Objectives

• Review guidelines for prenatal scanning
• Describe standard anatomic measurements
• Discuss normal anatomic structures identified on routine prenatal US
Overview: Normal

Maternal Anatomy

• Uterus and adnexa
• Placenta
• Cervix
• Amniotic fluid

Fetal Anatomy

• Sonographic predictors of gestational age
• Head, face, and neck
• Chest
• Abdomen
• Spine
• Extremities
ACR Practice Guidelines & Technical Standards

Imaging Parameters for a Standard Fetal Examination

Minimum Elements of a Fetal Anatomic Survey

Guidelines: 1st Trimester

- Location of pregnancy: (sac, embryo)
- Gestational Age: CRL, Mean gestational Sac
- Cardiac Activity (>5mm)
- Number: Chorionicity, amnionicity
- Nuchal region
- Uterus, cervix, adnexa
Basic 2\textsuperscript{nd} Trimester – WHO? WHEN?

- All pregnancies
- 18-22 weeks
- Well trained professionals
- Up to date equipment
  - Real time
  - 3-5 MHz abdominal transducer
  - Higher MHz linear transducer when possible
  - $\geq 5$-10 MHz transvaginal transducer
  - ALARA (power exposure)
Basic 2\textsuperscript{nd} Trimester – HOW?

6 BASIC STEPS

1. Maternal Anatomy
2. Location /Viability
3. Number
4. Biometry
5. Basic Anatomy
6. Report documentation
1. Maternal Anatomy

Guidelines

• Uterus and adnexa
• Placenta
• Cervix
• Amniotic fluid
Placenta

- Discoid
- Thickness = GA in weeks (+/- 10 mm). max ~ 4 cm³
- Assess shape, location, distance from internal cervical os, retroplacental complex

Abnormal shape: circumvallate, succenturiate lobe (5%), masses
Abnormal distance from os: > 2 cm from internal os;
placenta previa, vasa previa
Retroplacental complex: < 2 cm, hemorrhage, contraction, abruption
Placenta Differential

Placental penetration
- Placenta accreta
- Placenta increta
- Placenta percreta

Types of placenta previa
- Low-lying
- Marginal previa
- Complete previa
- Central previa
Placenta Previa

abnormal implantation of placenta over lower uterine segment or os

• Subtypes
  • Low-lying placenta – within 2 cm of internal os
  • Marginal previa – to edge but doesn’t cover
  • Complete previa – covers internal os
  • Central previa – placenta centered over internal os
Cervix

- 3-4 cm in length. Incompetent <2.5 cm
- < 2 cm increased risk of preterm birth
- If abnormal, image post-void and use translabial or transvaginal sonography
- funneling
Amniotic Fluid

- Subjective vs. AFI
- 6-24 cm normal AFI
- maternal
  - PROM, Dm
- fetal
  - obstruction, CNS
2. Location/Viability

- Heart beating
  - 120-160 bpm
- Fetal motion
- Fetal lie
3. Number

- 1\textsuperscript{st} trimester best time
- Chorionicity/amnionicity

<table>
<thead>
<tr>
<th></th>
<th>Dichorionic</th>
<th>Monochorionic Diamniotic</th>
<th>Monochorionic monoamniotic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Placenta</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Membrane</td>
<td>thick</td>
<td>thin</td>
<td>☐</td>
</tr>
<tr>
<td>Δ, twin peak</td>
<td>Δ</td>
<td>λ</td>
<td>☐</td>
</tr>
<tr>
<td>Gender</td>
<td>= / ≠</td>
<td>=</td>
<td>=</td>
</tr>
<tr>
<td>entangled cords</td>
<td>☐</td>
<td>☐</td>
<td>+</td>
</tr>
</tbody>
</table>
4. Biometry

- Gestational age
- Growth
  - BPD/HC/AC/FL
- Rigorous technique
  - Repeated measurements
  - Report percentiles, mean for GA, curves
Biparietal Diameter (BPD)

- Axial - Third ventricle and thalami
  - perpendicular to falx
  Symmetric hemispheres
- Measure outer skull margin to opposite inner skull margin
Head Circumference

- Plane of third ventricle and thalami
- Cavum septum pellucidum anteriorly
- Outer to outer margin of skull
Abdominal Circumference

Axial – round

- Measure skin line on transverse view
- Level of the junction of the umbilical vein, portal sinus, and fetal stomach
Femur Length

- Measured long axis of diaphysis –
  - cursors at junctions of bone with cartilage
  - avoid obliquity / exclude cartilaginous epiphyses
  - Mild curved appearance normal
  - <60 degree insonation

FL mild shortening

- ?fetal chromosomal abnormality or syndrome
5. Basic Fetal Anatomy

- Be SYSTEMATIC
- *Only* way to not miss major anomalies
SITUS
Fetal Head

- Skull
- Hemispheres – ventricles, choroid
- Midline- cavum, falx
- Posterior fossa- Cerebellum, cisterna magna
- Nuchal thickness
Ventricles

- transverse plane at distal atrium
- cursors inside/perpendicular to ventricular walls at level of choroid
- $N < 10 \text{ mm}$
- $3^{rd}$ ventricle should not exceed 3 mm in diameter
- $4^{th}$ ventricle triangular
Cavum Septum Pellucidum

presence of CSP to exclude agenesis of the corpus callosum
Corpus Callosum
Cerebellum

• Bilobed shape
• Hyperechoic midline vermis
• Hypoechoic cerebellar hemispheres
• Growth proportional to GA
• Cisterna Magna
Nuchal Fold

• Midline soft tissue posteriorly from outer surface of occipital bone
• Measured standard posterior fossa plane b/w 15 -21 wks
• > 6 mm abnormal
Lips/Face

Guidelines – orbits/mouth, lip, nose
Coronal plane - upper lip, philtrum, nose, brow, orbits exclude cleft, midface anomalies
Sagittal plane - micrognathia, frontal bossing
Spine

- longitudinal and transverse - cervical, thoracic, lumbar, and sacral spine
- transverse images best
- Overlying Skin
- Ossification centers
- Head to sacrum
Spine
Spine - Axial

- Vertebra 3 ossification centers
- Posterior 2 ossification centers (lamina) oriented inward or parallel
Chest: Normal

Size, appearance, shape
Lung parenchyma- homogeneous
4 Chamber Heart

Axial

Apex deviates leftward 45 degrees
Chamber closest to the chest wall is right ventricle
Chamber closest to the spine is left atrium
Evaluate atria, ventricles, septa, valves
Right Ventricular Outflow Tract (RVOT)

• Short axis base view of the heart –
  • perpendicular origins of RVOT and aorta
• Cephalad from standard 4 chamber view - axial plane towards base of heart
  • exclude outflow tract anomalies (e.g. truncus arteriosus, transposition)
Left Ventricular Outflow Tract (LVOT)

- Scanning left ventricle and then scanning toward the right shoulder of fetus - longitudinal axis view of LVOT
- Rotation in other direction obtain RVOT
3 vessel view
Figure 1. Standardized transverse scanning planes for fetal echocardiography include an evaluation of the four-chamber view (1), arterial outflow tracts (2 and 3), and the three-vessel trachea view (4). Ao indicates descending aorta; LA, left atrium; LV, left ventricle; PA, pulmonary artery; RA, right atrium; RV, right ventricle; and Tr, trachea.

Figure 2. Sagittal views of the superior and inferior vena cavae (1), aortic arch (2), and ductal arch (3). The scan angle between the ductal arch and thoracic aorta ranges between 10° and 15° during pregnancy, as illustrated by the A-chamber view.
Figure 3. Low and high short-axis views of the fetal heart. Ao indicates aortic valve; LV, left ventricle; PA, pulmonary artery; RA, right atrium; and RV, right ventricle.
Abdomen

- Stomach (presence, position)
- Bowel (< 2mm, < bone, no free fluid)
- Cord insertion
- Genitalia (when indicated)
Cord Insertion

3 vessel cord inserting into midline anterior abdominal wall

• Omphalocele midline with cord inserting into defect; gastroschisis lateral to cord insertion
3 Vessel Cord

2 umbilical arteries and 1 umbilical vein
  • single uterine artery associated with 30-60% increased incidence of other anomalies

Umbilical arteries along bladder margin caudally
Umbilical vein courses cephalic into liver
Kidneys

- 2 kidneys Length = GA
- Corticomedullary differentiation
- Minimal pyelectasis normal if < 4-5 mm
Bladder

Anechoic round, ovoid pelvic structure
Absent or distended bladder requires further evaluation
Extremities

• 4 limbs - Check presence of humerus, radius, ulna, femur, tibia, fibula
• Exclude club foot
• Assess hands
• Assess Motion
Extremities
Doppler
Normal umbilical artery / vein
Umbilical artery: Reversal of flow
MCA Doppler
MCA: increased diastolic “brain sparing”
Portal Vein

Ductus Venosus

Monophasic
Report

- Date
- GA
- Limits of exam
- Anomalies
- Recommendations
Summary

• Appropriate screening requires complete assessment of fetal anatomy
• Optimal time 18-22 weeks
  — ? First trimester
  — ? Third trimester
• Need to know anatomy, optimal positioning, and gestational age ranges to distinguish normal from abnormal