MR Imaging of Acute Abdomen during Pregnancy

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Learning Objectives

- Review the MR imaging of various pathology which may present as acute abdomen during pregnancy.
- Evaluate the impact of MR findings on patient care.
- Learn the MR sequences most useful for evaluation of the acute abdomen during pregnancy.

The acute abdomen during pregnancy

- The most common cause is appendicitis (3).
- Over the past decade new and bizarre causes (see the table in the next slide)(3).
- Challenging clinical picture due to altered anatomy and physiology (I.e. physiologic increased white cell count).
- The decision to obtain radiographic studies should be based on whether they are indicated.
- Radiographic studies utilizing X-ray can be potentially teratogenic for the fetus.

Conditions Causing Acute Abdomen During Pregnancy

Nonobstetrical	Obstetrical
Pyelonephritis	Preterm labor
Urinary calculi	Abruptio placenta
Cholecystitis	Chorioamnionitis
Cholelithiasis	Adnexal torsion
Bowel obstruction	Ectopic/heterotopic pregnancy
Pancreatitis	Pelvic inflammatory disease
Gastroenteritis	Round ligament pain
Acute mesenteric adenitis	Uteroovarian vein rupture
Carcinoma of large bowel	Myomatous red degeneration
Rectus hematoma	Rupture of uterine AVM
External hernia	Uterine rupture (placenta percreta) (rudimentary uterine horn)
Ischemic mesentaric necrosis	
Acute intermittent porphyria	
Perforated duodenal ulcer	
Pneumonia	
Meckel's diverticulum	
Tuberculosis peritonitis	

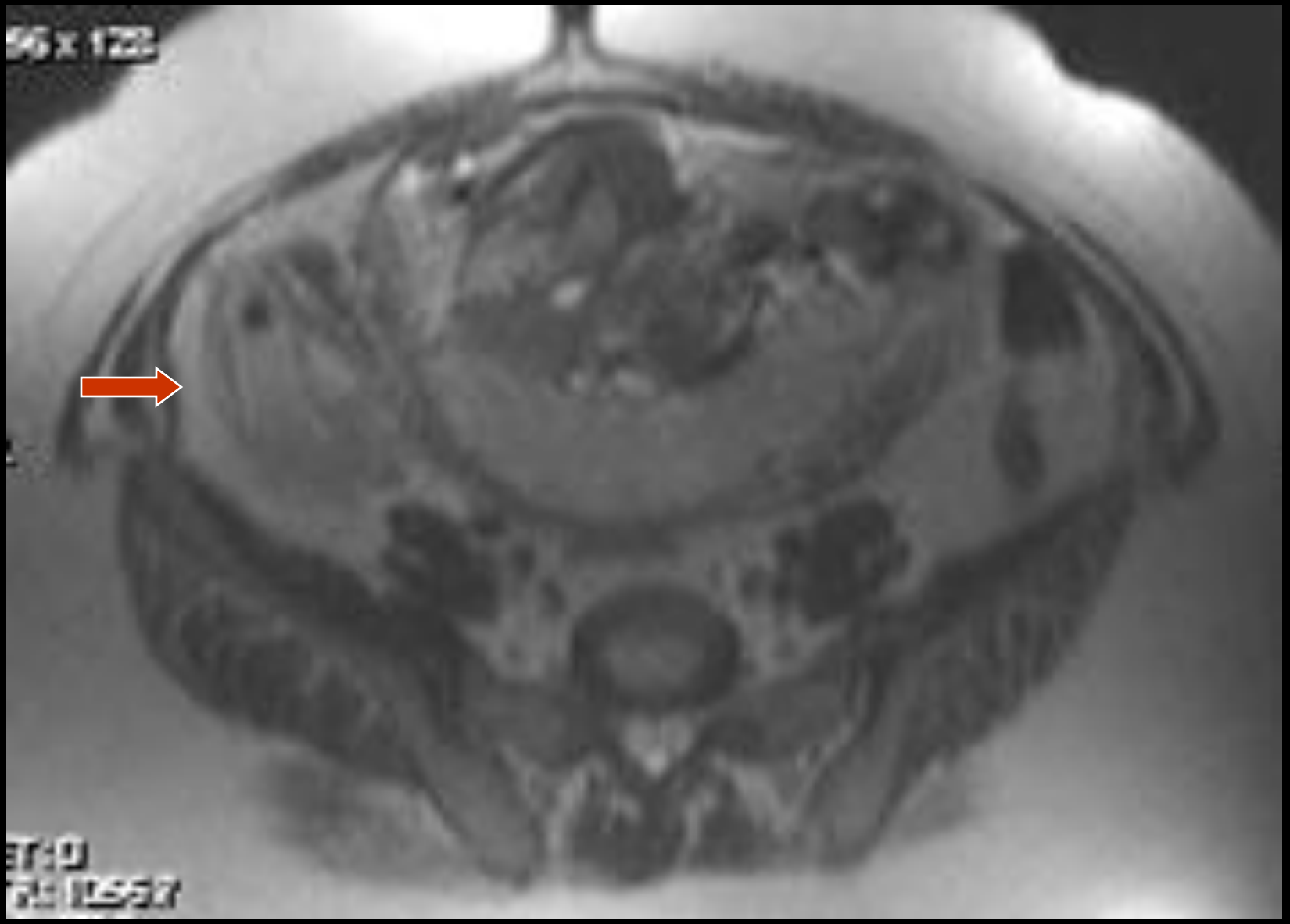
MR for imaging the acute abdomen in pregnant patients

- MR has been started to be utilized in obstetric imaging both in acute and non-acute conditions and both for maternal and fetal imaging.
- Safe in second and third trimester
- First trimester MR and use of Gadolinium during pregnancy are still controversial

MR Protocol

- SSFSE (Single shot fast spin echo)
  T2 weighted axial, coronal, sagittal
- T2w FSE
- STIR axial
- T1w FSE axial
- MRCP sequences (thin slice SSFSE, thick slice SSFSE and 3D T2w FSE) as needed.
- Gadolinium is not administered.

CASE PRESENTATIONS

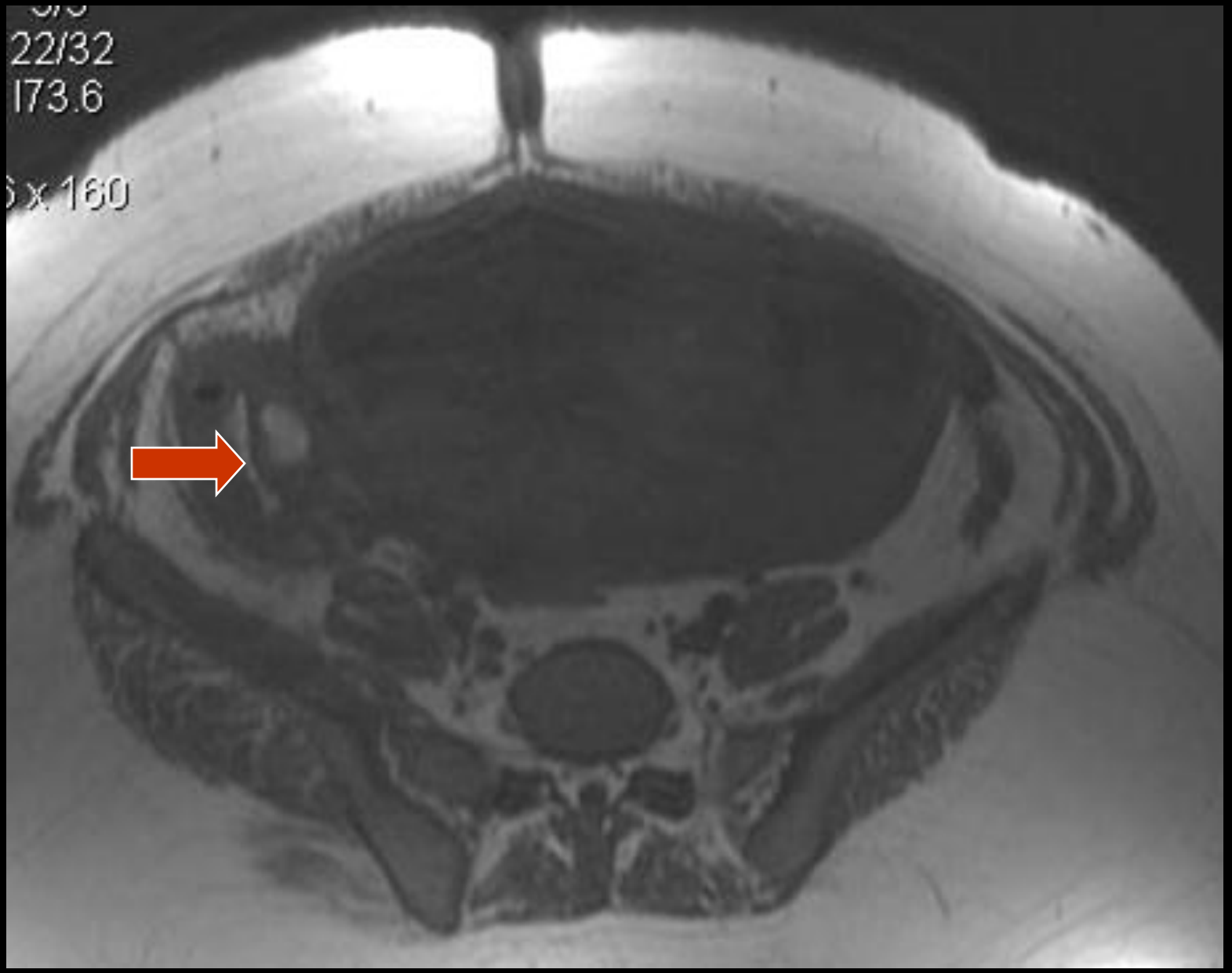


Dilated appendix with hypointense appendicolith representing acute appendicitis.

Axial FSE T2w image

Dilated appendix on coronal view.

Coronal SSFSE T2w image



Dilated appendix with hypointense appendicolith representing acute appendicitis.

Axial FSE T1w image

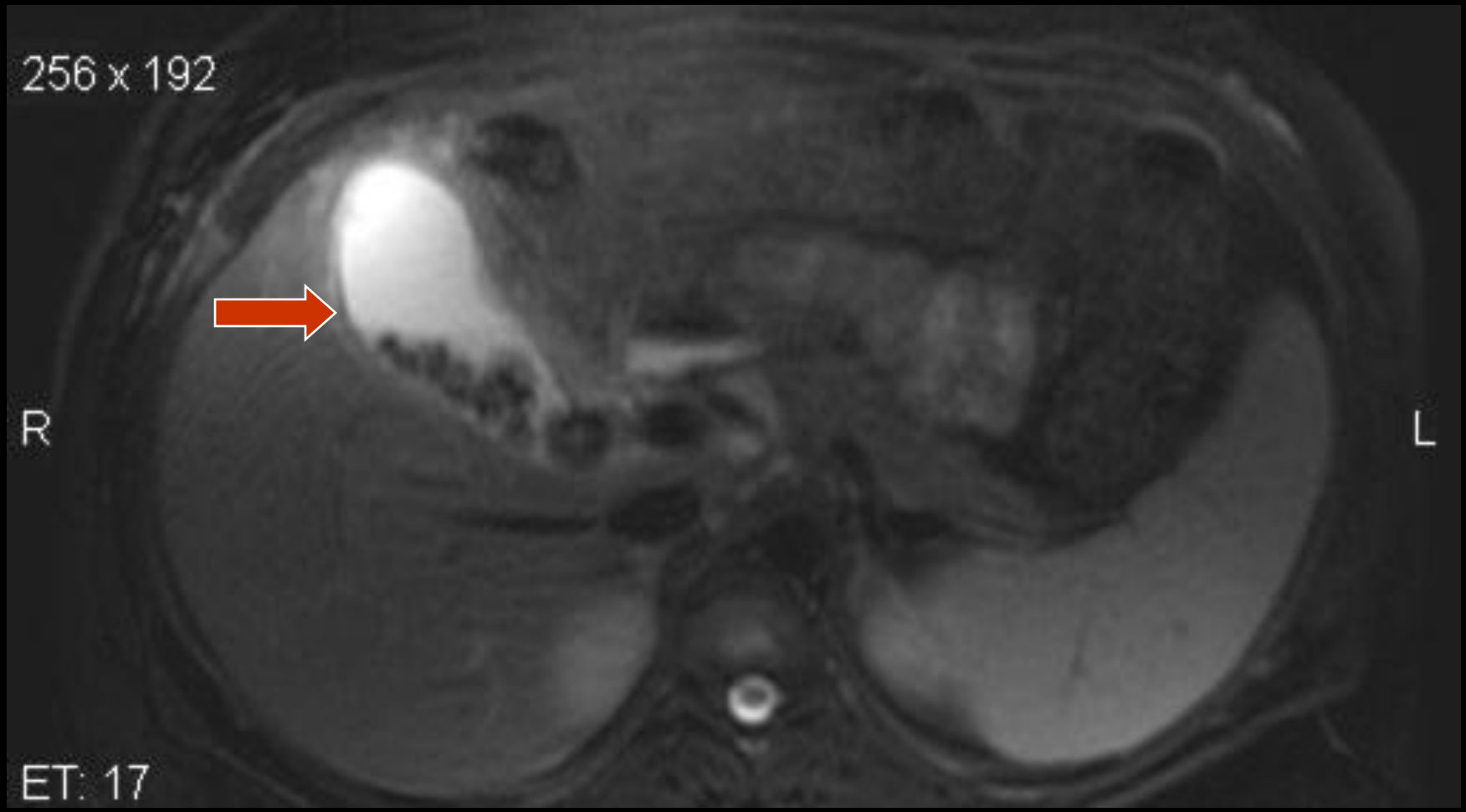
Appendicitis

- Most common non-obstetric surgical condition, also the most delayed due to overlap of symptoms with normal pregnancy(3).
- Most reliable symptom is right lower quadrant pain(3).
- Leukocytosis may be physiologic since the normal range in a gravid patient may range from 6,000 to 16,000(3).
- Delay may cause increased fetal and maternal mortality therefore early diagnosis is essential(3).

Appendicitis

MRI Findings:

- Marked wall enhancement and distention with fat-suppressed, contrast-enhanced T1 weighted images (2).
- However it is possible to make the diagnosis without contrast (2).
- T2 weighted images with fat suppression can show a thickened appendiceal wall, intraluminal fluid and peri-appendiceal inflammation.
- Appendicolith will appear as a round signal void in all sequences, however it might be difficult to differentiate from intra-luminal air.



Thick walled gallbladder with multiple hypointense stones

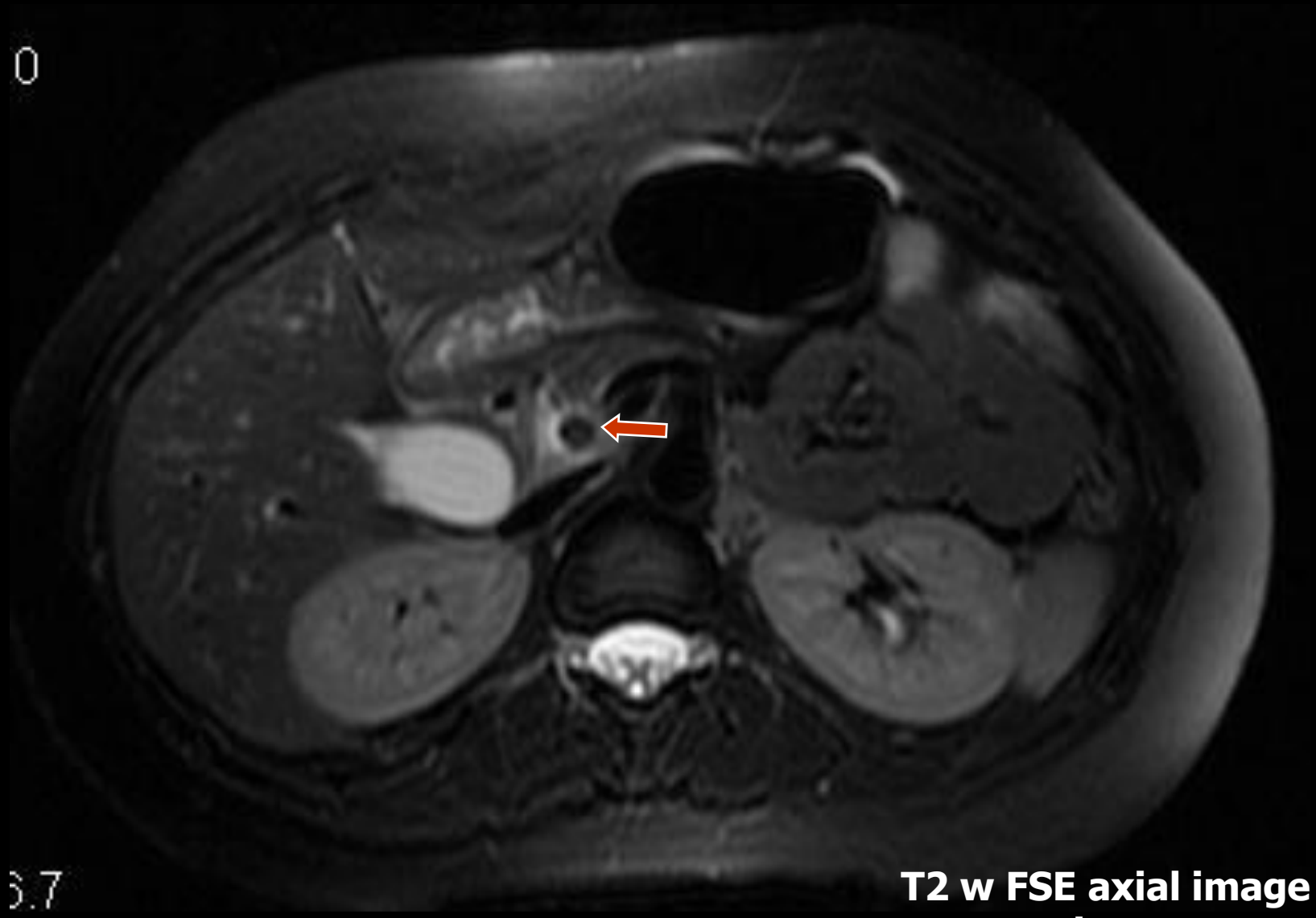
T2W image with fat supression

Cholecystitis

- Second most common surgical condition during pregnancy(1).
- 1/6000 to 1/10,000 pregnancies(3)
- Cause is usually due to cholelithiasis in >90%(3).
- LFTs elevated(1).
- Gad enhanced T1 weighted images with fat suppression show high sensitivity in diagnosing cholecystitis(7).

Dilated intra- and extrahepatic biliary dilatationwith a hypointense stone in the distal common bile duct

Thick slice SSFSE coronal image



Hypointense stone in the distal common bile duct

T2 w FSE axial image with fa suppression

Choledocholithiasis

- Heavily T2 weighted images can show filling defects within the CBD and secondary signs such as CBD and intrahepatic biliary dilatation(2).
- Treatment: cholecystectomy
- MRCP images – heavily T2 weighted images in a 3D display can demonstrate filling defects within the CBD as well as secondary signs such as biliary system dilatation.

Multiple stones in the infundibulum of the gallbladder compressing the proximal common bile duct and causing intrahepatic biliary dilatation. Distal common bile duct is normal in caliber.

Coronal SSFSE T2 w axial image

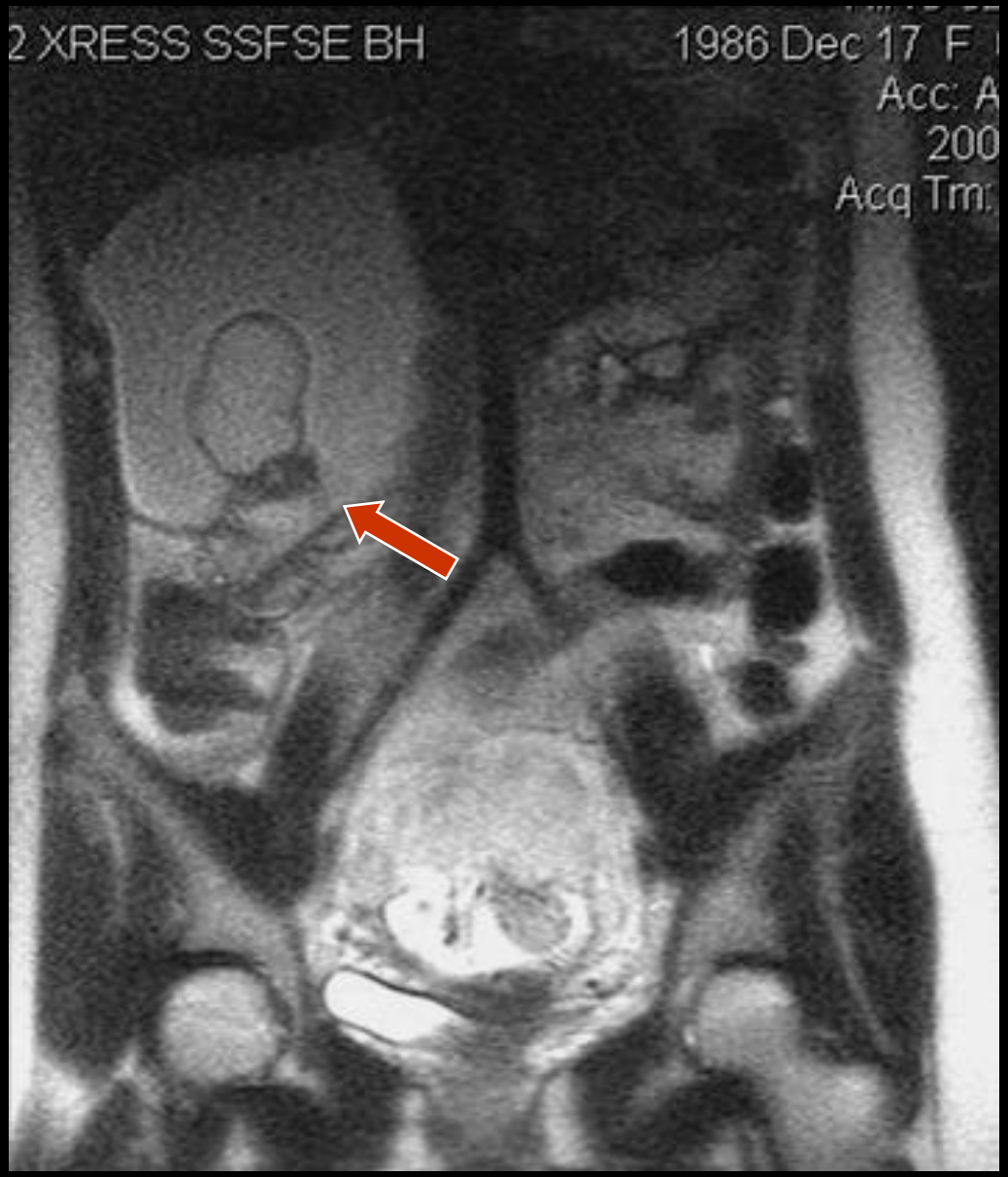
Axial SSFSE T2W image

Coronal MIP of thin slice MRCP images

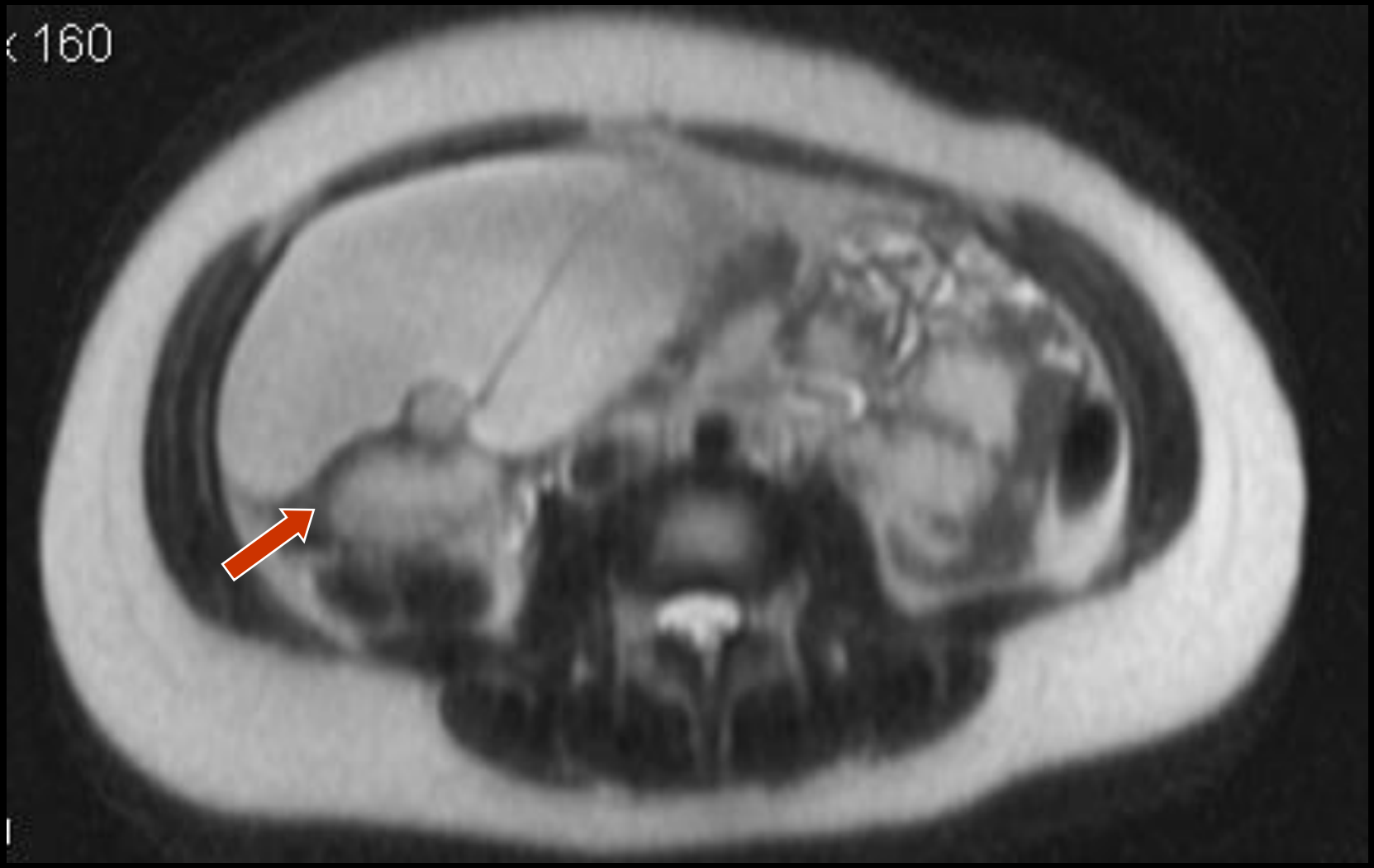
Mirrizi Syndrome

- Uncommon cause of obstructive jaundice that occurs in the setting of cholelithiasis and cholecystitis(10).
- Obstruction of the CHD is caused by an impacted stone within the cystic duct(10).
- Predisposing factors include low insertion of the cystic duct into the CHD. The cystic duct and the CHD travel in a sheath together before joining to become the CBD(10).

Axial FSE T2W image



Coronal SSFSE T2W image



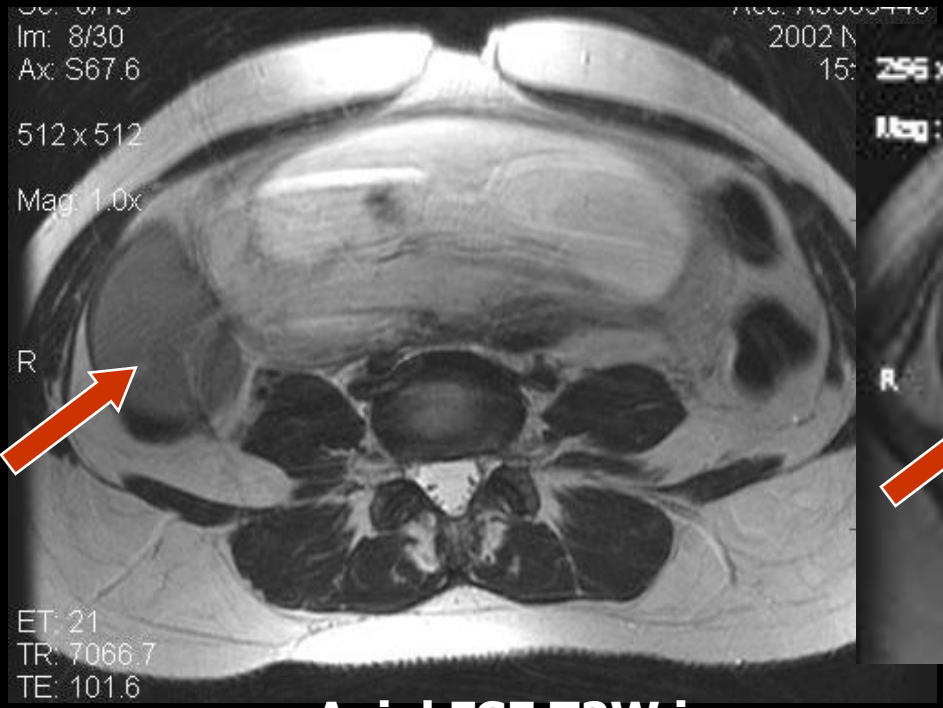
Axial SSFSE T2W image

Mature Cystic Teratoma

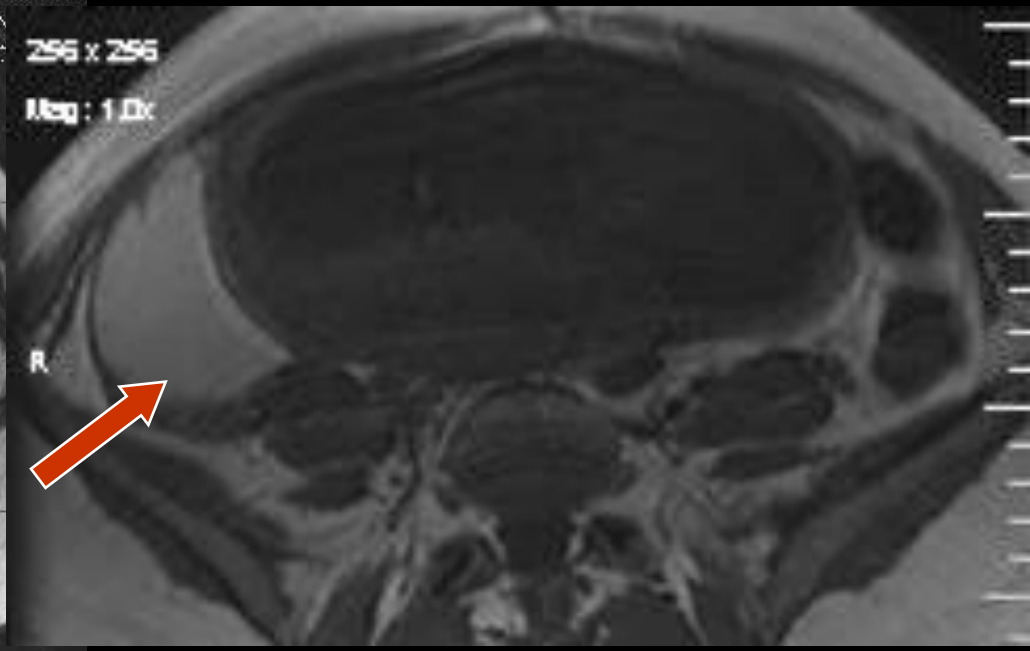
- 25-58% of all benign ovarian tumors, 70% if age <19 (6).
- Dermoids contain mesodermal, ectodermal and endodermal elements (6).
- Typically an epithelial lined cyst filled with sebaceous fluid, debris and hair (6).
- Intralesional mural nodule(Rockitansky nodule) is identified in >90% which may contain fat, teeth(7%)or calcifications(18%) (6).
- Common complication: Torsion which occurs in 16% of cases(6).
- Rare complication: Rupture(1%), Infection(1%), Autohemolytic anemia(1%), Malignant transformation(1-2%) (6).
- Malignant transformation should be suspected if size greater than 10 cm and postmenopausal age(6).

Mature Cystic Teratoma

- Characteristic MR features: Fat within the teratoma can be diagnosed with T1-weighted, T1 with fat suppression(2,4).
- Other MRI findings: Fat-fluid levels, dermoid nipple or mural nodule, and intracystic fat balls(7).
- Calcium and bone is present will demonstrate low intensity on all pulse sequences(7).



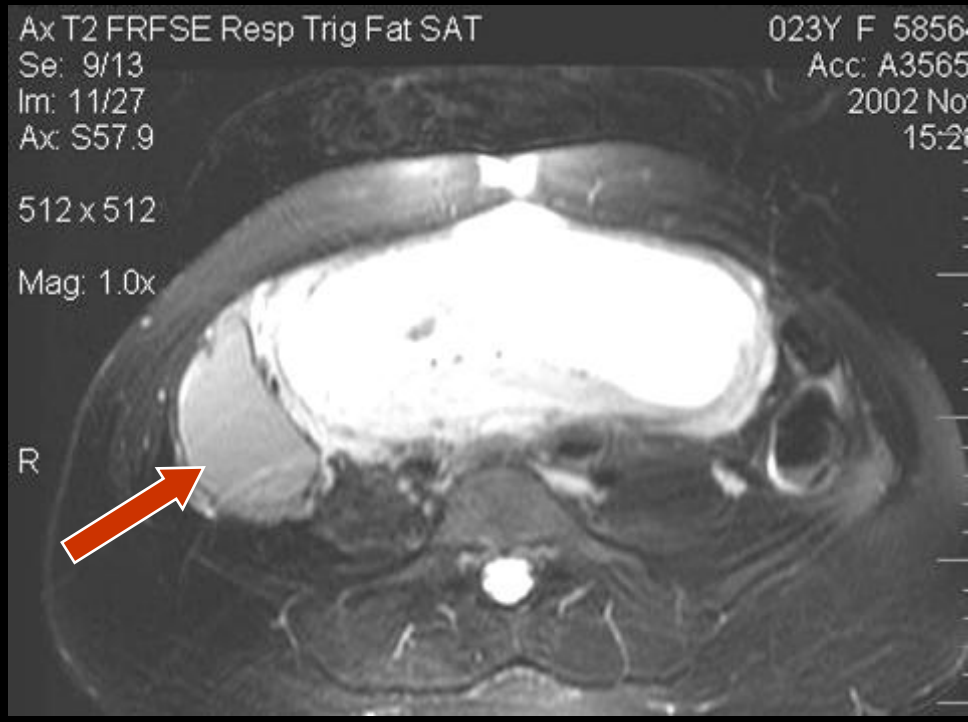
Axial FSE T2W image



Axial T1W image

Right ovarian cystic lesion bright on T1 and T2-weighted images.

Axial STIR

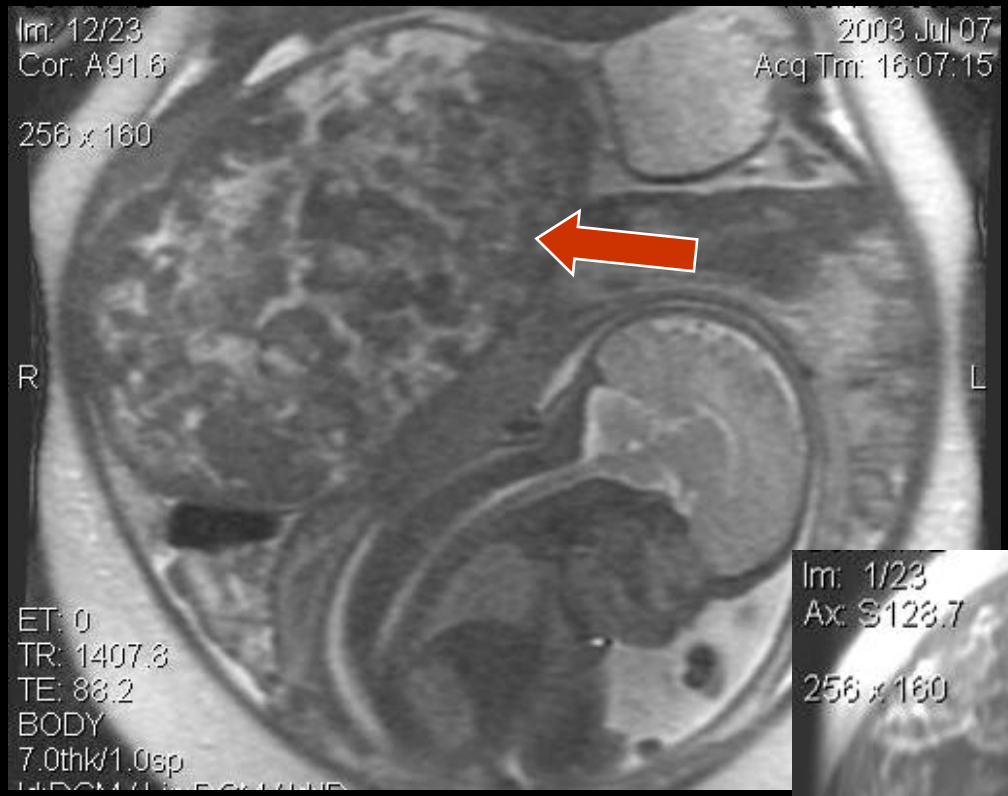


Axial T2W FSE image with frequency selective fat suppression

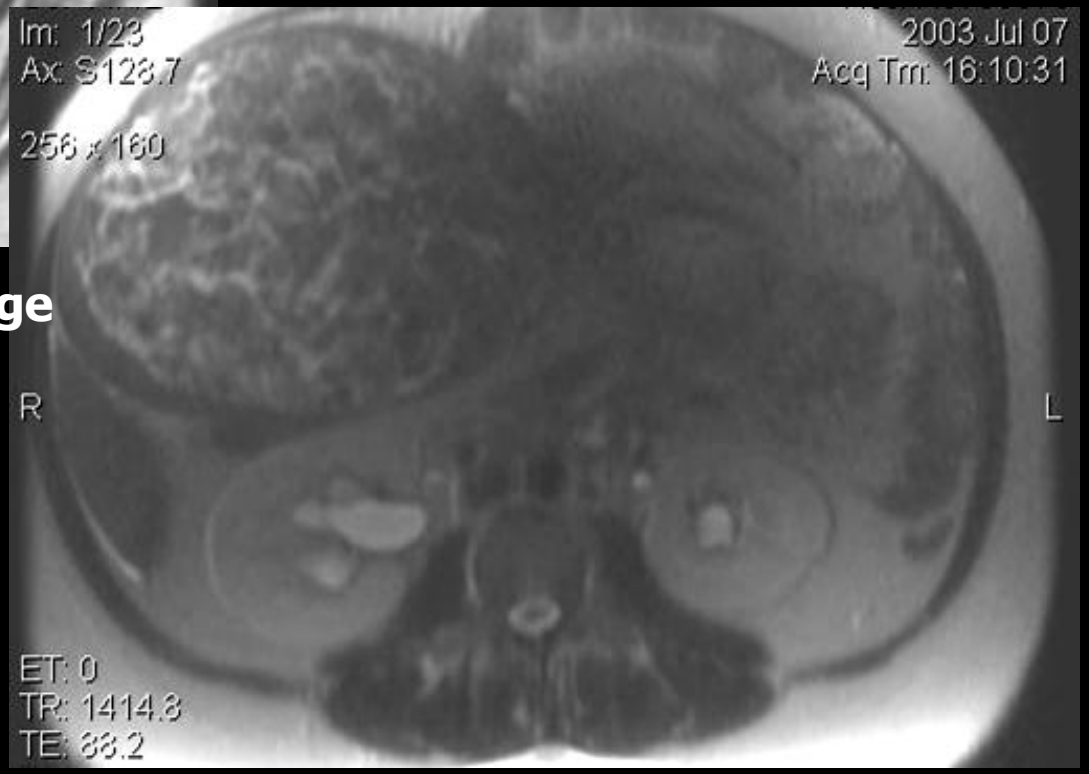
Lesion intesity is supressed on STIR but not on frequency selected fat supression image consistent with hemorrhagic content

Hemorrhagic Cyst

- Hemorrhagic cysts have typical appearance of blood products on T1W and T2W images(7).
- T1 weighted images will demonstrate low intensity due to subacute blood(7).
- T2 weighted images will demonstrate high signal(7).
- Fat suppressed images
- As the cyst ages, a hemosiderin rim will have low signal intensity on all sequesnces(7).



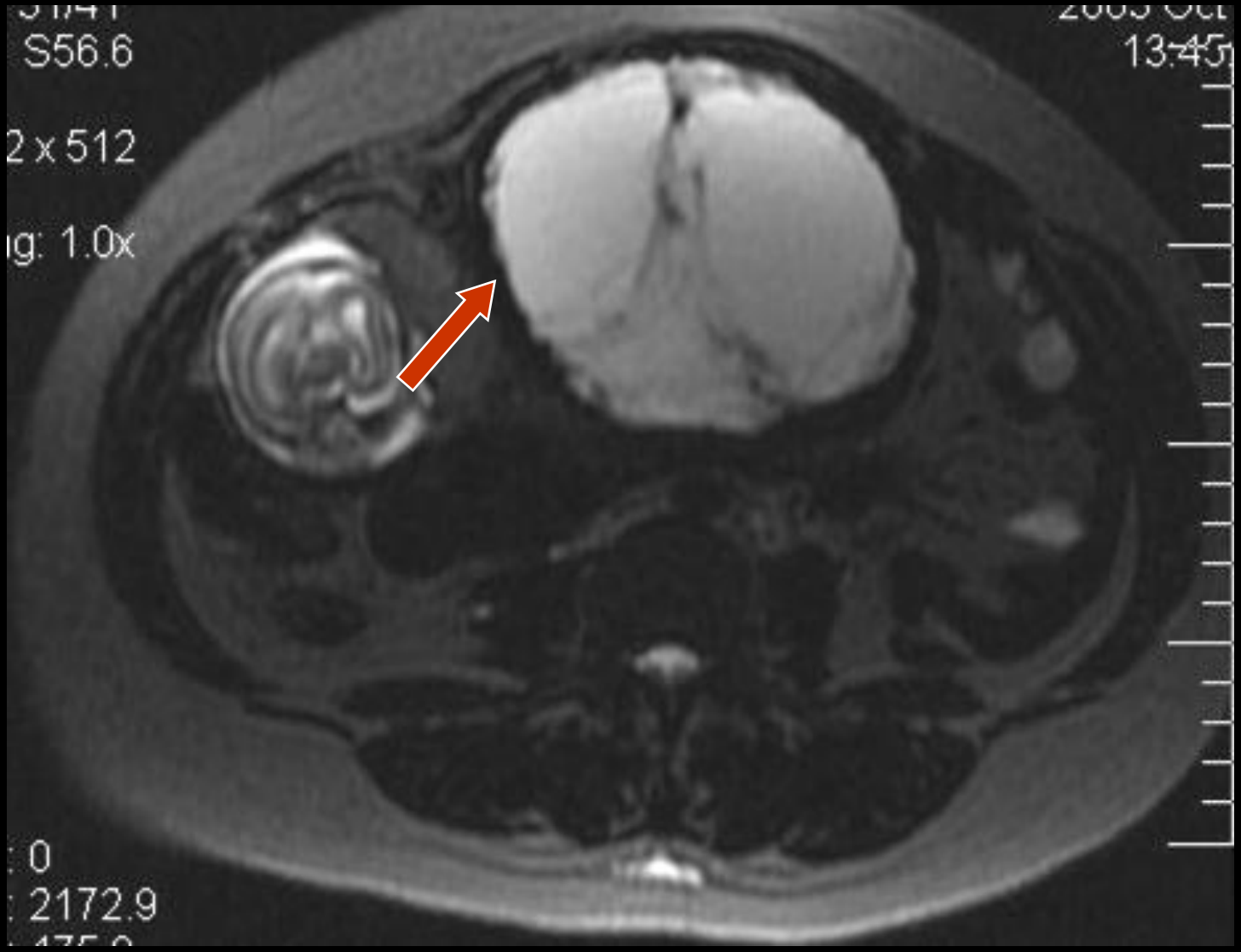
Coronal SSFSE T2W image



Axial SSFSE T2W image

Large Leiomyoma

- 25-50% of women of child bearing age(6).
- Composed of smooth muscle and variable amount of fibrous tissue, surrounded by a psuedocapsule of areolar tissue (6).
- Hormonal stimulation due to pregnancy can cause rapid growth(6).
- MRI findings: T2W images demonstrate a well circumscribed mass with predominantly low signal intensity (6).
- T1 weighted images show intermediate signal, often indistinguishable from surrounding uterine tissue(6).
- Degenerative changes appear as high signal on T2 weighted images(6).
- Foci of calcifications appear as low intensity on all sequences (6).

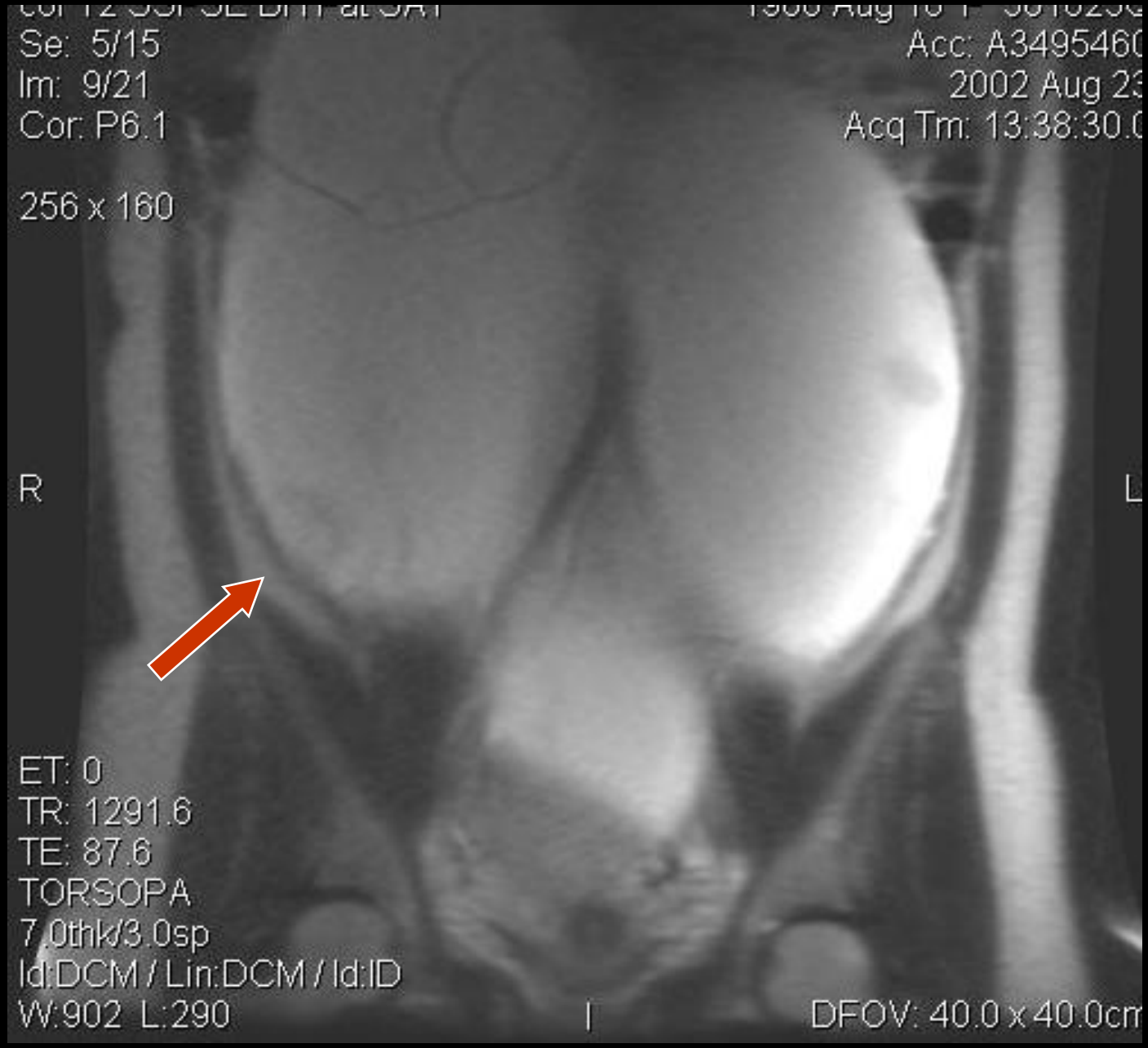


Axial T2W SSFSE image

Red Degeneration

- Red degeneration of uterine leiomyoma is due to hemorrhagic infarction of the leiomyoma as a result of obstruction of peripheral drainage veins(2,5).
- Symptoms:Abdominal pain, fever and leukocytosis(2).
- MRI: Peripheral rim shows Low signal intensity on T2WI and High signal intensity on T1WI(2,5).
- Signal intensity in the central portion is heterogeneous on T2W images and becomes gradually higher on T1W images (2,5).
- The entire mass does not show enhancement due to completely interrupted blood flow (5).

Coronal T2W SSFSE image

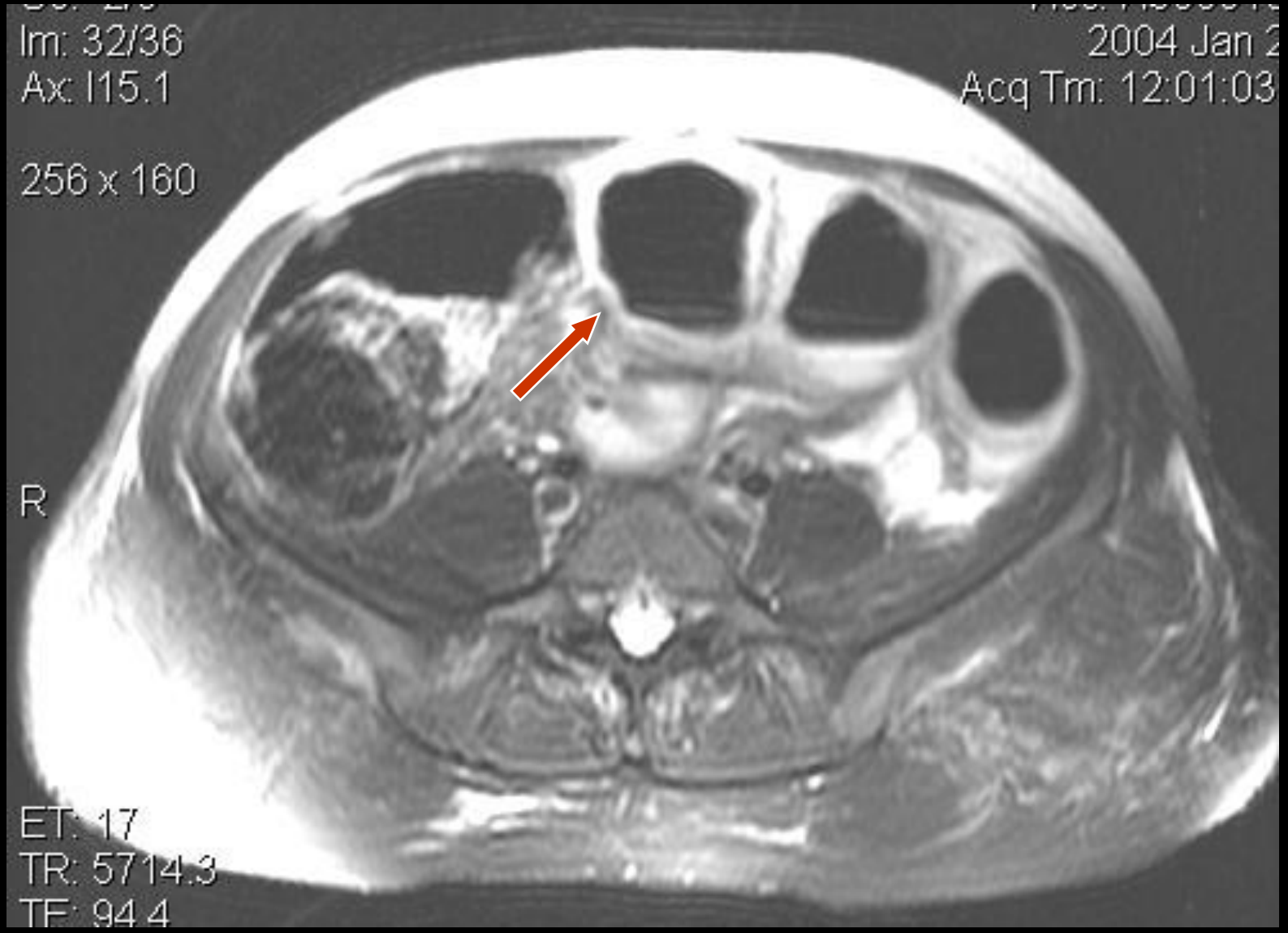


Coronal T2W SSFSE

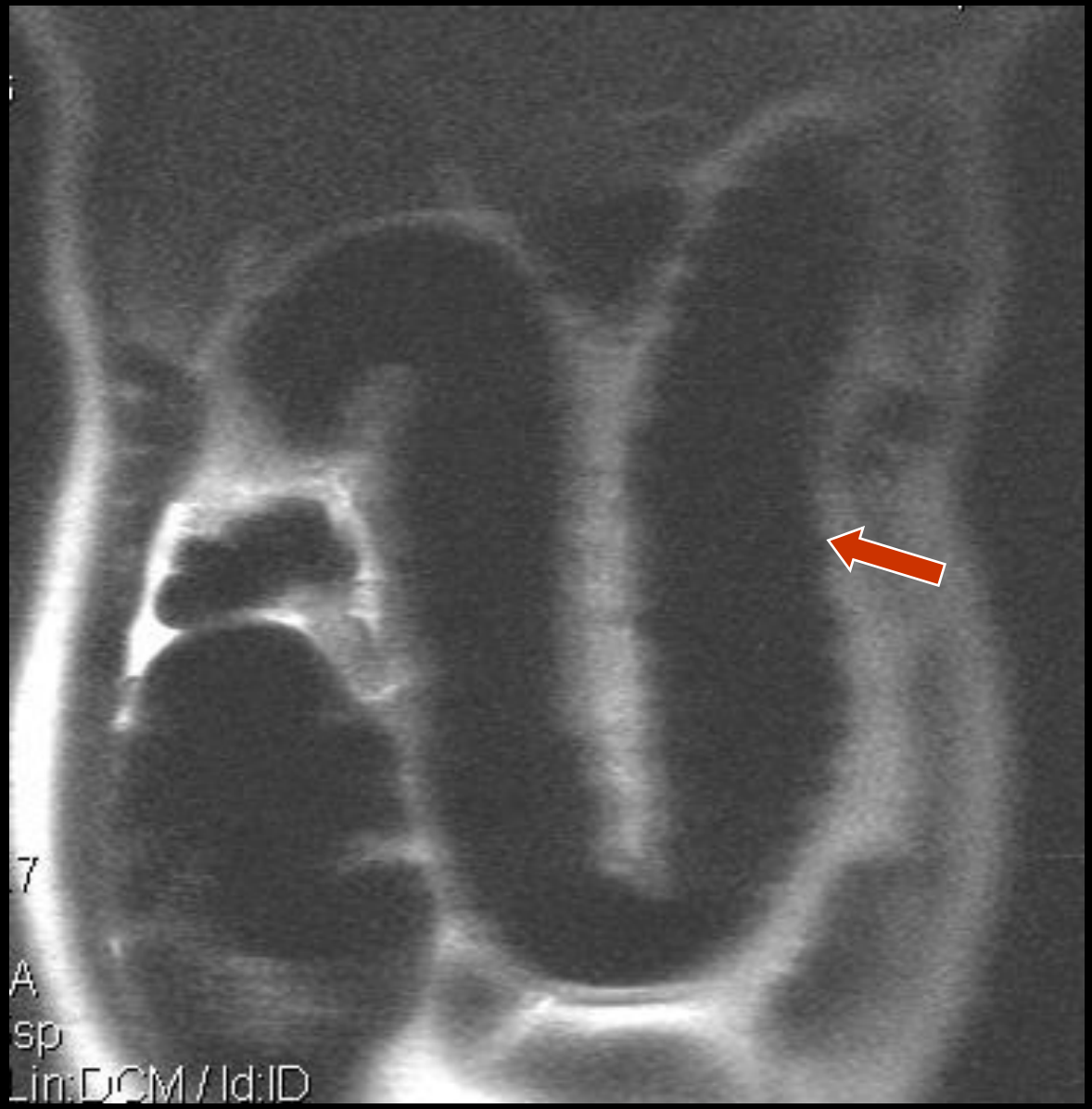
Axial T2W FSE image

Benign Mucinous Cystadenoma

- Multilocular cystic lesions with broad spectrum of signal intensities, filled with water like or mucinous contents.
- Multiple cysts of different signal intensities are typical.
- T1W images show intermediate signal and high/medium signal on T2W images.
- If complicated by hemorrhage, Low intensity signal is present on T1W images



Axial FSE T2W image



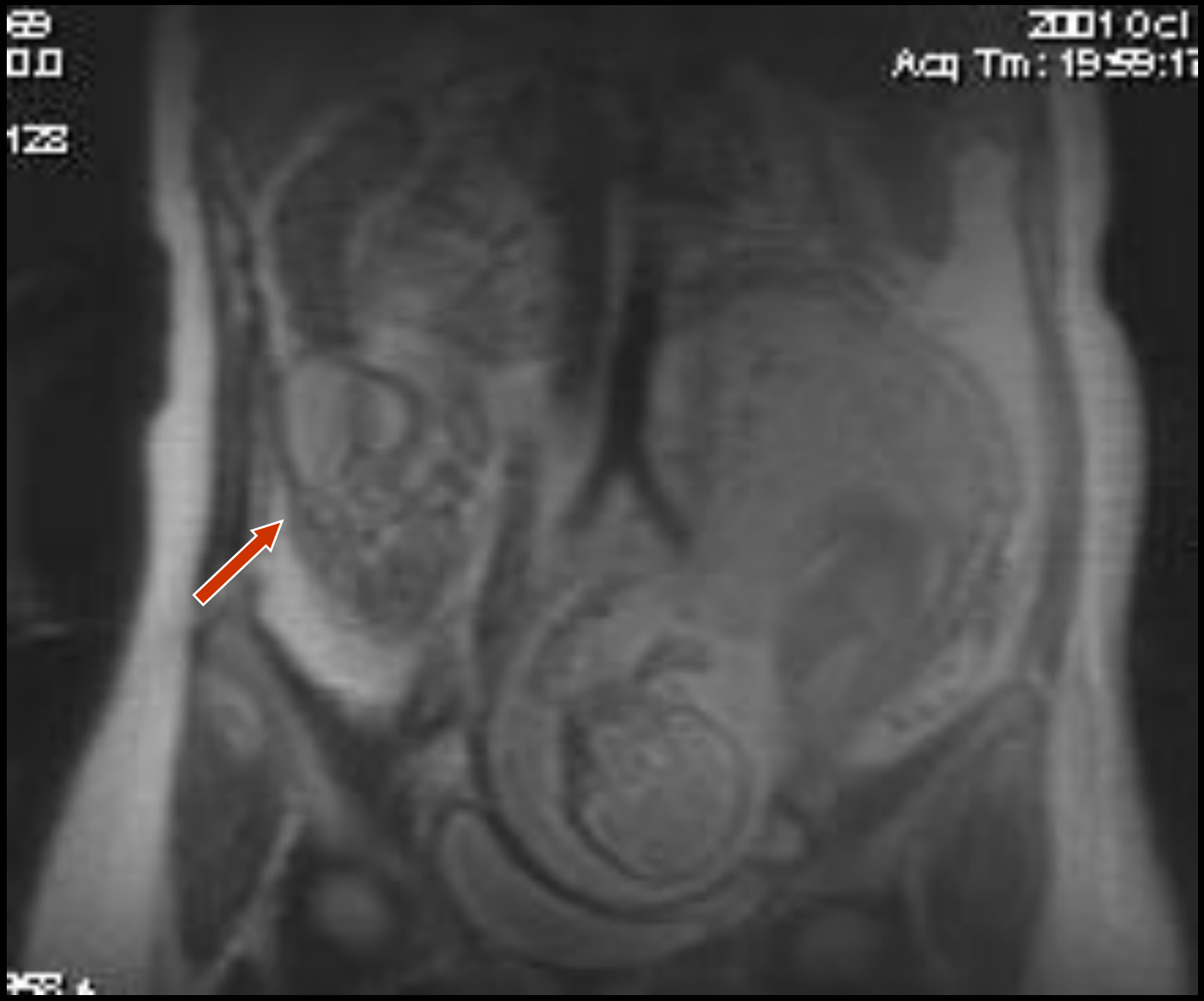
Coronal FSE T2W image

Colitis – Ulcerative colitis

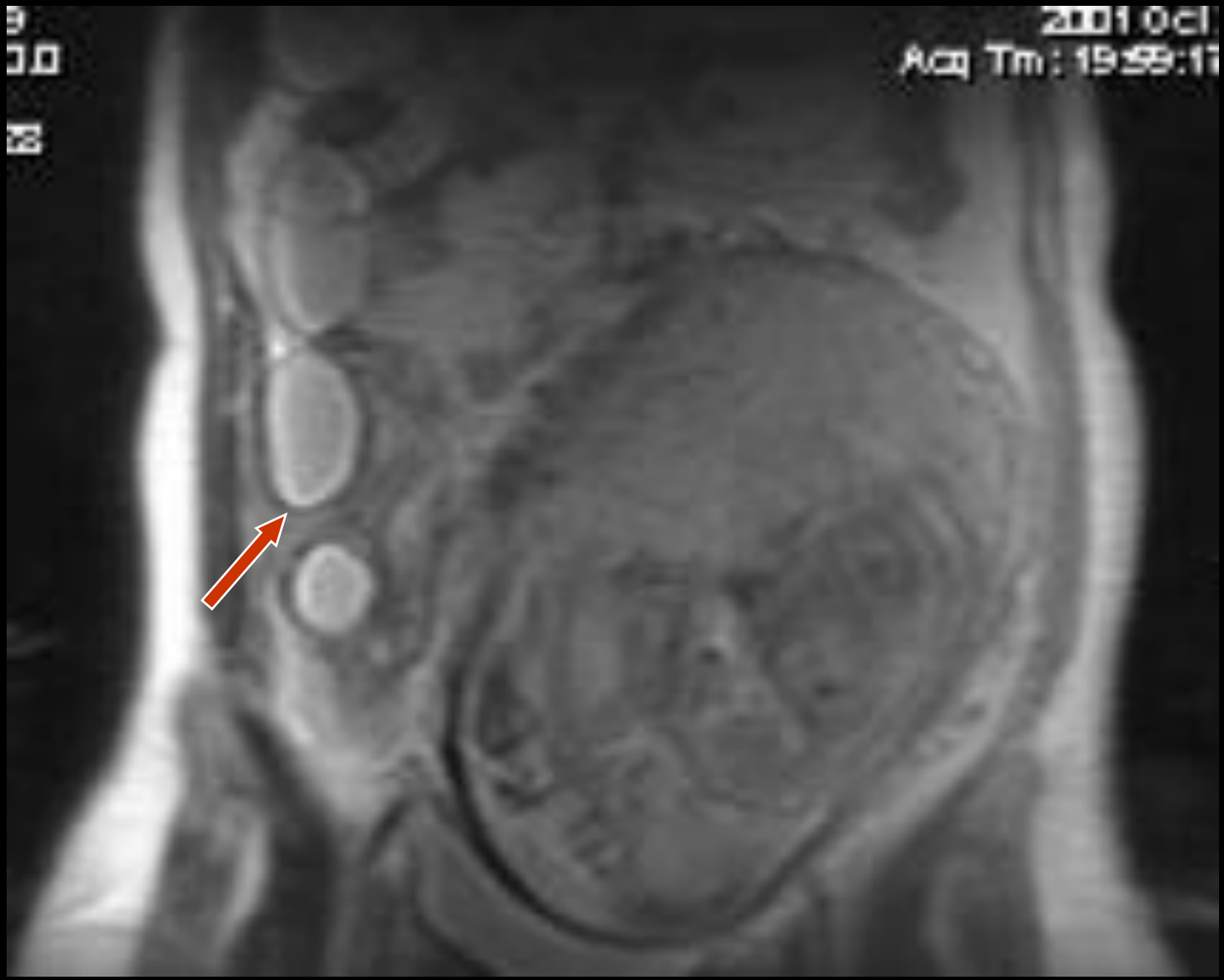
- Autoimmune disease with genetic predisposition.
- Mainly affects the rectum and spreads retrograde continuously without skip lesions.
- Symptoms: Intermittent diarrhea and rectal bleeding.
- Complications: Toxic Megacolon and Colon Cancer
- Treatment: Total Colectomy

Colitis – Ulcerative colitis

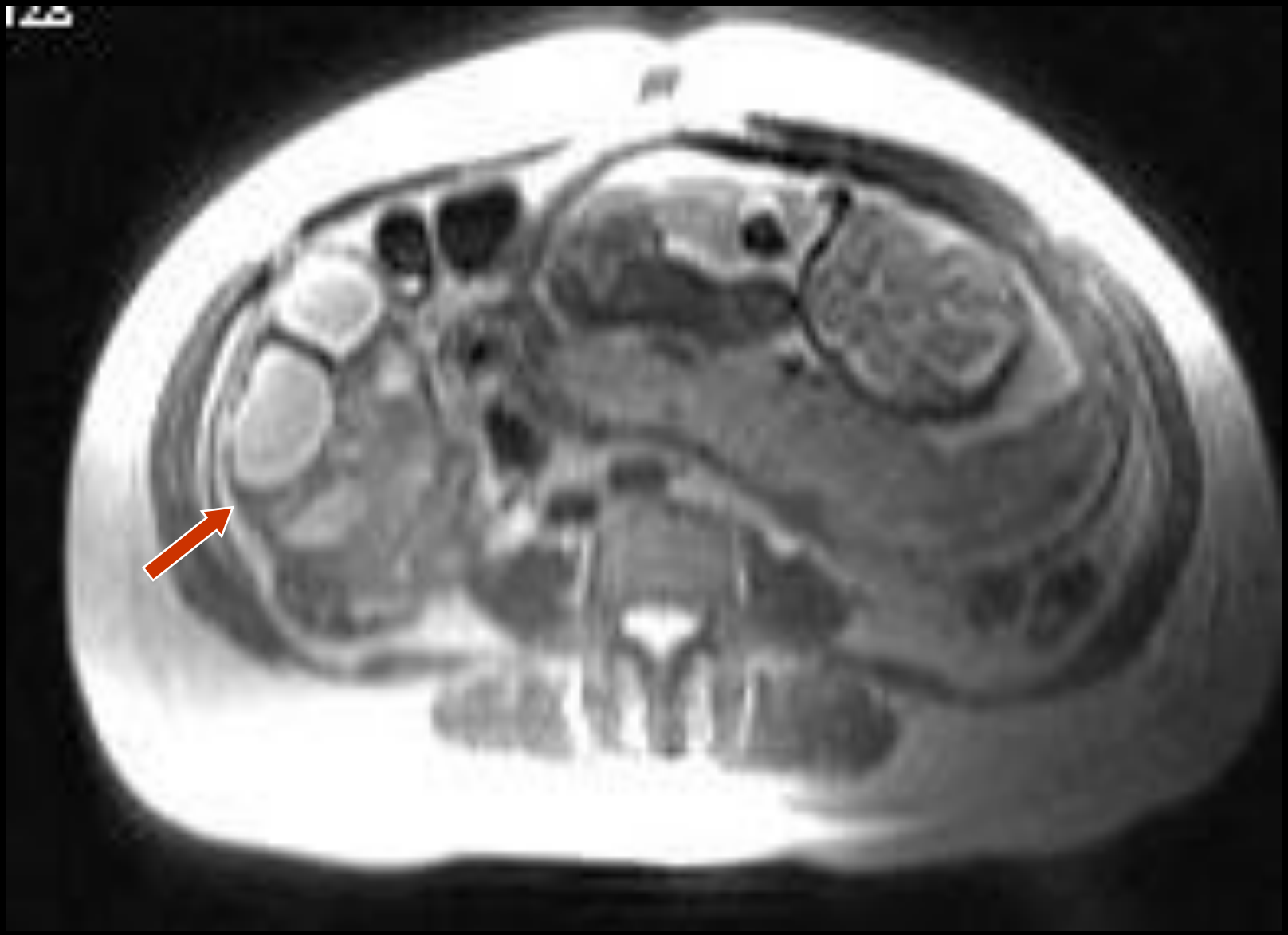
- T1 with gadolinium shows marked mucosal enhancement with sparing of the submucosa. (6).
- Inflammatory tissue stranding surrounds the colon (6).
- Long standing disease shows low signal intensity from submucosal edema and lymphangiectasia (6).
- 30% of patients also demonstrate backwash ileitis (6).



Coronal FSE T2W image



Coronal FSE T2W image



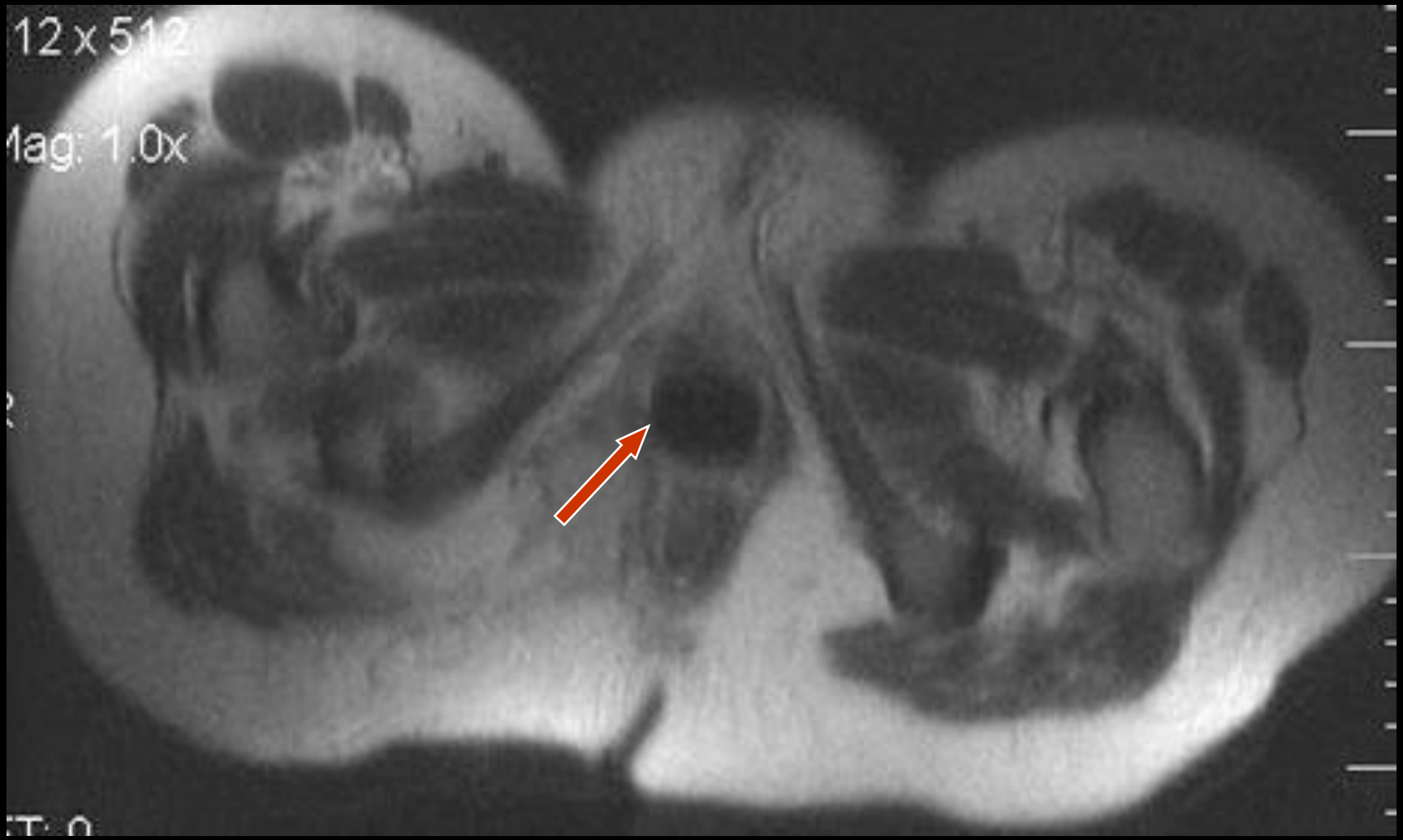
Axial FSE T2W image

Ovarian Torsion

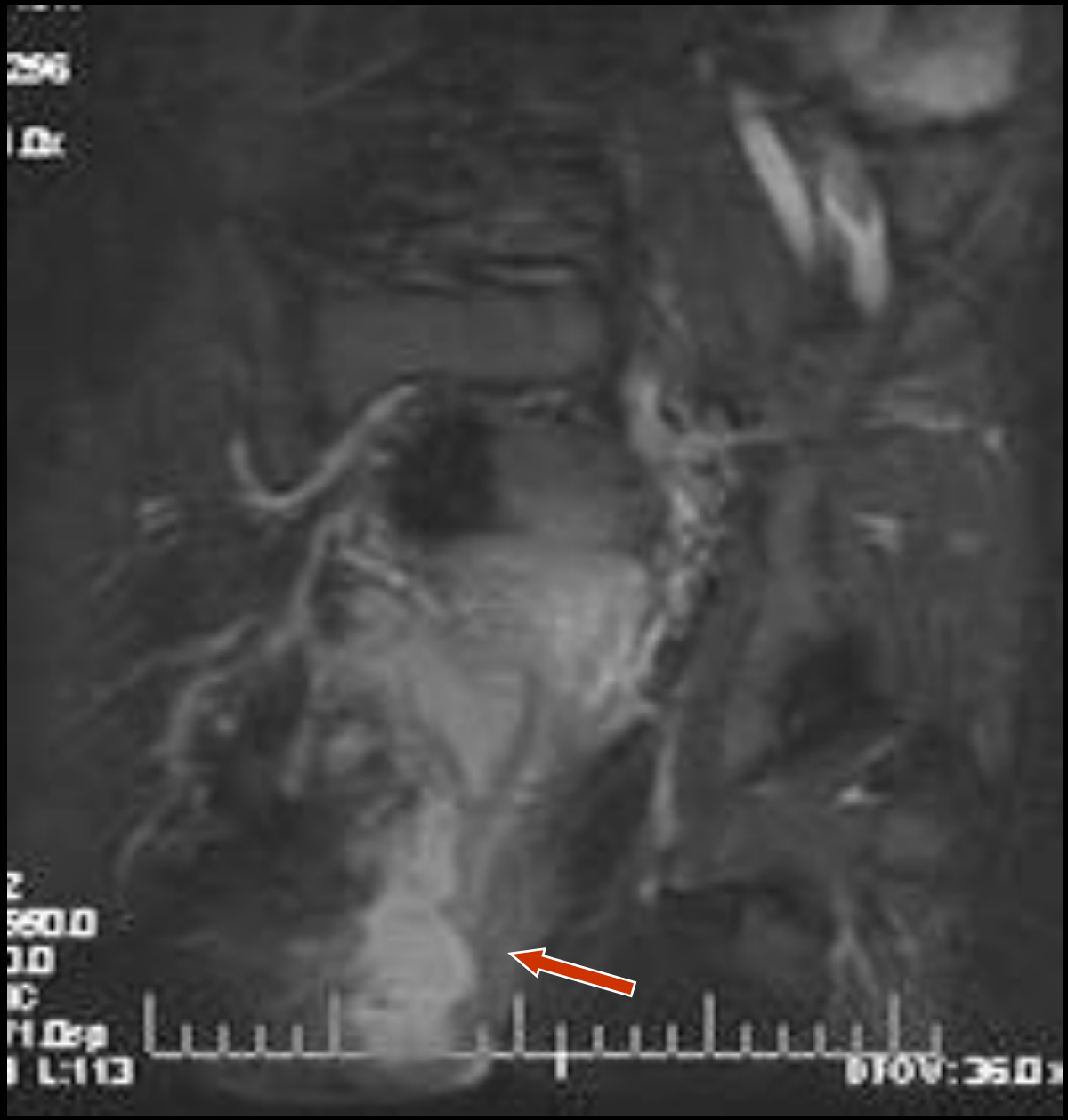
- Fifth most common gynecologic diagnosis(8).
- Symptoms – Abdominal pain, nausea and vomiting(8).
- Early diagnosis can salvage ovarian function(10%)(8).
- Torsion produces circulatory stasis, initially venous, then progresses to arterial(9).
- Predisposing factors include ipsilateral adnexal mass, usually benign(9).
- Teratoma is the most common benign neoplasm(9).

Torsion

- MRI findings:
- Tube thickening(84%)
- Ovarian cystic mass(76%)
- Ascites(64%)
- Deviation of the uterus(36%)
- Less Common: Hemorrhage and hemoperitoneum



Axial T1W image



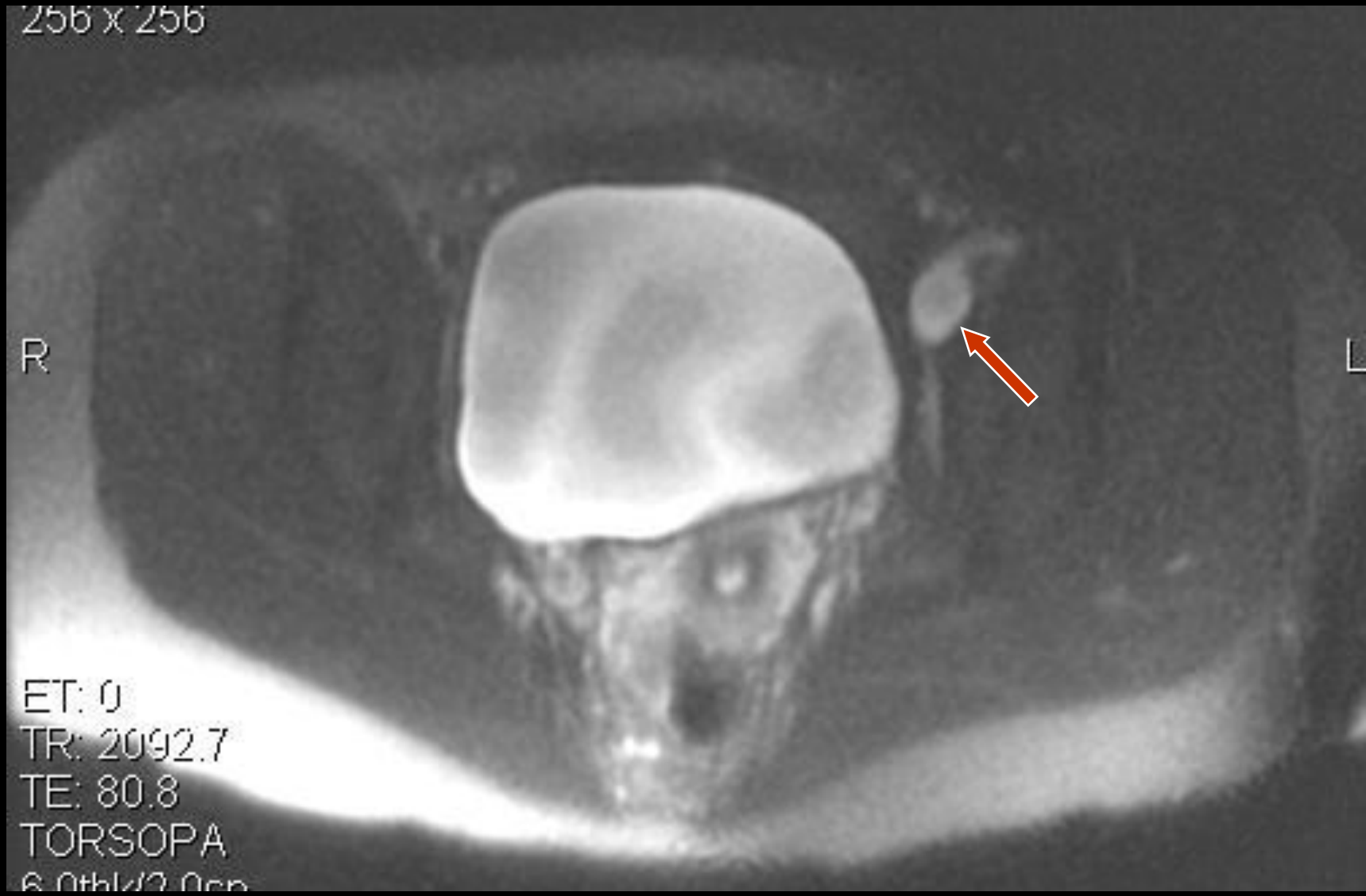
Coronal T2W image

Perirectal Abscess

- **MRI findings:**

  Non-specific – focal fluid collection with rim enhancement after IV contrast administration(7).

Axial SSFSE T2W image



Axial T2W image

DVT

- Ovarian and Pelvic vein thromboses are uncommon complication of preganancy(7).
- MRI – Acutely thrombosed vessels are enlarged and contain low signal intensity thrombus(7).
- Septic thrombus can cause streaky low intensity fat stranding on T1W images(7).

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