What's New in Obstetric Anesthesia

SFOAI Varmote 2023
Skåvsjöholm

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MORBIDITIES
REGIONAL
SECTION
NOVEL

No Disclosures

SpaceX, Boeing, Virgin Galactica,
Orbital Sciences, Sierra Nevada Corp

MORBIDITIES

Morbidity

Preeclampsia

Role: Preexisting CV Disease
Prevalence 2-8% All Pregnancies
Swedish Prevalence (2007-12) 2.9%
US Maternal Deaths (2011-15) 7%

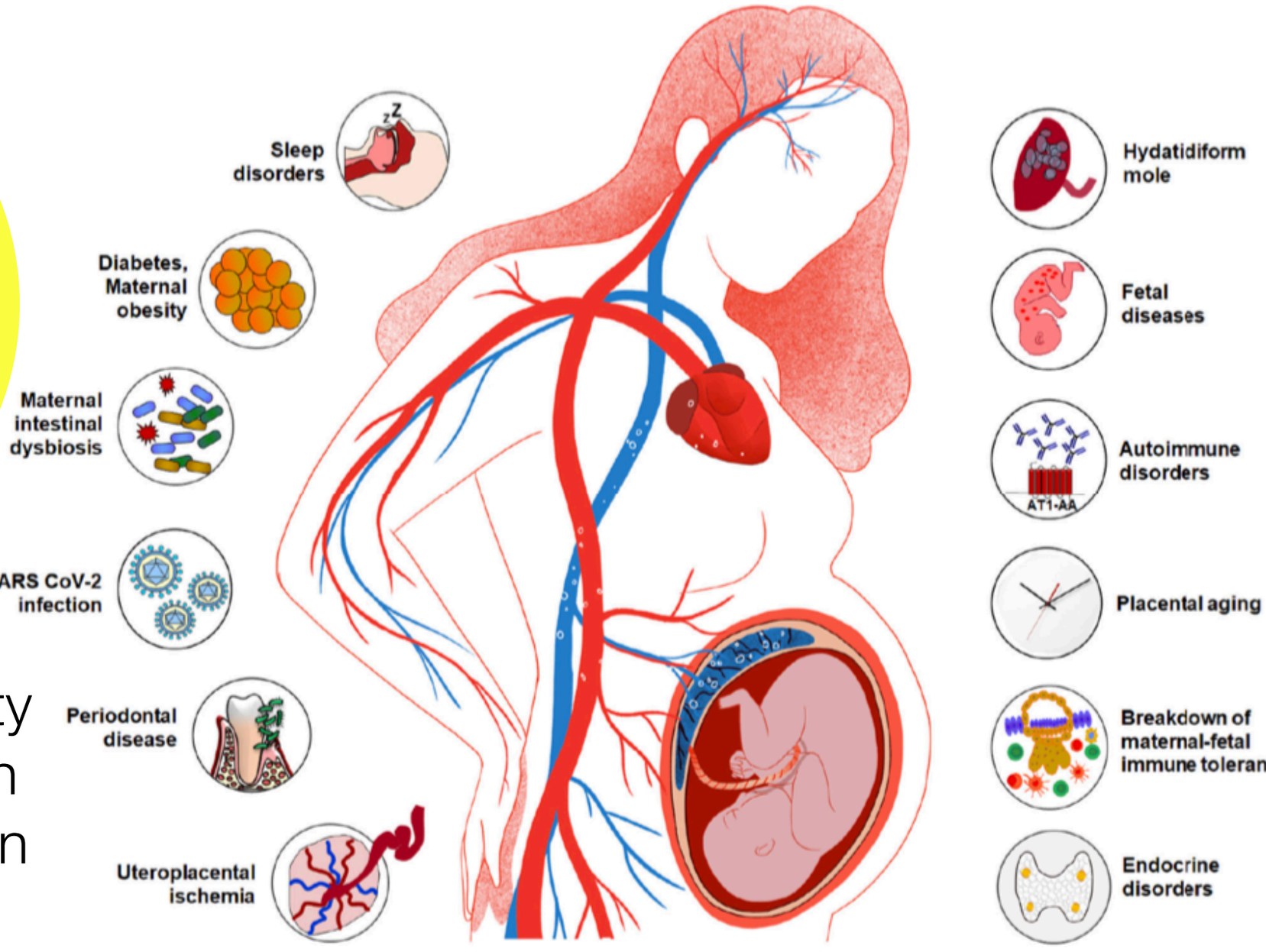
Betran AP, et al. Global Trends. BMJ Glob Health 2021; Pyykonen A, et al. Nordic Countries. Acta Obstet Gynecol Scand 2017; Ives CW, et al. Preeclampsia. State of the Art Review. J ACC Review 2020. Yang Y, et al. Preeclampsia Prevalence Sweden and China. JAMA Open Network 2022; Socialstyrelsen 2023

Morbidity: Preeclampsia Mechanism

Preeclampsia

Mechanism

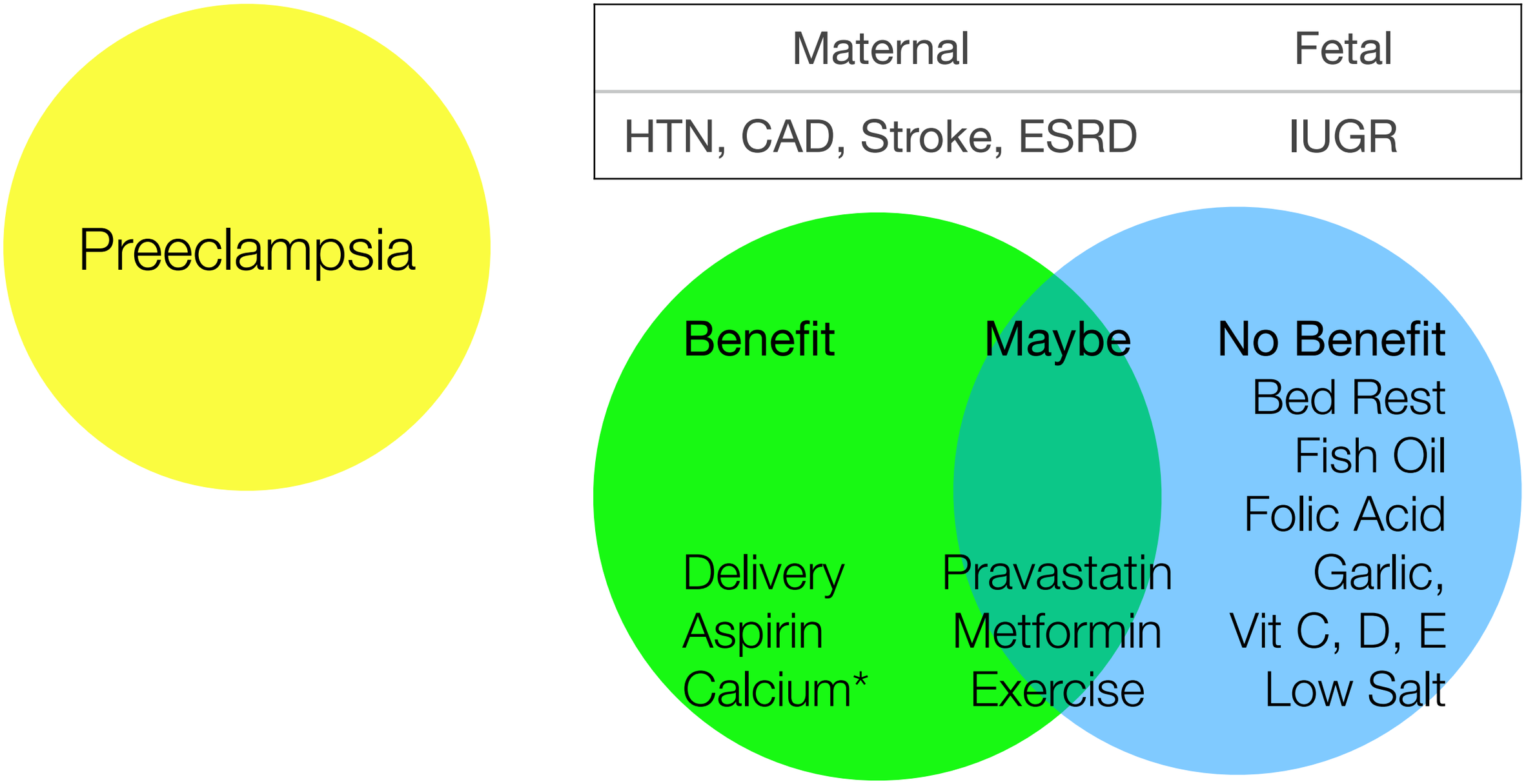
Na + Angio II Sensitivity
Sympathetic Activation
Endothelial Dysfunction
Inflammasomes



Jung E, et al. Etiology of Preeclampsia. Am J Ob Gynecol 2022; Chappell LC, et al. Lancet 2021; Magee LA, et al. NEJM 2022; Cornelius DC, et al. Preeclampsia Covid 19: Inflammasome. Curr Hypertens Rep 2022

Morbidity: Preeclampsia Result + Treatment

Maternal	Fetal
HTN, CAD, Stroke, ESRD	IUGR



Jung E, et al. Etiology of Preeclampsia. Am J Obstet Gynecol 2022; Chappell LC, et al. Lancet 2021;398:341-54; Magee LA, et al. Preeclampsia: NEJM 2022

Morbidity

Placenta Accreta Spectrum

Driver: Rise in CD

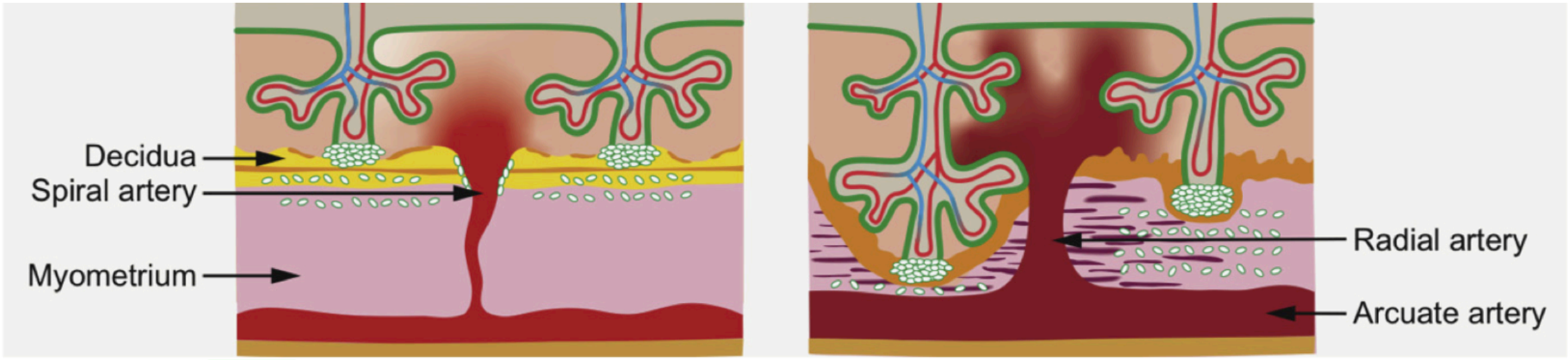
CD Global rate: (1966-97) 400% increase

CD Sweden rate (2022): 18.6%

CD Global rate by 2030, 28.5%

Betran AP, et al. Global Trends. BMJ Glob Health 2021
Pyykonen A, et al. Nordic Countries. Acta Obstet Gynecol Scand 2017; Socialstyrelsen 2023

Morbidity: Placenta Accreta Spectrum Mechanism



PAS

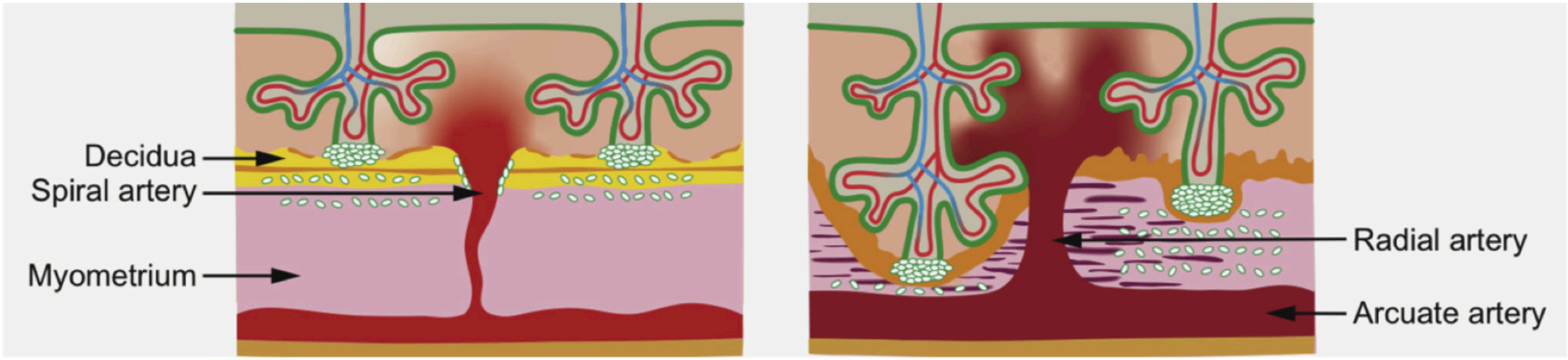
Mechanism

Old: Extravillous trophoblast (EVT) invasion

New: Loss of subdecidual myometrium
Development of anchoring villi through gaps
High pressure arterial inflow, placental lacunae, fibrinoid accumulation in 70%

Jauniaux E, et al. New Insights into the Etiopathology of PAS. AJOG 2022

Morbidity: Placenta Accreta Spectrum Treatment



PAS

Trimester	Modality	Notes
1st	Blood	ATT3, plasminogen, clustered trophoblasts
2nd	Ultrasound	Sensitivity 88-97%

Jauniaux E, et al. New Insights into the Etiopathology of PAS. AJOG 2022

Mortality

Maternal Mortality Ratio:

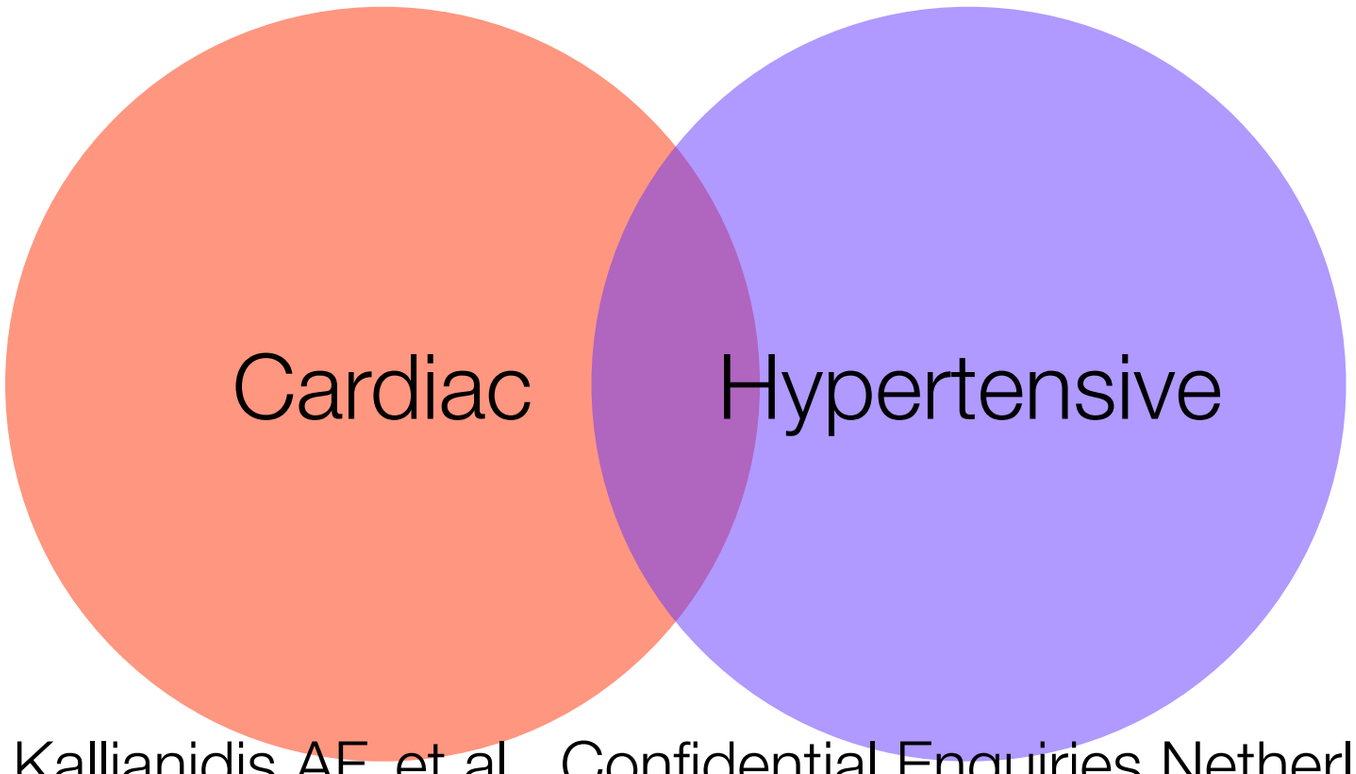
43% Global Reduction

3-5% Developed Countries Increase

50% Improvable Factors

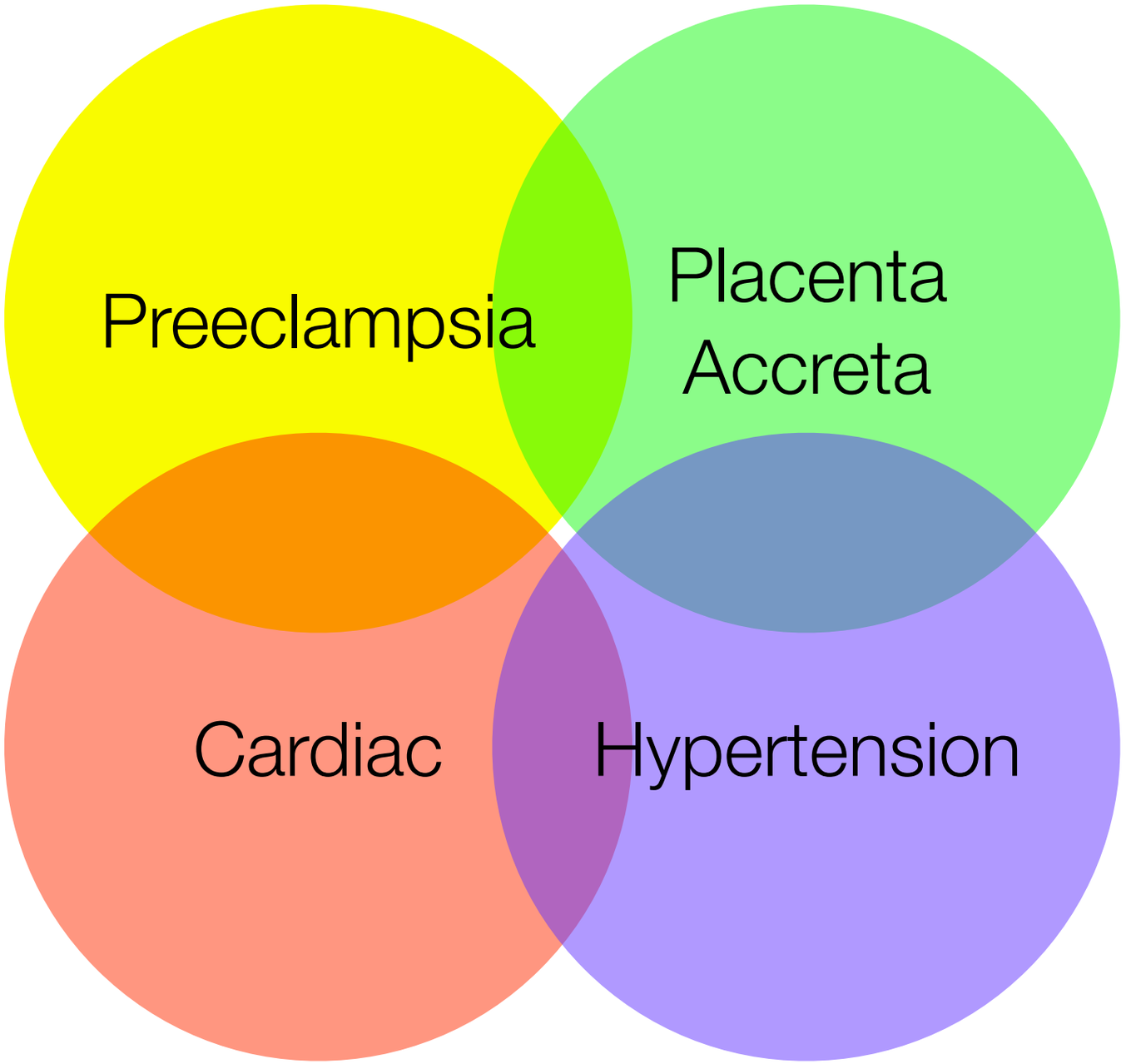
84% Preventable-CDC

Delayed Consult/Diagnosis
Delayed Referral/Advanced Care
Communication/Management



Kallianidis AF, et al., Confidential Enquiries Netherlands.Acta Obstet Gynecol Scand 2022. Meh C, BJOG 2022; MBRRACE-UK, 2022; CDC 2017-2019 (pub 2022)

Morbidity and Mortality



REGIONAL

ASA Quality Metrics: Obstetric Anesthesia

Neuraxial Analgesia

- Labor Analgesia Request Responsiveness
- Labor Epidural Replacements
- Post Dural Puncture Headache Accountability

ASA Committee on Obstetric Anesthesia Statement on Quality Metrics, Oct 26, 2022

Response: Infection, Coagulation, Preparation

Infection

Bacterial: Antibiotic Prophylaxis (ie. GBS, Chorioamnionitis)
Viral: COVID 19: Pro-Coagulation: PE 16.5%, DVT 14.8%
Anti-Coagulation: Thrombocytopenia

Joo Suh Y, et al. PE + DVT in COVID 19, Radiology 2020
Agostinis C, et al. COVID 19, Preeclampsia, Complement System. Front Immune 2021
SOAP Consensus Statement Pregnant/Postpartum on Thromboprophylaxis or Higher Dose Anticoagulants. Anesth Analg 2018. Ashken T, West S: BJA Educ 2021

Response: Infection, Coagulation, Preparation

Infection

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Coagulation

Antiplatelet/Anticoagulant
Thrombocytopenia

Joo Suh Y, et al. PE + DVT in COVID 19, Radiology 2020
Agostinis C, et al. COVID 19, Preeclampsia, Complement System. Front Immune 2021
SOAP Consensus Statement Pregnant/Postpartum on Thromboprophylaxis or Higher Dose Anticoagulants Anesth Analg 2018. Ashken T, West S: BJA Educ 2021

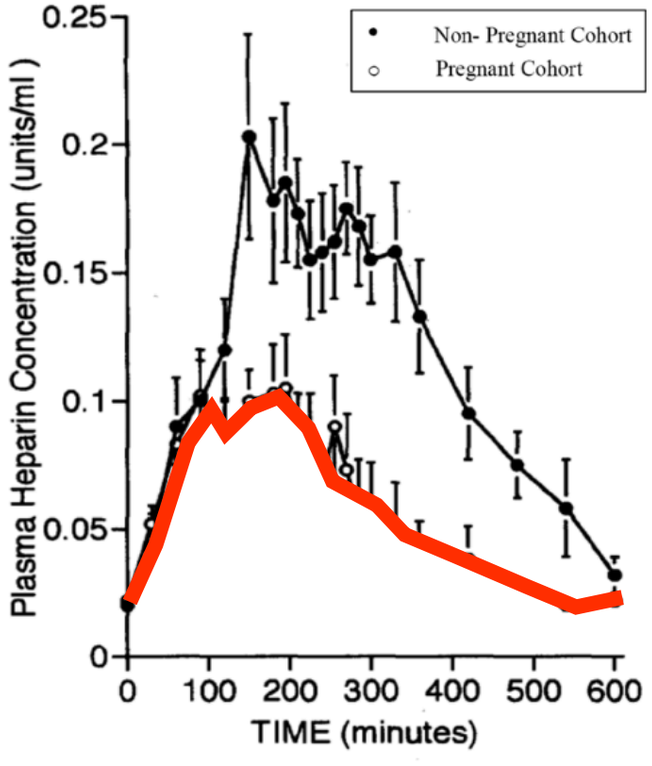


Figure 1. Plasma heparin concentrations in 6 pregnant women at mean gestational age 27 weeks, versus 6 nonpregnant women, after a single dose of weight-adjusted UFH SQ (mean ± standard error of 9500 ± 640 U). SQ indicates subcutaneous; UFH, unfractionated heparin.

Response: Infection, Coagulation, Preparation

Thrombocytopenia: Number, Rate of Change, Etiology

Quantitative + Qualitative Deficit: Destruction, NonImmune
Infection, DIC, Sepsis, TTP, Uremia, Gest, PIH

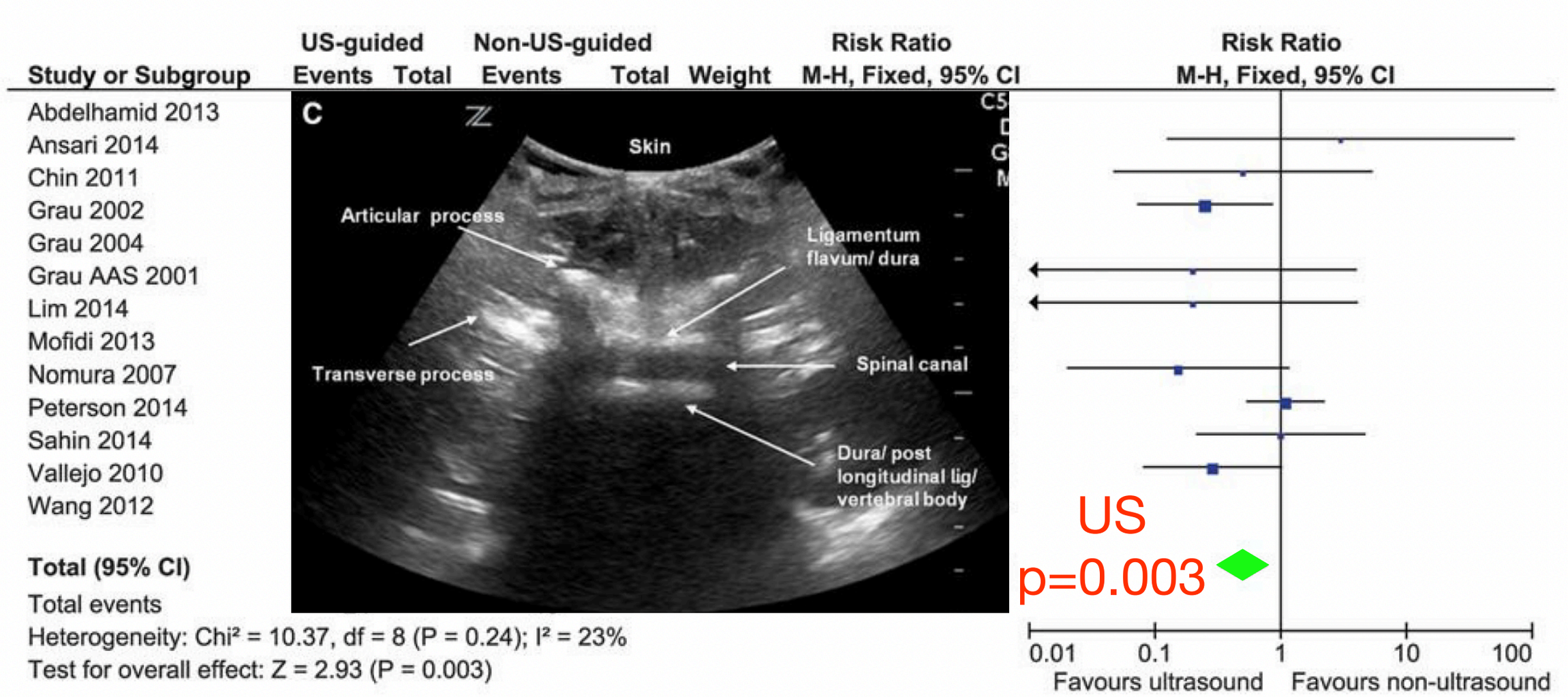
Consider Functional Assays (TEG, Platelet Function Assays)

Risks/Benefits
Hematoma 0.6%
(<1:1500) vs GA
Complications 6.5%

Platelet	Recommendation	Hematoma 95% CI
70 to 99 K	Reasonable to proceed	0 to 0.19%
50 to 69 K	Risk/benefit analysis	0 to 2.6%
0 to 49 K	Reasonable to avoid	0 to 9%

Bauer ME, et al. SOAP Interdisciplinary Consensus Statement Neuraxial Techniques in Obstetric Patients with Thrombocytopenia, 2021 (ASRA, ACOG, SMFM)

Response: Infection, Coagulation, Preparation



Better epidural space identity + depth = safety, efficacy, failures

Limited experience and real-time guidance

Perlas et al. Systematic Review and MetaAnalysis.RAPM 2016; Van de Putte, P. POC UltrasoundL Gastric, Airway, Neuraxial, Cardioresp. Curr Opin Anaesthesiol 2002

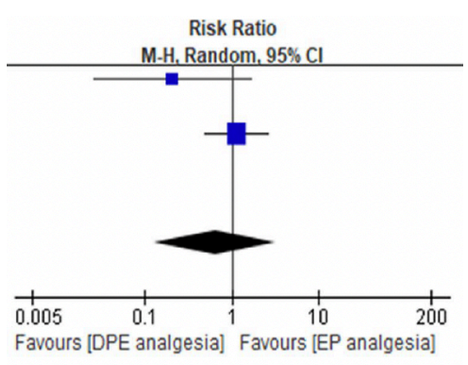
Labor Epidural Replacement: Neuraxial Technique

Failed Blocks	Epidural	CSE	DPE	Needle
Eappen n = 4240	13.1%	7.2%		25G
Norris n =1660	1.3%	0.2%		25G
Van de Velde n = 661/2075	3.18%	1.49%		27, 29G
Thomas n = 248	9.3%	8%		27G
Booth n = 955/1440	11.6%	6.6%		27G
Berger n = 1548		9.7%	6.4%	25G

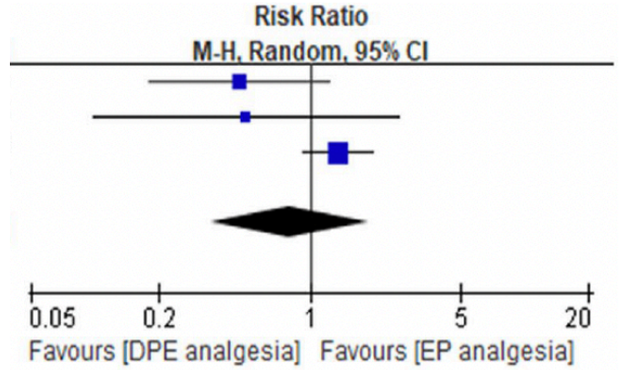
Eappen IJOA 1998; Norris IJOA 2000; Van de Velde Anaesth Intens Care 2001
Thomas Anesth 2005; Bauer, Tsen IJOA 2012; Booth Anesth 2016; Berger, IJOA 2022

Labor Epidural Replacement: Neuraxial Technique

	CSE	DPE	EPIDURAL
NONE	20 (50%)	31 (77.5%)	20 (50%)
ONE or MORE	20 (50%)	9 (22.5%)	20 (50%)
TIME TO TOP-UP	132 ± 85	250 ± 163	207 ± 133



Cath Adjust
p = 0.61



Cath Replace
p = 0.59

Chau A, Bibbo C, Tsen LC. Anesth Analg 2017; Yin H, Tong X, Huang H. J Anesth 2022

PDPH Epidural Blood Patch

	Partial success				Failure			
	Unadjusted*		Adjusted†		Unadjusted*		Adjusted†	
	OR (95% CI)	P-value	OR (95% CI)	P-value	OR (95% CI)	P-value	OR (95% CI)	P-value
Previous history of migraine headache								
No	Reference		Reference		Reference		Reference	
Yes	1.06 (0.57–1.95)	0.86	1.25 (0.61–2.56)	0.55	2.09 (1.16–3.78)	0.0149	3.16 (1.48–6.78)	0.0032
Level of accidental dural puncture								
L3/L5	Reference		Reference		Reference		Reference	
L1/L3	1.83 (1.12–2.98)	0.0152	2.69 (1.47–4.94)	0.0014	2.11 (1.23–3.60)	0.0065	3.28 (1.64–6.53)	0.0008
Time from accidental dural puncture to epidural blood patch (h)								
<48	Reference		Reference		Reference		Reference	
48 to <72	0.70 (0.38–1.28)	0.24	0.60 (0.30–1.19)	0.14	0.43 (0.23–0.78)	0.0060	0.37 (0.18–0.77)	0.0073
≥72	0.45 (0.25–0.78)	0.0046	0.36 (0.19–0.70)	0.0022	0.10 (0.06–0.19)	<0.0001	0.08 (0.04–0.16)	<0.0001

International, Prospective, Observational Cohort Study, n = 643 parturients
Complete Success (33%), Partial Success (39%), EBP Failure (28.3%)

EBP Failure:
Higher if Migraine and ADP occurred at L1/L3 vs. L3/L5
Higher if EBP < 48 hrs vs. ≥ 48 hrs

Sweden* Gupta A, et al. European Practices ADP, Failed Blood Patch. BJA 2022

CESAREAN SECTION

ASA Quality Metrics: Obstetric Anesthesia

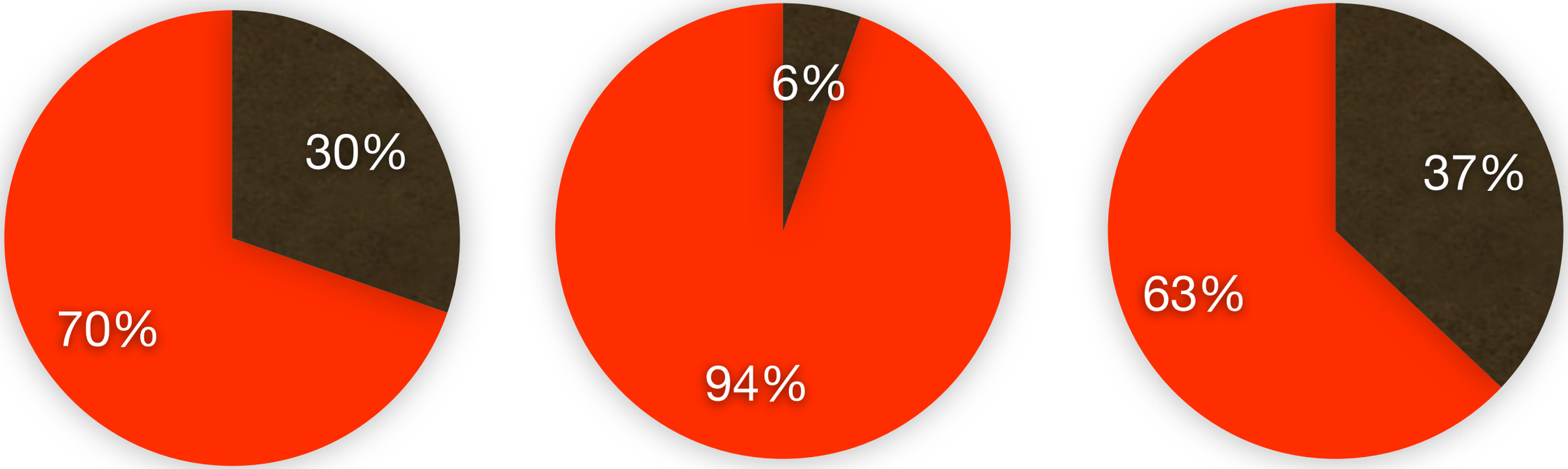
Cesarean Delivery

- Mode of Anesthesia: GA vs. Regional
- Neuraxial-induced Hypotension
- Post-op Opioid Consumption

ASA Committee on Obstetric Anesthesia Statement on Quality Metrics, Oct 26, 2022

Mode of Anesthesia: Maternal Mortality with GA

Case fatality ratio 2.3:1 to 16.7:1 to 1.7:1

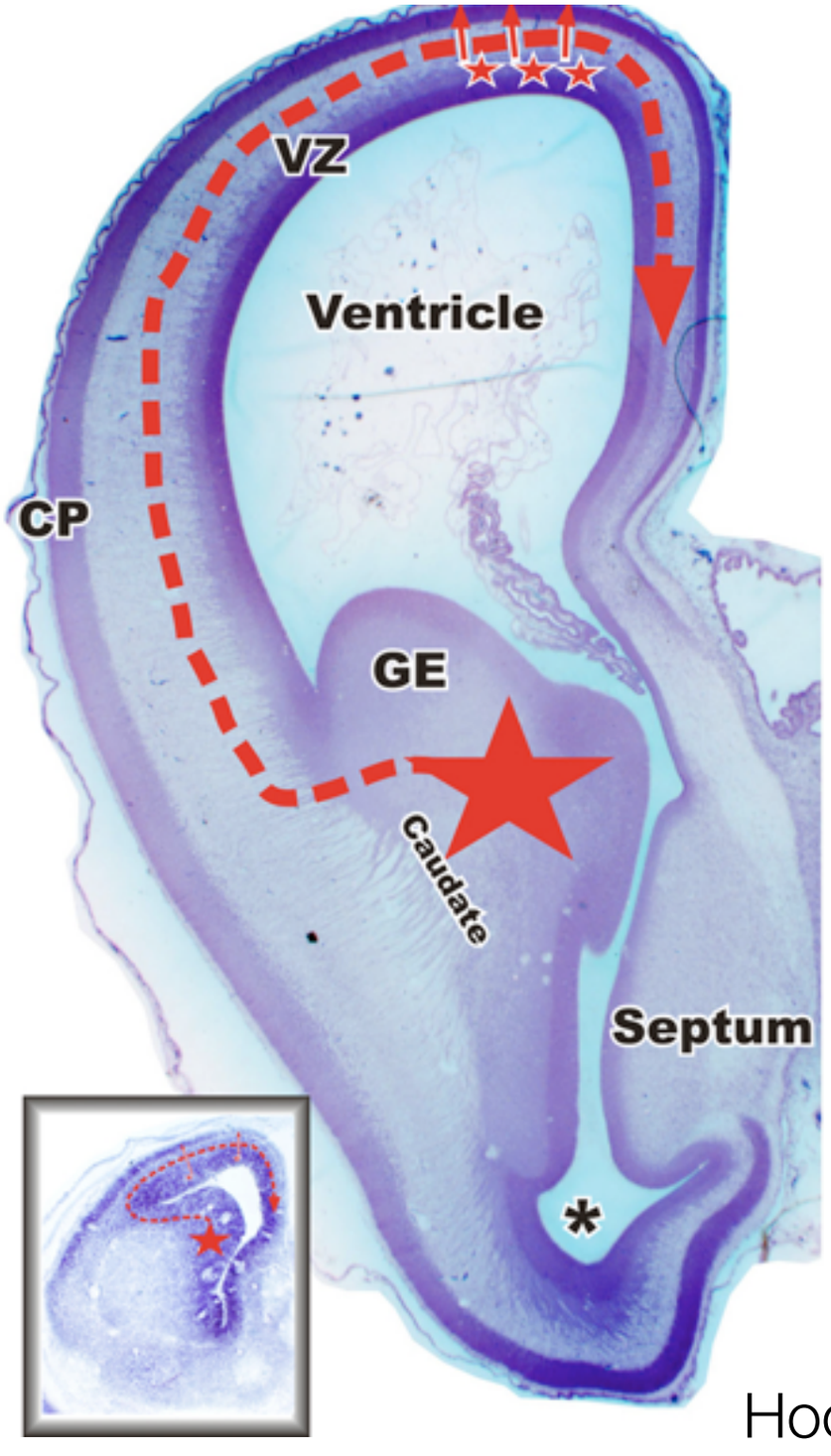


1979-1984 1985-1990 1991-2002

Regional
General

Hawkins, et al. Anesthesiology 1997;Obstet Gyn 2011

Mode of Anesthesia: Fetal Morbidity Worse with GA



- Neural Stem/Progenitor Cells (NPCs)
- Neuron Creation, Migration, Differentiation, Synapsis Formation, Reorganization
- GABA agonism
  NMDA antagonism

Jevtovic-Todorovic V, J Neurosci 2003
Soriano S, Anesth 2005; BMJ 2019; A&A 2020
Palanisamy A, et al. Anesth 2011; Behav Brain 2017
Hooijamans CR, SR + Meta. Nature Scientific Reports 2023

Management of Hypotension: Venous System

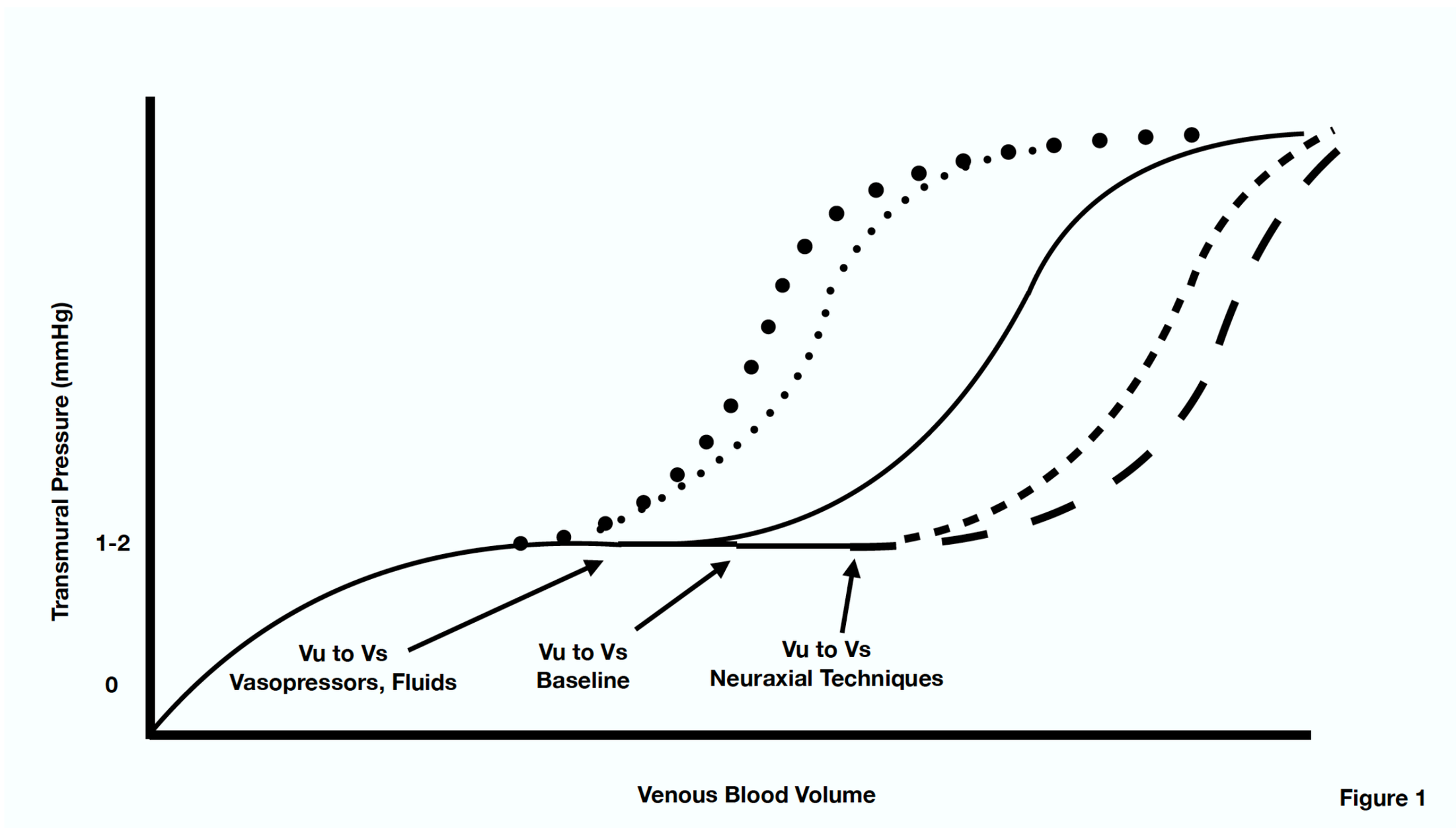
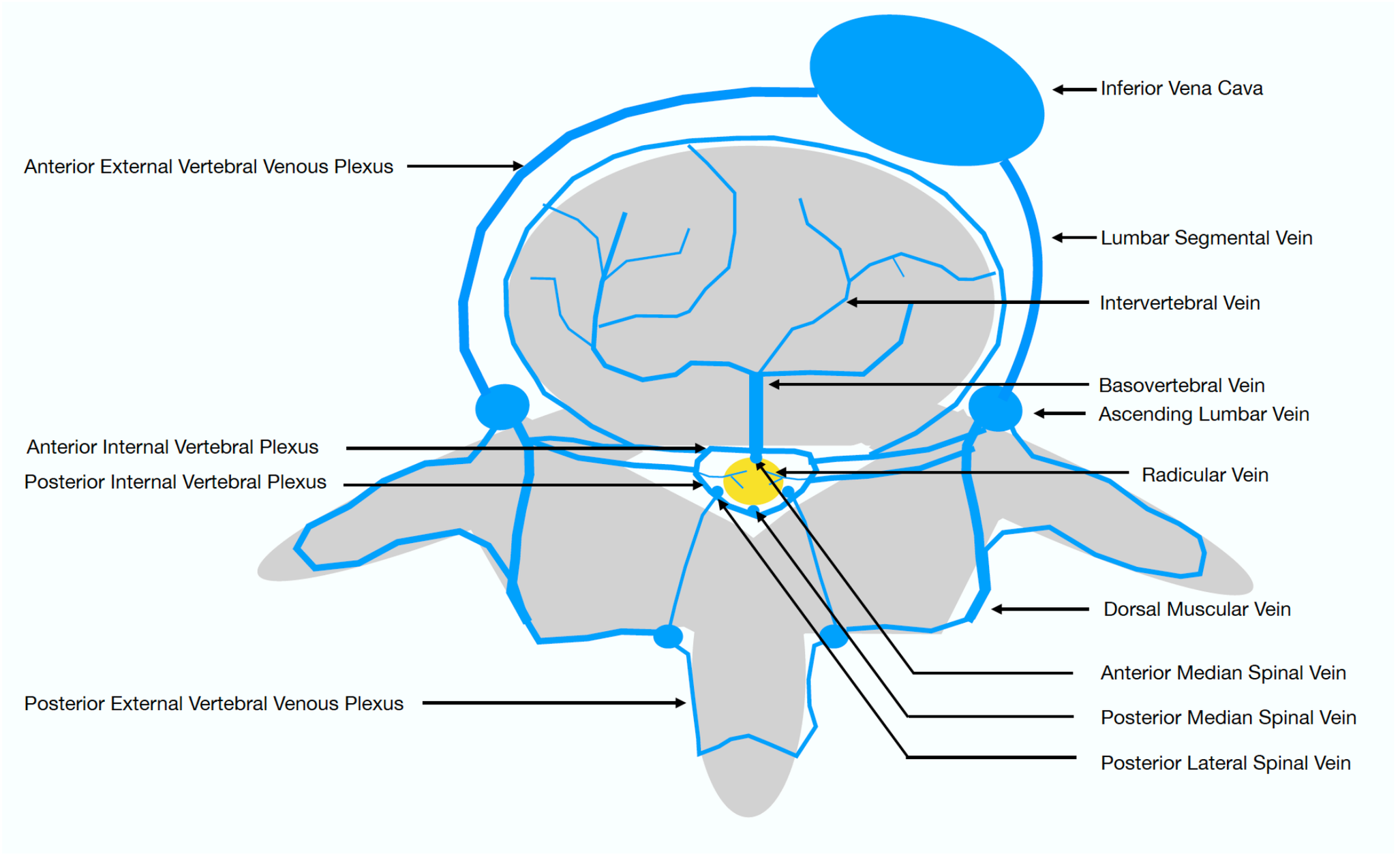


Figure 1

Tsen LC, Gelman S. The Venous System during Pregnancy. Part 1: Physiologic Considerations. Part 2. Clinical Considerations. IJOA 2022;50:

Management of Hypotension: Venous System



Tsen LC, Gelman S. The Venous System during Pregnancy. Part 1: Physiologic Considerations. Part 2. Clinical Considerations. IJOA 2022;50:

Management of Hypotension: Vasopressors

Table 1 Comparison of commonly used vasopressors.

	Ephedrine	Phenylephrine	Metaraminol	Noradrenaline	Adrenaline	Mephentermine
Receptor	β1, β2, weak α	α1	α1, weak β	α1, β	α1, β	α1, β
Mechanism	Indirect, weak direct	Direct	Direct and indirect	Direct	Direct	Indirect
Onset	Slow	Immediate	1–2 min	Immediate	Immediate	Immediate
Duration	Prolonged	Intermediate	Prolonged	Short	Short	Prolonged

Fetal Acidosis

Second Line:
If low HR

First Line: Goal: SBP > 90% Base
Infusion: 25-50 mcg/min
Start with Spinal

35 Studies

Kinsella SM, et al. International Consensus Statement on the Management of Hypotension with Vasopressors during Caesarean Section under Spinal Anaesthesia. Anaesthesia 2018; 73:71-92

Management of Hypotension: Vasopressors

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Maternal Bradycardia

Phenylephrine 0.18 (0.11-0.29)

Metaraminol 0.11 (0.04-0.26)

Norepinephrine 0.13 (0.06-0.28)

109 Studies (n = 8561)

Fitzgerald JP, et al. Prevention of Hypotension after Spinal Anaesthesia for Caesarean Section: A Systematic Review and Network Meta-Analysis of RCTs. Anaesthesia 2019

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Hypotension

Fetal Acidosis

Bradycardia

5 mcg/mL

Cardiac Output

Shorter Duration

13 RCTs (n = 2020)

Heesen, M, et al. Systematic Review of Phenylephrine vs Noradrenaline for Management of Hypotension Associated with Neuraxial Anaesthesia for Caesarean Section Anaesthesia 2020;

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Onset	Slow	Immediate	1–2 min	Immediate	Immediate	Immediate
Duration	Prolonged	Intermediate	Prolonged	Short	Short	Prolonged

Goal: SBP > 90% Base
Infusion: 2.5 mcg/min
Bolus: 5 mcg/mL
Start with Spinal

Heesen, M, et al. Systematic Review of Phenylephrine vs Noradrenaline for Management of Hypotension Associated with Neuraxial Anaesthesia for Caesarean Section Anaesthesia 2020;

Management of Hypotension: Vasopressors

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Duration	Prolonged	Intermediate	Prolonged	Short	Short	Prolonged

1 mcg/kg/min

Hypotension

Fetal Acidosis

Bradycardia

0.1 mcg/kg/min

Wang YB, et al. Comparison of Continuous Infusion of Epinephrine and Phenylephrine on Hemodynamics during Spinal Anesthesia for Cesarean Delivery: A RCT. Clin Ther 2020; 42:2001-9; Biricik E, et al. Rev Bras Anestesiol 2020;70:500-7.

Management of Uterine Tone

Oxytocin		Carbetocin
Bolus 1IU/30s Elective Bolus 3IU/30s Intrapartum Infusion: 2.5-7.5 IU/hr		Bolus 100 IU/30s
0.35 IU	Elective	14.8 mcg
0.78 IU	Elective BMI > 40	68 mcg
2.99 IU	Labor Arrest	121 mcg
Potency		Duration

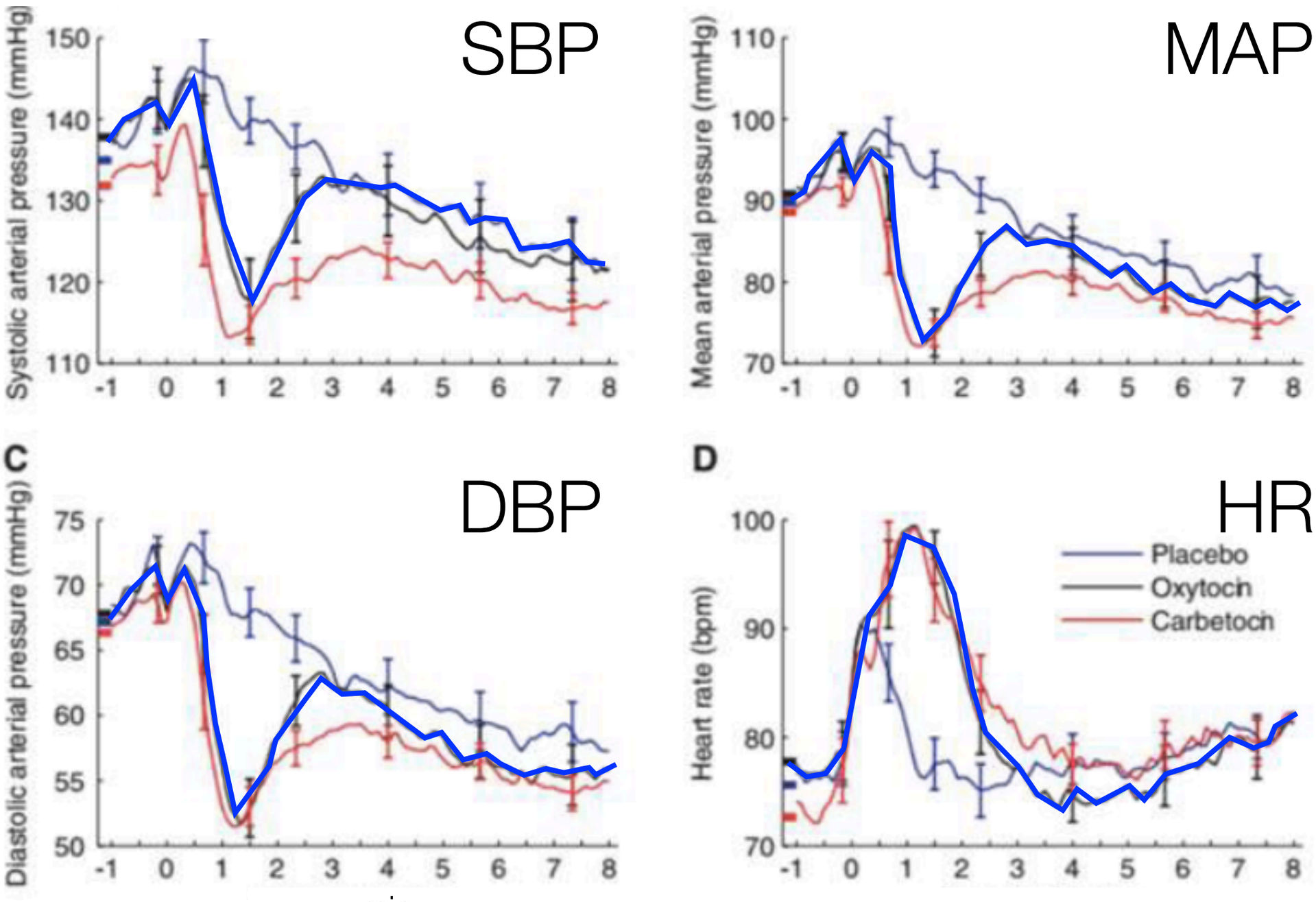
Carvalho JCA, et al. AJOG 2004; Balki M, et al. Ob Gyn 2006; Khan M, et al. Can J Anaesth 2014; Nguyen-Lu N, et al. Can J Anaesth 2015; Heesen M, et al. International Consensus Statement, Anaesthesia 2019; Drew T, et al. Anaesthesia 2020; Peska E, et al. Anaesthesia 2021

Management of Uterine Tone

Oxytocin
5 IU

Carbetocin
100 mcg

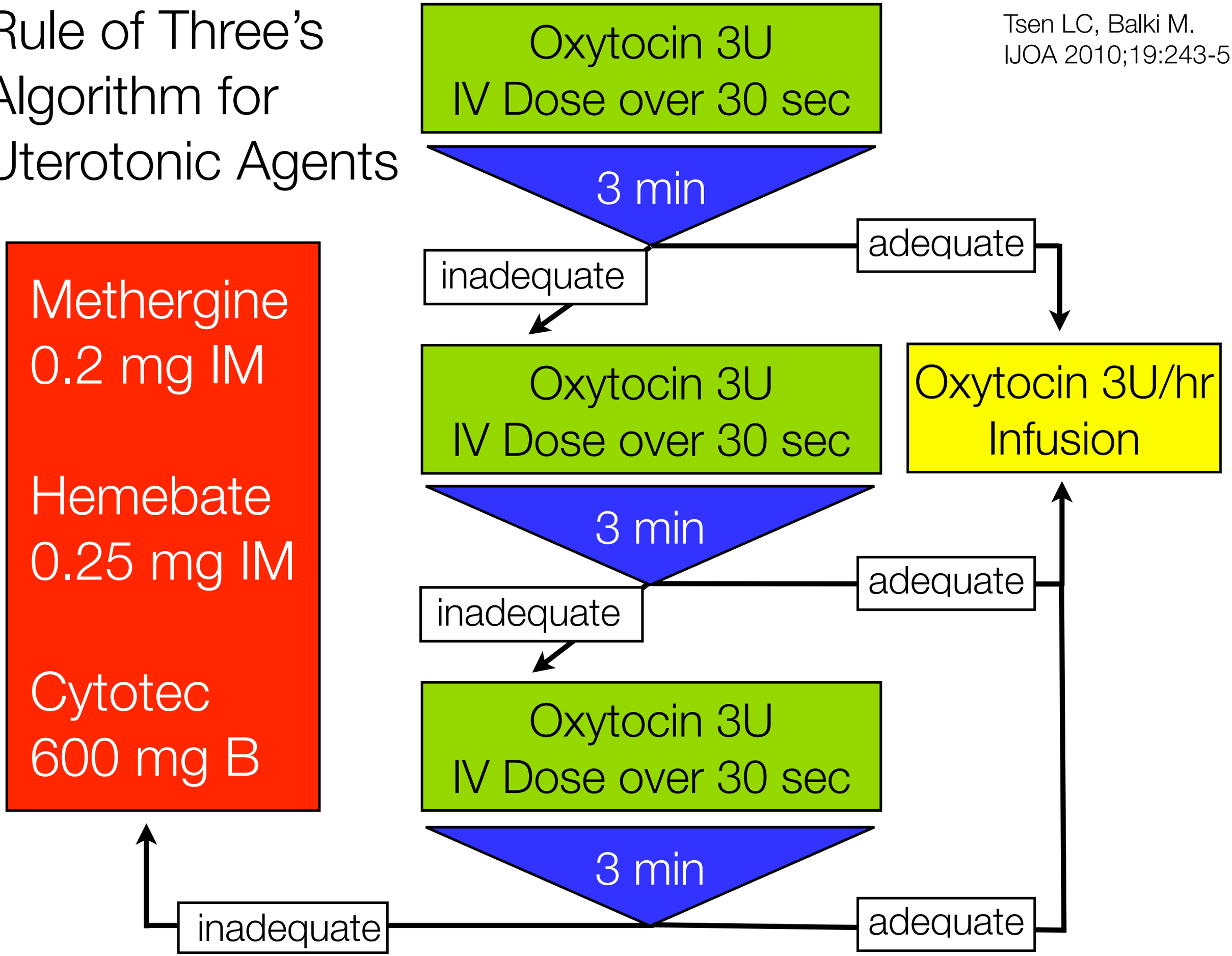
Placebo



Rosseland. Anesthesiology 2013; 119:541-51

Rule of Three's Algorithm for Uterotonic Agents

Tsen LC, Balki M.
IJOA 2010;19:243-5



ERAS

- **General/Process Metrics**
  - LOS, Pathway Compliance
  - Preoperative Fasting
  - First Fluid, Solid Intake
  - First Mobilization
  - Urinary Catheter Removal
- **Maternal Outcomes**
  - Analgesia Satisfaction
  - Postpartum Opioids Use/ Amount
  - PONV
  - Readmission Rate
  - Quality of Recovery
- **Neonatal Outcomes**
  - Breastfeeding Rate

Sultan P, et al. Expert Consensus ERAS after Cesarean Delivery. Anesthesiology 2022

NOVEL

Novel: In Utero Fetal Surgery

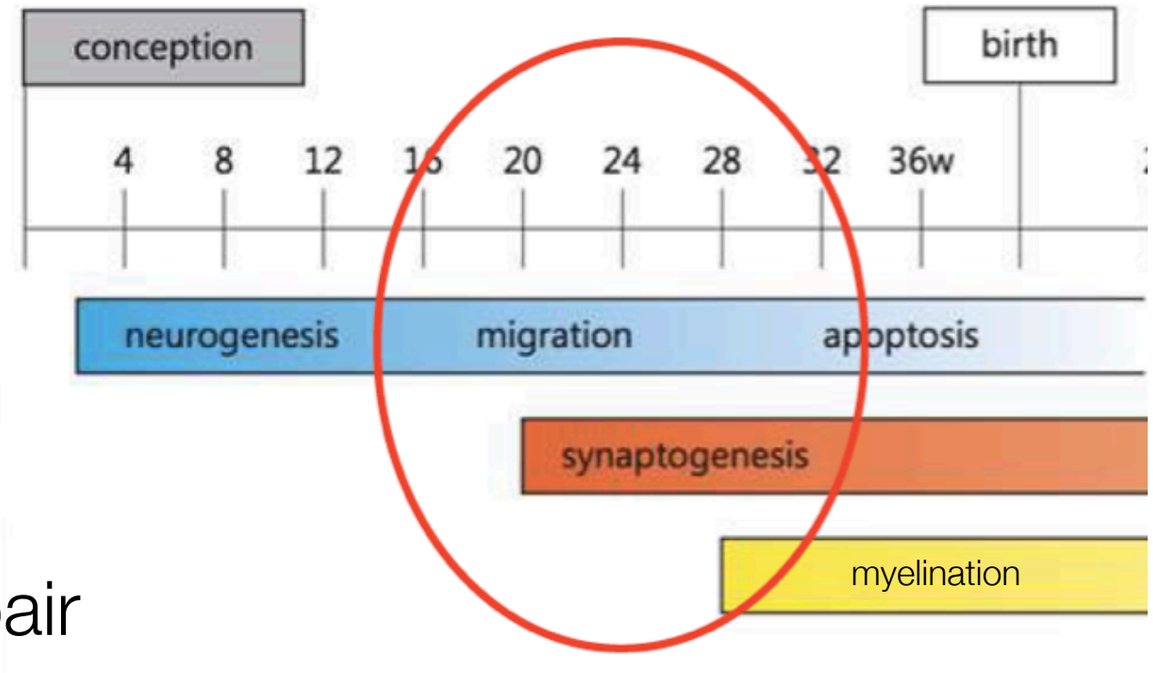
Anesthesia

Uterine Relaxation

Maternal Hypotension

Pulmonary Edema

Neurocognitive Development?



Spina Bifida Repair

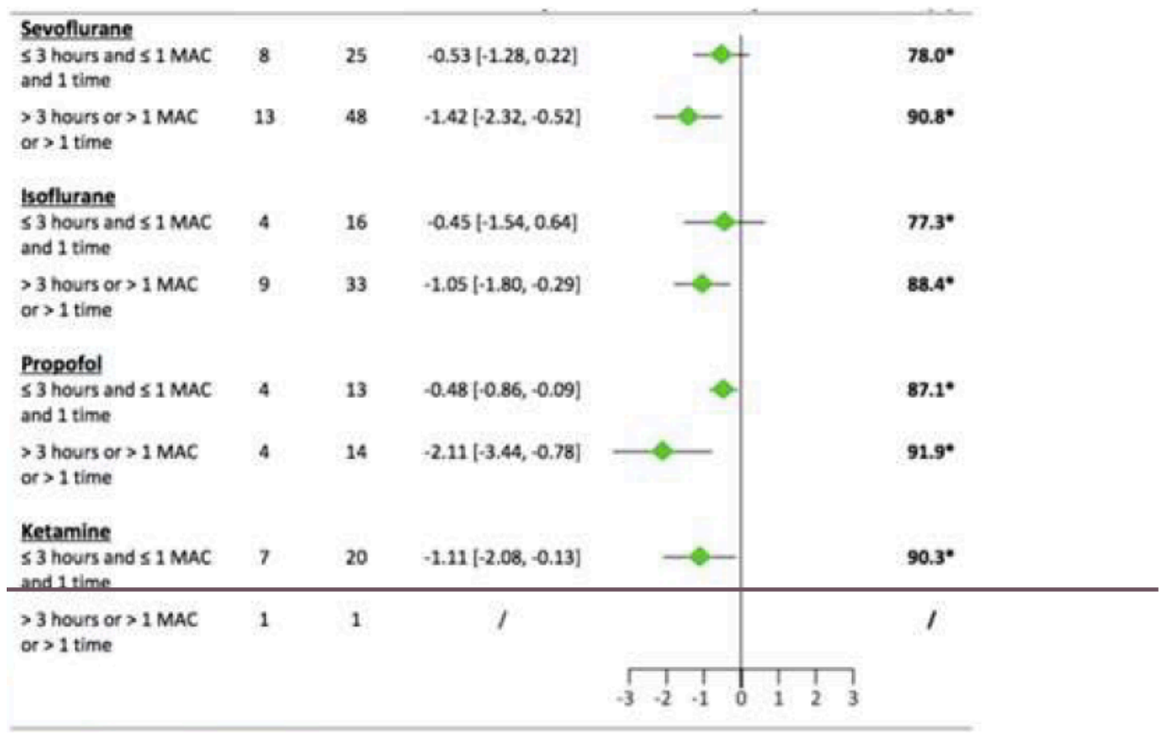
- Open Maternal-Fetal Surgery
- Minimally Invasive Fetoscopic Repair

Chmait RH, et al. Advances in Fetal Surgical Repair of Open Spina Bifida. Obstet Gynecol 2023:141:505-21.

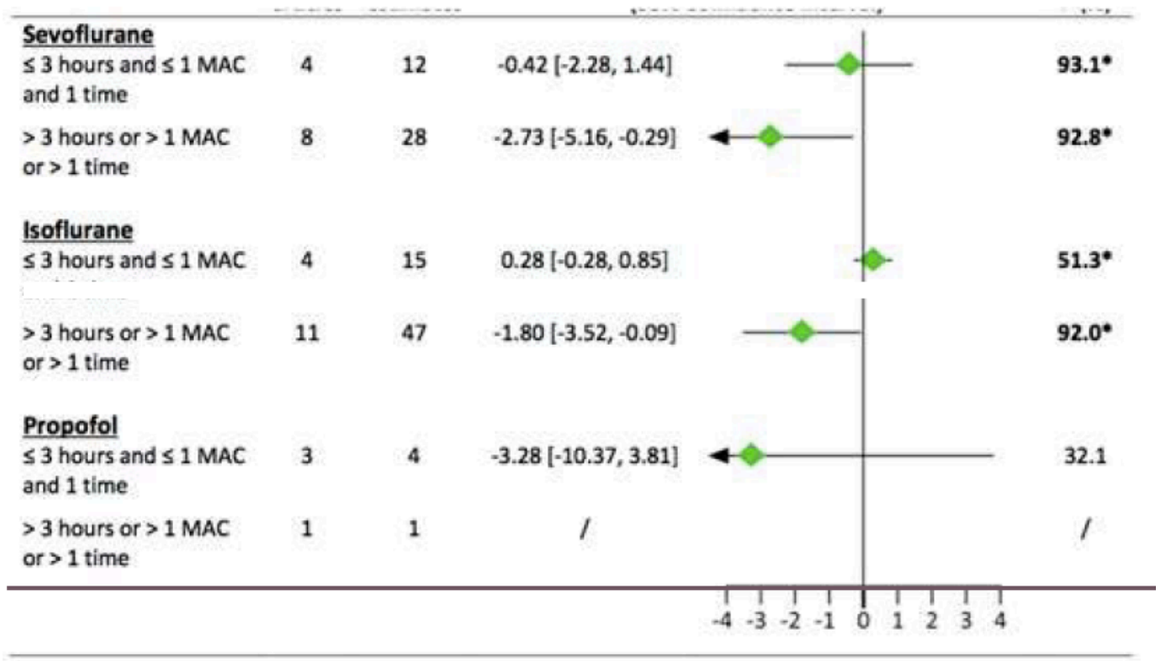
Novel: In Utero Fetal Surgery

- 73 preclinical animal studies, > 1 MAC, single long (> 3hrs) or multiple exposures

Impaired Learning & Memory



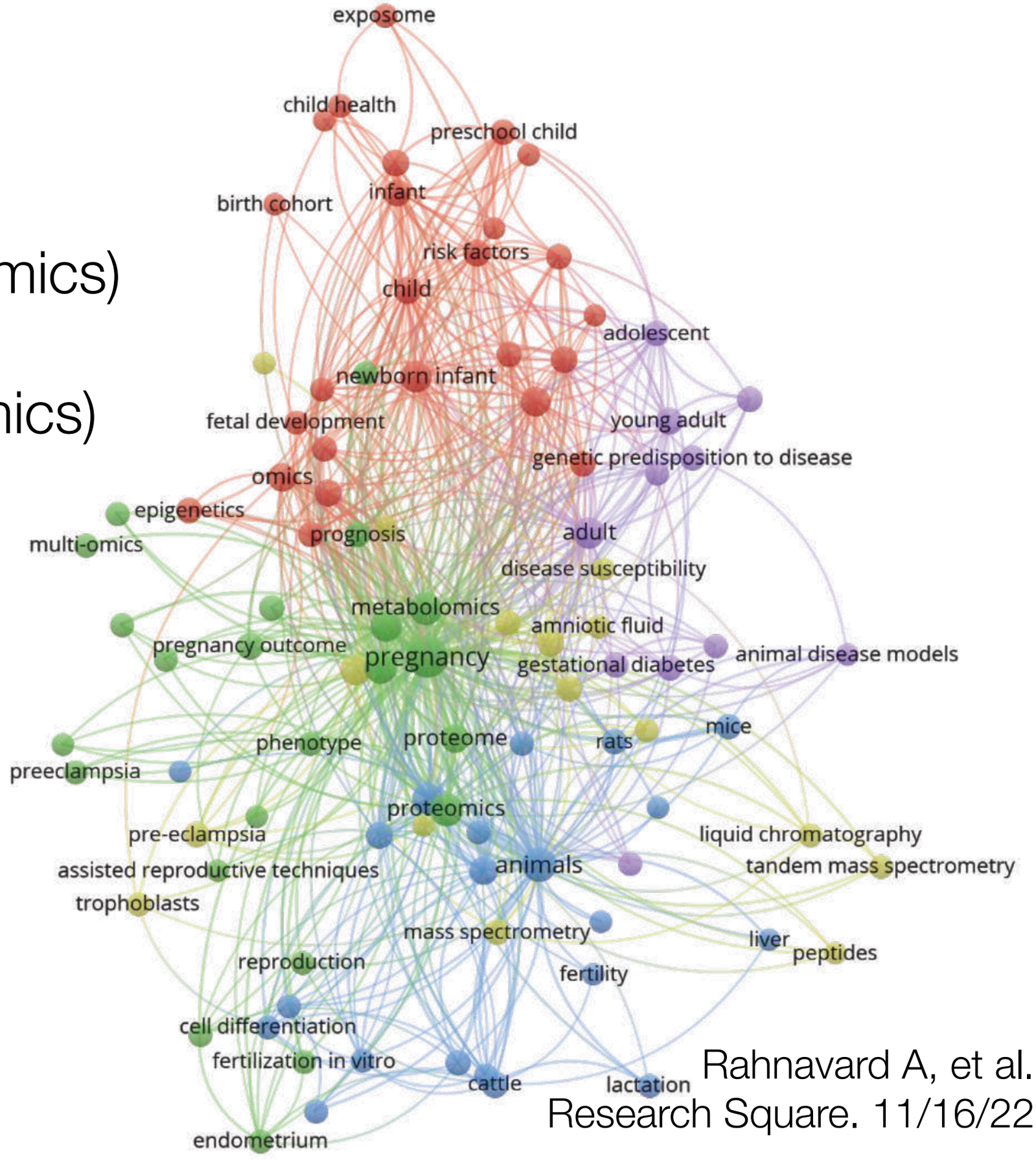
Increased Apoptosis



Bleeser T, et al. Effects of General Anaesthesia on Neurocognitive Development of the Fetus: A Systematic Review and Meta-Analysis. BJA 2021; Bleeser T, et al. Neurodevelopmental Outcomes After Prenatal Exposure to Anaesthesia Anaesthesia 2023;78:159-69.

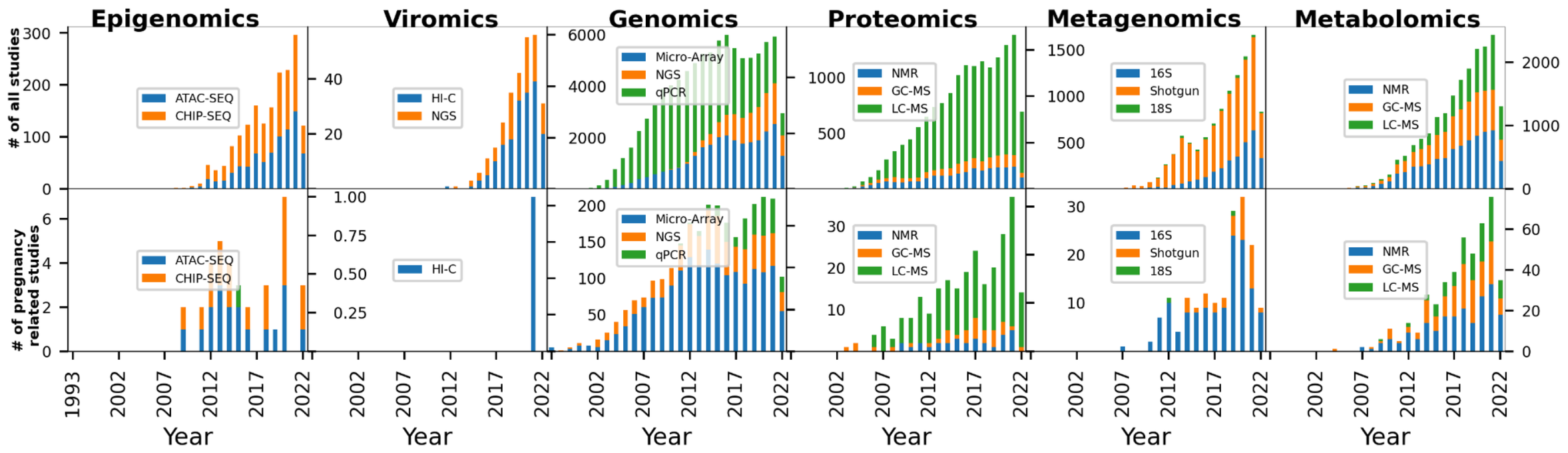
Novel: OMICS

- Gene (Transciptomics)
- Proteins (Proteomics)
- Metabolites (Metabolomics)
- Microbiota (Microbiomics)
- Epigenome (Epigenomics)



Rahnavard A, et al. Research Square. 11/16/22

Novel OMICS



Outcome	Sample GA (weeks)	AUC	Sensitivity	Specificity	Predictor Symbols (% inclusion in best combination)
Early PE	8–16	0.55	0.21	0.90	gpIIbIIIa(34%)
Early PE	16.1–22	0.65	0.31	0.90	Soggy-1(26%); IMDH2(20%); Siglec-6(14%); PKC-D(12%); MMP-12(10%); RBP(10%)
Early PE	22.1–28	0.89	0.77	0.90	Siglec-6(72%); Activin A(63%); VEGF121(34%)
Early PE	28.1–32	0.93	0.82	0.90	Siglec-6(72%); ALCAM(15%); FCN2(14%); VEGF121(12%)

ALCAM: activated leukocyte cell adhesion molecule; AUC: area under the receiver operating characteristic curve; early PE: early preeclampsia; *FCN2*: ficolin 2; GA: gestational age; gpIIbIIIa: glycoprotein IIb/IIIa; IMDH2: inosine-5'-monophosphate dehydrogenase (IMDH2); MMP: matrix metalloproteinase; PKC-D: protein kinase C delta type; RBP: retinol binding protein; Siglec-6: sialic acid binding immunoglobulin-like lectin; VEGF121: vascular endothelial growth factor A, isoform 121. Only proteins selected in 10% or more of the 200 bootstrap iterations are listed.

Rahnavard A, et al. Research Square. 11/16/22; Tarca AL et al. Prediction of Early Preeclampsia. Longitudinal Proteomics. PLoS One, 2019; Ghaemi MS, et al. J Matern Fetal Med 2021

What's New in Obstetric Anesthesia

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by
Nicholas Arioli

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