



Timing of Delivery in Fetal Growth Restriction

Jennifer Braverman, MD

Assistant Professor, Maternal Fetal Medicine

University of Colorado



The most common definition of FGR is estimated fetal weight $<10^{\text{th}}$ percentile and/or abdominal circumference $<10^{\text{th}}$ percentile.

- $>10\%$ of singleton pregnancies will have FGR!
- AC $<10^{\text{th}}$ percentile was added by SMFM in 2020¹ and ACOG in 2021.²
- Disclaimer: There are many causes of FGR. This talk primarily focuses on growth restriction due to placental dysfunction.

1. Society for Maternal Fetal Medicine. SMFM Consult Series #52: Diagnosis and management of Fetal Growth Restriction. Am J Obstet Gynecol 2020.
2. American College of Obstetrics and Gynecology. Practice Bulletin #227: Fetal growth Restriction. Obstet Gynecol 2021.

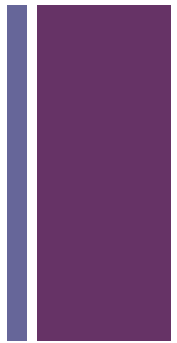
+ Estimated fetal weights have a significant margin of error and don't take growth potential into account.

- Parous mothers as good or better than ultrasound at estimating EFW at term.¹
- Hadlock formula (1991) based on 392 pregnancies, mostly white women, in Texas.²
- Studies have tried to use diverse populations to generate a single standard or make racial/ethnic specific standards, but haven't improved accuracy at predicting birthweights or morbidity.³

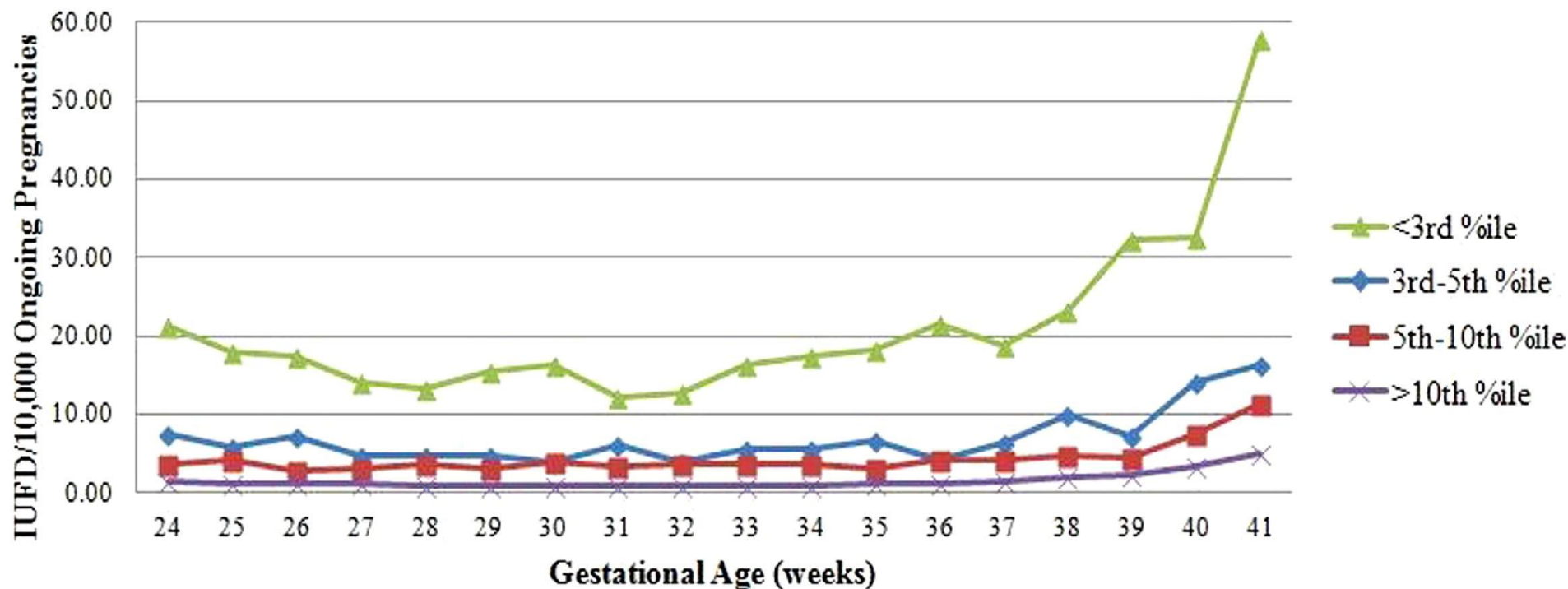
1. Chauhan S et al. Intrapartum clinical sonographic and parous patients' estimates of newborn birthweight. *Obstet Gynecol.* (1992); 79(6) 956-8.
2. Hadlock FP, Harrist RB, Martinez-Poyer, J. In utero analysis of fetal growth: a sonographic weight standard. *Radiology.* 1991; 181: 129-33.
3. Society for Maternal Fetal Medicine. SMFM Consult Series #52: Diagnosis and management of Fetal Growth Restriction. *Am J Obstet Gynecol* 2020.



Nevertheless, fetuses with EFW <10%ile are at increased risk



- The lower the percentile, the greater the risk





Goal of Delivery Timing Decision

Find the optimal balance between minimizing the risks of prematurity and preventing stillbirth.

Too early:
Excess risks of
prematurity

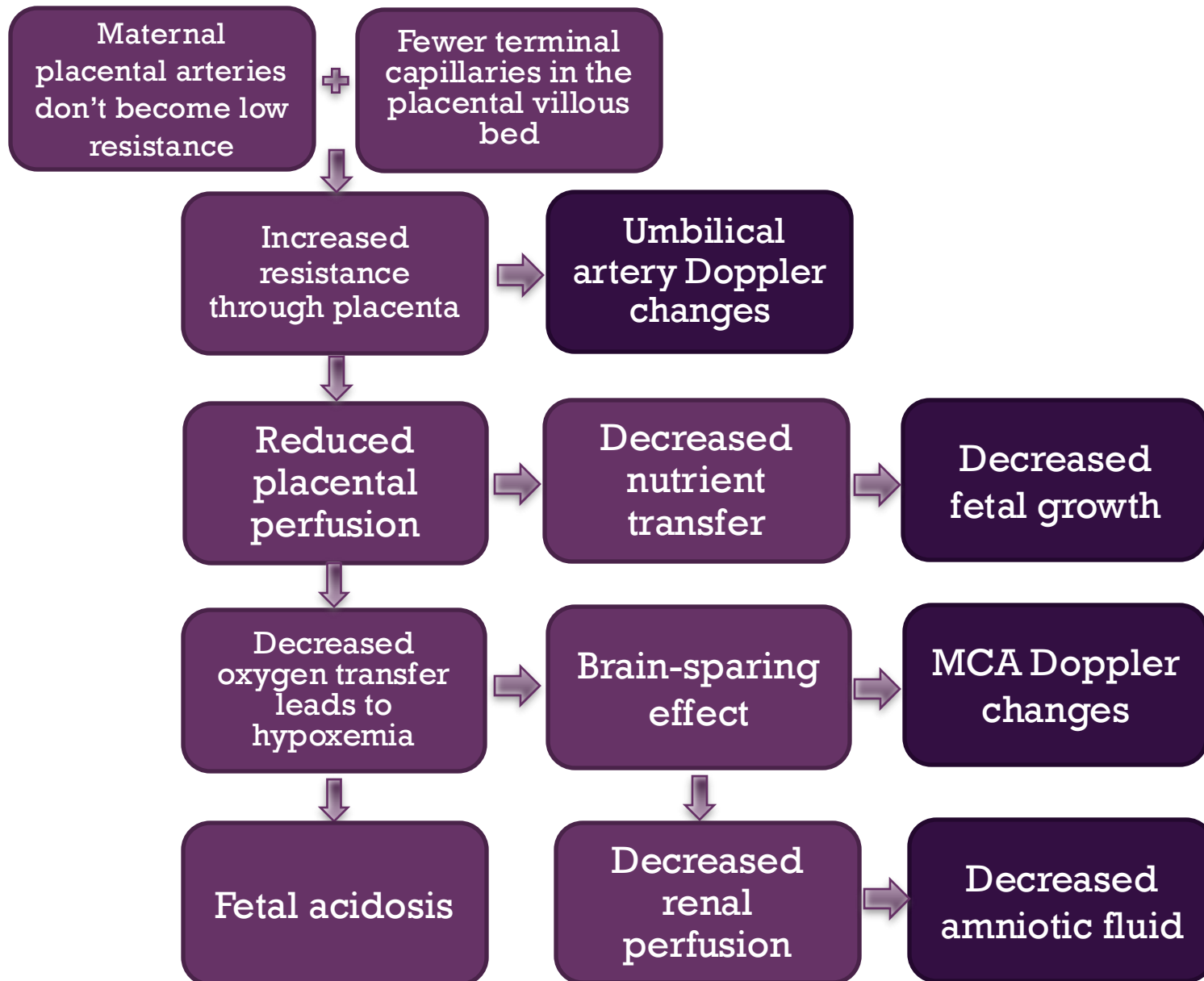


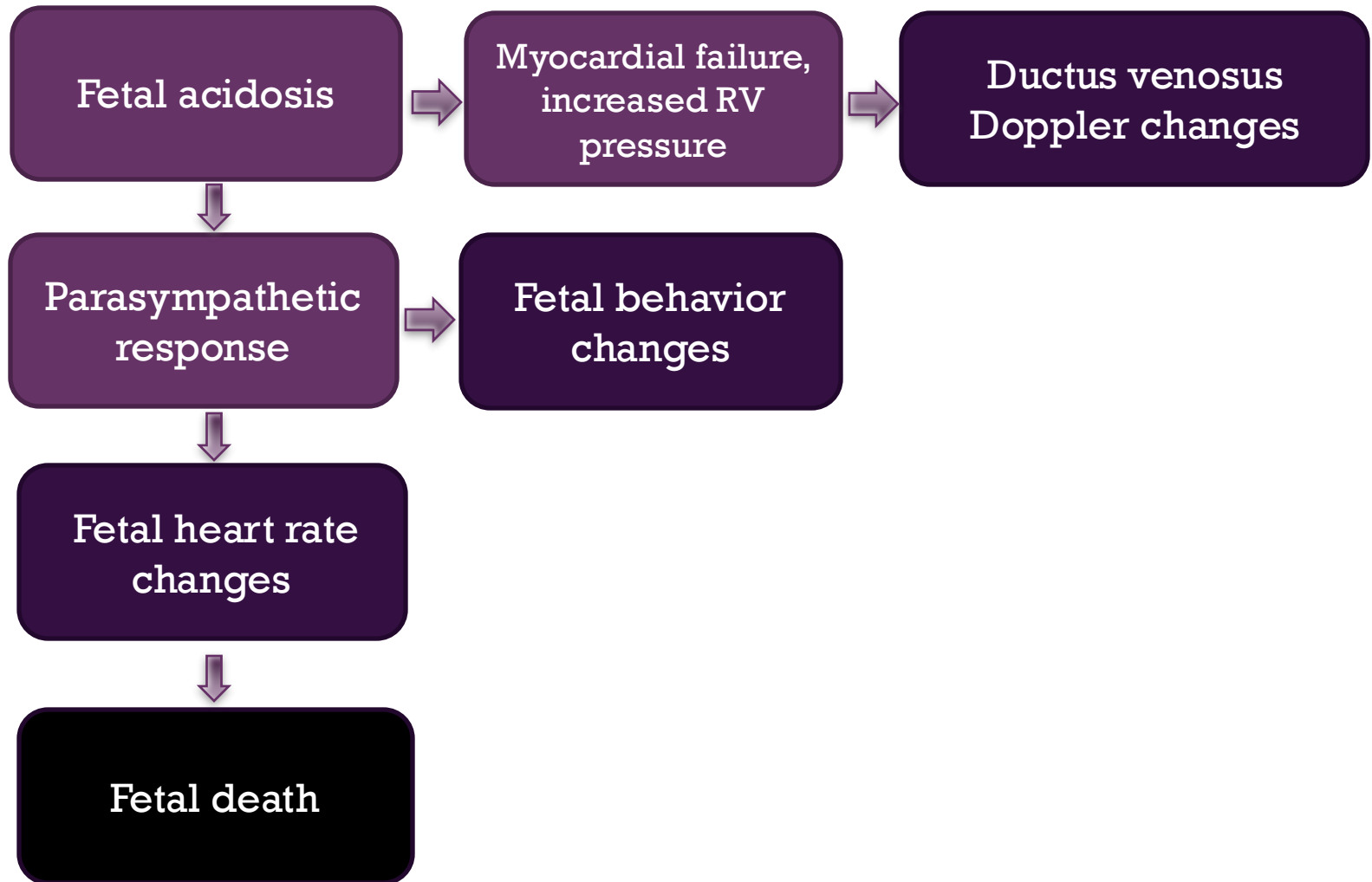
Too late:
Excess risk of
stillbirth, highly
compromised
newborn

+ Aside from EFW percentile, how can we identify the growth restricted fetus at risk of stillbirth or severe neonatal compromise?

By understanding the physiologic changes that take place in the growth restricted fetus, and using antenatal testing to detect these changes.







+ We can monitor indicators of chronic and acute changes.

■ Chronic changes

Fetal
growth

Amniotic
fluid

Umbilical
artery
Doppler

Middle
cerebral
artery
Doppler

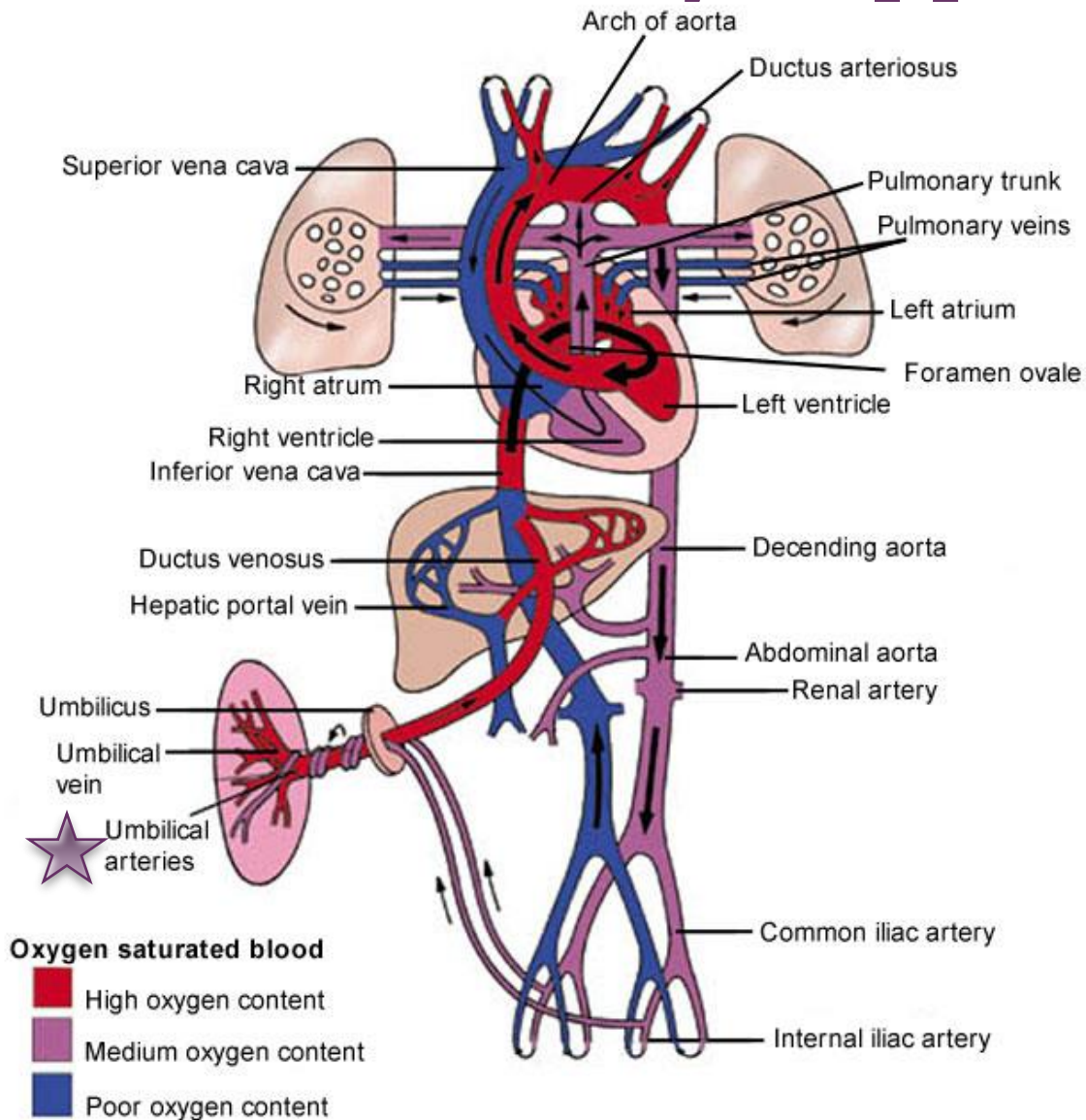
■ Acute changes

Fetal
heart
rate
changes

Fetal
behavior
changes

Ductus
venosus
Doppler

+ Umbilical Artery Doppler



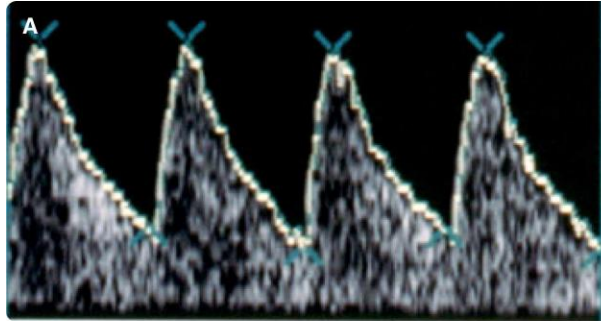
■ In normal physiology, low resistance through placenta allows for continuous forward flow through umbilical arteries.

■ As placental resistance increases, flow during diastole gradually decreases, becomes absent, and eventually reverses.

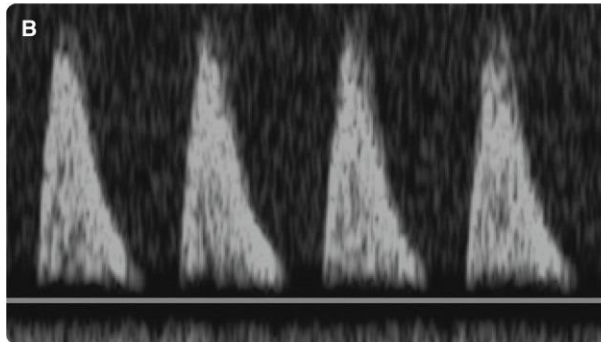


Umbilical Artery Doppler

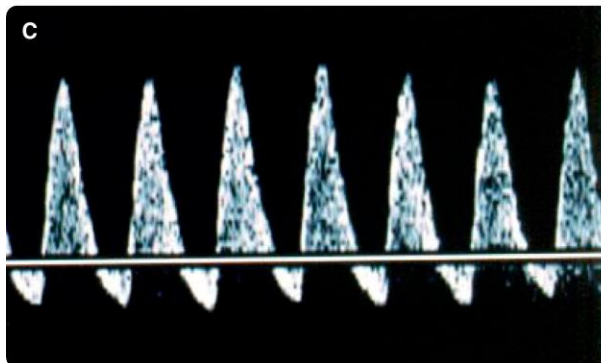
Increasing placental resistance



Normal



Absent End
Diastolic Flow



Reversed End
Diastolic Flow

1. Society for Maternal Fetal Medicine with Berkley E, Chauhan SP, Abuhamad A. SMFM Guideline: Doppler assessment of the fetus with intrauterine growth restriction. *Am J Obstet Gynecol.* 2012; 206 (4):300-8.

+ Umbilical artery Doppler changes correlate with placental pathology.

- Estimated that S/D ratio doesn't change until 30% of placental villous vasculature is abnormal.
- Becomes absent after 60-70% is abnormal.
- Reversed when >70% is abnormal.^{1,2}

1. Miller J, Turan S, Baschat AA. Fetal Growth Restriction. *Semin Perinatol*. 2008;32:274-280.
2. Galan H. Timing delivery of the growth restricted fetus. *Semin Perinatol*. 2011; 262-9.

+ Umbilical artery Doppler changes correlate with perinatal outcomes.

- Absent or reversed flow is associated with:^{1,2,3}
 - 50-80% rate of intrauterine hypoxemia
 - 40% chance of fetal acidemia
 - 80-fold increase in perinatal mortality.
- When flow progresses from absent to reversed, both risk of stillbirth and NICU admission are increased.^{2,3}
 - Risk of stillbirth: AEDF 6.8%, REDF 19% before 34 wks.
- Abnormal UA Doppler is a better predictor of respiratory distress syndrome and composite adverse perinatal outcome than abnormal BPP or NST.⁴

1. Galan H. Timing delivery of the growth restricted fetus. *Semin Perinatol.* 2011; 262-9.

2. Thompson JL, Kuller JA, Rhee EH. Antenatal surveillance of fetal growth restriction. *Obstetrical and Gynecological Survey.* 2012; 67 (9): 554-65.

3. Caradeux J et al. Risk of fetal death in growth-restricted fetuses with umbilical and/or ductus venosus absent or reversed end diastolic velocities before 34 weeks of gestation: a systematic review and meta-analysis. *Am J Obstet Gynecol.* 2018; 218: S774-782.

4. Gonzalez JM et al. Relationship between abnormal fetal testing and perinatal outcomes in intrauterine growth restriction. *Am J Obstet Gynecol.* 2007; 196 (5): e48-51.

+ Umbilical artery Doppler assessment improves outcomes.

- Cochrane Review (2017): Compared to not testing umbilical artery Doppler, testing is associated with improved outcomes, without increasing interventions:¹

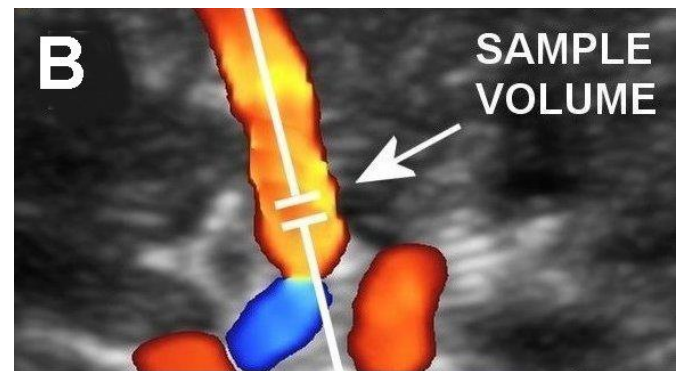
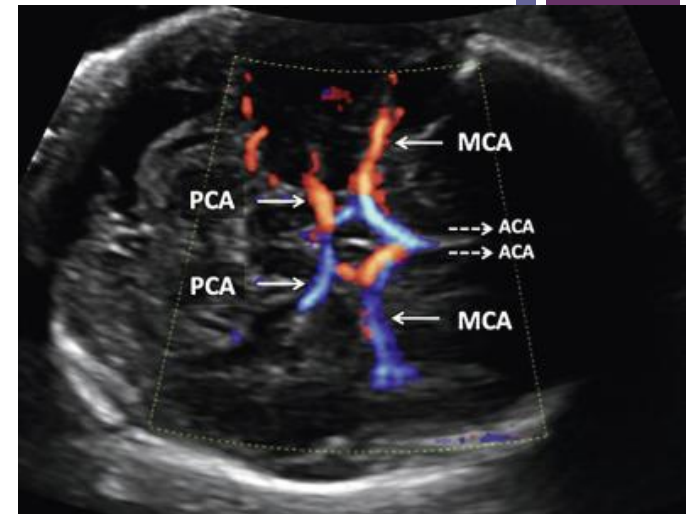
Outcome	Relative Risk	95% CI
Induction of Labor	0.89	0.80-0.99
Cesarean Delivery	0.90	0.84-0.97
Perinatal Death	0.71	0.52-0.98

- Rates of emergency cesareans and length of infant hospital stay also decreased with Doppler testing.
- ACOG and SMFM recommend serial UA Doppler.

1. Alfrevic Z, Stampalija T, Dowswell T. Fetal and umbilical Doppler ultrasound in high-risk pregnancies. *Cochrane Database of Systematic Reviews*. 2017 (6): article CD007529.

+ Middle cerebral artery Doppler may detect progression in the pathology of FGR.

- With hypoxemia, **compensatory** fetal cerebral vasodilation occurs: “Brain sparing”
- Decreased resistance → INCREASED diastolic flow.
- Fetus should be without breathing/body movements.
- Axial view of fetal head, identify Circle of Willis with color Doppler.
- Use 1 mm sample volume about 2 mm from the MCA origin.
- Ultrasound beam as close to parallel to flow as possible.





Cerebroplacental ratio may allow improved risk stratification.

- Divide the MCA Doppler indices by the UA Doppler indices.
- Information about both the placental condition and fetal response in one number.
- Potentially a better predictor of adverse perinatal outcome than either measurement alone.

$$PI = \frac{\text{Peak Systolic Velocity} - \text{Minimum Diastolic Velocity}}{\text{Mean Velocity}}$$

$$CPR = \frac{PI_{MCA}}{PI_{UA}}$$

+ Abnormal cerebroplacental ratio indicates increased risk.

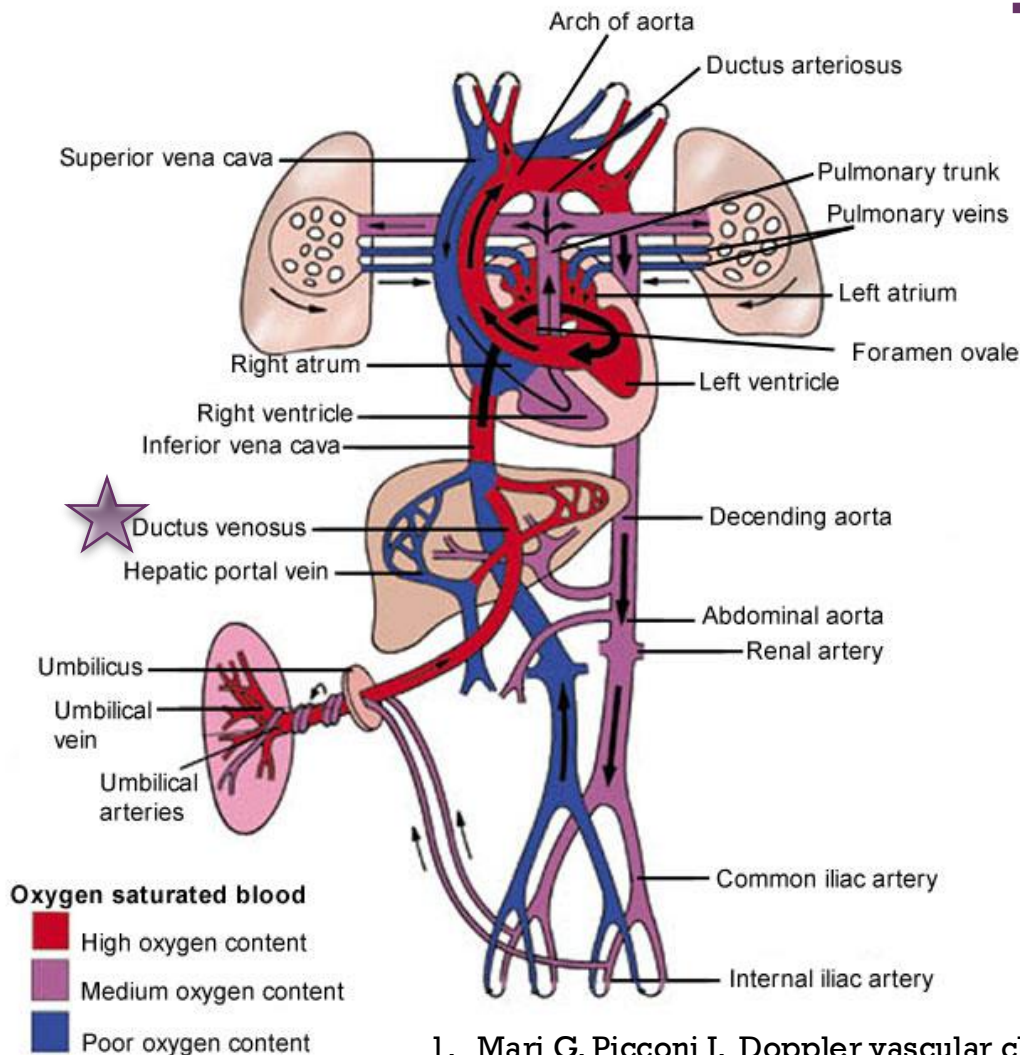
- Flood et al (2014)¹: Secondary analysis of the PORTO study:
 - Abnormal CPR: 11.7 times higher risk of composite adverse perinatal outcome compared to normal.
 - All 3 perinatal deaths in sample had abnormal CPR.

Doppler finding	Composite adverse perinatal outcome (OR)
Abnormal UA doppler	3.4
Abnormal UA doppler +Abnormal CPR	7.6
AEDF/REDF	7.9
AEDF/REDF +Abnormal CPR	13

1. Flood K, et al. The role of brain sparing in the prediction of adverse outcomes in intrauterine growth restriction: Results of the multicenter PORTO study. *Am J Obstet Gynecol.* (2013); 208(4) 290e1-6.



Ductus venosus Doppler is a marker of fetal **decompensation**.

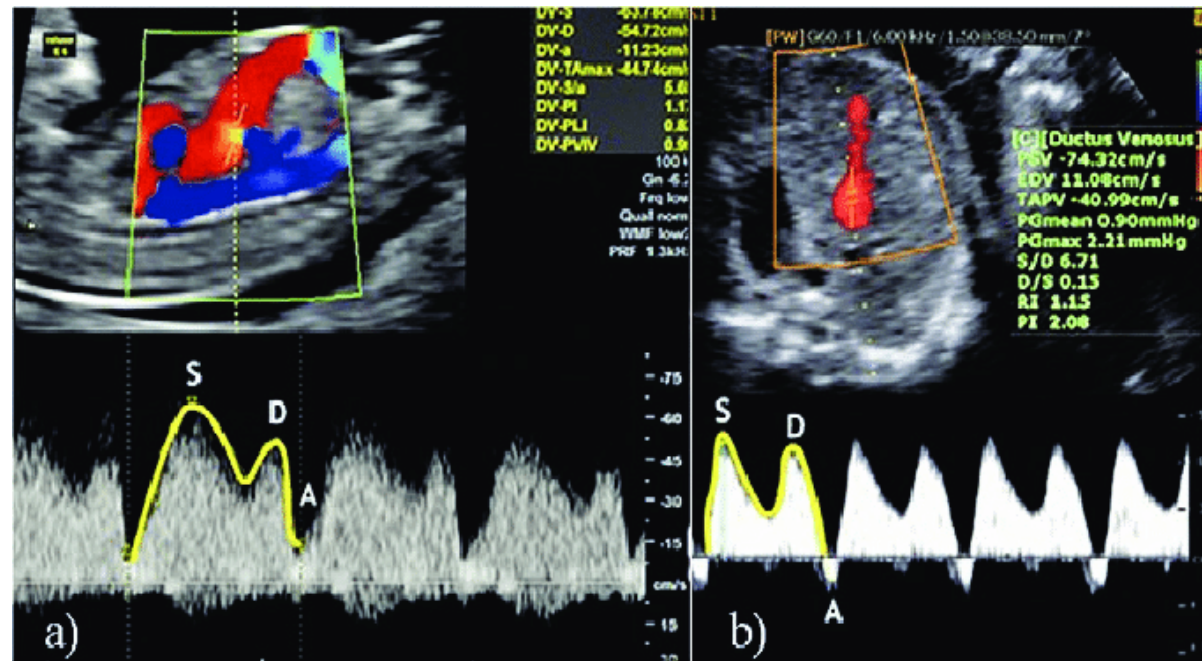


- With progressive acidosis, myocardial dysfunction occurs and RV pressure increases.
- During atrial contraction, flow toward the fetal heart is reduced, then absent, and eventually reversed.
- Abnormal flow in the ductus venosus is one of the last signs in the progression of fetal growth restriction pathology.¹

1. Mari G, Picconi J. Doppler vascular changes in intrauterine growth restriction. *Semin Perinatol.* 2008; 32 (3): 182-9.

+ Abnormal ductus venosus Doppler correlates with perinatal outcomes.^{1,2}

- Stillbirth
- Neonatal mortality
- Respiratory distress syndrome
- Bronchopulmonary dysplasia
- Intraventricular hemorrhage



1. Baschat AA et al. Relationship between arterial and venous Doppler and perinatal outcome in fetal growth restriction. *Ultrasound Obstet Gynecol.* 2000; 16: 407-16.
2. Baschat, AA. Doppler application in the delivery timing of the preterm growth-restricted fetus: another step in the right direction. *Ultrasound Obstet Gynecol.* 2004; 23: 111-118.

+ Abnormal ductus venosus Doppler is more concerning than abnormal umbilical artery or MCA Doppler.

- Abnormal DV Doppler indicates approximately 4-times higher risk of perinatal death than AEDF/REDF.¹
- Among preterm growth restricted fetuses with normal ductus venosus Doppler studies, evidence of brain sparing does not indicate increased frequency of adverse outcomes.¹

1. Baschat, AA. Doppler application in the delivery timing of the preterm growth-restricted fetus: another step in the right direction. *Ultrasound Obstet Gynecol.* 2004; 23: 111–118.

+ Middle cerebral artery and ductus venosus Dopplers are **not routinely** recommended by SMFM or ACOG.

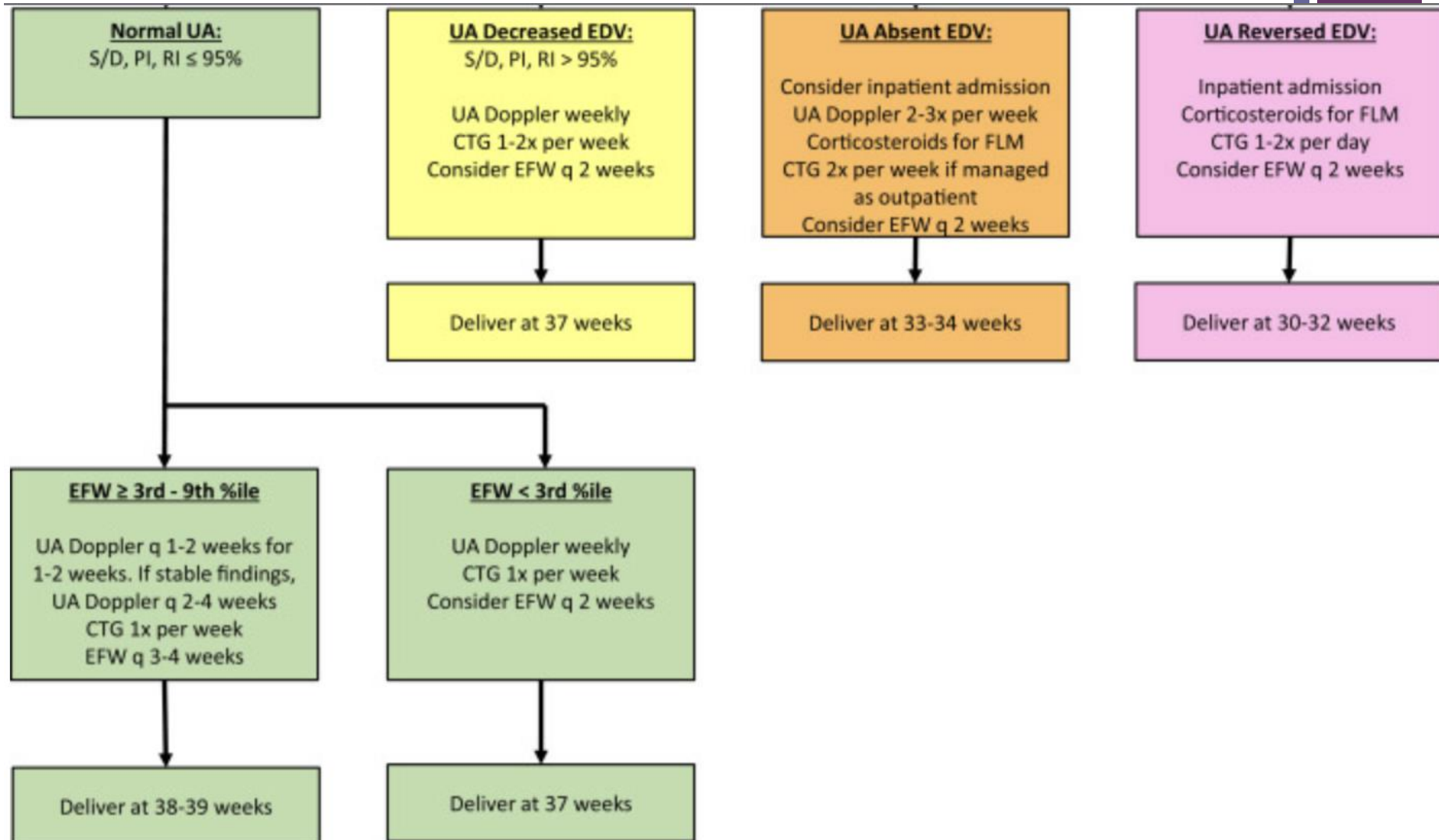
- Despite evidence that MCA and DV Doppler may be useful to further risk-stratify growth restricted fetuses, no prospective RCTs that show checking MCA or DV Dopplers leads to better outcomes.



How can we put all these pieces together?



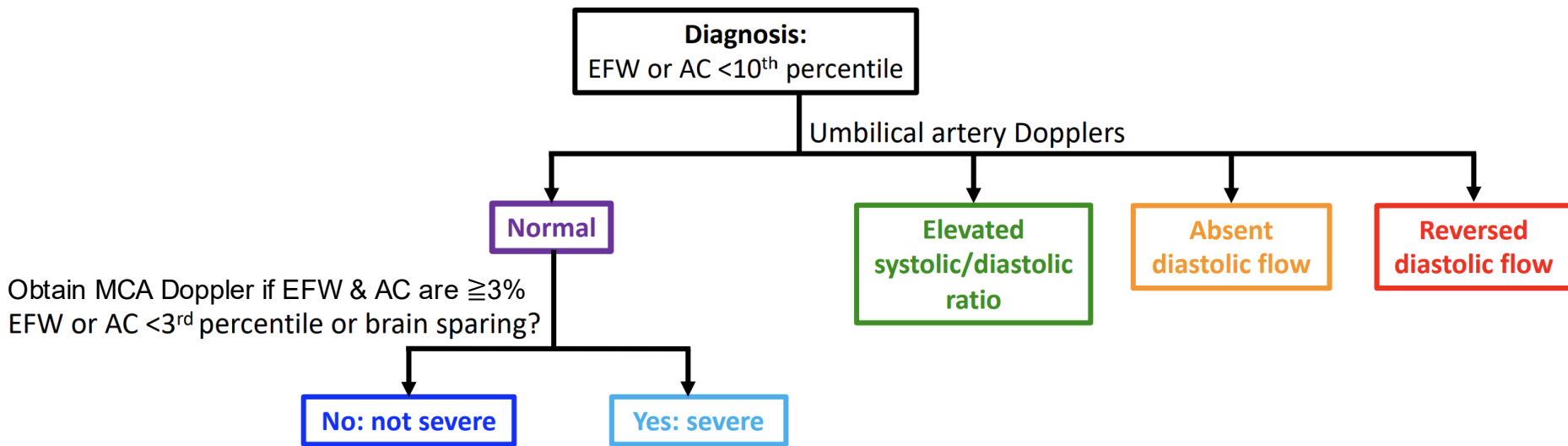
SMFM Management Algorithm





University of Colorado Consensus Algorithm

24



Admission	no	no	no	yes*	yes
Antenatal surveillance	Every week	2 per week	2 per week	2 per day	2 per day
Dopplers	Every 2 weeks	Every week	Every week	2 per week	2 per week
Delivery**	38 ⁰ -39 ⁰ weeks	37 ⁰ -37 ⁶ weeks	37 ⁰ -37 ⁶ weeks	33 ⁰ -34 ⁰ weeks	30 ⁰ -32 ⁰ weeks

+ Questions?

