Cardiac Lecture #4:
Acute MI & Arrhythmias

January 3, 2023

Updates

- Next Maternal Webinar <u>Feb 7th</u>

    Topic: Aortapathies | Speaker: Iris Krisha, MD

- REMINDER: Data Submission via Survey 123: Severe Hypertension & Cardiac Conditions

Lecture Recordings

Lectures 2022

- March 1, 2022 - **GaPQC Kick-Off Cardiac Education Webinar**
- September 6, 2022 - **Intro Lecture: Building a Cardio Ob Team**
- October 4, 2022 - **Lecture 1: Cardiac Physiology**
- November 1, 2022 - **Lecture 2: Cardiac Warning Signs**
- December 6, 2022 - **Lecture 3: Cardiomyopathy**

Open GaPQC Maternal Youtube Playlist

Lectures 2023

- January 3, 2023 – **Lecture 4: Acute MI/Arrhythmias**
- February 7, 2023 – **Lecture 5: Congenital Cardiac Lesions**
- March 7, 2023 – **Lecture 6: Valvular Heart Disease**
- May 2, 2023 – **Lecture 7: Pulmonary Hypertension**
- June 6, 2023 – **Lecture 8: Ob Anesthesia and L&D Considerations**

Open GaPQC Maternal Youtube Playlist

Lecture Presentations

March 1, 2022 - GaPQC Kick-Off Cardiac Education Webinar (pdf)	⭳ Download
September 6, 2022 - Intro Lecture: Building a Cardio-Ob Team (pdf)	⭳ Download
October 4, 2022 - Lecture 1: Cardiac Physiology (pdf)	⭳ Download
November 1, 2022 - Lecture 2: Cardiac Warning Signs (pdf)	⭳ Download

Key Driver Diagram: Maternal Cardiac Conditions

INTERVENTIONS

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.

- ❑ 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. *

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

- ❑ 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.

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

- ❑ 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.**

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

- ❑ 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**

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

- ❑ 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**

Maternal Health:
# Acute MI and Arrhythmias

Stacy Westerman, MD

Assistant Professor

Cardiac Electrophysiology

Emory University

Outline

- Maternal morbidity and mortality
  - Scope
  - Georgia specific data
- Hemodynamic changes of pregnancy
- Cardiac related morbidity and mortality: Acute myocardial infarction and arrhythmias
  - Causes
  - Management

Maternal mortality

- Pregnancy-associated Deaths
  - Defined by CDC and ACOG as death of a woman while pregnant or within one year of the end of a pregnancy
  - Includes both:
    - Pregnancy-related: death from any cause related to or aggravated by pregnancy or its management
    - Pregnancy-associated but not related

- Maternal mortality defined by WHO includes pregnancy-related deaths during pregnancy or within 42 days of termination of pregnancy
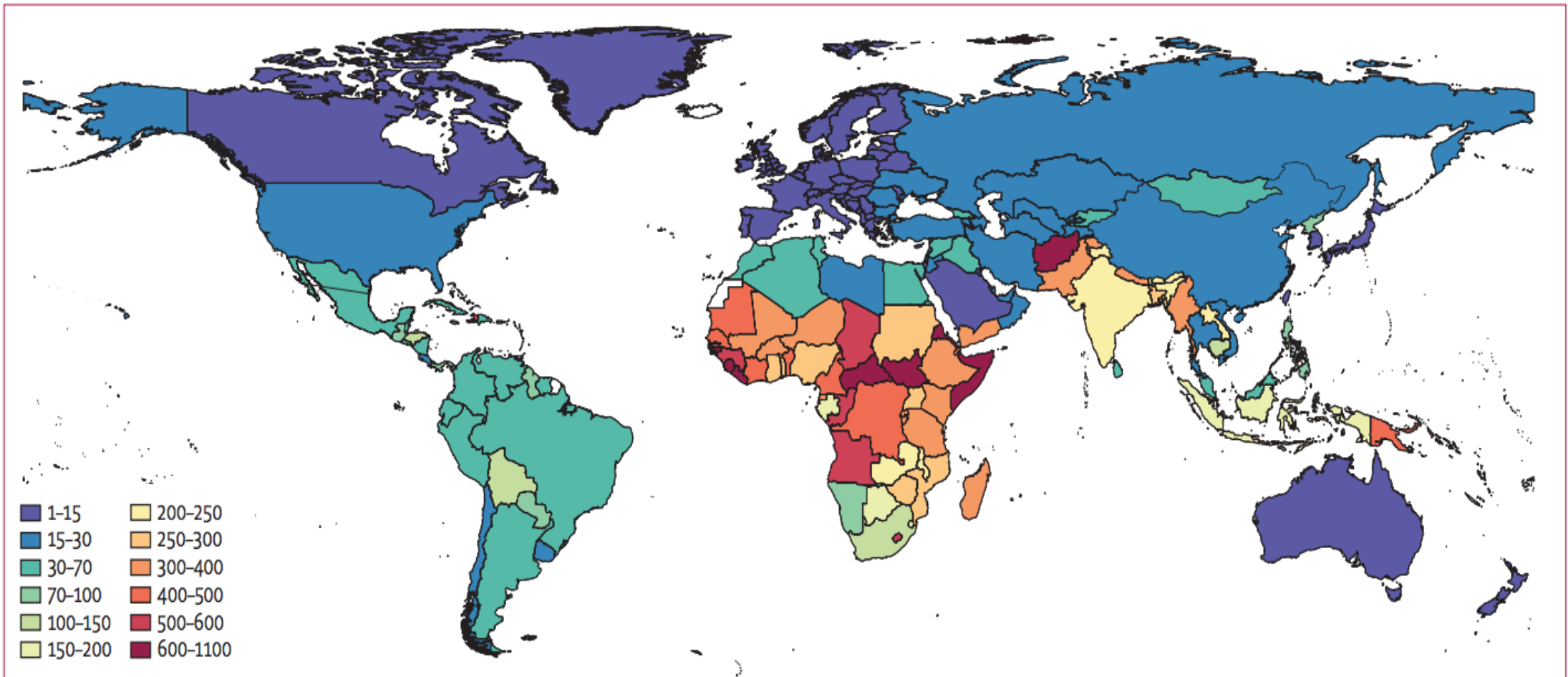
- Number of deaths per 100,000 live births, 2015

Global, regional, and national levels of maternal mortality, 1990–2015: a systematic analysis for the Global Burden of Disease Study 2015

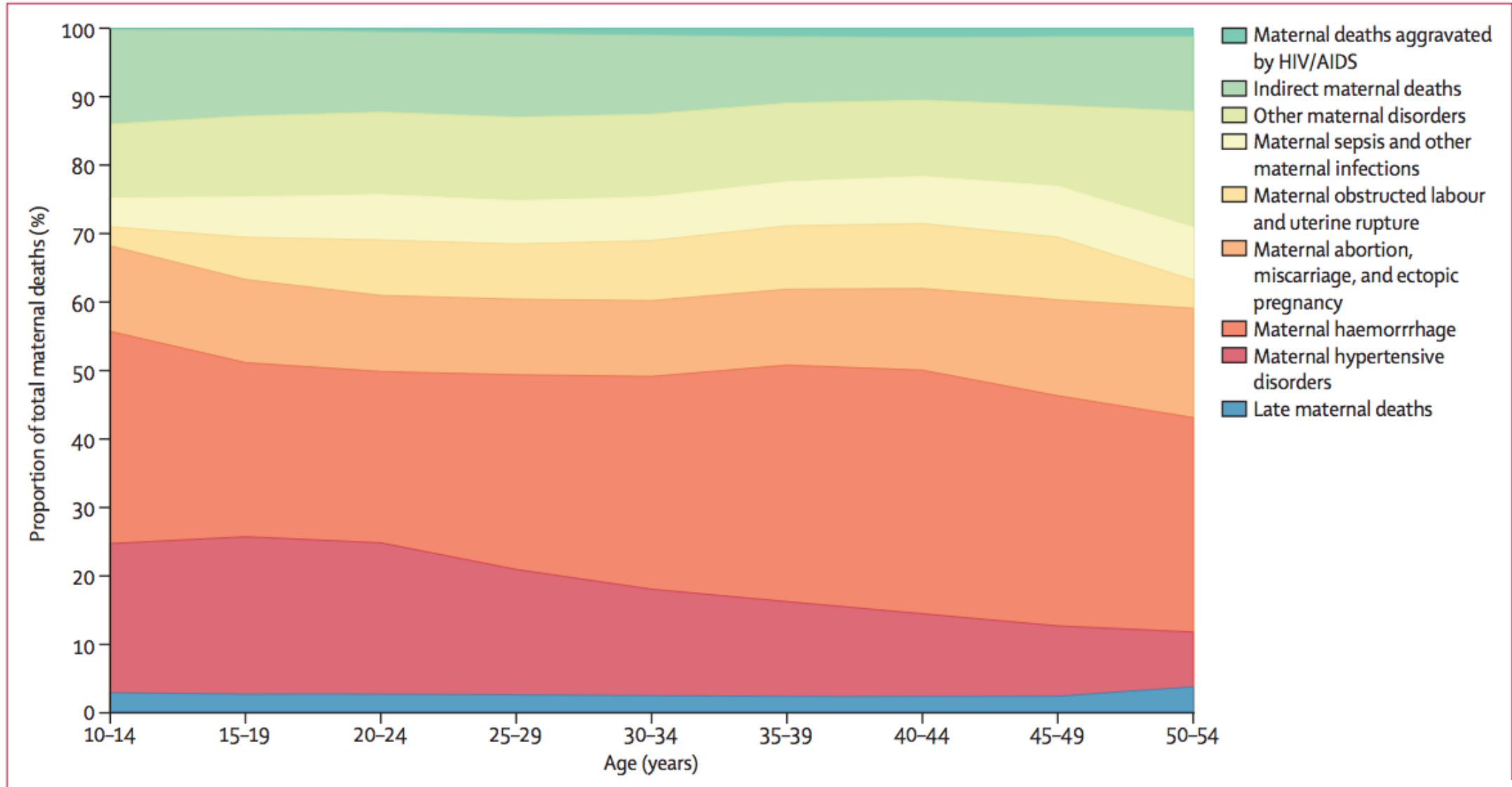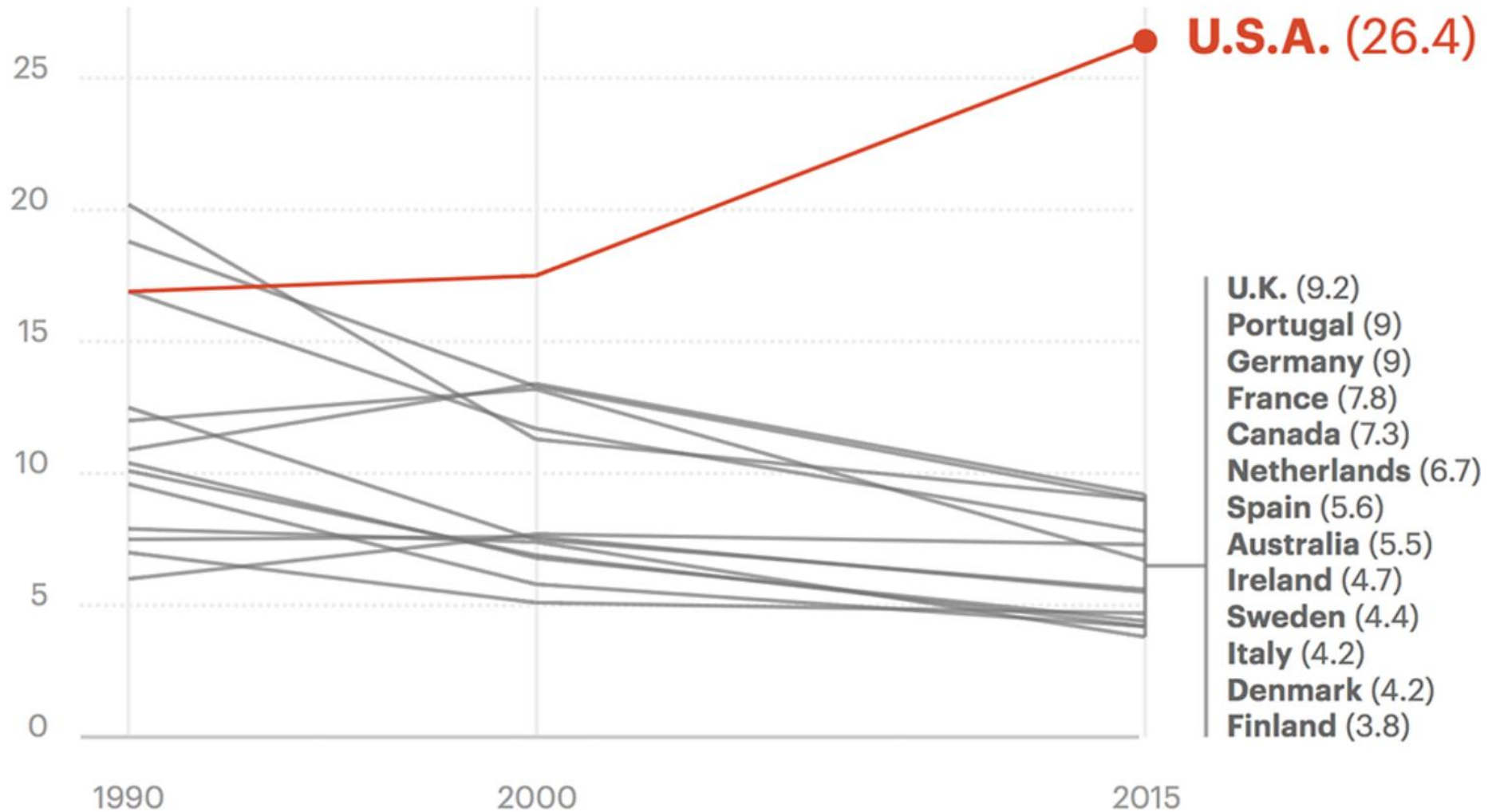GBD 2015 Maternal Mortality Collaborators*

Lancet 2016; 388: 1775–812

Figure 7: Global proportion of total maternal deaths by underlying cause and age, 2015

Maternal Mortality Is Rising in the U.S. As It Declines Elsewhere

Deaths per 100,000 live births

U.S.A. (26.4)

U.K. (9.2)
Portugal (9)
Germany (9)
France (7.8)
Canada (7.3)
Netherlands (6.7)
Spain (5.6)
Australia (5.5)
Ireland (4.7)
Sweden (4.4)
Italy (4.2)
Denmark (4.2)
Finland (3.8)

1990   2000   2015

Notes

"Global, regional, and national levels of maternal mortality, 1990–2015: a systematic analysis for the Global Burden of Disease Study 2015," *The Lancet*. Only data for 1990, 2000 and 2015 was made available in the journal.
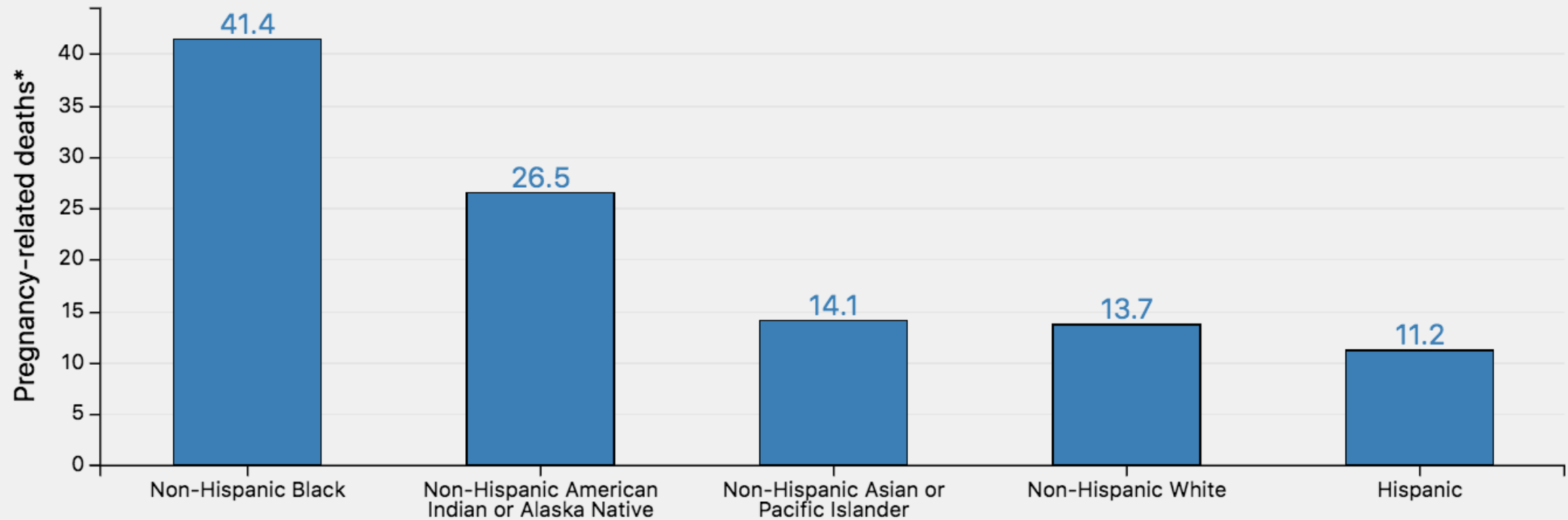
Trends in pregnancy-related mortality in the United States: 1987-2018

*Per 100,000 live births

Pregnancy-related mortality ratio | Reset
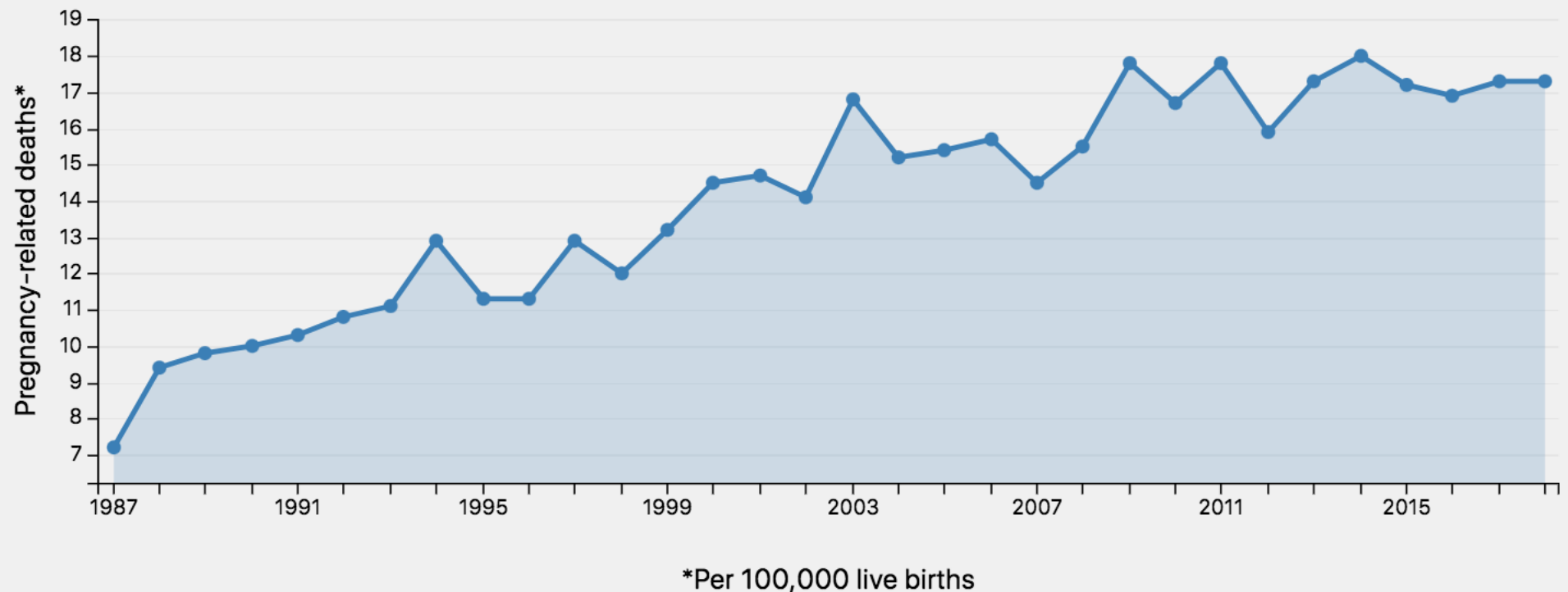
Data Table —

	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Pregnancy-related mortality ratio	7.2	9.4	9.8	10	10.3	10.8	11.1	12.9	11.3	11.3	12

Pregnancy-Related Mortality Ratio by Race/Ethnicity: 2016-2018

*Per 100,000 live births

Maternal Mortality Rate by State 2022

Georgia has the second highest maternal mortality rate in the US, 48.4 per 100k

Maternal Mortality Rate
< 5 | > 5 | > 10 | > 15 | > 20 | > 25 | > 30 | > 35 | > 40 | > 45 | > 50 | > 55 | > 60

https://worldpopulationreview.com/state-rankings/maternal-mortality-rate-by-state

Maternal Mortality Review Committees

Jurisdiction	Scope of work							Committee structure	
	Reviews maternal mortalities	Pregnancy-associated deaths			Maternal morbidity		Investigate or consider racial disparities	Multidisciplinary membership or expertise beyond physicians	Demographic representation required or considered in membership composition†
		Review deaths up to one year after pregnancy ends	Investigate every pregnancy-associated death	Determine preventability of death	Review cases or trends	Track morbidity data			
California	X	X	X		X	X	X	CBO,D, DOH, MH, MW, N, P/FM	X
Georgia	X			X				X	

Causes of pregnancy-related death in the United States: 2016-2018
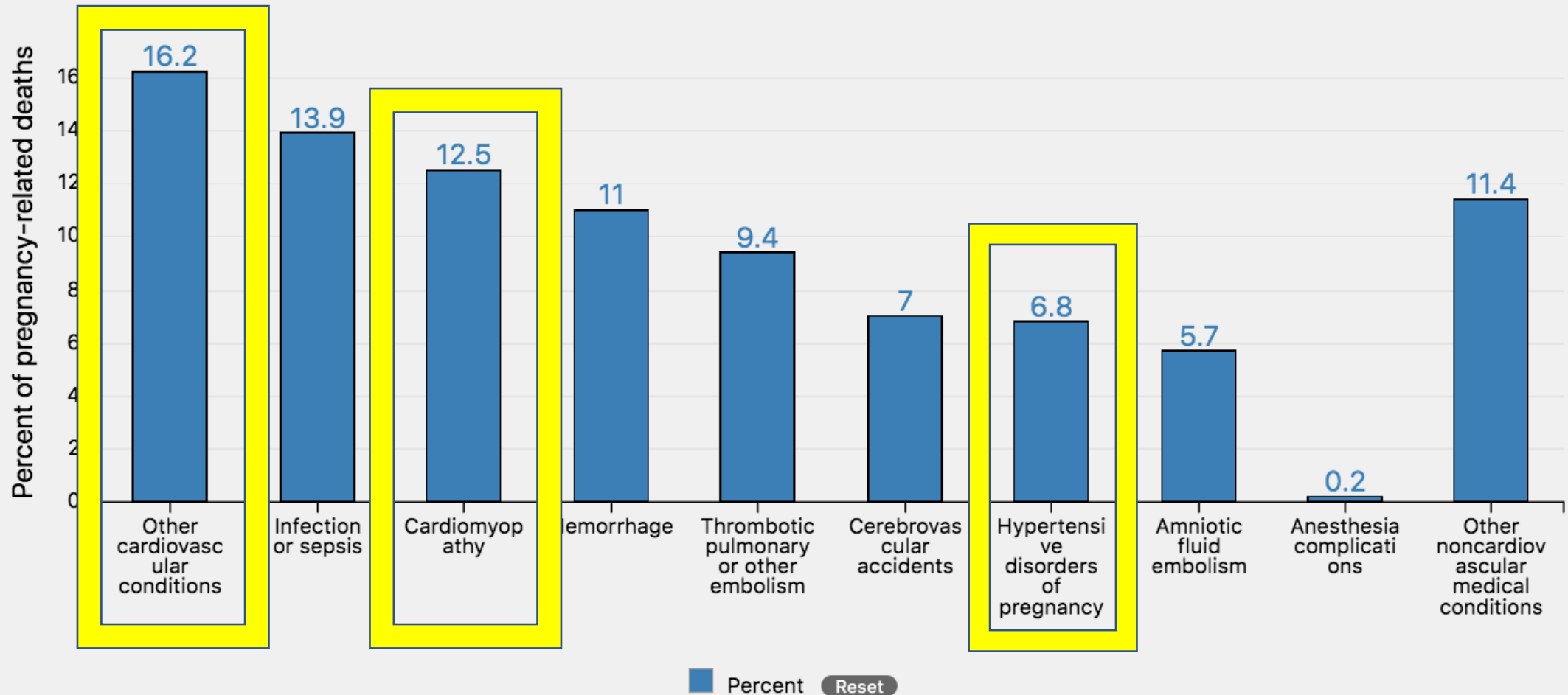
Physiologic changes of pregnancy

- Meet increased metabolic demands of mother and fetus
- Ensure adequate uteroplacental circulation

- Blood volume increases, cardiac output increases
- Systemic vascular resistance decreases

Physiologic changes of pregnancy

- Blood volume increases, cardiac output increases
  - Blood volume increases 30-50%, peaking at 34 weeks
  - Cardiac output increases from usual ~5L/min $\rightarrow$ up to 8.7 L/min by 3rd trimester
    - Increased stroke volume and increase in heart rate

- Systemic vascular resistance decreases
  - Falls 10-30% by week 8
  - Overall fall of ~40%, nadirs by ~week 32

- Decrease in SVR leads to stimulation of catecholamines and an increase in sympathetic tone --> increase in HR and contractility
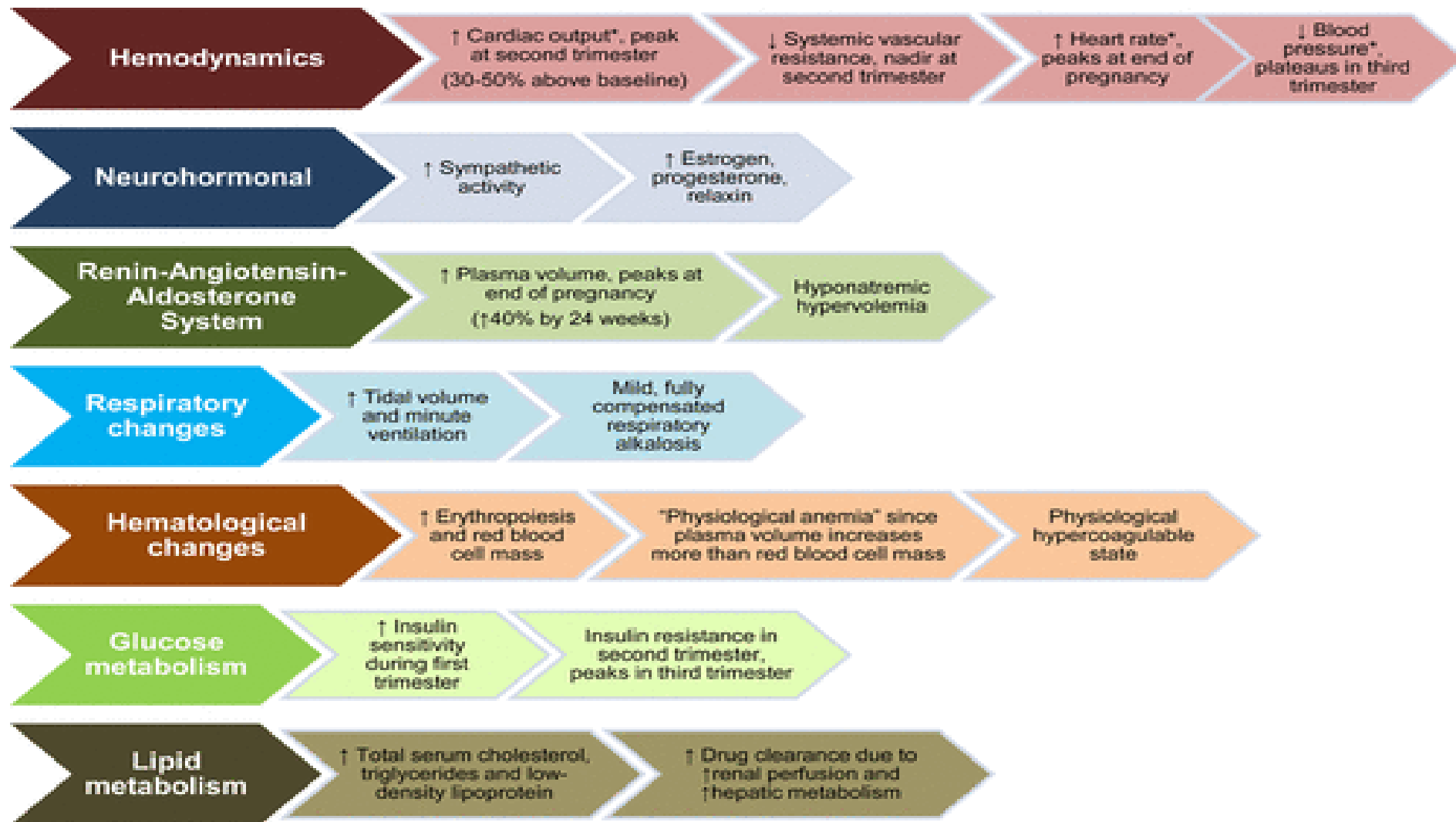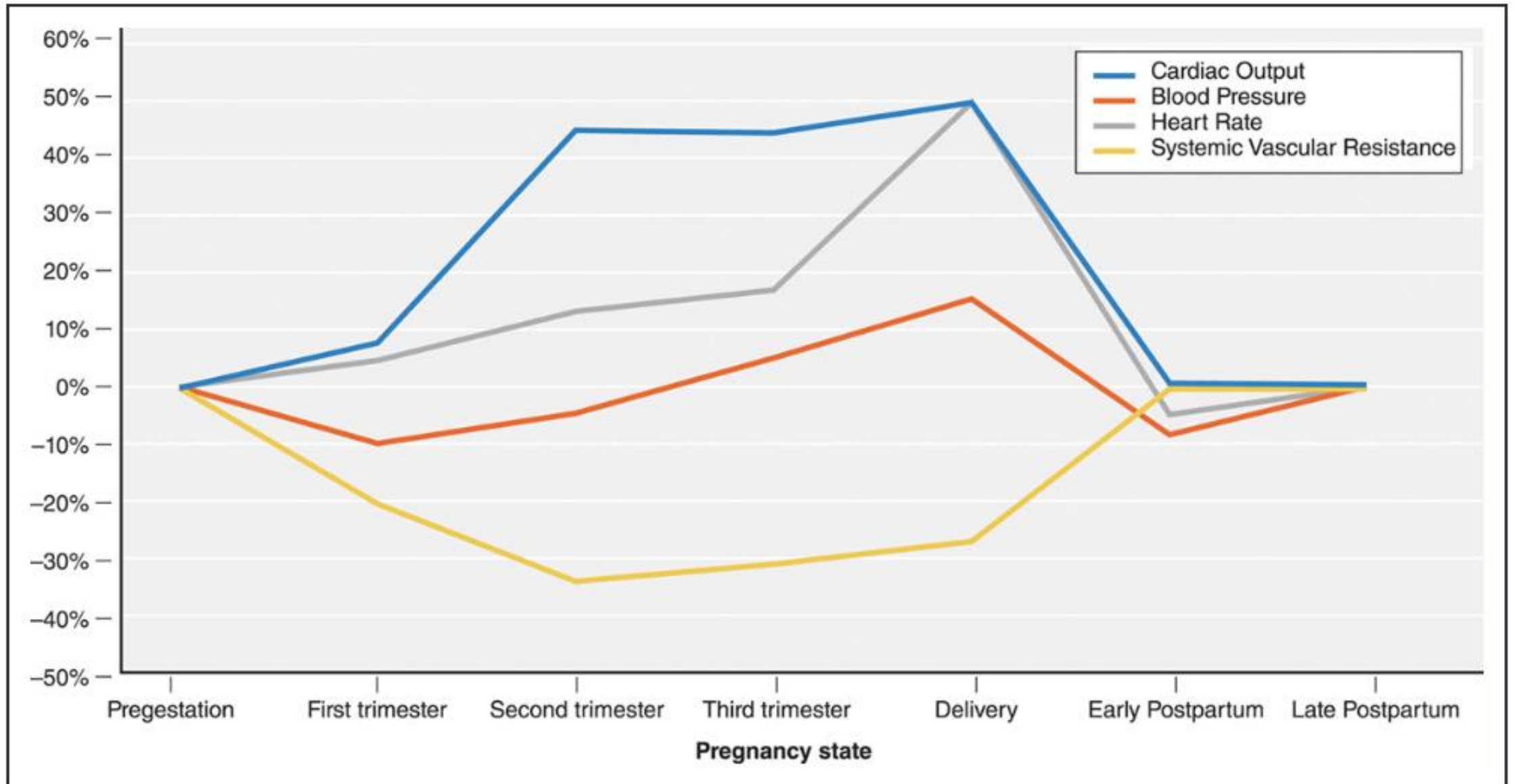
Cardiac changes

- Increase in left atrial size

- Increase in left ventricular size

- Increase in wall thickness

- Increase in left and right ventricular mass

- LVEF remains stable

- PCWP does not increase

Hemodynamic changes at delivery

- Cardiac output increases further
  - Partly due to "autotransfusion" of uretoplacental circulation to systemic circulation with contractions
- Heart rate increases

- After delivery, fall in stroke volume
- Gradual fall in heart rate

Hemodynamics
- ↑ Cardiac output*, peak at second trimester (30-50% above baseline)
- ↓ Systemic vascular resistance, nadir at second trimester
- ↑ Heart rate*, peaks at end of pregnancy
- ↓ Blood pressure*, plateaus in third trimester

Neurohormonal
- ↑ Sympathetic activity
- ↑ Estrogen, progesterone, relaxin

Renin-Angiotensin-Aldosterone System
- ↑ Plasma volume, peaks at end of pregnancy (↑40% by 24 weeks)
- Hyponatremic hypervolemia

Respiratory changes
- ↑ Tidal volume and minute ventilation
- Mild, fully compensated respiratory alkalosis

Hematological changes
- ↑ Erythropoiesis and red blood cell mass
- "Physiological anemia" since plasma volume increases more than red blood cell mass
- Physiological hypercoagulable state

Glucose metabolism
- ↑ Insulin sensitivity during first trimester
- Insulin resistance in second trimester, peaks in third trimester

Lipid metabolism
- ↑ Total serum cholesterol, triglycerides and low-density lipoprotein
- ↑ Drug clearance due to ↑renal perfusion and ↑hepatic metabolism

| Preconception		Pregnancy			Labor
Baseline		First Trimester	Second Trimester	Third Trimester	
Hemodynamic	CO	↑	↑↑	↑↑	↑↑↑↑
	SVR	↓	↓↓	↓↓	
	HR	↑	↑↑	↑↑↑	↑↑↑↑
	BP	↓	↓	↔	(Pain)
Neurohumoral		↑ Sympathetic activity			
		↑ Estrogen/progesterone/relaxin			
Renin/angiotensin	Plasma volume*	↑↑	↑↑↑	↑↑↑↑	↑↑↑↑↑
RBC changes	RBC mass	↑	↑↑	↑↑	(Autotransfusion)
Structural changes	LV wall mass	↑	↑	↑	
	Chamber sizes	4-Chamber enlargement			
	Aorta	Increased distensibility			

AMI in pregnancy

- 41 year old woman with history of endometriosis and PCOS
- G3P0SAb3
- Husband with 2 children from prior relationships
- Underwent IVF, 1 embryo was implanted, became pregnant with twins (split of one embryo or pregnancy from ovulated egg)

- Placenta previa, twins delivered via c-section
- Presented to OSH 5 days later with chest pain radiating to back into left shoulder and arm with dyspnea
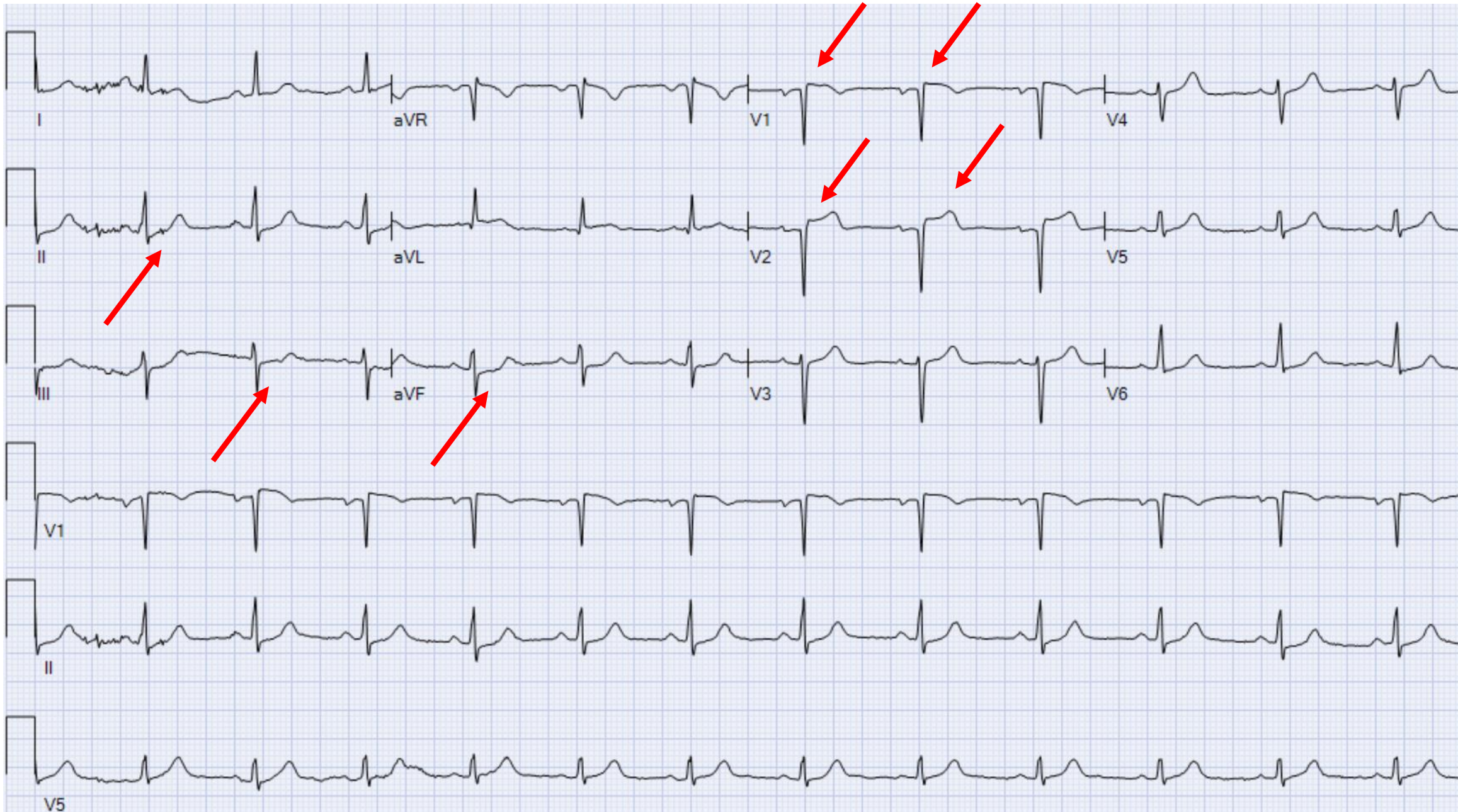
Cath lab images
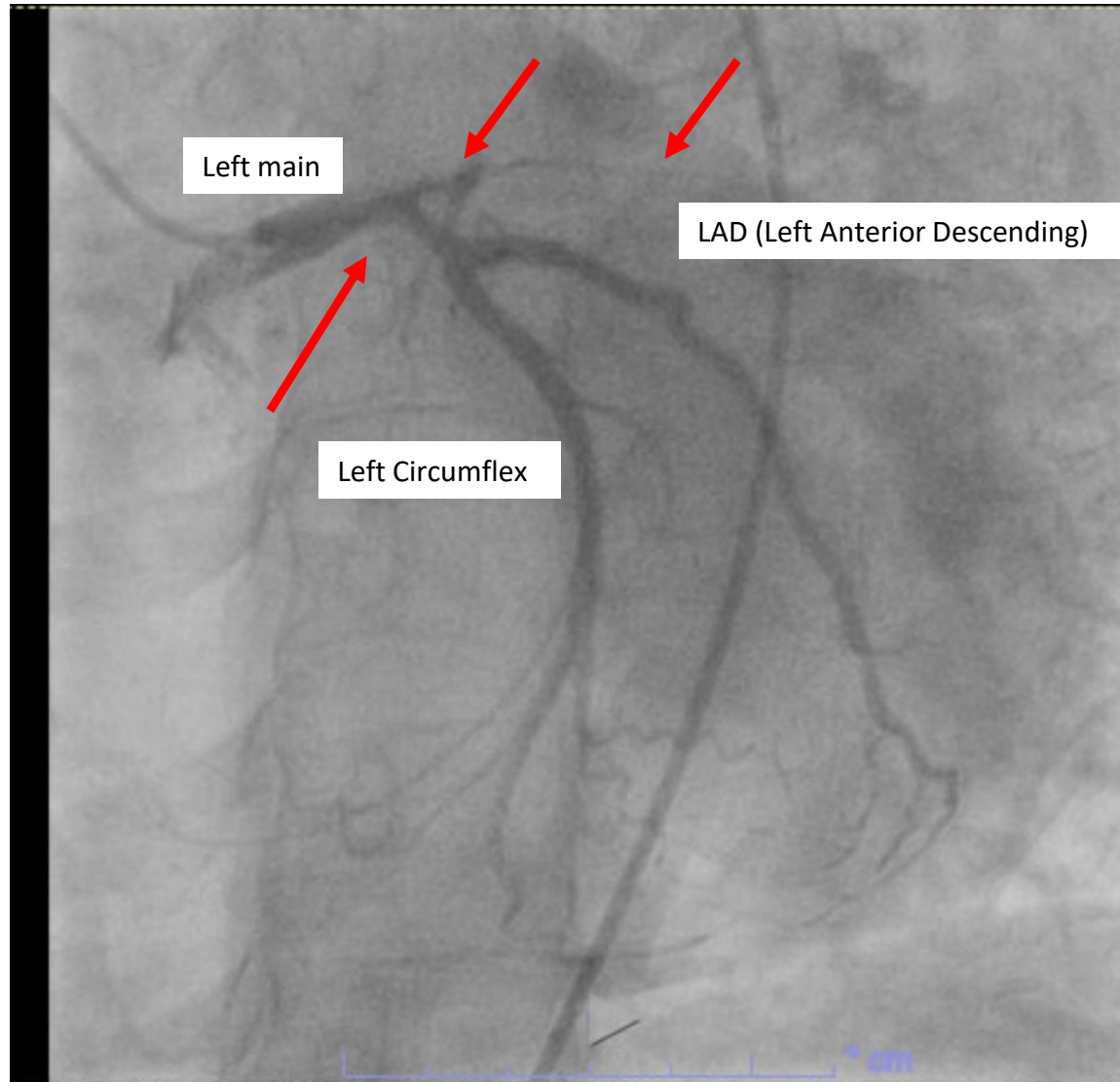
Acute myocardial infarction (AMI)

- Pregnancy associated MI: Myocardial infarction during pregnancy or the post-partum period

- Accounts for over 20% of maternal cardiac deaths

- 2.8-8.1 per 100,000 deliveries
  - 4 fold higher than among non-pregnant reproductive age women
  - Incidence is increasing: Older mothers, increased awareness, more comorbidities

- 5% associated mortality
  - Higher than AMI among non-pregnant reproductive age women

- Peak incidence in third trimester and post-partum period

PAMI: risk factors

- Maternal risk factors:
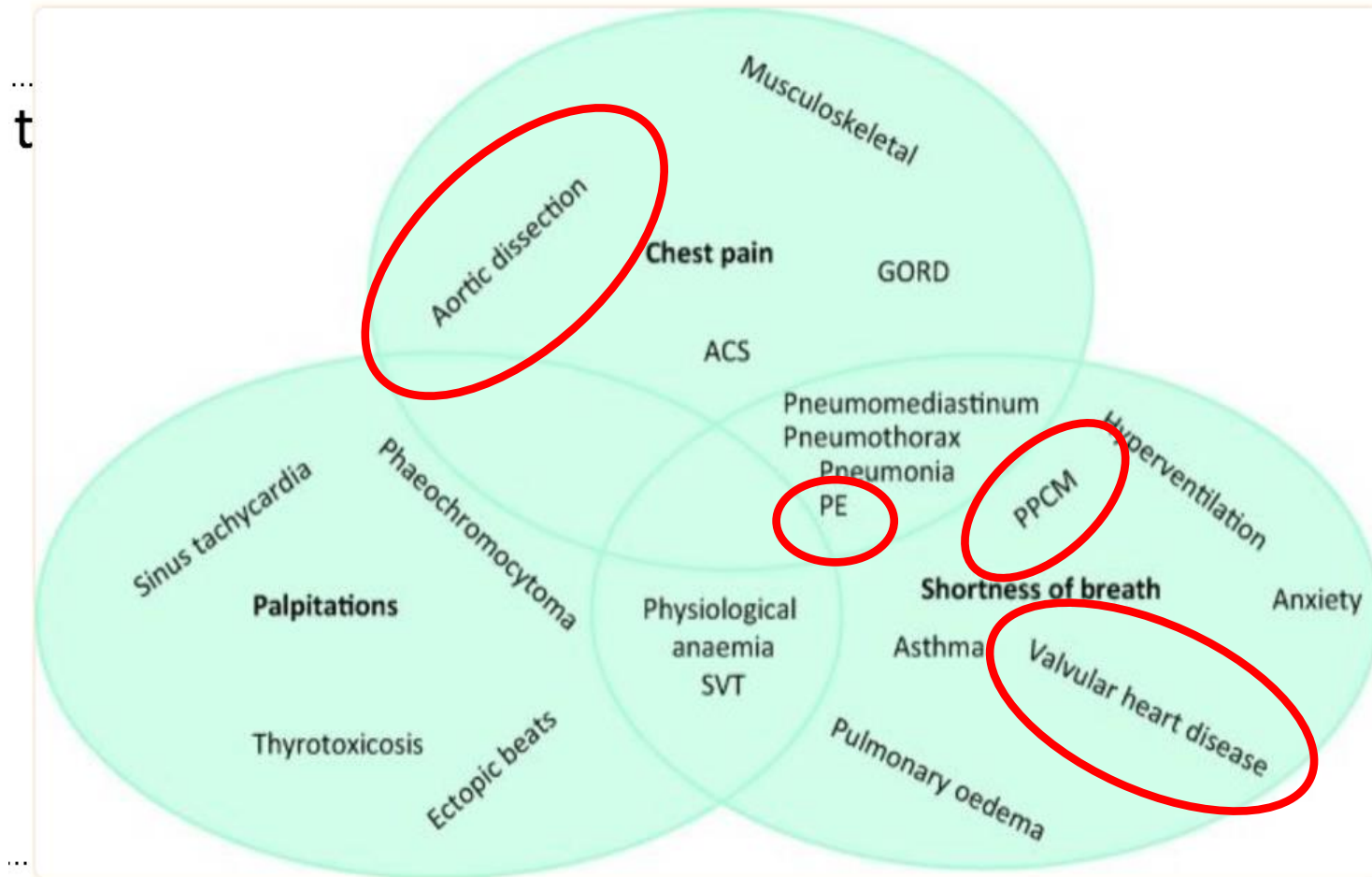 - Smoking
  - Hyperlipidemia
  - Hypertension
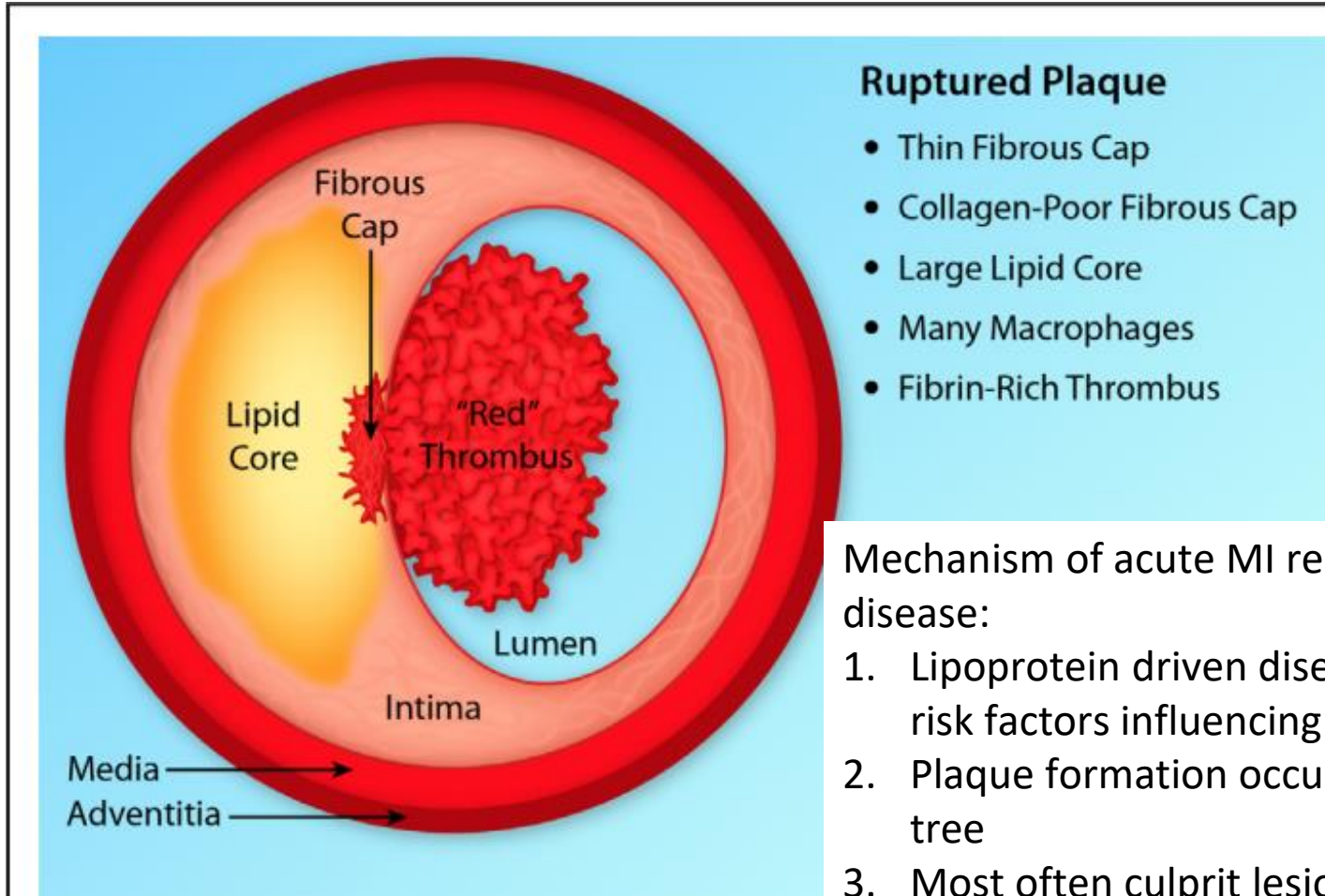 - Diabetes
  - Thrombophilia
  - Age >35
  - Anemia

- Pregnancy related risk factors:
  - Hemodynamic changes: increased cardiac output
  - Hormonal changes: Excess progesterone
  - Multiparity, post-partum infection, post-partum hemorrhage

PAMI: Presentation

- Cardiac arrest/ventricular arrhythmias
- Ischemic changes on EKG
- Elevated cardiac biomarkers
  - CK and CKMB, HS-Trop can be elevated after delivery
- Severe JVD
- Murmur of MR, diastolic murmurs
- Crackles
- Wall motion abnormalities on echocardiogram

AMI: Common mechanism

Ruptured Plaque

- Thin Fibrous Cap
- Collagen-Poor Fibrous Cap
- Large Lipid Core
- Many Macrophages
- Fibrin-Rich Thrombus

Mechanism of acute MI related to atherosclerotic disease:
1. Lipoprotein driven disease with traditional cardiac risk factors influencing progression
2. Plaque formation occurs at specific sites of arterial tree
3. Most often culprit lesion is a "vulnerable lesion" with a thin fibrous cap and acellular, highly thrombogenic lipid rich core
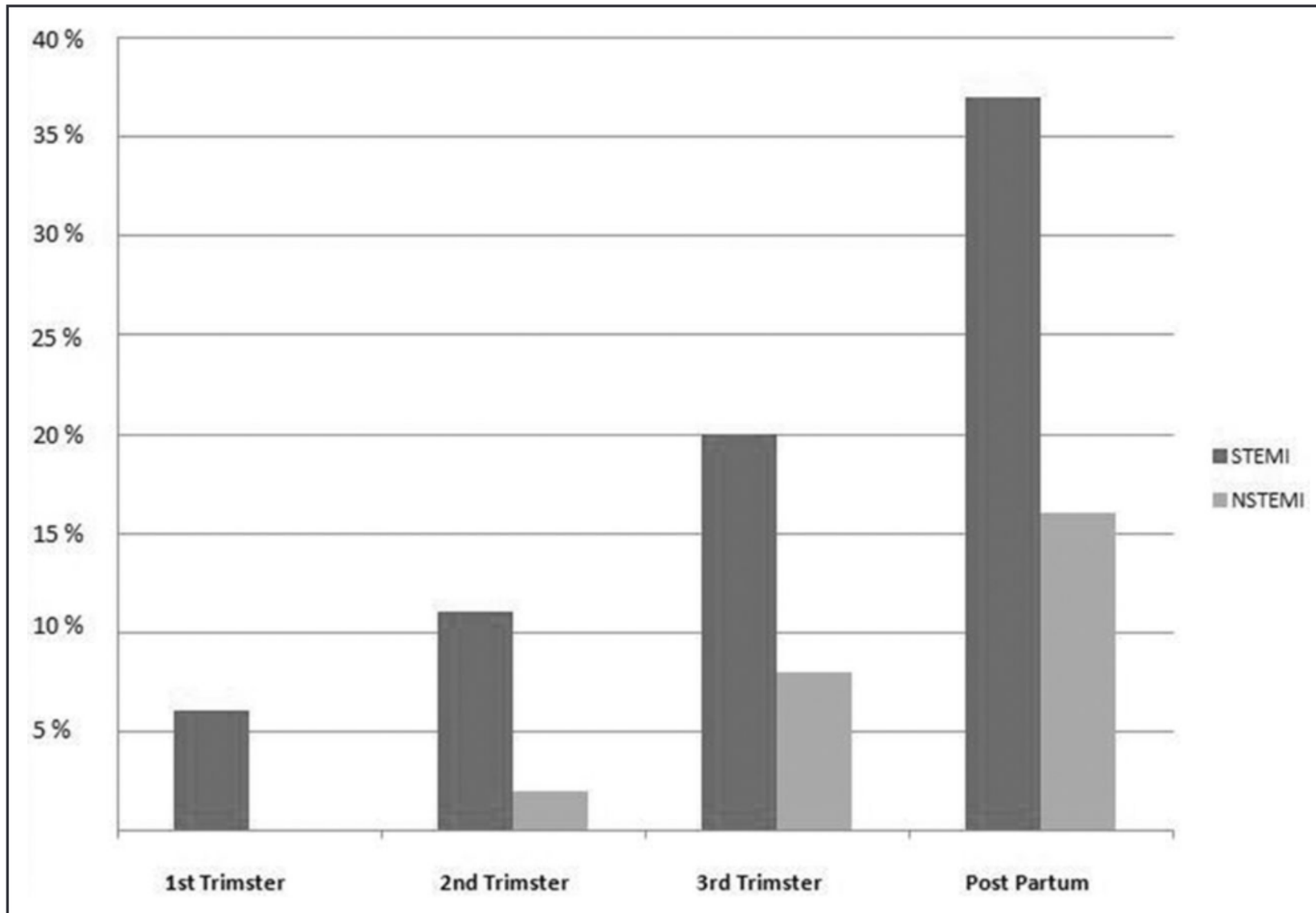
PAMI: Mechanisms

- Atherosclerotic coronary artery disease
  - 1/3 cases
- SCAD: Spontaneous coronary artery dissection
  - 1/3 cases (25% - >40%)
  - *In nonpregnant populations SCAD is cause of AMI in 0.28-1.1% of cases*
- Embolic event or in-situ thrombosis
  - Hypercoagulable state
- Coronary vasospasm
  - Increased vascular reactivity
- Microvascular dysfunction
  - Will present as NSTEMI

PAMI: Mechanisms

- Review of 150 patient with PAMI, published in literature from 2006-2011 or presented in other forums

Table 1. Patient Demographics (Table view)

Variable	Patients, n (%)
Mean±SD age, y	34±6
Age ≥30 y	113 (75)
Age ≥35 y	65 (43)
Anterior MI location	104 (69)
Multiparous	71 (47)
Obesity	20 (13)
Preeclampsia	10 (7)
Hypertension	23 (15)
Diabetes mellitus	13 (9)
Smoking	37 (25)
Family history	14 (9)
Hyperlipidemia	30 (20)

- 75% STEMI
- ~80% Third trimester or post-partum

Table 2. Mechanisms of AMI (132 Patients) (Table view)

Cause of AMI	First Trimester, n	Second Trimester, n	Third Trimester	Postpartum, n	Total, n (%)
Coronary dissection	…	3	12	41	56 (43)
Atherosclerosis	8	10	10	7	35 (27)
Clot	3	10	3	6	22 (17)
Normal	1	2	5	3	11 (9)
Spasm	…	…	1	1	2 (2)
Takotsubo	…	…	…	3	3 (2)

- SCAD: 73% presented post-partum, 21% in 3rd trimester
  - LAD affected in 39 patients, LM in 24.
  - 34/56 with only single vessel involvement
- Atherosclerotic heart disease: evenly distributed among trimesters
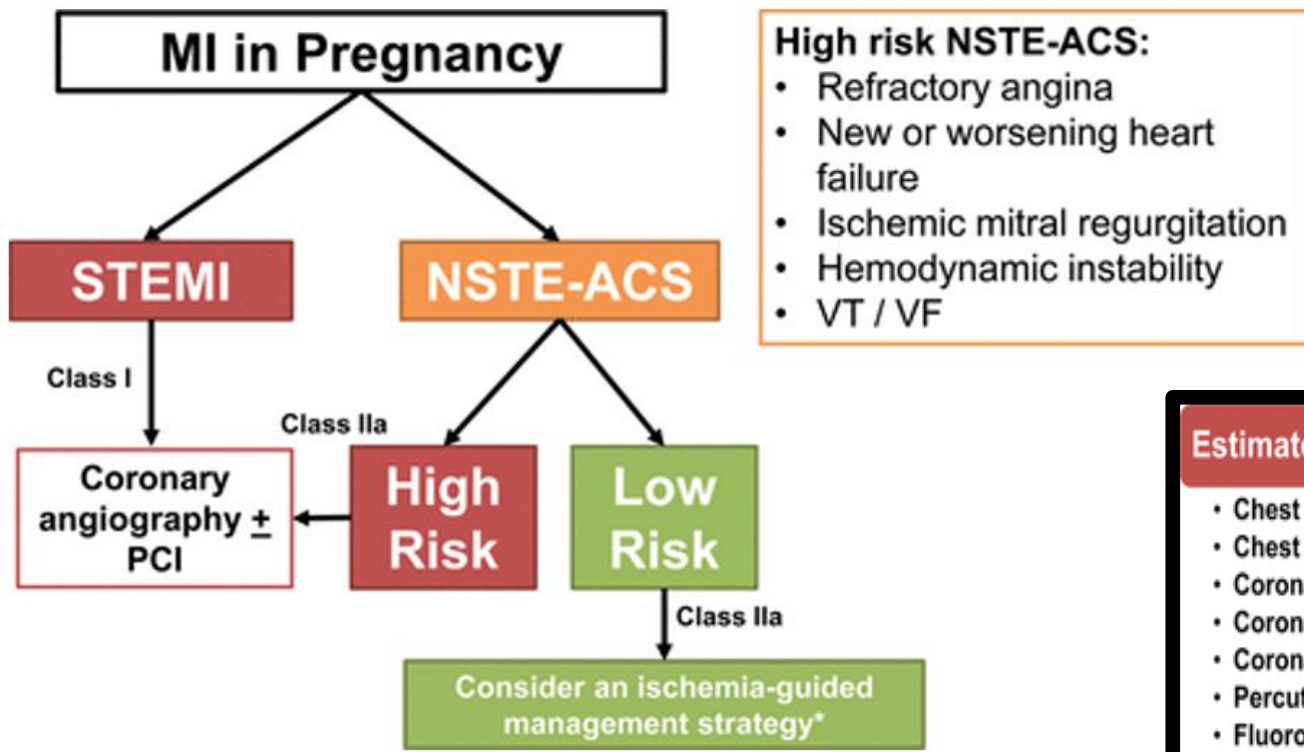
Interventions:

59 underwent PCI

30 required CABG

Table 3. Complications (Table view)

Complication	Patients, n (%)
Heart failure/cardiogenic shock	56 (38)
Ventricular arrhythmias	18 (12)
Recurrent angina/MI	29 (19)
Maternal mortality	10 (7)
Fetal mortality	7 (5)

General management strategies

- Early revascularization is the goal in patients with STEMI and unstable NSTEMI
  - Increased risk of complications and limited technical success in SCAD
  - Open heart surgery associated with 20-33% fetal death
- Thrombolytics should generally be avoided due to risk of maternal and fetal hemorrhage, worsening of dissection
- Drug safety data is limited:
  - ACE-I and statins are contraindicated
  - Clopidogrel suggested reserved for PCI with stenting
  - Beta blockers generally advised
  - Aspirin is considered safe, 81 mg ok throughout pregnancy
  - Heparin may be used, but might not be appropriate once SCAD is diagnosed
  - Loop diuretics are considered safe

MI in Pregnancy

High risk NSTE-ACS:
- Refractory angina
- New or worsening heart failure
- Ischemic mitral regurgitation
- Hemodynamic instability
- VT / VF

STEMI → Class I → Coronary angiography ± PCI

NSTE-ACS → High Risk / Low Risk

Class IIa → Coronary angiography ± PCI (from High Risk)

Low Risk → Class IIa → Consider an ischemia-guided management strategy*

Estimated Fetal Dose (mGy)* According to Exam:
- Chest x-ray (2 views): 0.0005-0.01
- Chest CTA for pulmonary embolus: 0.01-0.66
- Coronary CTA (prospective gating): 1†
- Coronary CTA (retrospective gating): 3†
- Coronary angiography: 0.074
- Percutaneous coronary intervention: dependent on procedure with reports of <1
- Fluoroscopy of the groin to heart catheter passage: 0.094 to 0.244 per minute

Estimated Threshold Dose (mGy) According to Gestation and Effect:
Note the magnitude of difference for the estimated fetal dose with the exams listed above and the estimated threshold dose for fetal harm listed below.
- 0-2 weeks (pre-implantation): 50-100, Death or nothing
- 2-8 weeks (organogenesis): 200-250, Congenital anomalies, growth restriction
- 8-15 weeks: 60-310, Severe intellectual disability (high risk), intellectual deficit, microcephaly
- 16-25 weeks: 250-280, Severe intellectual disability (low risk)
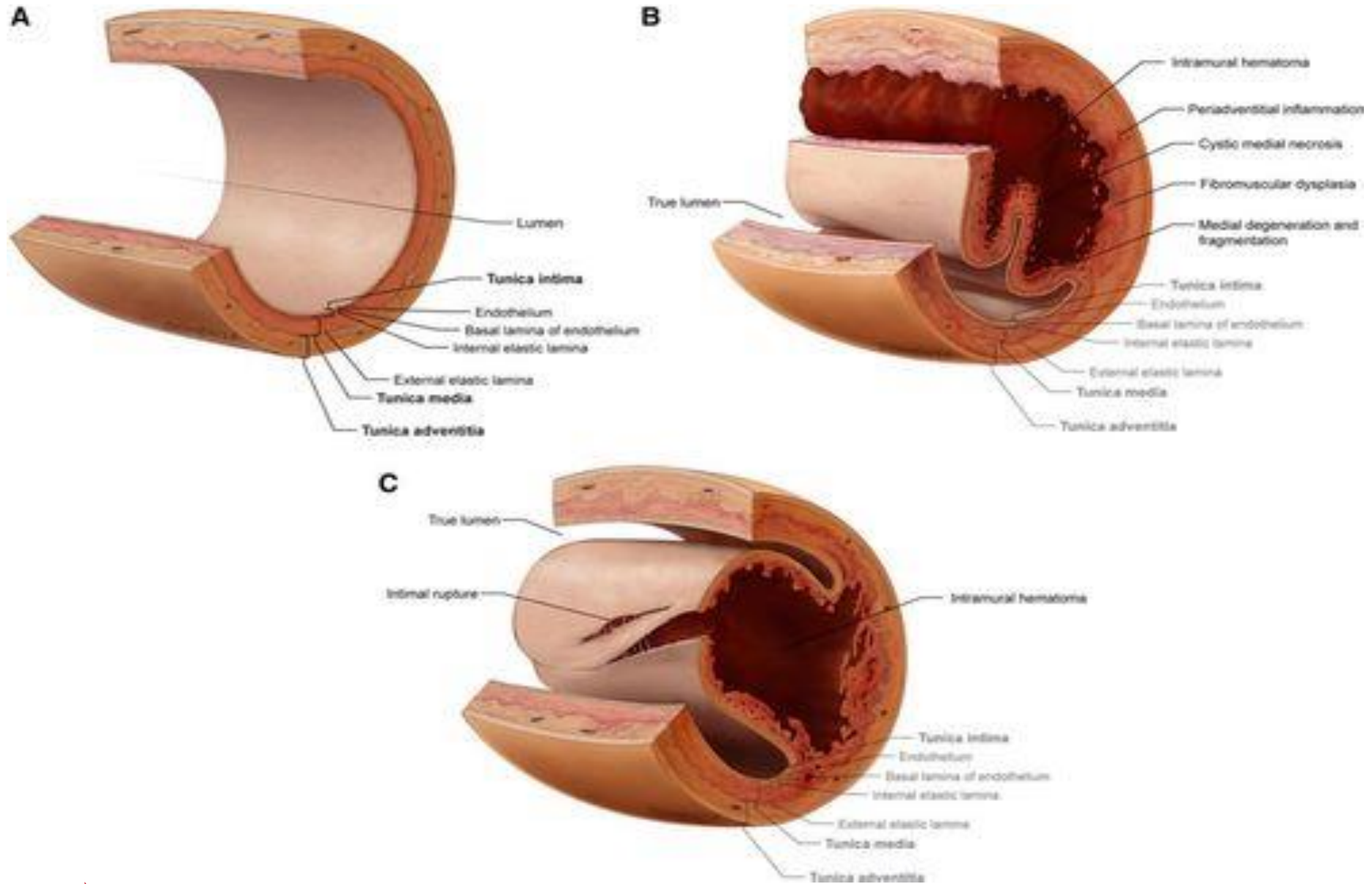
Labor and delivery

- Delivery should wait 2-3 weeks

- If CABG is indicated, may consider early c-section if pregnancy is advanced enough

- Vaginal delivery, early pain control (epidural)

- Future pregnancy is high risk

SCAD

- Separation within the arterial wall by intramural hematoma
  - Spontaneous intramedial hemorrhage
  - Intimal rupture leading to medial dissection

Physiologic changes of pregnancy can be predisposing

- Weakening of vascular wall related to estrogen and progesterone:
  - Decreased collagen synthesis
  - Increased media mucopolysaccharide content
  - Inflammatory changes and release of proteolytic enzymes
  - Degradation of collagen matrix
  - → Lack of structural support of the vessel and weakening of vessel wall
- Increase in cardiac output with pregnancy and labor/delivery → increased shear stress on coronary arteries
  - Shear stress is the frictional force generated by blood flow on the endocardium

P-SCAD

- Mean presenting age 33 years
- Patients may present with chest pain, dyspnea, heart failure symptoms, ventricular arrhythmias, and cardiogenic shock
- Gold standard imaging is coronary angiography
  - Risk of propagation of dissection
  - Presents as long diffuse stenosis
  - Atherosclerotic plaques are usually absent
 - Tendency of proximal coronary involvement (including LM and LAD), multivessel dissections, and worse LVEF

P-SCAD management

- Many dissections will heal on their own

- Percutaneous coronary intervention (stenting) can be technically challenging
  - Identifying true lumen can be challenging
  - Dissection extension is a real risk

- CABG is reserved for LM dissection or when PCI is not feasible or fails
  - Can also be technically challenging
  - Spontaneous healing of native coronary vessel can lead to graft failure

- Mechanical support (balloon pump, ECMO) may be needed

Management
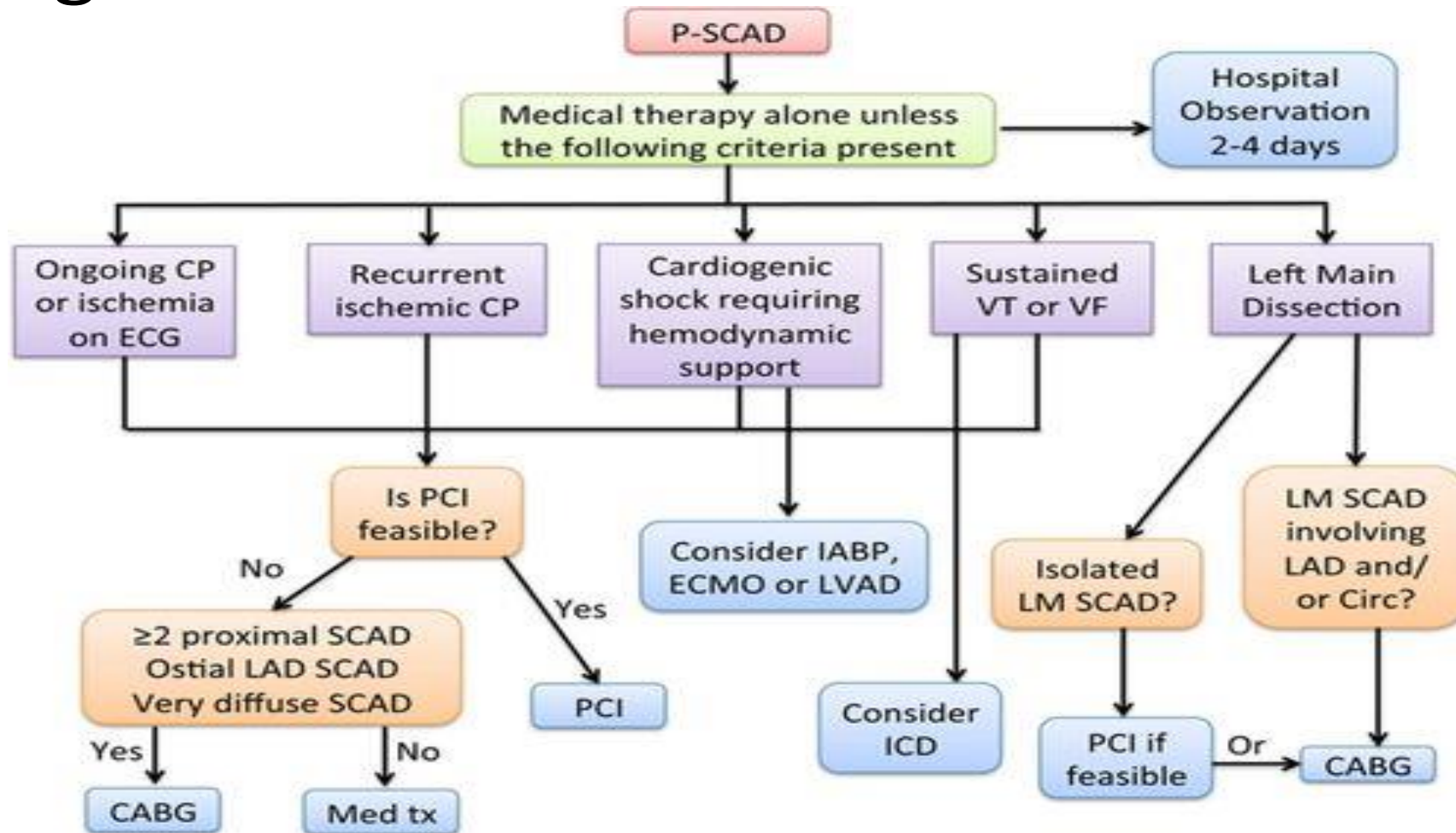
Our patient
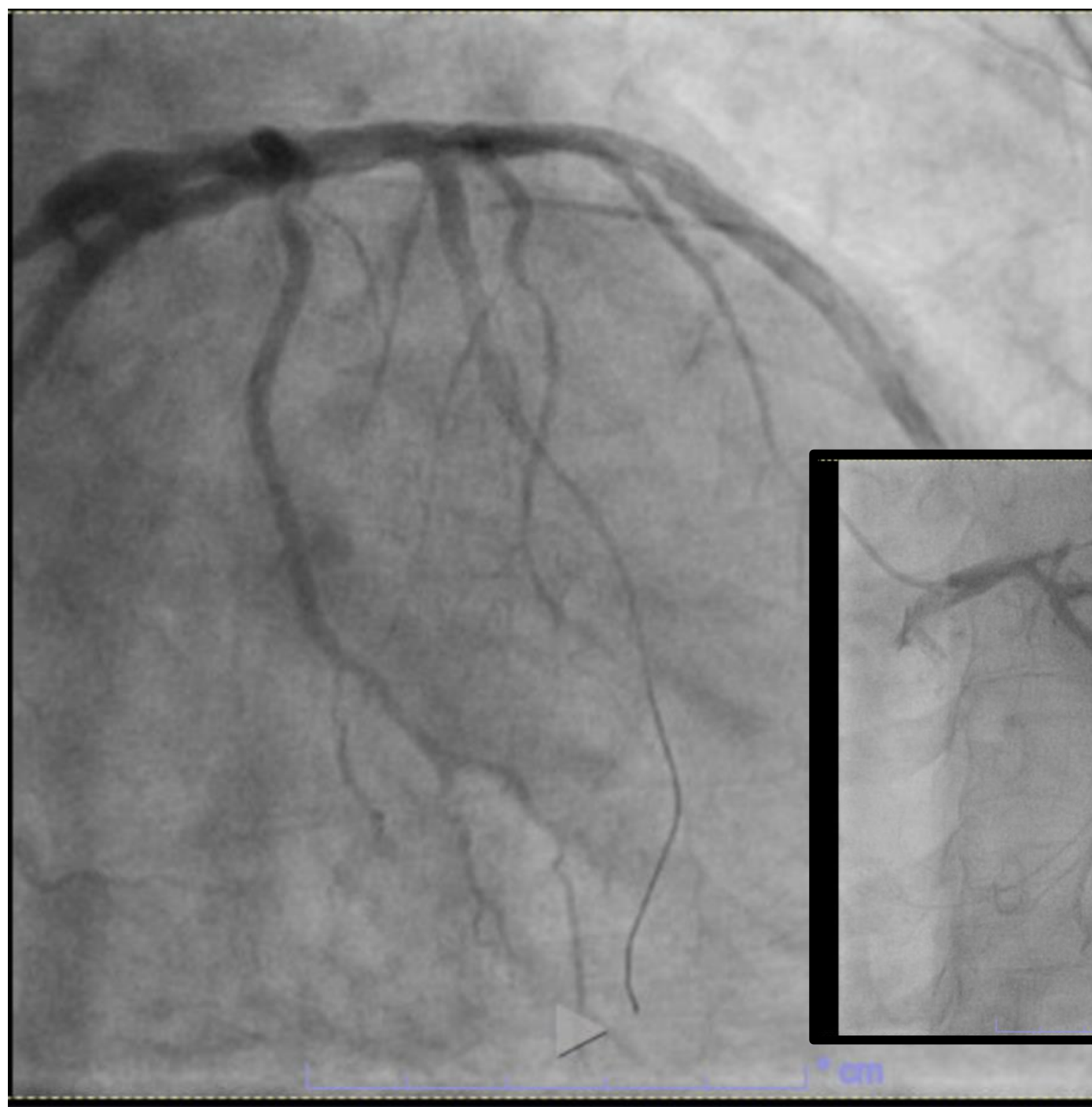
Our patient

- Underwent stenting to LAD

- Started on DAPT, statin, BB, and ARB

- LVEF 30-35%, discharged on LifeVest

- NYHA class III, doing well, exercising and active

- LVEF improved to 40-45%, but MRI shows scarring in LAD distribution, risk for future cardiac arrhythmias

Arrhythmias in pregnancy

- 28 year old woman, first pregnancy
- Baseline HR 80, got Apple Watch during pregnancy and found HR >100, usually 120-130
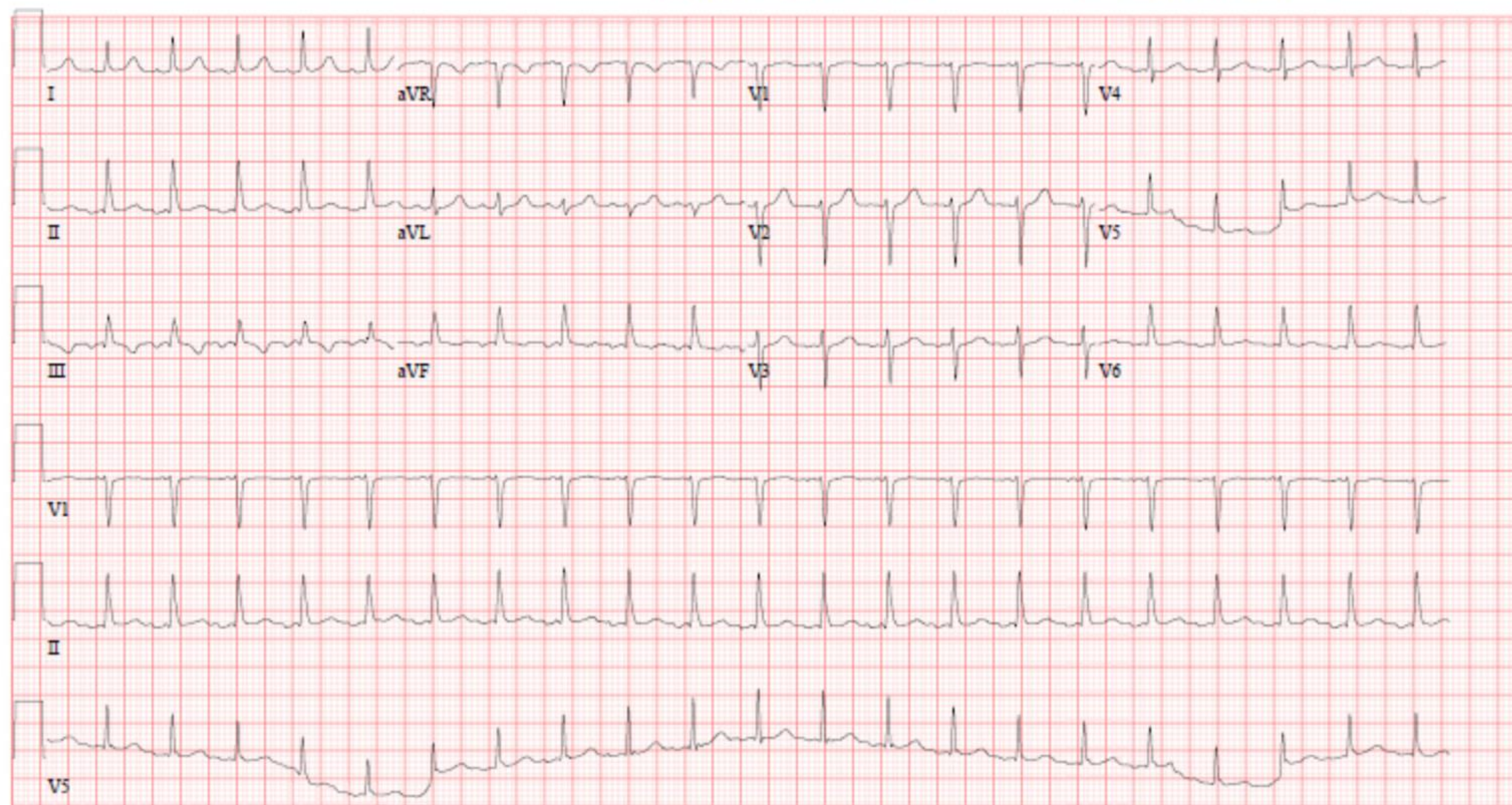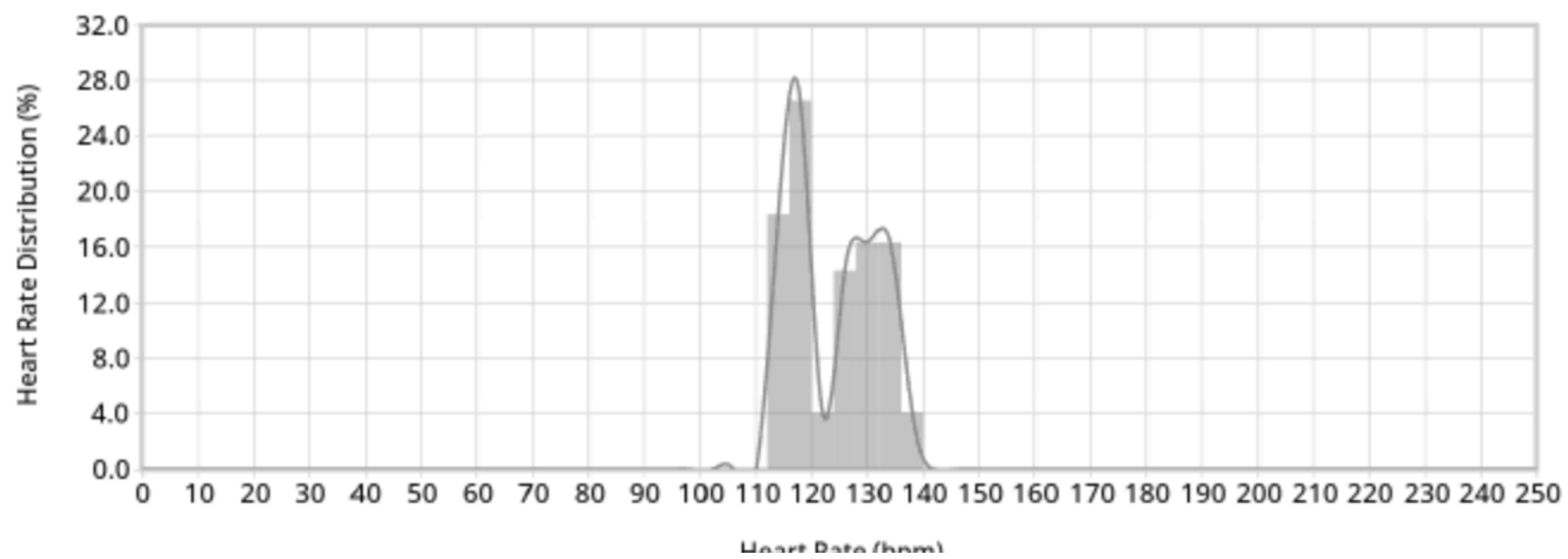
- Treated with beta blocker, resting heart rate down 80-100 bpm

Arrhythmias in pregnancy

- Common!
- Can be continuation of known arrhythmia or new manifestation
- Hemodynamic, hormonal, and autonomic changes of pregnancy contribute
  - Increased blood volume → atrial and ventricular stretch
  - Increased heart rate may be arrhythmogenic
  - Estradiol and progesterone proarrhythmic
  - Adrenergic responsiveness increased in pregnancy
  - Estrogen increases number of adrenergic receptors in the myocardium

General management themes for arrhythmias

- Exclude contributing medical conditions (hyperthyroidism, PE, etc)
- Treat when significant symptoms or risk to mother or fetus
- Try to prevent by curative management of arrhythmia prior to pregnancy
- Most drugs are category C (risk cannot be ruled out), but many are safely used
- Cardioversion does not appear to compromise blood flow to the fetus and unlikely to induce fetal arrhythmias
- Adenosine appears safe to use (can acutely terminate SVT)
- Ablation is an option with low radiation exposure to the fetus

Table 2. Characteristics of Antiarrhythmic Drugs in Pregnancy

Drug	Vaughan–Williams Class	FDA Risk Category*	Potential Adverse Effects	Teratogenic	Use During Lactation
Quinidine	IA	C	Thrombocytopenia, ototoxicity, torsades de pointes	No	Compatible but caution advised
Procainamide	IA	C	Drug-induced lupus, torsades de pointes	No	Compatible for short-term use
Disopyramide	IA	C	Uterine contractions	No	Compatible
Lidocaine	IB	B	Bradycardia, CNS adverse effects	No	Compatible
Mexiletine	IB	C	Bradycardia, CNS effects, low Apgar score	No	Compatible
Flecainide	IC	C	Well tolerated in structurally normal hearts	No	Compatible
Propafenone	IC	C	Same as flecainide	No	Unknown
Propranolol	II	C	Bradycardia, growth retardation, apnea	No	Compatible
Metoprolol	II	C	Same as propranolol	No	Compatible
Atenolol	II	D	Low birth weight	No	No
Pindolol	II	B	…	No	Compatible
Sotalol	III	B	β-blocker effects, torsades de pointes	No	Compatible, but caution advised
Amiodarone	III	D	Fetal hypothyroidism, growth retardation, prematurity	Yes	Avoid
Dofetilide	III	C	Torsades de pointes	Unknown	Unknown
Dronedarone	III	X	Vascular and limb abnormalities, cleft palate	Yes	Contraindicated
Ibutilide	III	C	Torsades de pointes	Unknown	Unknown
Verapamil	IV	C	Maternal hypotension, fetal bradycardia	No	Compatible
Diltiazem	IV	C	Same as verapamil	Unknown	Compatible
Adenosine	N/A	C	Dyspnea, bradycardia	No	Unknown
Digoxin	N/A	C	Low birth weight	No	Compatible

Arrhythmia specifics

- PACs and PVCs are common, generally don't require treatment

- SVT is the most common sustained arrhythmia during pregnancy
  - 24 per 100,000 hospital admissions
  - 20-50% of patients with preexisting SVT will experience exacerbation
  - Medical treatment: Beta blockers, verapamil
  - Refractory: flecainide, quinidine for AVRT, digoxin for AVNRT
  - WPW with atrial fibrillation: Procainamide
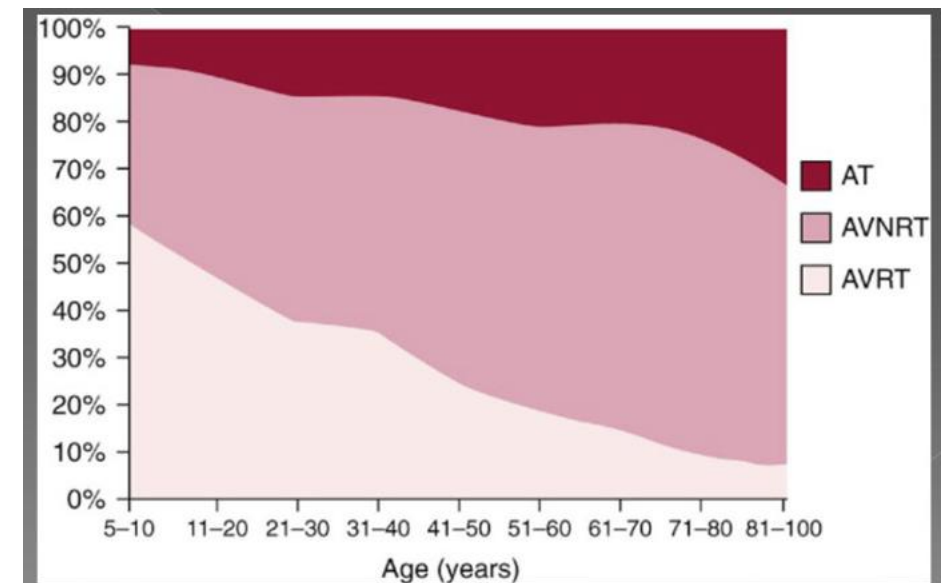
Arrhythmia specifics

- Atrial fibrillation and atrial flutter are uncommon
    - 2 per 100,000 hospital admissions
    - 50% of those with pre-existing atrial fibrillation will have symptomatic episodes
    - Sotalol or flecainide are the preferred antiarrhythmics for long term suppression
- Ventricular fibrillation and ventricular tachycardia are uncommon
    - 2 per 100,000 hospital admissions
    - 27% of those with prior VT will experience recurrence
    - Usually in setting of structural heart disease
    - In normal hearts, more likely RVOT/fascicular VT
    - Sotalol, lidocaine, mexiletine, procainamide are drug options

Specific populations that predispose to ventricular arrhythmias

- LQTS (increased risk of arrhythmias in post-partum period)
- HCM
- ARVC
- Congenital heart disease
- CPVT

CIEDs (Pacemaker and ICD)

- Brady-arrhythmias are uncommon during pregnancy
  - Congenital AV block may be identified at pregnancy
- Data on ICDs are lacking: literature review showed 133 pregnant women with ICD. Does not seem to be increased of ICD therapies during pregnancy or delivery
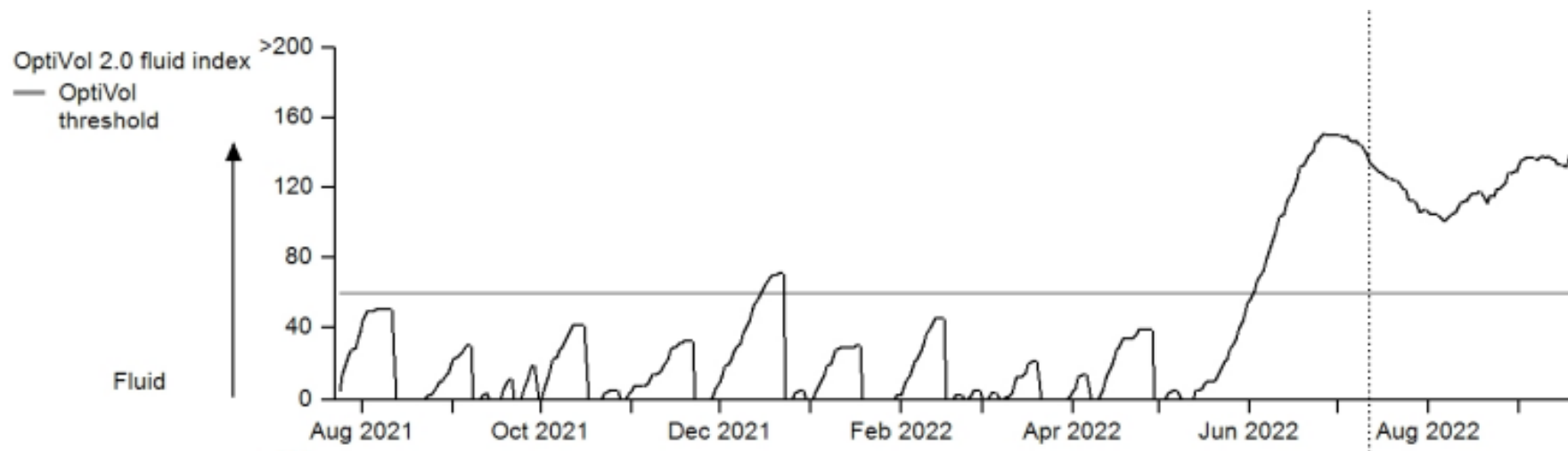
Ablation for arrhythmias in pregnancy

- Reasonable threshold for concern for fetal exposure is 50 mGy – this level has not been associated with fetal anomalies or pregnancy loss
- One study investigated theoretic fetal radiation exposure during catheter ablation for SVT, found to be <1 mGy
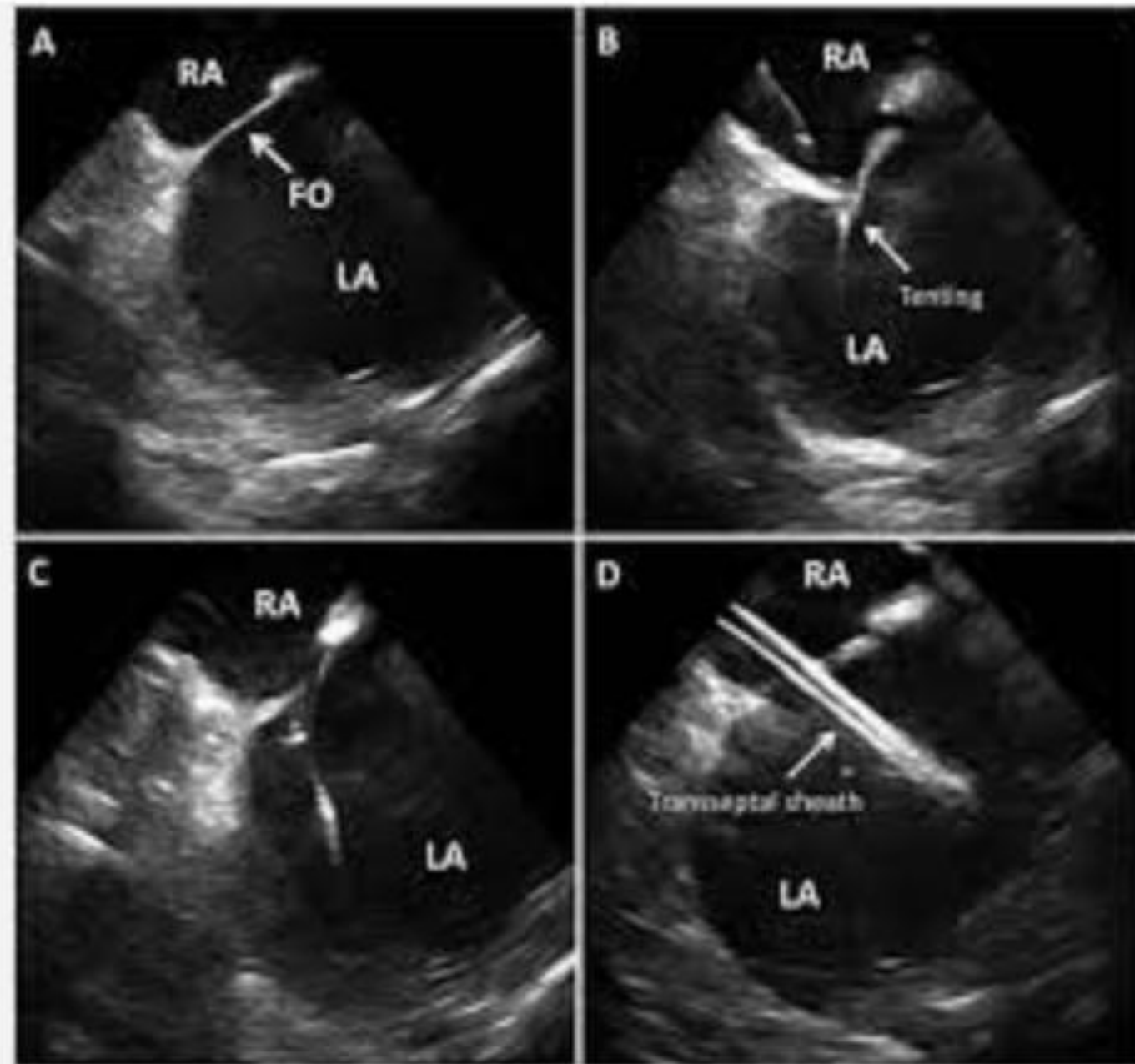
Table 6 Recommended surveillance levels at time of delivery in women with arrhythmias

Risk for arrhythmia with haemodynamic compromise at delivery		Level of surveillance[a]	Class[b]	Level[c]
Low-risk	PSVT, AF, idiopathic VT, low-risk LQTS, WPW syndrome	1	I	C
Medium-risk	Unstable SVT, VT, those with an implanted ICD, VT and structural heart disease, Brugada syndrome; moderate risk: LQTS, catecholaminergic polymorphic VT	2	I	C
High-risk for life threatening arrhythmia	Unstable VT in structural heart disease/congenital heart disease, unstable VT/TdP in high-risk LQTS patients, short QT syndrome, high-risk catecholaminergic polymorphic VT	3	I	C

| Descriptions of actions to be planned	Surveillance level		
	Low 1	Medium 2	High 3
Consult cardiologist	x		
Consultation with multidisciplinary team including arrhythmologists at specialized centre		x	x
Mode and location of delivery as advised by obstetricians	x	x	
Caesarean delivery recommended			x
Monitor cardiac rhythm (telemetry, external rhythm monitor)		(x)	x
Intravenous line		x	x
Arterial line			x
Prepare for intravenous administration of adenosine		x	
Prepare for intravenous administration of a beta-blocker		x	x
Prepare for intravenous administration of selected antiarrhythmic drugs			x
External cardioverter defibrillator at site		x	x
Delivery at thoracic operating theatre			x
Prepare for transfer to cardiac intensive care unit post-partum if needed			x

Patient follow up

- At 36 weeks fetus was diagnosed with fetal growth restriction
- C-section at 37 weeks (baby breech), 5 lb, 5 oz
- Almost immediate drop in heart rate

1 week prior to delivery
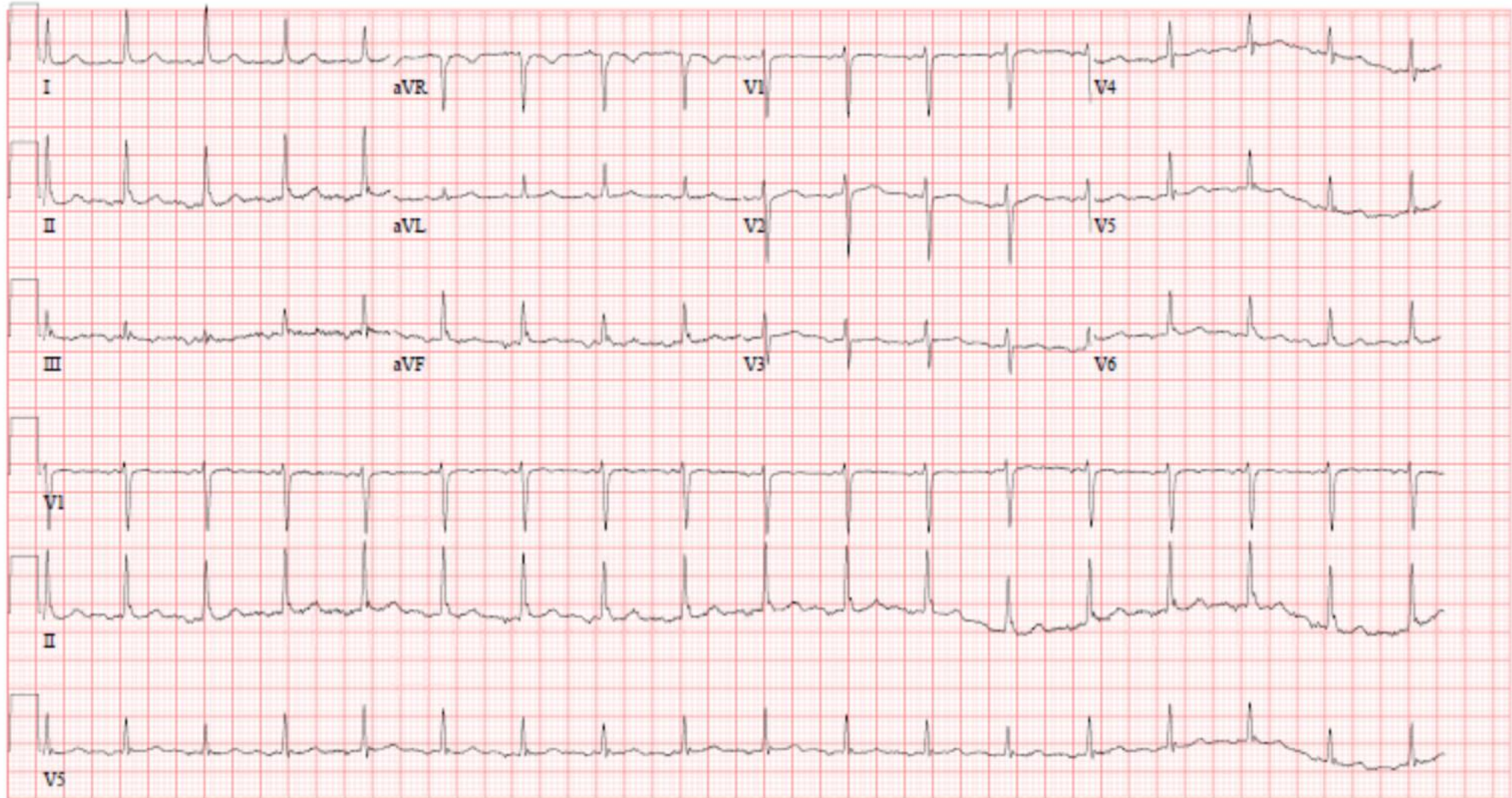
2 weeks post delivery
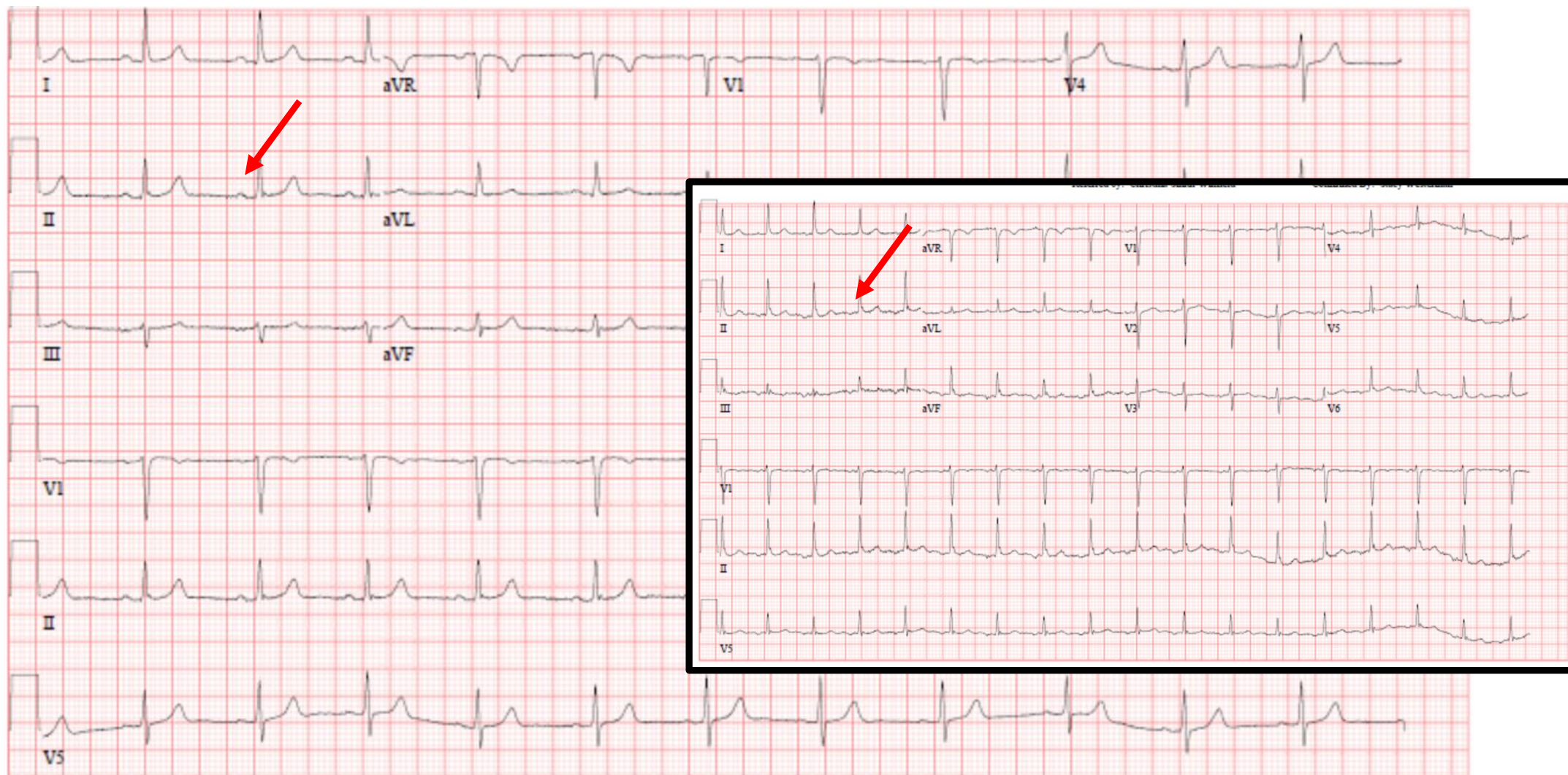
- Brought her to EP lab to try induce AT, unsuccessful

Take home points

- Cardiovascular disease is one of the leading causes of maternal mortality in the US

- Acute MI is more common in pregnancy then in a similar non-pregnant population

- Arrhythmia in pregnancy is common: SVT and atrial arrythmias are more common than ventricular arrhythmias

- A multi-disciplinary approach should be taken to managing these patients: Invasive procedures can be utilized for cases that pose high risk to mother and fetus

Works cited

- Sanghavi ,M and Rutherford JD. Cardiovascular physiology of pregnancy. Circulation. Sept 2014. 130(12): 1003-1008
- Vijayaraghavan, R et al. Pregnancy-related spontaneous coronary artery dissection. Circulation. 2014. 130(21): 1915-1920
- Enriquez A et al. Contemporary management of arrhythmias during pregnancy. Circulation Oct 2014. 7(5): 961-967
- Elkayam, U et al. Pregnancy-associated acute myocardial infarction. Circulation. 2014. 129(16): 1695-1702
- Tweet M et al. Pregnancy-associated myocardial infarction. Circulation. 2020. 13(11)
- Heart disease and pregnancy, 2nd Ed. Steer PJ and Gatzoulis MA. Cambridge University Press. 2016
- 2018 ESC Guidelines for the management of cardiovascular diseases during pregnancy. European Heart Journal (2018)39, 3165-3241
- Mehta, L et al. Cardiovascular considerations in caring for pregnant patients: A scientific statement from American Heart Association. Circulation. June 2020. 141(23): e884-e903