PI Session: 2021.11.19_D and T_Radiology: Imaging of Reproductive system 2_ Preparatory_Marcus John Julius, M.D.

Objectives: At the end of this session, students will be able to:

1. Incorporate correct imaging terminology in the description of ultrasound images (including simple cysts).
2. Utilize sonography (and Beta-HCG levels) to differentiate ectopic pregnancy from spontaneous abortion.
3. Create useful differential diagnoses based on sonographic findings of oligohydramnios and polyhydramnios.
4. Differentiate placenta previa from placental abruption on sonographic imaging.
5. Characterize the imaging appearance of uterine leiomyomas on a variety of imaging modalities.
6. Formulate imaging differential diagnoses for adnexal masses of varying complexity (ranging from purely cystic to purely solid).

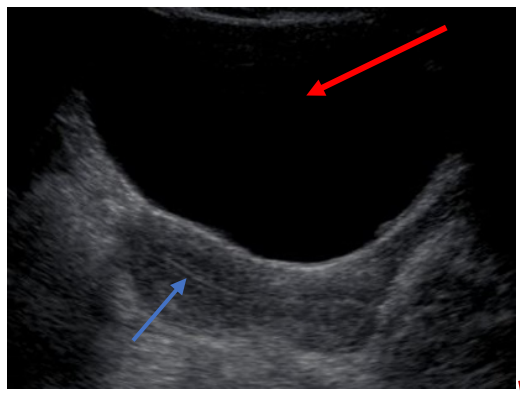
Ultrasonography

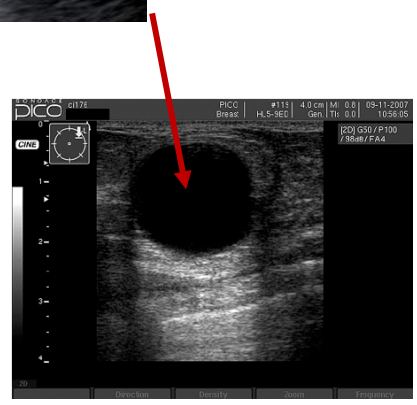
TERMINOLOGY

- '*Echoic*': root word
  - -Prefixes describe the underlying echogenicity
    - '*an*', '*hypo*', '*iso*' (better yet, intermediate), and '*hyper*.
- Echogenicities may vary:
  - -Within a given organ
  - -Among different organs
- A normal pattern of echogenicity exists within normal organs
- *Note*: *Comparison of adjacent relative echogenicities may be made*

Anechoic

-Absence of reflected sound waves
-Commonly seen with fluid-filled structures
-'Black' appearance
-Urinary bladder (*arrow at right*)
-Simple cyst (see below)
-[**Note**: Endometrium is **hyperechoic**!]



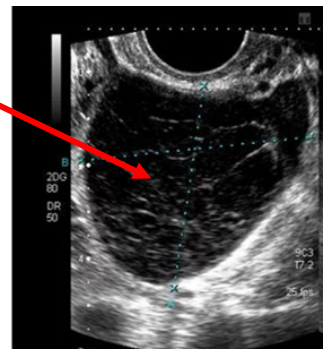


Note: A *simple cyst* is a well-characterized benign entity (arrow at right)

-Anechoic
-Thin, imperceptible wall
-Posterior acoustic enhancement
-Lack of vascularity

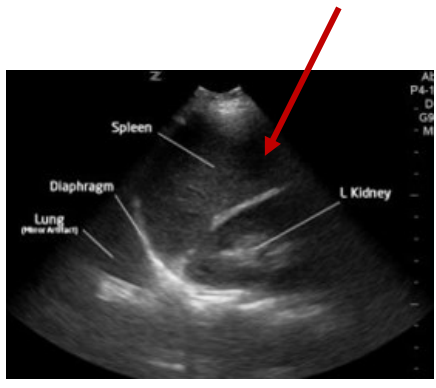
Hypoechoic

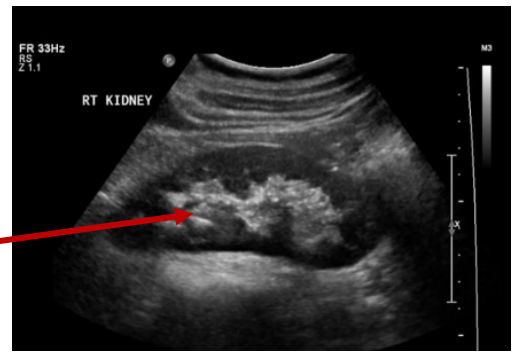
-Diminished degree of reflected sound waves
-'Dark' appearance (but not completely devoid of echoes)
-Debris within complicated cyst (*arrow at right*)
-*Note*: The term *hypoechoic* can also be used to compare two different structures



Isoechoic

-Medium degree of reflected sound waves
-Intermediate ('gray') appearance
-Often representative of normal solid organs
-Spleen (*arrow at right*)
-*Note*: The term *isoechoic* can also be used to compare two different structures which appear *similar* sonographically





Hyperechoic

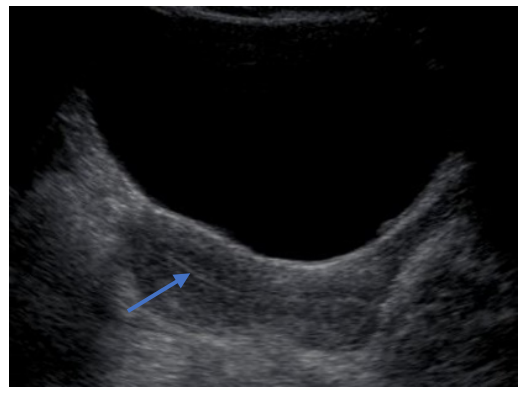
-High degree of reflected sound waves

-Bright ('white') appearance

-Central echogenic complex in renal sinus (*arrow at right*)

-Endometrial stripe is hyperechoic (see *blue arrow* below)

-*Note*: The term *hyperechoic* can also be used to compare two different structures



ADVANTAGES OF ULTRASONOGRAPHY

-No ionizing radiation

-Infinite imaging planes

-Dynamic imaging (i.e. vascular assessment; fetal assessment)

DISADVANTAGES OF ULTRASONOGRAPHY

-User-dependent

-Limited assessment of osseous structures

-Bowel gas often obscures detail

-Sonography in ectopic pregnancy

-Pregnancy outside the confines of the uterus

-Clinical presentation: Pain (95%). Vaginal bleeding (85%). Adnexal mass (40%)

-Incidence: 0.5%-1.0%

-Location:

-Tubal: 97% Most commonly at ampulla (then isthmus)

-Interstitial/cornua: 2%

-Ovarian: 1%

-Cervical: very rare

Note: *Adnexa*: Ovaries and fallopian tubes (as well as supporting ligaments)

Risk factors

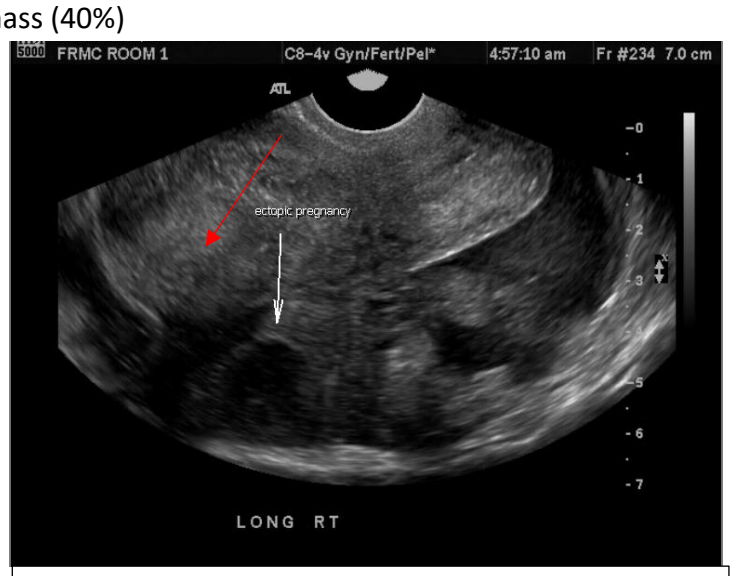
-Prior ectopic pregnancy

-IUD (intra-uterine device)

-H/O PID (pelvic inflammatory disease)

-Tubal surgery

-IVF (in vitro fertilization)



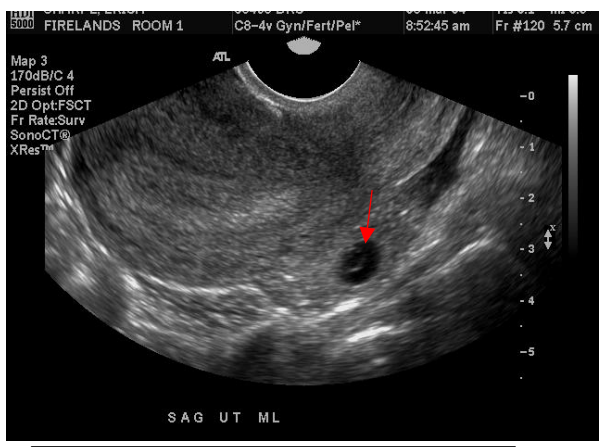
Complex adnexa mass (white arrow) representing ectopic pregnancy. Empty uterus (red arrow)

-'1-7-11' rule (utilizing transvaginal sonography, TV): Based on B-HCG levels (in mIU/ml)

-At 1,000 mIU/ml, a gestational sac *must* be visualized within the uterus

-At 7,000 mIU/ml, a yolk sac *must* be visualized within the aforementioned gestational sac

-At 11,000 mIU/ml, a fetal pole *must* be visualized within the gestational sac



Gestational sac and yolk sac (red arrow) outside the confines of the empty uterus

Sonographic features of ectopic pregnancy

-'Suggestive'

-No IUP (intrauterine pregnancy)

-Pseudogestational sac (intrauterine fluid, without decidual reaction)

-Cul-de-sac fluid/blood

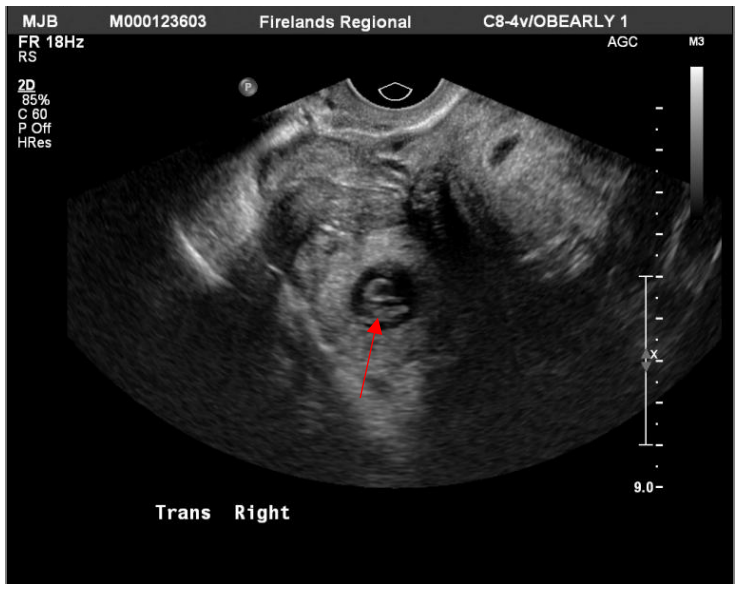
-Cystic adnexal mass (10% chance of ectopic)

-'More definitive'

-Complex adnexal mass (95% chance of ectopic)

-Adnexal ring sign (echogenic ring in adnexa, surrounding an unruptured ectopic pregnancy, 95% chance of ectopic)

-Live extrauterine pregnancy, 100%



Fetal pole (red arrow) in the right adnexa

Note: Serial B-HCG levels (and serial TV sonography) assist in differentiating ectopic pregnancy from spontaneous abortion

-In early normal (orthotopic) pregnancy, B-HCG levels double every 2-3 days.

-In ectopic pregnancy, B-HCG levels rise at *a slower rate* than in an orthotopic pregnancy (i.e. slower doubling time)

-B-HCG levels *fall* in spontaneous abortion!

-Amniotic fluid volume

-Single pocket measurement

-Oligohydramnios: largest pocket is <2cm

-D/D (oligohydramnios):

-Fetal demise

-Fetal renal abnormalities

-IUGR (intra-uterine growth retardation)

-PROM (premature rupture of membranes)

-Post-dates

-Chromosomal abnormalities

Oligohydramnios

-Polyhydramnios: largest pocket is >8cm

-D/D (polyhydramnios)

-Idiopathic, 40%

-Maternal, 40%

-Maternal DM

-Maternal HTN

-Fetal, 20%

-CNS lesions (neural tube defect)

-Proximal GI obstruction

-Chest mass

-Twin-twin transfusion

Polyhydramnios

--Placenta previa on sonography

-Placenta abnormally covering the internal cervical os

-Risk factors:

-Increasing maternal age

-Multiparity

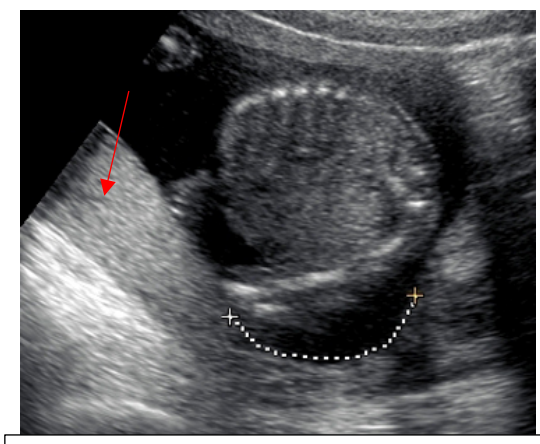
-Prior C-section

-Complications:

-3rd trimester bleeding

-Premature labor

-Perinatal/maternal death



Normal posterior placenta (red arrow), distant from cervix (as shown my dotted line)

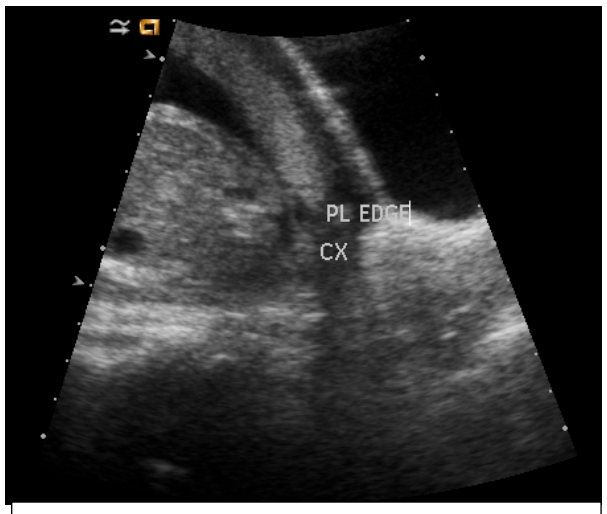
-Subtypes of placenta previa

-'low-lying': placental edge within 1 cm of internal cervical os

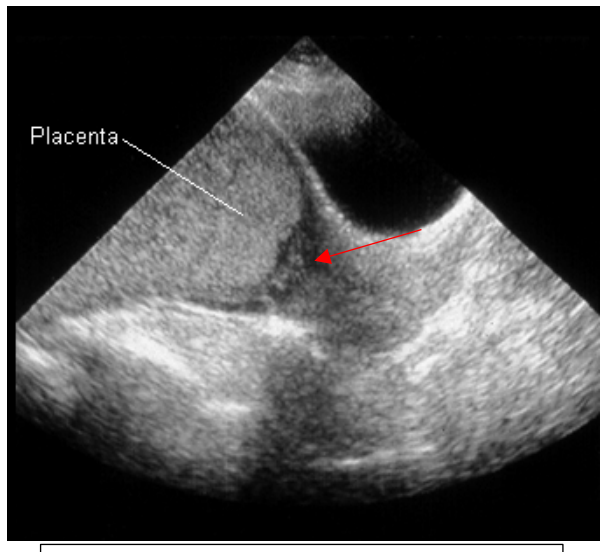
-'marginal': placenta extends to internal cervical os

-'partial': placenta *partially* covers the internal cervical os

-'complete': placental *completely* covers the internal cervical os



Marginal placenta (PL) previa with respect to internal cervical os (CX)



Complete placenta previa with respect to internal cervical os (red arrow)

-<u>Placental separation on sonography</u>

-Separation of the placenta from underlying myometrium secondary to hemorrhage

-Spectrum

-<u>Subchorionic hemorrhage</u> (often 1st trimester)

-Overall good outcome (venous source)

-<u>Placental abruption</u> (often in 3rd trimester)

-Complications (arterial source)

-Pain

-Bleeding

-Fetal/maternal death is possible

-Intrauterine growth retardation (IUGR) in chronic cases

-Incidence: 1:100 pregnancies

-Risk factors

-Multiparity

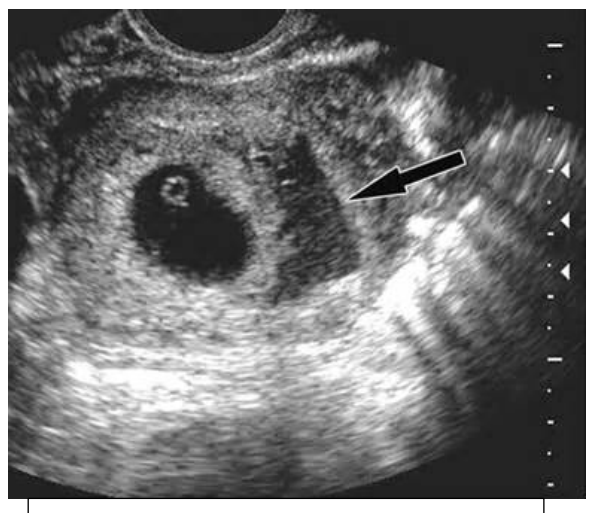
-Increasing maternal age

-Pre-eclampsia/eclampsia

-Trauma

-Smoking

-Cocaine use



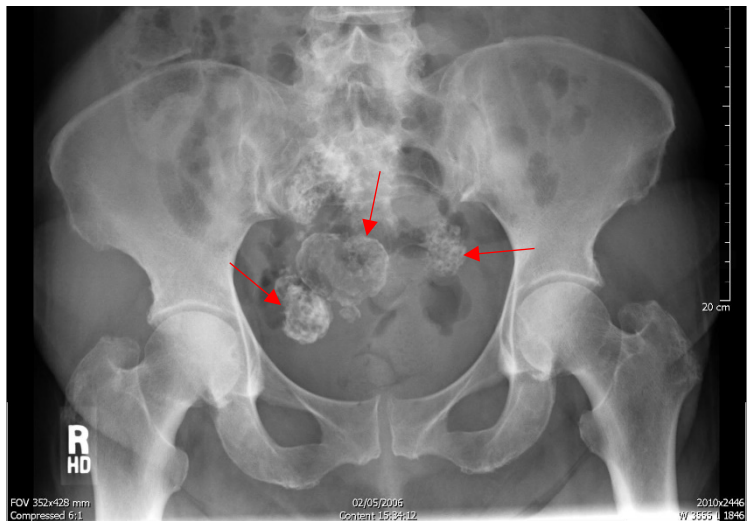
Subchorionic hemorrhage (black arrow)

Placental abruption

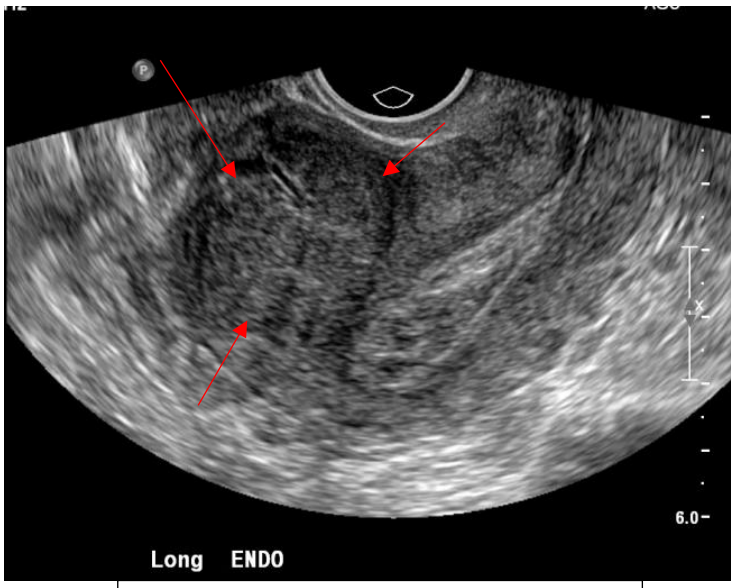
Uterine leiomyoma ('fibroid')

-In 30-40% of women of reproductive age
-Growth influenced by levels of estrogen production
-Complications:
-Pelvic pain due to torsion, infarction or necrosis
-Infertility and pregnancy complications
-Heavy prolonged periods

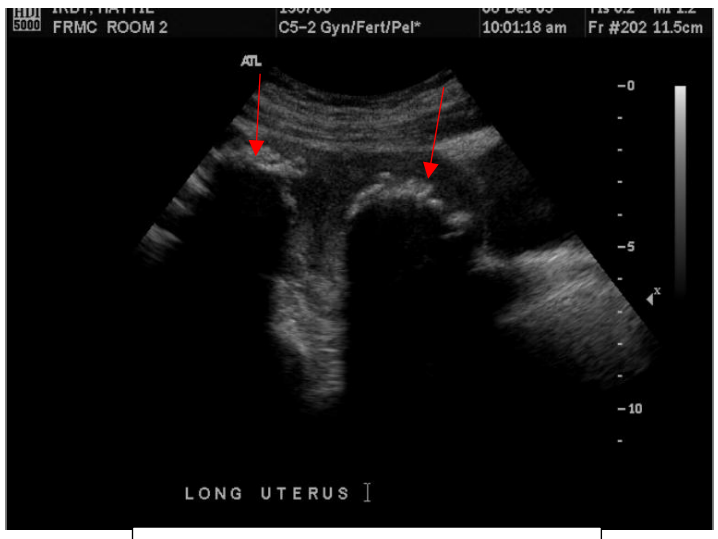
-Radiographs
-May reveals fibroids is they are calcified
-Sonography
-solid masses (various echogenicities)
-calcifications may be present
-echogenic foci
-posterior acoustic shadowing
-necrosis/degeneration
-cystic (anechoic to hypoechoic foci)



Calcified uterine leiomyomata (arrows)



Fundal uterine leiomyoma (arrows)

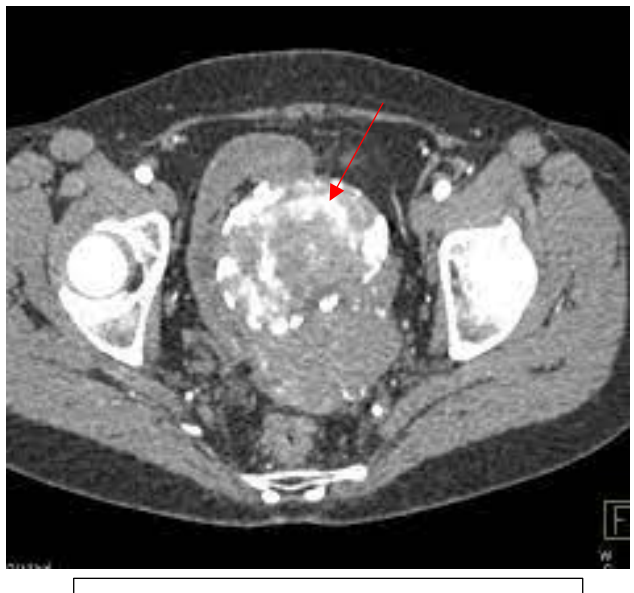


Calcified uterine fibroids (arrows) with posterior acoustic shadowing

Computerized axial tomography (CT)

-soft tissue density
-potential calcifications and/or cystic changes
-variable enhancement

Uterine fibroids (arrowheads/arrows) (lumen.luc.edu)



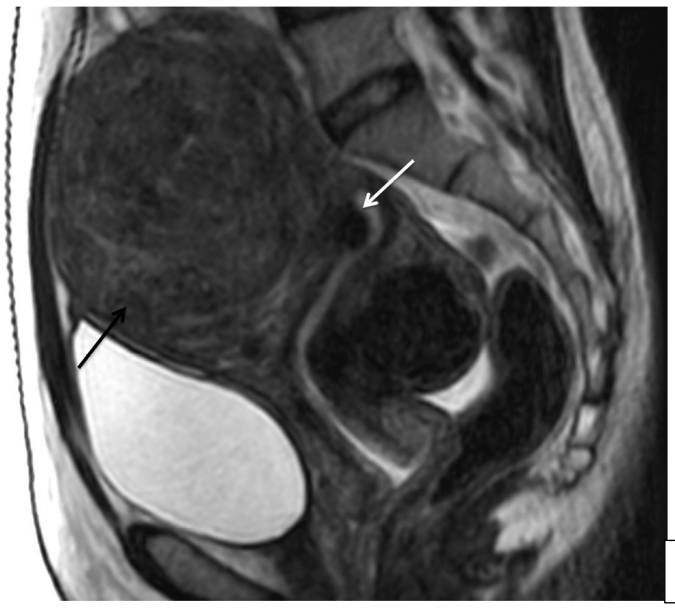
Calcified uterine leiomyoma (arrow) (ctisus.com)

Magnetic resonance imaging (MRI)

-Hypointense on T1 and T2 (if non-degenerated)

-Cystic degeneration (T2 hyperintensity)

-Variable signal in other types of degeneration (i.e. hyaline, red, myxoid)



Fundal fibroid (arrows) on MRI

-Adnexal masses

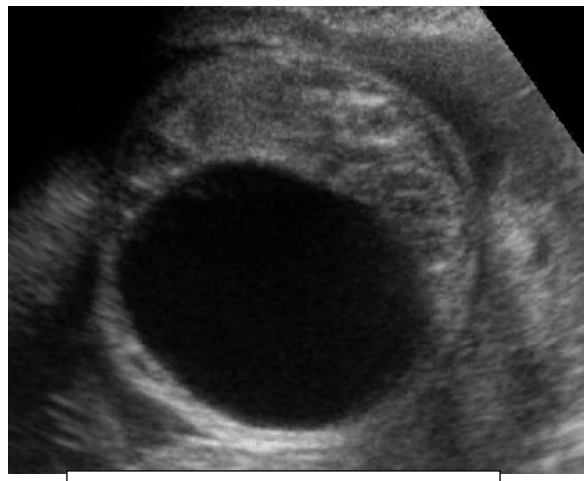
-D/D of completely cystic adnexal mass

-physiologic ovarian cyst (>3cm)

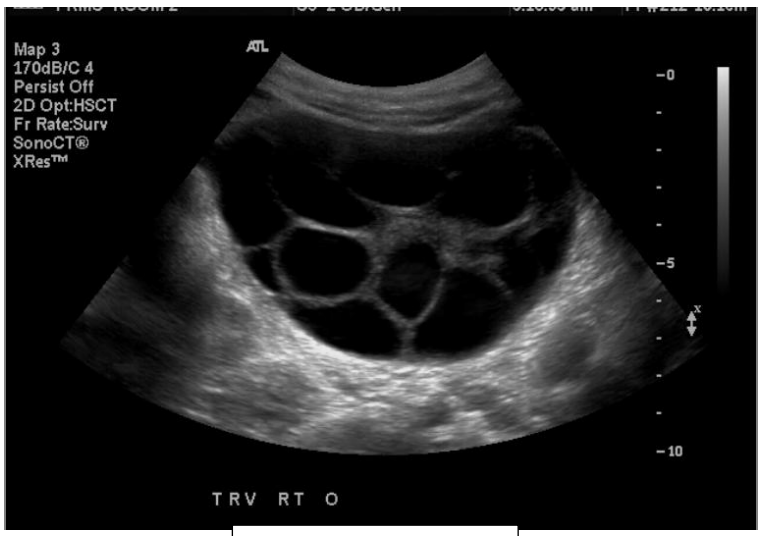
-benign cystic neoplasm (cystadenoma)

-hydrosalphinx

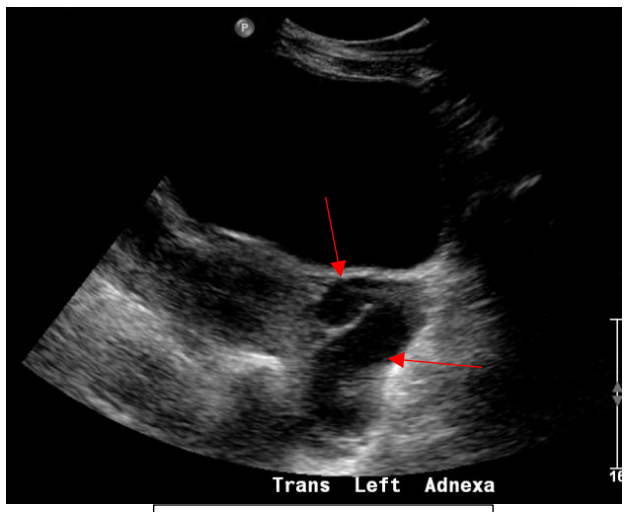
-para-ovarian cyst



Simple ovarian cyst (4.5cm)



Polycystic ovary



Hydrosalphinx (arrows)

-D/D of complex (primarily cystic) adnexal mass

-Hemorrhagic ovarian cyst (see image to the right)

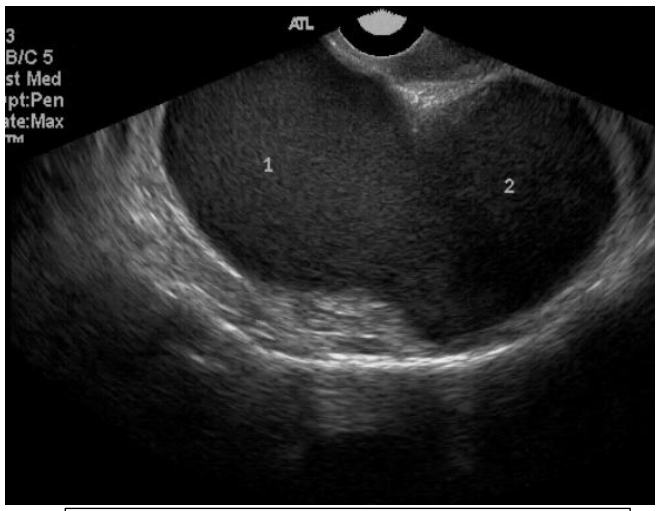
-Endometrioma

-Cystadenoma/cystadenocarcinoma

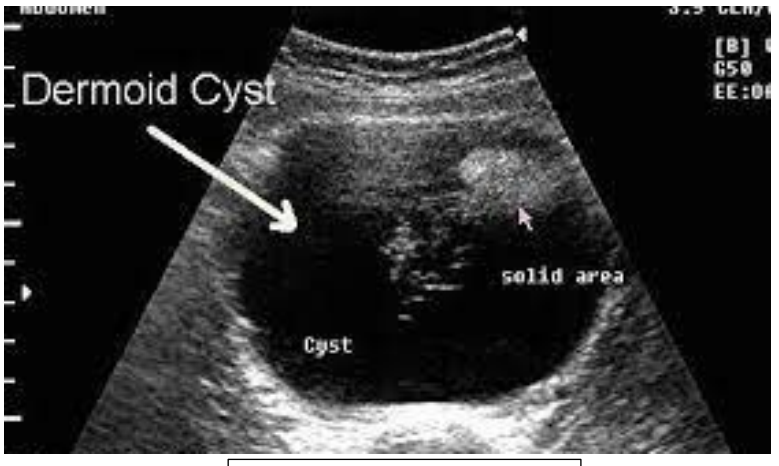
-Dermoid/Teratoma

-Tubo-ovarian abscess

-Ectopic pregnancy



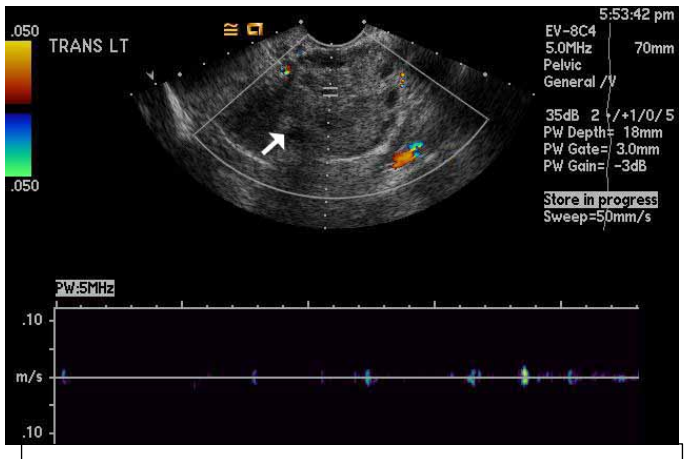
Hemorrhagic ovarian cyst vs endometrioma



Teratoma (dermoid cyst)

-D/D of complex (primarily solid) adnexal mass

-Dermoid/Teratoma
-Ectopic pregnancy
-Ovarian torsion
-Ovarian malignancy



Ovarian torsion (lack of vascular flow on Doppler)

-D/D of solid adnexal mass

-Primary ovarian neoplasia
-Metastatic disease to the ovary (Krunkenberg tumor)
-Pedunculated uterine fibroid

Primary ovarian mass (in 80-year-old female)

Krunkenberg tumors (colon neoplasia metastatic to bilateral ovaries

References:

-Clinical Radiology: The Essentials. Daffner et al. 4th ed. (Chapter 6).

-Primer of Diagnostic Imaging. Weissleder et al. 4th ed. (Chapters 4 and 9).

-Genitourinary Radiology: The Requisites. Zagoria et al.

-Note: Medical images are from anonymized patient data and online archives (as detailed)

OPTIONAL: Want to know more?

https://www.med-ed.virginia.edu/courses/rad/

www.auntminnie.com

www.acr.org

www.rsna.com