

# **Acute abdomen in pregnancy: A pictorial review of imaging findings in non-obstetric conditions**

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# Learning objectives

- To understand the altered pathophysiology of common conditions in the pregnant patient.
- Imaging findings in acute non-obstetric abdominal conditions in pregnancy, in particular on MRI.
- Understand the merits and limitations of the non-ionising imaging modalities used in pregnancy.

# Prevalence of acute abdominal conditions in pregnancy

Condition	Prevalence
Appendicitis	1 in 1500 pregnancies
Gallbladder disease	Sludge formation – 31% of pregnancies Stone formation – 2% of pregnancies (only 28% symptomatic)
Bowel obstruction	1 in 3000 pregnancies
Pancreatitis	1 in 3000 pregnancies (mostly secondary to cholelithiasis)
Nephrolithiasis	1 in 3300 pregnancies
Ovarian torsion	1 in 10000 adnexal lesions will need surgical intervention

Table 2: Prevalence of non-obstetric causes of acute abdomen in pregnancy [1]

# Challenging clinical presentation due to changes in anatomy and physiology

- Altered prevalence of acute abdominal conditions.
- Clinical examination is more difficult with the gravid uterus entering the abdomen at around 12 weeks.
- Displacement of the abdominal viscera may make it difficult to localise pain.

Physiological Change	Effect
Elevated progesterone	Increased appetite
Decrease in lower oesophageal sphincter pressure	Reflux Heartburn
Delayed gastric emptying	Nausea and vomiting Aspiration during anaesthesia
Ureteric compression	Urinary stasis (infection and urolithiasis)

# Risks of misdiagnosis

- Optimum diagnosis is important in pregnancy as:
  - There are increased risks in misdiagnosis, due to altered physiology such as alkalosis, hypocapnia and leucocytosis in pregnancy.
  - Risks to the mother and foetus in untreated abdominal conditions, which could result in increased maternal and foetal mortality and morbidity[1].
  - It is also important to bear in mind the increased risk of preterm labour and challenging surgery in pregnancy, hence unnecessary intervention should be avoided[1].
  - Increased risk of anaesthesia in pregnancy to mother and foetus [1]

# Imaging limitations

- Risks of radiation
  - Clinicians and patients alike are concerned about foetal radiation exposure
  - Possible increased radio sensitivity of the breasts during later stages of pregnancy [2]
- Safety concerns
  - Unknown effect of strong magnetic fields on foetal development [3]
  - Unknown effect of gadolinium exposure to the foetus [3]
- Ability of the patient to tolerate prolonged imaging

[3] Ray JG, Vermeulen MJ, Bharatha A, Montanera WJ, Park AL. Association Between MRI Exposure During Pregnancy and Fetal and Childhood Outcomes. *JAMA*. 2016 Sep 6;316(9):952-61. doi: 10.1001/jama.2016.12126. PubMed PMID: 27599330.

[2] Chen J, Lee RJ, Tsodikov A, Smith L, Gaffney DK. Does radiotherapy around the time of pregnancy for Hodgkin's disease modify the risk of breast cancer? *Int J Radiat Oncol Biol Phys*. 2004 Apr 1;58(5):1474-9. PubMed PMID: 15050326.

# Imaging modalities

- Ultrasound is usually the first imaging modality due to absence of ionising radiation, availability and can be portable if required. It provides valuable information (depending on the experience of the operator). Foetus can be assessed simultaneously, if appropriate.
- Ultrasound is also very useful in aiding percutaneous intervention, if required.
- Diagnostic limitations include displacement of abdominal organs by gravid uterus, difficulty in visualisation due to body habitus and inability of the patient to lie flat for prolonged examination.
- MRI is the preferred cross sectional imaging modality.

# MRI Protocol

- MRI sequences should be tailored to the clinical question, stage of pregnancy and ability of the patient to tolerate MRI.
- Usually supervised by an abdominal radiologist in our institution.
- Standard sequences are : T2 HASTE axial and coronal; T2 axial fat saturated on 1.5 T scanner. T1 weighted and diffusion weighted sequences are added if deemed necessary by the supervising radiologist.
- General anaesthesia and Gadolinium is avoided unless absolutely necessary to mother's health.



# MRI Protocols

- In our institution, the following sequences are used:
  - T2 HASTE coronal and axial
  - T2 Fat Saturated axial
  - T1 weighted axial
  - Optional:
    - T1 Fat saturated
    - Diffusion weighted sequences
    - High resolution T2 TSE axial to area of interest
  - Gadolinium has never been administered.

Sequence	Benefits
T2 HASTE coronal and axial	Quick Localises pathology
T2 Fat saturated axial	Subtle inflammatory changes are visualised
T1 axial	To identify haemorrhage Also useful for anatomy
High resolution T2 TSE	Targeted to area of interest, improves resolution
Diffusion weighted	Rarely used Helps to identify pus Differentiate abscess from fluid collection

# Safety and Limitations of MRI

- A study of 1737 pregnancy patients undergoing MRI showed no increased risk of stillbirth, death, congenital anomalies, neoplasm, or vision or hearing loss. However, rare adverse outcomes may not be detected with a study of this size.[3]
- The same study showed a slight increase (adjusted HR, 1.36; 95% CI, 1.09 to 1.69) in rheumatological, inflammatory, or infiltrative skin conditions in the child following exposure to gadolinium.
- Gadolinium should be avoided during pregnancy unless absolutely essential for the mother's health.

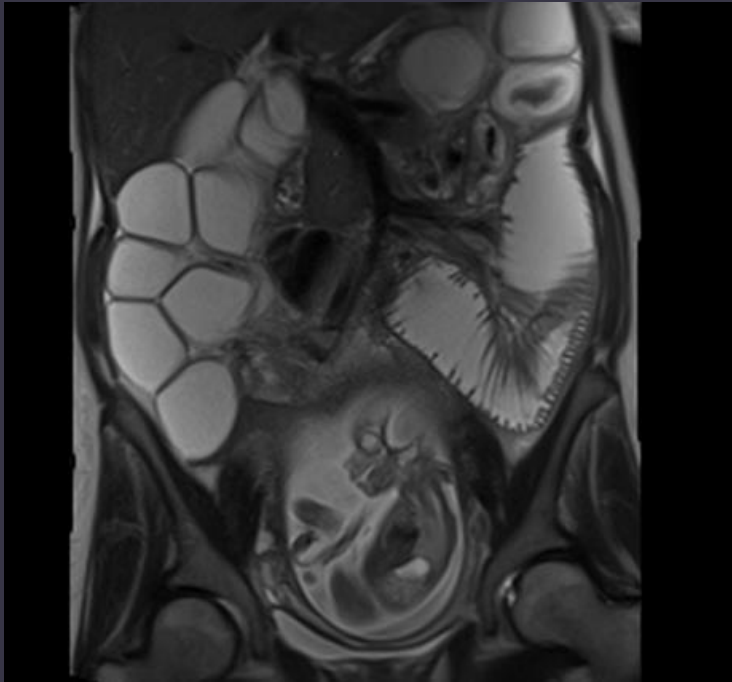
# Cases

# Case 1

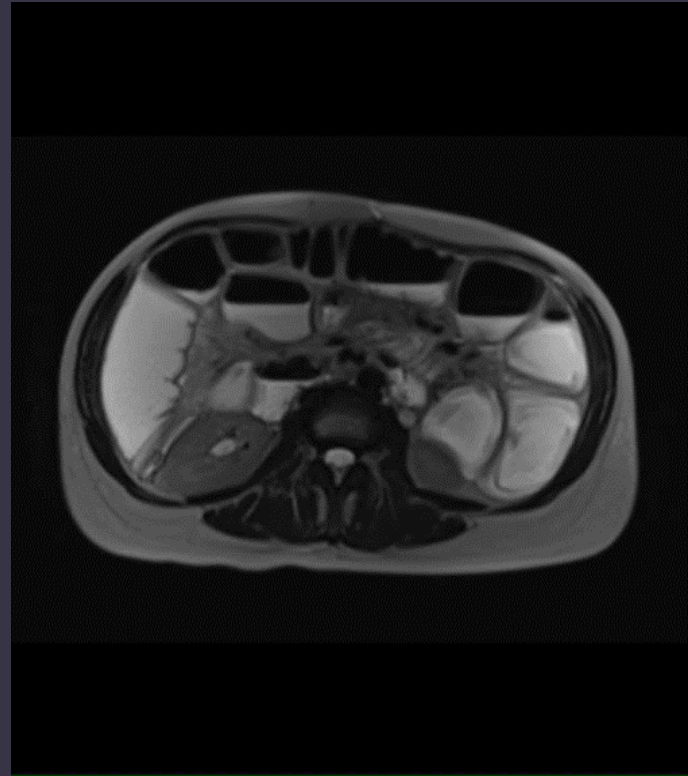
- 31 year old lady, 20 weeks pregnant.
- Admitted with vomiting and abdominal pain.
- Previous history of colectomy and ileo-anal pouch formation for ulcerative colitis
- Raised inflammatory markers and marginally raised amylase
- Ultrasound at admission did not identify an abnormality.
- MRI was performed 3 days later due to worsening clinical picture

# Case 1

**T2 HASTE Coronal**



**T2 HASTE Axial** (*click to play*)



# Case 1

- MRI showed dilated proximal small bowel with collapsed distal small bowel in keeping with small bowel obstruction, presumed to be adhesional in view of previous history.
- Imaging findings were confirmed on laparotomy and adhesiolysis performed.

- *Learning point:*

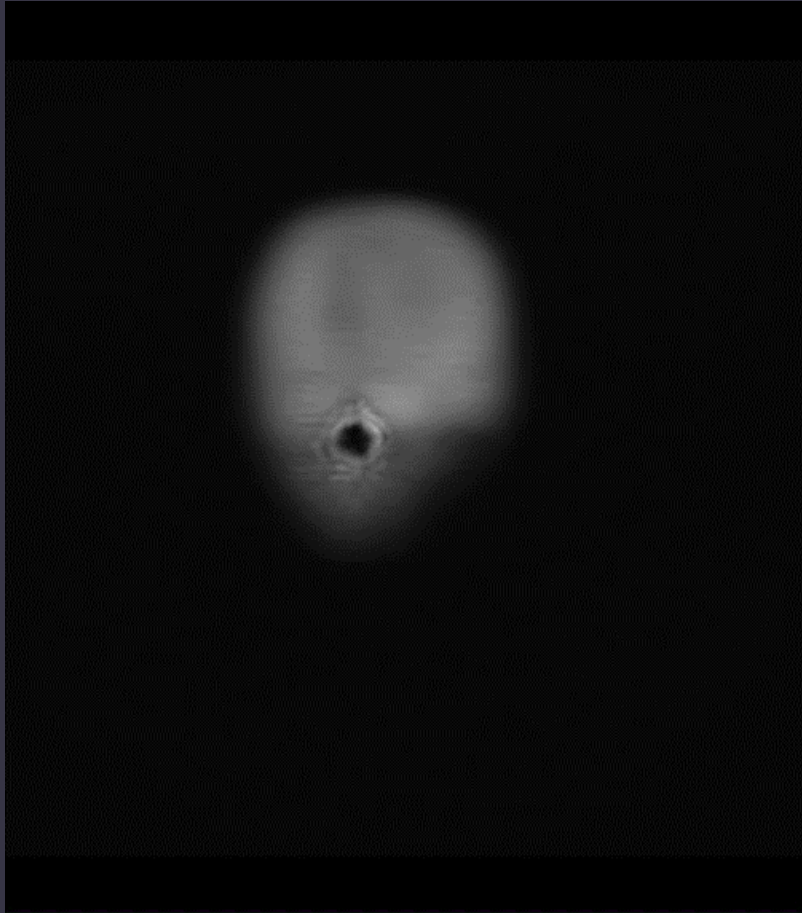
*MRI can provide useful diagnostic information to guide appropriate intervention especially as surgery would be challenging and involve administration of general anaesthesia.*

## Case 2

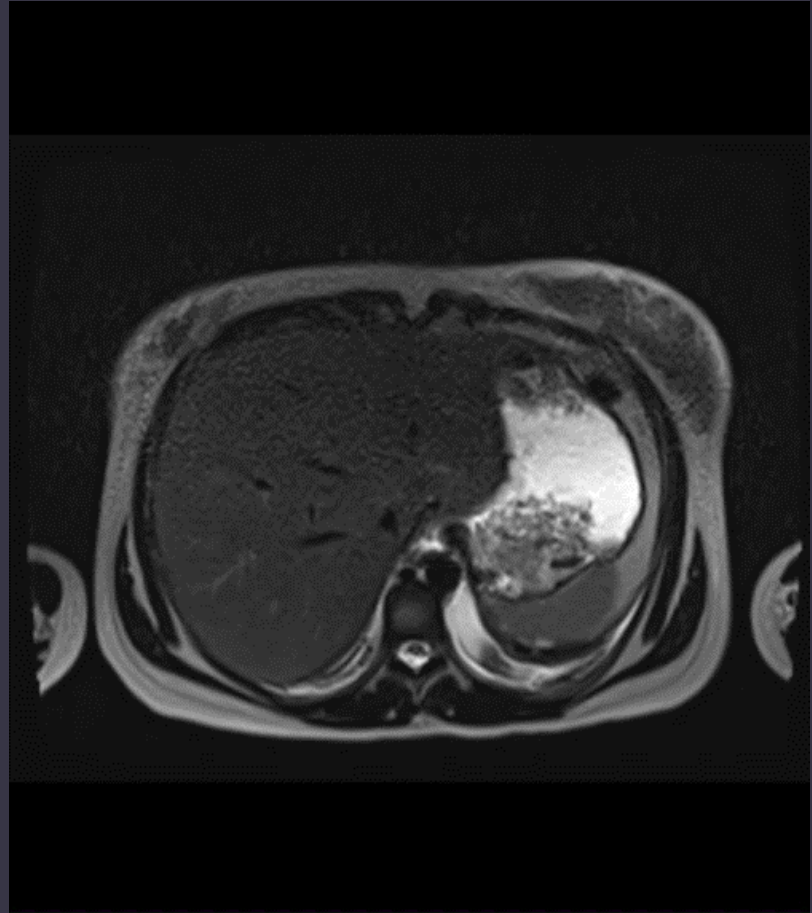
- 20 year old, 28 weeks pregnant with acute abdomen.
- Raised inflammatory markers.
- Limited MRI performed as patient could not tolerate the examination

# Case2

**T2 coronal** (*click to play*)



**T2 axial** (*click to play*)





# Case 2

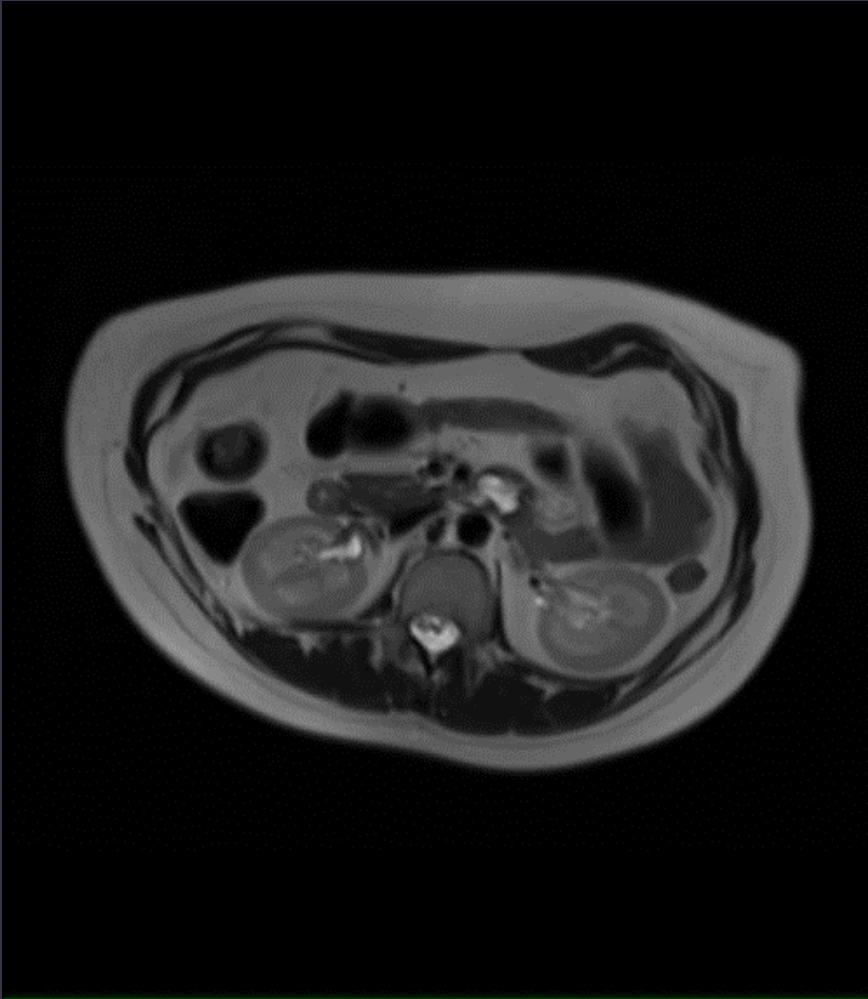
- MRI showed dilated fluid filled dilated small bowel loops with an inflammatory collection in the left lower quadrant.
- Matted loops of small bowel seen adjacent to this, with a tubular structure close to this, of unsure origin.
- No inflammatory changes seen around the caecum.
- Focal pyelonephritis of the right kidney also noted.
- Laparotomy confirmed small bowel obstruction secondary to perforated Meckel's diverticulum.

*Learning point:*

*Limited MRI sequences can identify presence of significant pathology, however exact aetiology may not be identified. This will be useful to justify invasive intervention.*

# Case 3

T2 axial (*click to play*)



- 30 year old lady, 12 weeks pregnant, RIF pain and raised inflammatory markers.
- MRI shows dilated appendix(10mm) with surrounding inflammatory changes.

# Case 3

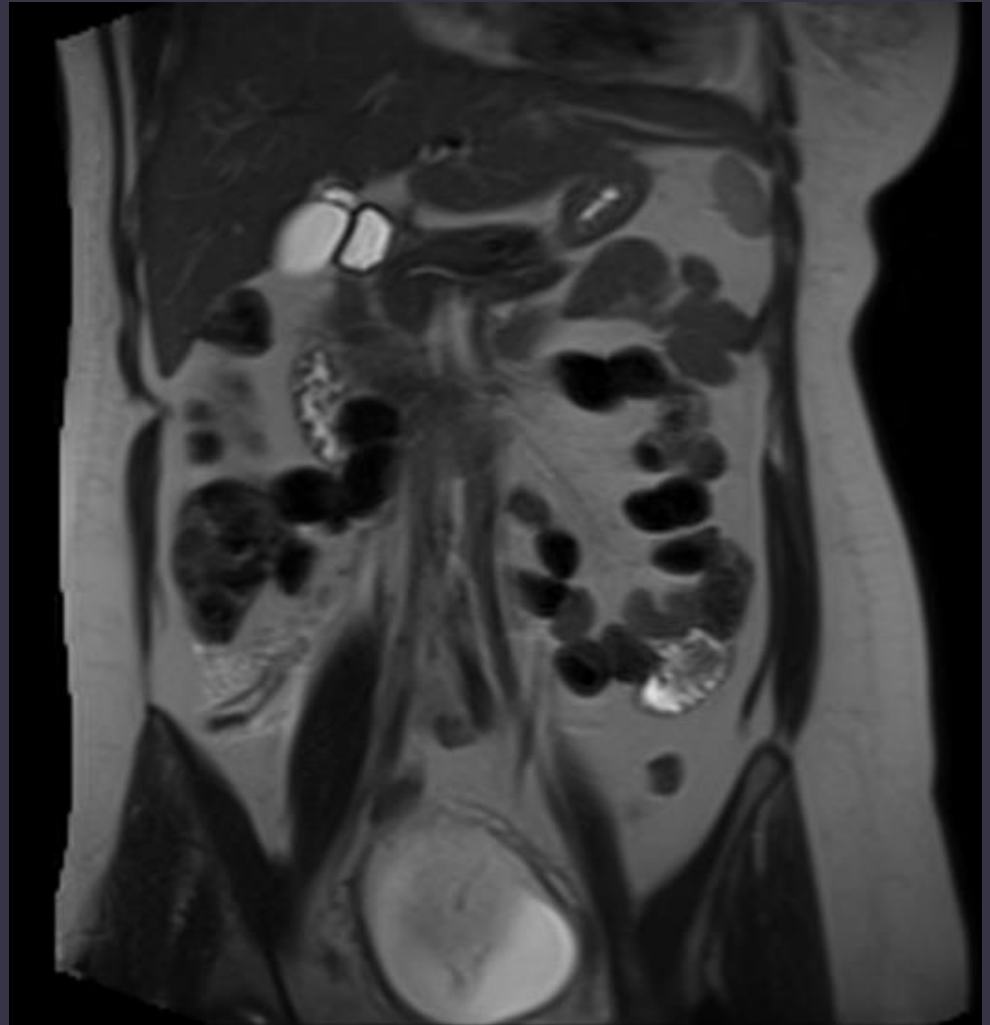
- Uncomplicated appendicitis confirmed on laparotomy.
- Appendicitis is the most common cause of acute abdomen in pregnancy.

## Case 3

These changes were also seen on the localiser/scout views!

*Learning point:*

*A few images can provide valuable diagnostic information although a definitive diagnosis cannot be made.*



# Case 4

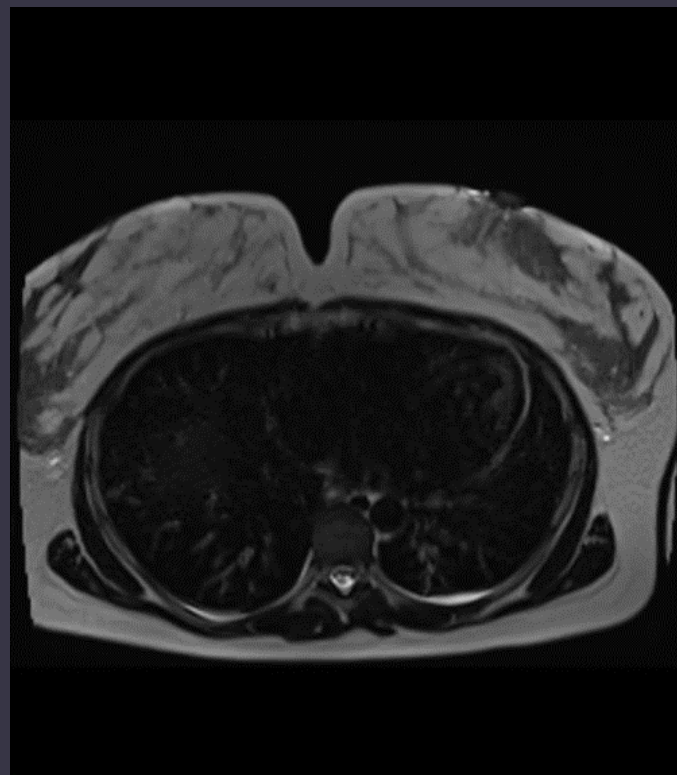
- 23 year old, 34 weeks pregnant.
- Admitted with few days of lower abdominal pain and diarrhoea, treated for sepsis.
- Blood culture positive for *Eikonella sp* and hence MRI requested to rule out collections

# Case 4

**T2 coronal** (*click to play*)



**T2 axial** (*click to play*)



# Case 4

- Retro-colic collection with subcapsular extension.
- Tubular blind ending structure close to the collection, in keeping with perforated appendicitis.
- The collection was drained percutaneously under ultrasound guidance. As the patient recovered and was subsequently asymptomatic, an interval appendicectomy was not performed.

*Learning point:*

*Ultrasound guided intervention must be considered in appropriate cases to avoid more invasive surgery and general anaesthesia.*

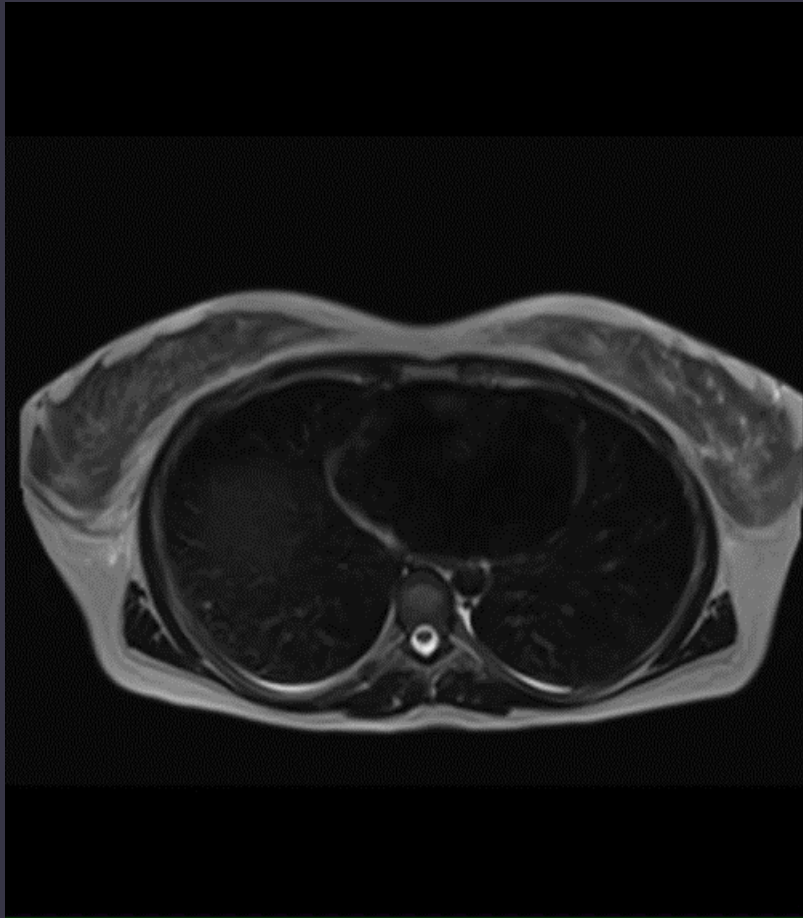
# Case 5

- 33year old lady, 21 weeks pregnant with abdominal pain and history of previous pancreatitis.
- Raised inflammatory markers and amylase.
- US showed a cystic abnormality in the pancreas.
- MRI performed to rule out acute complications of pancreatitis and a collection.



# Case 5

**T2 axial** (*click to play*)



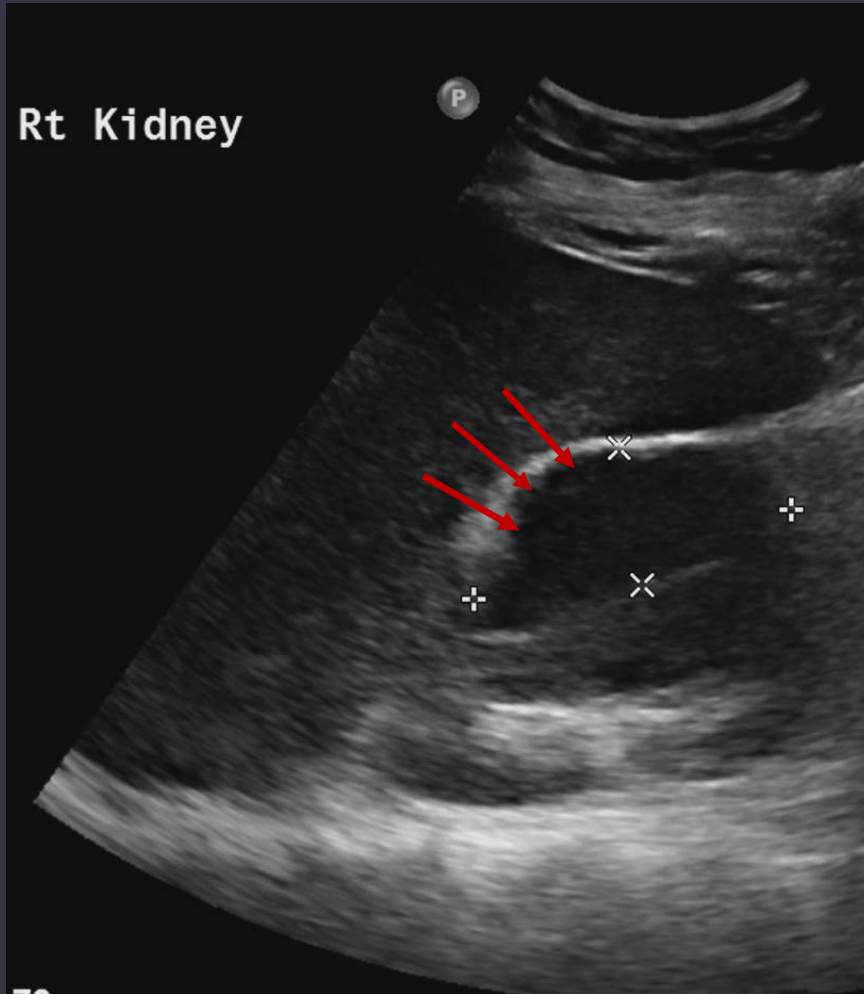
**T2 coronal** (*click to play*)



# Case 5

- MR showed mild inflammatory changes surrounding the pancreas and confirmed the cystic abnormality seen on ultrasound.
- No convincing features to suggest an abscess were identified. The cystic abnormality was presumed to be a pseudocyst. A diagnosis of acute on chronic pancreatitis was suggested.
- Follow up MRI post partum showed stability in the size of the cyst, in keeping with a pseudocyst.

# Case 6



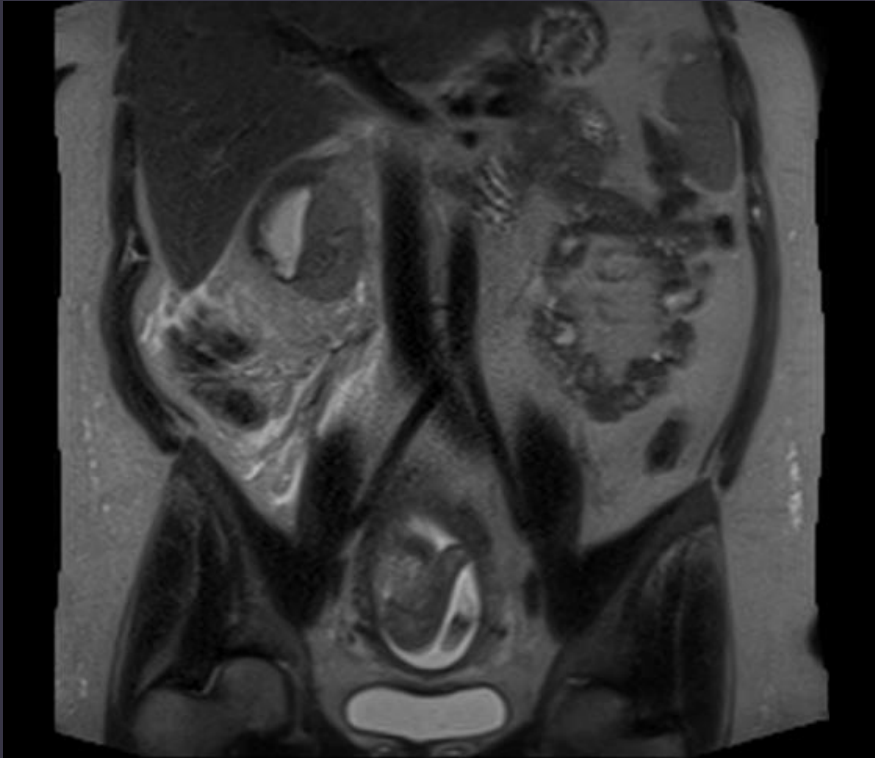
- 30 year old lady, 19 weeks pregnant.
- Presented with acute right iliac fossa and right loin pain. Patient was septic with raised inflammatory markers.
- Differential diagnosis: Acute appendicitis vs acute pyelonephritis.

# Case 6

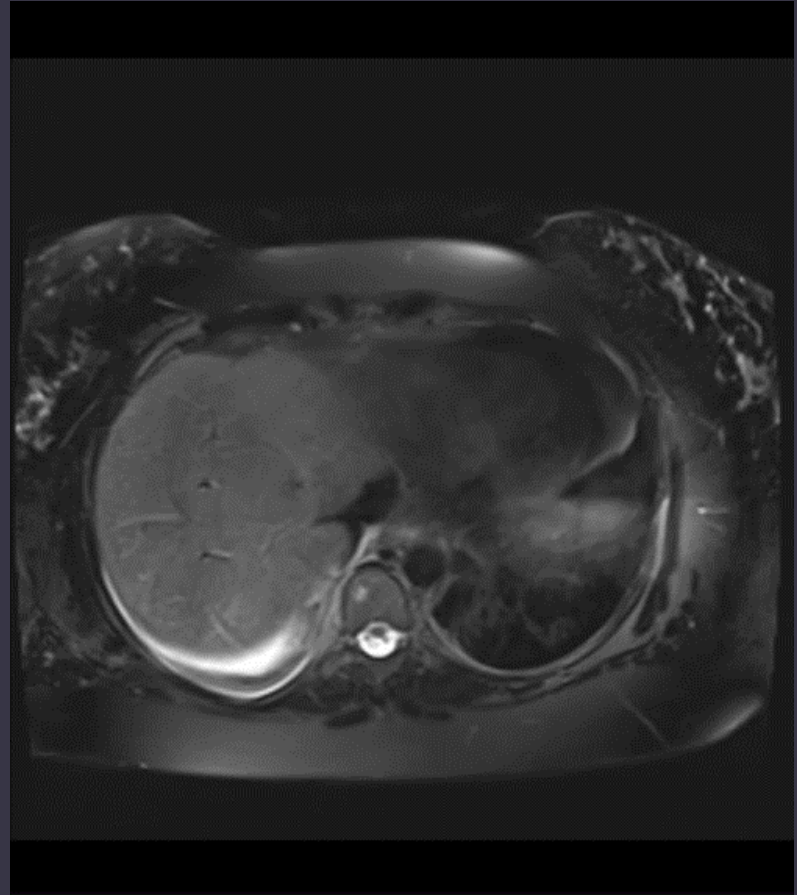
- Initial ultrasound showed an echogenic collection in anterior right pararenal space. Ultrasound could not differentiate between an abscess and haemorrhage. MRI was recommended.
- There was no history of trauma

# Case 6

**T2 coronal**



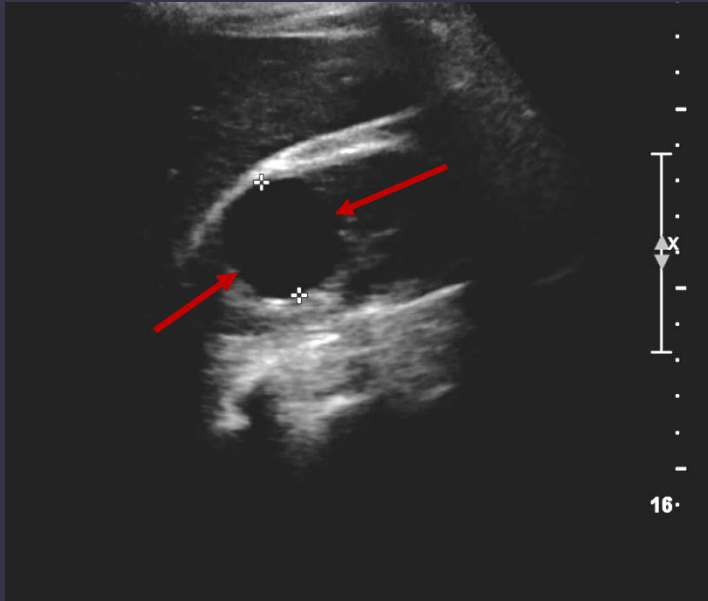
**T2 axial (click to play)**



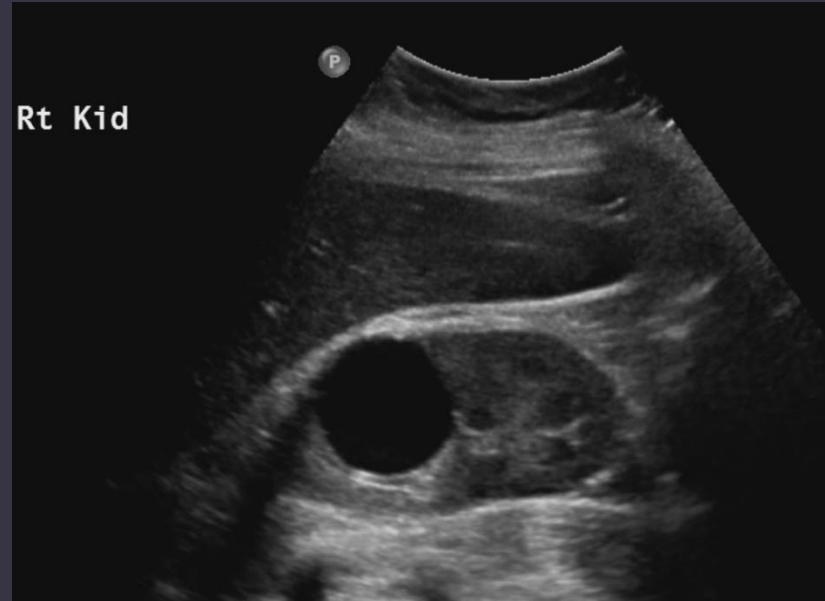
# Case 6

- MRI confirmed a sub-capsular collection in the right kidney.
- There was shading on T2 weighted sequences and intermediate to high signal intensity on T1 fat saturated sequences.
- Prominent surrounding inflammatory changes.
- No cortical tumour or angiomyolipoma identified.
- Diagnosis of an abscess or haemorrhagic collection was suggested.
- Patient was conservatively managed and responded to antibiotics.

# Case 6



**Follow up ultrasound 1 week later-liquefying contents and reduction in size**



**Ultrasound post partum – further resolution with a residual small cystic lesion.**

# Summary

- Imaging is a valuable diagnostic tool to confirm or refute a diagnosis in acute abdominal conditions in pregnancy.
- This can justify or avoid invasive procedures, beneficial to both the mother and foetus.
- The clinician and radiologist should be aware of the limitations of the various modalities.
- Judicious selection of imaging should be used to aid diagnosis and perform percutaneous intervention, where appropriate.



# References

- Kilpatrick CC, Monga M. Approach to the acute abdomen in pregnancy. *Obstet Gynecol Clin North Am.* 2007 Sep;34(3):389-402, x. Review. PubMed PMID: 17921006
- Ray JG, Vermeulen MJ, Bharatha A, Montanera WJ, Park AL. Association Between MRI Exposure During Pregnancy and Fetal and Childhood Outcomes. *JAMA.* 2016 Sep 6;316(9):952-61. doi: 10.1001/jama.2016.12126. PubMed PMID: 27599330.
- Chen J, Lee RJ, Tsodikov A, Smith L, Gaffney DK. Does radiotherapy around the time of pregnancy for Hodgkin's disease modify the risk of breast cancer? *Int J Radiat Oncol Biol Phys.* 2004 Apr 1;58(5):1474-9. PubMed PMID: 15050326.