MMV.

High Risk ANE Consult

- Because of her worsening symptoms and MS, the decision was made to proceed with CS at 35.2wks. The patient was admitted before her scheduled CS and transitioned from warfarin to a heparin drip for continued anticoagulation of her MMV.
- Anesthesia for her CS was provided using a dural puncture epidural (DPE), invasive hemodynamic monitoring including arterial line and peripheral venous pressure monitoring, and targeted vasopressor/fluid therapy.
- During DPE dosing, after a T10 level was obtained with 0.5% bupivacaine, cardiothoracic surgery performed a cut-down with wire placement in the femoral vessels in case there was a need to transition to ECMO emergently. Upon obtaining a T4 level of anesthesia, an uneventful CS, requiring minimal vasopressor support, resulted in delivery of a male infant with Apgars of 8 and 9.
- Uterine atony was prevented through the use of carefully titrated intravenous doses of methylergonovine maleate rather than an oxytocin infusion. (less cardiac depressant, methergine supports afterload that stenotic valve patient prefer)



Figure 3: TTE 1-month postpartum reveals improvement in turbulent flow across the MMV

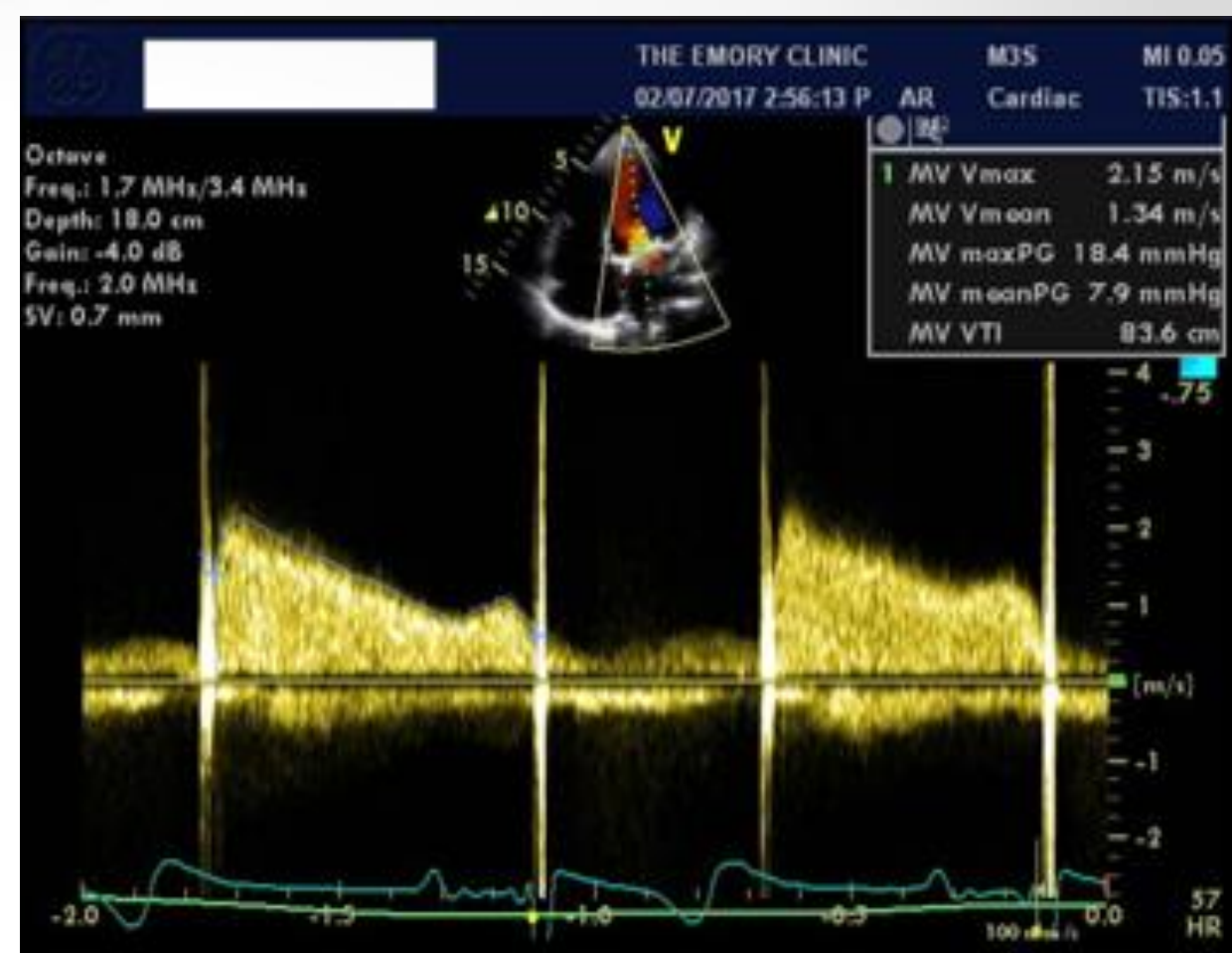


Figure 4: TTE 1-month postpartum reveals reduced mean pressure gradient 8mmHg across the MMV



Grady Obstetric Anesthesiology Family



REFERENCES:

- McQUAID, EMILY MD*; LEFFERT, LISA R. MD*; BATEMAN, BRIAN T. MD, MSc†,‡ The Role of the Anesthesiologist in Preventing Severe Maternal Morbidity and Mortality, Clinical Obstetrics and Gynecology: June 2018 - Volume 61 - Issue 2 - p 372-386
- Abir G, Mhyre J. Maternal mortality and the role of the obstetric anesthesiologist. Best Pract Res Clin Anaesthesiol. 2017 Mar;31(1):91-105. doi: 10.1016/j.bpa.2017.01.005. Epub 2017 Feb 3. PMID: 28625309.
- Edwards ML, Jackson AD. The Historical Development of Obstetric Anesthesia and Its Contributions to Perinatology. Am J Perinatol. 2017 Feb;34(3):211-216. doi: 10.1055/s-0036-1585409. Epub 2016 Jul 19. PMID: 27434694.
- Mireault D, Loubert C, Drolet P, Tordjman L, Godin N, Richebé P, Zaphiratos V. Uterine Exteriorization Compared With In Situ Repair of Hysterotomy After Cesarean Delivery: A Randomized Controlled Trial. Obstet Gynecol. 2020 May;135(5):1145-1151. doi: 10.1097/AOG.0000000000003821. PMID: 32282591.

REFERENCES:

- Kim WH, Hur M, Park SK, Yoo S, Lim T, Yoon HK, Kim JT, Bahk JH. Comparison between general, spinal, epidural, and combined spinal-epidural anesthesia for cesarean delivery: a network meta-analysis. *Int J Obstet Anesth*. 2019;37:5–15. doi: 10.1016/j.ijoa.2018.09.012. [[PubMed](#)] [[CrossRef](#)] [[Google Scholar](#)]