

Fetal Medicine Update - Day Two (A Day's Doppler)
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MCA Doppler: When and How to Use It

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Patient comes in for a scan

- She is late
- Referral says "third trimester scan"
- You decide to do biometry, BPP

Fetal Biometry					
Main Fetal Biometry:					
BPD	75.1 mm	24	Size 14	Normal	
HC	290.0 mm	24	Size 14	Normal	
AC	270.3 mm	12%	Size 14	Normal	
FL	55.4 mm	7%	Size 14	Normal	
Fetal Weight Calculation:					
ETW	1,719 g	10%			
ETW (kg)	3.76 kg				
Calculated by	Hadlock (HC, AC, FL)				
Amniotic Fluid / FHR:					
AF MVP	4.70 cm				
AFI	12.6 cm				
FHR	158 bpm				
Other					

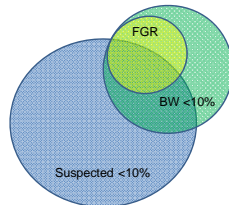


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FGR vs SGA

- SGA: reflects weight percentile (<10%)
- FGR: Reflects pathological growth, not reaching the biological potential.
- Our goal is to correctly identify FGR.



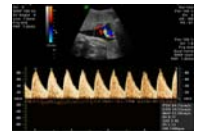
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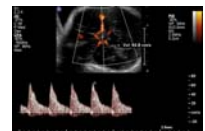
How to assess?

EFW, BPP and:
our common doppler tools:

Umbilical artery PI



Middle cerebral artery PI



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Umbilical artery

- No benefit for routine use in low risk pregnancies.
- Increased PI - an **early** sign of placental villous insufficiency/ increased resistance
- Correlated with placental pathology

Alfirevic Cochrane 2010

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MCA

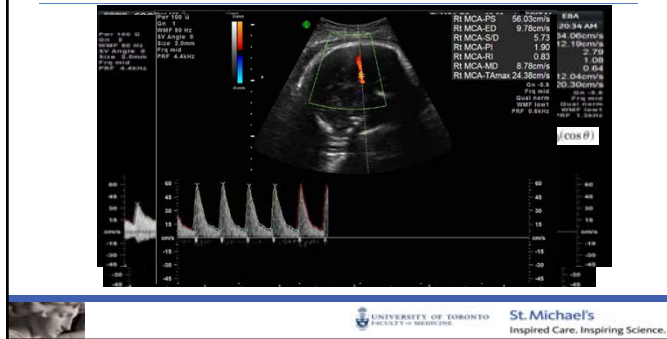
- Velocity and resistance to flow are measured.
- Reflects decreased LV afterload
- MCA PI classically used to identify fetal vascular redistribution and to guide clinical management.
- Correlation with UA indices can be variable
- Prone to variability and sensitive to poor technique



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What is the problem with the image?

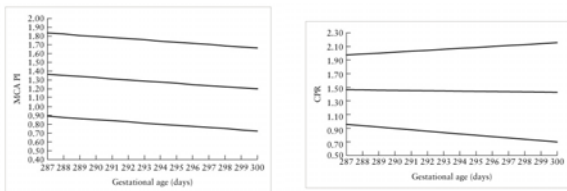


Technique

A transverse view of the fetal brain is obtained at the level of the biparietal diameter. The transducer is then moved towards the base of the skull at the level of the lesser wing of the sphenoid bone. Using color flow imaging, the middle cerebral artery can be seen as a major lateral branch of the circle of Willis, running anterolaterally at the borderline between the anterior and the middle cerebral fossae (Figure 9). The pulsed Doppler sample gate is then placed on the middle portion of this vessel to obtain flow velocity waveforms. Due to the course of this blood vessel, it is almost always possible to obtain an angle of insonation which is less than 10°. During the studies, care should be taken to apply minimal pressure to the maternal abdomen with the transducer, as fetal head compression is associated with alterations of intracranial arterial waveforms.

An axial section was obtained through the fetal brain, caudal to the level required for measurement of the biparietal diameter, with identification of the MCA using color or power Doppler settings, and an angle of insonation of 0–10°; the angle correction did not exceed 3°. The sample volume was placed near the internal carotid artery, and a measurement of the peak Doppler waveform taken after obtaining five representative waveforms.

MCA PI decreases late in pregnancy

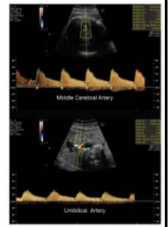


Ultrasound Obstet Gynecol 2004; 24: 447-453.

The question remains: how do we differentiate between FGR and SGA?

Is CPR the answer?

- Cerebro-Placental Ratio
- MCA PI / UA PI
- Represents the interaction between alterations in cerebral blood flow and placental resistance.
- Some 20% of term fetuses < 10% with normal UA Doppler have abnormal MCA Doppler, probably secondary to fetal hypoxia
- Thought to more accurately represent the fetal compensatory response to adverse intra-uterine environment.



Obstet Gynecol 2011; 117: 618-626
AJOG 2015 213(1): 5-15
Ultrasound Obstet Gynecol 2015; 45: 279-285.

Study	Design	Population	Variable	Outcome	Result
Khalil et al. ¹	Retrospective	EFW < 10% 34-36 weeks	CPR < 5%	NICU	CPR (not BW %) associated with NICU admission
PORTO ²	Prospective (semi-blinded)	EFW < 10%	CPR < 1.0 CPR < 5%	Composite adverse perinatal outcome ³	All CPR measures positively associated with risk of adverse perinatal outcome (OR 4.1-11.8)
Morales-Roseño ⁴	Retrospective	Term with recent US	CPR < 5%	Arterial and Venous cord PH	CPR (and not BW) was significantly correlated with both arterial-blood and venous-blood pH **
Prior ⁵	Prospective (blinded)	Term 'low risk' before active labour	CPR < 10%	Intrapartum fetal compromise	Low CPR predicted CD due to 'fetal compromise'
Cruz-Martinez ⁶	Prospective	> 37 weeks EFW and BW < 10%	CPR < 5%	CD for NRPHR	BW < 10% and CPR < 5% had higher incidence of CD and CD due to NRPHR.
Grammelin ⁶	Retrospective	90 women with Doppler exam 30-41 weeks	CPR < 1.08	Adverse perinatal outcome	CPR < 1.08 associated with PTB, SGA, CD for NRPHR, Apgar < 7, NICU, Neonatal morbidity
Flood ⁷	Prospective	881 women EFW < 10%	CPR < 1.0, CPR < 1.08, CPR < 5% (Bachall)	Composite adverse perinatal outcome	CPR < 1.0 OR 11.7 CPR < 5% JR 6.2

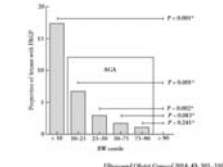
¹Intraventricular hemorrhage, periventricular leukomalacia, hypoxic-ischemic encephalopathy, necrotizing enterocolitis, bronchopulmonary sepsis, and death
** Confirmed by Nicolaides 2015 BUT DR 5-11% for a FPR of about 5% (Ultrasound Obstet Gynecol 2015; 45: 409-420)

¹ Am J Obstet Gynecol 2015; 213(issue 1) p.57.e110-57.e17
² Am J Obstet Gynecol 2014; 211:288.e1-5
³ Ultrasound Obstet Gynecol 2015; 45: 156-16
⁴ AJOG 2013, Volume 208(issue 2) Page p. 124
⁵ Obstet Gynecol 2011; 117(3), pp 618-626
⁶ Obstet Gynecol 1992; 79: 416-20
⁷ Am J Obstet Gynecol 2014; 211:288.e1-5

Are there **small** "normal" sized fetuses?

- Failure to achieve growth potential
- "normal" varies based on the growth standard used
- These fetuses have increased risk of adverse outcomes
- Can MCA/CPR identify these fetuses?

Abnormal CPR, can be found when BW > 10%

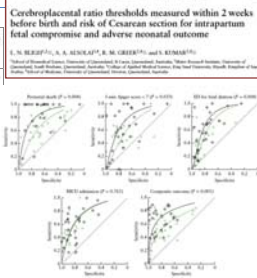


Ultrasound Obstet Gynecol 2014; 43: 301-305.

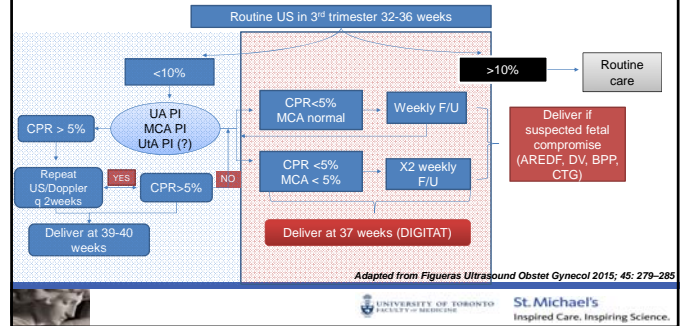
Evidence?

Prognostic accuracy of cerebroplacental ratio and middle cerebral artery Doppler for adverse perinatal outcome: systematic review and meta-analysis

- Large variability in outcomes measured and thresholds used
- CPR generally outperformed UA and MCA alone
- High false negative and false positive rate will likely lead to difficulties in clinical implementation



How can we implement?

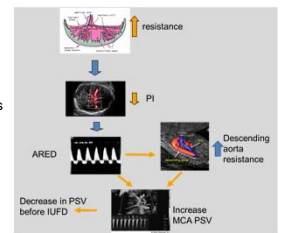


<http://medicinafetalbarcelona.org/calco/>



MCA PSV in IUGR

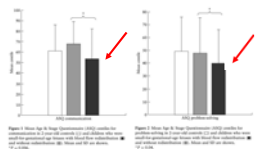
- Increase in MCA PSV might be a predictor of perinatal mortality in IUGR fetuses
- Initially, a low MCA-PI might reflect decreased brain vascular resistance and a slight increase in blood flow.
- With increased severity, the MCA-PSV increases, as a consequence of increased left cardiac output.
- When the process becomes more severe, a portion of the blood ejected from the right ventricle is shifted to the brain through the aortic isthmus because of a high vascular resistance in the descending aorta.



Ozcan T. Ultrasound Obstet Gynecol 1998

Food for thought

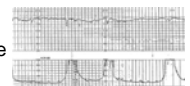
- “SGA term fetuses with isolated abnormal MCA-PI may have a higher risk of subtle neurodevelopmental deficits at 2 years of age, mainly in the communication and problem-solving areas.”



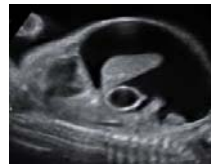
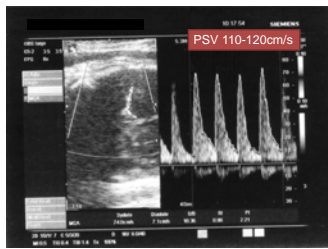
Elbornson Obstet Gynecol 2006; 52: 894-899.

Case 2

- Healthy G1 P0, 39 weeks.
- IOL due to gestational HTN.
- Notes decreased fetal movements X 2 days.
- Uncomplicated pregnancy. RH +ve. GBS -ve
- Tracing has reduced variability and mild tachycardia.
- Bedside scan : BPP 4/8
- A decision is made to induce labour.
- Tracing remains with minimal variability baseline 160-170. No maternal pyrexia



When in doubt.... Get probe out



B-K strongly positive

- Emergency CS
- Apgar 3/3
- PH 7.1/BE -11
- Hgb: 40

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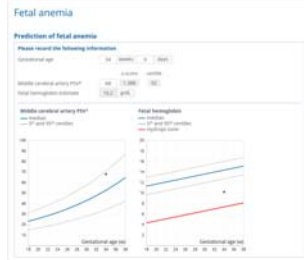
- Prenatal identification of fetal anemia can allow
 - intrauterine transfusion OR
 - Timely delivery with appropriate O negative blood ready for neonatal transfusion.
- Anemia can be the result of many causes including fetal-maternal hemorrhage, parvovirus, TAPS, internal bleeding (SCT) and alloimmunization
- Important step in the workup of fetal hydrops

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MCA in the management of the alloimmunized pregnancy

- MCA PSV is a good predictor of fetal anemia in RH alloimmunized pregnancies
- Also predictive for other RBC alloimmunization
- Used to guide need for referral for FBS
- ~ double gestational age is > 90%
- Higher threshold is needed after transfusion



<https://fetalmc.org/research/assess/anemia>

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Key points

- MCA PI with CPR is a useful tool in managing suspected late FGR
- Consider MCA PSV assessment in cases of clinically significant decreased fetal movement
- Invaluable in management of alloimmunization, monochorionic pregnancies and workup of fetal hydrops
- Technique is critical.

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