Imaging of the Placenta: Ultrasound

Alfred Abuhamad, MD.
Eastern Virginia Medical School
Nothing to Disclose
Today's Obstetric Ultrasound

- 30 min
- 29 min (Fetus)
- 1 min (Placenta)
Outline

• Placental Biometry
• Color and pulsed Doppler
• 3D Ultrasound
• Elasticity
• Limitations
Placental Biometry

- Placental thickness
- Placental basal plate surface
- Placental volume
Placental Thickness and Fetal Weight

Table 2
Comparison of the median for the placental endocrinologic and ultrasound measurements in normal controls (n = 42) and PE (n = 14).

<table>
<thead>
<tr>
<th>Variables</th>
<th>Controls</th>
<th>PE</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Median</td>
<td>LQ; UQ</td>
<td>Median</td>
</tr>
<tr>
<td>Placental thickness (mm)</td>
<td>18.7</td>
<td>16.0; 23.2</td>
<td>17.9</td>
</tr>
<tr>
<td>Basal plate surface (mm²)</td>
<td>431</td>
<td>329; 499</td>
<td>329</td>
</tr>
<tr>
<td>Placental volume (mm³)</td>
<td>61.4</td>
<td>47.8; 92.6</td>
<td>48.6</td>
</tr>
<tr>
<td>fβhCG (MoM)</td>
<td>1.06</td>
<td>0.73; 1.58</td>
<td>1.14</td>
</tr>
<tr>
<td>Inhibin A (MoM)</td>
<td>0.96</td>
<td>0.79; 1.33</td>
<td>1.37</td>
</tr>
<tr>
<td>PAPP-A (MoM)</td>
<td>1.08</td>
<td>0.76; 1.33</td>
<td>0.52</td>
</tr>
</tbody>
</table>

Data are presented as median and lower quartile (LQ); upper quartile (UQ).
Color and Pulsed Doppler

- Maternal vessels (spiral)
- Fetal vessels (chorionic)
- Uterine arteries
- Umbilical arteries
- Umbilical vein
Maternal Vessels
Fetal Vessels
Doppler and Placental Perfusion

• In late onset SGA pregnancies:
  – Uterine Doppler and umbilical vein flow are surrogates for placental under-perfusion

Ultrasound Obstet Gynecol 2014;10.1002 (Epub) – Parra-Saavedra
3D Ultrasound

• Vascularization Index / variations
• Placental volume
3D Fractional Volume

Location for measurement moved to correspond with sites selected in Figure 1b

Stereology grid placed in plane A for counting

Volume of placenta traced in 4D View (outlined in yellow)
Table 2: Studies regarding the value of different parameters from 3D assessment for the prediction of adverse pregnancy outcome.

<table>
<thead>
<tr>
<th>Study</th>
<th>Year</th>
<th>N</th>
<th>Week</th>
<th>Population</th>
<th>Parameter</th>
<th>Prediction</th>
<th>Screening</th>
</tr>
</thead>
<tbody>
<tr>
<td>Merce</td>
<td>2005</td>
<td>99</td>
<td>14-40</td>
<td>Normal</td>
<td>PB, VI, Fl, VFI</td>
<td>Correlation with GA</td>
<td>Useful</td>
</tr>
<tr>
<td>Zalud</td>
<td>2007</td>
<td>199</td>
<td>14-25</td>
<td>Normal</td>
<td>VI, Fl, VFI</td>
<td>Definition of indices in 2nd trimester</td>
<td>Useful</td>
</tr>
<tr>
<td>GJiot</td>
<td>2008</td>
<td>45</td>
<td>23-37</td>
<td>Normal &amp; FGR</td>
<td>VI, Fl, VFI</td>
<td>FVW in Normal and IUGR</td>
<td>Useful</td>
</tr>
<tr>
<td>Zalud</td>
<td>2008</td>
<td>199</td>
<td>14-25</td>
<td>Normal</td>
<td>VI, Fl, VFI</td>
<td>Correlation with maternal age and parity</td>
<td>Placental indices have constant distribution</td>
</tr>
<tr>
<td>DePaula</td>
<td>2009</td>
<td>295</td>
<td>12-40</td>
<td>Normal</td>
<td>VI, Fl, VFI</td>
<td>Quantitative analysis of PV</td>
<td>Altered 3D placental indices, useful</td>
</tr>
<tr>
<td>Rizo</td>
<td>2009</td>
<td>84</td>
<td>11-14</td>
<td>Low PAPP-A</td>
<td>PV, VI, Fl, VFI</td>
<td>Pregnancy outcome</td>
<td>Altered 3D placental indices, useful</td>
</tr>
<tr>
<td>Noguchi</td>
<td>2009</td>
<td>208</td>
<td>12-40</td>
<td>Normal</td>
<td>PB, VI, Fl, VFI</td>
<td>FGR</td>
<td>VI &amp; VFI more reliable than Fl in PB</td>
</tr>
<tr>
<td>Tuuli</td>
<td>2010</td>
<td>120</td>
<td>11-14</td>
<td>Normal</td>
<td>VI, Fl, VFI</td>
<td>Correlation of indices±PB</td>
<td>Significant correlation</td>
</tr>
<tr>
<td>Hafner</td>
<td>2010</td>
<td>383</td>
<td>11-14</td>
<td>Normal</td>
<td>PV, PQ, VI, Fl, Uterine art. Doppler</td>
<td>Pregnancy outcome</td>
<td>Useful for IUGR and PE</td>
</tr>
<tr>
<td>Yigiter</td>
<td>2011</td>
<td>310</td>
<td>11-14</td>
<td>Normal</td>
<td>PV, VI, Fl, VFI, uterine art. Doppler</td>
<td>PAPP-A, IGF-1, free β-hCG</td>
<td></td>
</tr>
<tr>
<td>Obido</td>
<td>2011</td>
<td>388</td>
<td>11-14</td>
<td>Normal</td>
<td>PV, VI, Fl, VFI</td>
<td>Adverse pregnancy</td>
<td></td>
</tr>
</tbody>
</table>

PB: Placental sonobiopsy; VI: Vascularization index; Fl: Flow index; VFI: Vascularization flow index; PV: Placental volume; PQ: Placental quotient; PE: Pre-edampsia; FGR: Fetus growth restriction; FVW: Flow velocity waveforms

J Ultrasound Obstet Gynecol 2013:7(1):73
Placental Elasticity by Ultrasound

- Tissue stiffness and compliance
- Measuring the shear wave that propagates through tissue in recoil
Placental Elasticity: Acoustic Radiation Force Impulse Imaging

A plastic bag

transducer

region of interest (ROI)

water

placenta

buffer material

B

Intermediate cord insertion marginal

Placenta 34 (2013) 1009e1013
Placental Elasticity: AR Force Impulse Imaging

Vs: Velocity of lateral shear wave
Faster wave correlates with stiffer tissue

Placenta 34 (2013) 1009e1013
Limitations

• Technical error in measurement
• Placenta cannot be seen in its entirety after 24 weeks
• Anterior placenta is more amenable to ultrasound imaging
• Movement and pulsation of maternal vessels introduce error
• Wide scope validation studies not done