OB/GYN Imaging Overview

Marcus John Julius, M.D.

Session Objectives

- To delineate the various imaging modalities available for assessment of the female pelvis (including radiographs, sonography, CT, MRI)
- To compare and contrast transvaginal and transabdominal sonography.
- To illustrate the pertinent findings on a normal pelvic sonogram of the non-gravid uterus
- To demonstrate the role of pelvic CT and pelvic MR in the assessment of diseases of the female pelvis
- To display the sonographic features of a normal first trimester pregnancy
- To discuss the main biometric features of a normal $2^{nd}/3^{rd}$ trimester pregnancy

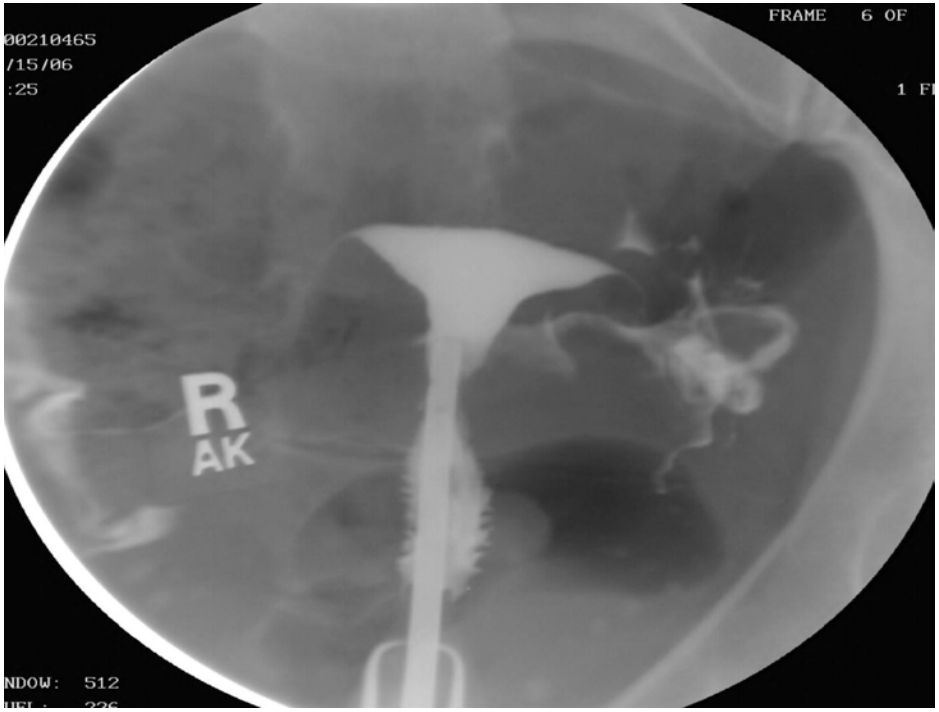
Imaging modalities for assessment of the female pelvis

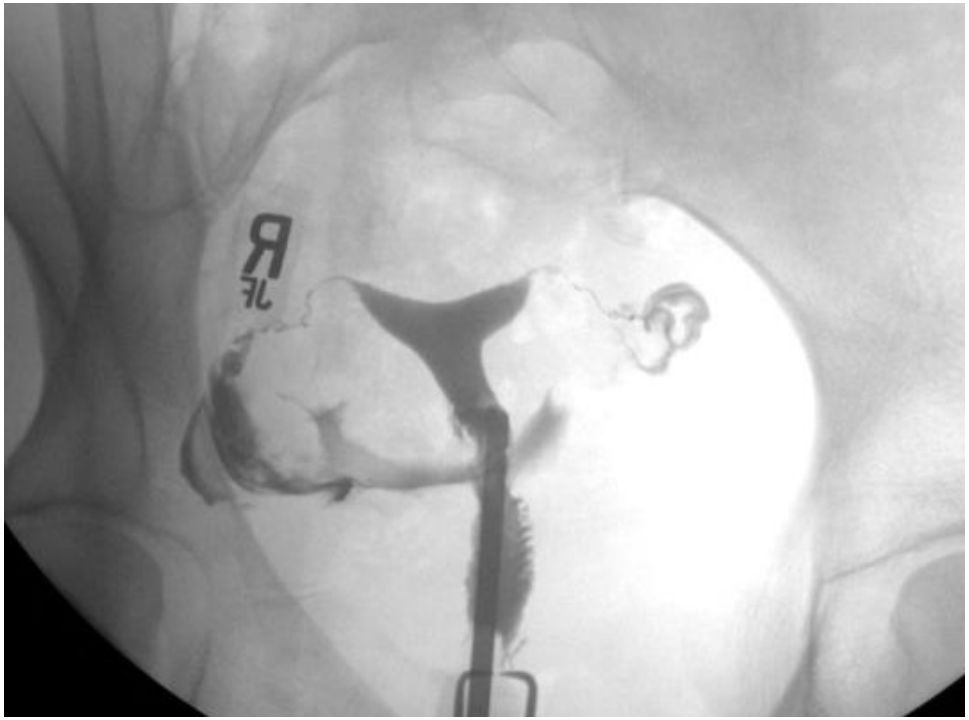
- Radiographs
  - *Hysterosalpingogram (HSG)*
- Sonography
  - Transabdominal
  - Transvaginal
- Computerized axial tomography (CT)
- Magnetic resonance imaging (MRI)

Indications for Hysterosalpingography

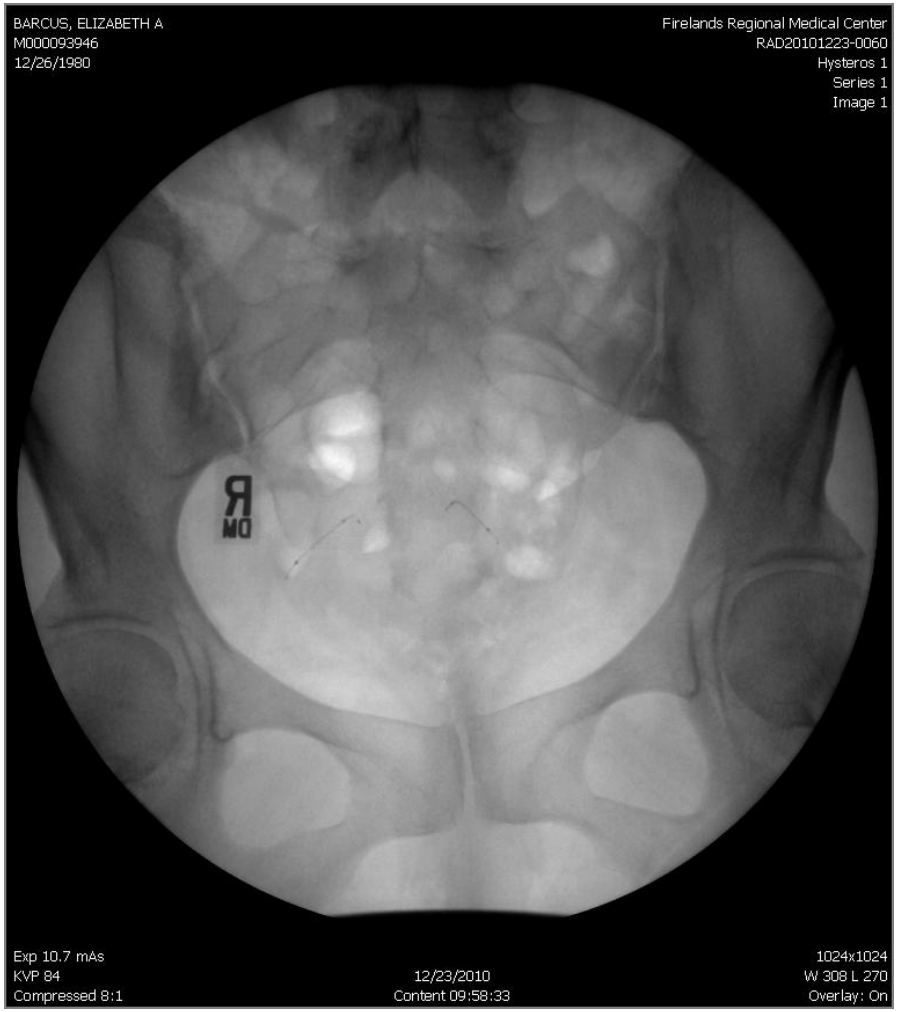
- Infertility
- Recurrent spontaneous abortion
- Dysfunctional uterine bleeding
- Assess tubal patency after surgery/sterilization

Normal Hysterosalpingogram





Essure micro-inserts



Imaging modalities for assessment of the female pelvis

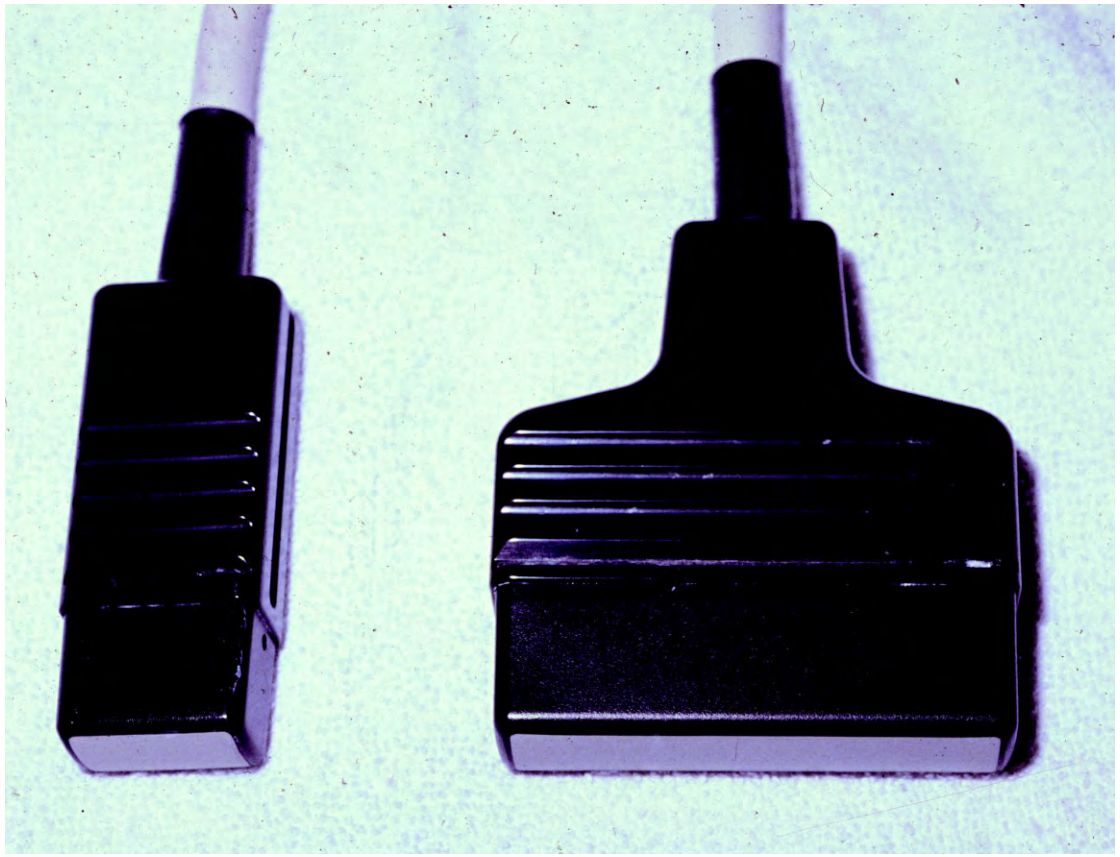
- Radiographs
  - Hysterosalpingogram (HSG)
- *Sonography*
  - Transabdominal
  - Transvaginal
- Computerized axial tomography (CT)
- Magnetic resonance imaging (MRI)

Attributes of ultrasound

- Non-invasive
- Atraumatic
- Biologically safe
- No ionizing radiation
- Ideal for serial assessment of the reproductive system

Transducer

- Pulses of ultrasound are transmitted to the body by placing the transducer on the skin
  - A gel is placed on the skin to eliminate air
  - The gel increases the transmission of ultrasound to and from the body
- The same transducer transmits and receives ultrasound pulses.
- A short burst of sound is produced (4ms)
- The transducer then listens for a return echo (100ms)
- The returning echo vibrates the crystals producing electricity
- The electricity is used to make an image



Patient Preparation Pelvic Exam

- Transabdominal
  - Full urinary bladder
    - Push bowel out of the way
  - Gel used as coupling agent
- Transvaginal
  - Empty urinary bladder
    - Keep structures close to transducer
  - Gel used for comfort

Scanning Planes

- Longitudinal (Sagittal)
- Transverse
- Coronal
- Oblique

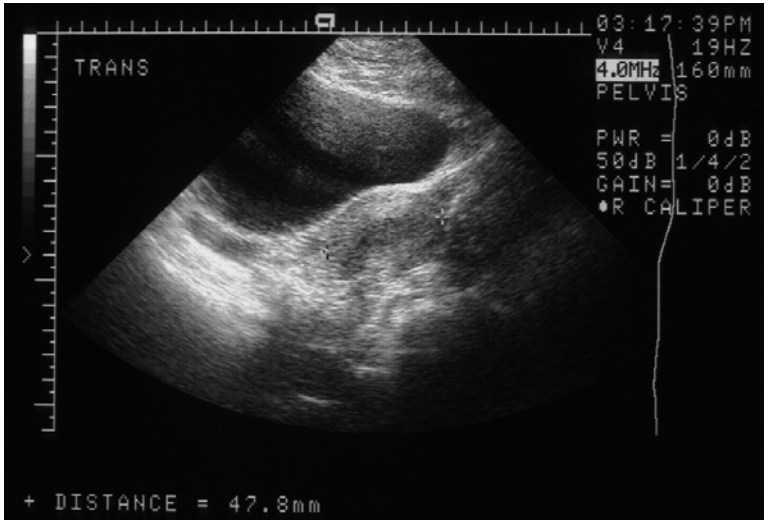
Transabdominal Ultrasound

- Exam performed with patient supine
- Scan over anterior aspect of pelvis
- Patient drinks 32 oz of water 1 hour before examination
- Image protocol
  - Longitudinal & transverse scans
  - Uterus, cervix, cul-de-sac, right and left adnexa (ovaries)
  - Measurements of uterus and ovaries
  - Doppler evaluation of ovaries

Image Orientation

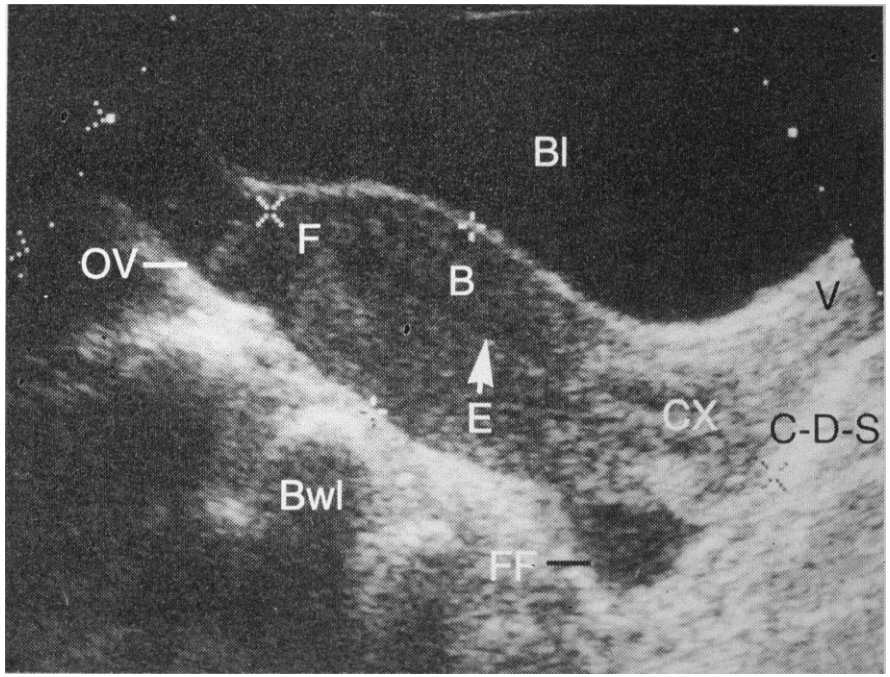
- Sagittal
  - Patient's head on left

- Transverse
  - Patient's right on the observers left (as if looking up from feet)

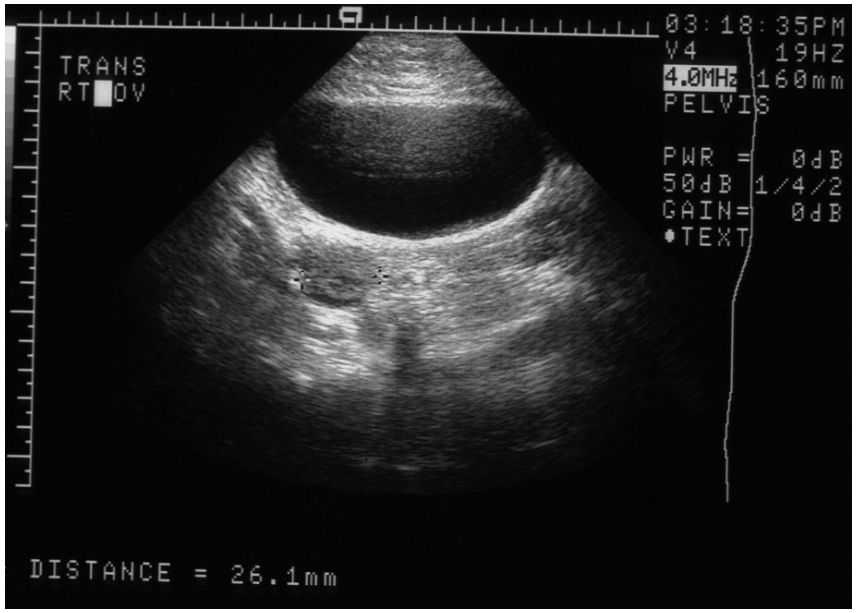


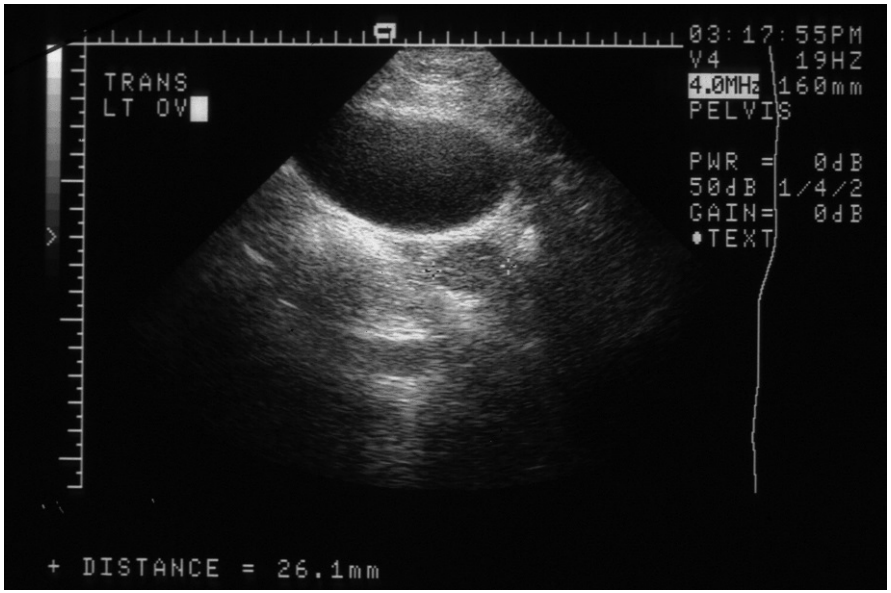
Uterus (transabdominal)

- Consists of a fundus, body, and cervix
  - Retroflexed vs. anteflexed
- Sonographic appearance
  - The myometrium should have a homogeneous texture
  - The margins of the uterus should be smooth and regular
- Size depends on age

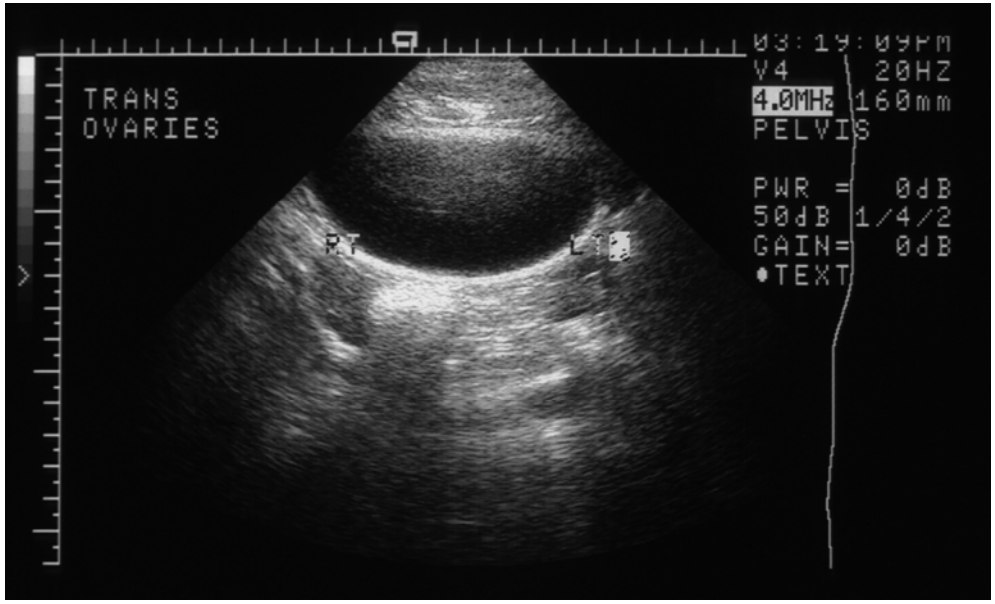


Ovaries (transabdominal)





Transabdominal Ultrasound



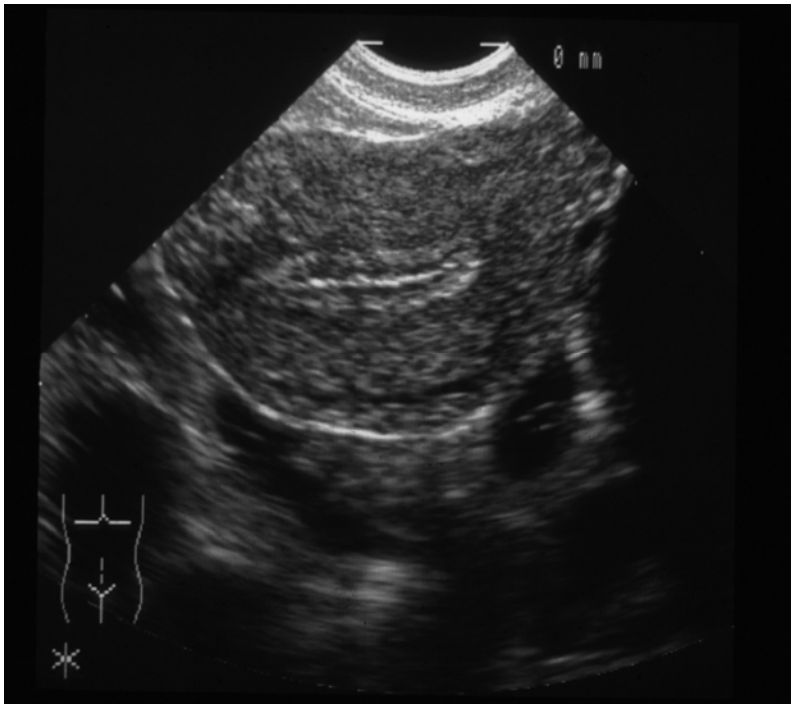
- Limitations
  - Patient unable to fill bladder
  - Obese patients
  - Retroverted uterus
  - Masses lying posterior beyond the range of the transducer

Transvaginal Ultrasound

- Exam performed with the patient supine
- Empty bladder
- Transducer covered with a latex sleeve
- Transducer inserted into vagina
- Image protocol: sagittal & coronal planes
  - True axial planes not possible secondary to limited range of motion
- Advantages
  - Empty bladder is more comfortable for the patient
  - Ability to examine obese or gaseous patients
  - High tissue characterization compared to transabdominal
- High resolution transducers are used (5 - 10Mhz)

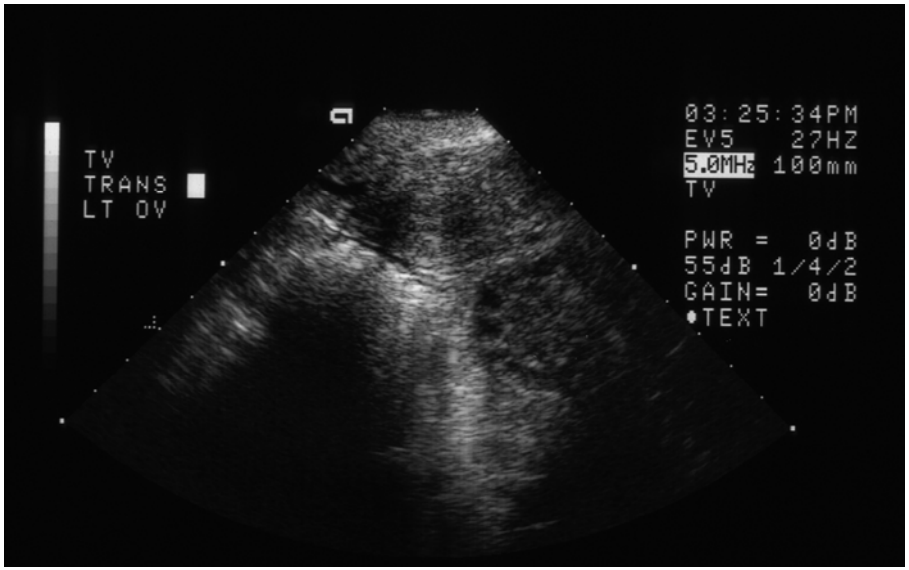
Uterus (transvaginal)

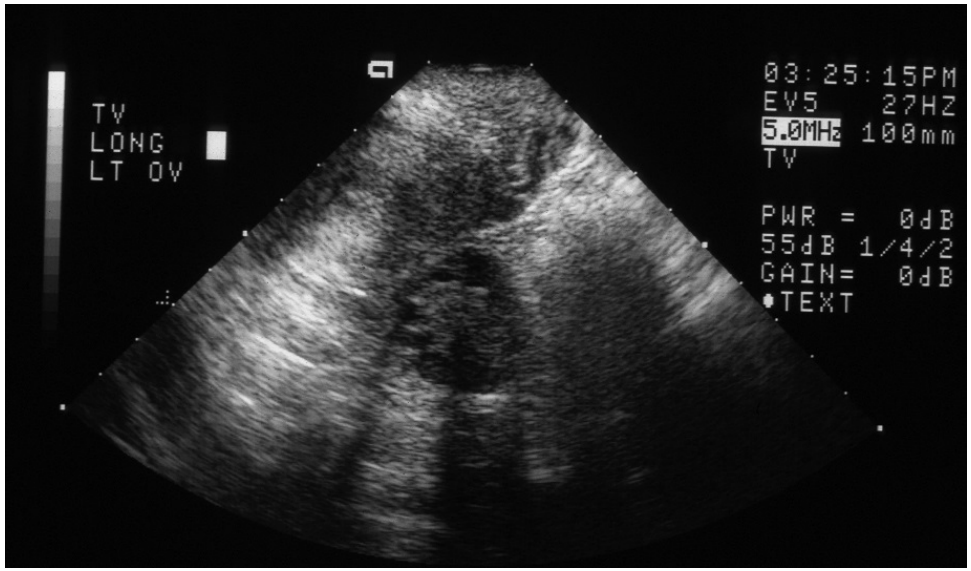
Longitudinal



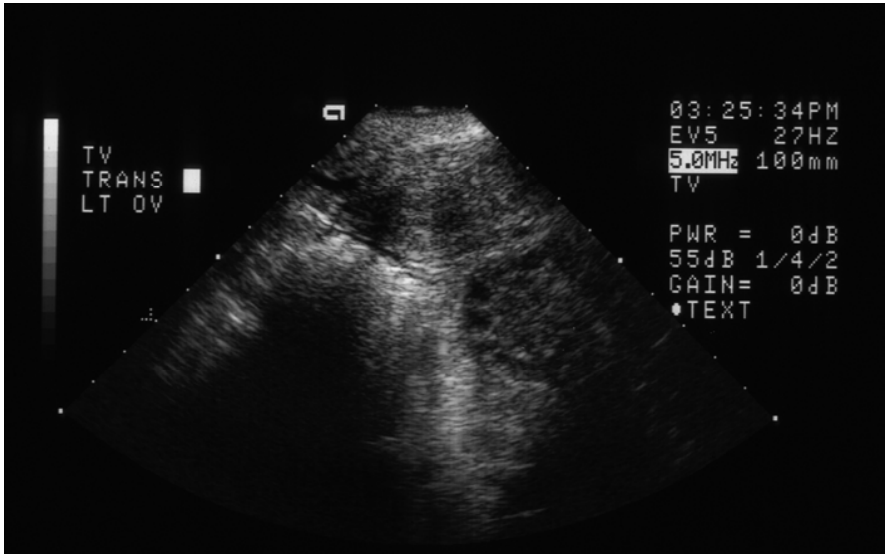
Transverse

Ovary (transvaginal)





Transvaginal Ultrasound



- Limitations
  - Patient refusal
  - Lack of patient tolerance
  - Age (premenarche & menopausal)

Imaging modalities for assessment of the female pelvis

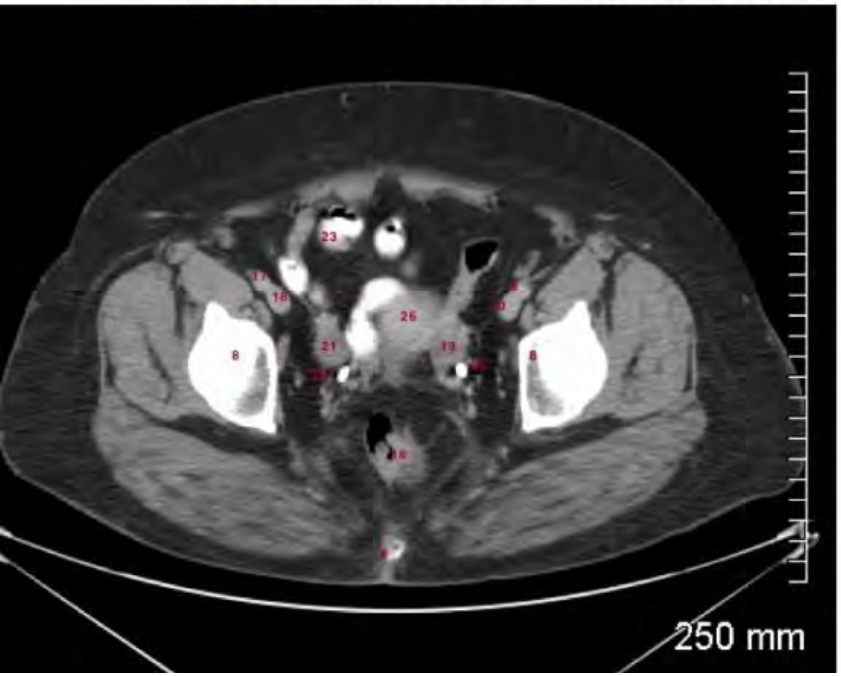
- Radiographs
  - Hysterosalpingogram (HSG)
- Sonography
  - Transabdominal
  - Transvaginal
- *Computerized axial tomography (CT)*
- Magnetic resonance imaging (MRI)

Pelvic CT

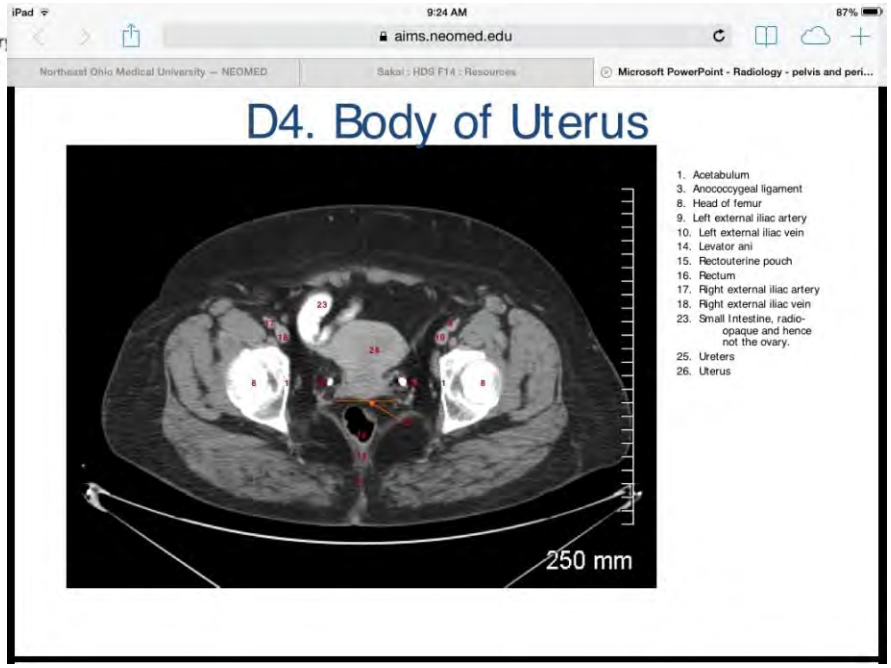
- Utilizes ionizing radiation
- Imaging data acquired in axial plane (with reconstructions possible in sagittal and coronal planes)
- Ideally utilizes PO and IV contrast (IV contrast is iodinated)
- Allows for assessment of a variety of pelvic disease processes (including inflammatory and neoplastic conditions)
- Supplements pelvic sonography (especially in the staging of pelvic malignancies)

Normal Pelvic CT

D3. Fundus of Uterus



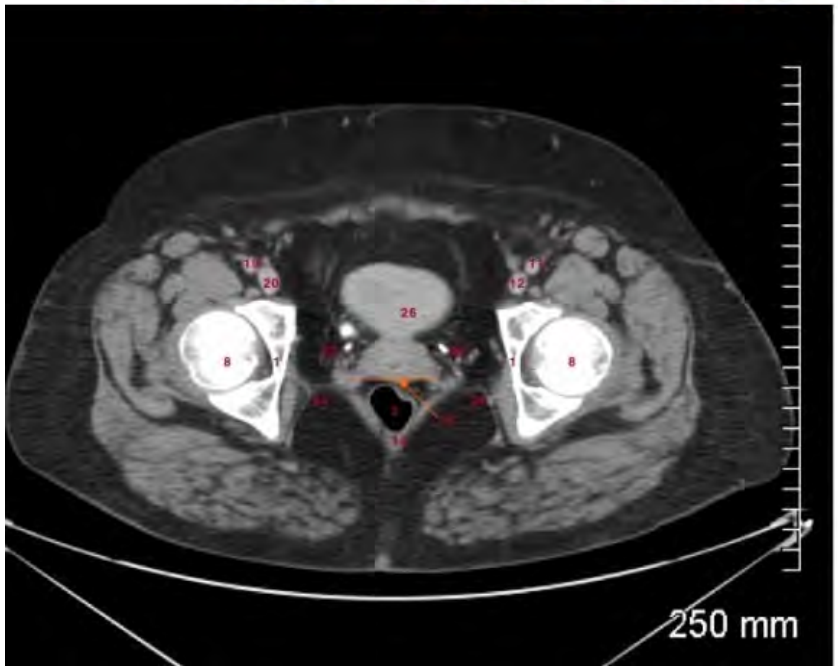
6. Coccyx
8. Ilium
9. Left external iliac artery
10. Left external iliac vein
13. Left ovary
16. Rectum
17. Right external iliac artery
18. Right external iliac vein
21. Right ovary
22. Sigmoid colon
23. Small intestine
25. Ureters
26. Uterus (fundus)



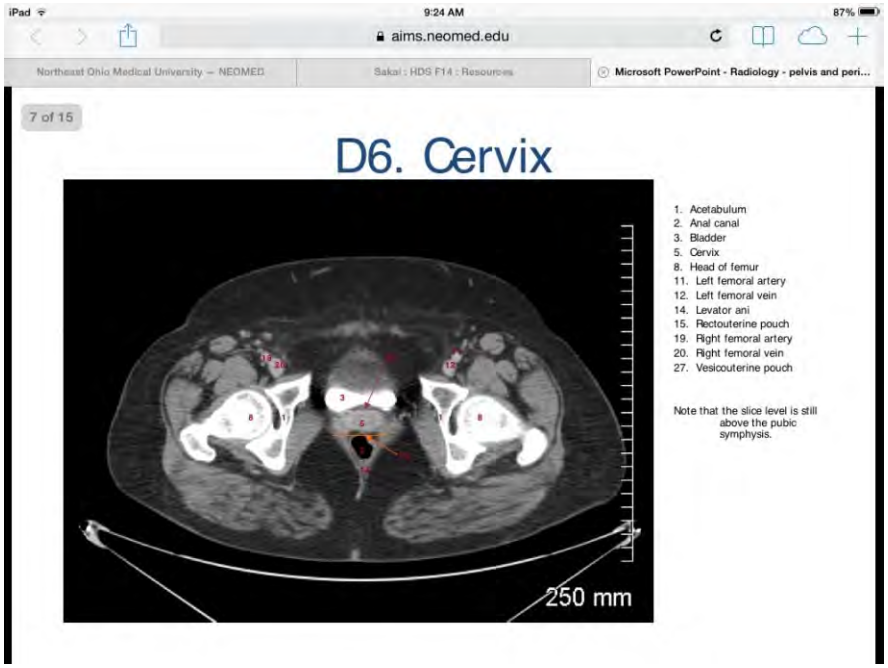
NEOMED images: HDS

Normal Pelvic CT

D5. Lower Uterus



1. Acetabulum
2. Anal canal
8. Head of femur
11. Left femoral artery
12. Left femoral vein
14. Levator ani
15. Rectouterine pouch
19. Right femoral artery
20. Right femoral vein
24. Transverse cervical ligament
25. Ureters
26. Uterus



NEOMED image: HDS

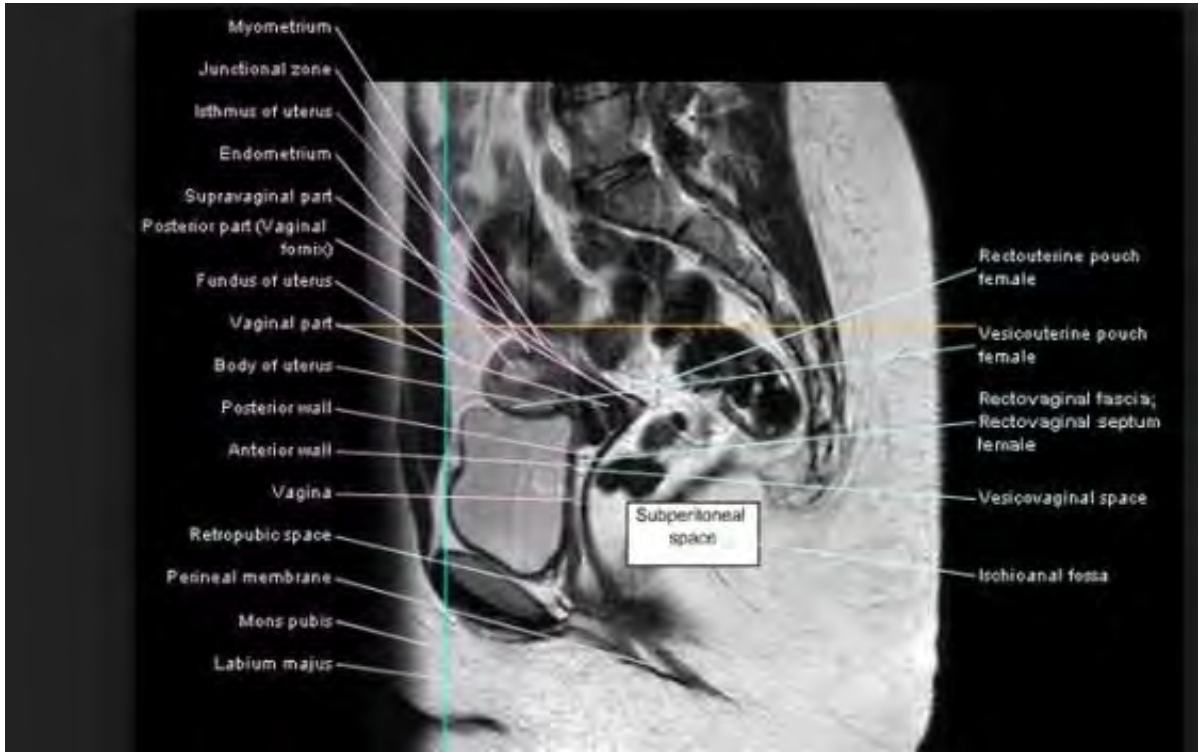
Imaging modalities for assessment of the female pelvis

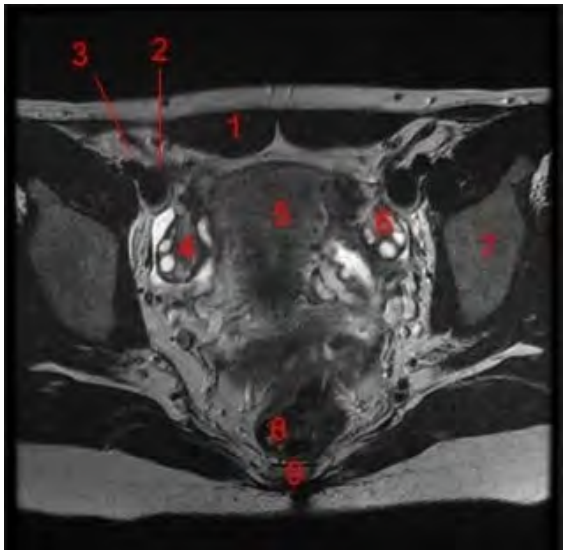
- Radiographs
  - Hysterosalpingogram (HSG)
- Sonography
  - Transabdominal
  - Transvaginal
- Computerized axial tomography (CT)
- *Magnetic resonance imaging (MRI)*

Pelvic MR

- Utilizes no ionizing radiation (but cannot be performed in patients with unapproved pacemakers, aneurysm clips, neurostimulators, etc.)
- Imaging data acquired in a multitude of native imaging planes (axial, coronal, sagittal, oblique)
- Ideally utilizes IV contrast (IV contrast is comprised of gadolinium)
- Allows for assessment of a variety of pelvic disease processes (including inflammatory and neoplastic conditions)
- Supplements pelvic sonography (especially in the staging of pelvic malignancies)

Normal Pelvic MR





1. Rectus abdominis muscle
2. External iliac vein
3. External iliac artery
4. Right ovary
5. Uterus
6. Left ovary
7. Ischium
8. Rectum
9. Coccyx

Obstetrical Ultrasound

Basic Examination Guidelines

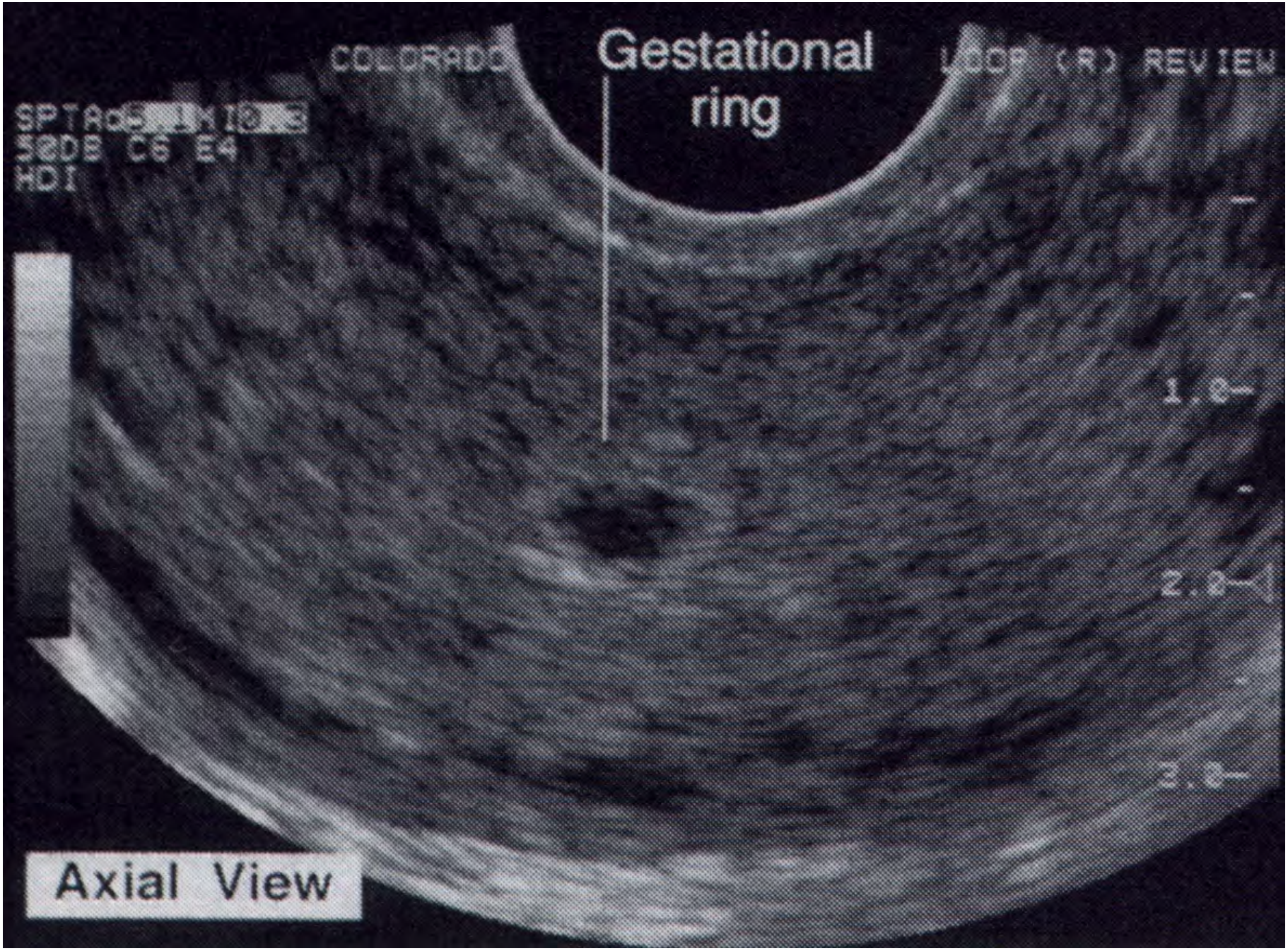
- First Trimester
  - Documenting the presence or absence of intrauterine pregnancy
- Second and Third Trimester Guidelines
  - Evaluate Anatomy
  - Evaluate Growth

First Trimester

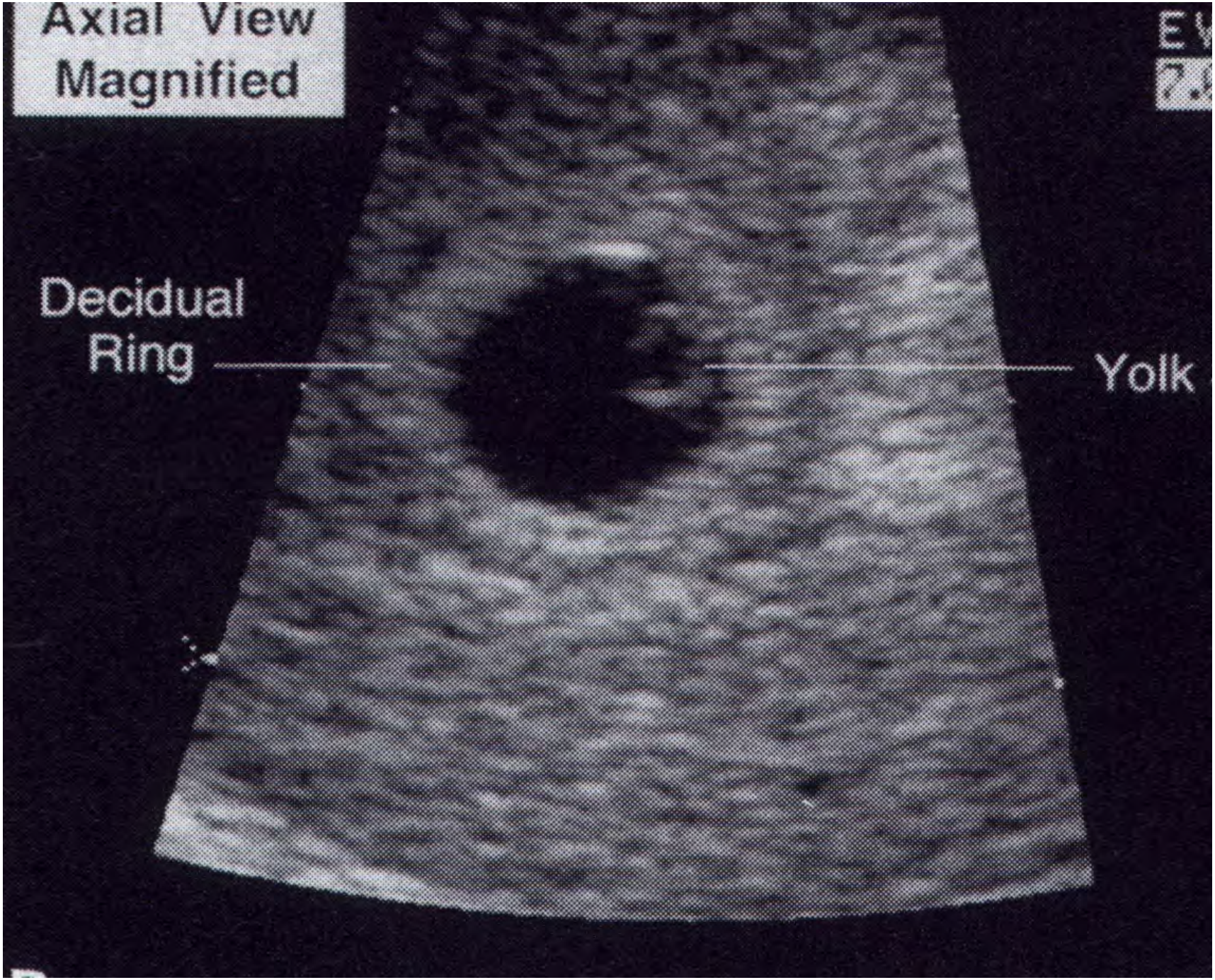
- Document intrauterine location
- Locate *gestational sac*
- Document *yolk sac* (5 weeks)
- Document and measure *fetal pole*
- Evaluate embryo cardiac activity
- Determine presence of multiple gestations
- Survey pelvis/adnexal structures

Gestational Sac

- Earliest evidence of gestation
- Visualized at 4.5-5 menstrual weeks
- Hyperechoic ring with fluid-filled center
  - Must contain a yolk sac to differentiate from a ‘pseudosac’, seen with ectopic pregnancy



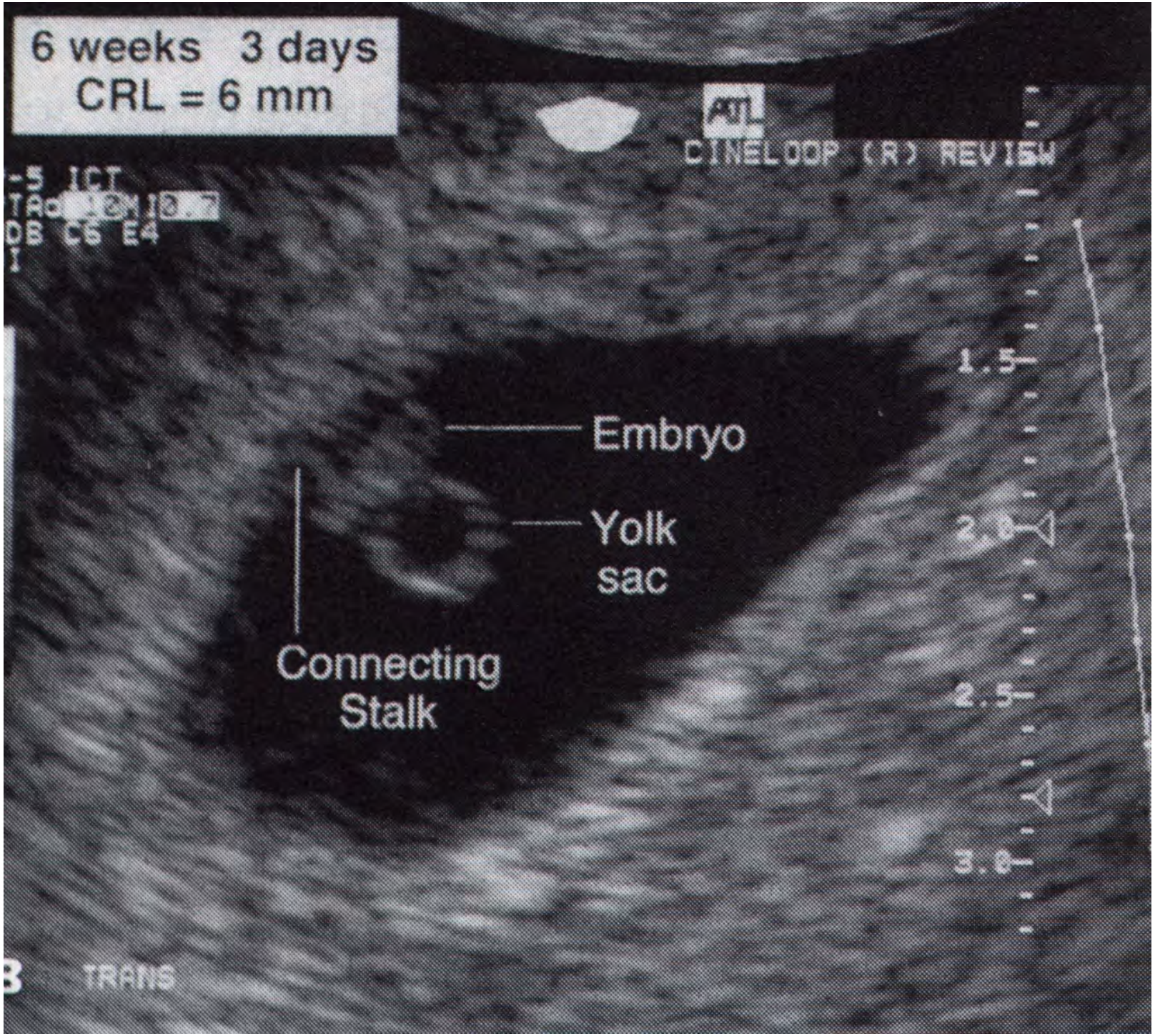
Source: Laura Cawthon, M.D., Akron, OH



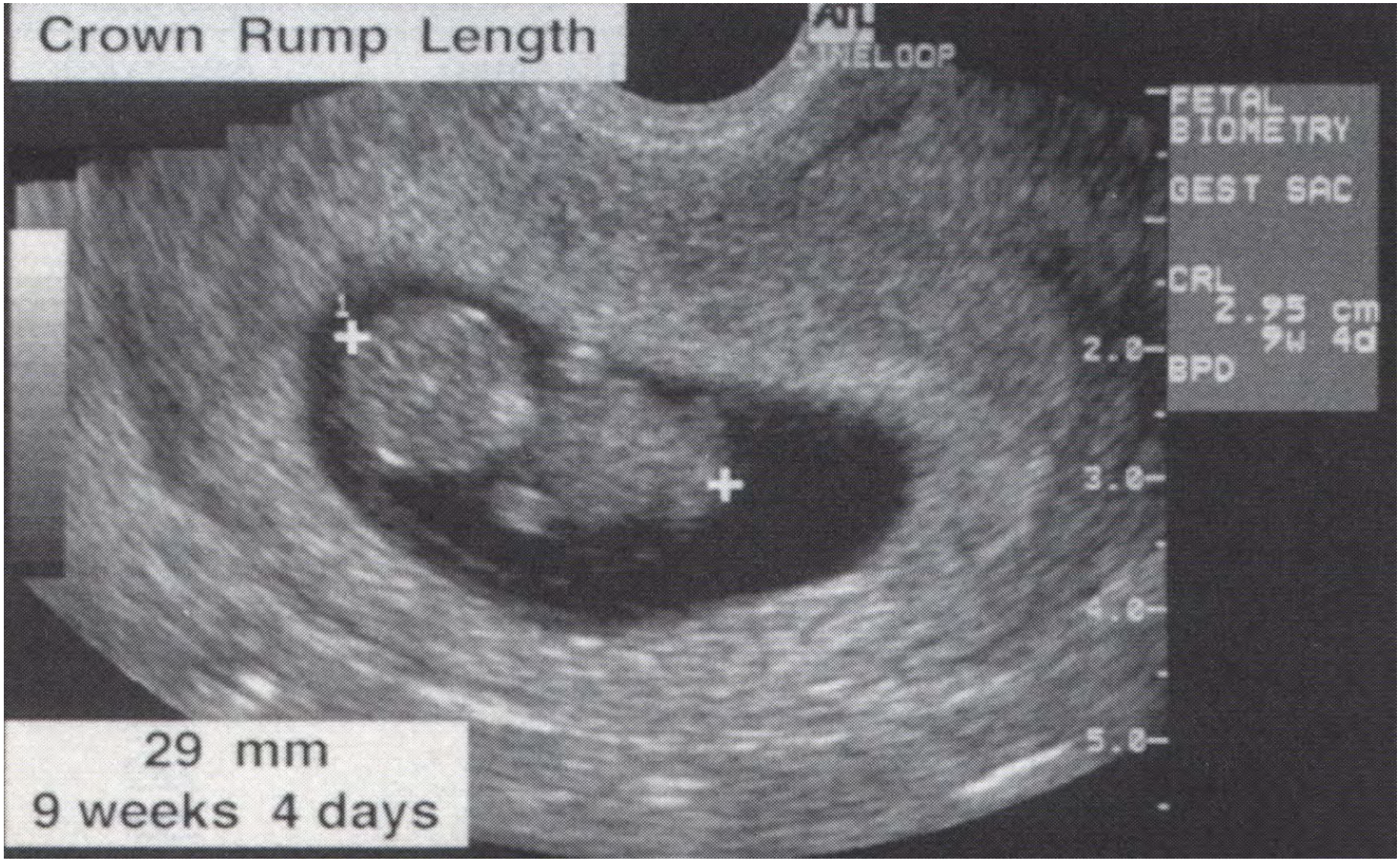
Source: Laura Cawthon, M.D., Akron, OH

Fetal Pole

- First evidence of an embryo
- Initially visualized at 5-6 weeks (2mm)
- Measure *Crown Rump Length* - most accurate measure of gestational age
- Evaluate for Cardiac activity visualized at approximately 6.5 weeks with a 6mm CRL



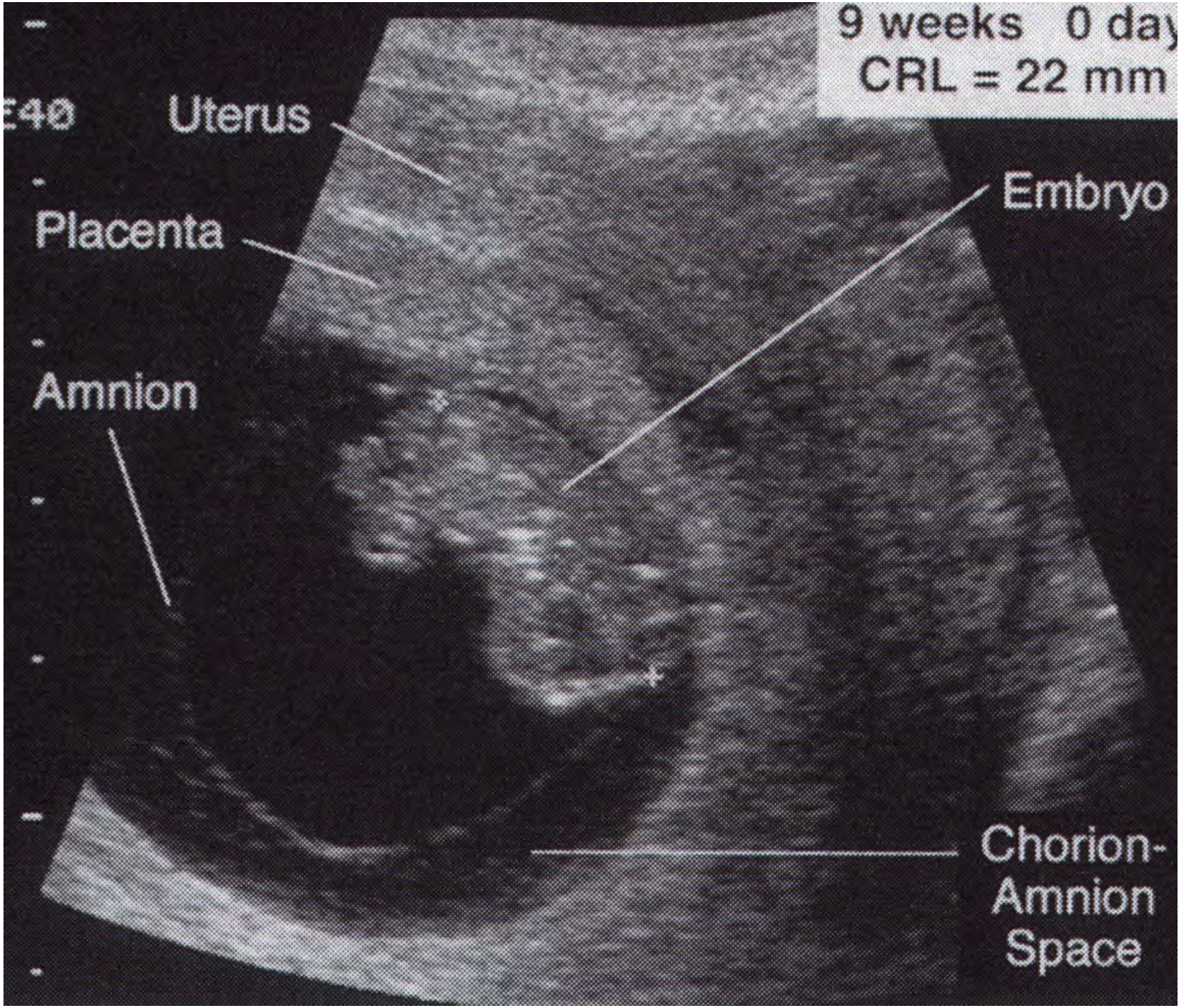
Source: Laura Cawthon, M.D., Akron, OH



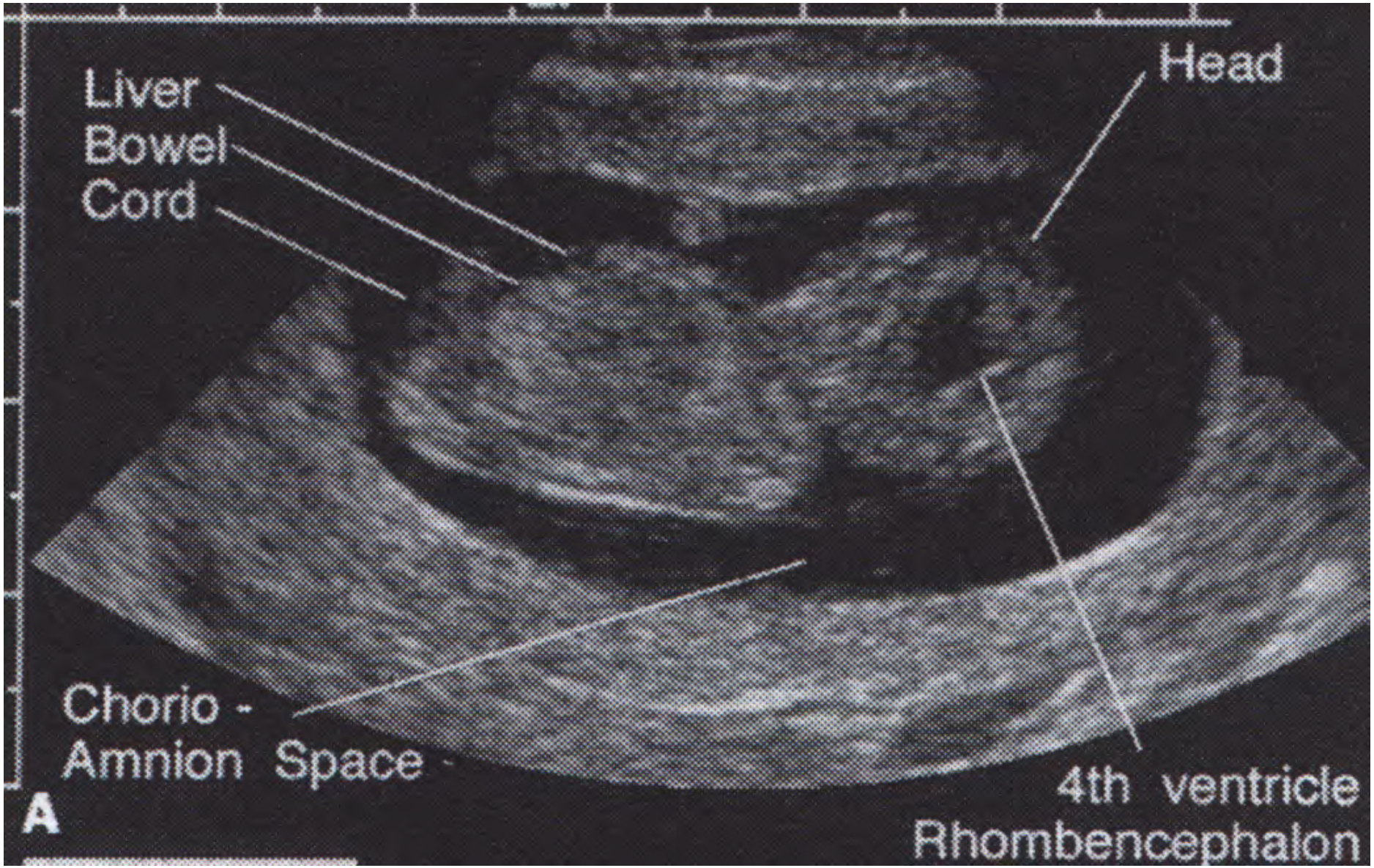
Source: Laura Cawthon, M.D., Akron, OH

Other Structures 1st Trimester

- Placenta
- Amnion
- Amniotic space (sonolucent fluid)
- Limb buds
- Rhombencephalon
- Physiologic herniation of bowel (10 weeks)



Source: Laura Cawthon, M.D., Akron, OH



Source: Laura Cawthon, M.D., Akron, OH

2nd and 3rd Trimester Criteria

- Fetal Anatomical Structures
- Amniotic Fluid Volume
- Placenta
- Fetal Position
- Heart Rate and Rhythm
- Fetal Movement
- Cervix, Uterus and Adnexal Structures

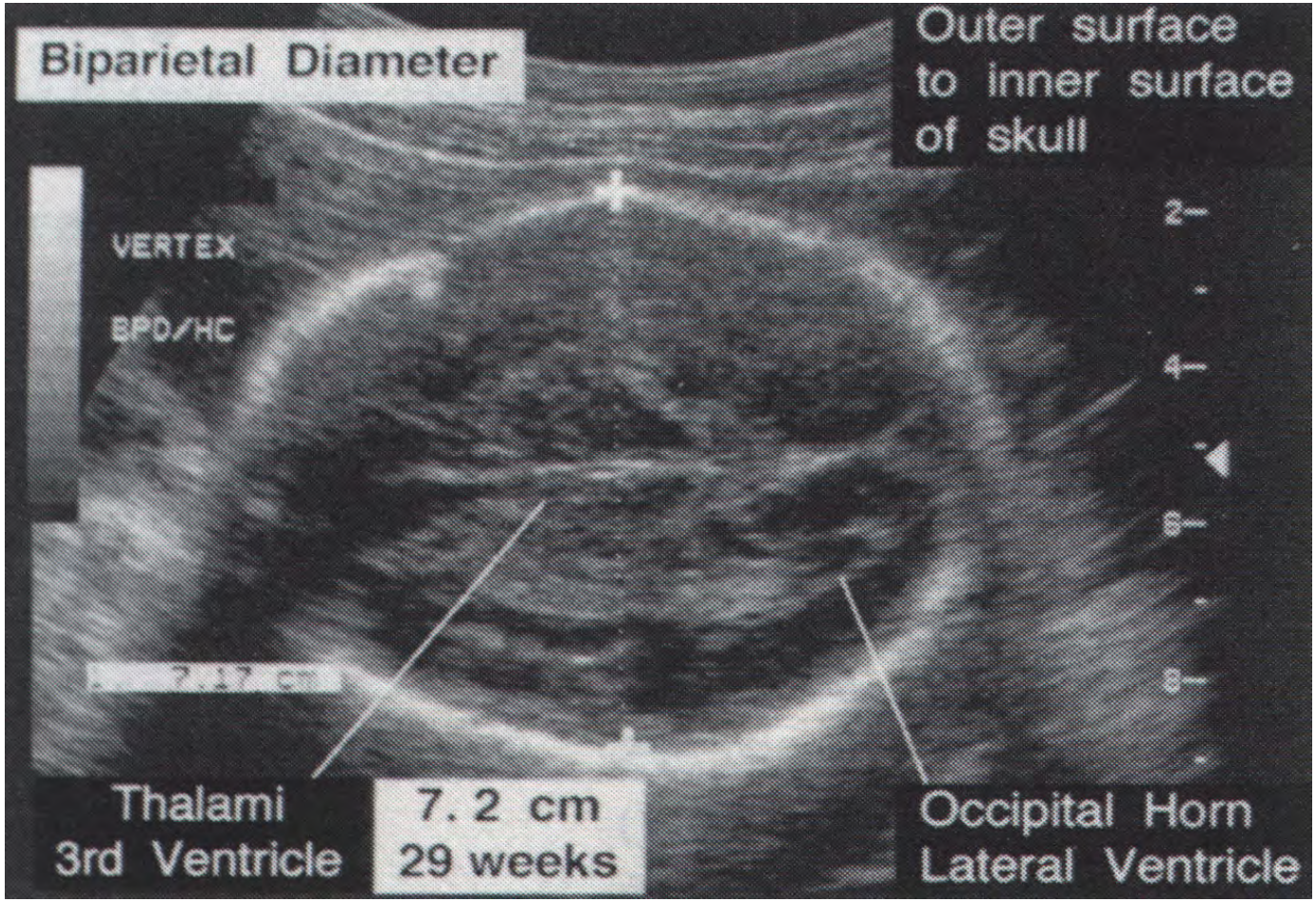
Fetal biometry

- Biparietal diameter (BPD)
- Head circumference (HC)
- Abdominal circumference (AC)
- Femur length (FL)

Biparietal Diameter

- Axial projection at the level of the thalami
- Measurement of BPD is outer table of calvarium to inner table of calvarium
- Visualize atria of the lateral ventricles
- Atria must NEVER be greater than 10mm.
- Choroid typically fills the atria

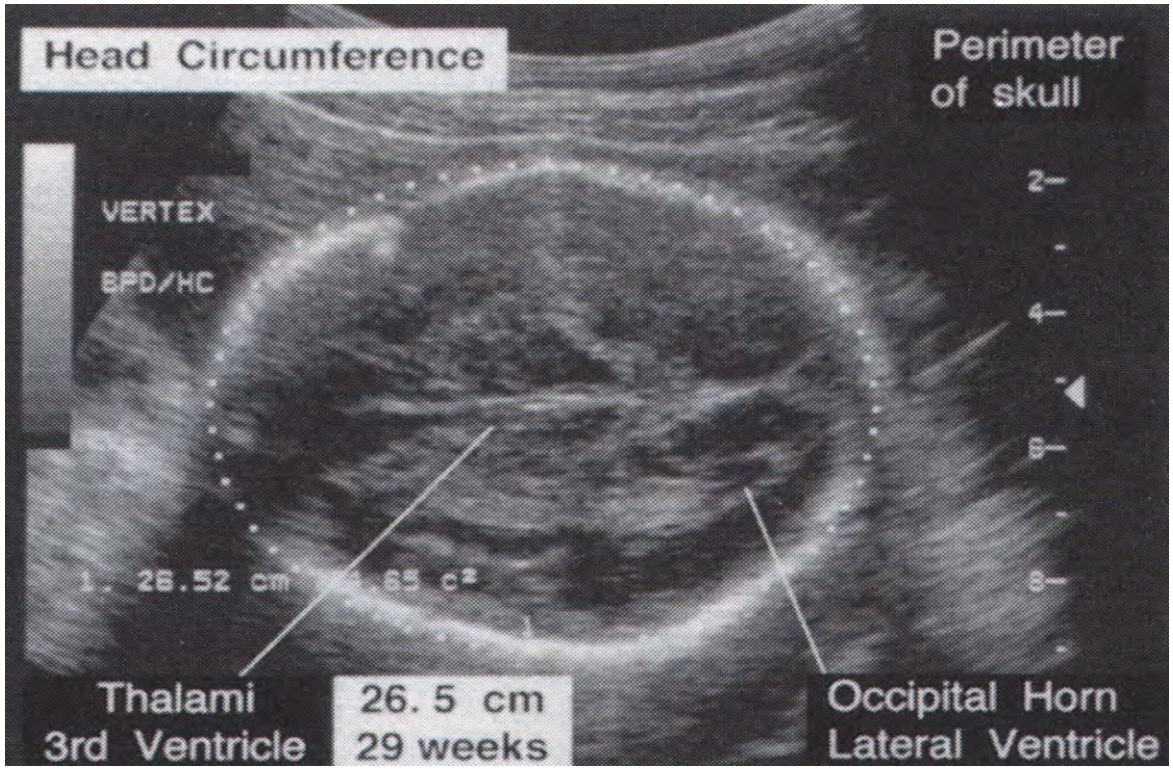
BPD


Biparietal Diameter
Outer surface to inner surface of skull
VERTEX
BPD/HC
2
4
6
8
Thalami 3rd Ventricle
7. 2 cm 29 weeks
Occipital Horn Lateral Ventricle

Head Circumference

- Circumference measured at same level as biparietal diameter
- *Dolichocephaly*: flattened and elongated fetal head; BPD may be artificially decreased.
- *Brachiocephaly*: Shortened wider fetal head
- May “correct” BPD based on head shape
-

HC


Head Circumference
Perimeter of skull
VERTEX
BPD/HC
Thalami
3rd Ventricle
26. 5 cm
29 weeks
Occipital Horn
Lateral Ventricle

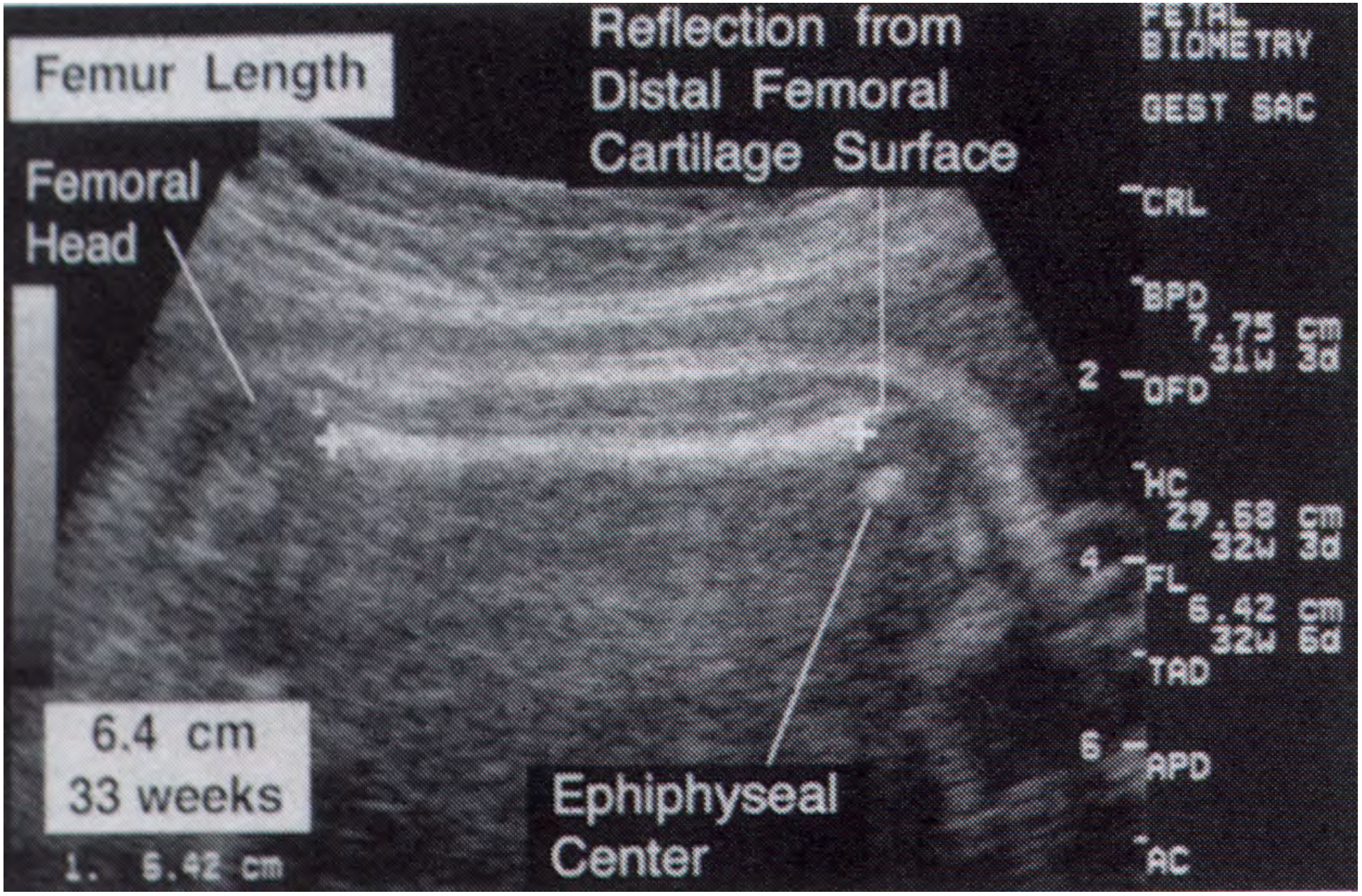
Abdominal Circumference

- Circumference of fetal abdomen in a transverse plane at the level of the intrahepatic portion of the umbilical vein.

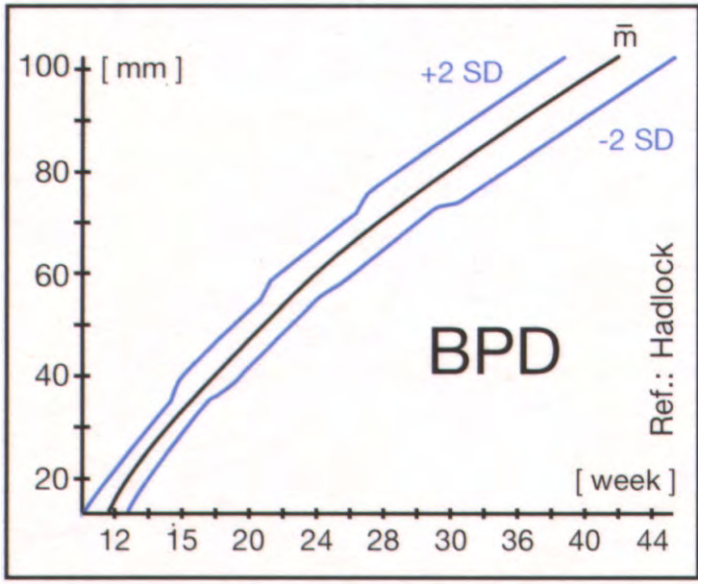
AC

Femur Length

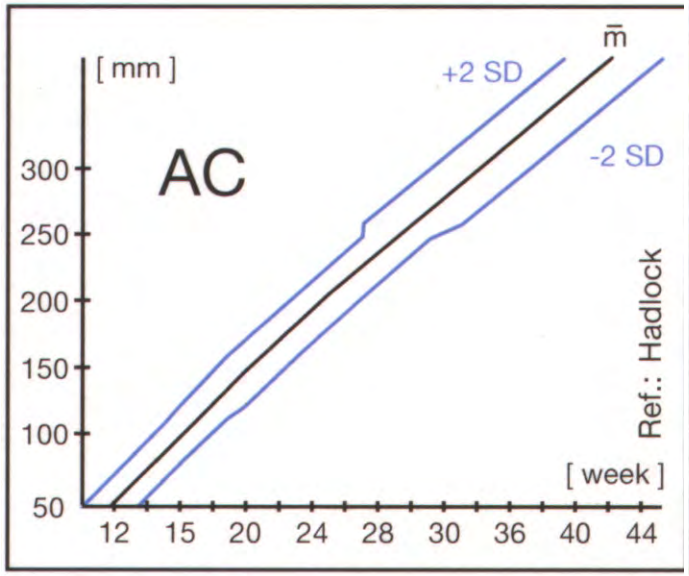
- Measure length from origin to distal aspect of the diaphysis
- Accurate parameter of fetal age from 10 weeks onward



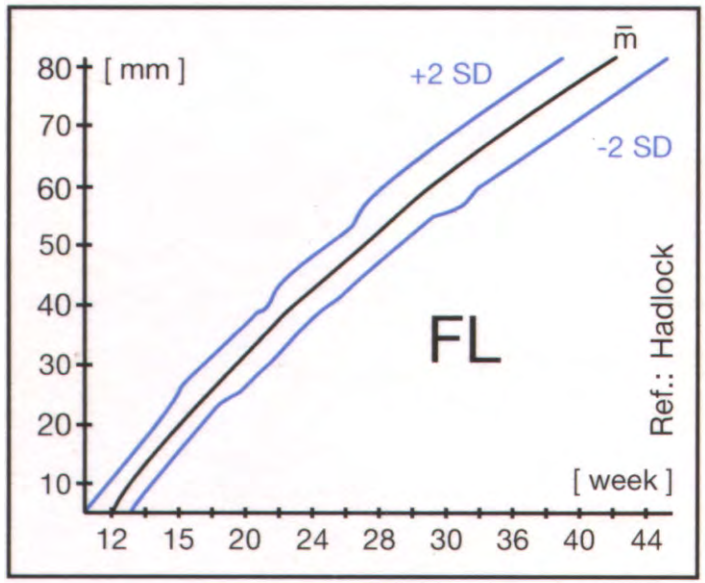
Source: Laura Cawthon, M.D., Akron, OH



Biparietal diameter (BPD)



Abdominal circumference (AC)



Femoral length (FL)

Summary

- Your baseline knowledge of the aforementioned imaging modalities will be applied to assessment of disease processes of the female pelvis in non-pregnant (GYN) and pregnant (OB) states
- Please utilize this lecture (along with you Reproductive imaging PI preparatory materials) for optimal performance in your Reproductive imaging PI session