

Cardiac Assessment Optimization for Obstetric Analgesia & Anesthesia

Obstetrical Anesthesiologists Intensivists Association
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A Cautionary Tale



A Fable

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



Cardiac Assessment: Learning Objectives



Anticipation

Needs

Tactics

Cardiac Assessment: Learning Objectives



Anticipation

Needs

Tactics

Cardiac Assessment: [Anticipation](#)



Cardiac Anticipation: Case

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

- Preeclampsia (BP 168/88), gDiabetes, gThrombocytopenia, Mitral Stenosis
- Surgical History: Cholecystectomy, Appendectomy, Gastric Bypass
- Baby "Heart Problem" Operation



Cardiac Anticipation: Case

Cardiac Disease: 1-4% Pregnancies

Increasing: Congenital Heart Disease, Advanced Maternal Age, Risk Factors: DM, HTN, Pre-eclampsia, Obesity, Multifetal Pregnancies.

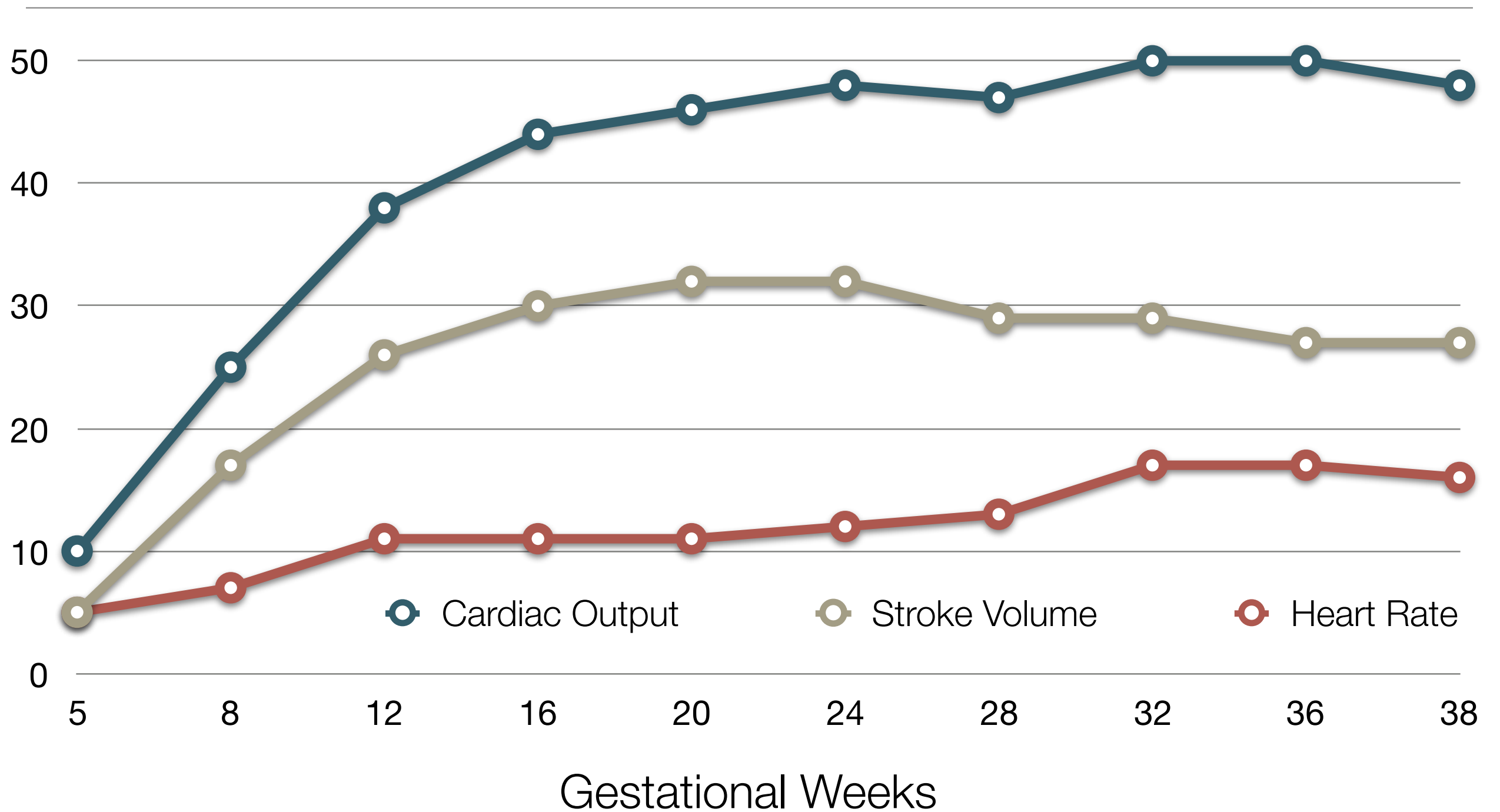
Decreasing: Rheumatic Valve

#1: NonOB Maternal Mortality

Elkayam U, et al. High Risk Cardiac Disease in Pregnancy. Parts 1 & 2, JACC 2016; 68:396-410

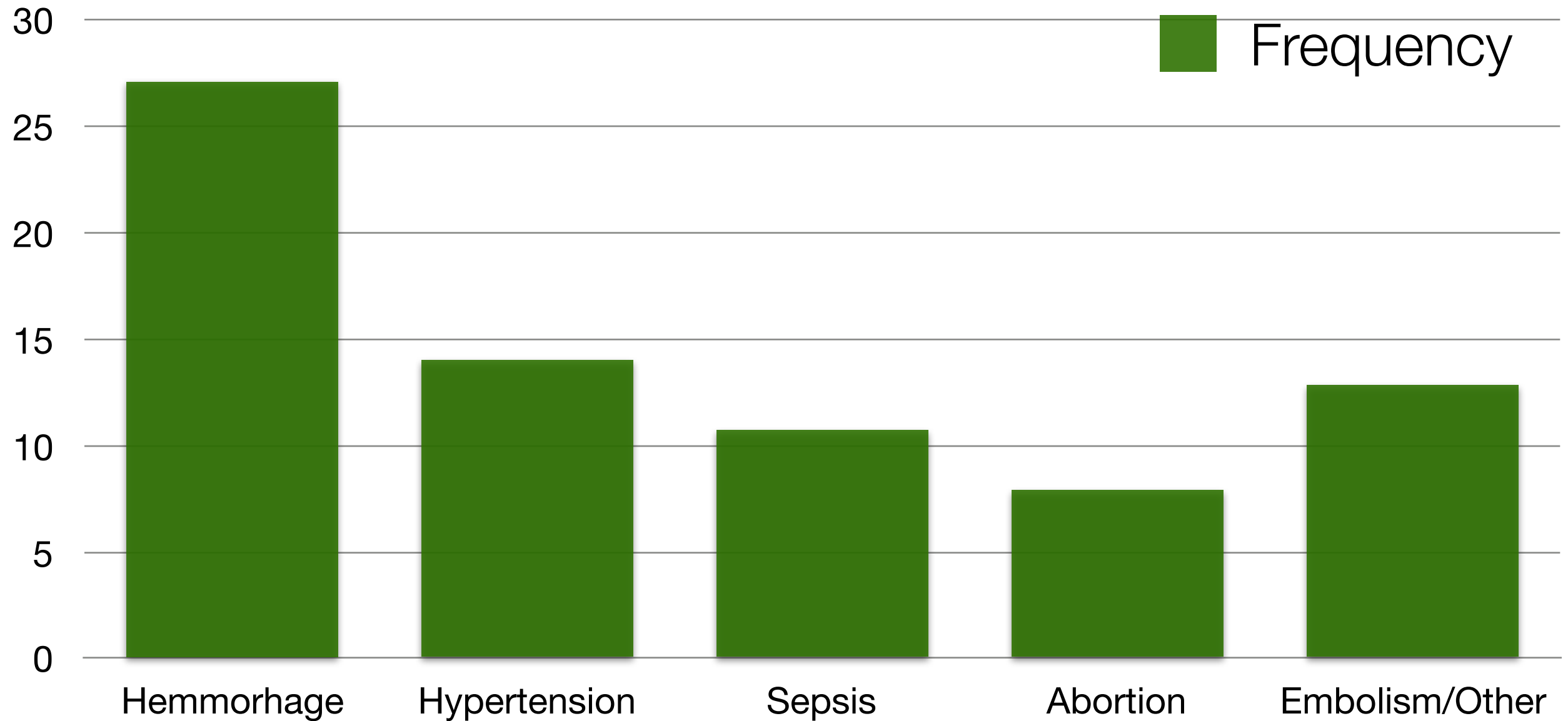


Cardiac Anticipation: % Change in Pregnancy



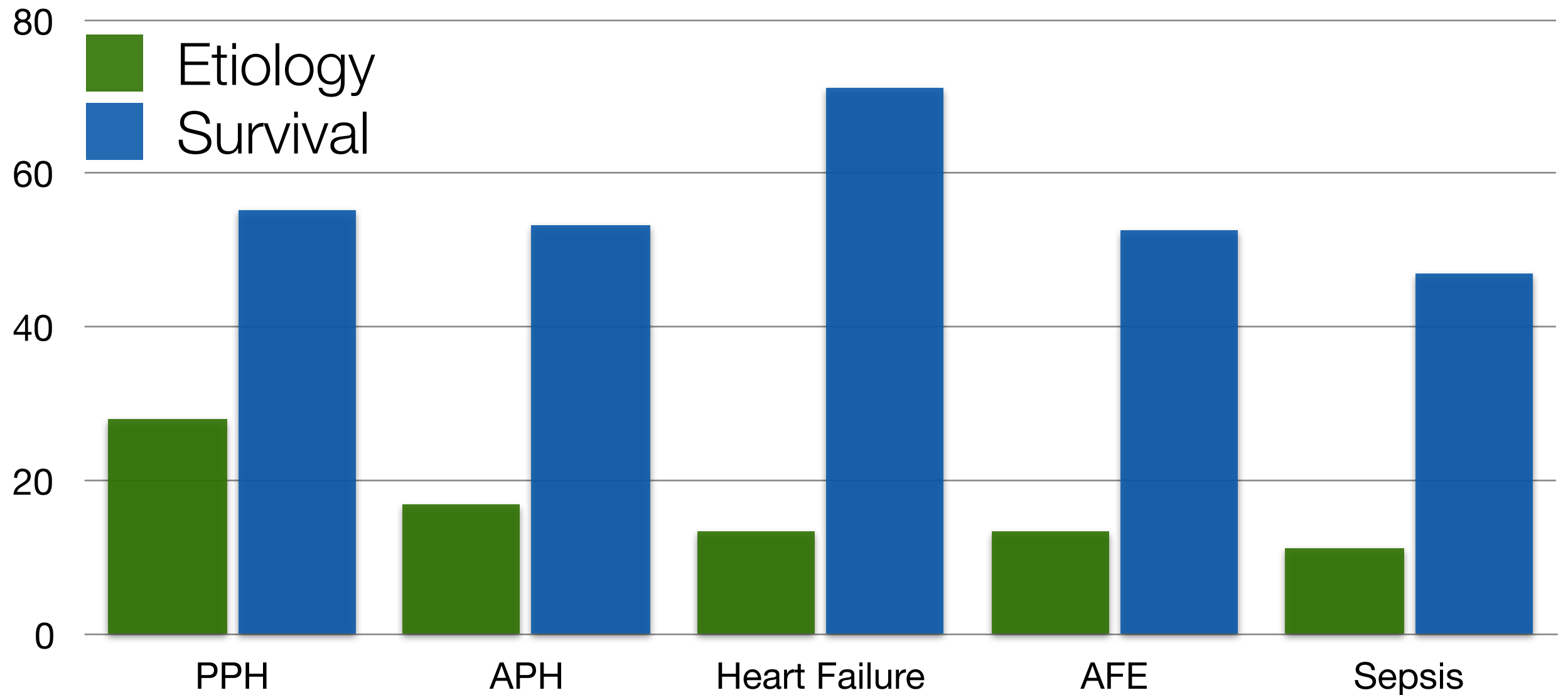
Ouzounian JG, Elkayam U. Physiologic changes during normal pregnancy and delivery. Cardio Clin 2012;30:317-29.

Cardiac Anticipation: Maternal Mortality



Say L, et al. Global causes of Maternal Death: A WHO Systematic Analysis 2003-2012
Lancet Glob Health 2014; 2:3323-33.

Cardiac Anticipation: Cardiac Resuscitation



Mhyre J, Tsen LC, Einav S, Kuklina DV, Leffert L, Bateman BT. Cardiac Arrest during Hospitalization for Delivery in the United States, 1998-2011. *Anesthesiology* 2014;120:810-8

Cardiac Anticipation: Evaluation

Valve	Congenital	Pulm Htn	Aortopathy	Cardio Myopathy
Physical, EKG, Echo	Physical, EKG, Echo	Physical, EKG, Echo	Physical, EKG, Echo	Physical, EKG, Echo

Elkayam U, et al. High Risk Cardiac Disease in Pregnancy. Parts 1 & 2, JACC 2016; 68:396-410

Cardiac Anticipation: Evaluation

Valve	Congenital	Pulm Htn	Aortopathy	Cardio Myopathy
	CT, MRI		CT, MRI	
Physical, EKG, Echo	Physical, EKG, Echo	Physical, EKG, Echo	Physical, EKG, Echo	Physical, EKG, Echo

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Cardiac Anticipation: Evaluation

Valve	Congenital	Pulm Htn	Aortopathy	Cardio Myopathy
Stress, BNP	Sat, Capacity, peak VO ₂ , CI, BNP			Electrophys Stress, BNP
	CT, MRI		CT, MRI	
Physical, EKG, Echo	Physical, EKG, Echo	Physical, EKG, Echo	Physical, EKG, Echo	Physical, EKG, Echo

Elkayam U, et al. High Risk Cardiac Disease in Pregnancy. Parts 1 & 2, JACC 2016; 68:396-410

Cardiac Anticipation: Adverse Maternal Outcomes

Class I	Class II	Class II-III	Class III	Class IV (Preg Contraind)
Mild Pulm Stenosis		Mild LV Impairment	Mech Valve Systemic RV	Pulm Htn LVEF < 30% NY Class III-IV
PDA, MVP		Valvular	Fontan, Cyanotic, Complex CHD	Severe Coarct Aorta Severe MS, AS
Repaired Simple Lesion	Unrepaired ASD, VSD, TOF	No Aorta + M Aorta < 45 + Bicuspid AV	Aorta >40 +M Aorta > 45 + Bicuspid AV	Aorta > 45 +M Aorta > 50 + Bicuspid AV

Balci A et al. Prospective validation and assessment of cardiovascular and offspring risk models for pregnant women with CHD. Heart 2014;100:1373-81

Cardiac Assessment: Needs



Cardiac Needs: Combined Care Plans

Valve	Congenital	Pulm Htn	Aortopathy	Cardio Myopathy
Arrhythmia Inotropics	Arrhythmia Inotropics	Vasodilators Diuresis	Anti-HTN Beta Blocker	Beta Blocker Vasodilator Diuretics
Valvuloplasty Replacement	Surgery		Surgery	
Vaginal	Vaginal	Vaginal	Cesarean	Vaginal

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Cardiac Needs: Valve Pathology

Valve
Arrhythmia Inotropics
Valvuloplasty Replacement
Vaginal

Testing: Serial Clinical and TTE

TTE: Severity-Pregnancy Overestimates
Estimate by Valve Area Tracing

Balloon Valvuloplasty: 2nd Trimester to limit
radiation/abdominal shield

Valve Surgery: Fetal Mortality 20-30%
Bioprosthetic preferred over Mechanical

Cardiac Needs: Valve Pathology

Valve	Preload	HR	Contractile	SVR	PVR
Arrhythmia Inotropics	+	-			-
Valvuloplasty Replacement		+		-	-
	+	-		+	
Vaginal	+	+		-	

Robertson JE, et al. J Obstet Gynaecol Can 2012;34:812-9; Ouyang DW, Int J Cardiol 2010; 144:195-9.

Cardiac Needs: Prosthetic Valve Anticoagulation

Drug	Dosing	Issues
Warfarin	Not 6-12, Off 36 wks INR 2.5-3.5; < 5mg/day	Embryopathy (1-30%) Miscarriage (15-56%) Fetal Bleeding
UFH	aPTT > 2x control On 36 wks	Thromboembolism No placental cross
LMWH	BID to anti-Xa 0.8-1.2 iu/ml at 4 hrs; Off 36 wks	More predictable, less HIT, lower bleeding Test often
Aspirin	Mechanical Valve 75-100 mg	2nd and 3rd trimester High dose-bleed, IUGR, Closure PDA

Nishimura RA, et al. 2014 AHA/ACC Guideline for the Management of Patients with Valvular Heart Disease. J Am Coll Cardiol 2014;63:2438-88.

Cardiac Needs: Complex Congenital Disease

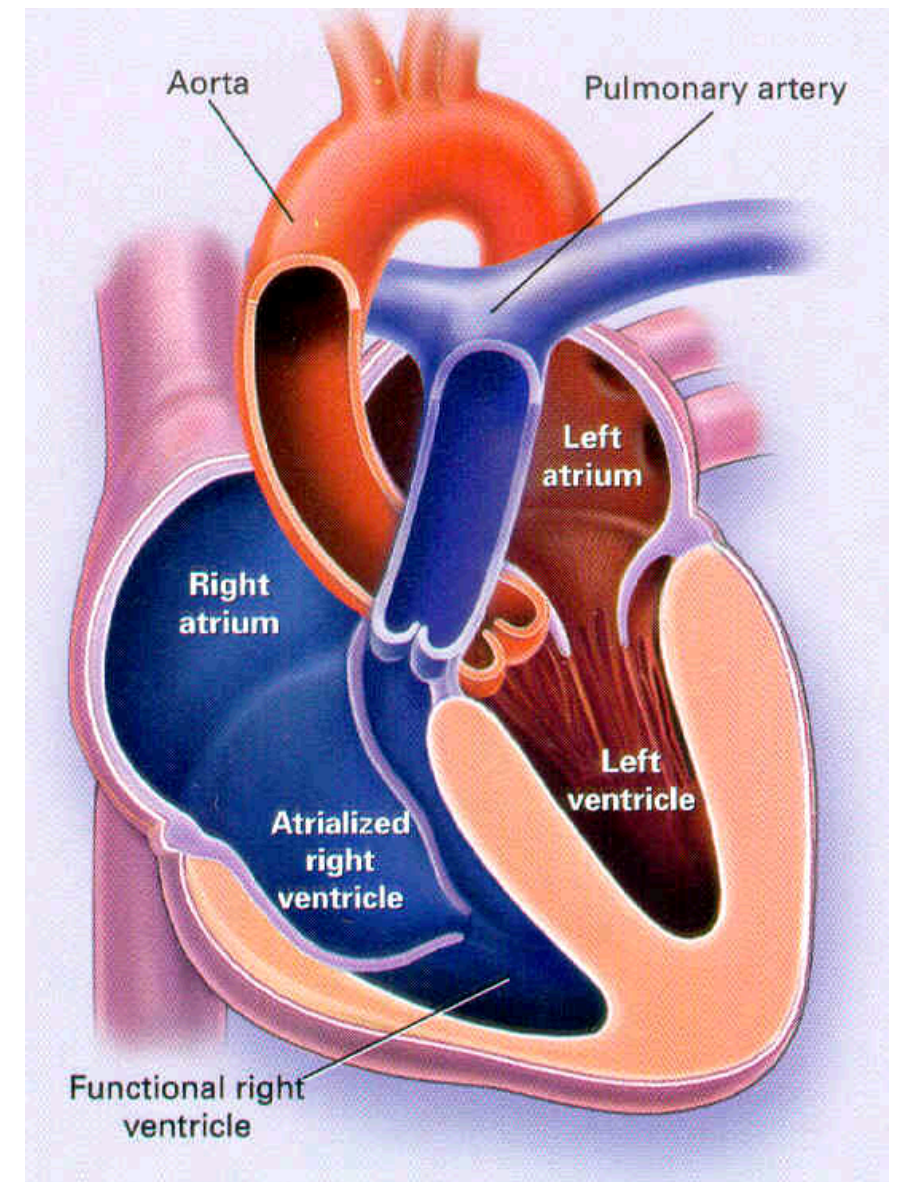
Congenital
Arrhythmia Inotropics
Vaginal

Mortality: 0.5%

Morbidity (<20%)
4x < valvular or
cardiomyopathy

Arrhythmias,
Heart Failure

Anatomic Sketch



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Cardiac Needs: Complex Congenital Disease

Disorder	Pathology	Issues	Complications	Goals
Fontan	Single Ventricle	Elevated SVR Passive Pulm	Arrhythmias PE, Valve Reflux	SR, Preload, Decrease SVR
Systemic RV	Repaired TGA	RV Failure TR	Arrhythmias Sinus Dysfxn	Maintain HR
Uncorrected Cyanotic Dz	Tetralogy Fallot	O2 Sat	Heart Failure, Arrhythmias, PE	Oxygen Anticoag

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Cardiac Needs: Pulmonary Hypertension

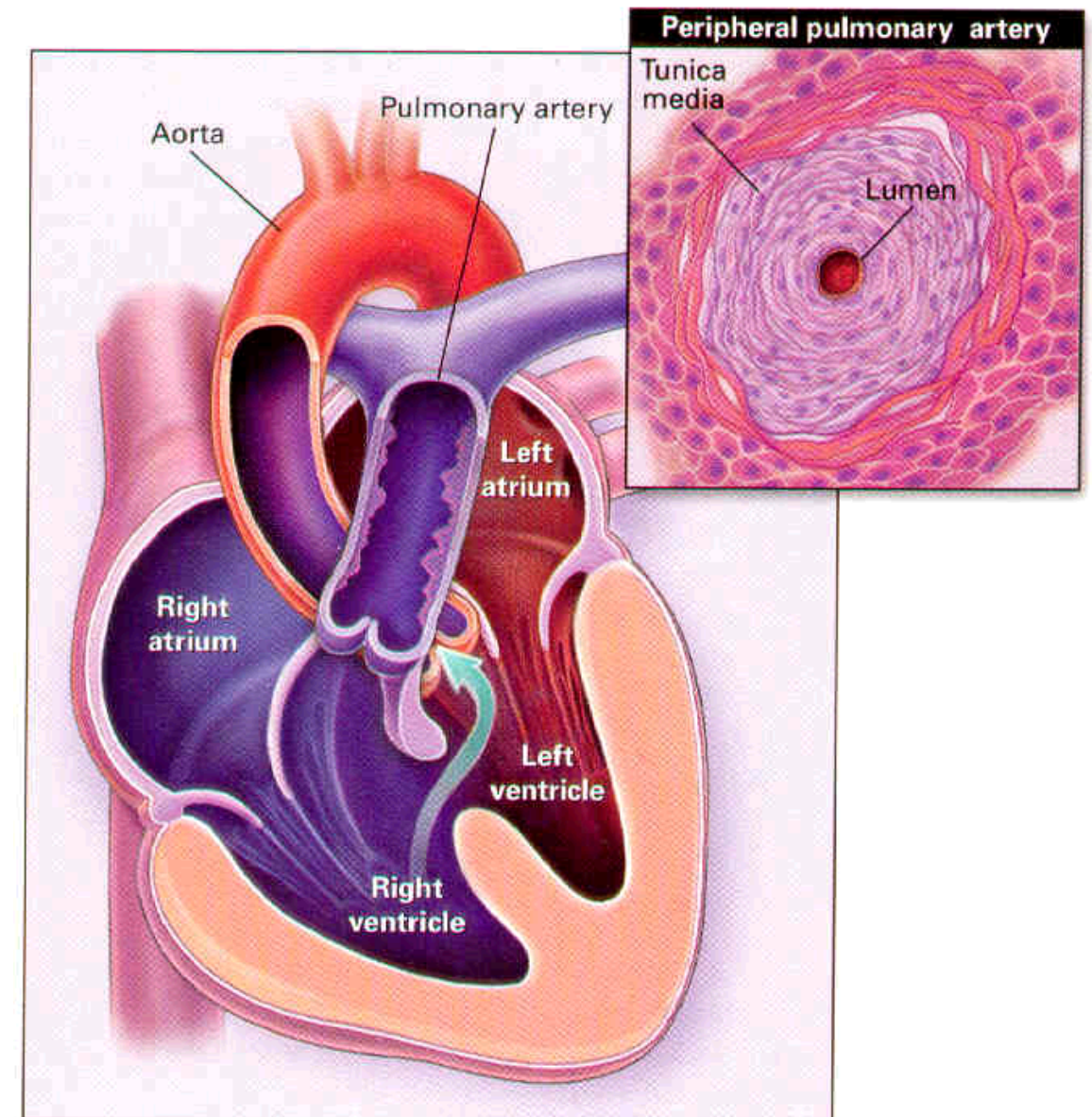
Pulm HTN
Vasodilators Diuresis
Vaginal

PAP: ≥ 25 mmHg

RV Failure

Pulm Dilation
Ca Blocker, NO,
Prostacyclin,
Endothelin Antagonist
Phosphodiesterase Inhibitor

Eisenmenger



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Cardiac Needs: Pulmonary Hypertension Agents

Drug	Dosing	Issues
Endothelin Receptor Blocker	Bosentan Ambrisentan	Teratogenic
Calcium Channel Blocker	Nifedipine, Amlodipine, Diltiazem	Only Vasoreactive Positive
Prostacyclin	Sildenafil, Tadalafil, Iloprost (inhaled)	
Soluble Guanylate Cyclase Stimulator	Adempas	Contraindicated in Pregnancy

Nishimura RA, et al. 2014 AHA/ACC Guideline for the Management of Patients with Valvular Heart Disease. J Am Coll Cardiol 2014;63:2438-88.

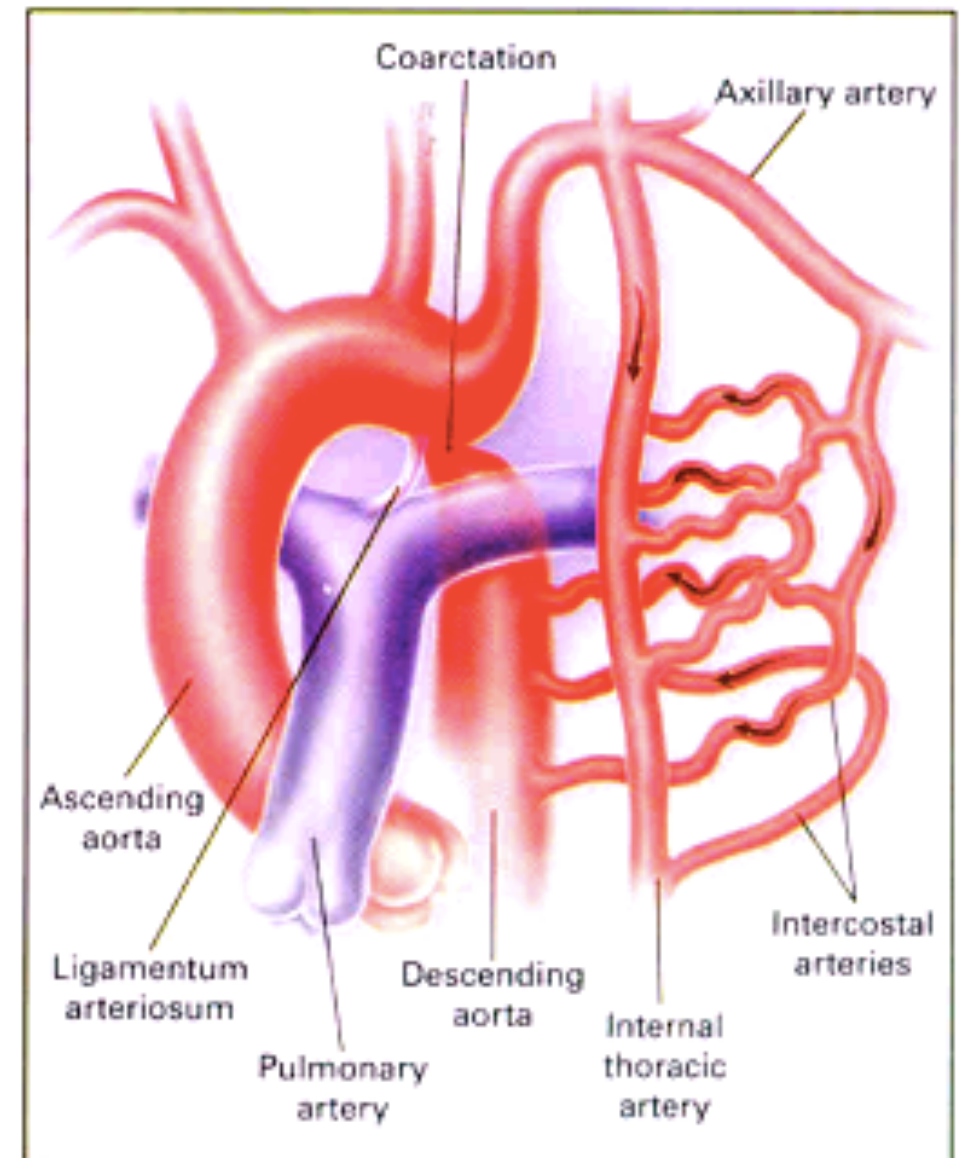
Cardiac Needs: Aortopathy

Aortopathy
Anti-HTN Beta Blocker Surgery
Cesarean

Aortic Coarctation and Dissection

TTE, TEE: Proximal & Distal Aortic Diameter, Valve & Cardiac Function
CT/MRI

CD: Aorta \geq 40 mm, Preg Change, Hx Dissection



Robertson JE, et al. J Obstet Gynaecol Can 2012;34:812-9; Ouyang DW, Int J Cardiol 2010; 144:195-9.

Cardiac Needs: [Aortopathy](#)

Disorder	Example	Issues
Fibrillin	Marfan Syndrome	Aortic Repair \geq 45 mm, Pregnant \geq 5 mm Beta Blocker: Growth Rate
Collagen	Ehlers-Danlos	
Transforming Growth Factor Beta Receptor	Loeys-Dietz	
Aortic Wall Composition	Turner, Bicuspid Aortic Valve	T: BAV + Coarctation

Nishimura RA, et al. 2014 AHA/ACC Guideline for the Management of Patients with Valvular Heart Disease. J Am Coll Cardiol 2014;63:2438-88.

Cardiac Needs: **Cardiomyopathy**

Cardio myopathy	LV impaired systolic function ± dilation
Beta Blocker Vasodilator Diuretics	Etiology Idiopathic (50%), toxic, infectious, genetic
Vaginal	Eisenmenger

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Cardiac Needs: **Cardiomyopathy**

Disorder	Risk Factors	Etiology	Speculations
PPCM	African-American AMA, Multifetal, HTN	Selenium low, viral, stress, vascular?	SR, Preload, Decrease SVR
c	Repaired TGA	Arrhythmias Sinus Dysfxn	Maintain HR
Uncorrected Cyanotic Dz	Tetralogy Fallot	Heart Failure, Arrhythmias, PE	Oxygen Anticoag

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Cardiac Assessment: **Tactics**



Cardiac Tactics: Institutional Gaps?

- **Institutional Issues**-75% of fatal maternal cardiac arrests
- OB “High Risk Parturient” **Multidisciplinary Care Team?**
 - Emergency Call List? **Access**
- High Risk **Consultation Service/Clinic?**
- Local **Protocols**, Patient Tracking

Lipman S, Cohen S, Einav S, Jeejeebhoy F, Mhyre JM, Morrison LJ, Katz V, Tsen LC, Daniels K, Halamek LP, Suresh MS, Arafeh J, Gauthier D, Carvalho JCA, Druzin M, Carvalho B. [SOAP Consensus Statement](#) on the Management of Cardiac Arrest in Pregnancy. *Anesth Analg* 2014;118:1003-16.

Cardiac Tactics: “High Risk Parturient” Team Gaps?

- **Personnel:** OB, Anesthesia, Neonatology, Consultants, Nurses, Surgical Technician
- Team **Training and Performance:** Critical Behavioral Skills
- Team Planning, **Patient Optimization & Care Coordination, Communication**

Lipman S et al. Am J Obstet Gynecol 2010;203:179.e1-5

CMACC. Section on Preventable Deaths 2011;47-8

Yang C, et al. Resuscitation 2012;83:1055-60

Cohen SE, et al. IJOA 2008;17:20-5

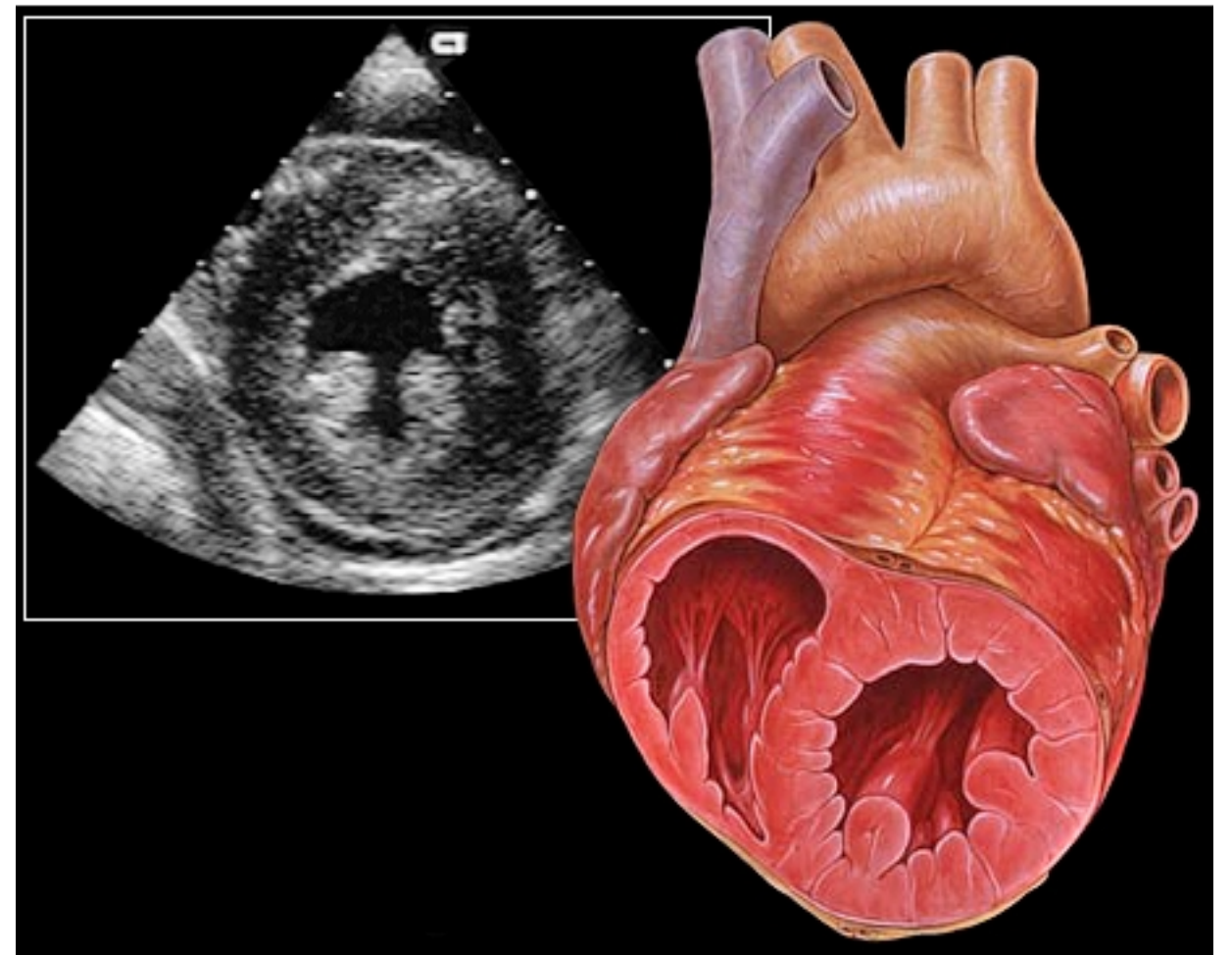
Cardiac Tactics: Individual Gaps?

- **Technical/Knowledge** Gaps

- High Risk Knowledge-Continuing Education

- TTE, Algorithms

- ACLS: **Completion** variable, **retention** poor, few **OB specific**



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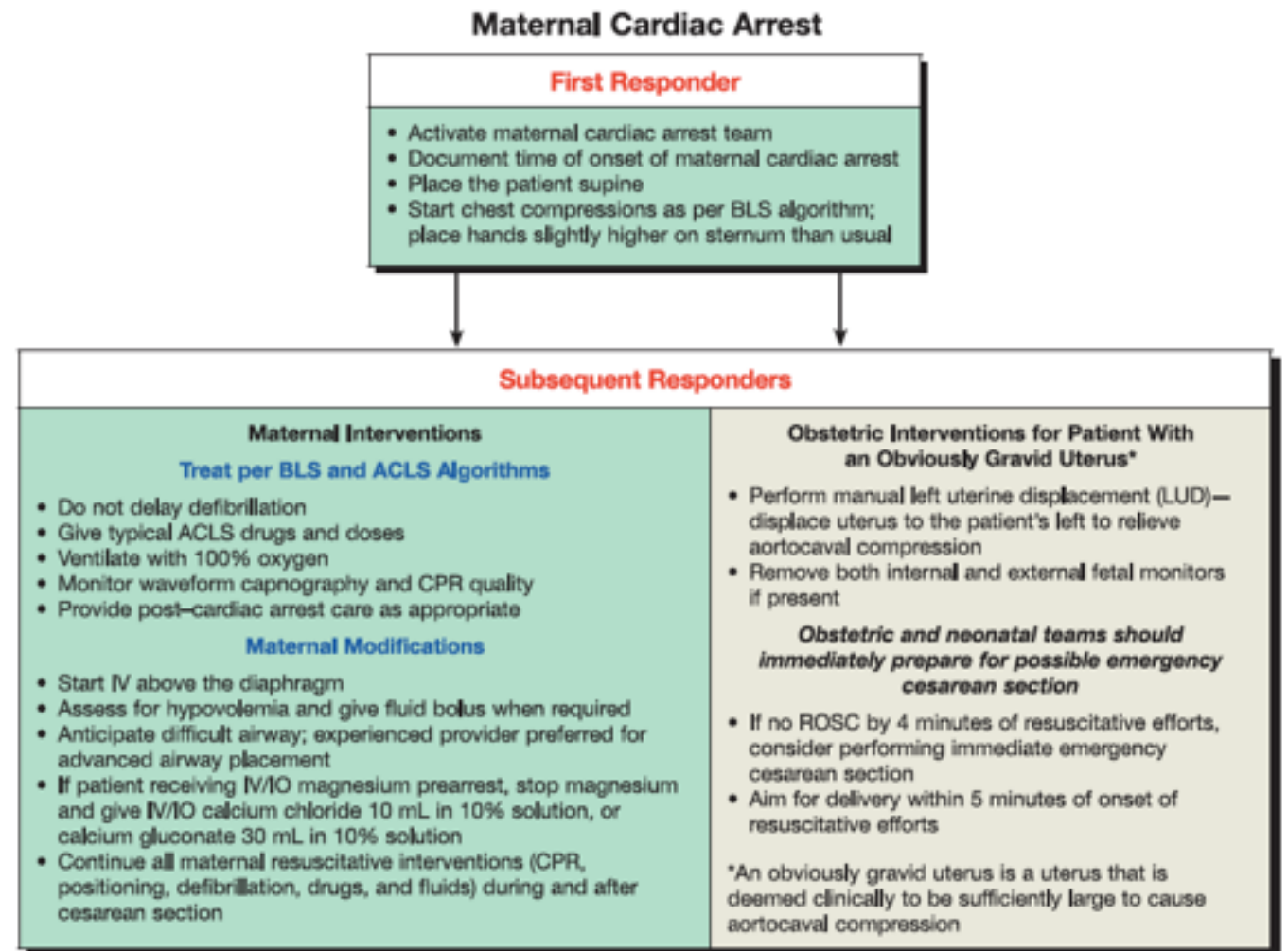
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Cardiac Arrest Management: Anticipation

- 2010 AHA Cardiac Algorithm
- Society for Obstetric Anesthesia and Perinatology
- **Multidisciplinary Group:** Specialties, Academic/Private, Physician/Nurse, Resuscitation/Simulation



Lipman S, Cohen S, Einav S, Jeejeebhoy F, Mhyre JM, Morrison LJ, Katz V, Tsen LC, Daniels K, Halamek LP, Suresh MS, Arafah J, Gauthier D, Carvalho JCA, Druzin M, Carvalho B. [SOAP Consensus Statement](#) on the Management of Cardiac Arrest in Pregnancy. *Anesth Analg* 2014;118:1003-16. AHA, ACLS 2010

Left Uterine Displacement

A



Push

B

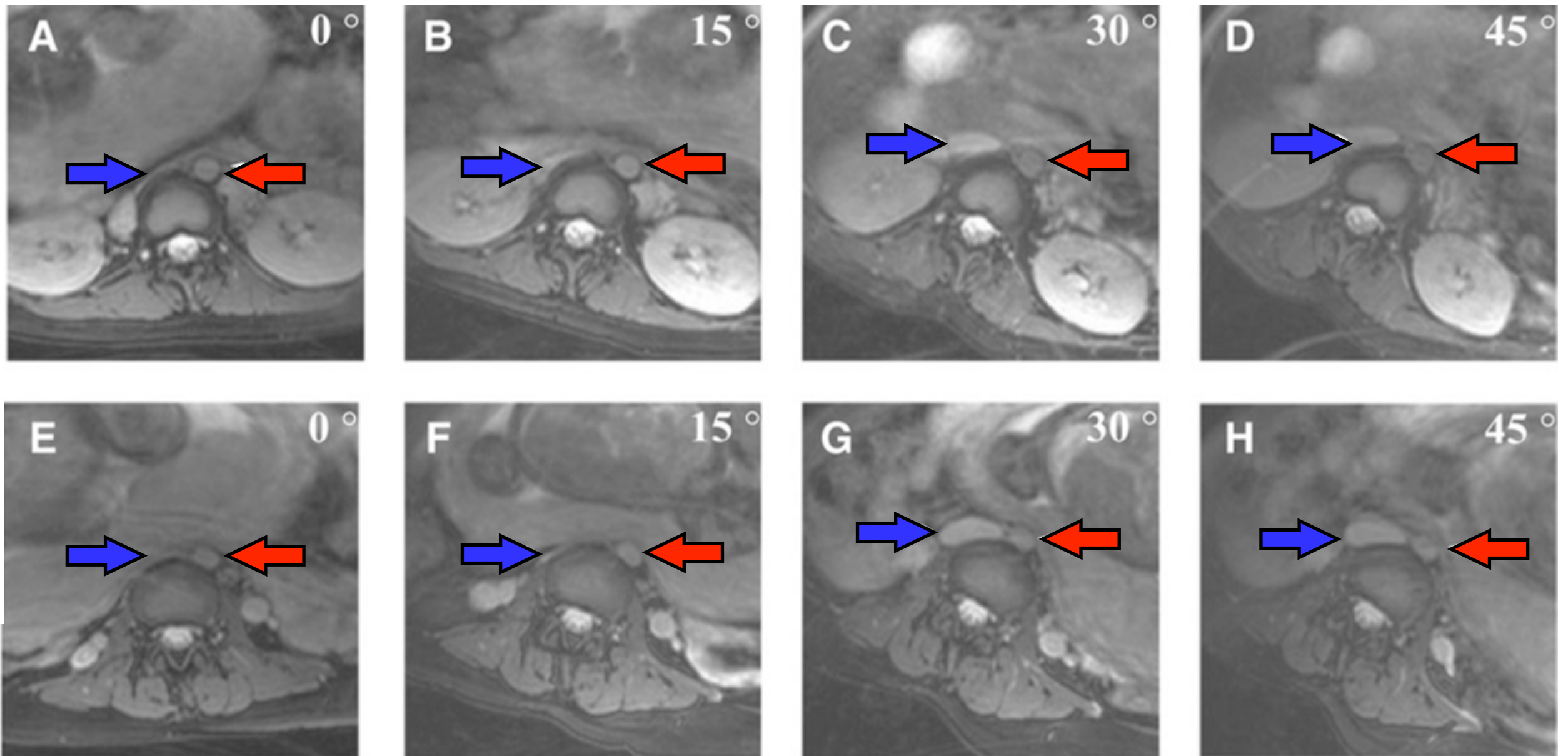


Pull

A, Manual LUD, performed with one-handed technique. B, Two-handed technique during resuscitation.

Left Uterine Displacement

Term Parturients; L2-3 (A-D); L4-5 (E-H): **Inferior Vena Cava**, **Abdominal Aorta**



Cardiac Assessment: Summary

Anticipation

Needs

Tactics



Cardiac Assessment: Case

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

- Preeclampsia (BP 168/88), gDiabetes, gThrombocytopenia, Mitral Stenosis
- Surgical History: Cholecystectomy, Appendectomy, Gastric Bypass
- Baby "Heart Problem" Operation



Cardiac Assessment





Sol Shnider Obstetric Anesthesia

San Francisco, CA

March 2-5, 2017

46th Annual SOAP Meeting

Bellevue (Seattle), WA

May 10-14, 2017



Questions?