Dr Solmaz Piri
Obstetrician & Gynecologist
Prenatalologist
Fetoplacental & Uterine artery Dopplers
The risk of a term stillbirth in a nulliparous 36 years old woman is greater than the risk of her having a child with a chromosomal abnormality.
Uterine arteries
Using Doppler ultrasound, the main branch of the uterine artery is easily located at the cervicocorporeal junction, with the help of real-time color imaging. Doppler velocimetry measurements are usually performed near to this location, either transabdominally or transvaginally.
Figure 1 Waveform from uterine artery obtained transabdominally in first trimester.
Note: In women with congenital uterine anomaly, assessment of uterine artery Doppler indices and their interpretation is unreliable, since all published studies have been on women with (presumed) normal anatomy.
What is the appropriate technique for obtaining umbilical artery Doppler waveforms?
There is a significant difference in Doppler indices measured at the fetal end, the free loop and the placental end of the umbilical cord. For the sake of simplicity and consistency, measurements should be made in a free cord loop. However, in multiple pregnancies, and/or when comparing repeated measurements longitudinally, recordings from fixed sites, i.e. fetal end, placental end or intraabdominal portion, may be more reliable. Appropriate reference ranges should be used.
blood flow resistance in the umbilical artery (UA) reflects the loss of crosssectional perfusion area in the terminal villous arterial tree
What is the appropriate technique for obtaining fetal middle cerebral artery Doppler waveforms?
An axial section of the brain, including the thalami and the sphenoid bone wings, should be obtained and magnified.

- **Color flow mapping** should be used to identify the circle of Willis and the **proximal MCA**
- The pulsed-wave Doppler gate should then be placed at the **proximal third of the MCA**, close to its origin in the internal carotid artery
- The angle between the ultrasound beam and the direction of blood flow should be kept as close as possible to 0°
- Care should be taken to avoid any unnecessary pressure on the fetal head.
- At least three and fewer than 10 consecutive waveforms should be recorded. The highest point of the waveform is considered as the PSV (cm/s).
Figure 5 Color flow mapping of circle of Willis.
Fig. 14.6. Flow velocity waveforms of the MCA in an AGA fetus. The reversed flow is due to head compression.
Figure 6 Acceptable middle cerebral artery Doppler shift waveform. Note insonation angle near 0°.
Fig. 14.2. Flow velocity waveforms of the middle cerebral artery in appropriate-for-gestational-age (AGA) fetuses at different gestational ages. (From [4])
What is the appropriate technique for obtaining fetal venous Doppler waveforms?
Figure 7 Ductus venosus Doppler recording with sagittal insonation aligning with the isthmic portion without angle correction. Low-velocity vessel wall filter (arrow) does not interfere with a-wave (a), which is far from zero line. High sweep speed allows detailed visualization of variation in velocity.
Figure 8 Ductus venosus recording showing increased pulsatility at 36 weeks (a). Interference, including highly echogenic clutter along the zero line, makes it difficult to verify reversed component during atrial contraction (arrowheads). (b) A repeat recording with slightly increased low-velocity vessel wall filter (arrow) improves quality and allows clear visualization of reversed velocity component during atrial contraction (arrowheads).
Antenatal management and delivery of IUGR

Early IUGR: easy to identify, difficult to treat
Late IUGR: difficult to identify, easy to treat
In the early IUGR fetus....

Brain damage is likely to be caused by malnutrition, rather than by hypoxemia.
Early IUGR is easy to identify

All screening and diagnostic tests work properly
(especially umbilical artery Doppler)

75% of IUGR is accompanied by maternal hypertensive disease
Rank order of changes

Abnormal umbilical artery waveforms
Abnormal behavioral state development
Qualitative movement changes
Reduced amniotic fluid volume
Heart rate decelerations
Reduced heart rate variation
Ductus venosus
Reduced generalized movements
Reduced breathing movements
Absence of movements
Terminal heart rate pattern

hypoxemia  acidemia

Bekedam, Ribbert, Visser 1990
TRUFFLE Group

Randomized Management Study in IUGR

- Computerized CTG
- Early ductus changes
- Late ductus changes

All groups as safety net: computerized CTG, umbilical artery Doppler
20 European perinatal centers between 2005 and 2010. Women with a singleton fetus at 26–32 weeks of gestation, with abdominal circumference less than 10th percentile and umbilical artery Doppler pulsatility index >95th percentile, were recruited.
The timing of delivery of a baby with early preterm fetal growth restriction (FGR) poses the obstetrician with a serious dilemma.
recruited women at very preterm gestations to a European multicenter study on FGR, in which management was delivery based on the results of ductus venosus Doppler or CTG-STV monitoring according to one of three randomized arms.
The gestational age at both study entry and delivery were strongly related to infant outcome.
The most important independent determinants of the composite poor outcome (death or severe morbidity) were the presence of gestational hypertensive morbidity at study entry, gestational age at study entry; and estimated fetal weight at study inclusion.
describe somewhat better than expected perinatal outcomes in this high-risk group of fetuses, which are likely to be attributable to developments both in neonatal care and in antenatal monitoring.
But
Cerebral palsy in preterm and term SFD* infants: Population based study of 334 infants with cerebral palsy

<table>
<thead>
<tr>
<th>Category</th>
<th>OR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Early preterm &lt;34 wks</td>
<td>0.8 (0.4-1.4)</td>
</tr>
<tr>
<td>Late preterm 34-37 wks</td>
<td>1.1 (0.4-3.4)</td>
</tr>
<tr>
<td>Term &gt;37 wks</td>
<td>5.2 (2.7-10.1)</td>
</tr>
</tbody>
</table>

*customised, <10th centile preterm, <5th centile term; Jacobsson et al., BJOG 2008
Term IUGR / Small for dates

Many screening and diagnostic tests do not work properly
(and that holds especially for umbilical artery Doppler)

IUGR is not accompanied by maternal hypertensive disease
Interval Doppler – Fetal Heart Rate changes

Abnormal umbilical artery Doppler occur only if there is a 30-50% reduction of placental function/capacity.

- Early in pregnancy the small fetus can live on half of the placenta
- Late in pregnancy the fetus cannot
SGA <5th, normal amniotic fluid and Dopplers: Rescan in 2 weeks

Oligogydramnios, EFW >10th, normal Dopplers: Rescan in 2 weeks

SGA <10th AND oligohydramnios with normal Dopplers: Rescan in 1 week

SGA 5th – 10th normal amniotic fluid and Dopplers: Rescan in 4 weeks

Abnormal Doppler irrespective of growth or amniotic fluid: To see consultant on same day
Fetal assessment at 41 wks

Detection rate (%) vs. False positive rate (%)

- Fetal Heart Rate variation
- Amniotic fluid index
- Umbilical artery Doppler S/D

Weiner et al., AJOG, 1994; n = 367
## Risk factors for 3rd trimester stillbirth

<table>
<thead>
<tr>
<th>Risk Factor</th>
<th>OR multivariate</th>
</tr>
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<tbody>
<tr>
<td>IUGR / SFD</td>
<td>7.0 (3.3-15.1)</td>
</tr>
<tr>
<td>Age &gt;35 yrs</td>
<td>4.1 (1.0-16.5)</td>
</tr>
<tr>
<td>BMI &gt;25 Kg/m²</td>
<td>4.7 (1.7-10.2)</td>
</tr>
<tr>
<td>Education &lt;10 yrs</td>
<td>3.4 (1.2-9.6)</td>
</tr>
<tr>
<td>IUGR / BMI &gt;25 Kg/m²</td>
<td>71 (14 - 350)</td>
</tr>
</tbody>
</table>

(univariate OR)

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Froen, Gardosi et al., Acta Obstet Gynecol Scand 2004; 83: 801-7;
Unexplained stillbirth (n=76), Controls (n=582)
FGR versus Placental Failure

Early placental failure:
- FGR a cardinal feature
- Low metabolic demands
- Long latency to demise

Late placental failure:
- FGR rarely seen
- High metabolic demands
- Short latency to demise
The lower the birthweight, the higher the proportion of fetuses showing signs of redistribution.

Ultrasound Obstet Gynecol 2014; 43: 303–310
CPR and Mortality

Uterine perfusion, fetal size and CPR all associated with PNM

<table>
<thead>
<tr>
<th></th>
<th>N=2832</th>
<th>Adj OR</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perinatal death (n=18)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BW centile</td>
<td></td>
<td>0.98</td>
<td>0.080</td>
</tr>
<tr>
<td>UtAD PI</td>
<td></td>
<td>0.63</td>
<td>0.300</td>
</tr>
<tr>
<td>CPR MoM</td>
<td></td>
<td>0.004</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

Multivariable regression shows that only CPR significantly associated with PNM.
The combination of EFW and CPR discordance had the best predictive performance for perinatal mortality (AUC=0.96).

Detection rate = 87.5%
False positive rate = 6.7%
Positive LR = 13.08
Negative LR = 0.13

Khalil A et al. AmJOG. 2015
But not approved in prospective studies
Why to screen in the first trimester

Vainio et al., BJOG 2002
120 women
Prior pre-eclampsia
Prior stillbirth
Prior IUGR <28 weeks

bilateral uterine artery notching at 11-14 weeks

90 randomized
P<0.05

Aspirin 0.5 mg//Kg/day
11.6% PIH
2.3% PIH < 37 weeks
4.7% Pre-eclampsia
2.3% IUGR

Placebo
37.3%
20.9%
23.3%
7.7%

Yu et al., UOG 2004
19950 women

880 elevated uterine artery Doppler at 22-24 weeks

560 randomized

Aspirin 150 mg/day
18%
6%
22%

Pre-eclampsia
Pre-eclampsia requiring delivery <34 weeks
IUGR

Placebo
19%
8%
24%
Aspre Clinical trial
Co-occurrence of cardiovascular & prothrombotic risk factors in women with a history of pre-eclampsia

1224 Women with prior pre-eclampsia

- 66% - Circulatory risk profile
- 19% - Hyperhomocysteinemia
- 15% - Metabolic syndrome
- 11% - Thrombotic profile
- 22% - no abnormalities

Distribution of risk profiles in a specific population

Sholten et al., Obstet Gynecol 2012
Placental success - mean BP

MAP = Diastolic BP + (Systolic BP - Diastolic BP) / 3

Mean arterial pressure = AUC 0.76

N=1024, PE 5.2%, <34 weeks 1.8%

Poon et al., 2009: n=9,149; Early-PE 0.5% Late-PE 1.5% GH 1.7%
Aspirin started by 16 weeks

- ASA and preeclampsia:
  - < 16 weeks - RR 0.47 (0.34-0.65, prevalence 9.3% vs. 21.3%)
  - > 16 weeks - RR 0.81 (0.63-1.03, prevalence 7.3% vs. 8.1%)

- ASA and fetal growth restriction:
  - < 16 weeks - RR 0.44 (0.30-0.65, prevalence 7% vs. 16.3%)
  - > 16 weeks - RR 0.98 (0.87-1.10 prevalence 10.3% vs. 10.5%)

ASA >20 wks = 2.5 x increased abruption risk

Bujold et al, Obstet Gynecol, 2010

### JNC 7 - CRITERIA

<table>
<thead>
<tr>
<th>Classification of Blood Pressure (BP)*</th>
<th>SBP mmHg</th>
<th>DBP mmHg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal</td>
<td>&lt;120</td>
<td>&lt;80</td>
</tr>
<tr>
<td>Prehypertension</td>
<td>120–139</td>
<td>80–89</td>
</tr>
<tr>
<td>Hypertension, Stage 1</td>
<td>140–159</td>
<td>90–99</td>
</tr>
<tr>
<td>Hypertension, Stage 2</td>
<td>≥160</td>
<td>≥100</td>
</tr>
</tbody>
</table>

No pre-existing cardiovascular risks

- Rx HTN > stage 1
- <140 / <90

Pre-existing vascular risks

- Rx pre-HTN
- <120 / <80
Blood pressure tracking during pregnancy and the risk of gestational hypertensive disorders: The Generation R Study

Women with subsequent gestational hypertension or pre-eclampsia have first trimester BP of >120/74

Gaillard et al, Eur Heart Journal, 2011
The Treatment of Hypertension During Pregnancy: When Should Blood Pressure Medications Be Started?

Scantlebury et al., Curr Cardiol Rep, 2013

Easterling et al, 1999
- Atenolol vs. placebo
- >22 weeks, if CO > 7.8
- Atenolol: BW ↓ 440gr
- SGA rate 4.8%
- PET reduced 5fold

v. Dadelzsen et al, 2000
- MAP ↓ 10 = BW ↓ 145gr
- BP & fetal growth relate over narrow range
- Diastolic BP important
- 3rd trim. effect greater
- Normal outcome occurs with JNC-7 normotension

Half the Sky: How to Change the World

Nicholas D. Kristof & Sheryl WuDunn
Professor Amartya Sen [the Nobel Prize winning economist] found that: about 107 million females are missing from the globe today ...

On average girls are brought to the hospital only when they are sicker than boys.

The best estimate is that a little girl dies from discrimination every four minutes.
ОБЩЕСУЖЕНЕ

АЗЫ КАРЛИЦ
Ульяна Головкина
Перфорация головки
1866 г.
Looking at maternal & neonatal mortality and morbidity is a great way to look at a health system as a whole because it requires you to do a great many things.

Saving women’s & neonates lives is imperative but it is neither cheap nor simple.
Thank you very much for your attention