**First Trimester Ultrasound**

- Mean Gestational Sac Diameter
- Crown Rump Length
- Embryonic Cardiac Activity
- Yolk Sac

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**Obstetrical Measurements**

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**Anembryonic Gestation**

“Blighted Ovum”

MSD ≥ 25mm “No embryonic pole”

Crown-Rump Length

- Embryonic length
- Most accurate US measurement for estimation of gestational age (+/- 5-7 days)
  - especially between 6 - 9 weeks

Avoid Inaccurate CRL

1st Trimester (GS & CRL)

- Qualitative
  - Small, tight GS relative to size of embryo

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**1st Trimester (GS & CRL)**

**Qualitative**
- Small, tight GS relative to size of embryo

**Quantitative**
- \((\text{MSD} - \text{CRL})\)
  - Normal if \(> 5\) mm (92%)
  - Abnormal if \(< 4\) mm (94% miscarriage)

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**CRL Measurements**

TRV vs. SAG

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Bromley, et. al. 1991
Kurtz et. al. 1992
**1st Trimester**

- Estimates of CRL which are poor estimates should be excluded from the mean CRL.
- Gestational age should not be an average of that based on MSD and CRL.
- EDD is determined on the initial first trimester ultrasound based on CRL and **SHOULD NOT BE CHANGED** based on subsequent ultrasounds.

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**Embryonic Cardiac Activity**

- Should have visible heart beat \( CRL \geq 7 \text{mm} \)

*Peter M. Doubilet, Carol B Benson et al, N Engl J Med 2013; 369:1443-51*

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**Embryonic Cardiac Activity**

- Bradycardia < 80 bpm: poor prognosis
- Absence may be NL in embryos < 4 mm
Caution

In keeping with the ALARA principle, M-mode should be used instead of spectral Doppler to document embryonic heart rate.

"Don’t"

Time-averaged acoustic intensity delivered to the fetus is lower with M-mode than with spectral Doppler.

Diagnostic Challenge

Embryonic Yolk Sac

- Failure to visualize (MSD ≥ 13mm)
- Size: > 7mm
- Shape: irregular
- Calcified / echogenic

Embryonic Yolk Sac

"Don’t"

"Don’t"
**Embryonic Yolk Sac**

- "Outer To Outer"

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**Increased NT**

- Chromosome abnormalities
  - (T13, T18, T21, XO)
- Cardiac defects
- Genetic syndromes
- Skeletal dysplasias
- Miscarriage
- Discordance of NT in monochorionic twins is an early marker for TTTS

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**Embryonic Yolk Sac**

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**2nd & 3rd Trimester Measurements**

- Biparietal diameter
- Head circumference
- Lateral atrial ventricular diameter
- Transverse cerebellar diameter
- Cisterna magna
- Nuchal fold (16 to 20 weeks)
- Abdominal circumference (including skin)
- Femur diaphysis length
- Humerus diaphysis length
An imaging parameter for a standard fetal examination includes determining gestational age using various measurements:

- BPD / HC
- AC
- FL
- HL

• How does this age compare to menstrual dates?
• How the head, body & femur correspond to each other?
• Measurements & ultrasound age need to be correlated

**Biparietal Diameter**

- After CRL, BPD is next most reliable US parameter for age prediction
- Accuracy decreases as pregnancy advances, especially after 26 weeks

**Abnormal Head Shape**

- Brachycephalic: (larger BPD)
- Dolicocephalic: (smaller BPD)

**Cephalic Index**

“Ratio used to evaluate head shape”
**Cephalic Index**

"Ratio used to evaluate head shape"

- **CI** = \( \frac{\text{BPD}}{\text{FOD}} \times 100 \)

- Normal range
  - At 1SD = 74-83
  - At 2SD = 70-86

- Dolicocephalic CI < 70
- Brachycephalic CI > 86

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**Caution**

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Obstetrical Measurements

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Obstetrical Measurements

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3/6/2019
**Abnormal Head Shape**
- What should you use?
  - Area corrected BPD
  - Head circumference

**Area Corrected BPD**
- Calculate when CI is \( \leq 70 \) or \( \geq 86 \)
- Corrects BPD to an ideal head shape

\[
BPD_{ac} = \sqrt{\frac{(BPD \times FOD)}{1.265}}
\]

Doubilet PM, Greenes RA, AJR, 142:797-800, 1984

**Head Circumference**
- HC takes into account the shape of the head
- When properly done, HC is a reliable measurement for gestational dating
- HC is measured at the same level a BPD, around the outer perimeter of the bony calvarium, excluding subcutaneous tissues of the skull

**Head Measurements**
How to Locate the Atrium?

- The glomus of the choroid plexus…
  - Easy to identify

- Location of the glomus may change depending
  - On the shape of choroid plexus
  - On the degree of dilatation of ventricle

- Neuroanatomy suggests a more reliable landmark
  - Internal parieto-occipital sulcus
How to Locate the Atrium?

- Location of the glomus may change depending
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Neuro-anatomy suggest a more reliable landmark
- Internal parieto-occipital sulcus

Anterior landmark: cavum septi pellucidi or columns of fornix
Posterior landmark: ambient cistern (echogenic triangular area)
Measurement: performed opposite the internal parieto-occipital sulcus

Internal Parieto-occipital Sulcus
**Cerebellar View – Cerebellum Shape**

**Cerebellar View – Cisterna Magna**

- Size: 2-10 mm
  - < 2 mm spina bifida (ACII)
  - > 10 mm Dandy-Walker

*land marks are not well visualized*

*columns of fornix instead of CSP*

*too much atrium of the LV seen*

*scanning plane is off axis*

*orbits are visualized*

*land marks are not well visualized*

*scanning plane is off axis*

*orbits are visualized*

*petros & sphenoid bones are seen*
**Abdominal Circumference**

- Not used for dating a pregnancy
- Used for estimation of fetal weight
  - Detection of growth restriction & macrosomia
- Compared to fetal head size for symmetry

**How to measure?**

- Measure across entire abdomen
- Perpendicular to spine
  - Do not oblique
Abdominal Circumference

HC:AC Ratio

- Varies with gestational age
- Ratio is approximately 1:1
  - Range of means: from 1.23 at 13-14 weeks to 0.96 at 41-42 weeks
- Ratio decreases with age
  - BPD growth slows
  - Abdominal growth continues

If you are certain of GA based on the earlier study then the ratio is valuable

<table>
<thead>
<tr>
<th>GA (weeks)</th>
<th>Mean</th>
<th>5% to 95% percentile</th>
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</thead>
<tbody>
<tr>
<td>13 – 14</td>
<td>1.25</td>
<td>1.14 to 1.31</td>
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<tr>
<td>15 – 16</td>
<td>1.22</td>
<td>1.05 to 1.39</td>
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<tr>
<td>17 – 18</td>
<td>1.18</td>
<td>1.07 to 1.29</td>
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<td>19 – 20</td>
<td>1.18</td>
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<td>21 – 22</td>
<td>1.15</td>
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<td>23 – 24</td>
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<td>25 – 26</td>
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<tr>
<td>33 – 34</td>
<td>0.96</td>
<td>0.95 to 1.00</td>
</tr>
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</table>

Campbell Br J Obstet Gynaecol 84:165-174, 1977
**Femoral Length**

- Length of femoral shaft (diaphysis)
- Do not include distal "epiphyseal spur"

**Humerus Length**

**Fetal Weight**
**Estimated Fetal Weight**

- Should include at least the following three fetal parameters
  - Head, Abdomen & Femur

- In general US accuracy is 15-20% (95% confidence range)
- **Remember** that you are not dealing with an absolute number

- (±15% of 4000 gm is 600 gm (3400-4600 gm))

**Very Important!**

**Estimated Fetal Weight**

For estimated fetal weight to have clinical value, one must know the gestational age to obtain weight percentile

**Neonatal Weight**

<table>
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<th>10th</th>
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</tbody>
</table>

**Interval Growth Rate**

Scans for growth evaluation can typically be performed at least 3 weeks apart