Sequelae of Pregnancy Complications

Preeclampsia
Peripartum Cardiomyopathy
Amniotic Fluid Embolism

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Objectives

- Discuss selected serious pregnancy complications with major clinical sequelae
  - Preeclampsia
  - Peripartum cardiomyopathy
  - Amniotic fluid embolism

Obstetric ICU Admissions Indications

- **21,639 patients from 50 studies**
  - **#1: Hemorrhage 28.4%**
  - ***#2: HTN diseases 26.6%***
  - **#3: Sepsis/Infection 8.4%**
  - ***#4: Cardiac 7.8%***
  - ***#5: Pulmonary 5.1%***

Ananth CV, Smulian JC. Epidemiology of Critical Illness in Pregnancy. In: Critical Care Obstetrics. 2017

Obstetric ICU Mortality Causes

- 536 patients from 42 studies
  - *#1: HTN diseases* *20.0%*
  - #2: Hemorrhage 19.6%
  - #3: Sepsis/Infection 14.9%
  - *#4: Pulmonary* *12.1%*
  - *#5: Cardiac* *11.6%*

Ananth CV, Smulian JC. Epidemiology of Critical Illness in Pregnancy. In: Critical Care Obstetrics. 2017

Preeclampsia Epidemiology

- 3-8% of pregnancies
- >80,000/yr maternal deaths worldwide
  - >16% of all maternal deaths (1 PE death every 7 min)
- #7 cause of maternal death in US
  - 1 of 11 maternal deaths (2006-10)
- #3 cause of fetal death in US
  - >5% of US fetal deaths >20 wks
- US hospitalizations (2005-09) – $2.2 billion
  - 3.8% of delivery hosp (ave LOS 4 days)
  - 3.9% of non-delivery hosp (ave LOS 3 days)

Ananth CV, Smulian JC. Epidemiology of Critical Illness in Pregnancy. In: Critical Care Obstetrics. 2017

Preeclampsia Complications

- CV - Severe HTN, pulmonary edema
- Renal - Oliguria, renal failure
- Heme - Hemolysis, thrombocytopenia, DIC
- Neuro - Sz, cerebral edema, hemorrhage, cortical blindness
- Hepatic - Dysfunction, rupture
- Placental - Abruption, IUGR, fetal distress, IUFD
- Major cause of preterm birth
  - 15-20% of PTB burden

Gestational Hypertensive Disease Classification

- **Only 4 Categories with fuzzy boundaries**
  - **Preeclampsia-eclampsia**
  - **Chronic hypertension (any cause)**
  - **Chronic hypertension with superimposed preeclampsia**
  - **Gestational hypertension**

Working group Report on High Blood Pressure in Pregnancy-NIH 2000, ACOG Task Force 2013, ACOG Practice Bulletin 2019

Gestational Hypertensive Disease

- **Diagnosis and severity**
  - **BP**
  - **Proteinuria**
  - **Signs and symptoms**
  - **Laboratory**

Working group Report on High Blood Pressure in Pregnancy-NIH 2000, ACOG Task Force 2013, ACOG Practice Bulletin 2019

Gestational Hypertensive Disease

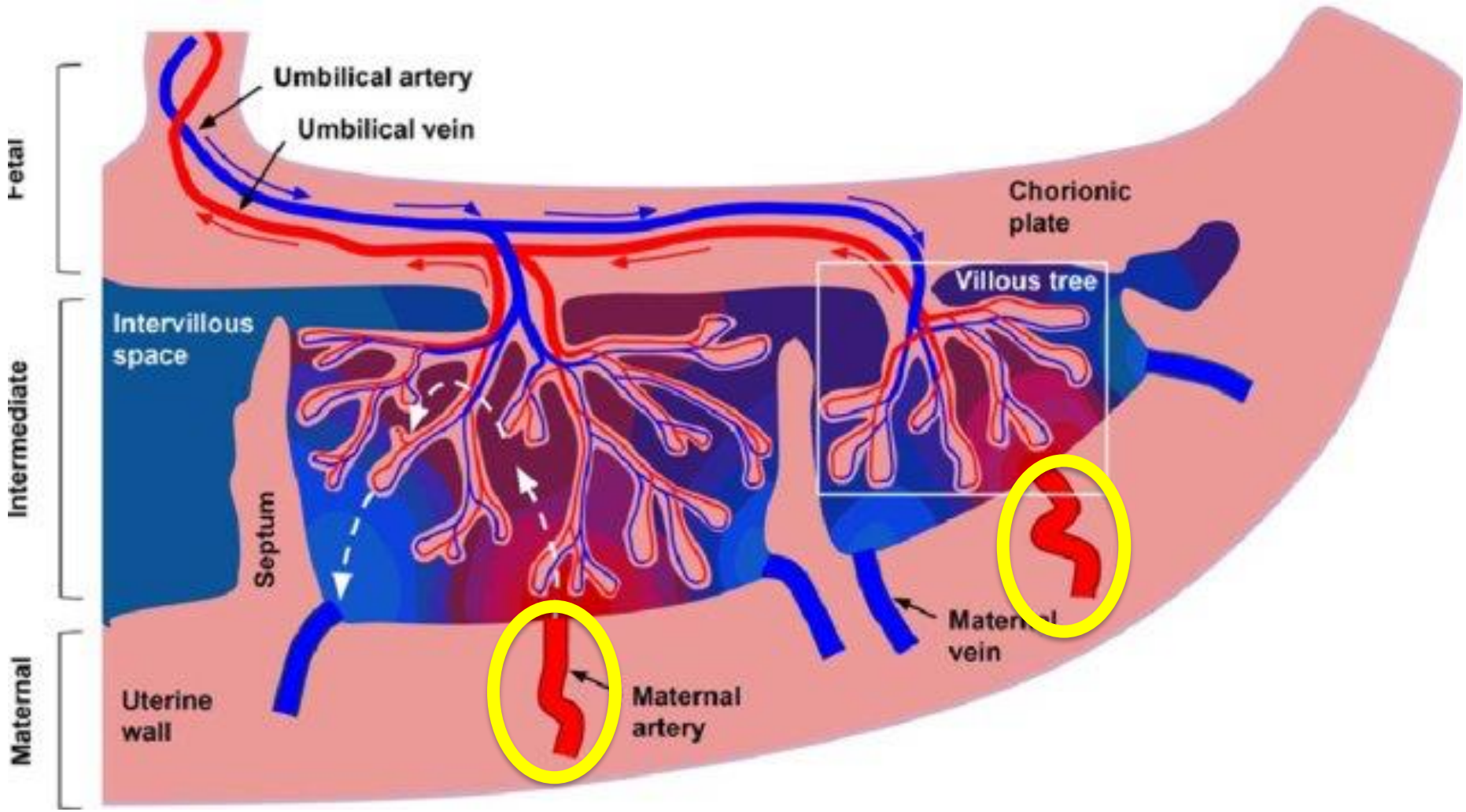
- **Preeclampsia is a *syndrome* that requires abnormal placentation**
  - **Older attempts at definitions have used "arbitrarily" selected markers rather than changes that are important pathophysiologically**

ACOG Task Force 2013, ACOG Practice Bulletin 2019

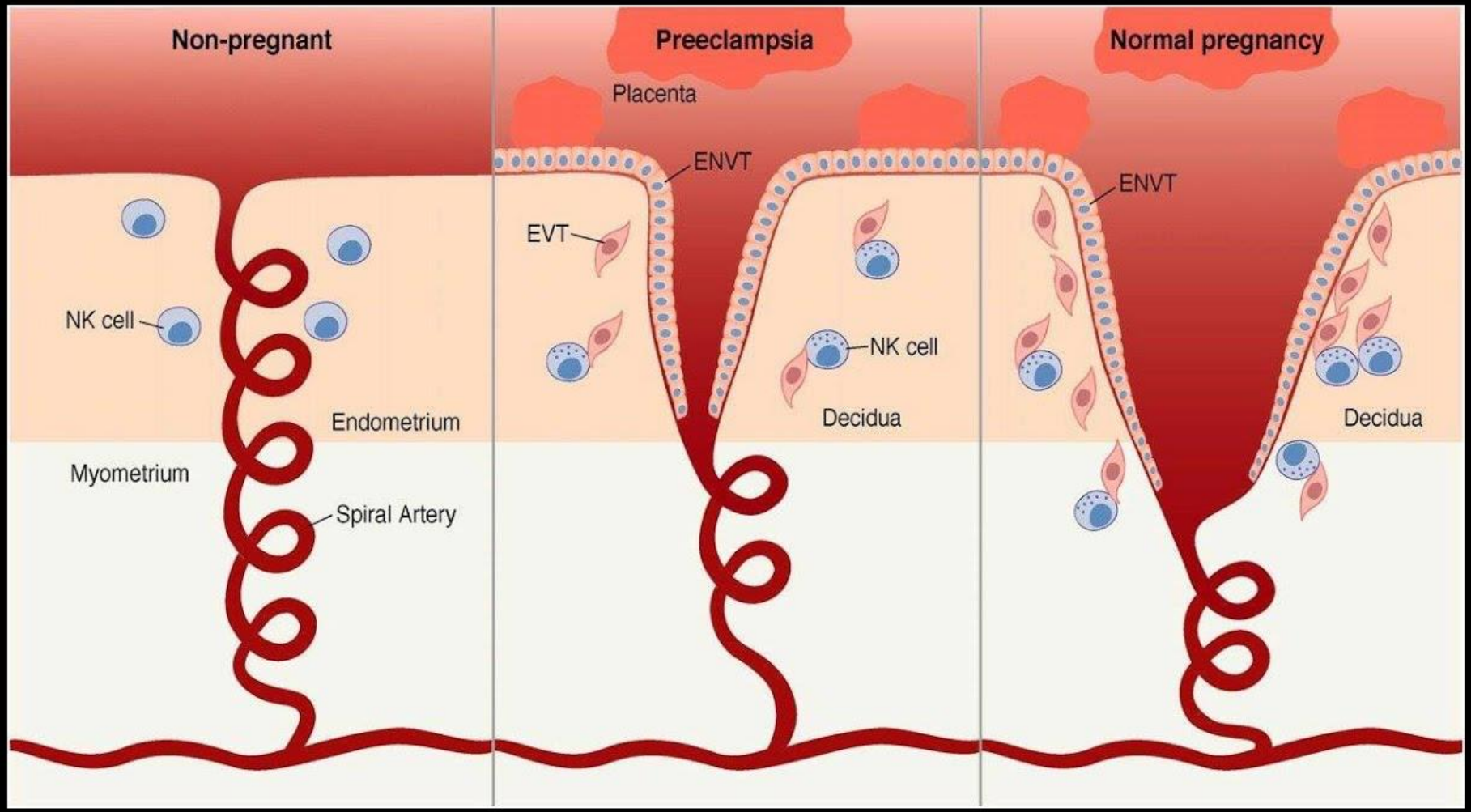
Shift in Approach

- **Preeclampsia/eclampsia:**
  - **Does NOT respect BP or proteinuria "criteria"**
  - **Is the result of a physiologic process**
  - **Is variable in presentation and progression**
  - **Is challenging for predicting complications**
  - **Is easy to underestimate clinical impact**
  - **Is increasingly recognized as a *sentinel* event for future health issues**

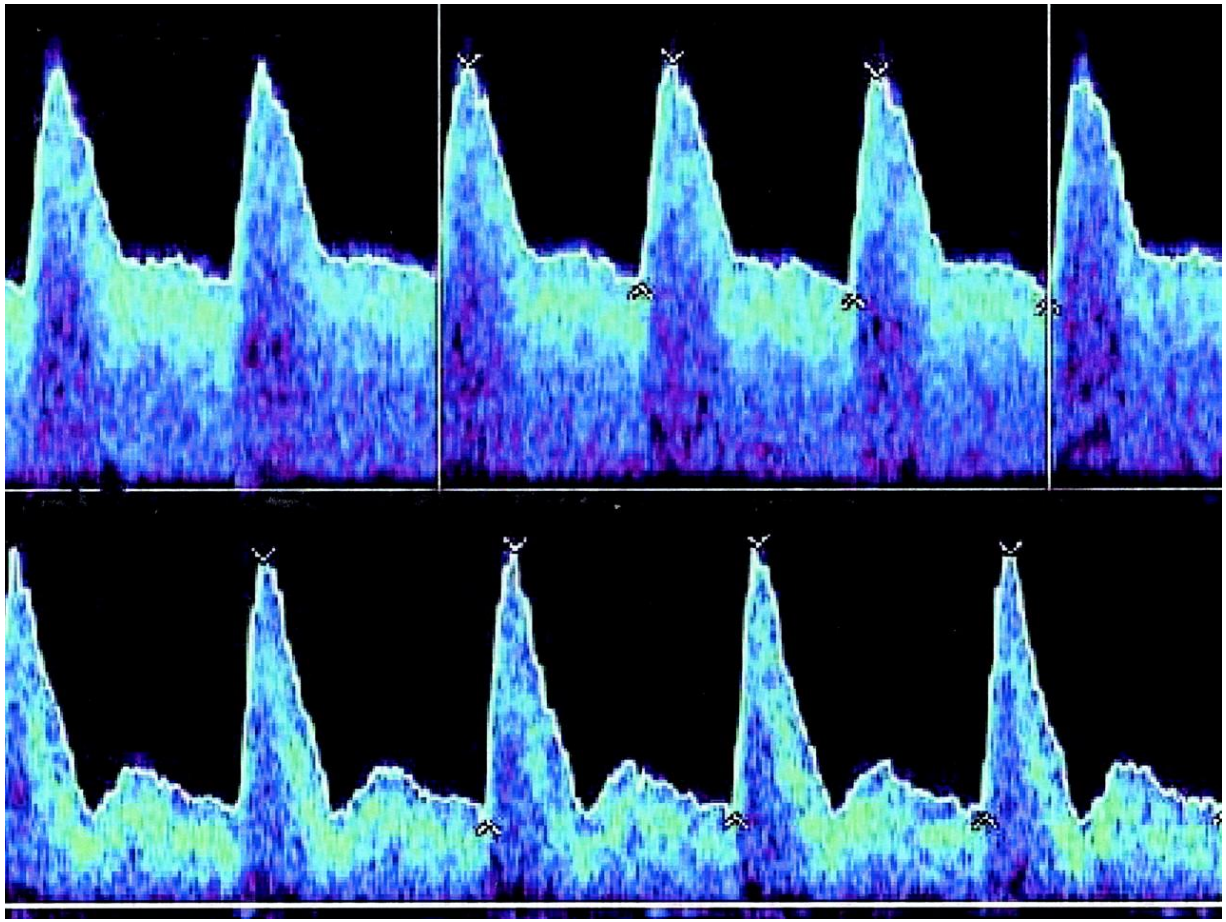
Preeclampsia Physiology



Spiral Artery Conversion



Ultrasound Doppler Spectrum of Uterine Artery Blood Velocity.

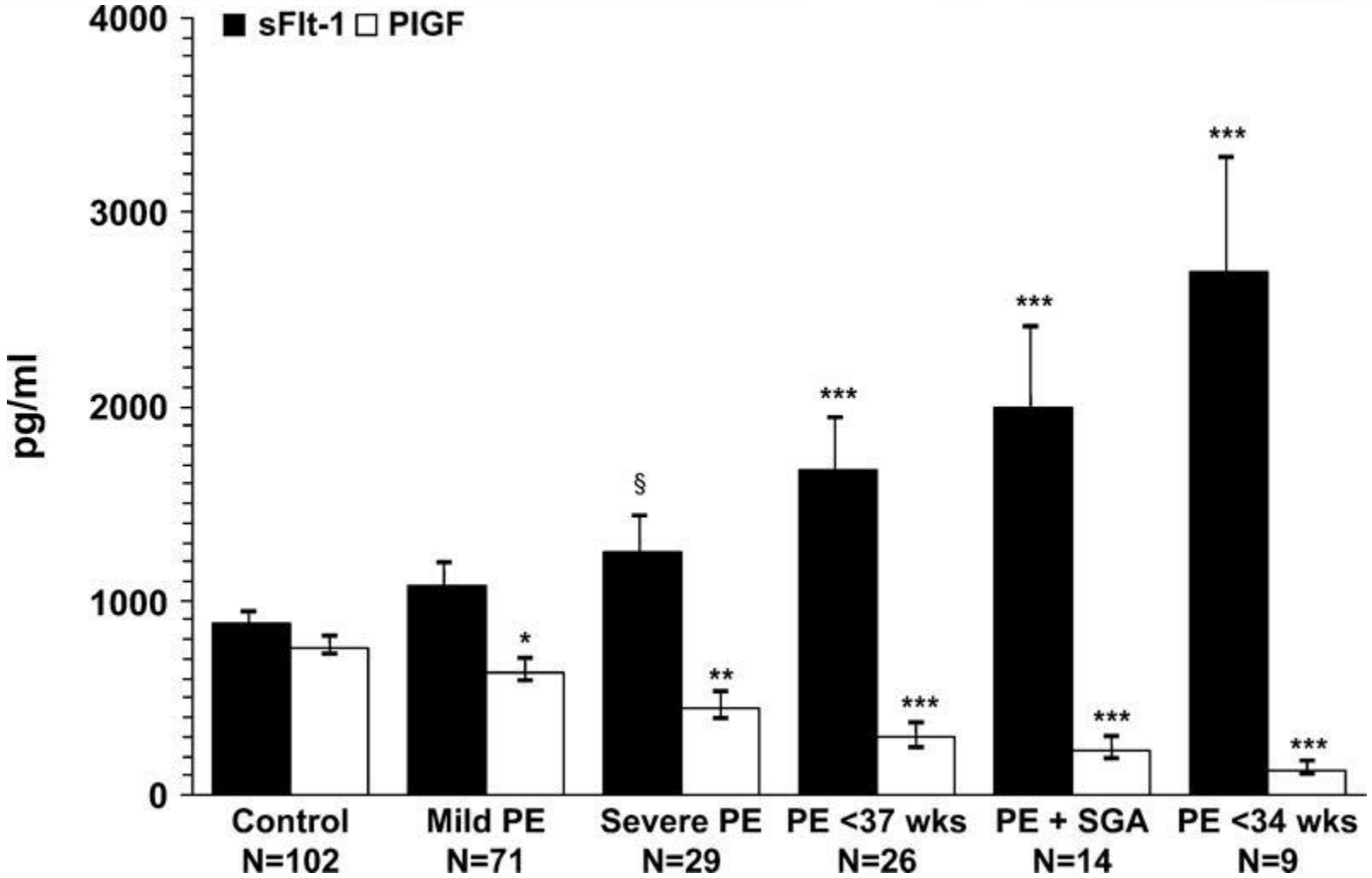


Pietryga M et al. Circulation 2005;112:2496-2500

Vascular Angiogenesis

- VEGF (vascular endothelial growth factor)
  - Increases placental angiogenesis
  - Increases vasodilation (NO & prostacyclin)
- PlGF (placental growth factor)
  - Increases placental angiogenesis
  - Increases vasodilation
- sFlt-1 (soluble VEGF receptor)
  - Binds VEGF to prevent angiogenic activity
  - Antagonizes PlGF (placental growth factor)
- Soluble endoglin
  - Antagonizes angiogenesis as TGF receptor

sFlt and PLGF at 21-32 wks by PE Status and Severity



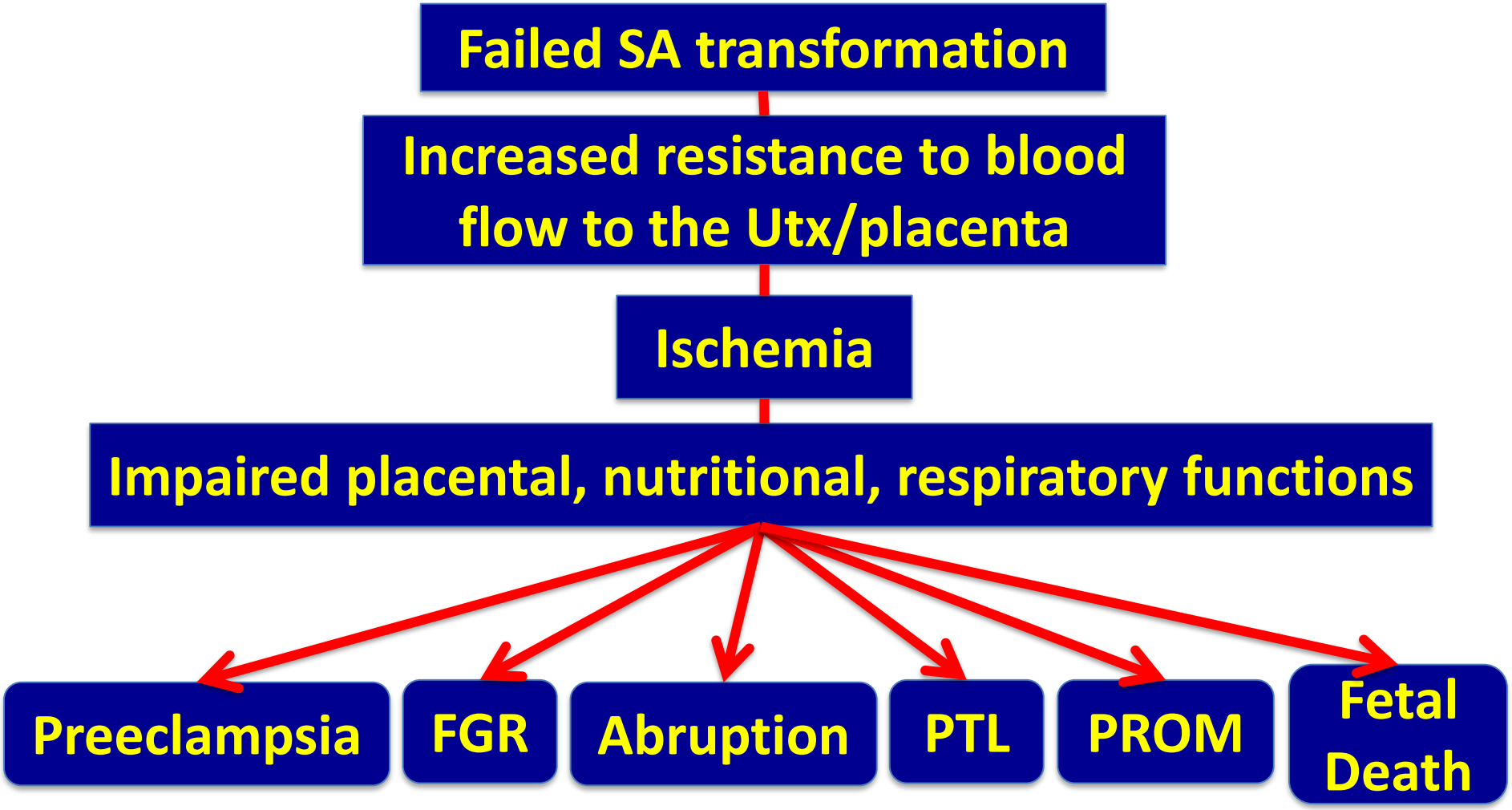
Levine, Maynard, et al. NEJM 2004: 350; 672

Preeclampsia Stages

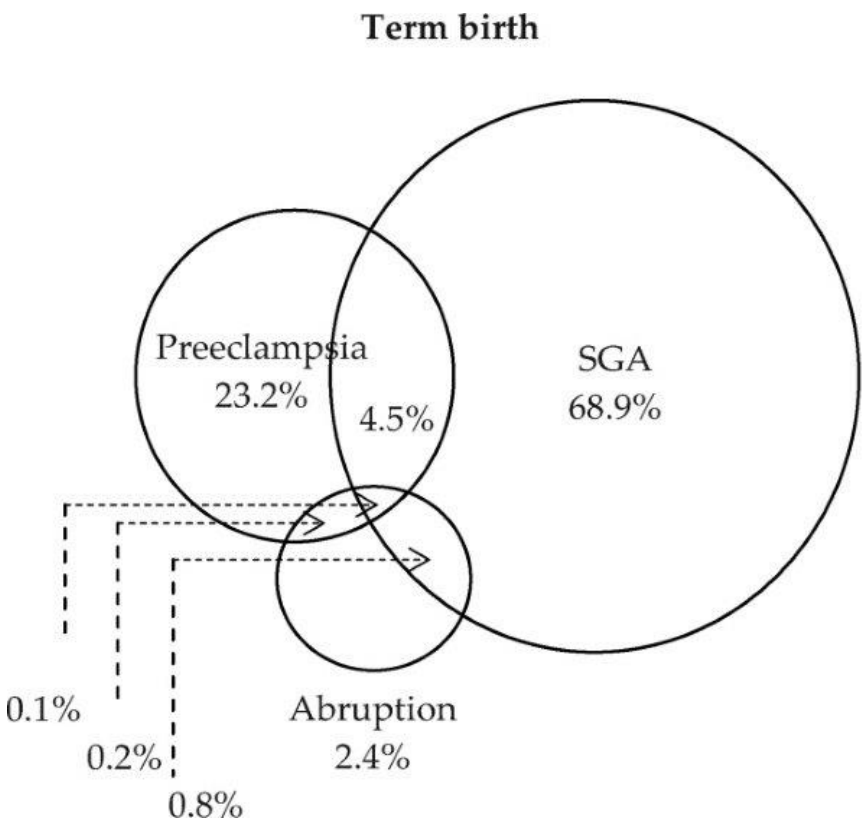
- **First stage - Deficient placentation**
  - Failed spiral artery remodeling
  - Shift of low pressure flow to higher pressure pulsatile flow
  - Villous injury (ischemia-reperfusion)
  - Secretion of factors leading to clinical preeclampsia
- **Second stage - Systemic vascular inflammation**
  - Endothelial activation
  - Systemic inflammatory network (leukocyte/complement activation, acute phase response, abn coagulation function, insulin resistance, hyperlipidemia)
  - Clinical presentations
- **Stage extent = clinical spectrum**

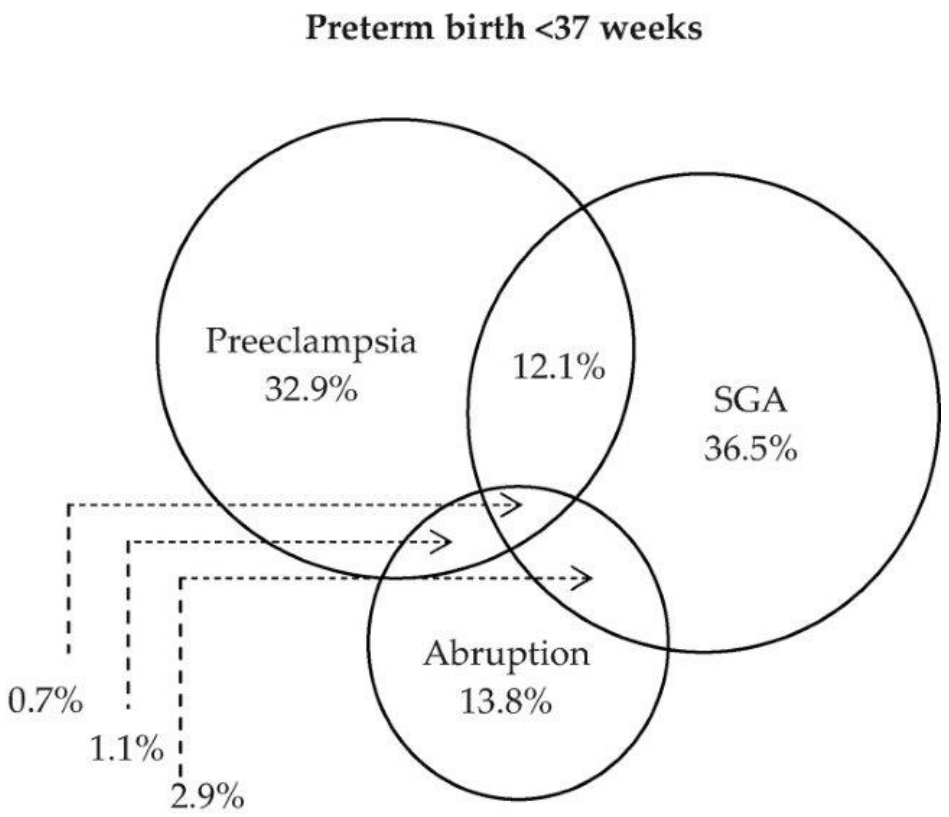
Redman WG, Staff AC. AJOG 2015;213:S9-11.

Failure of Spiral Artery Transformation Beyond Preeclampsia



Spectrum of Ischemic Placental Disease by Gestational Age





Ananth CV, Smulian JC, Vintzileos AM. J Matern Fetal Neonatal Med. 2010;23:887-93

Preeclampsia Sequelae

- Maternal
  - Occurrence/recurrence
  - Cardiovascular
  - Renal
  - Mortality
- Fetal
  - Preterm birth
  - FGR
  - Metabolic/CV dysfunction

Prediction Approaches

Genomic/proteomics/metabolomics

Uterine artery Doppler

PlGF

Clinical risk factors

PAPP-A

APA

sFLT

Inhibin

sENG

BMI

MSAFP

VGEF

A-Disintegrin

Uric acid

Placental Protein 13

Roll-over test

Thrombophilias

Metalloprotease-12

Risk Factors (selected)

- Preeclampsia in a previous pregnancy
- Nulliparity
- Age >40 years or <18 years
- Family history of preeclampsia
- Chronic hypertension
- Chronic renal disease
- Antiphospholipid antibody syndrome or inherited thrombophilia
- Vascular or connective tissue disease
- Diabetes mellitus (pregestational and gestational)
- High body mass index
- Race
- Unexplained fetal growth restriction (FGR)
- Woman herself was small for gestational age
- FGR, abruptio placentae, or fetal demise in a previous pregnancy

Preeclampsia Prediction

- **Clinical risk factors: modestly helpful**
  - **Sensitivity 37% for early onset PE**
  - **Sensitivity 29% for late onset PE**
  - **FPR of 5-15%**
- **Combined (serum free PlGF, PAPP-A, uterine artery Doppler PI, MAP, BMI, medical and obstetrical histories)**
  - **76% sensitivity for preterm preeclampsia**
  - **38% sensitivity for term preeclampsia**
  - **10% screen positive rate**

Recurrence Risk

1st preg	NL	Gest HTN	PE/ecl	CHTN	Superimp PE	All
Gest Htn	30%	47%	5%	16%	2.3%	70%
PE/eclampsia	42%	34%	11%	11%	2%	58%
CHTN	12%	35%	3%	46%	5%	88%
Superimp PE	6%	29%	12%	41%	12%	94%
Total	27%	41%	6%	23%	3%	73%

Recurrence of hypertensive disorder in 2nd pregnancy
Hjartardottir, et al AJOG, 194, 916-20

Strategies Without Prevention Benefit

- Proper prenatal care
- Frequent visits + home rest
- Low-salt diet
- High protein diet
- High calcium diet
- High vitamin C and E diet
- Nutritional supplements
  - Mg
  - Zinc
  - Folate
  - Selenium ?
- Diuretics
- Antihypertensives
  - Meta-analysis
  - 9 trials, >7000 subjects
  - Decreases BP and edema, NOT preeclampsia
- Antithrombotic agents
  - Dipyridamole
- Nitric oxide donors
- LMWH (enoxaparin)

Prophylaxis – Low Dose ASA

- Initial trial in 1979 had benefit, 30+ since then.
- Appears safe (anomalies, maternal/fetal/neonatal physiology, homeostasis)
- Askie, et al. mega analysis (N=32,000, 31 RCTs) o

Prevention	NNT
Preeclampsia	114
Perinatal mortality	333
SGA	167
PTB <34 weeks	143

Prevention

USPSTF - 81 mg/d ***Use if 1 high risk factor** ****Consider if several moderate risk factors**	***1 – Prior PE, multiples, chronic htn, types 1 and 2 DM, renal Dz, autoimmune Dz** ****≥2 – Nulliparity, BMI >30, FHx of PE, AA/low SES, ≥35 y/o, prior IUGR/SGA/adverse outcome/long pregnancy interval >10yr**

~30% reduction in recurrent preeclampsia after USPSTF guidelines published

Prophylaxis-ASA

- **ASPRE Trial**
  - ***"Combined multi-marker screening and randomized patient treatment with Aspirin for evidence-based preeclampsia prevention"***
  - **Multimarker screening**
  - **11-13 6/7 weeks**
  - **ASA 150 mg versus placebo daily**

Rolnik DL, et al. Aspirin versus Placebo in Pregnancies at High Risk for Preterm Preeclampsia. NEJM;2017:377:613-22.

Prophylaxis-ASA

- ASPRE Trial
- <37 weeks preeclampsia: 1.6% vs 4.3%
  - OR 0.38 (CI: 0.2, 0.74)
- <34 week outcomes
  - Preeclampsia: 0.4% vs 1.8% OR 0.18 (CI: 0.03, 1.03)
  - SGA: 0.9% vs 1.7% OR 0.53 (CI: 0.16, 1.77)
  - SAB/IUFD no PE: 1.8% vs 2.3% OR 0.78 (CI: 0.31, 1.95)
  - Abruption: 0.1% vs 0.4% OR 0.36 (CI: 0.02, 7.14)
- >37 weeks preeclampsia: 6.6% vs 7.2%
  - OR 0.95 (CI: 0.57, 1.57)

Rolnik DL, et al. Aspirin versus Placebo in Pregnancies at High Risk for Preterm Preeclampsia. NEJM;2017:377:613-22.

Prophylaxis-ASA

- **Additional analyses**
  - **Benefit consistent across all medical Hx, OB Hx and country subgroups**
  - **≥90% compliance = higher benefit**
    - **OR: 0.24 (0.09, 0.65)**
  - **Benefit not detected with chronic HTN**

Later-Life Cardiovascular Dz

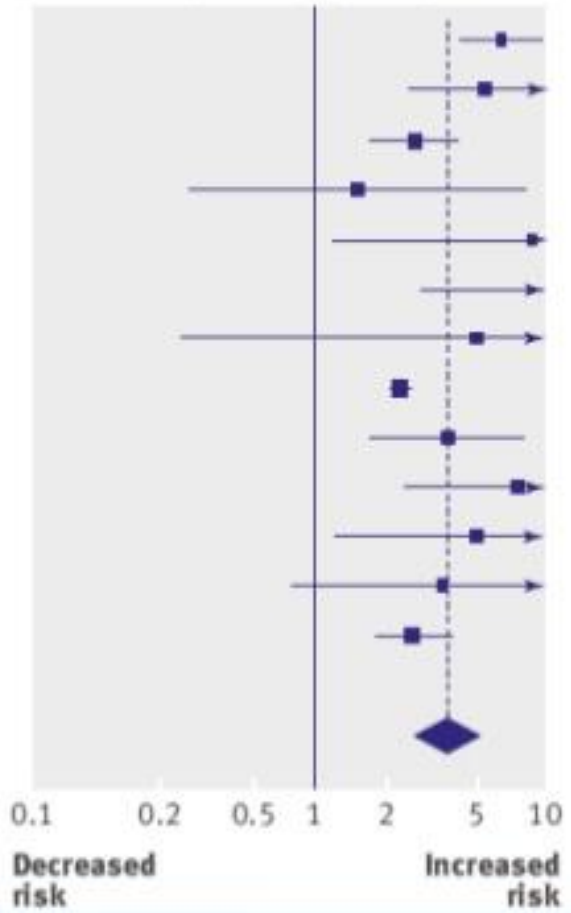
- **Sentinal event for CV disease**
  - **Mild** **RR - 2.0**
  - **Moderate** **RR - 3.6**
  - **Severe** **RR - 5.4**
- **ACOG Task Force (quality of evidence: Low)**
  - **Consider *lifestyle modification* (healthy weight, physical activity, not smoking) and early evaluation for the highest risk women**
  - **If preterm or recurrent preeclampsia**
    - **Yearly BPs, lipids, fasting blood glucose, BMI**

Preeclampsia and risk of HTN

Study	Hypertension: Total No of cases/ women who had pre-eclampsia	Hypertension: Total No of cases/ women who did not have pre-eclampsia	Relative risk (random) (95% CI)	Weight (%)	Relative risk (random) (95% CI)
Adams 1961[w1]	40/53	21/185		14.25	5.91 (3.89 to 8.98)
Epstein 1964[w2]	37/48	7/114		8.97	5.34 (2.50 to 11.42)
Sibai 1986[w3]	60/406	23/409		13.52	2.63 (1.66 to 4.17)
Carleton 1988[w4]	3/23	2/23		2.91	1.50 (0.28 to 8.10)
Nisell 1995[w5]	9/45	1/44		2.12	8.80 (1.16 to 6.66)
North 1996[w6]	20/50	1/50		2.23	20.00 (2.79 to 143.35)
Laivuori 1996[w7]	2/22	0/22		1.03	5.00 (0.25 to 99.24)
Hannaford 1997[w8]	377/2371	922/14 831		18.59	2.35 (2.08 to 2.65)
Marin 2000[w9]	30/94	12/86		8.88	3.70 (1.72 to 7.97)
Shammas 2000[w10]	23/47	3/46		5.45	7.50 (2.42 to 23.26)
Hubel 2000[w11]	10/30	2/30		3.81	5.00 (1.19 to 20.96)
Sattar 2003[w12]	7/40	2/40		3.49	3.50 (0.77 to 15.87)
Wilson 2003[w13]	216/443	55/206		14.74	2.62 (1.77 to 3.87)
Total (95% CI)	834/3658	1051/16 086		100.00	3.70 (2.70 to 5.05)

Test for heterogeneity: χ^2=32.05, df=12, P=0.001, I^2=62.6%

Test for overall effect: z=8.20, P<0.001



3.7x higher

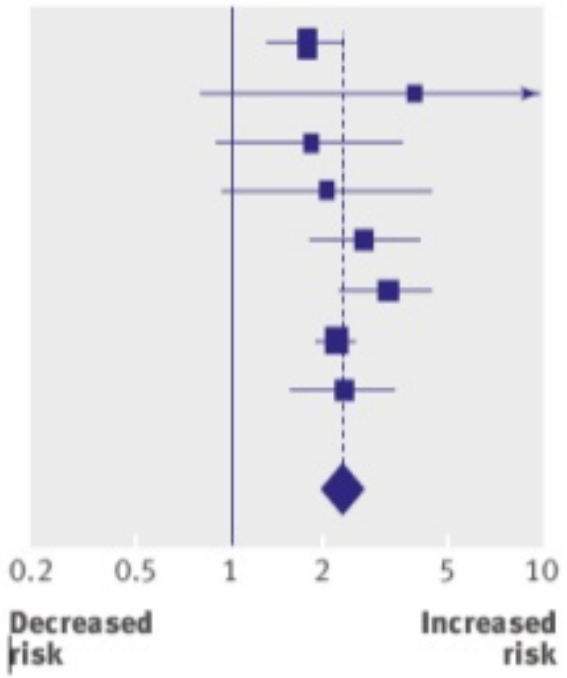
Reference: Bellamy et al. Pre-eclampsia and risk of cardiovascular disease and cancer later in life: systematic review and metaanalysis. BMJ 2007;335;974.

Preeclampsia and risk of CVD

Study	Ischaemic heart disease: Total No of cases/ women who had pre-eclampsia	Ischaemic heart disease: Total No of cases/ women who did not have pre-eclampsia	Relative risk (random) (95% CI)
Hannaford 1997[w8]	69/2371	216/14 831	1.65 (1.26 to 2.16)
Irgens 2001[w15]	27/24 155	325/602 117	3.61 (0.76 to 17.18)*
Smith 2001[w16]	12/22 781	31/106 509	1.70 (0.86 to 3.35)
Wilson 2003[w13]	26/1043	10/796	1.95 (0.90 to 4.22)
Kestenbaum 2003[w14]	35/20 552	64/92 902	2.55 (1.70 to 3.83)†
Funai 2005[w17]	41/1070	269/35 991	3.01 (2.18 to 4.33)
Ray 2005[w18]	228/36 982†	1262/950 885	2.10 (1.82 to 2.42)
Wirkstrom 2005[w19]	176/12 533	2306/383 081	2.21 (1.56 to 3.31)†
Total (95% CI)	614/121 487	4483/2 187 112	2.16 (1.86 to 2.52)

Test for heterogeneity: χ^2=9.60, df=7, P=0.21, I^2=27.1%

Test for overall effect: z=10.00, P=0.001



2.2x higher

Fig 1 | Pre-eclampsia and risk of fatal and non-fatal ischaemic heart disease events in later life. *Early and late pre-eclampsia combined (see table 2 on bmj.com). †Mild and severe pre-eclampsia combined (see table 2 on bmj.com). ‡All maternal placental syndromes

Reference: Bellamy et al. Pre-eclampsia and risk of cardiovascular disease and cancer later in life: sytematic review and metaanalysis. BMJ 2007;335;974.

Preeclampsia and risk of Stroke and DVT.

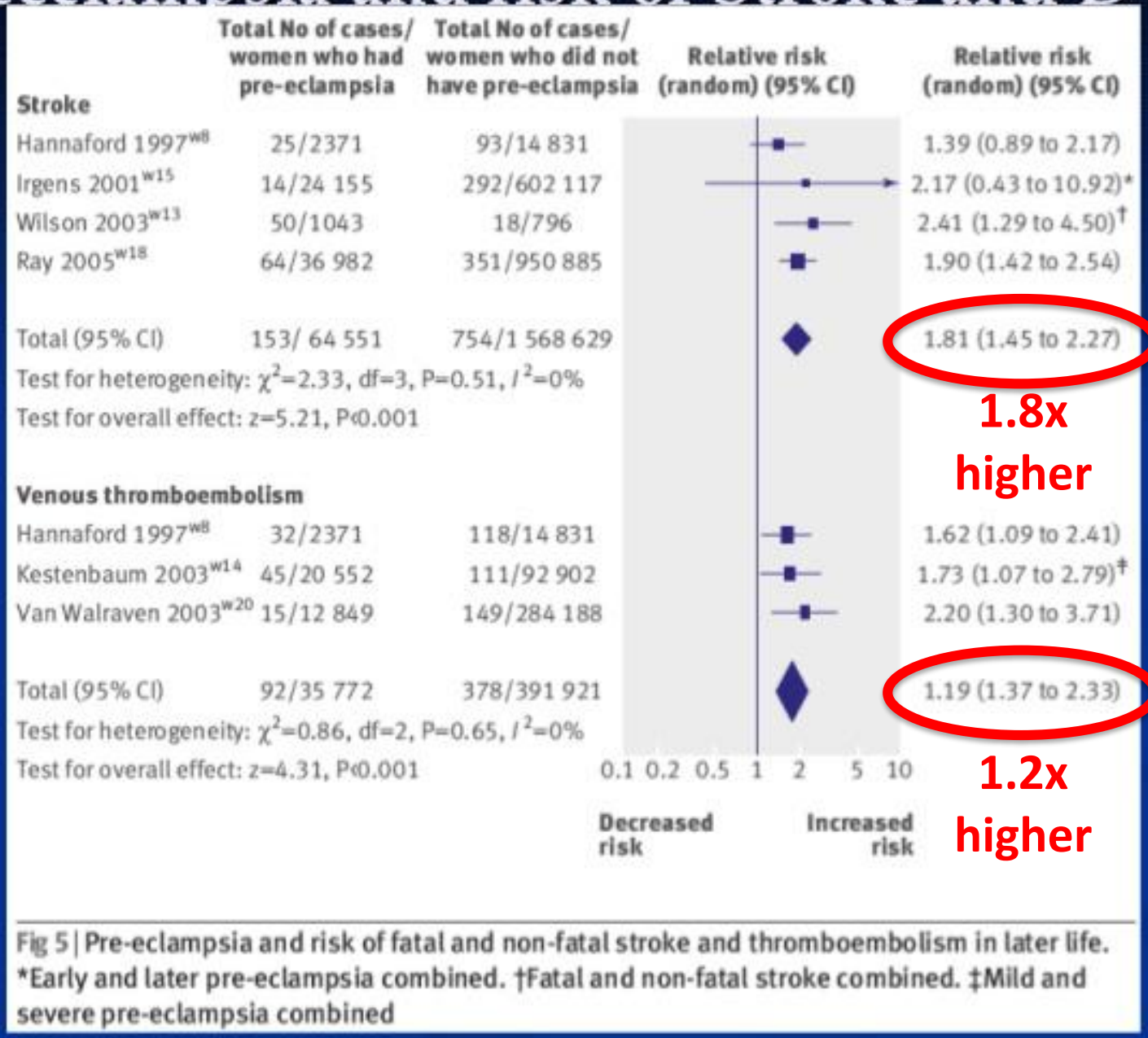


Fig 5 | Pre-eclampsia and risk of fatal and non-fatal stroke and thromboembolism in later life. *Early and later pre-eclampsia combined. †Fatal and non-fatal stroke combined. ‡Mild and severe pre-eclampsia combined

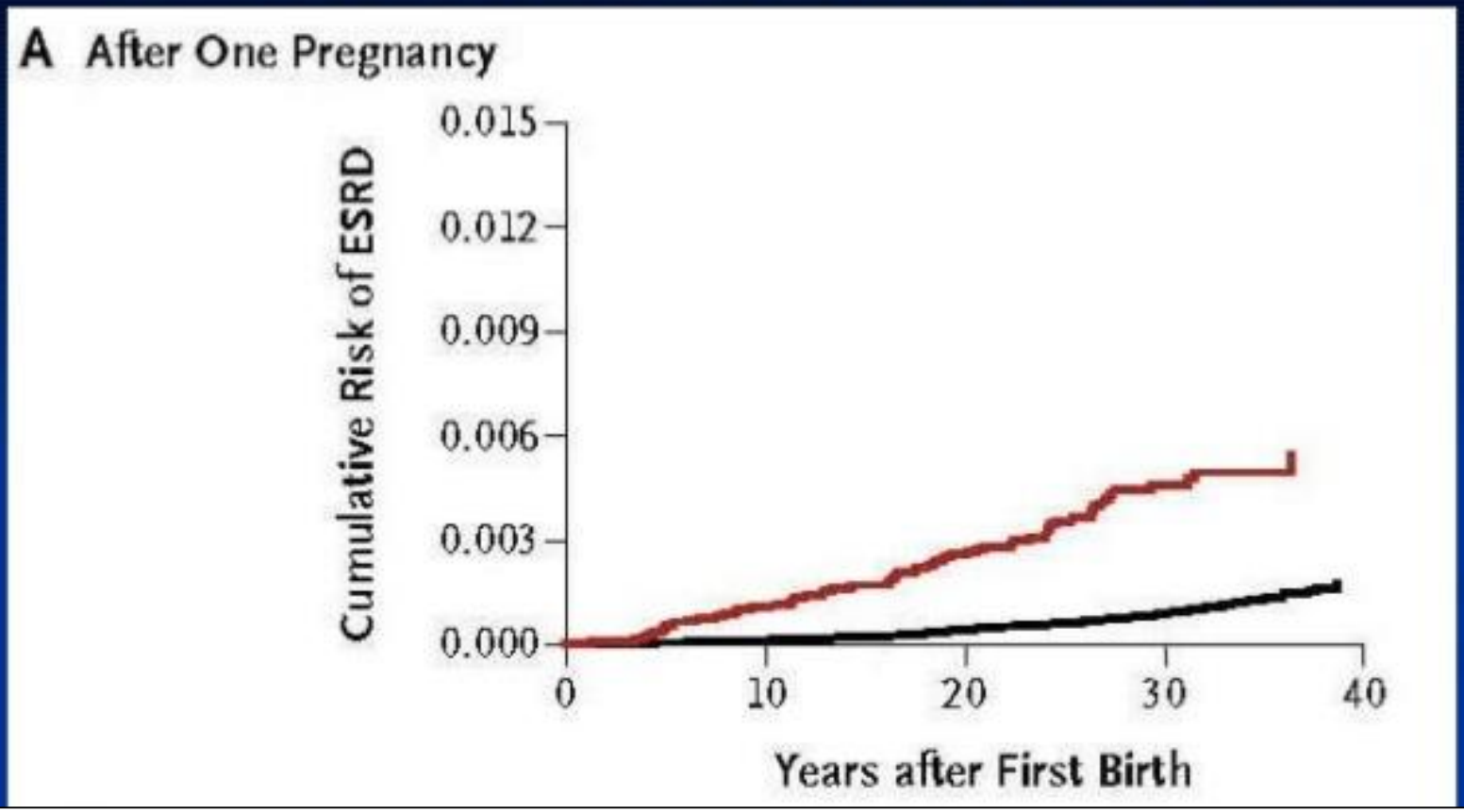
Reference: Bellamy et al. Pre-eclampsia and risk of cardiovascular disease and cancer later in life: sytematic review and metaanalysis. BMJ 2007;335;974.

Preeclampsia and risk of having a kidney biopsy later in life

Figure 1. Cumulative risk for having a kidney biopsy according to pregnancy-related variables. Norway, childbirths 1967 to 1998 and kidney biopsies 1988 to 2002.

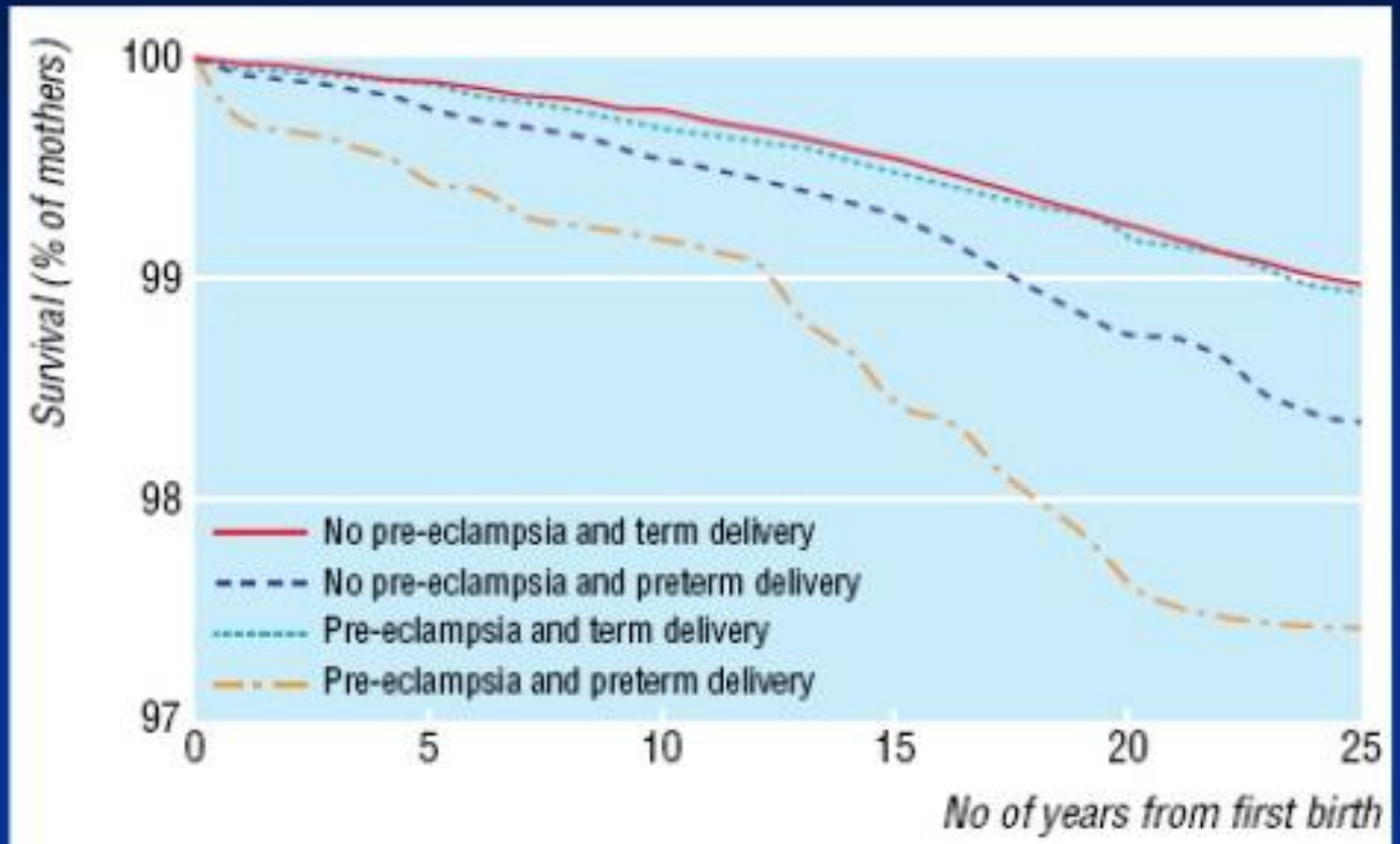
Reference: Vikse et al. Adverse perinatal outcome and later kidney biopsy in the mother. J Am Soc Nephrol. 2006 Mar;17(3):837-45.

Cumulative risk of ESRD



Ave 17 ± 9 yr f/u	RR of ESRD
• Preeclampsia 1st pregnancy	3.1x
• Preeclampsia 2nd pregnancy	5.3x
• Preeclampsia ≥2 pregnancies	10.9x

Preeclampsia and long term mortality



Long term survival of mothers after their first delivery, according to whether they had pre-eclampsia and gestational age of baby at birth (term=37 weeks or more)

Reference: Irgens et al. Long term mortality of mothers and fathers after preeclampsia: population based cohort study. BMJ. 2001 Nov 24;323(7323):1213-7.

Status of Interval Care

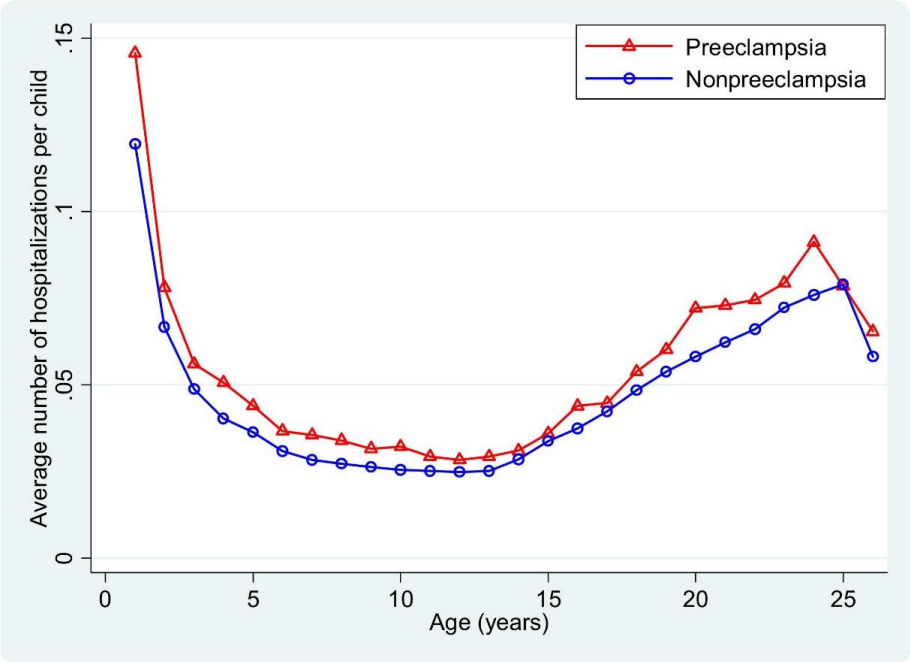
- In 2011, AHA added preeclampsia, pregnancy-induced hypertension, and gestational diabetes as evidence-based risk factors in guidelines to classification of CVD risk in women (Mosca et al., 2011).
- Many providers are unaware of sex-specific CVD risk factors or preventive strategies tailored for women (Ehrenthal et al., 2013).
- Only 9% of internists and 38% of OBGYNs provided CV risk reduction counseling to women with a history of preeclampsia. Young, Hacker, and Rana (2012)

Status of Interval Care

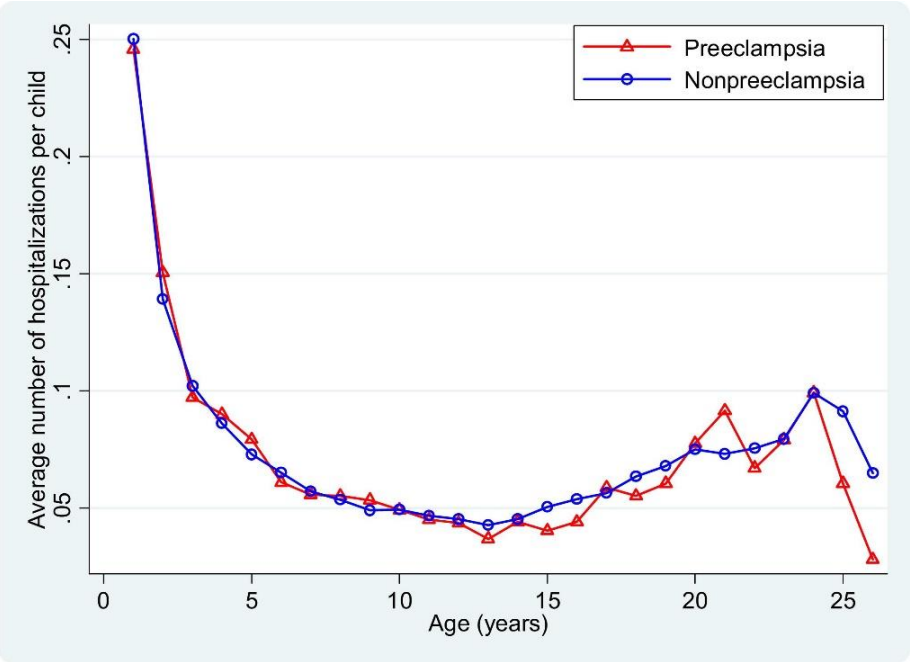
- **Recent AHA guidelines (2014) for prevention of stroke in women reported that 18.2% of women with a history of preeclampsia had a cardiovascular event in the 10 years following the birth of an affected pregnancy compared to 1.7% of women with uncomplicated pregnancies (Bushnell et al., 2014).**

Ave Hospitalizations per Child Born Preterm and Term

1.6 million births 1978-2004, Denmark, Up to 27 years follow-up



Preterm



Term

Chun S. et al. Health of children born to mothers who had preeclampsia: a population-based cohort study. AJOG 2009:201;269

Disease-Specific Hospitalizations for Term, non-SGA Children by PE Status

• Endocrine/Nutr/Metab	1.6
• Dz of blood + related organs	1.5
• Neoplasms (Benign)	1.4
• GU/renal	1.3
• Circulatory	1.3
• Nervous system	1.3
• Infectious	1.2
• Respiratory system	1.2
• GI	1.2
• MS/Connective Tissues	1.2
• Mental/behav Disorders	1.1
• Skin	1.1

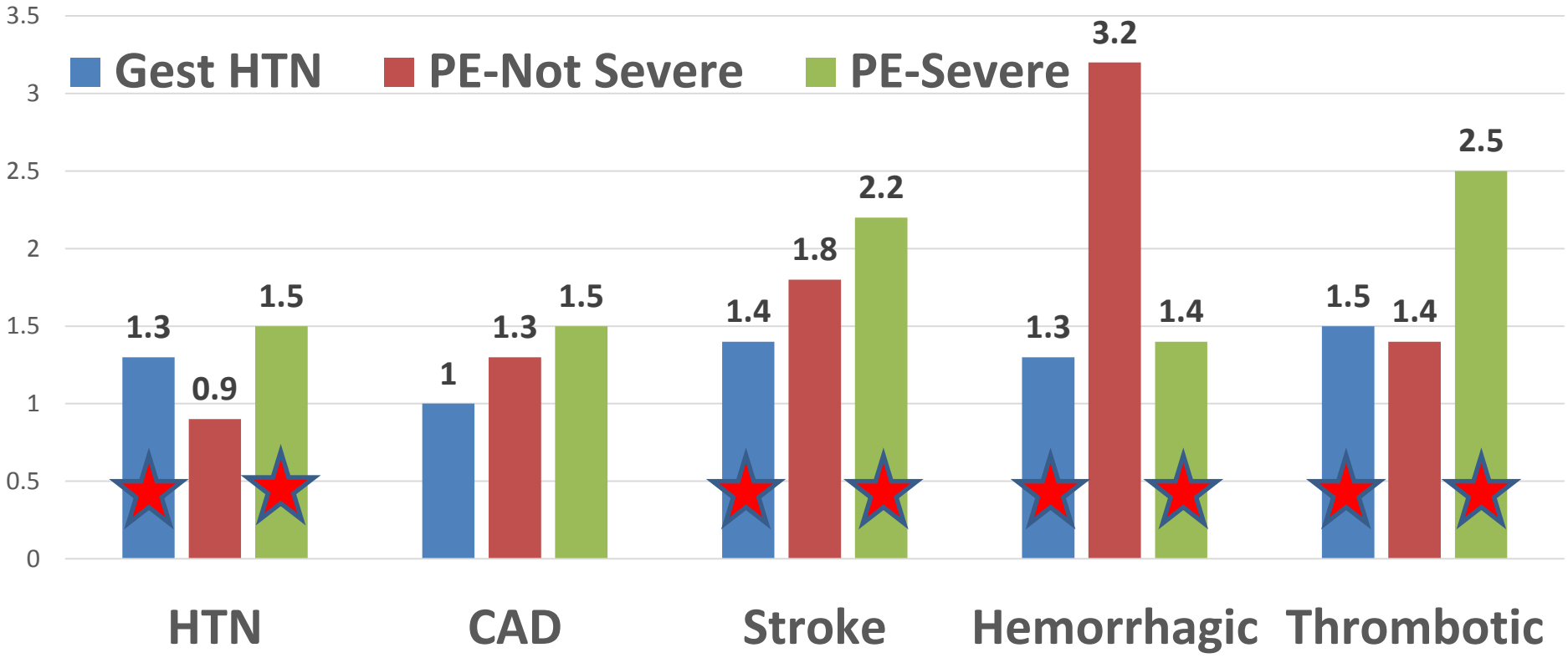
Chun S. et al. AJOG 2009:201;269

Childhood Sequelae

- Children, adolescents, young adulthood
  - Increased systolic BP
  - Increased diastolic BP
  - Increased BMI
  - Unclear associations
    - Lipid profiles
    - Glucose metabolism
- Consistent for genders and birth weights

Preeclampsia-Associated Risk of CV Disease in Adult Offspring of Term Births

6410 births, 1934-1944, Finland, Assessed for 1971-2003



Kajantie E, et al. Stroke 2009

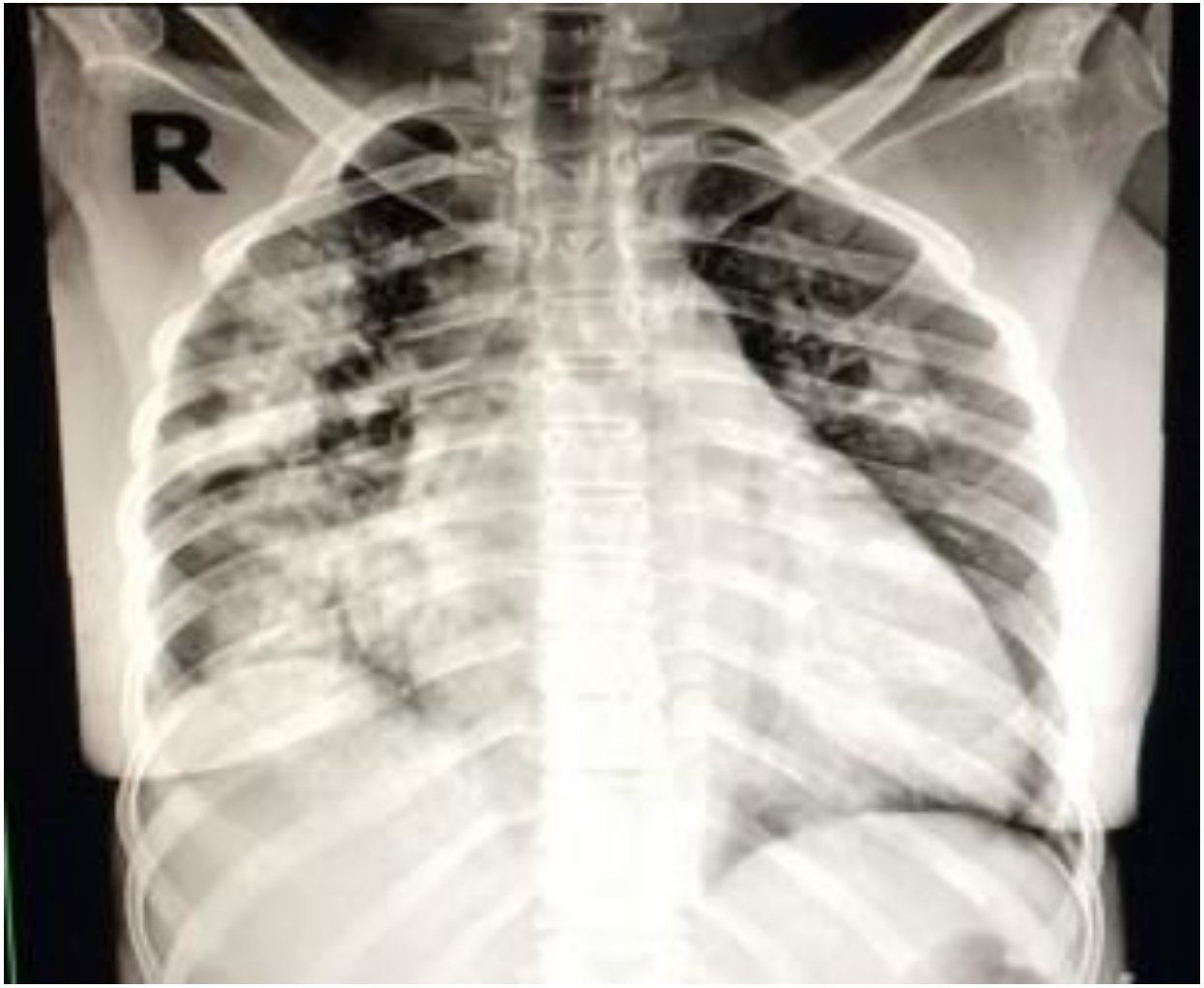
Summary: Preeclampsia Sequalae

- ***Preeclampsia is bad***
- **Disease of placenta with complicated etiology – vascular, inflammatory, mechanical, genetic, other components**
- **Prediction/prevention laudable**
  - **Reduces immediate morbidity**
- **Maternal and fetal long-term sequelae**
  - **Proportionate to PE severity**
  - **Unclear how to prevent long-term issues**

Peripartum Cardiomyopathy

- **Clinical presentation**
  - **38 y/o woman 7d postpartum**
  - **SVD after labor induction for preeclampsia**
  - **4^{th} pregnancy and BMI 38 kg/m^2**
  - **Progressive dyspnea, edema, fatigue, cough**
  - **Tachypnea, tachycardia, mild-moderate HTN, ± proteinuria, low O_2 sat**
  - **CXR-enlarged heart, pulmonary congestion**
  - **Echo – LV dilation and systolic dysfunction, right side enlargement, MVR, pulmonary HTN**

Peripartum Cardiomyopathy



Peripartum Cardiomyopathy

- **Described in 1849**
- **Definition**
  - ***Left ventricular dysfunction and development of cardiac failure without a known cause and occurring in the final month of pregnancy and up to 5 months postpartum.***

Peripartum Cardiomyopathy

- Increasing in US
  - 1:4350 births (1990s)
  - 1:2230 births (mid-2000s)
- Risk factors poorly predictive
  - Increased maternal age (x10 if >40 y/o)
  - Black race (x5-15)
  - HTN disorders (x5-30)
  - Multifetal gestations (9% of cases)

Peripartum Cardiomyopathy

- **Causes/triggers?**
  - ***Hemodynamic stress***
  - ***Viral myocarditis***
    - ***Coxsackie, echo, parvo***
  - ***Microchimerism-myocyte engraftment with fetal stem cells with immune dysfunction***
  - **Genetic factors (TTNCI, TTN, STAT3)**
  - **Prolactin - increased cathepsin D peptidase**
  - **Antiangiogenic factors – sFlt inhibiting VGEF**

Peripartum Cardiomyopathy

- **Multiple-Hit Theory**
  - **Gene mutations = susceptibility**
  - **High prolactin at term/postpartum cleaved by increased cathepsin D (mutation linked)**
  - **Prolactin fragment (vasoinhibin) myocardial toxicity**
  - **Exacerbated by increased sFlt**

Cunningham, et al. Obstet Gynecol 2019;133:167

Peripartum Cardiomyopathy

- Criteria for Diagnosis
  - ≤1 mo before delivery or ≤5 mo postpartum
  - No other cause identified
    - Sepsis, thyrotoxicosis, anemia, viral, etc
  - No heart Dz prior to 1 mo before delivery
  - Echo criteria
    - EF <45% and/or
    - Motion-mode fractional shortening <30%
    - LV end diastolic dimension >2.7 cm/m^2
  - Cardiac MRI promising
  - Bx if transplant considered

Peripartum Cardiomyopathy Management

- High acuity unit with cardiac monitoring
- Immediate
  - Fluid management, diuresis, O_2
  - Preeclampsia Tx with magnesium sulfate if indicated
  - Medical therapies
    - Beta blocker, hydralazine/nitrates, calcium channel blockers if pregnant, ACE inhibitors or ARBs after delivery, anticoagulation
    - Bromocriptine?
- Antepartum
  - Anesthesia, fetal monitoring, vaginal delivery if stable
- Postpartum
  - Contraception, counseling, modest activity, echo 6 mos

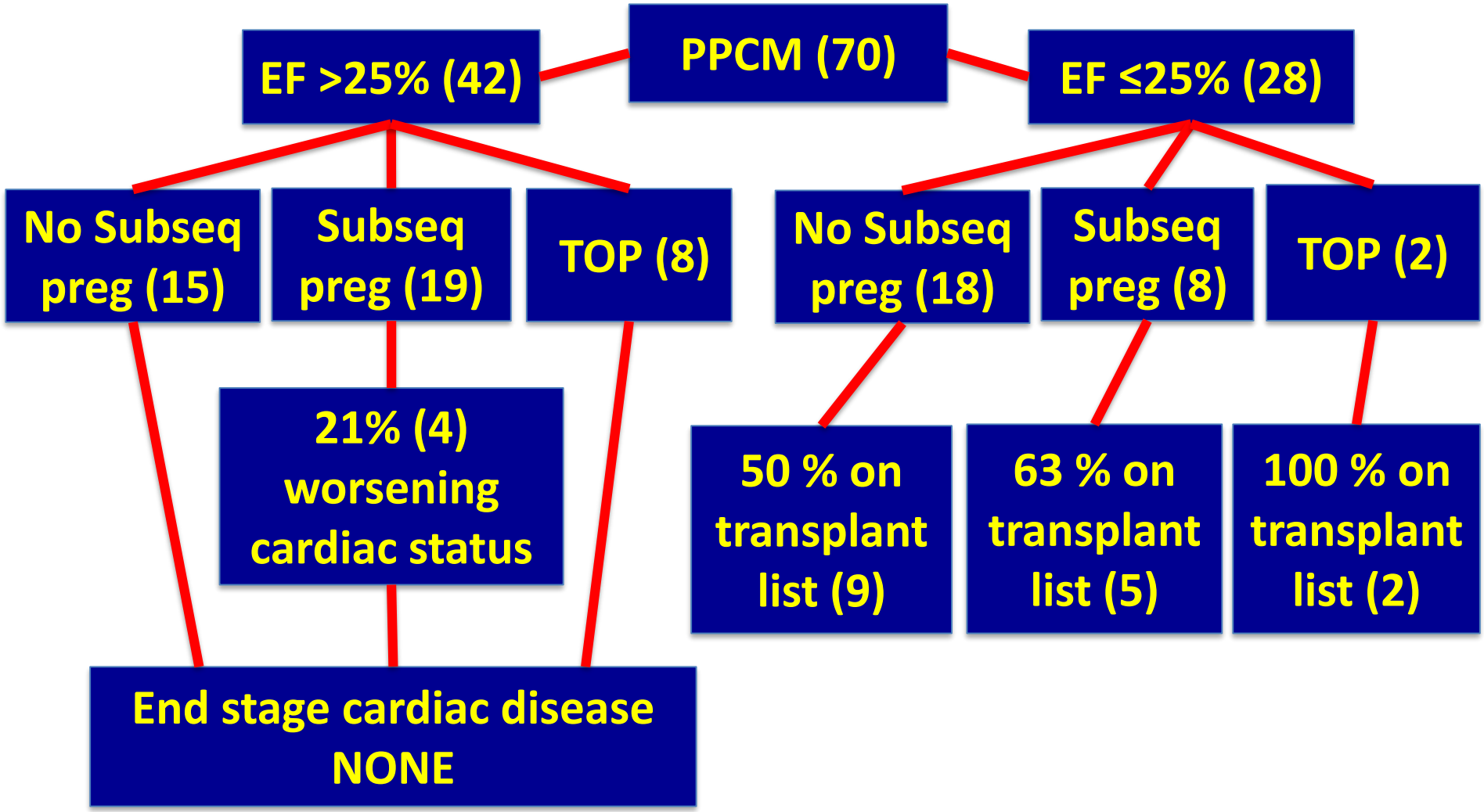
Hibbard, et al. Obstet Gynecol 1999;94:311

Sequelae Peripartum Cardiomyopathy

- Ventricular function recovery (EF >50%) ~70%
- Major event or persistent EF <35% ~13%
- Most recovery by 6 months PP
- 1/8 year mortality ~4/16%
- Arrhythmias 38% of mortality
  - Wearable defibrillator vest for EF <30% until recovery?
- Thromboembolism ~7%
  - Anticoagulation at least until 2 mo PP
- Transplant ~10%
  - 5% of female cardiac transplants in US occur after PPCM
- Medication duration – no consensus

Arany Z, Elkayam U. Ciculation 2016;133:1397-1409.

Peripartum Cardiomyopathy
1-6 yr Follow-Up Based on Initial EF



Habli M, et al. AJOG. 2008:199:415.e1-415.e5,

Summary
Peripartum Cardiomyopathy

- Serious pregnancy complication
- Serious maternal morbidity and mortality risks
- Prognosis largely based on degree of recovery
- Serious counseling needed after event

Amniotic Fluid Embolism

- **"Anaphylactoid Syndrome of Pregnancy"**
  - **Sudden CV collapse**
  - **Altered mental status**
  - **DIC**
- **First described in 1926**
- **True incidence unclear (~1:15,000-50,000)**

"Diagnostic waste basket" of unexplained peripartal deaths

Amniotic Fluid Embolism

- Maternal mortality rate ~20%
  - Up to 50% of deaths in first hour
- 80% survivors neurologic damage
- <10% of cardiac arrest patients survive neurologically intact
- Neonatal outcome
  - ~60% survive with 50% neurologically damaged if event prior to delivery

Amniotic Fluid Embolism

- During labor
- During C/S
- After NSVD
- During second trimester TOP
- After amniocentesis
- After cerclage removal
- AFE has been reported to occur as late as 48 hours post delivery

Amniotic Fluid Embolism

- Etiology is unknown
- Physical embolic obstruction not likely
- Exposure to fetal/amniotic fluid antigens
  - Genetic susceptibility?
  - Abnormal activation of immunologic mechanisms
  - Release of vasoactive/procoagulants
  - Stimulation of complement activation
- Systemic inflammatory response

Amniotic Fluid Embolism Risk Factors

- AMA
- Multiparity
- Meconium
- Cervical laceration
- IUFD
- Short labor
- Placenta accreta
- Polyhydramnios
- Uterine rupture
- Maternal allergy Hx
- Chorioamnionitis
- Macrosomia
- Male fetal sex
- Oxytocin (NO!)
- Tetanic contractions (NO!)

Risk factors are neither sensitive nor specific.

This condition is NOT predictable nor preventable!

Amniotic Fluid Embolism Clinical Features

- Hypotension 100%
- Fetal distress 100%
- Pulm edema/hypoxia 93%
- Cardiopulm arrest 87%
- Cyanosis 83%
- Coagulopathy 83%
- Dyspnea 49%
- Seizure 48%
- Atony 23%
- Bronchospasm 15%
- Transient HTN 11%
- Cough 7%
- Headache 7%
- Chest pain 2%

70% present in labor

Clark S,1995

Amniotic Fluid Embolism

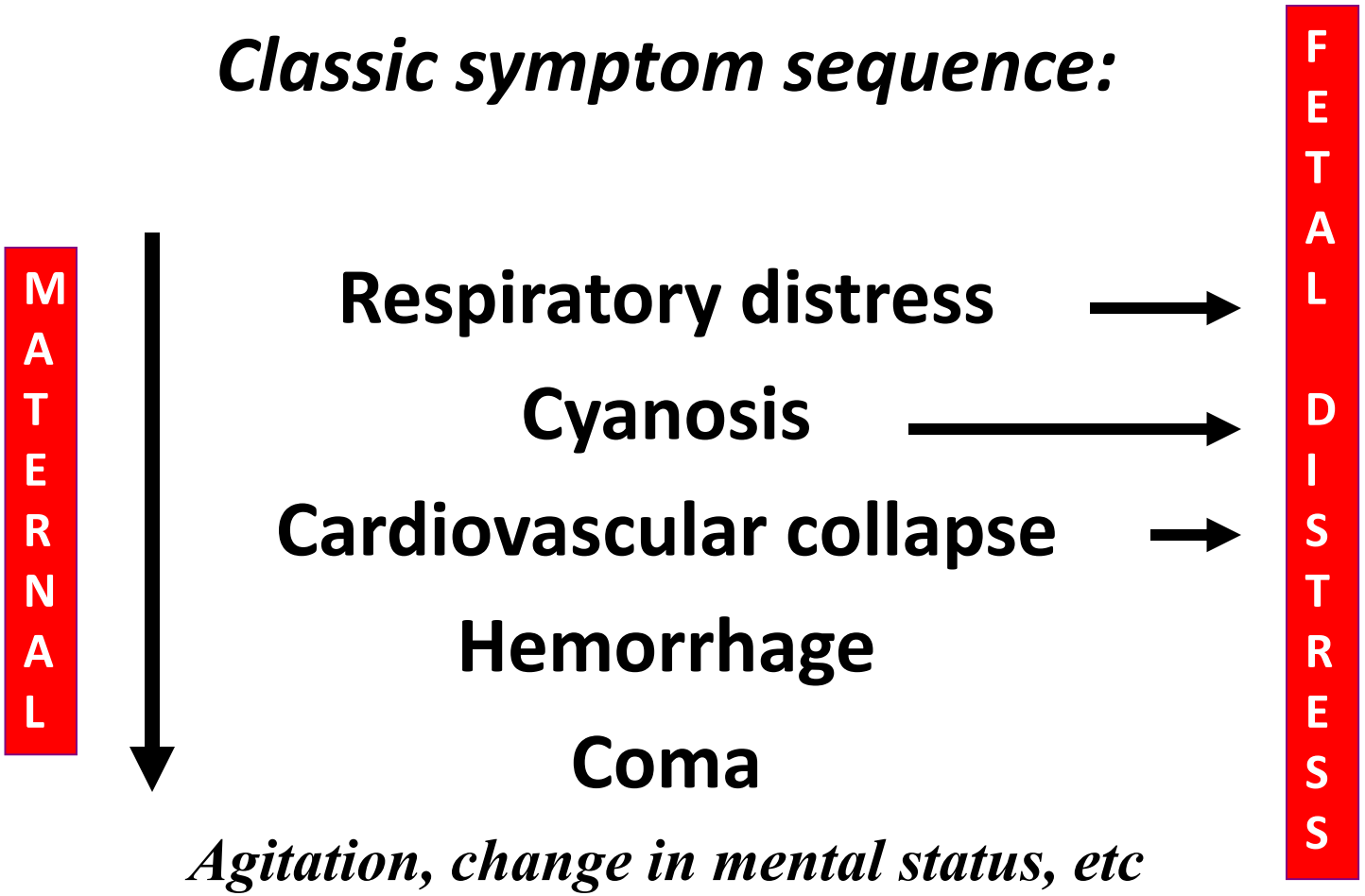
Phase 1 → Severe pulmonary/systemic HTN
V/Q mismatch
Profound hypoxemia
Right heart failure

Phase 2 → Left ventricular dysfunction
Acute pulmonary edema

Phase 3 → Global heart failure
Acute lung injury/ARDS
Coagulopathy

Amniotic Fluid Embolism

Classic symptom sequence:



Agitation, change in mental status, etc

Amniotic Fluid Embolism

- Rapid deterioration limits interventions
- ***DELIVERY!***
- Cardiac/pulmonary support (aggressive)
- Correct atony
- Correct coagulation abnormalities
  - Ave replacements >30 uPRBCs
  - FFP, cryoprecipitate, TXA
  - Not recombinant factor VIIA
  - Not Heparin
  - Potential Tx
    - AT III concentrates, leukotriene inhibitors, ECMO, balloon pumps, hemofiltration, plasma exchange tfn, steroids, C1 esterase inhibitors (inhibits C1 esterase, Factor XIIA, complement activation)

Amniotic Fluid Embolism

- **Perimortem cesarean delivery:**
  - **After 5 minutes of unsuccessful CPR in arrested mothers, abdominal delivery is recommended**
- **Maternal death usually occurs due to:**
  - **Sudden cardiac arrest/arrhythmias**
  - **Hemorrhage due to coagulopathy**
  - **ARDS**
- **Risk of recurrence is unknown**

Unpredictable* and *NOT* *preventable

AFE and Reproductive Decisions

- **80 women with AFE had preserved fertility after delivery**
  - **70% had no further children at 4 (1–18) years from the index delivery.**
  - **32.5% of these women or their partners chose permanent sterilization.**

Moaddab A, et al. Eur J Obstet Gynecol Reprod Biol. 2017 Apr;211:33-36

Pregnancy Complication Sequelae - Other

- **Selected fertility**
  - **Less likely to pursue subsequent pregnancy, especially if child did not survive**
- **Mental health**
  - **44% depression after severe PE with complications**
  - **11% PTSD after PE**
  - **Anxiety and depression common after serious pregnancy complications (mother AND family)**

Geller PA. Pregnancy as a stressful life event. CNS Spectr. 2004;9:188-97

Summary

- Preeclampsia
  - Common, tricky, but can be managed appropriately to minimize risks and reduce occurrence/recurrence
- Peripartum cardiomyopathy
  - Uncommon with moderate morbidity and mortality, but can be managed
- Amniotic fluid embolism
  - Rare with high morbidity and mortality with few management options
- Pregnancy complications are serious and have long term consequences