Imaging the Acute Abdomen in Pregnancy

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Disclosures

- None

Acknowledgement: Dr. Mike Wells

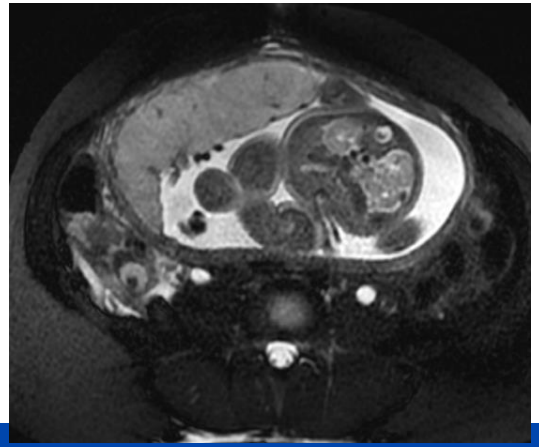
Background

- Anatomic and physiologic changes during pregnancy makes clinical diagnosis of common causes of abdominal pain challenging
- Imaging plays vital role in identifying the precise cause and guiding the management
- **US** is often the first modality of choice followed by **MRI** as problem solving tool
- Radiography and CT should not be withheld
- **“Don’t penalize her for being pregnant!”**

Khandelwal A, Fasih N, Kielar A. Imaging of acute abdomen in pregnancy. Radiol Clin North Am. 2013.

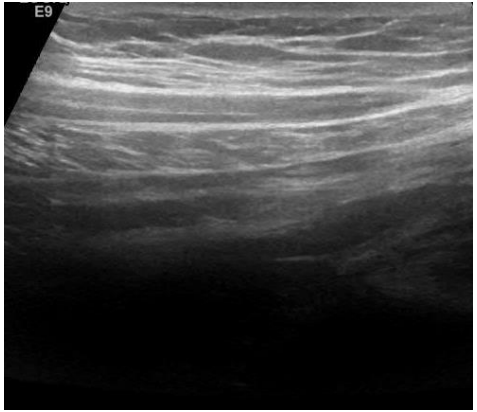
Introduction

- Impaired Clinical Assessment
  - Leukocytosis of pregnancy
    - WBC up to 16.9 cell/uL
  - Liver lab abnormalities, elevated CRP
  - Limited physical exam



Introduction - Ultrasound

- Ultrasound
  - Advantages
    - Fast, cheap, safe
    - Can potentially assess all pathology
  - Limitations
    - Small FOV, Bowel gas, body habitus
      - **Bowel, pancreas, ureters, mesentery, pelvic vasculature**
      - Potentially adnexa, posterior placenta



Gupta, R., S. K. Bajaj, N. Kumar, R. Chandra, R. N. Misra, A. Malik and B. B. Thukral (2016). "Magnetic resonance imaging - A troubleshooter in obstetric emergencies. A pictorial review." Indian J Radiol Imaging 26(1): 44-51.

Introduction – Computed Tomography

At doses **< 50 mGy**

- No known risk of deterministic effects

Doses **≥ 30 mGy**

- ICRP ~ **doubling** of the **low baseline risk** of childhood cancer (1.0-2.5 in 1000)

Estimates of fetal exposure:

- From routine appendicitis CT: 19.9 – 43.6 mGy
- **Adjusting AEC/coverage can easily half this ~13 mGy**
- Low dose exams < 4 mGy…

Introduction – Computed Tomography

Iodinated IV Contrast

Crosses the placenta..

Considered safe for use in pregnancy
FDA class B

No ACR recommendation to screen for pregnancy

ACR (2017). ACR Manual on Contrast Media Version 10.3. A. C. o. D. a. C. Media.

Introduction - MRI

Gadolinium:

Crosses placenta, **Lifetime in amniotic fluid is unknown**

Limited information available regarding fetal toxicity

Retrospective Canadian Study

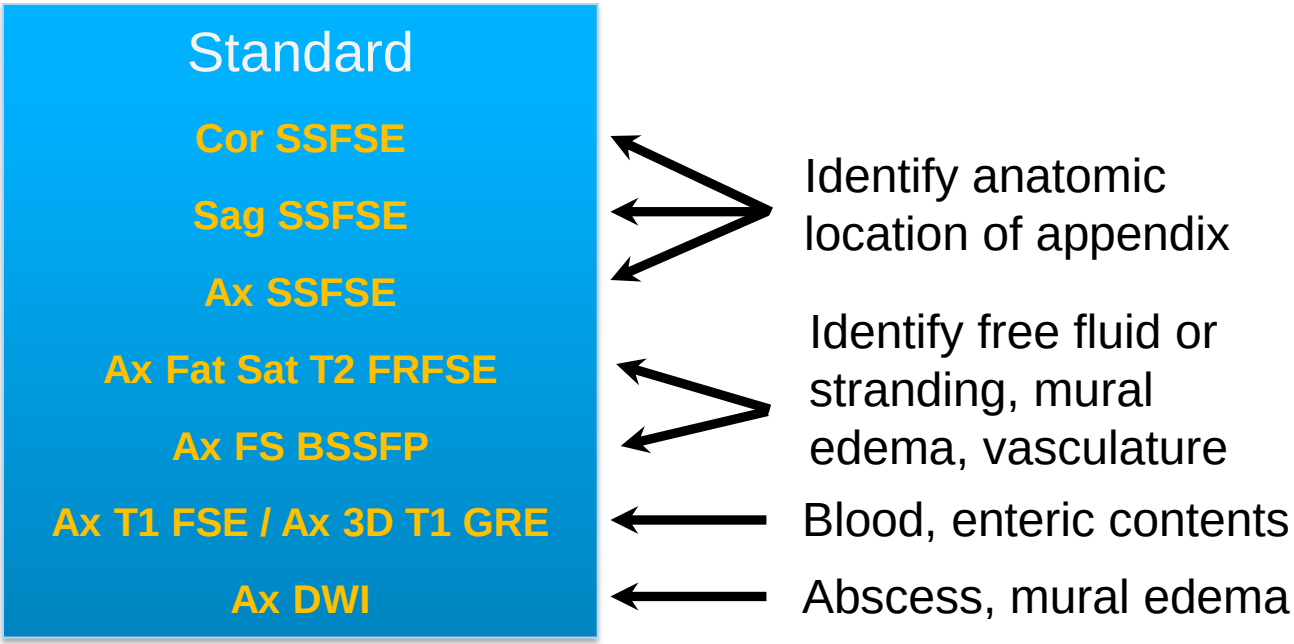
- ?Increased risk? Rheum/Inflamm/Infiltrative Dz & Stillbirth
- Many limitations of this study

Risks are considered unclear
FDA group C

Use only if critical to the exam & potential benefits outweigh the unknown, but potential, fetal risk

ACR (2017). ACR Manual on Contrast Media Version 10.3. A. C. o. D. a. C. Media.

MRI Sequences – Appendicitis Protocol



Causes of Maternal Abdominal Pain

Unique to Pregnancy

- ✓ Abortion
- ✓ Ectopic pregnancy
- ✓ Preterm labor
- ✓ Placental abruption
- ✓ Uterine rupture
- ✓ Hydronephrosis of pregnancy
- ✓ HELLP
- ✓ Acute fatty liver of pregnancy

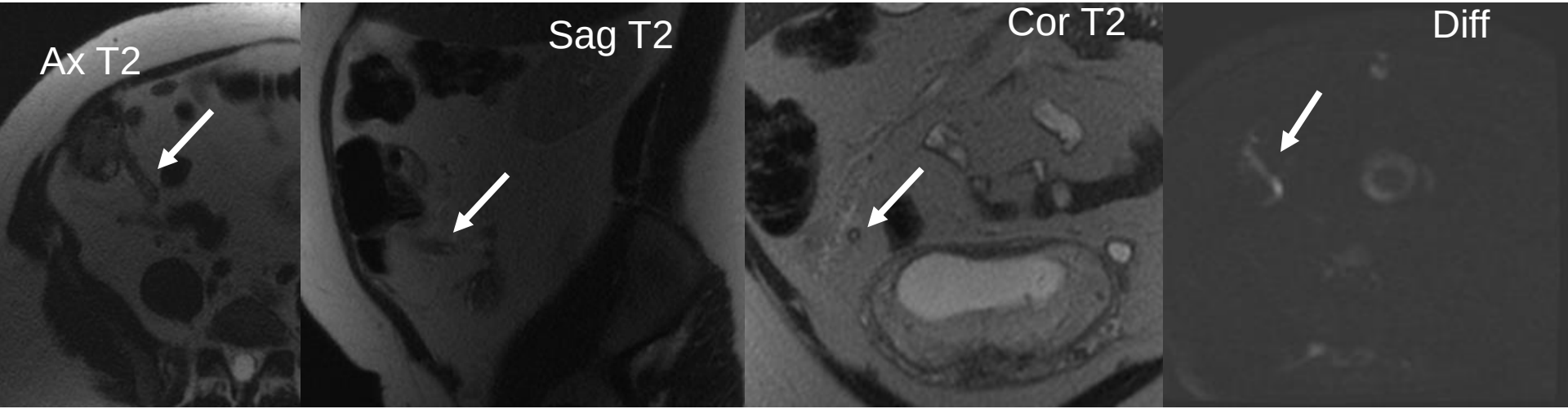
Increased incidence in pregnancy

- ➢ Adnexal torsion
- ➢ Uterine leiomyoma
- ➢ Peptic ulcer disease
- ➢ Cholelithiasis
- ➢ Vascular thrombosis
- ➢ Aneurysm rupture

Other causes

- ❖ Appendicitis
- ❖ Inflammatory bowel disease
- ❖ Bowel obstruction
- ❖ Urolithiasis
- ❖ Pyelonephritis
- ❖ Pancreatitis

37/f with inconclusive USG for ? appendicitis



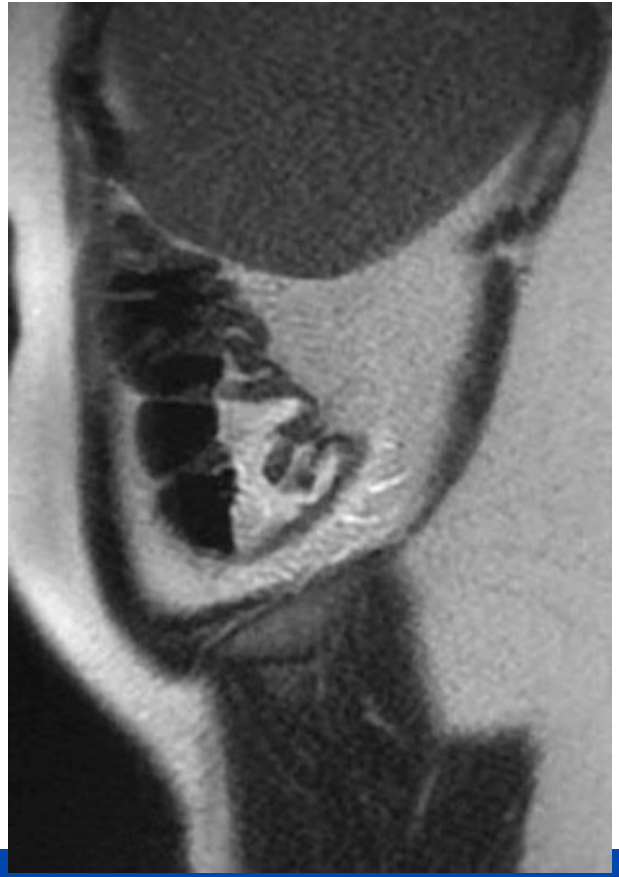
Early Acute Appendicitis

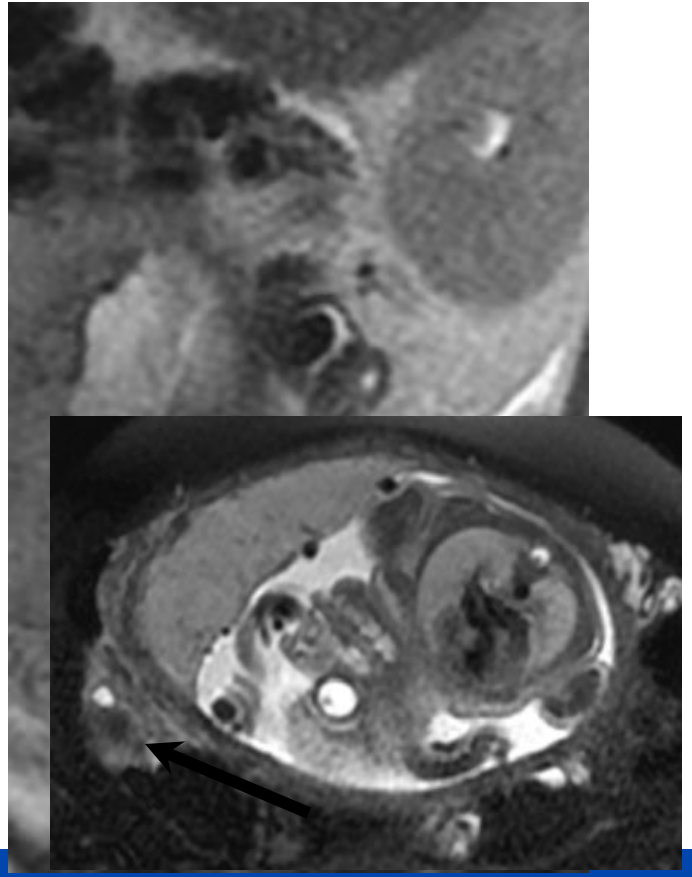
The most common non-obstetric reason for emergency surgery during pregnancy

Pooled Se of 97% and Sp of 95%

Duke, E., B. et al. (2016). "A Systematic Review and Meta-Analysis of Diagnostic Performance of MRI for Evaluation of Acute Appendicitis." AJR Am J Roentgenol **206**(3): 508-517.

Appendicitis





Acute Appendicitis

High Negative Predictive Value

NPV near 100%

? Appendix not seen **&** No secondary findings ?

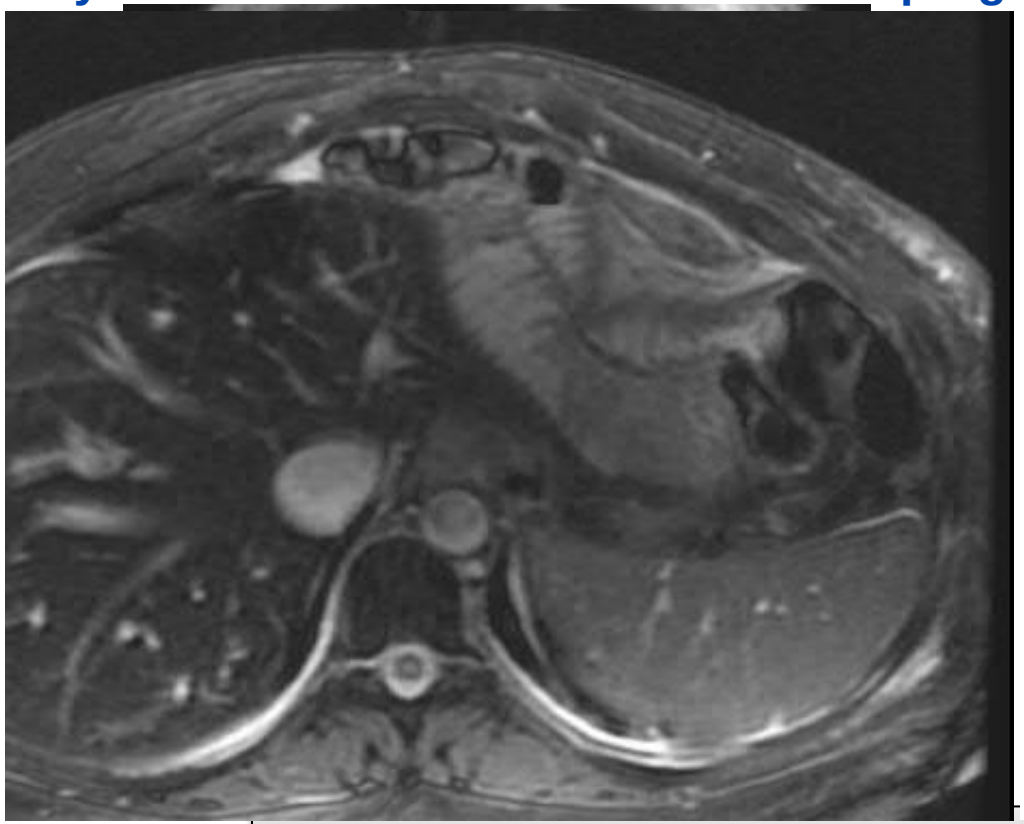
10-20%

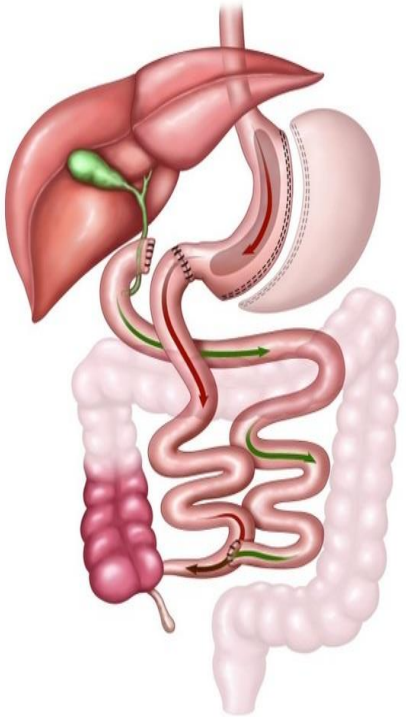
Appendix Not Seen		
1st Trimester	2nd	3rd
38.5%	50%	57.1%

Consider negative

Patel, D., J. et al (2017). Abdom Radiol (NY) 42(7): 1857-1863.
Burke, L. M., et al.. (2015). Am J Obstet Gynecol 213(5): 693 e691-696.
Kereshi, B., K. et al. (2017). Abdom Radiol (NY).

History of a duodenal switch. 24 hours of progressive lower abdominal pain.





Acute closed loop intestinal obstruction

Intestical Obstruction

1 in 2,500 pregnancies

↑ Morbid Obesity Procedures

↑ Proctocolectomies (IBD, Polyposis)

Due to adhesions in 70% of cases

Usually presents in 3rd trimester

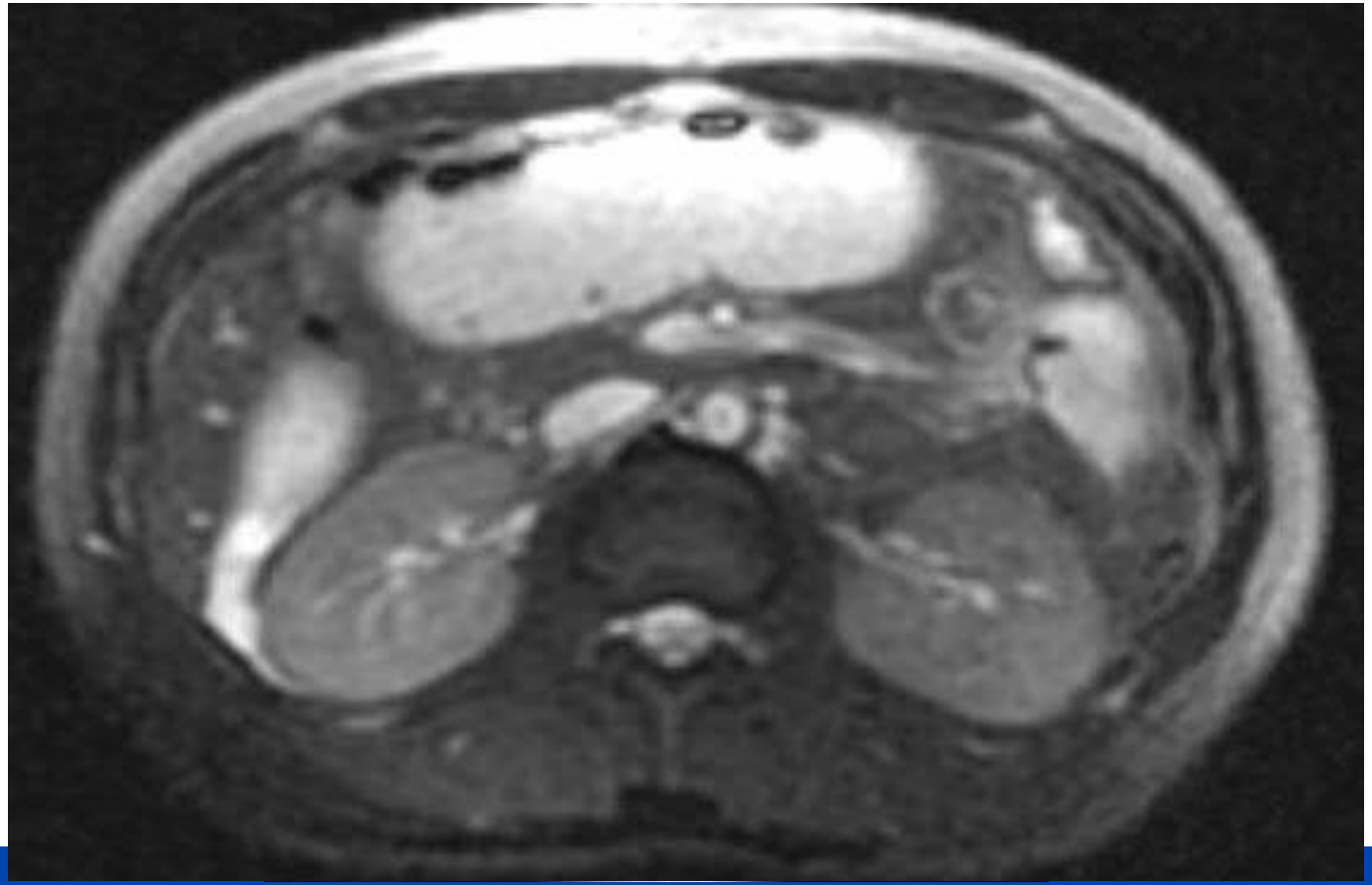
2-6% maternal mortality

17% rate of fetal loss

Woodfield, C. A., et al. (2010). AJR Am J Roentgenol 194(6 Suppl): WS14-30.
Webster, P. J., et al. (2015). Ann R Coll Surg Engl 97(5): 339-344.

20 hours progressive periumbilical pain & emesis

High Grade SBO



High Grade SBO

- Surgery:
- High grade obstruction

- “Adhesive Band”:
- Omphalomesenteric duct remnant

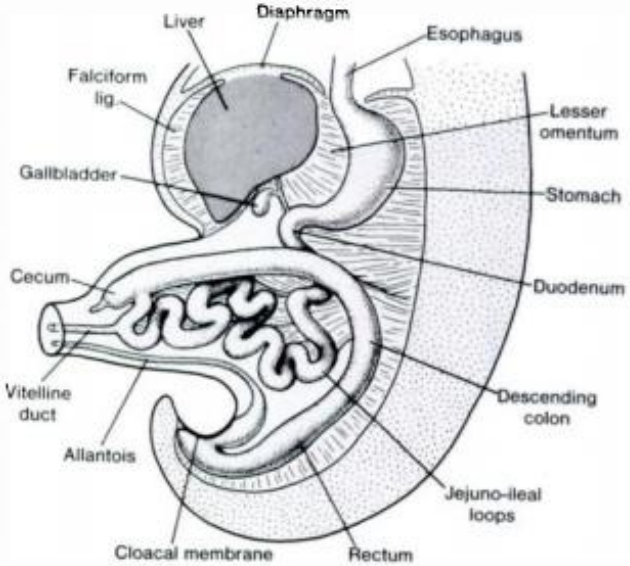
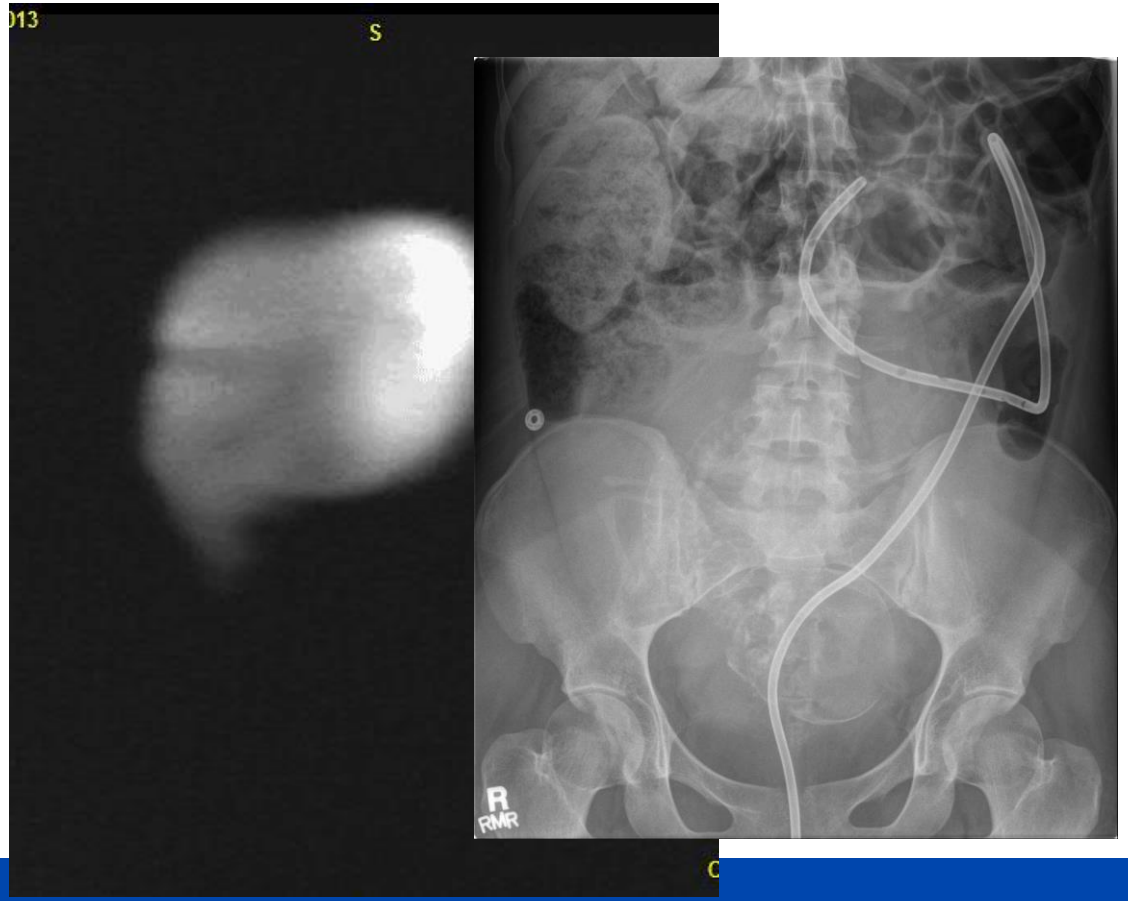
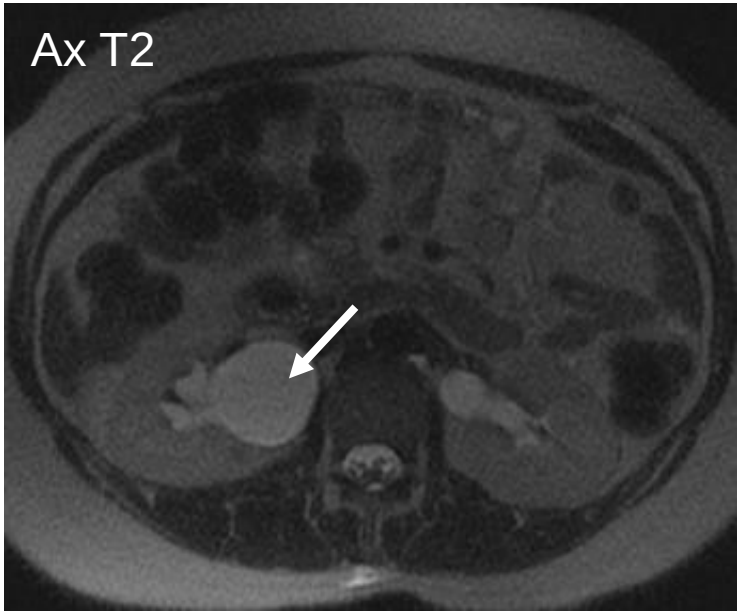


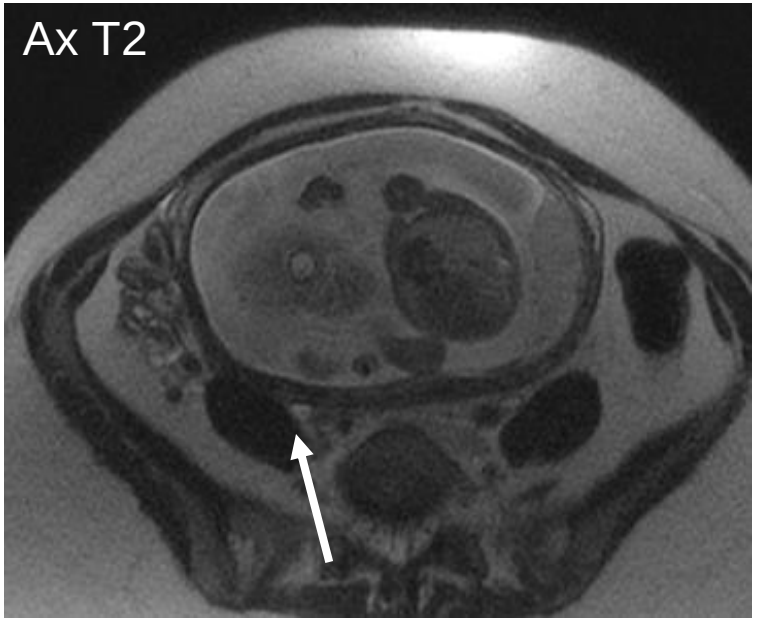
Figure 1. Schematic lateral view of the umbilical cord structures in an 8-week-old fetus illustrates the proximal connections of the vitelline duct and allantois. *lig* = ligament. (Reprinted, with permission, from reference 2.)

Sigmoid Volvulus



30-year-old with right lower abdominal pain





Physiologic Hydronephrosis of Pregnancy

- Seen in 90% of gravid females. Common on right side

Urolithiasis

10% of the population gets kidney stones

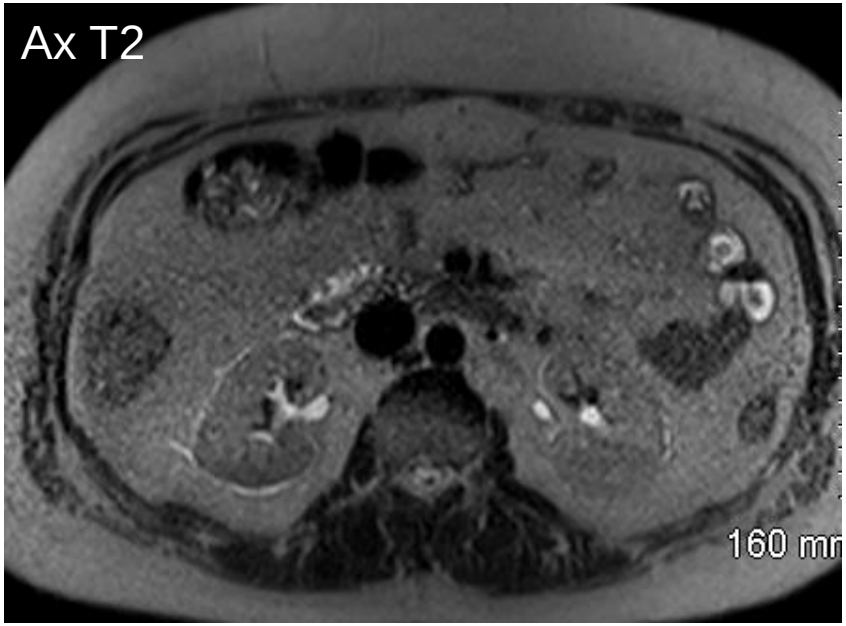
1 in 200-1500 pregnancies

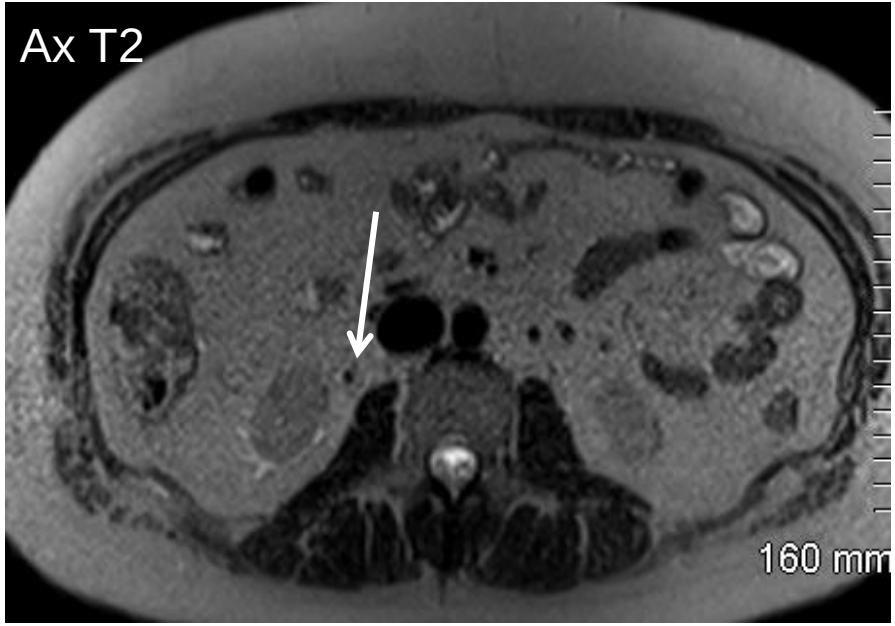
Most common cause for non-obstetric hospitalization

↑ Risk of:

Preterm labor
Preterm delivery
Premature rupture of membranes
Recurrent pregnancy losses
Mild pre-eclampsia

Woodfield, C. A., et al. (2010). "AJR Am J Roentgenol 194(6 Suppl): WS14-30.
Semins, M. J., et al. (2013). Urolithiasis **41**(1): 43-46.
Burke, L. M., et al. (2015). Am J Obstet Gynecol **213**(5): 693 e691-696.



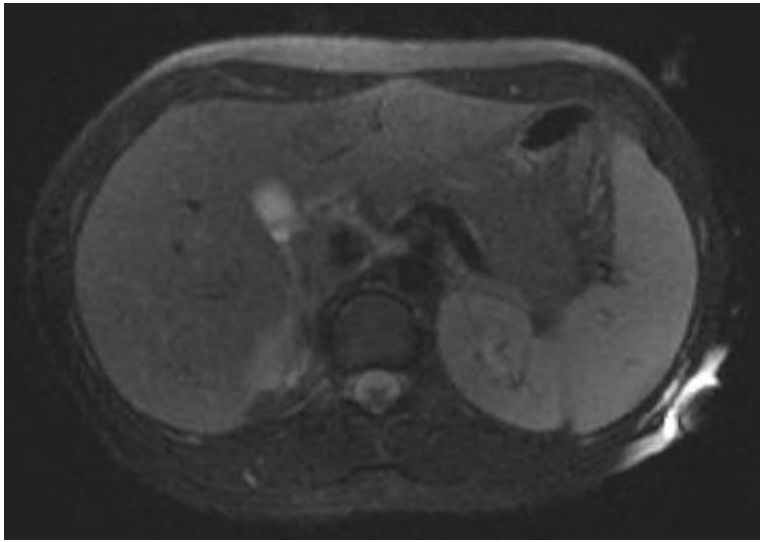


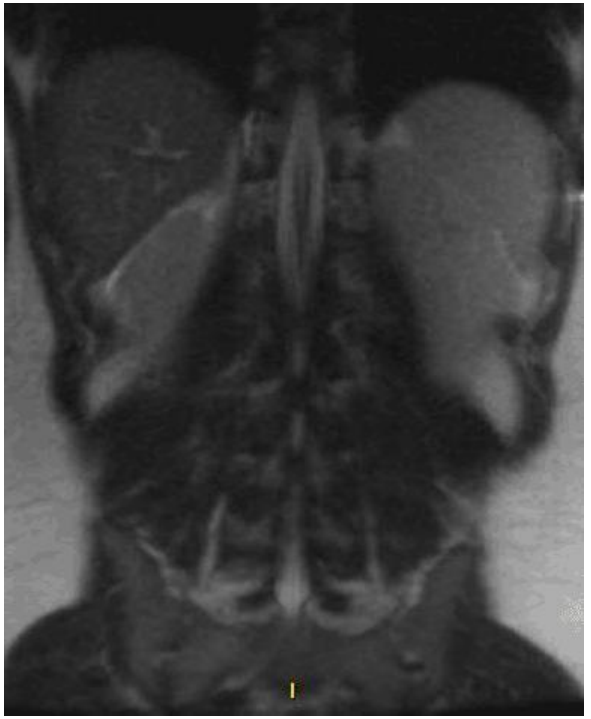
Renal stone disease

CT>> MRI for stone detection

Complications include pyelonephritis and preterm labor induced by renal colic

26 yF Several days progressive RLQ pain US Negative





Stone Disease and Pancreatitis

Cholelithiasis or Choledocholithiasis

Decreased motility + cholesterol synthesis **= ↑ Sludge & Stones**

- 2-4% of pregnant women have gallstones
- 5% Symptomatic

Acute Cholecystitis

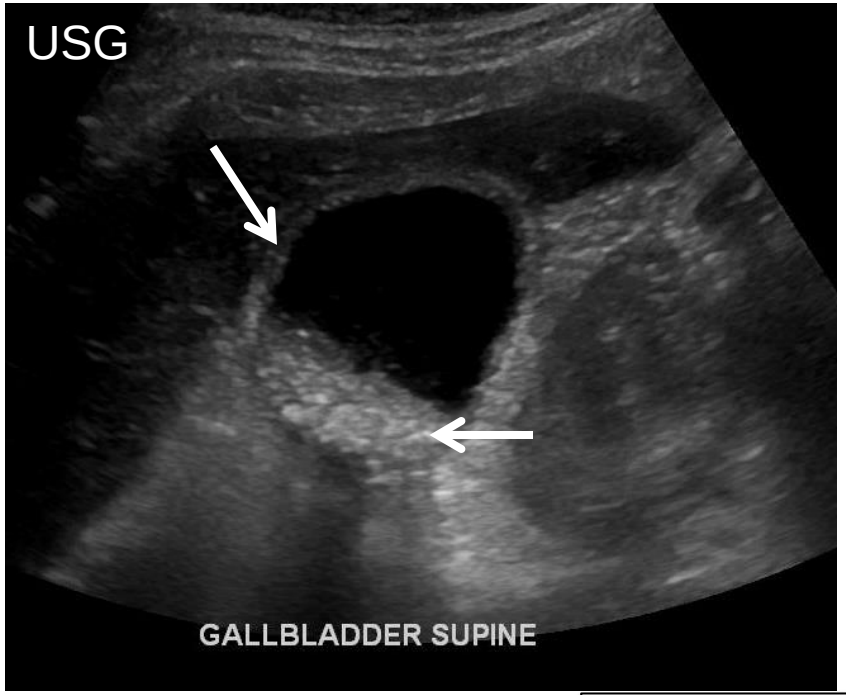
- ↑ Cholelithiasis **but not** Cholecystitis
- **2nd most frequent non-obstetric surgery**

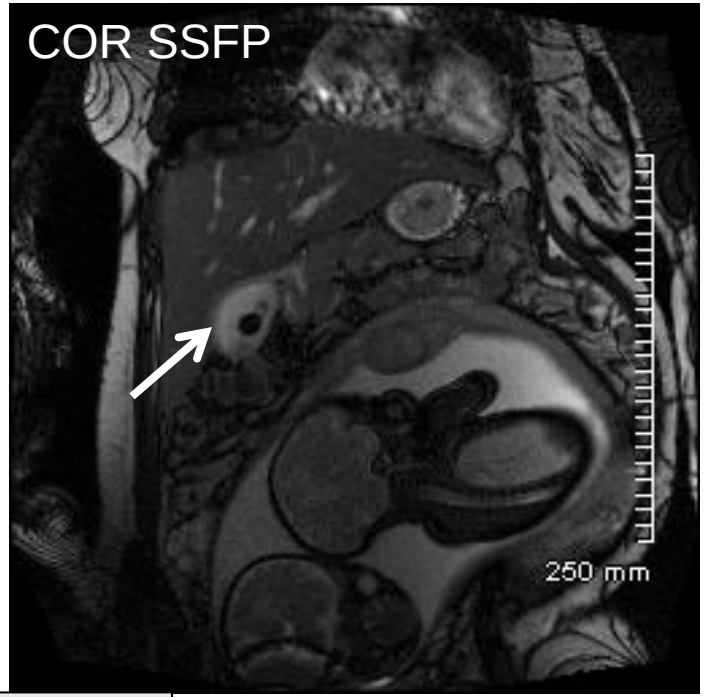
Acute Pancreatitis

- Rare in pregnancy
- 3rd trimester, **Caused by gallstones**

Leyendecker, J. R., et al (2004). Radiographics **24**(5): 1301-1316.
Himoto, Y., et al (2015). Eur J Radiol Open **2**: 101-110.

26-year-old RUQ pain and twin gestation





Acute cholecystitis

HELLP and AFLP

HELLP Syndrome

Associated with Preeclampsia

Vasospasm leads → Endothelial injury

Congestion/edema → necrosis → hemorrhage, rupture

Variable Presentation

Acute Fatty Liver of Pregnancy

Severe fatty infiltration

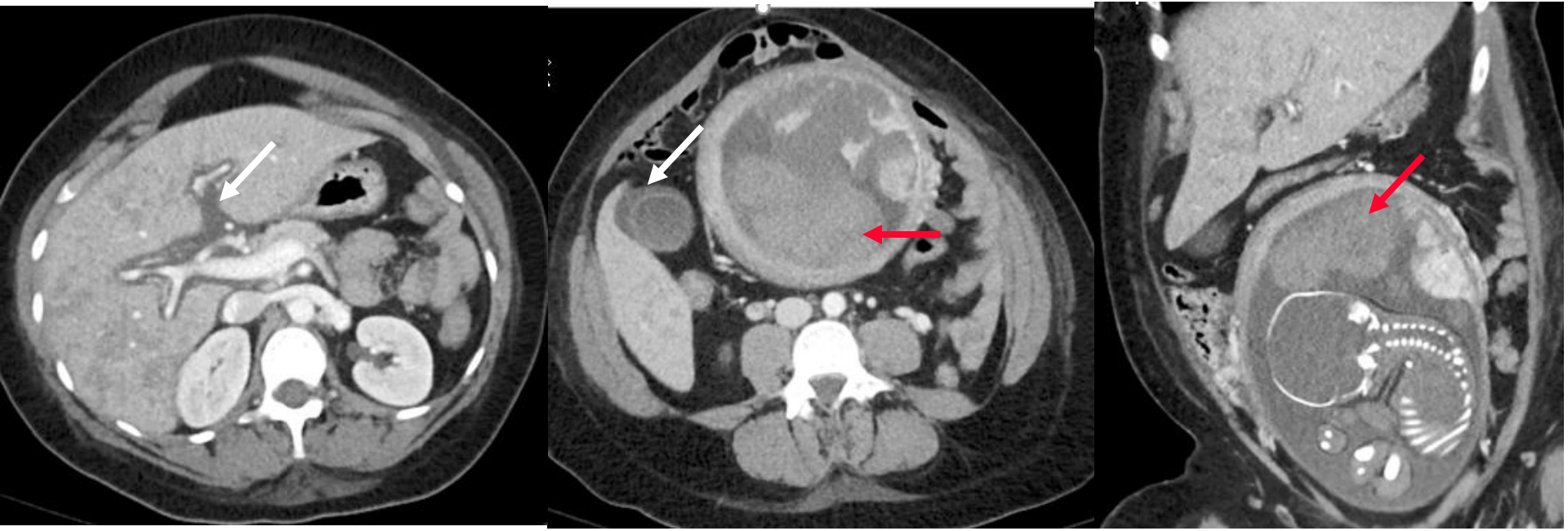
Hepatic dysfunction → coagulopathy and hypoglycemia.

Steatosis, hepatomegaly, periportal edema, collapsed GB

Exclude Other Pathology

Leyendecker, J. R., et al (2004). Radiographics **24**(5): 1301-1316.
Himoto, Y., et al (2015). Eur J Radiol Open **2**: 101-110.

28 wks gestation with severe hypertension and RUQ pain



Vasospasm→ endothelial injury →congestion/edema →necrosis → hemorrhage/rupture

HELLP Syndrome

Adnexal Torsion

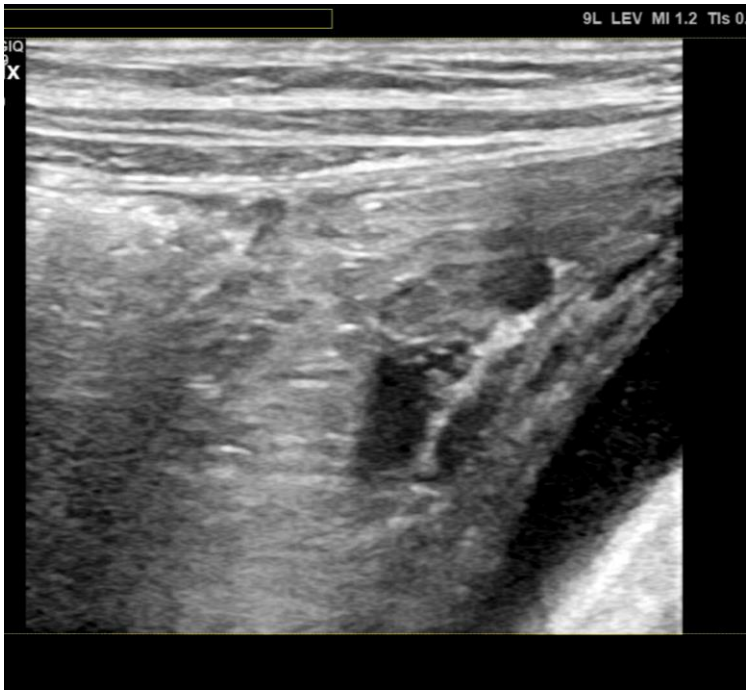
Risk of ovarian torsion **increased** during pregnancy
1 in 1800; similar to appendicitis

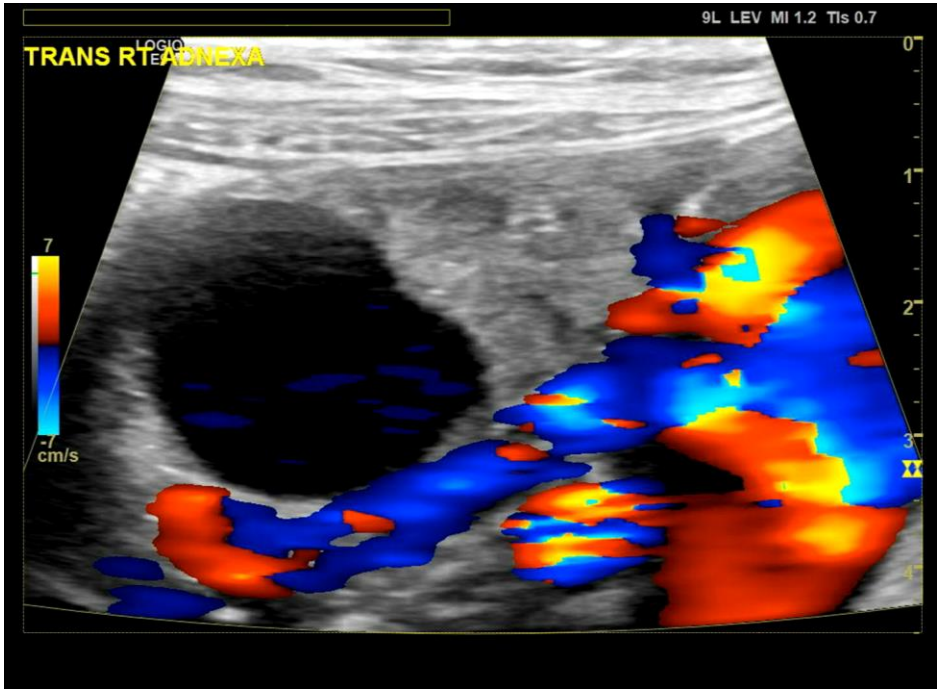
Risk is due to an increase:

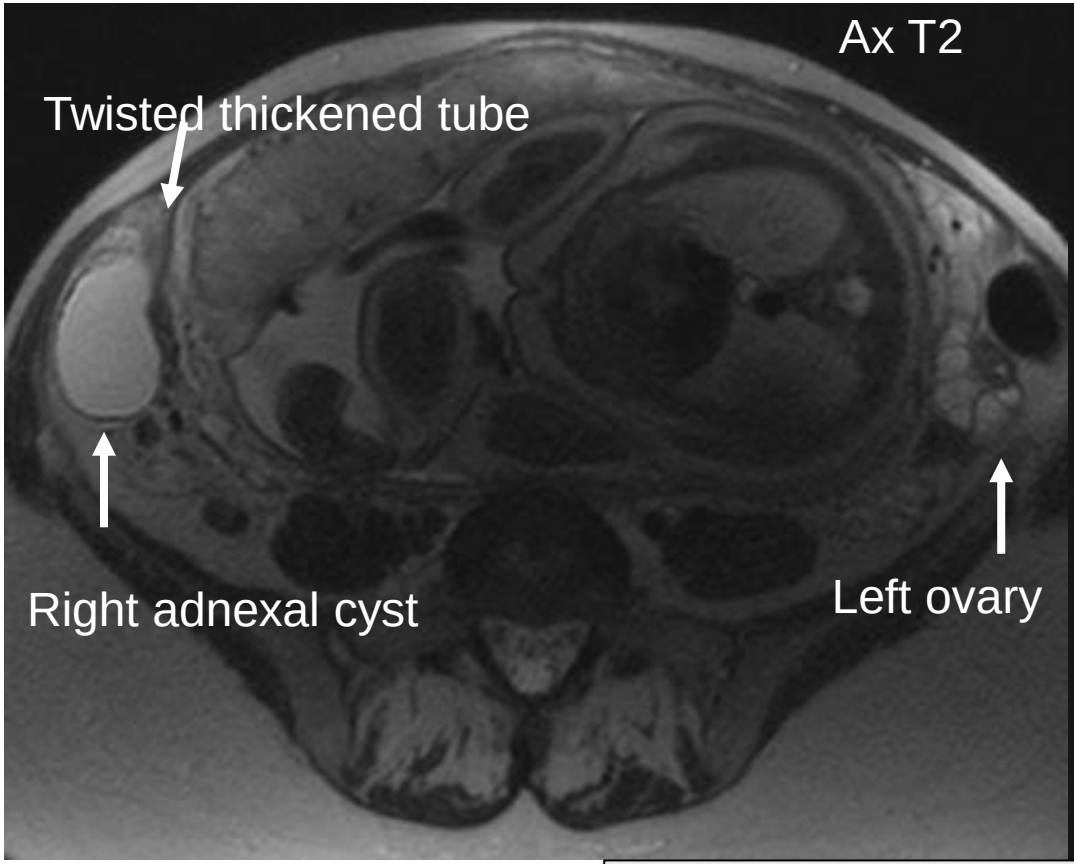
- **Adnexal masses (7% torse in pregnancy)**
- Ligamentous laxity
- Enlargement of uterus

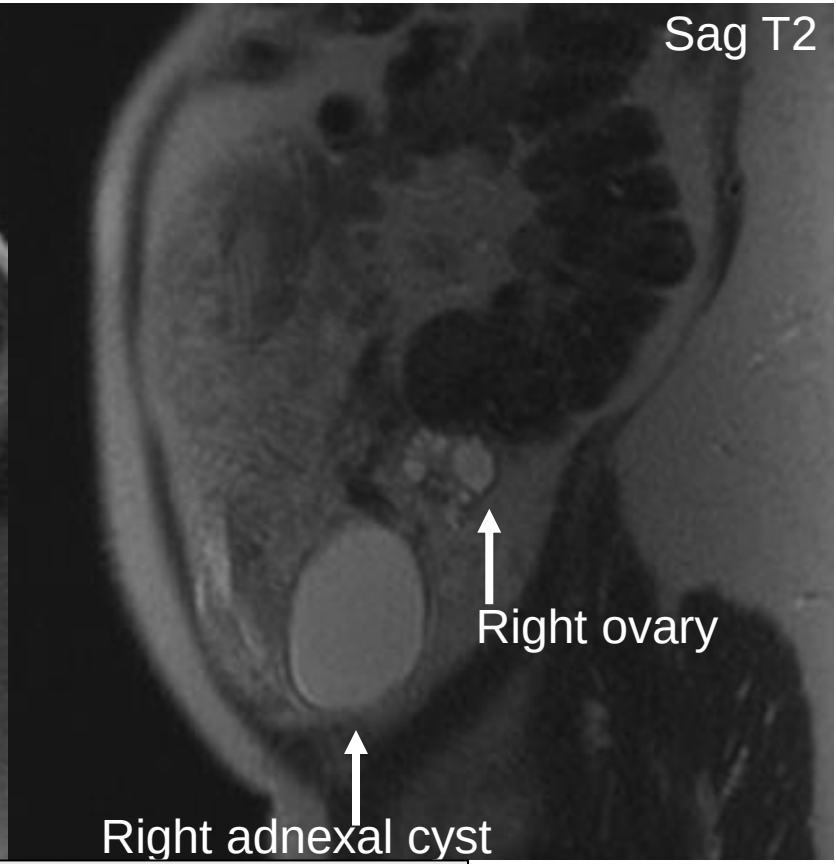
Melnick, D. M., W. L. Wahl and V. K. Dalton (2004). "Management of general surgical problems in the pregnant patient." Am J Surg 187(2): 170-180.

36-year pregnant female with abdominal pain ? Appendicitis versus ovarian torsion

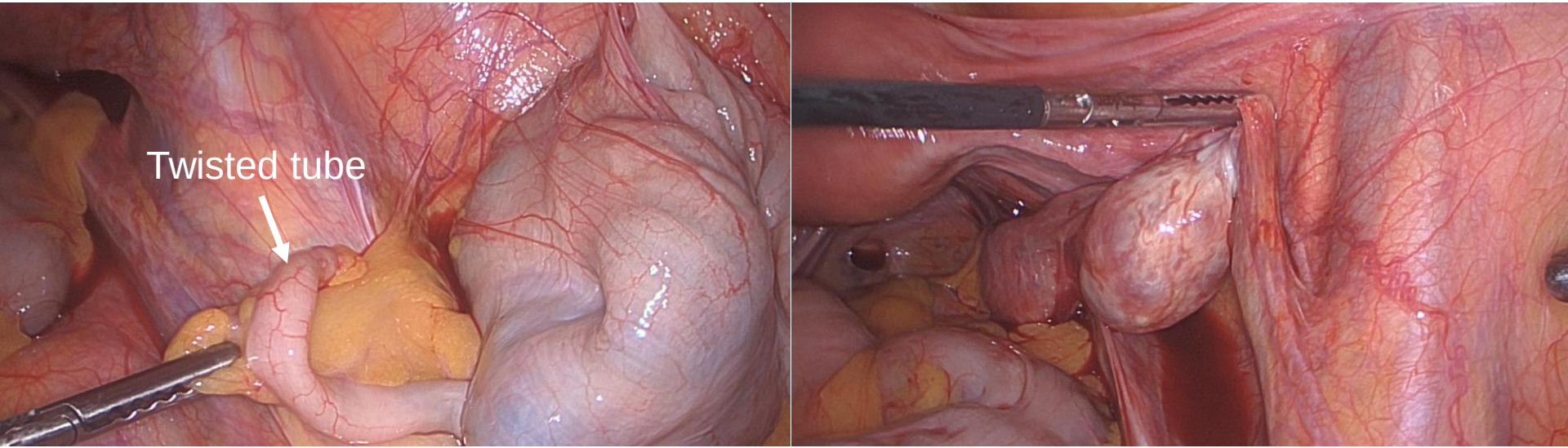








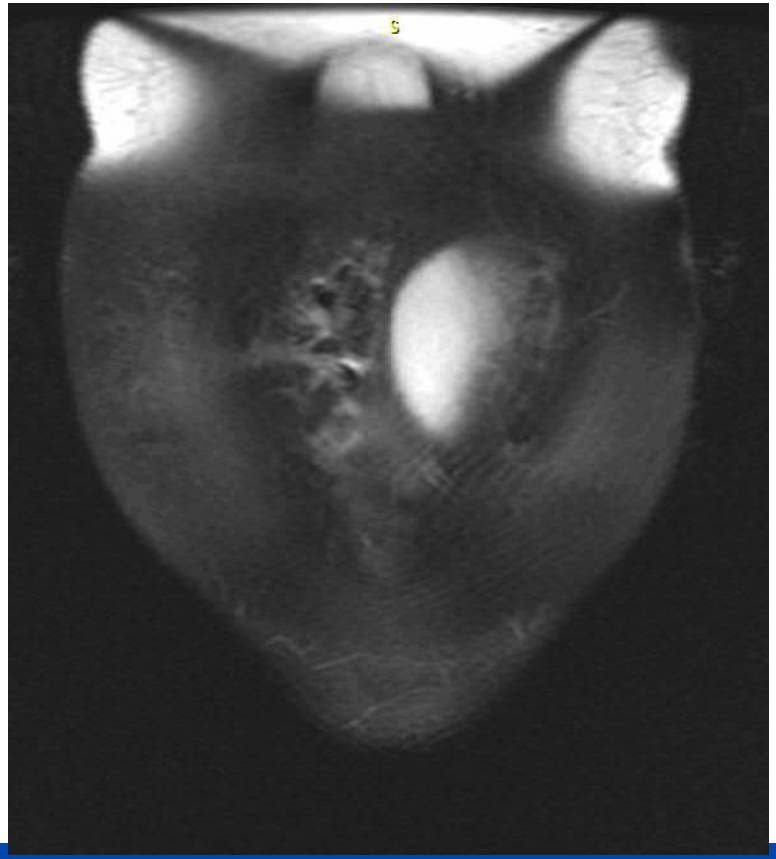
Intermittent Isolated Tubal Torsion

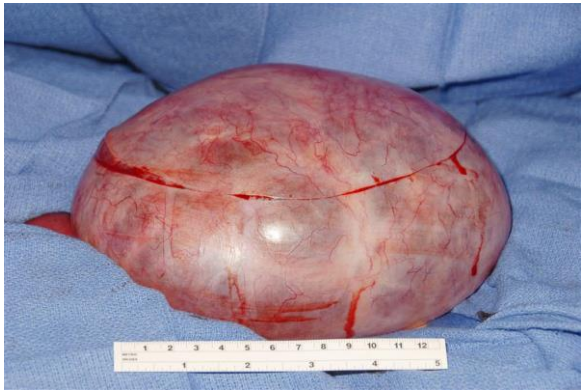


Right tubal torsion with paratubal cyst

MRI can used as problem solving tool in complex cases

Mucinous Cystadenoma





Ovarian Hyperstimulation

6 weeks after IVF

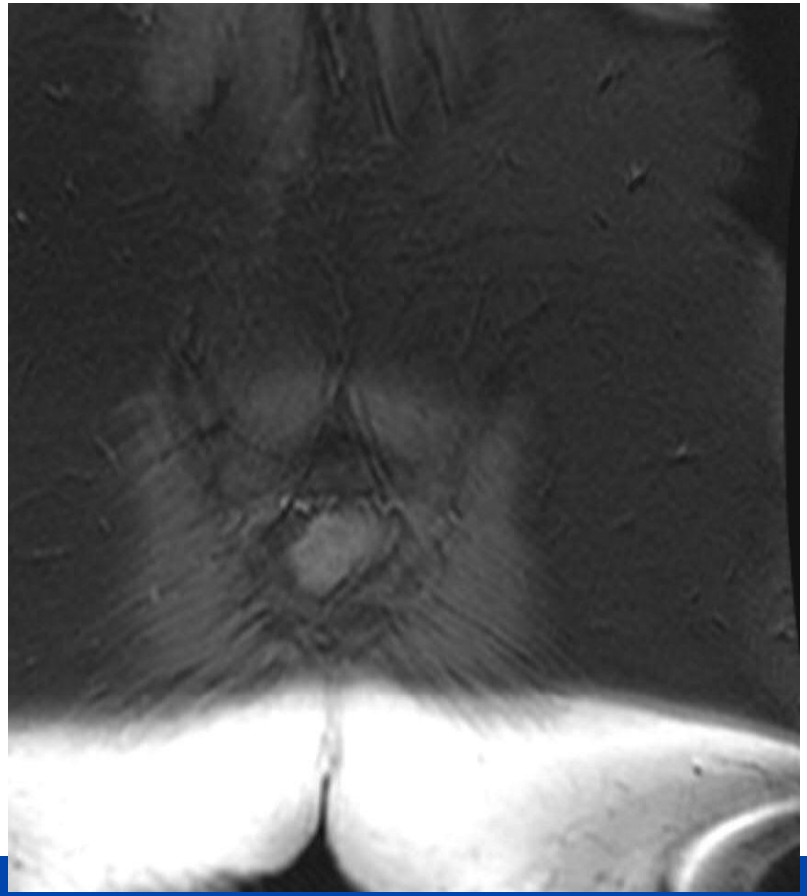
RLQ pain.
Nausea and vomiting

US:

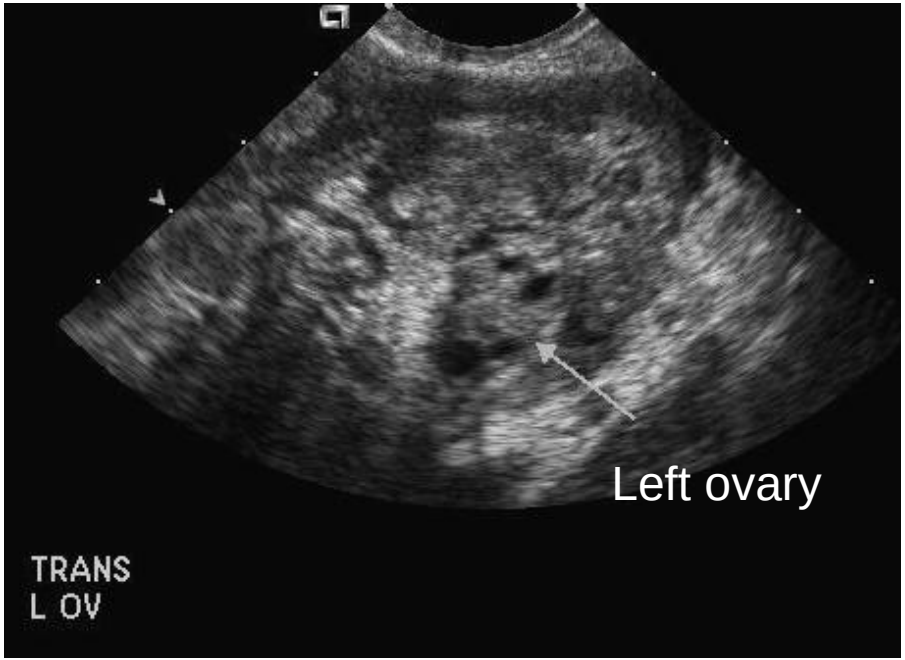
- Slightly less flow in R ovary
- Asymmetrically large
  126 vs 56 mL

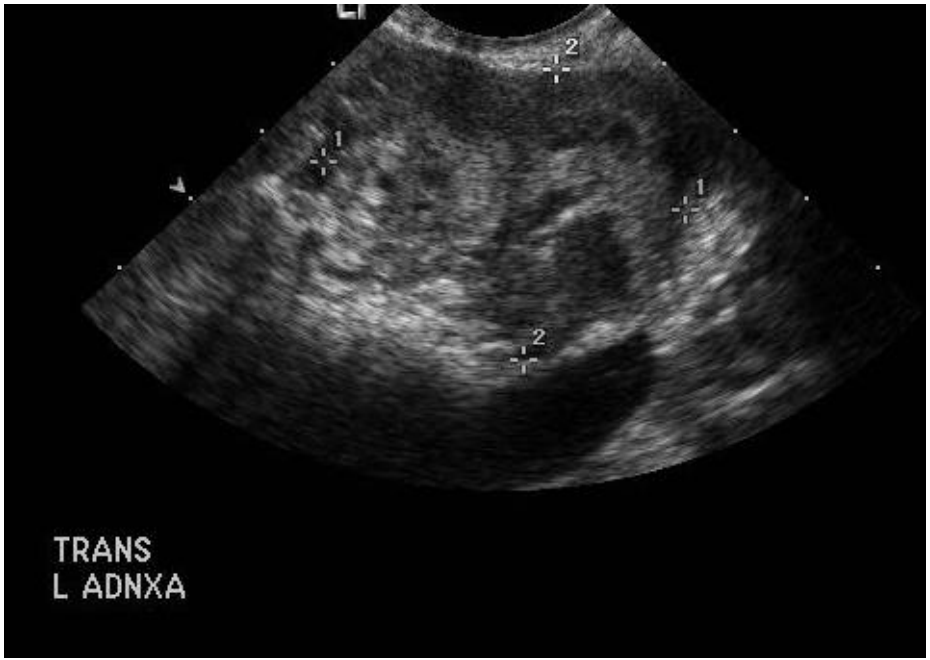
MRI:

? Torsion, or other etiology - appendicitis?

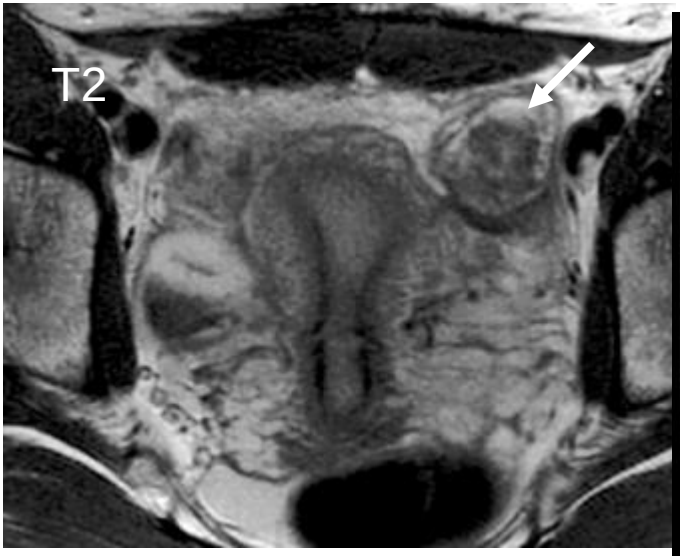


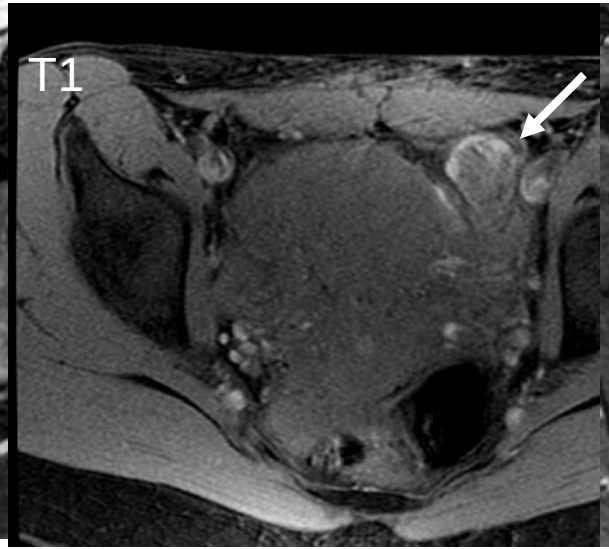
24 year with recent abortion with vaginal bleeding and left pelvic pain

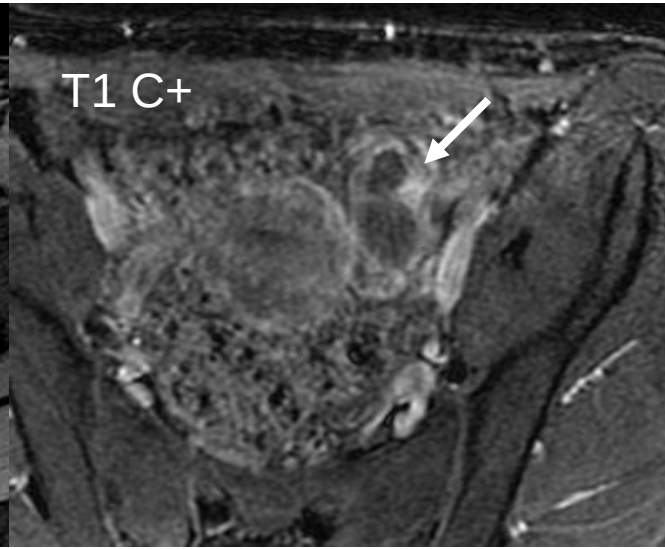




Indeterminate left adnexal mass and MRI was recommended





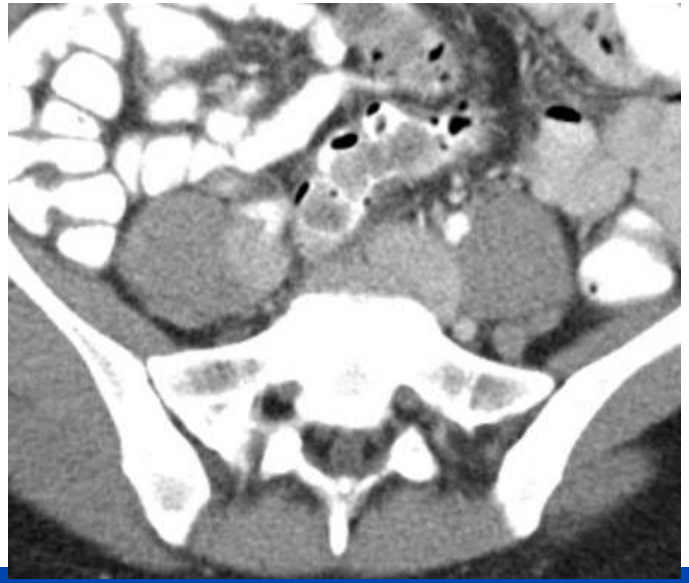


Unruptured Tubal Ectopic Pregnancy

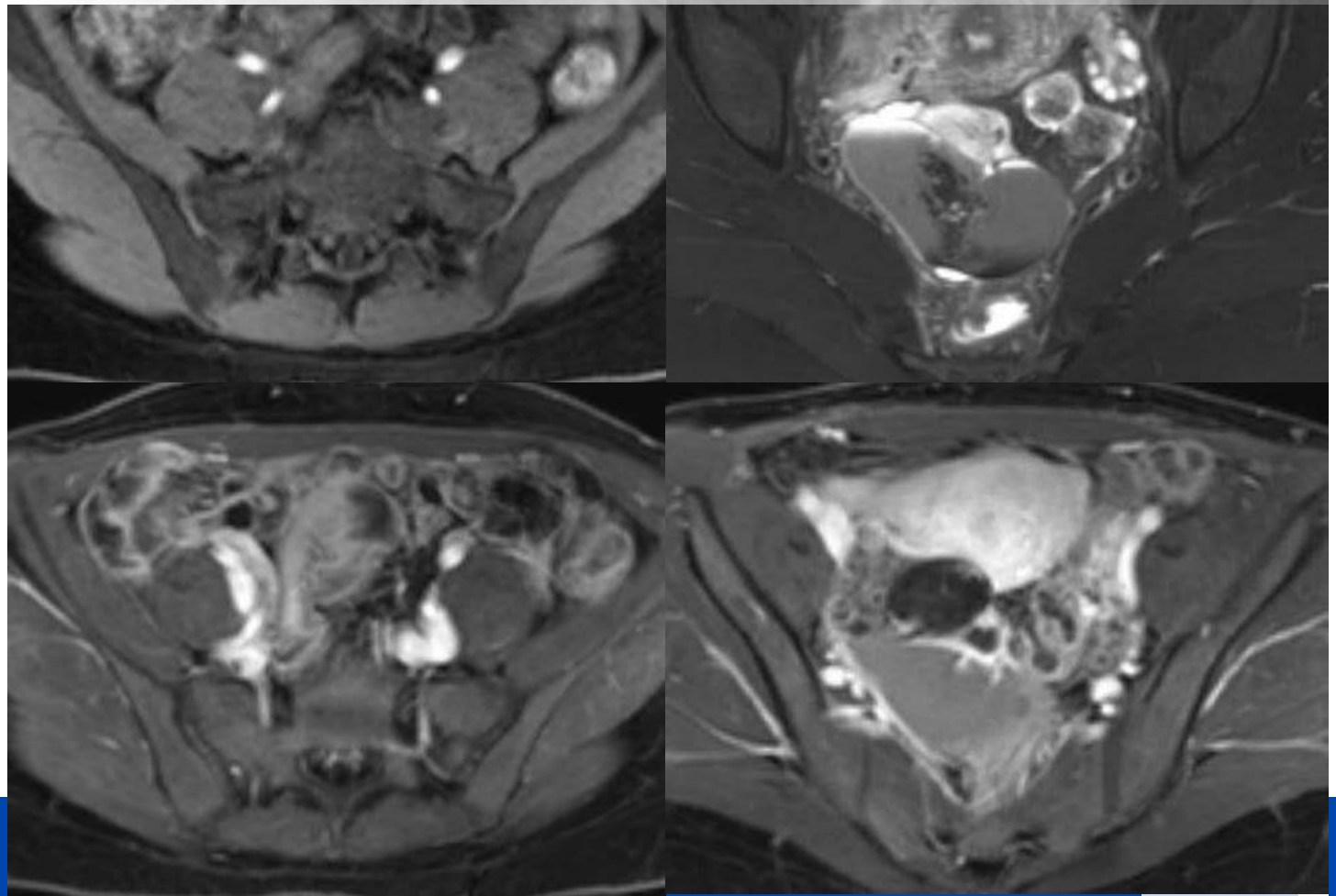
2% of all pregnancies can be ectopic and it is most frequent cause of death in pregnancy.

Triad of pain, vaginal bleeding and tender adnexal mass

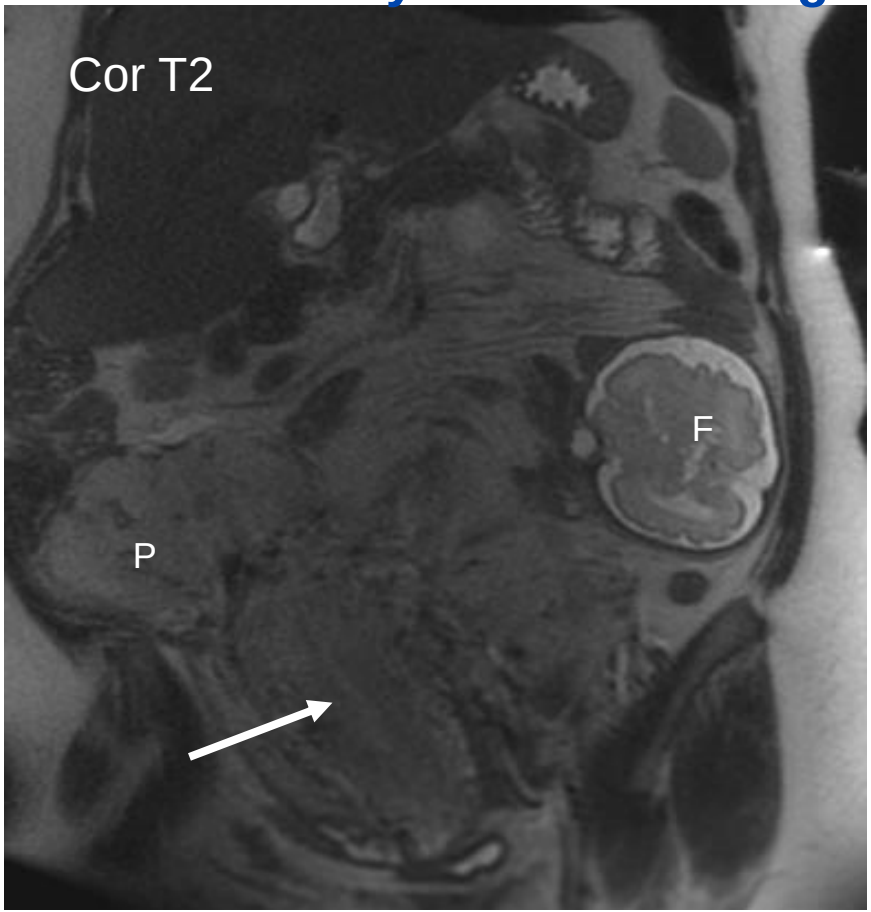
History:
- **bHCG 5800. US neg for intrauterine pregnancy.**
- **bHCG declined to 117 over “several” weeks.**
- **Intermittent RLQ pain, which is now severe.**
- **CT shows pelvic “mass”**

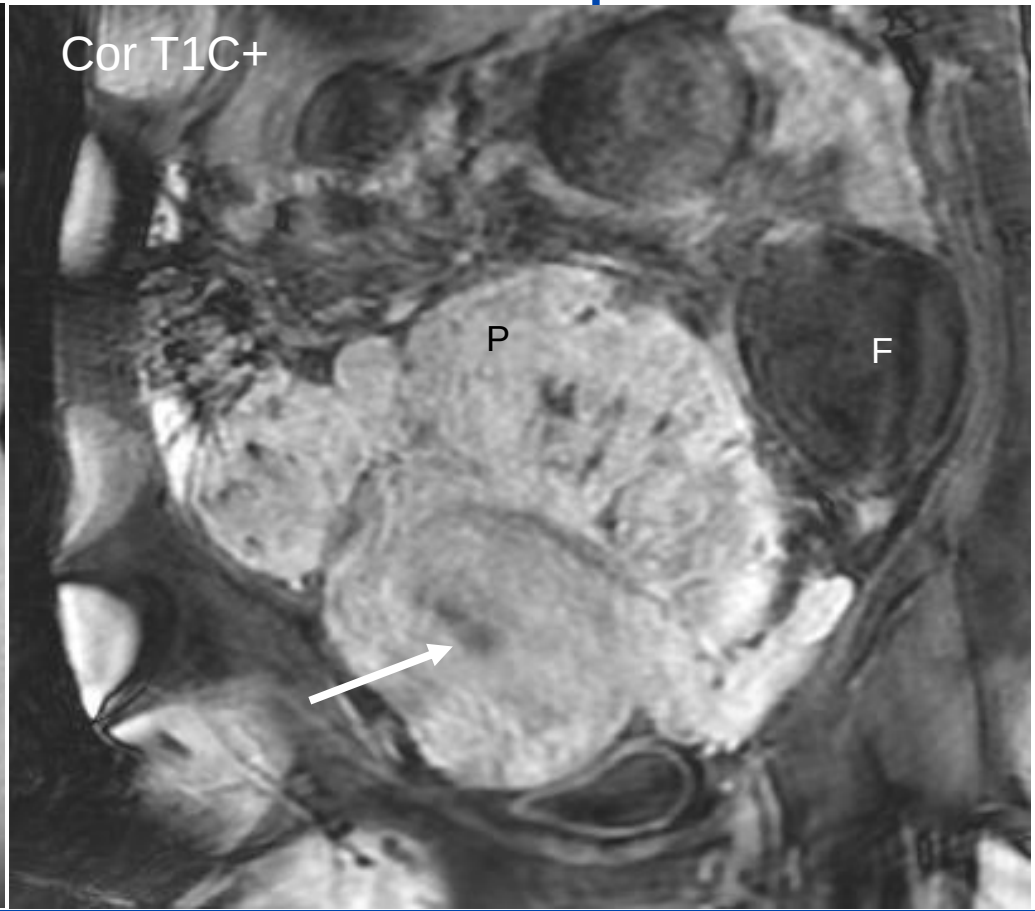


Tubal Ectopic



41-year-old 30 wks gestation with abdominal pain





Abdominal ectopic pregnancy

Placental Abruption

Premature separation of placenta

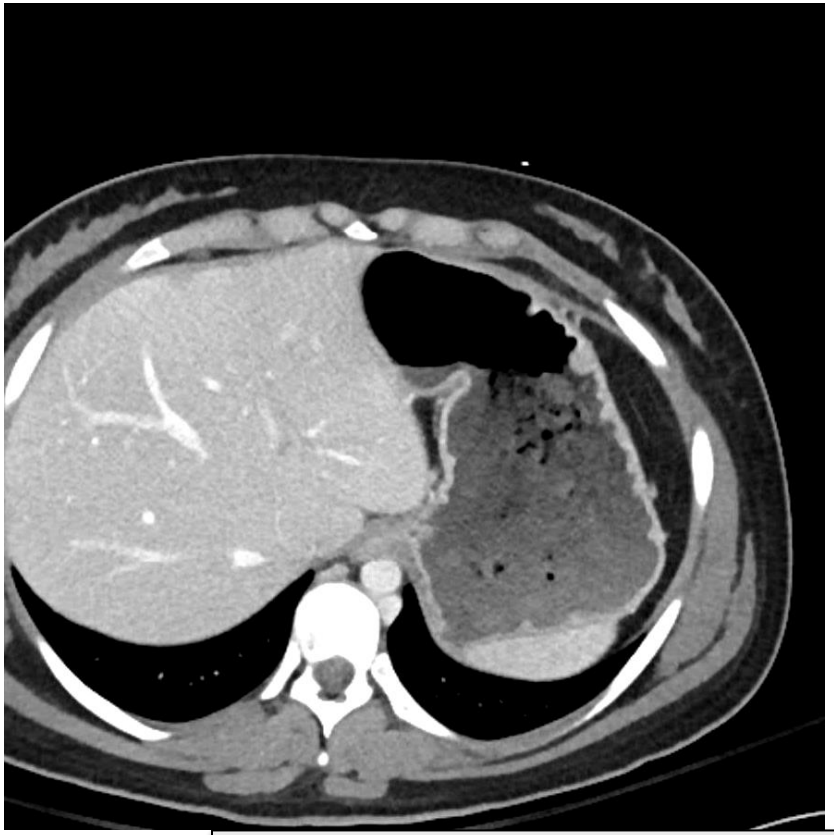
1% of all pregnancies

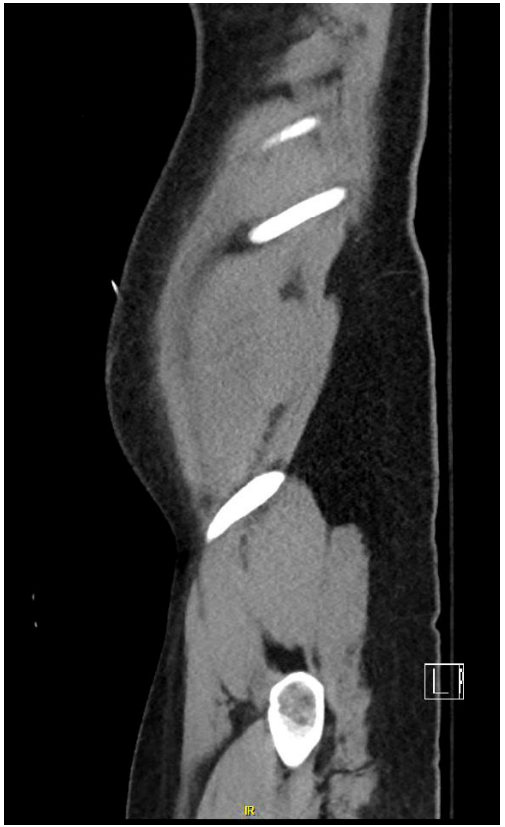
Most common cause of 3rd trimester bleeding

25% of perinatal deaths

Ramalingam, V., C. LeBedis, J. R. Kelly, J. Uyeda, J. A. Soto and S. W. Anderson (2015). "Evaluation of a sequential multi-modality imaging algorithm for the diagnosis of acute appendicitis in the pregnant female." Emerg Radiol 22(2): 125-132.

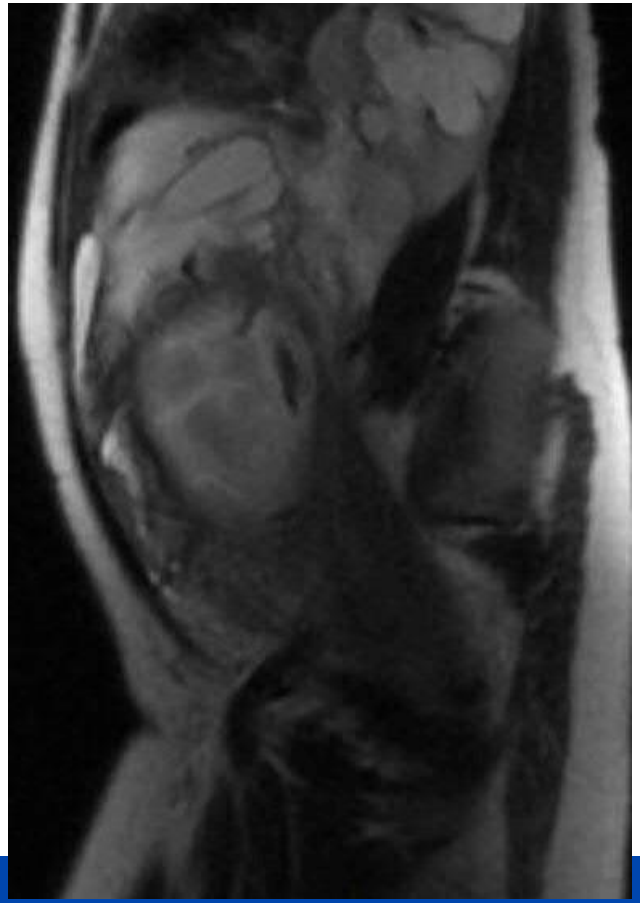
21 y old with MVC→ hit the guard rail → with abdominal pain

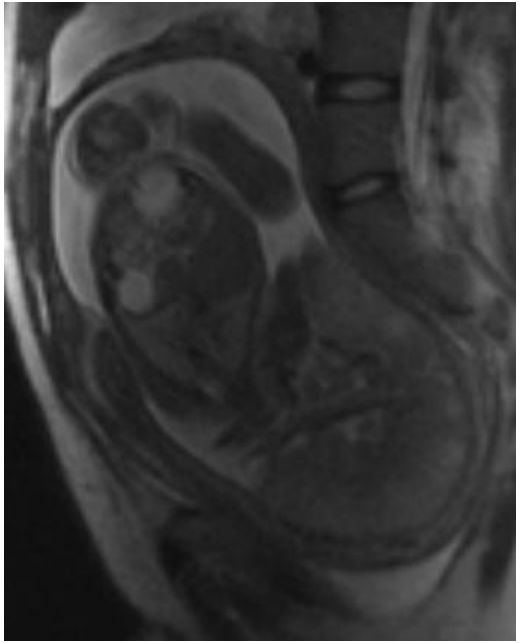




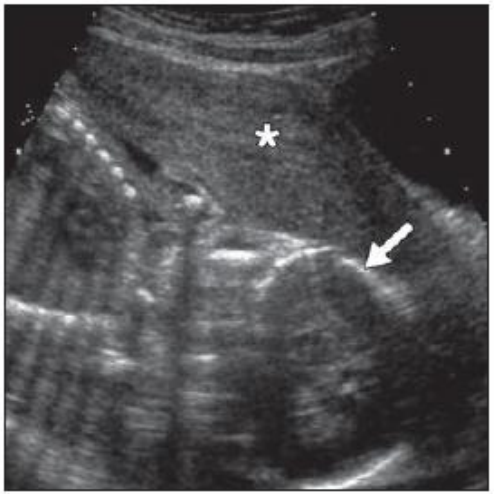
Complete Placental Abruption

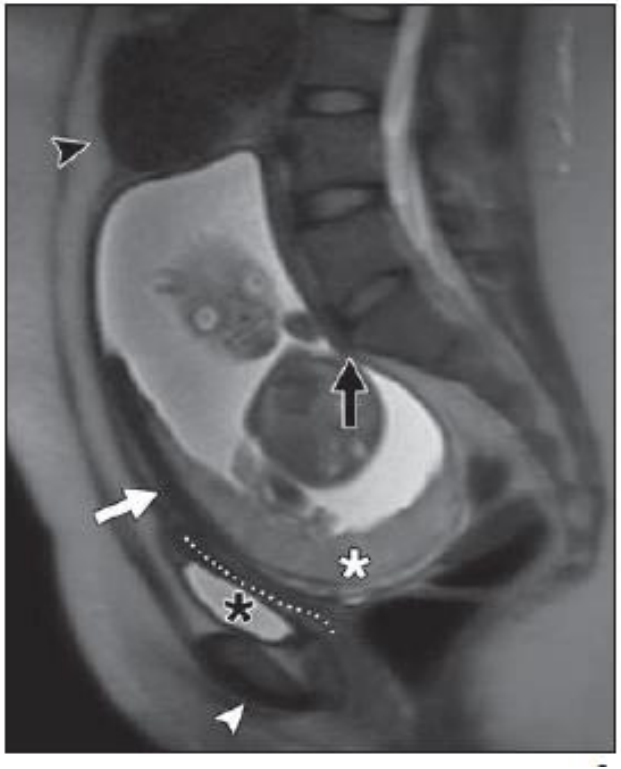
Incarcerated Uterus - Adhesions





Incarcerated Uterus





Gardner, C. S., et al. (2013). AJR Am J Roentgenol 201(1): 223-229.

Incarcerated Uterus

Presentation is Variable

1st trimester:

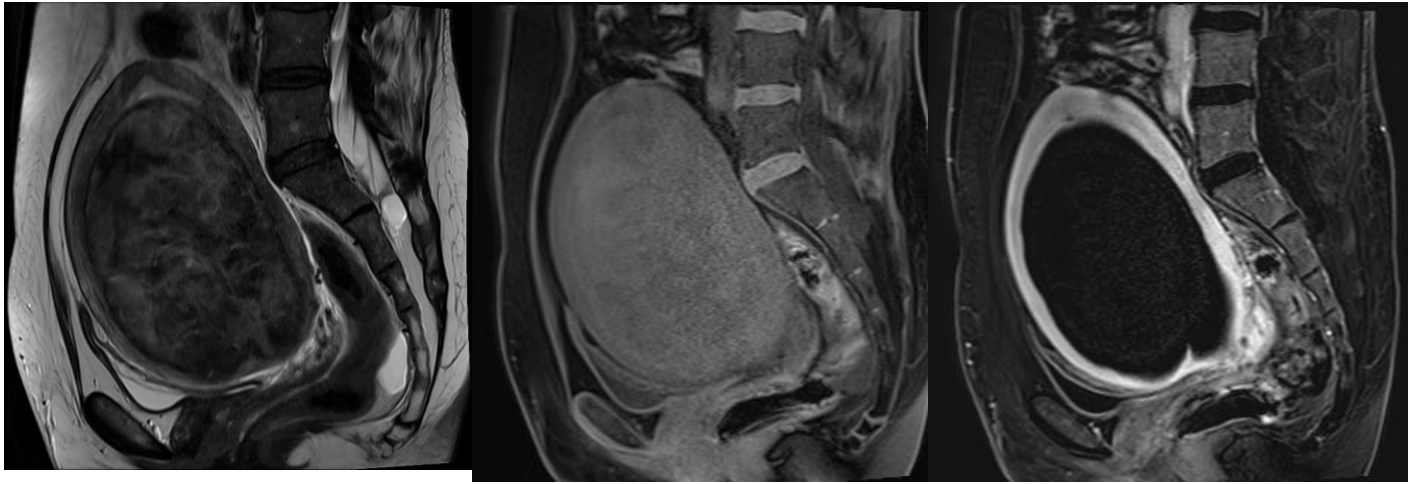
- Acute urinary retention
- Rectal pressure or tenesmus
- Miscarriage

2nd & 3rd trimesters:

- Uterine rupture
- Bladder rupture
- Renal failure
- Premature labor and delivery
- Fetal death
- Sepsis

Gardner, C. S., T. A. Jaffe, B. S. Hertzberg, R. Javan and L. M. Ho (2013). "The incarcerated uterus: a review of MRI and ultrasound imaging appearances." AJR Am J Roentgenol 201(1): 223-229.

54/f with acute onset pelvic pain



Carneous degeneration of a uterine fibroid

Deep Venous Thrombosis

Thromboembolic disease ↑↑ in pregnancy

Stasis & Hypercoagulability

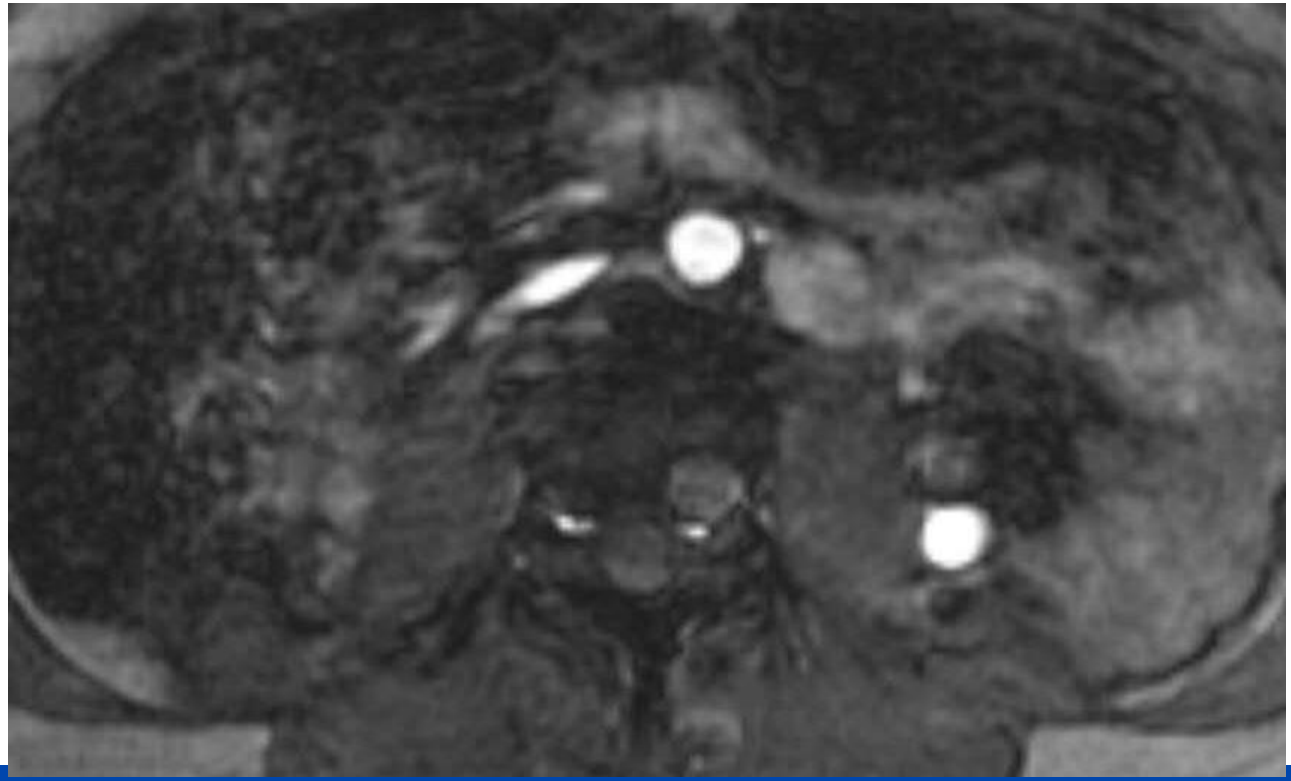
Most events in the lower extremities → US

At risk for:

- Pelvic
- Mesenteric
- Gonadal thrombi
- Hepatic (Budd-Chiari) (US)

Preference: MRV >>> Contrast enhanced CT

Left leg pain. US shows slow flow
? Compression vs thrombosis of pelvic veins



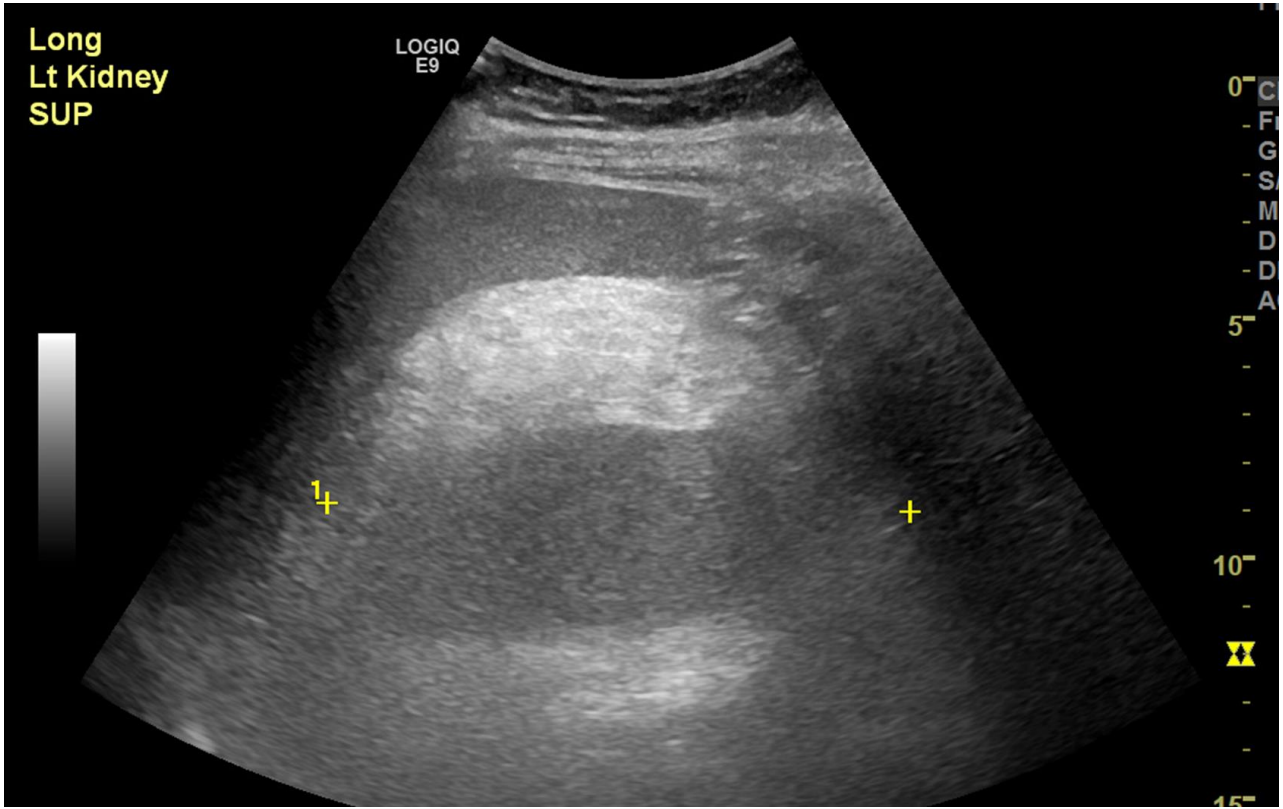
Bonus case..

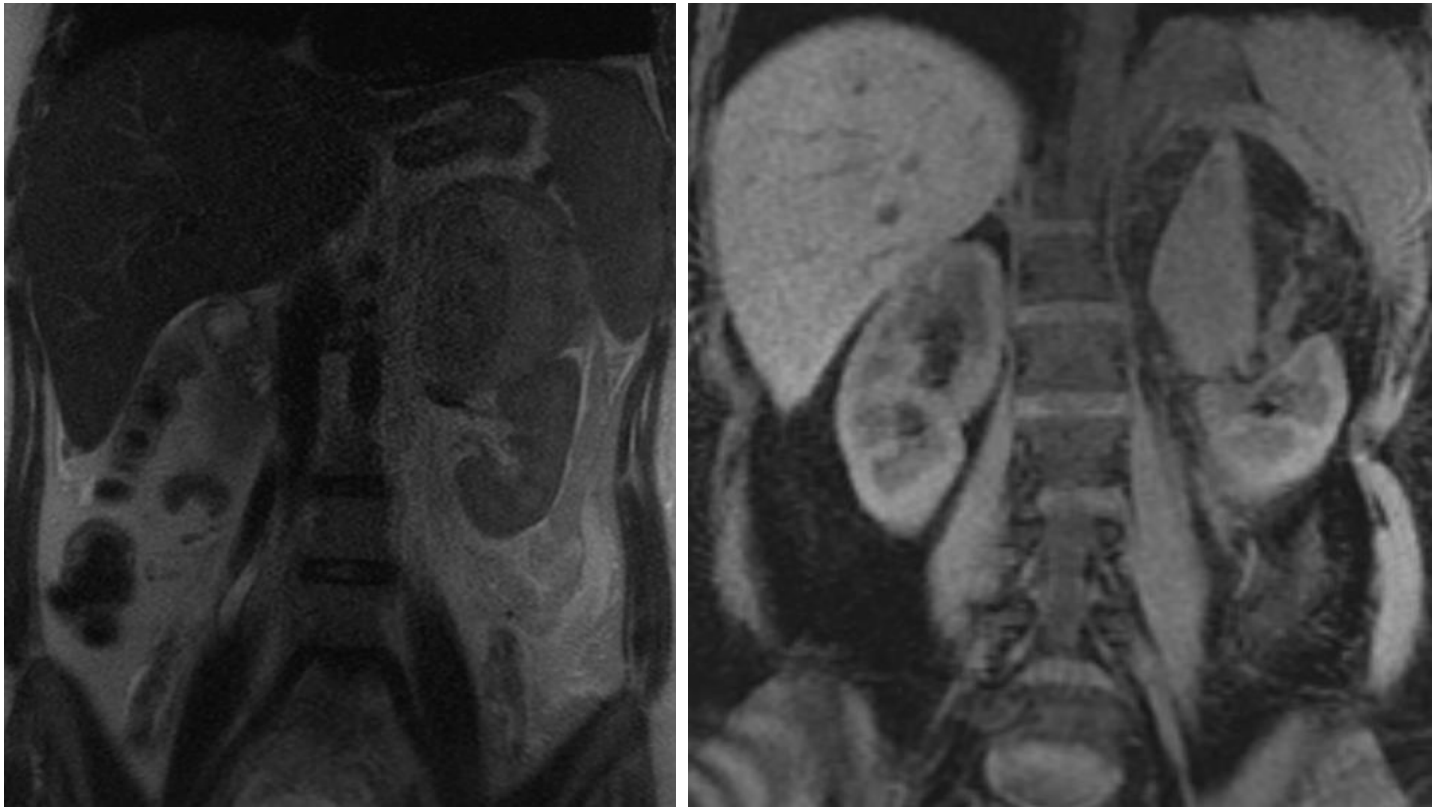
1

26 year old female

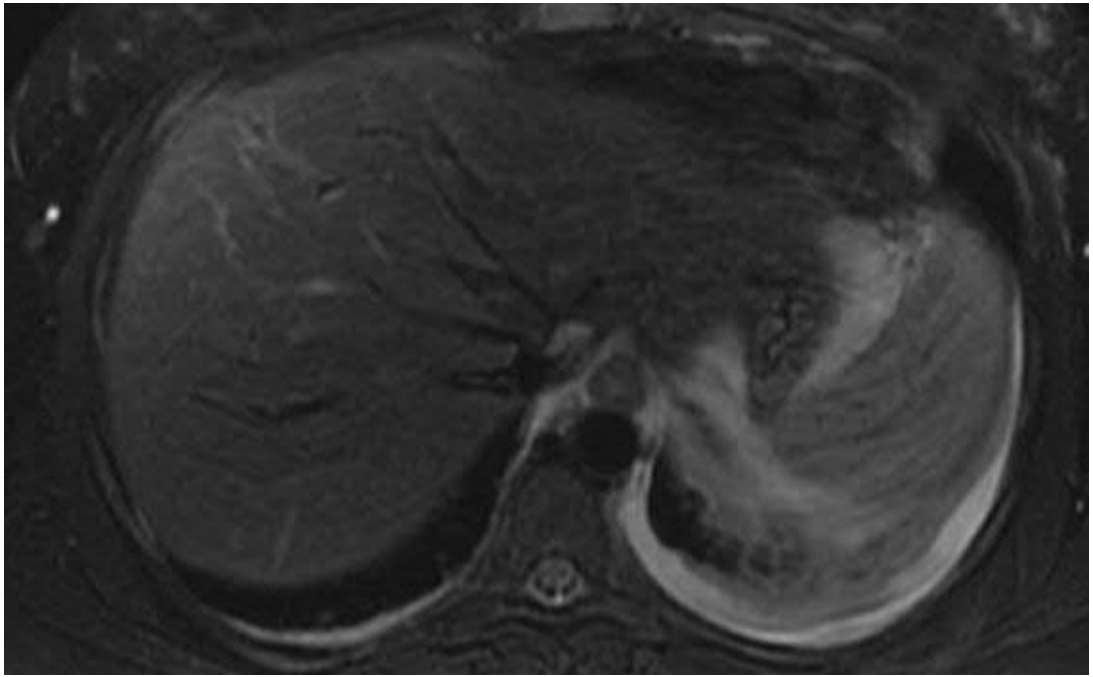
Acute onset LUQ pain began 1 day prior.
Outside ultrasound saw a “mass” in left upper quadrant.

26 yF acute onset LUQ pain. “LUQ Mass” on US.

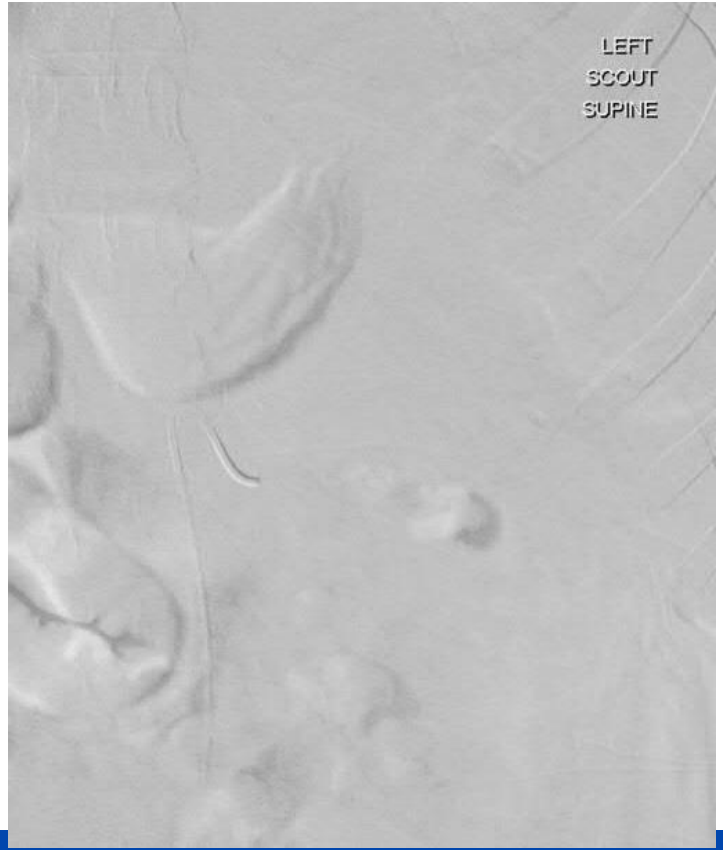




Bleeding AML



Bleeding AML



Angiomyolipoma

25% have estrogen and progesterone receptors

→ Can grow during pregnancy

Series of 45 reported cases:

- The average size was 10cm
- Average presentation is 26-27th week

TAE is the standard treatment (stable patient)

Effective for stopping bleeding

Prevents re-rupture during the pregnancy

Myoen, S., K. et al. (2015). Int J Urol **22**(7): 710-712.
Cetin, C., et al. (2015). Turk J Obstet Gynecol **12**(2): 118-121

Summary

- Abdominal pain in pregnancy has wide differential diagnosis
- Appropriate use of multimodal imaging can help with accurate diagnosis and guide appropriate management

Thank you

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