RC 307 Imaging the female pelvis
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# Imaging for pelvic pain in pregnancy

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# Introduction

- ✓ The pregnant patient with pelvic pain presents a challenge to the clinician.
- ✓ Acute pelvic pain in pregnant women may be the manifestation of various gynaecological and non-gynaecological conditions.
- ✓ The clinical evaluation of pregnant patients is confounded by physiological and anatomical changes related to pregnancy.
- ✓ Prompt diagnosis and intervention is critical to minimize maternal and fetal mortality.

# Learning Objectives

- ✓ To become familiar with the most common causes of pelvic pain in pregnancy
- ✓ To understand how to diagnose non-gynaecologic causes of pain in pregnancy
- ✓ Review the imaging features of various pathologies which may present as acute pelvic during pregnancy

# Imaging of emergencies in pregnancy

## *Outline*

1. Imaging modalities
2. MRI technical protocol and Normal Findings
3. Evaluation of maternal gynaecologic diseases
4. Evaluation of maternal non-gynaecologic diseases
5. Evaluate the impact of  Imaging findings on patient care

The Teaching points are highlighted in the white boxes.

# 1. Imaging modalities

- Imaging in pregnancy remains a controversial issue with concern for the effects of ionizing radiation

➢Exposure to ionizing radiation should be limited there is no evidence to suggest that the risk to the fetus after a single imaging study is significant

➢Ultrasound and MRI have classically been considered safe modalities, and first choice options when feasible.

# 1. ULTRASOUND (US) in Pregnancy

- ✓ Sonography is a safe imaging technique to use in pregnant patients
- ✓ Due to higher resolution of anatomic detail, Transvaginal US should be used; Transabdominal is recommended when uterine and adnexal structures are beyond the field of view of the transvaginal probe
- ✓ In addition, duplex and color or power Doppler imaging can be used to characterize vascularity
- ✓ Limitations: operator dependent and in the presence of a gravid uterus, intraabdominal organs may be displaced and be difficult to visualize on sonography

# 1. CT in Pregnancy

✓Imaging radiation must be applied at levels as low as reasonably achievable (ALARA)

✓Narrow collimation and wide pitch  slightly reduces image quality, but provides a large reduction in radiation exposure.

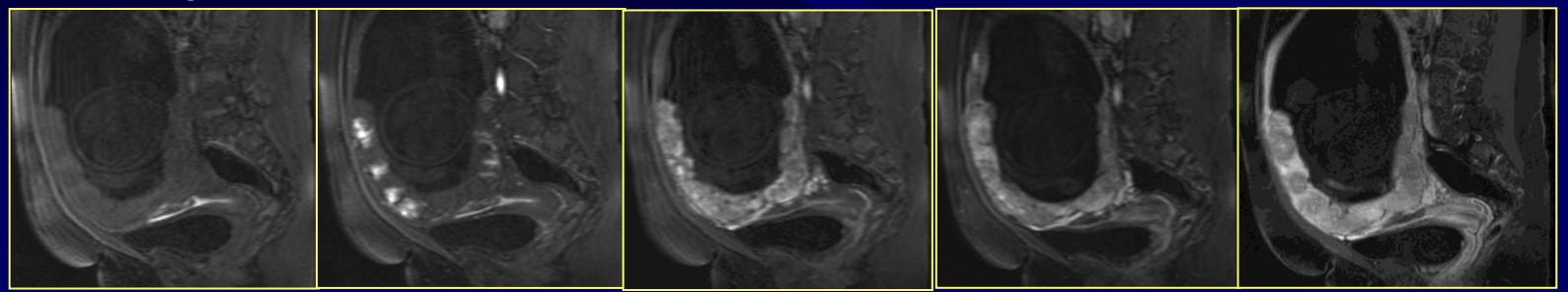
| |
|---|
| One size does not fit all: do not use standard protocols |
| Decrease kilovoltage for small patients |
| Decrease milliamperage and use automatic tube current modulation |
| Increase pitch to >1 |
| Obtain a single scout view and avoid directly imaging the fetus for planning purposes |
| Limit the field of view |
| Avoid imaging in multiple phases |
| Use more recently available novel reconstruction algorithms to reduce noise in images, thus allowing reduction of milliamperage or increase in noise level requirements during scanning |
| Lead shielding of the mother; most pronounced effect with circumferential shielding |
| Internal barium shielding with use of oral 30% barium sulfate solution |
| Local quality assurance program to monitor CT protocols and the resulting dose |

| | | CT Protocol | | Imaging Parameters | |
|---|---|---|---|---|---|
| Type of CT Examination | Dose (mGy) | Section Thickness (mm) | Noise Index | Tube Current–Time Product (mAs) | Pitch |
| CT of the chest | 0.02 | 2.5 | 30 | 80 | 1.375 |
| CT pulmonary angiography | 0.02 | 1.25 | 30 | 88 | 0.984 |
| CT of the abdomen | 1.3 | 2.5 | 36 | 110 | 1.375 |
| CT of the kidney, ureter, and bladder | 11 | 2.5 | 36 | 110 | 1.375 |
| CT of the pelvis | 13 | 2.5 | 36 | 130 | 1.375 |
| CT of the abdomen and pelvis | 13 | 2.5 | 36 | 130 | 1.375 |
| CT angiography | 13 | 2.5 | 30 | 130 | 1.375 |

# 1. MRI in Pregnancy

- ✓ A systematic cross-sectional evaluation of the entire abdomen with excellent anatomic resolution
- ✓ lack of ionizing radiation, multiplanar capability, and improved soft-tissue contrast and wider field of view
- ✓ No studies have shown adverse effects on the fetus or the outcome of the pregnancy.

- ✓ Limitations: MRI is NOT usually performed in the 1st trimester, this being the period of organogenesis.
- ✓ Gadolinium crosses placenta
  - ✓ is currently not recommended for use in the pregnant patient unless the potential benefit outweighs the potential risk to the fetus.

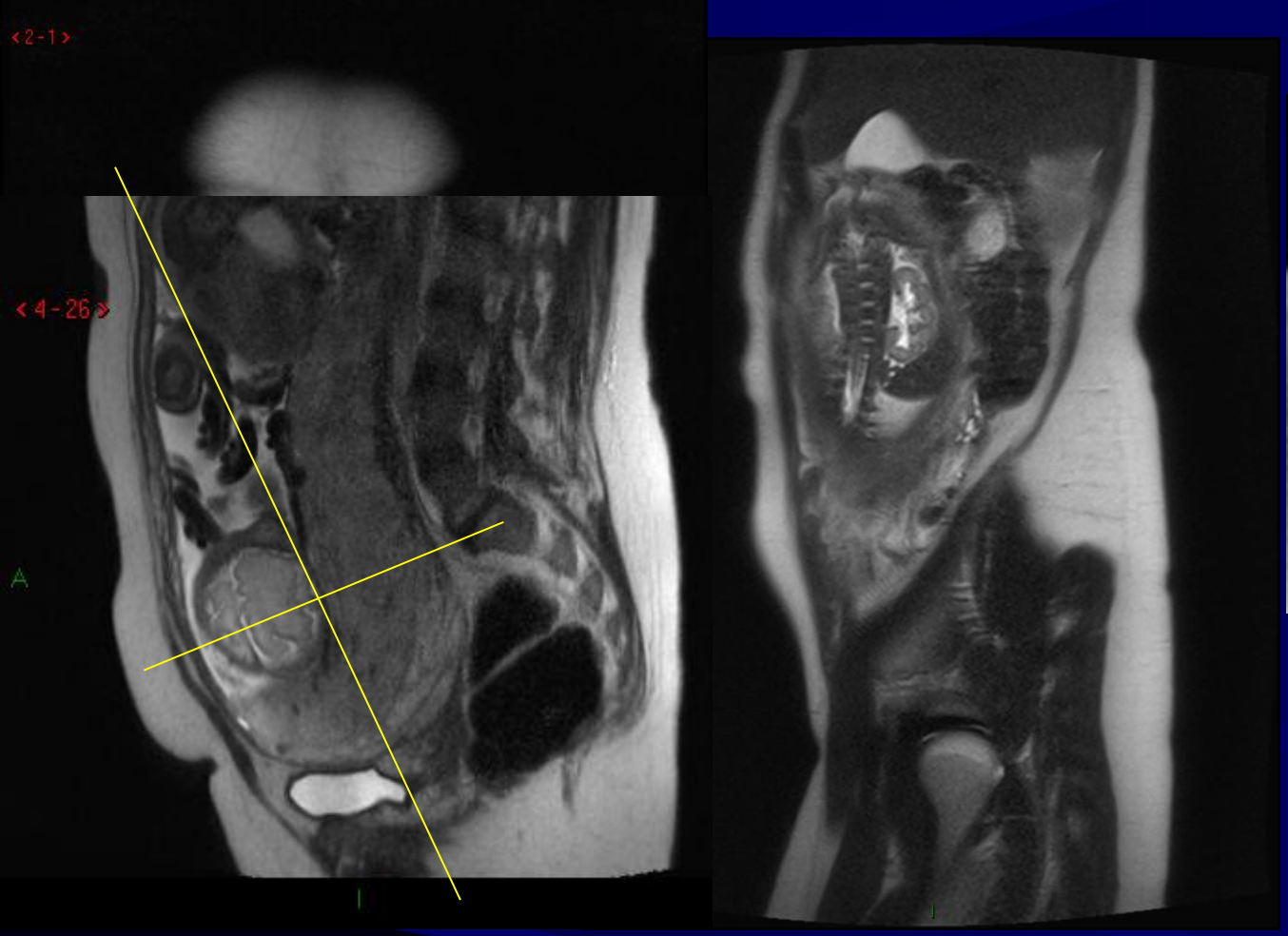


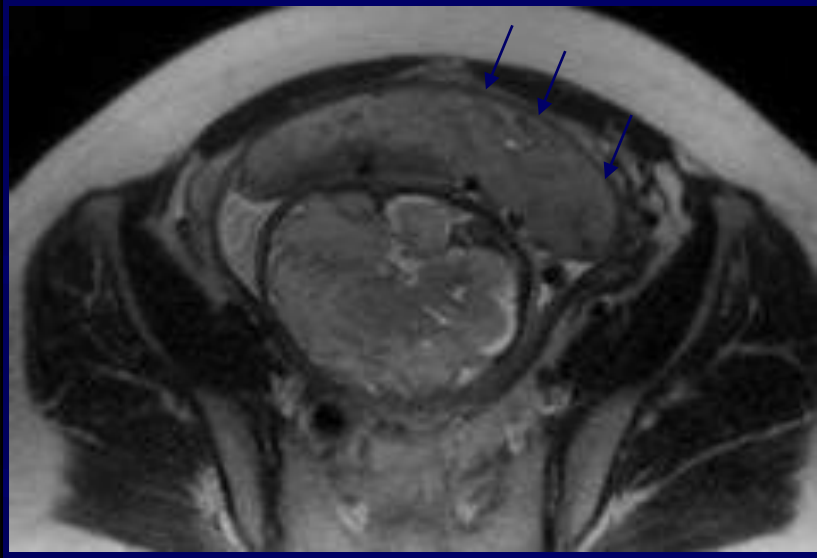
# 2. MRI TECHNICAL PROTOCOL

- ✓ 1.5 T
- ✓ Phase array coil
- ✓ Parallel Imaging
- ✓ Short Breath hold

| Parameter | True FISP* | | T2-weighted Half-Fourier RARE† | | Sagittal T1-weighted Three-dimensional Imaging‡ | Sagittal Diffusion-weighted Imaging§ |
|---|---|---|---|---|---|---|
| | Transverse | Coronal/Sagittal | Transverse | Coronal/Sagittal | | |
| TR/TE (msec)‖ | 4.3/2.2 | 4.3/2.2 | 1000/90 | 1000/90 | 4.1/1.1 | 3200/75 |
| Flip angle | 50° | 50° | 150° | 150° | 10° | 10° |
| Field of view (mm) | 320–400 | 320–400 | 320–400 | 320–400 | 320–400 | 320–400 |
| Matrix | 256 × 224 | 256 × 224 | 256 × 224 | 256 × 224 | 256 × 224 | 256 × 192 |
| Parallel imaging factor | 2 | 2 | 2 | 2 | 3 | 2 |
| Section thickness (mm) | 5 | 5 | 4 | 4 | 2.5 | 5 |
| Intersection gap (mm) | 0 | 0 | 0 | 0 | 0 | 0 |
| No. of signals acquired | 1 | 1 | 1 | 1 | 1 | 6 |
| Receiver bandwidth (kHz) | 125 | 125 | 200 | 200 | 310 | 1930 |
| Acquisition time (sec) | 19 | 21 | 15–20 | 15–20 | 15–18 | 180 |

- This protocol is modified individually according to the clinical condition.
- Some additional sequences (such as MRCP, MR urography or MR angiography sequences) are used if required.

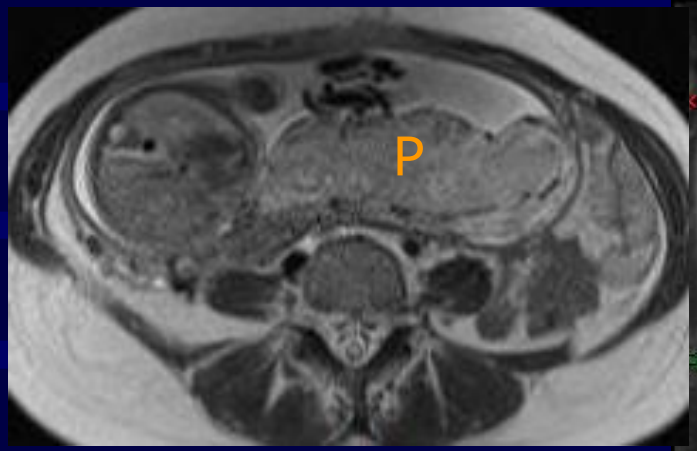


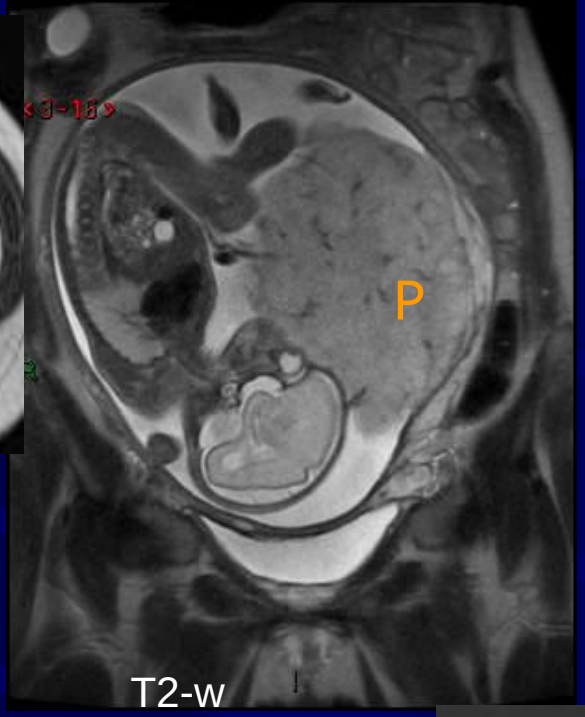



Use thin section (3-4 mm thickness)
The sequence should be perpendicular to Myometrium-placenta border

## HASTE

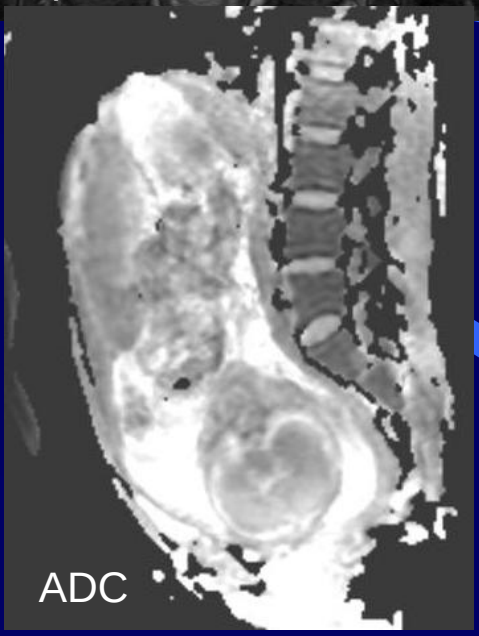
- The distinction between the myometrium and the placenta can be difficult.
- The myometrium is of intermediate signal intensity on T2-weighted images and may “blend” into placenta.
- Partial volume averaging makes assessment difficult.



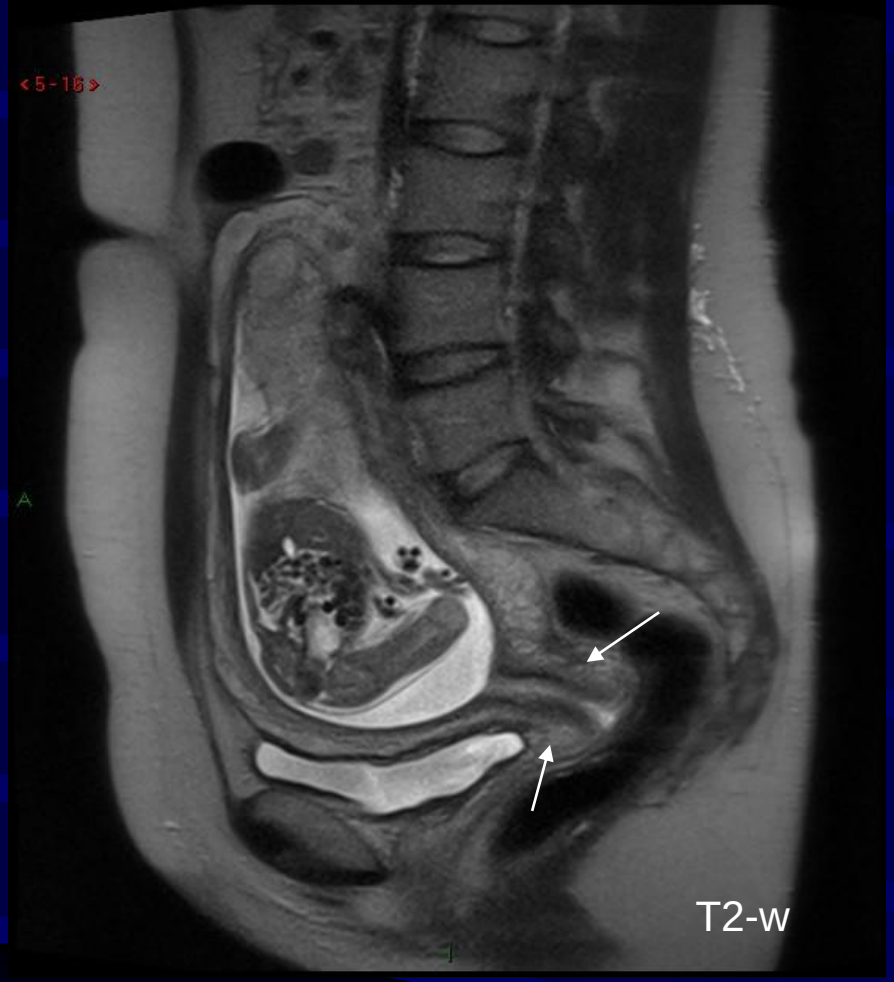







Placenta is located anterior or posterior uterine wall

Thickness< 4 cm;  Homogeneous signal intensity on T1-w, T2-w and DWI





Cervix:
Length>3 cm
High signal intensity endocervical canal,
Intermediate signal intensity mucosal folds,
low signal intensity fibrous stroma

Ovaries in pregnancy have
a low signal intensity stroma and
small follicles

# Causes of acute abdominal and pelvic pain in pregnancy

## Gynaecologic/Obstetric

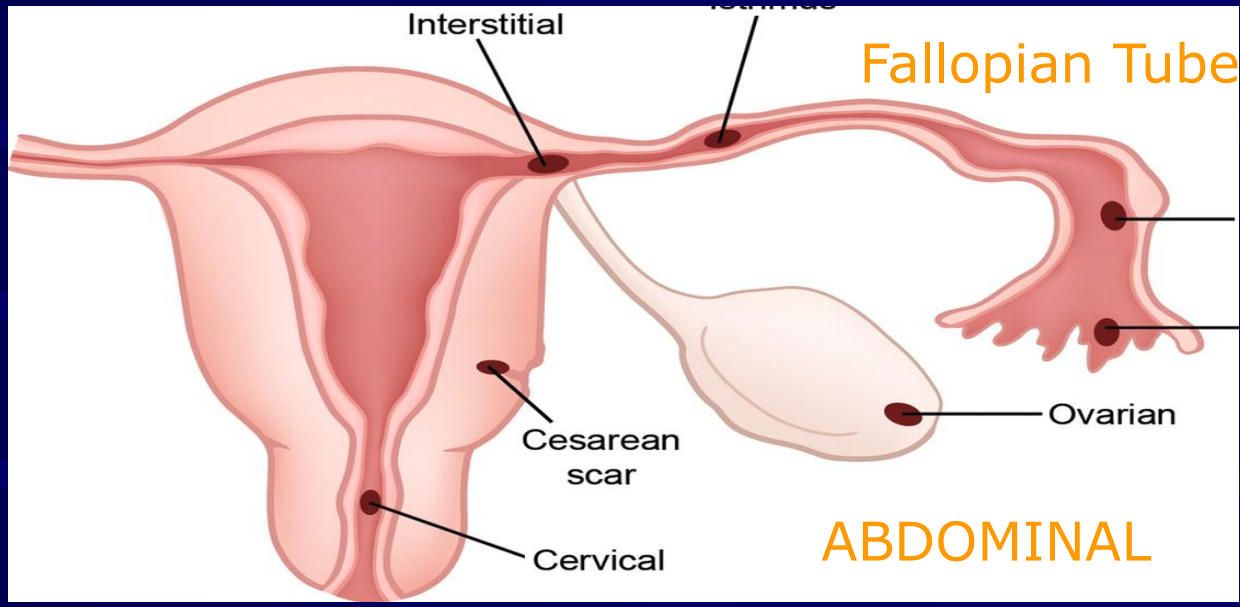
1. Ectopic pregnancy
2. Placental Abruption
3. Placenta percreta
4. Uterine Dehiscence and Rupture
5. Preterm Labor
6. Leiomyomas red degeneration
7. Ovarian Mass
8. Ovarian Torsion

## Non Gynaecologic

1. Appendicitis
2. Bowel obstruction
3. Hydronephrosis
4. Pyelonephritis
5. Deep venous thrombosis

# 1) Ectopic Pregnancy

- **Classic Symptoms**
  - Abdominal pain 95%
  - Vaginal Bleeding 85%
  - Palpable adnexal mass, 40%
- **Diagnosis**
  - Serum quantitative human chorionic gonadotropin (hCG)
    - Absence of an intrauterine gestational sac and hCG concentrations >1500-2000 IU/L
    - Presence of an embryo in a gestational sac in a location other than the endometrial cavity

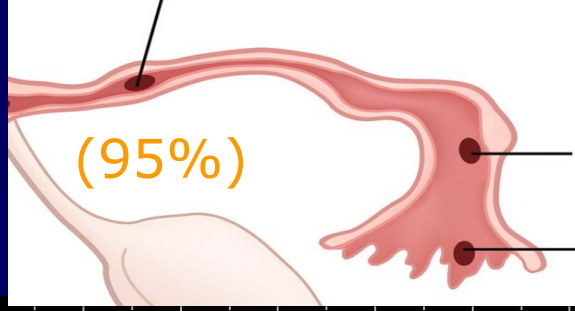


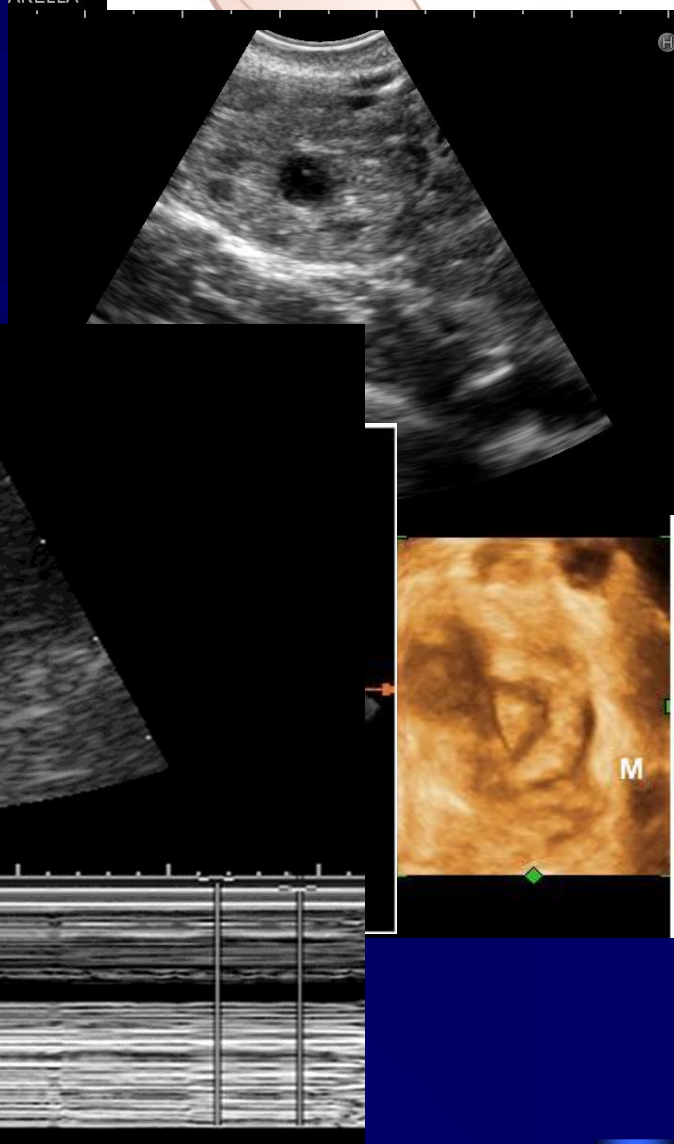

- **Management**
  - Emergency surgical management if rupture has occurred and/or patient is hemodynamically unstable
- **Prognosis**
  - Ruptured ectopic pregnancies account for 4- 10 percent of all pregnancy related deaths.

# Tubal Ectopic Pregnancy

## Ultrasound Findings

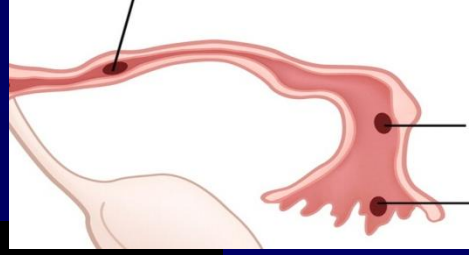
- ✓ Tubal Hematoma (60%) mass with heterogeneous echotexture
- ✓ Tubal ring (50%) echogenic ring separate from ovary
- ✓ “Lights up” with color doppler
- ✓ +/- embryo



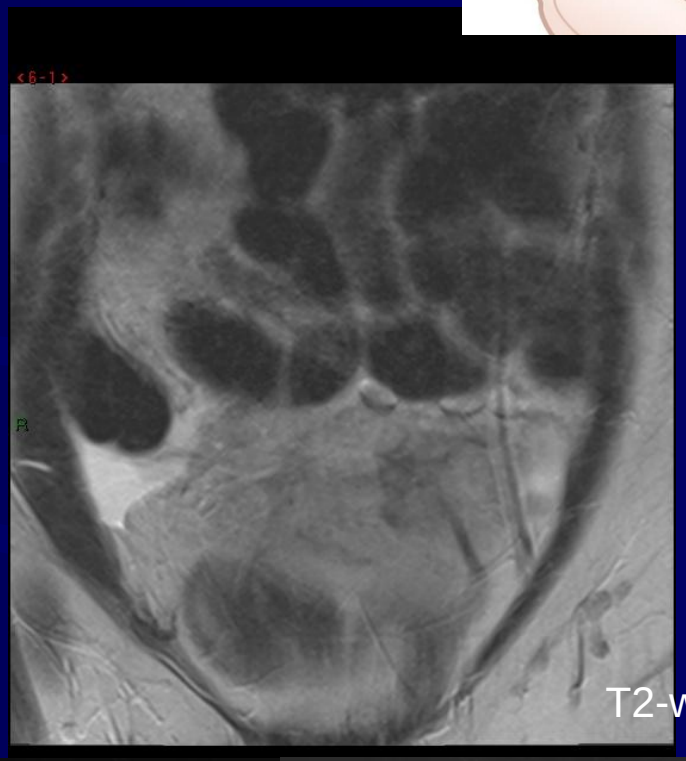



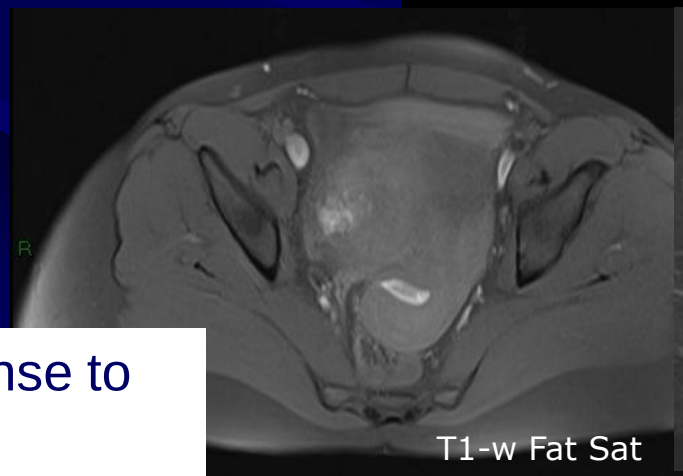
# Tubal Ectopic Pregnancy

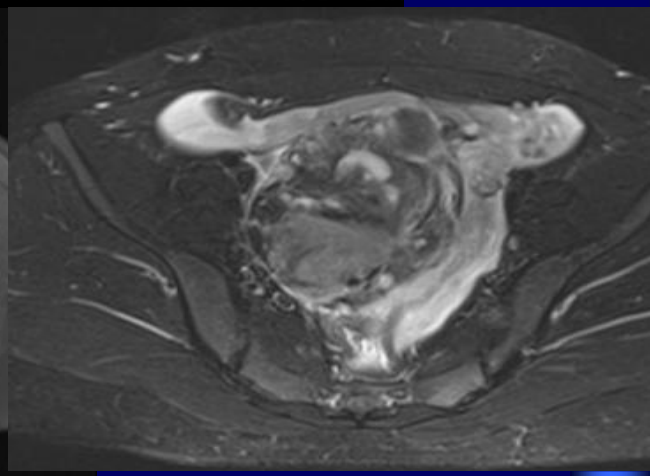
## MR Findings



- ✓ Extrauterine mass with heterogeneous signal intensity.
- ✓ an adnexal mass composed of a gestational sac and hematoma are visualized
- ✓ ruptured gestational sac, leading to hemoperitoneum
- ✓ Hemorrhagic ascites are hyperintense to water onT1-weighted images






Hemorrhagic ascites are hyperintense to water on T1-weighted images.

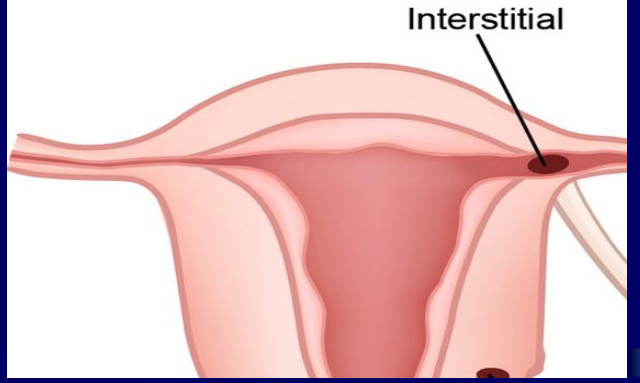
# Interstitial Ectopic pregnancy 3%

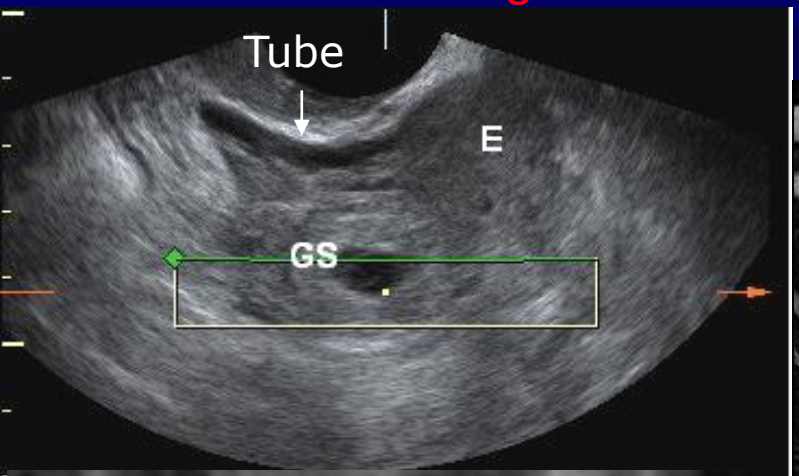
Gestational sac high in uterus

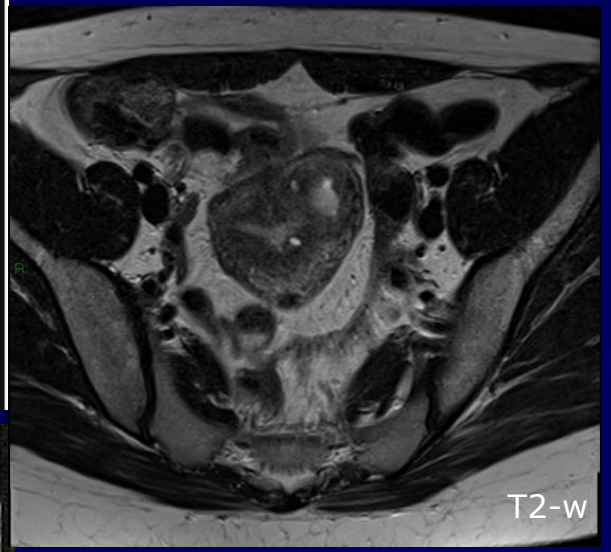
No communication with endometrial cavity

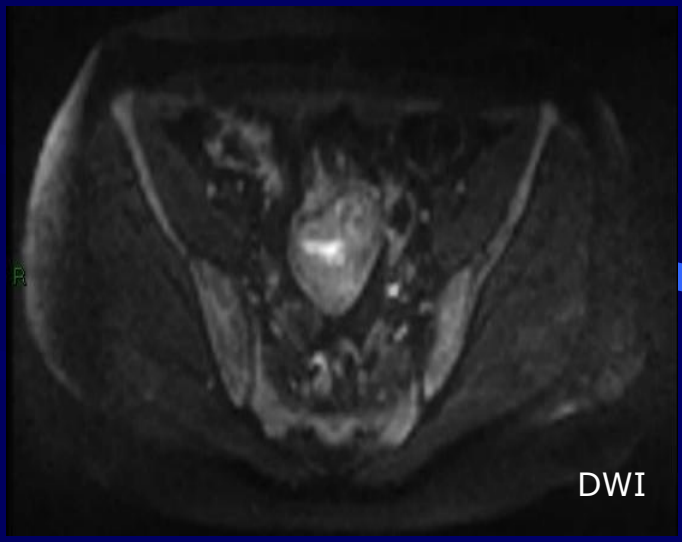
Less than 5 mm of myometrium around the sac

MR is accurate in diagnosis

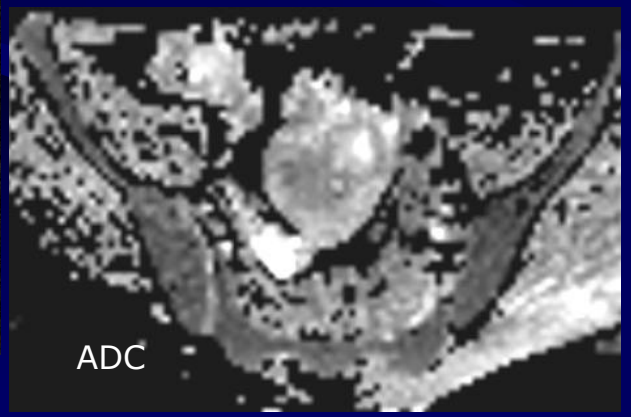


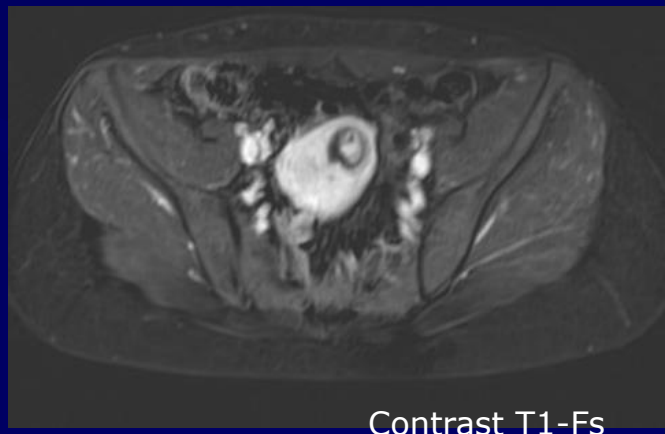



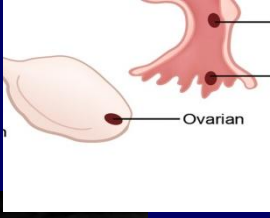




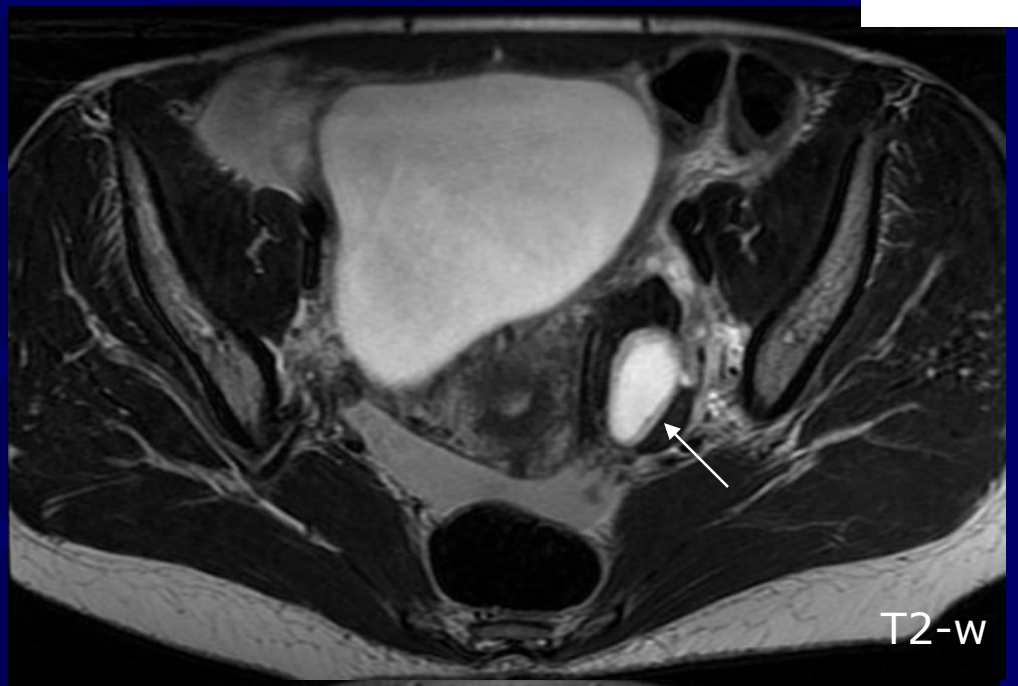



# Ovarian 1%

Gestational sac inseparable from ovarian tissue.





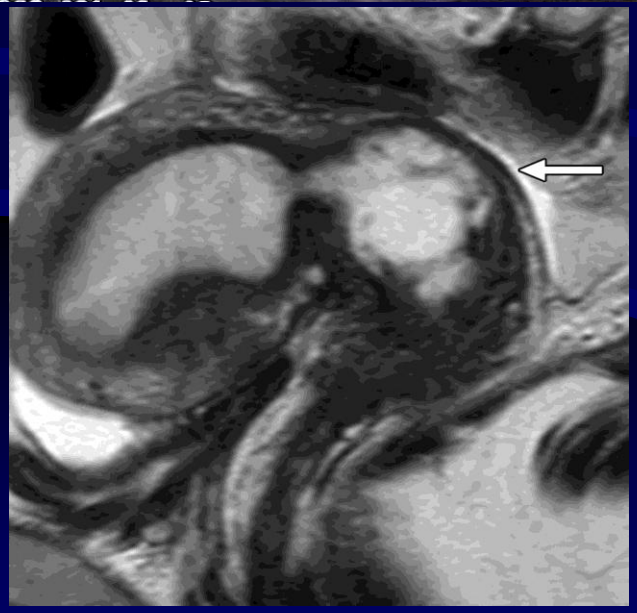



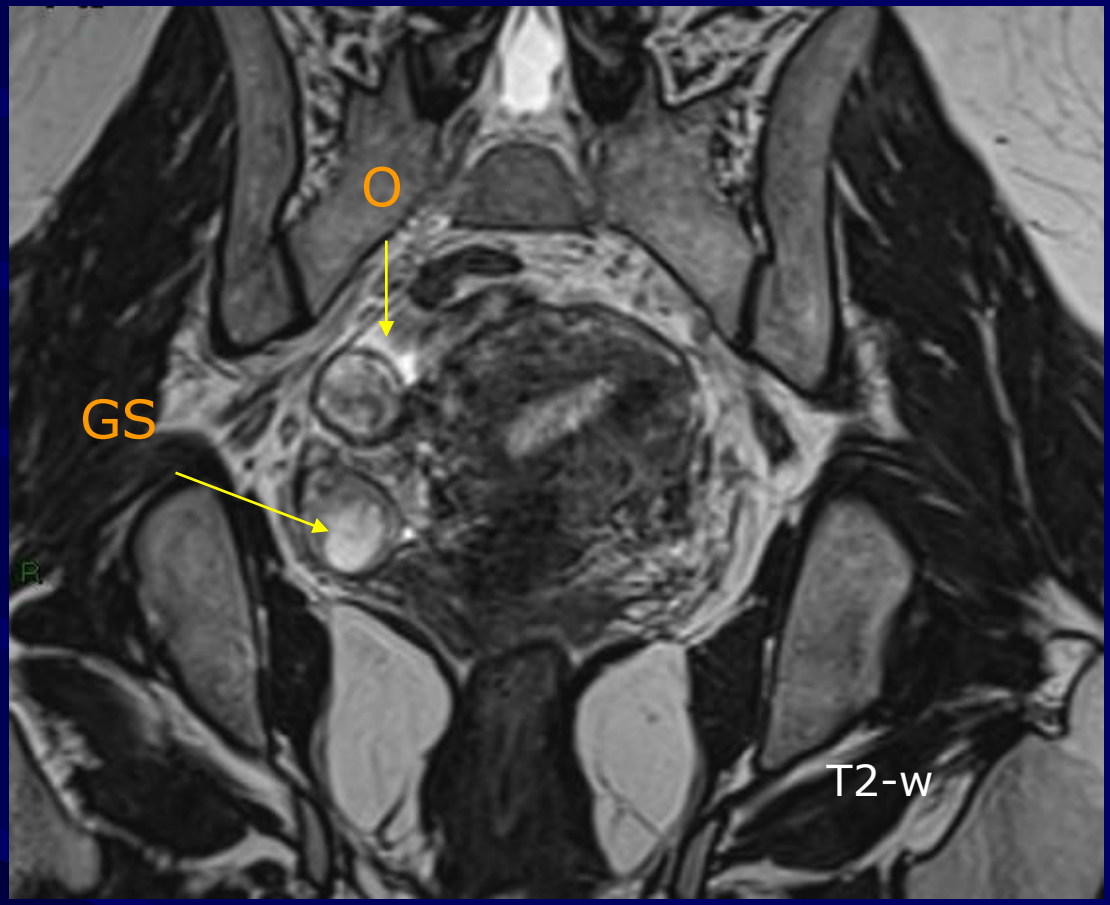

- Cervical: <1% Implantation of gestational sac within cervical stroma

Abdominal: <1% usually develops in the ligaments of the ovary

Gestational sac is separated from the uterus and ovaries.

Treatment is laparoscopy or laparotomy




TVS in combination with quantitative serum assays of hCG allow the diagnosis.

A negative TVS does not exclude an ectopic pregnancy.

MRI accurate for diagnosis of extratubal location

Masakazu Hirakawa et al
Am. J. Roentgenol., Jun 2009; 192: 1601 - 1607

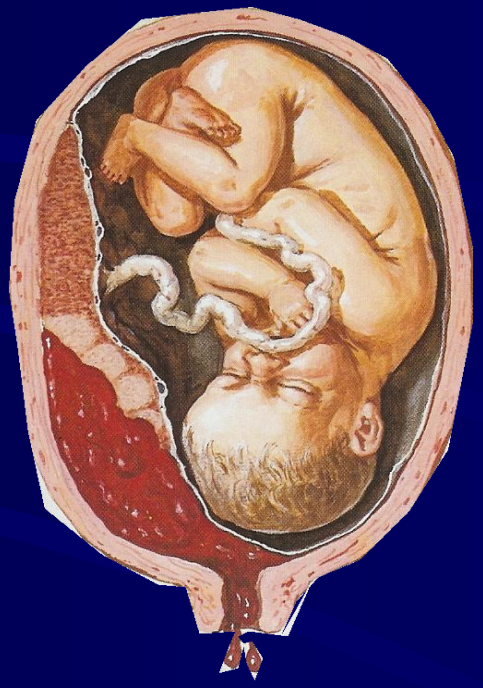
# 2) Placental Abruption

- Premature Separation of placenta from uterus
- Complicates 1-4% of births

- **Classic Symptoms**
  - Pelvic pain
  - Vaginal Bleeding
- **Diagnosis**
  - Blood Clot Marginal Retroplacental

- **Management**
- Rest and intensive feto-maternal monitoring
  - Emergency cesearean

- **Prognosis**
- **Excellent if <30% placenta detached**



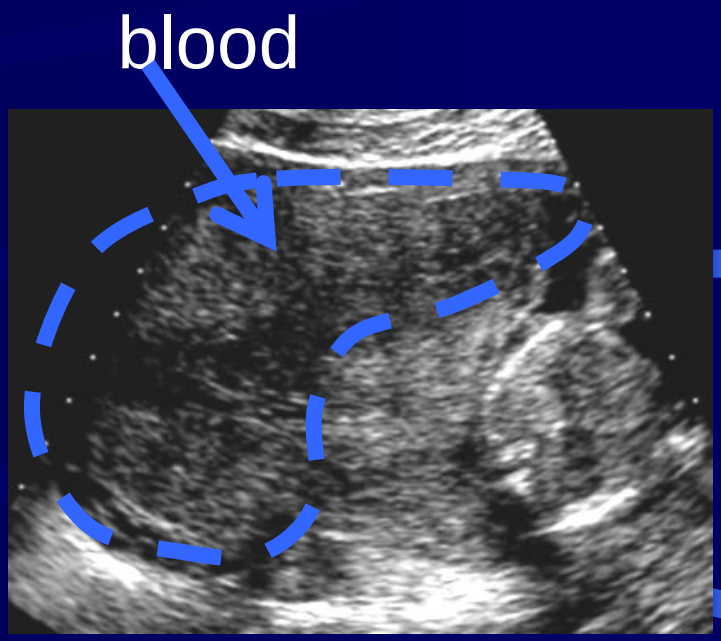
Marginal

Retroplacental

# Placental Abruption

## ULTRASOUND

- ✓ US appearance varies with age and size of hematoma
- ✓ US is not sensitive in detecting placental abruptions (50%)
- ✓ - acute hemorrhage echo texture is very similar to that of the adjacent placenta
- ✓ - many subacute clots may not be visualized since blood dissects out from beneath the placenta and drains through the cervix



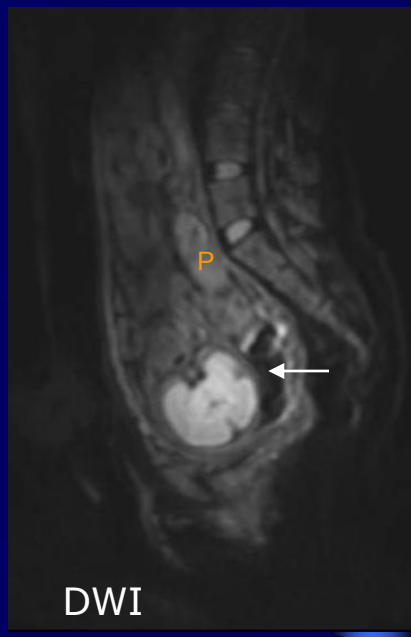

# Placental Abruption

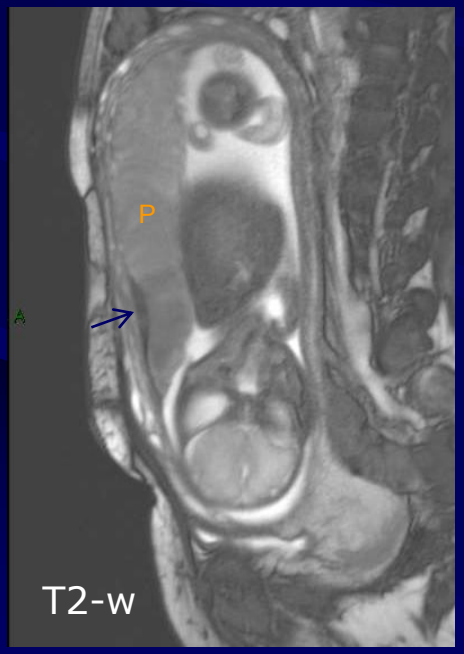
## MRI

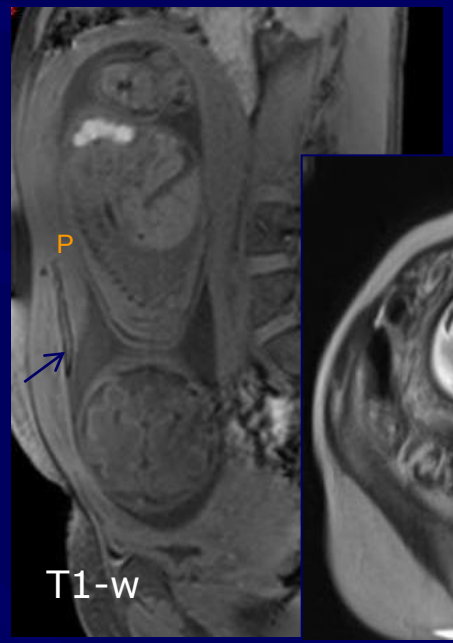
MR is an extremely accurate modality to identify placental abruptions

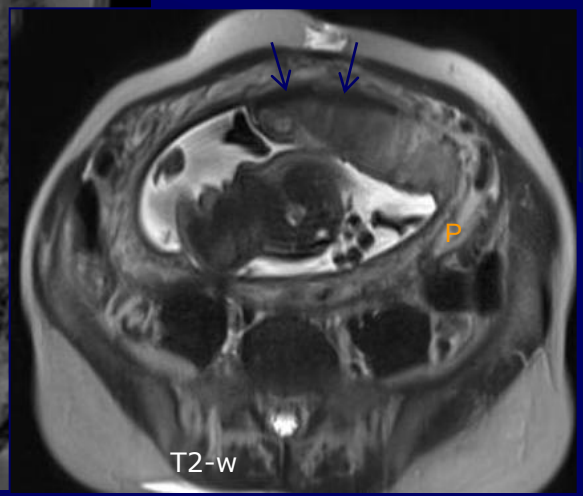
T1- and T2-weighted sequences are complementary and both are required for complete tissue characterization; by considering the signal changes on T1- and T2-weighted and DWI images it is possible to estimate when the bleeding occurred



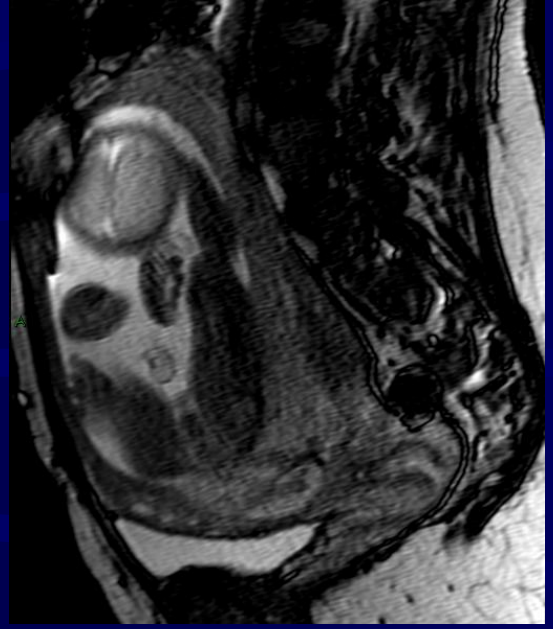


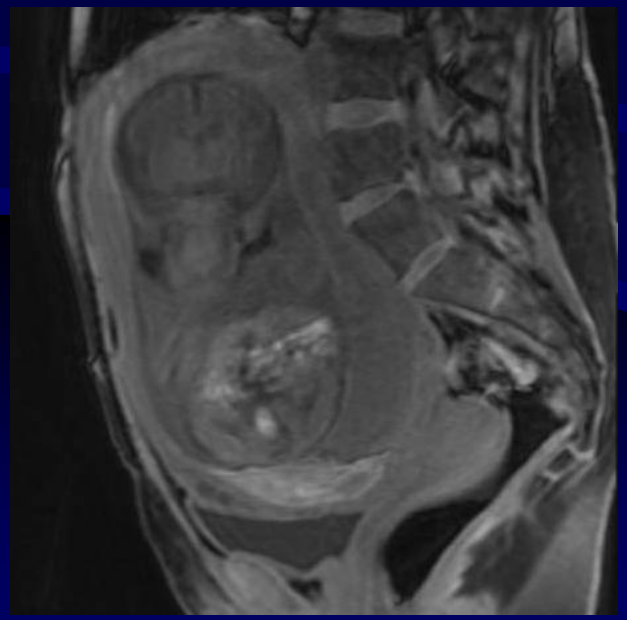




Masselli G et al. Radiology 2011

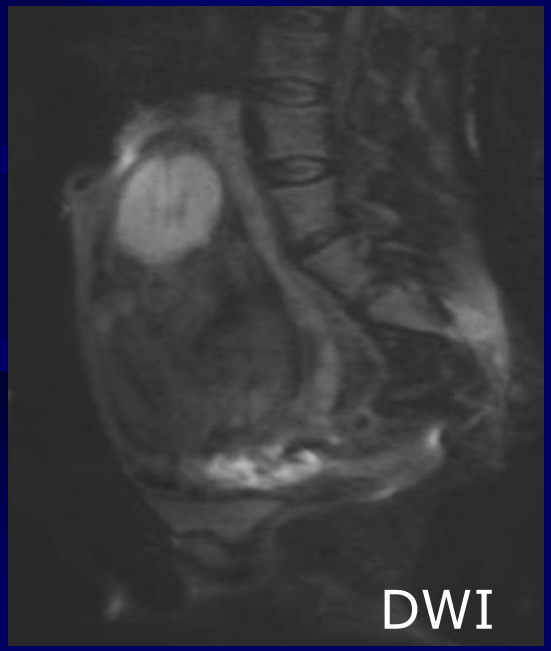



True Fisp

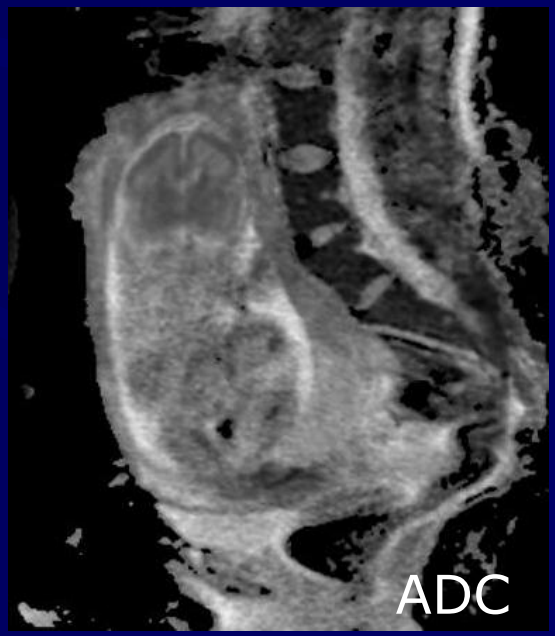
T2-w



T1 Fat Sat

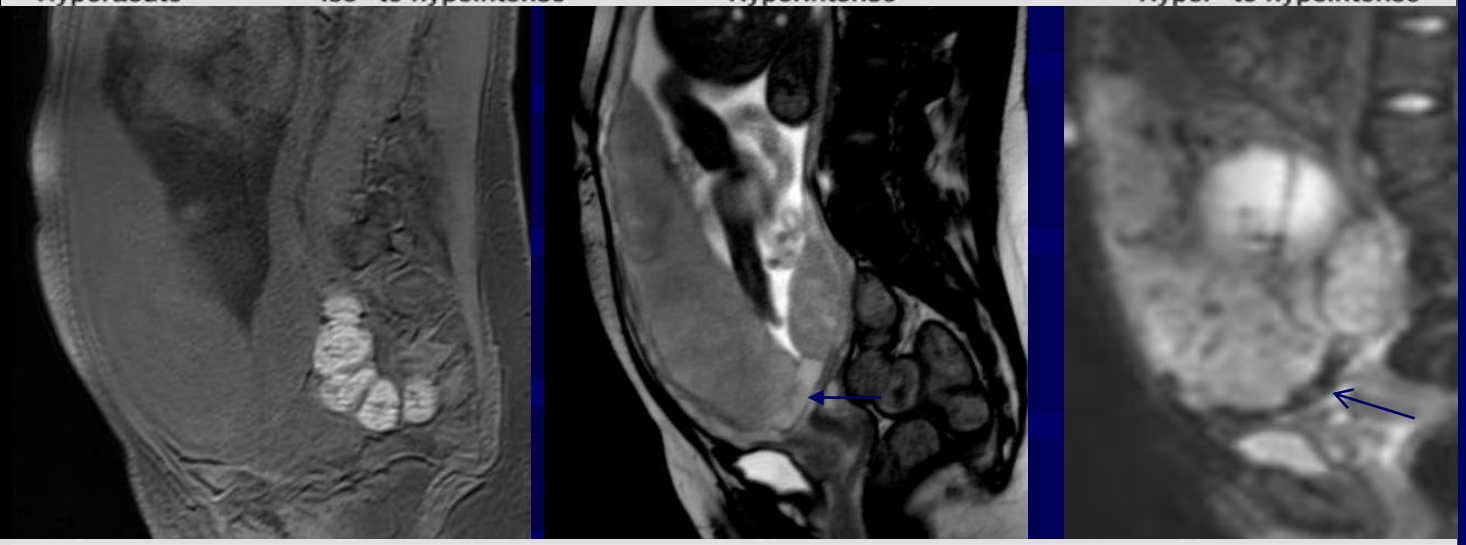


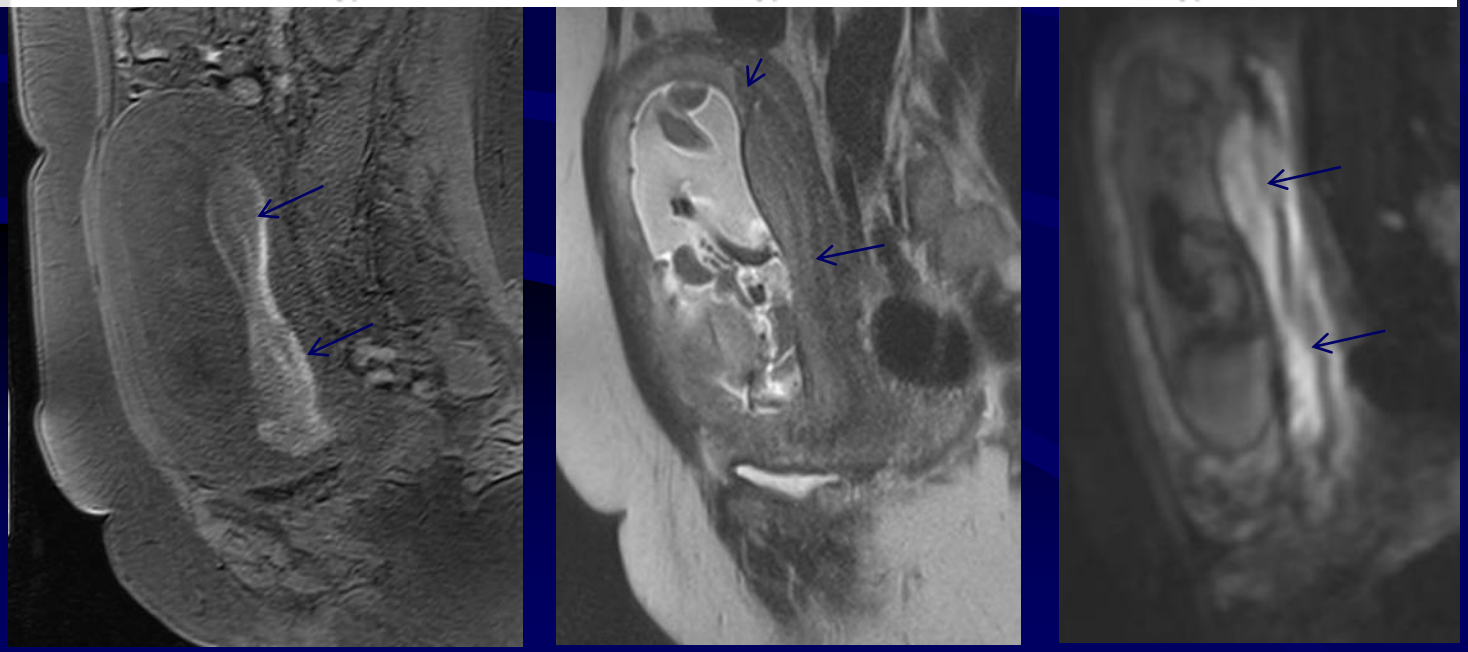
DWI



ADC

| Stages | T1-weighted MR Imaging | T2-weighted MR Imaging | Diffusion-weighted MR Imaging |
|---|---|---|---|
| Hyperacute | Iso- to hypointense | Hyperintense | Hyper- to hypointense |
| Late subacute | Hyperintense | Hyperintense | Hyperintense |

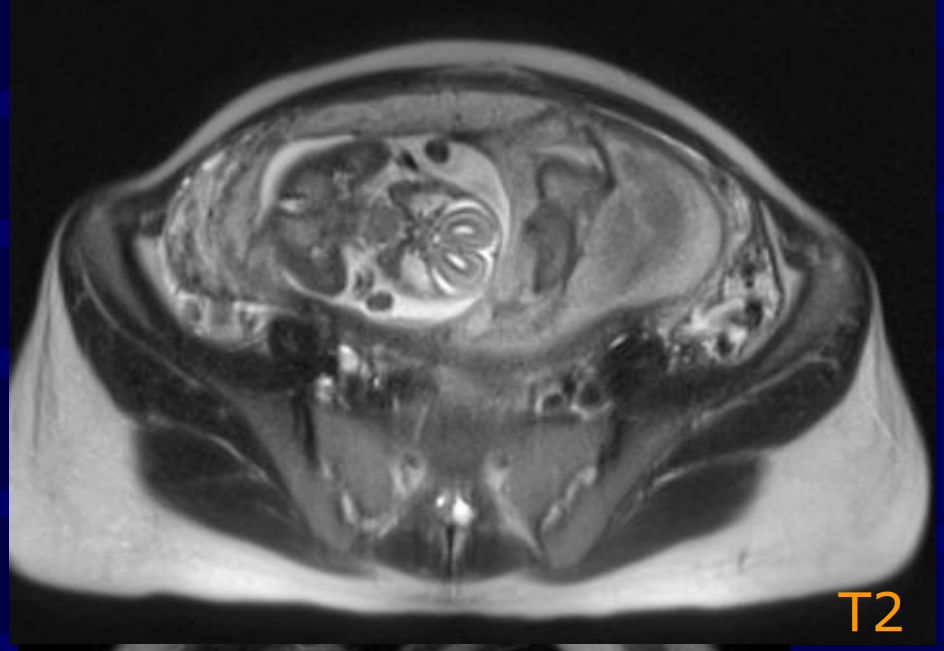


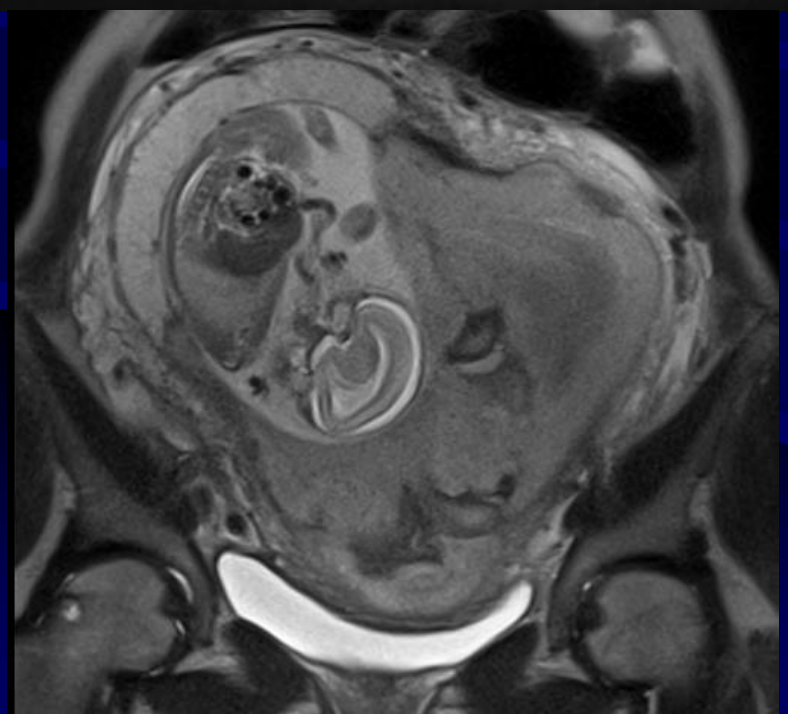


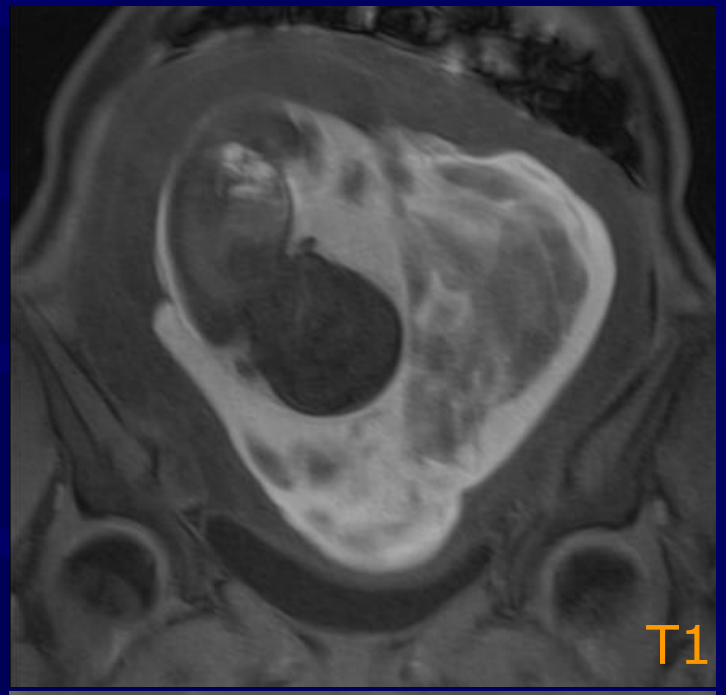
MR signs of acute or recent bleeding within a hematoma indicate a potentially unstable abruption
while hematomas with late subacute bleeding are stable.

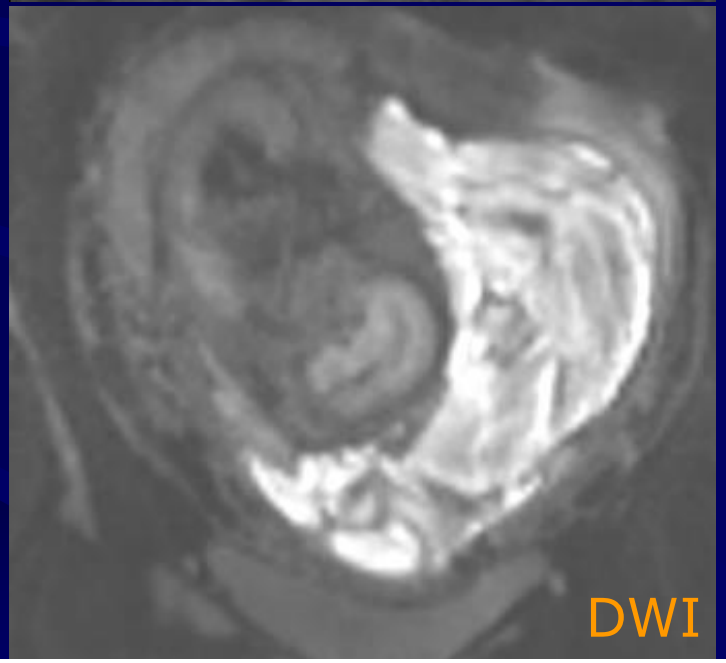
Delivery one day after MR

Delivery 28 days after MR

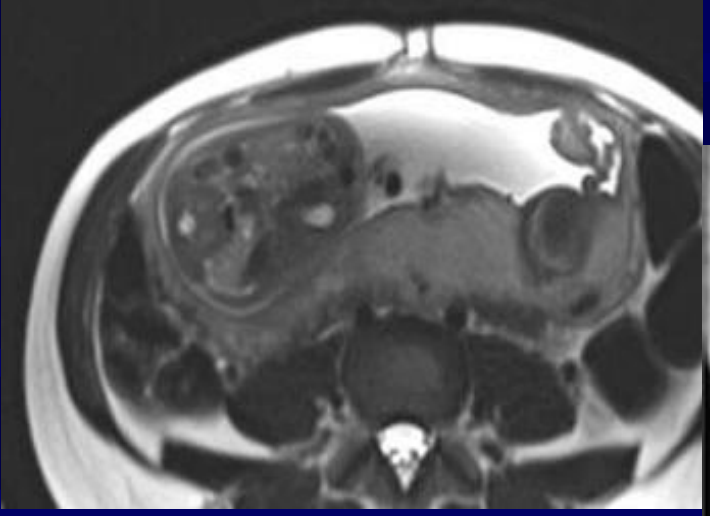


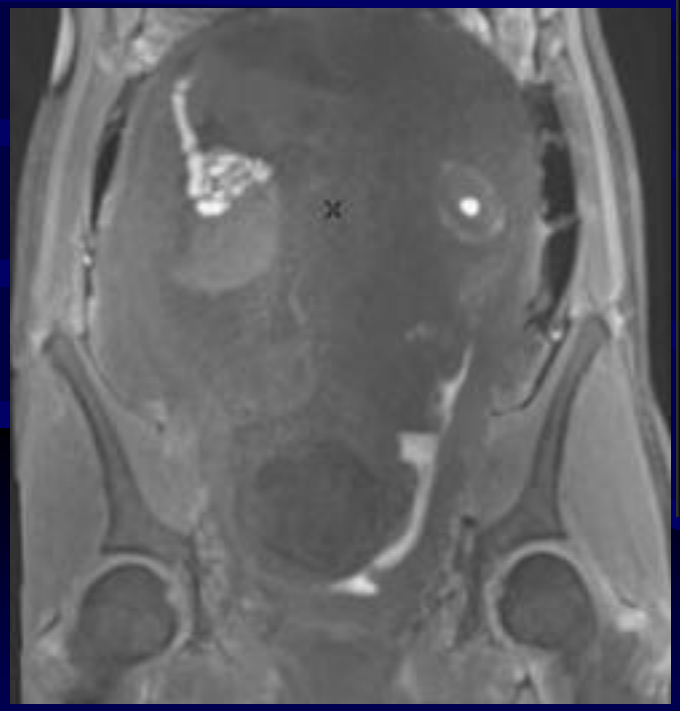



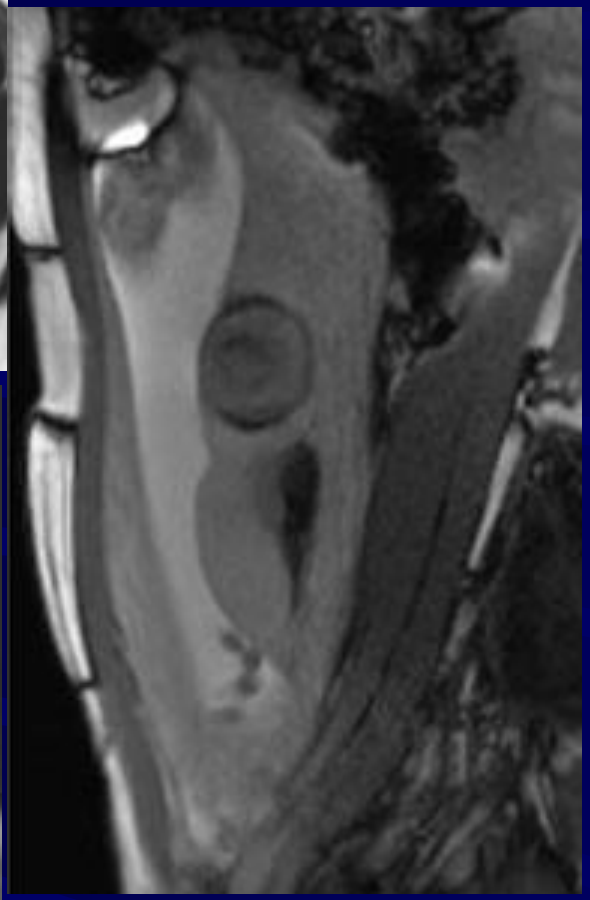



MR is accurate modality and can aid in clinical management of patients with abruption.





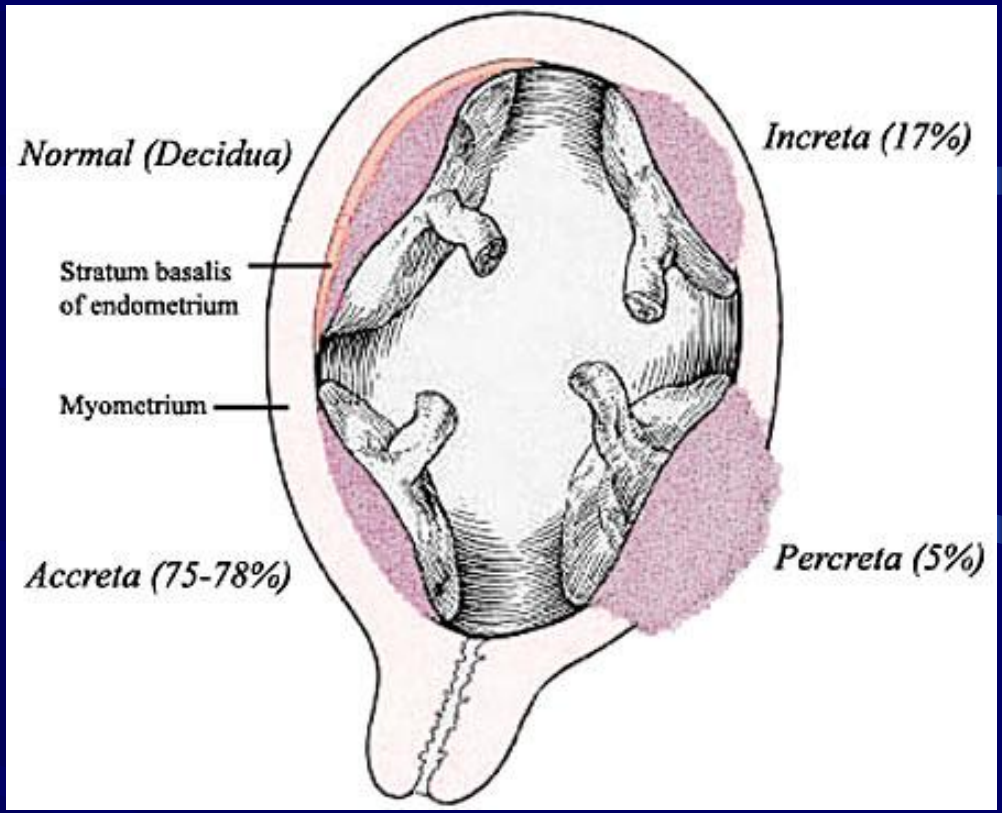


MRI is an extremely accurate investigation that identifies, with an excellent inter-observer agreement, the origin of second and third trimester uterine bleeding.

Masselli G Eur Radiol. 2011 Sep;21(9):1841-9.

# 3) Placenta Percreta

➢ Placenta accreta, placenta increta and placenta percreta represent a spectrum of placental adhesive disorders ( PAD)




**Diagnosis**

Chorionic villi invade both the myometrium and uterine serosa and extend into neighbouring organs (bladder and rectum).

- **Classic Symptoms**
  - pelvic pain

**Prognosis:**

Placenta fails to separate after fetus at delivery-Uncontrollable Hemorrhage-Maternal mortality risk 7%

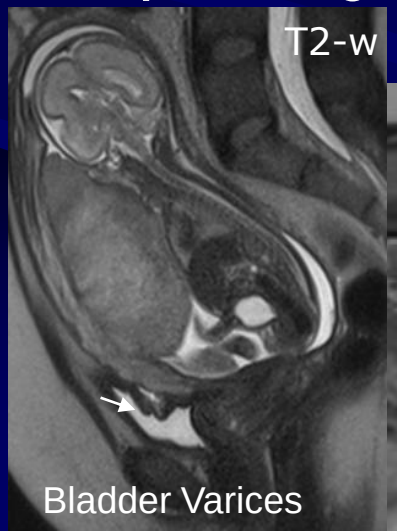
- **Management**
  - Consider pre-operative placement of arterial occlusion catheters.

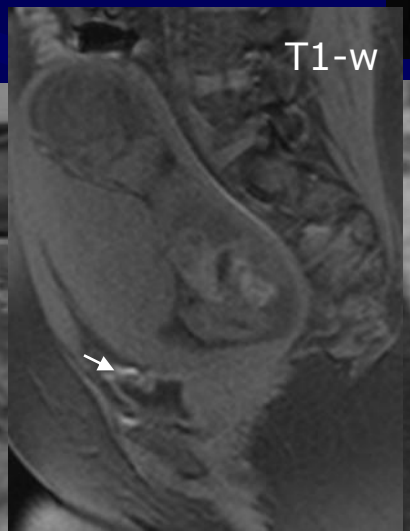
## US:

Loss of subplacental hypoechogenic zone
Irregular placental vascular lacunae


## MR:

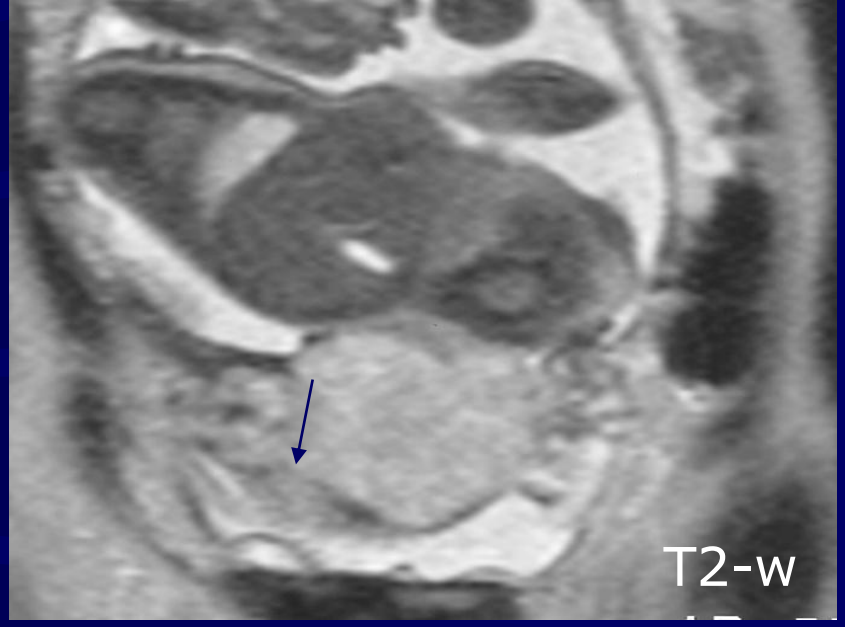
Loss of normal low signal myometrium.
Extension of intermediate signal placental tissue beyond uterine margins.
Loss of fat planes between uterus/pelvic organs.

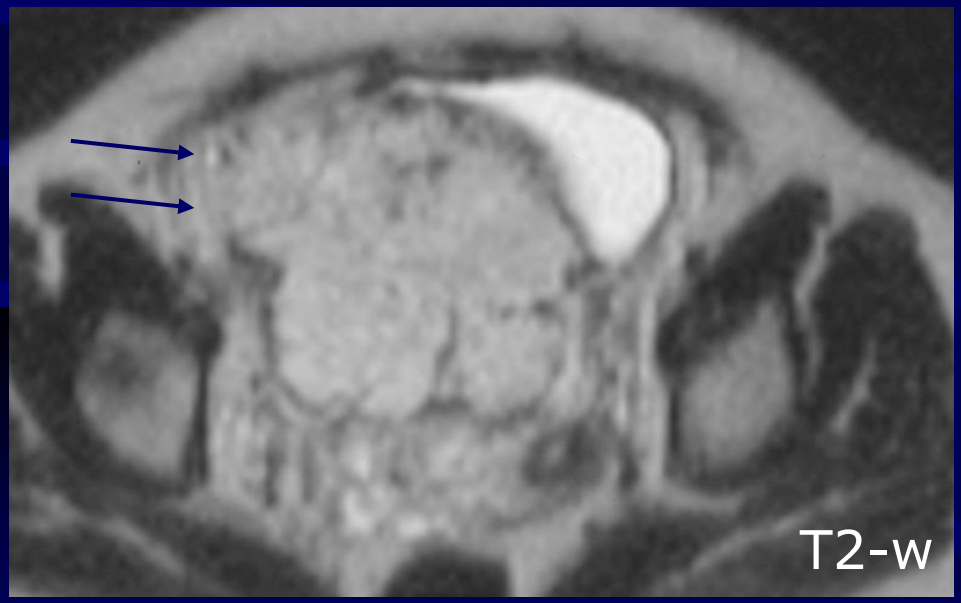





Masselli G et al. Eur Radiol 2008


Placenta percreta in bicornuate Uterus

Consider MRI where the US diagnosis is unclear, patients with history of myomectomy or posterior placenta

# 4) Uterine rupture dehiscence

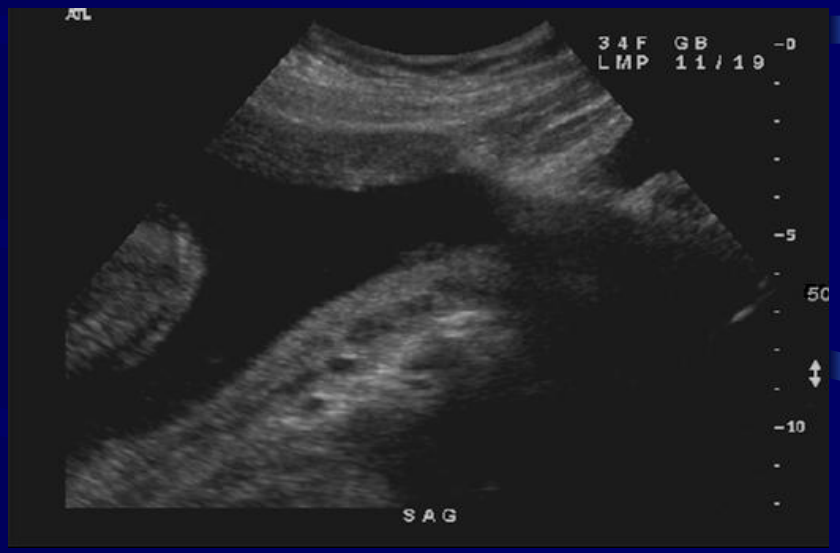
- Uterine Rupture: Full thickness tear of the uterine wall
- Uterine dehiscence: Incomplete rupture, with disrupted myometrium but intact serosa

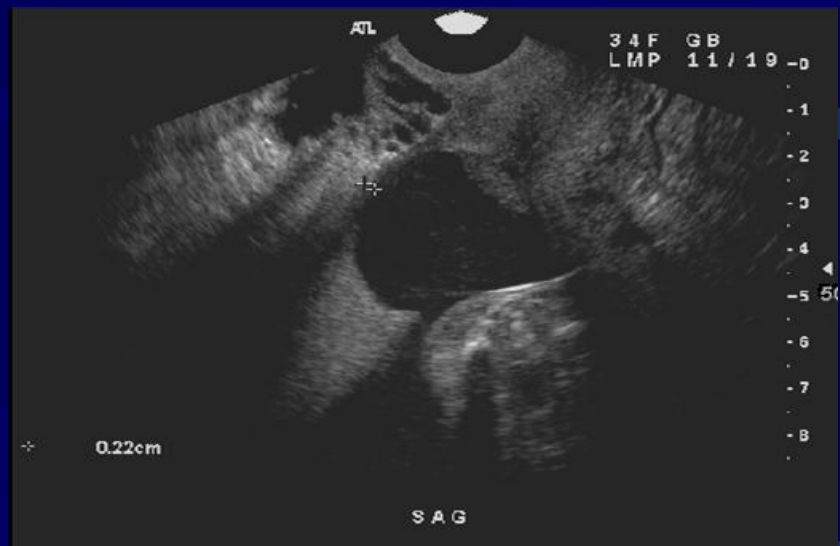
Predisposition – previous uterine surgery, previous prolonged labor

- Most commonly occurs in anterior lower segment

**Classic Symptoms**

- Pelvic pain with bleeding
  - ✓ US shows fluid defect contiguous with fluid in the endometrial cavity
  - ✓ Free pelvic fluid

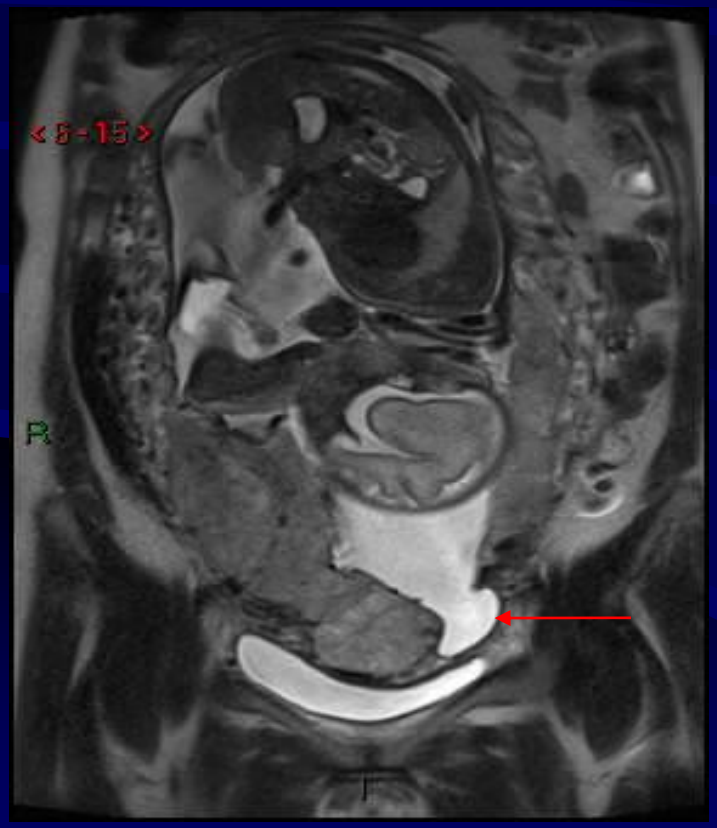


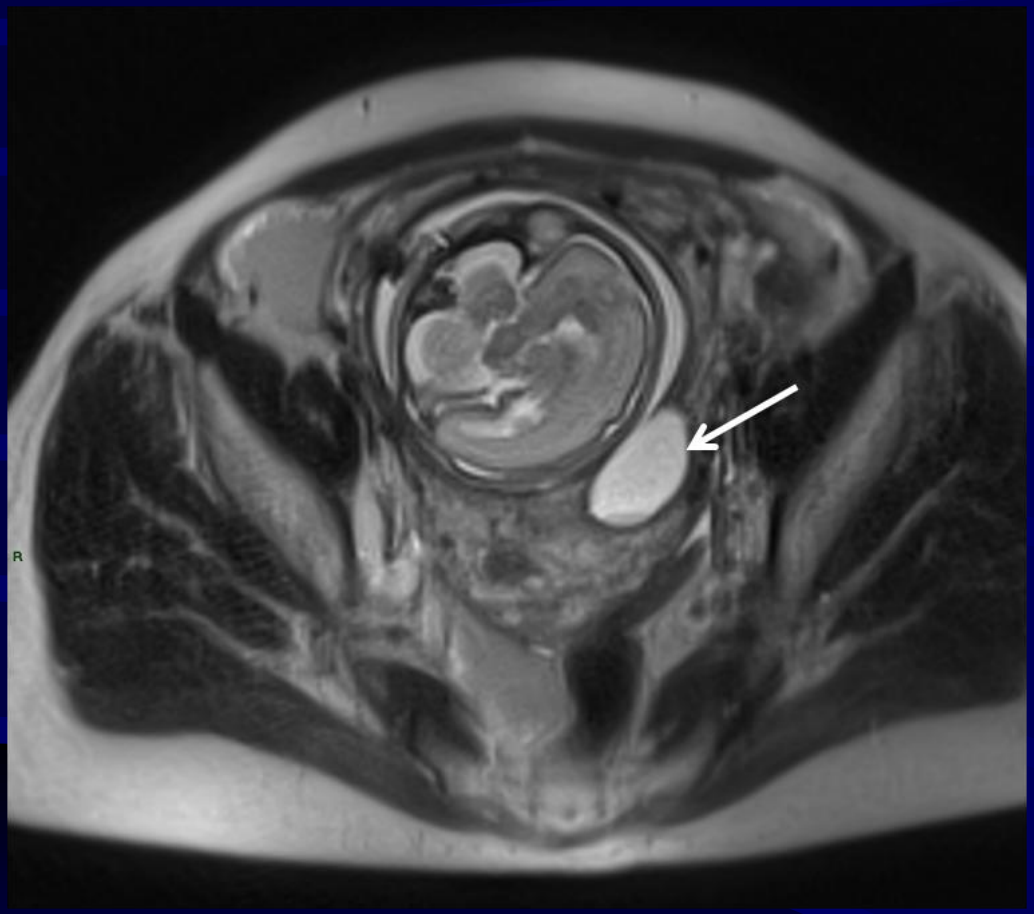
- MR is accurate in differenting

Uterine dehiscence: Incomplete rupture, with disrupted myometrium but intact serosa

continuation of pregnancy



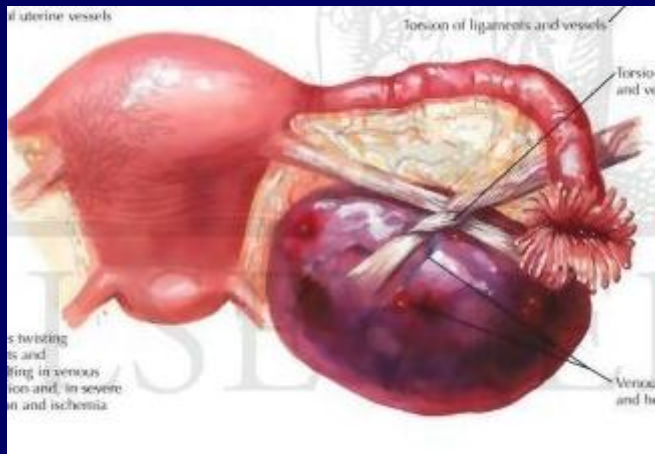

- Uterine rupture Full thickness tear of the uterine wall:
- Emergency laparotomy and delivery



US for evaluation of anterior myometrium; accurate in early gestation, but in II-III trimesters, fetus often obscures complete US evaluation.
Perform MRI if patients clinically stable to differentiate tear from dehiscence.

# 5) Ovarian torsion

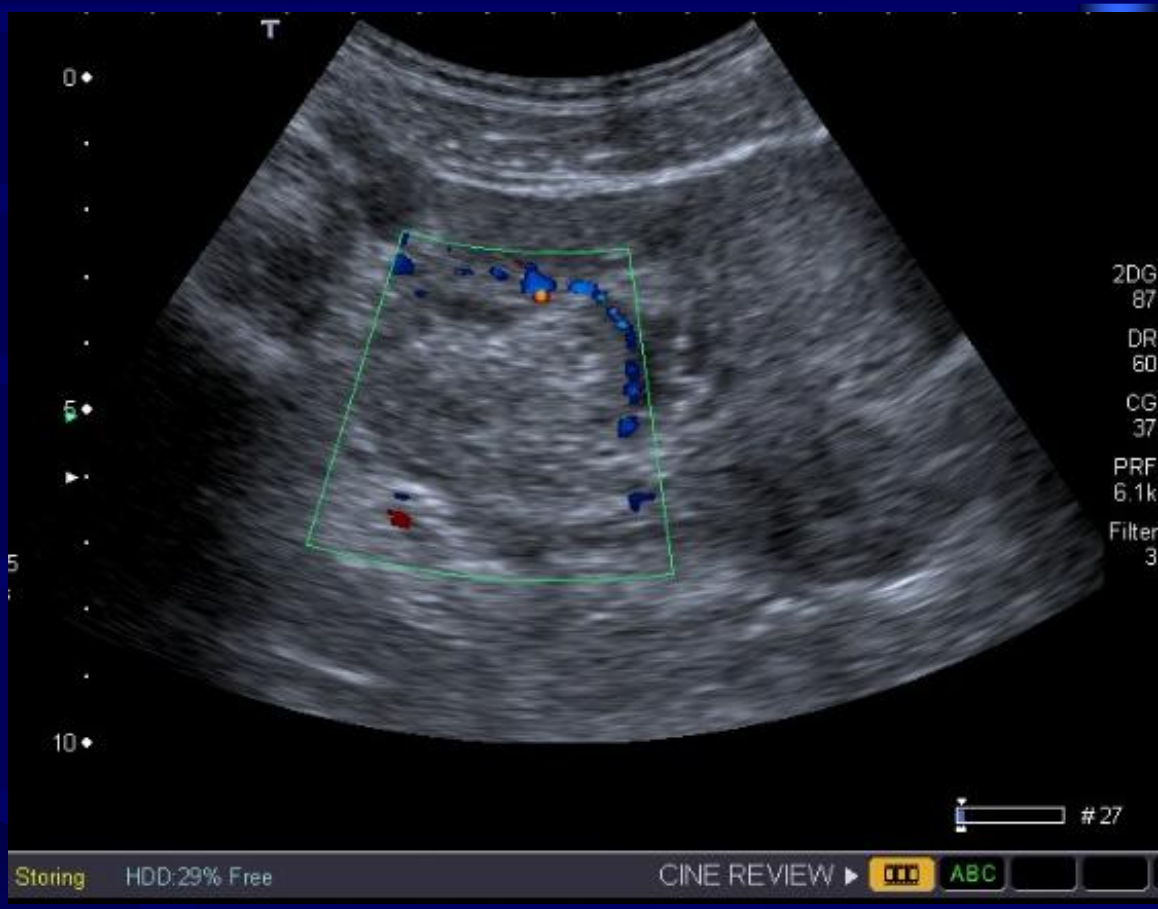
- ✓ Partial or complete rotation of vascular pedicle, compromising lymphatic and venous drainage and ultimately arterial inflow.
- ✓ 20% are found in pregnancy.
- ✓ Acute pelvic pain, nausea, vomiting.
- ✓ Typically occurs during periods of rapid uterine expansion (8-16 gw) or involution (puerperium)
- ✓ Early diagnosis before tissue necrosis may allow ovary-sparing laparoscopic detorsion



# Ovarian torsion:

## ULTRASOUND

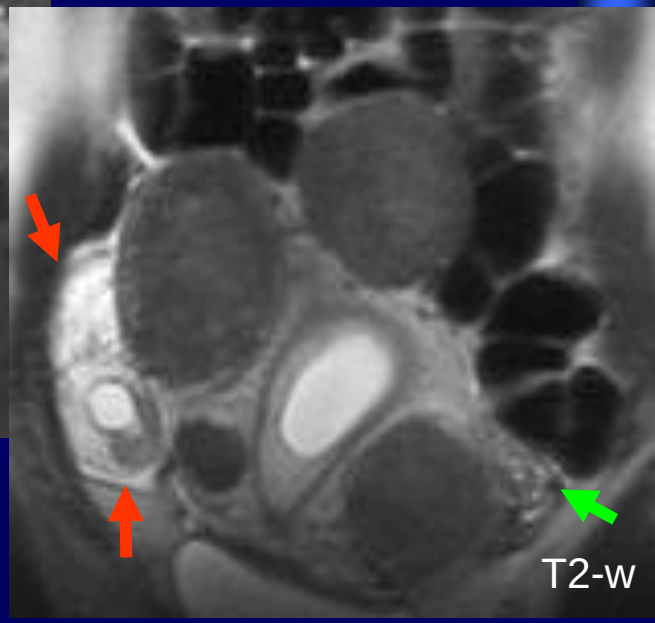
- ✓ Large ovary with small peripheral cyst
- ✓ Central stroma is heterogeneous: hyperechoic hemorrhage and hypoechoic edema
- ✓ Doppler evaluation: Presence of blood flow does NOT exclude torsion



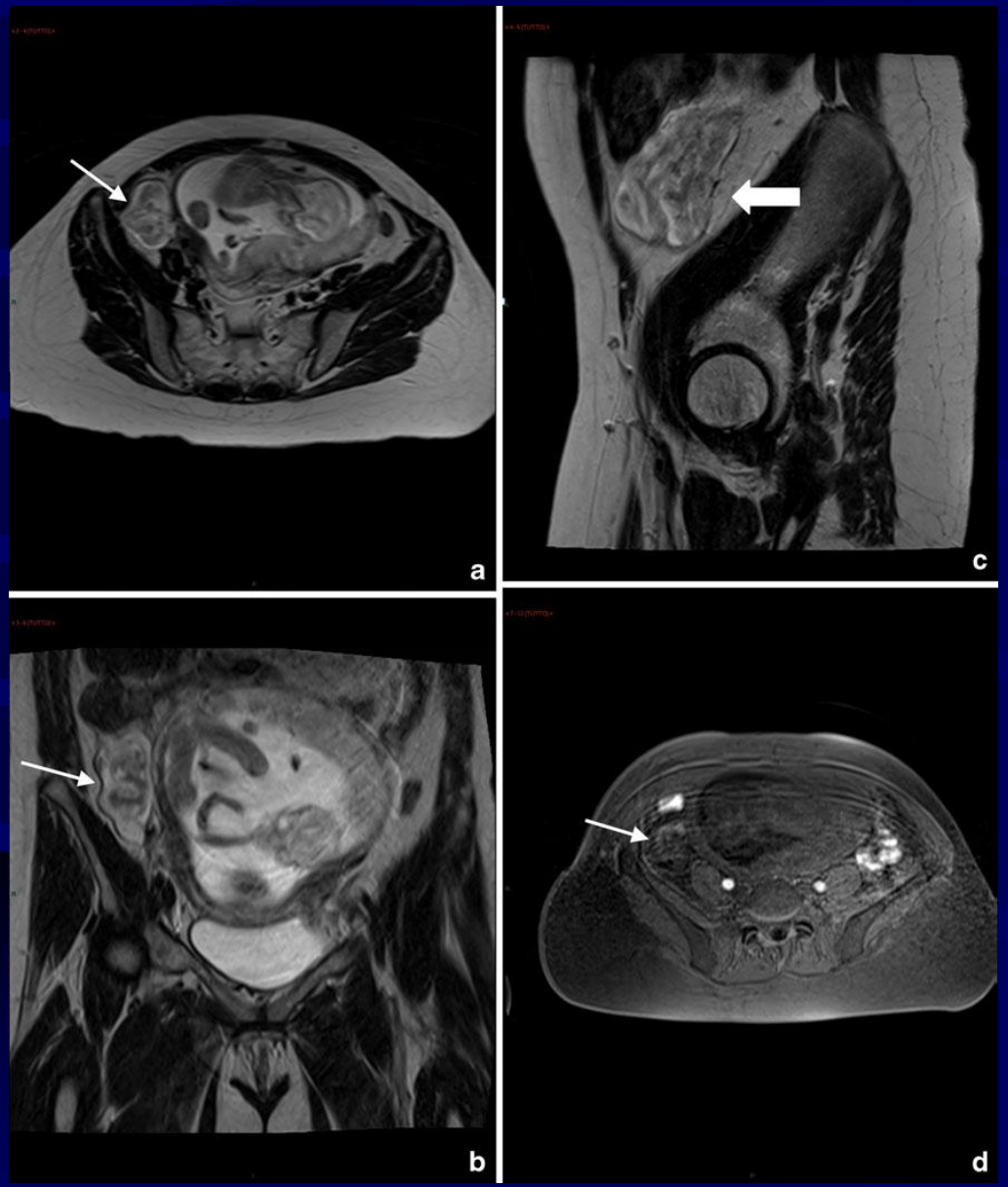
# Ovarian torsion:

## MRI

- ✓ MR imaging findings in ovarian torsion vary depending on the stage of the disease.
- ✓ Initially, there is ovarian enlargement caused by stromal edema, which appears as diffuse high signal intensity on T2-weighted image
- ✓ Distended, thickened faloppian tube
- ✓ Hemorrhagic infarction High signal T1w; Low-high signal T2w


The early diagnosis can be challenging using US.
MR can provide additional information to confirm the diagnosis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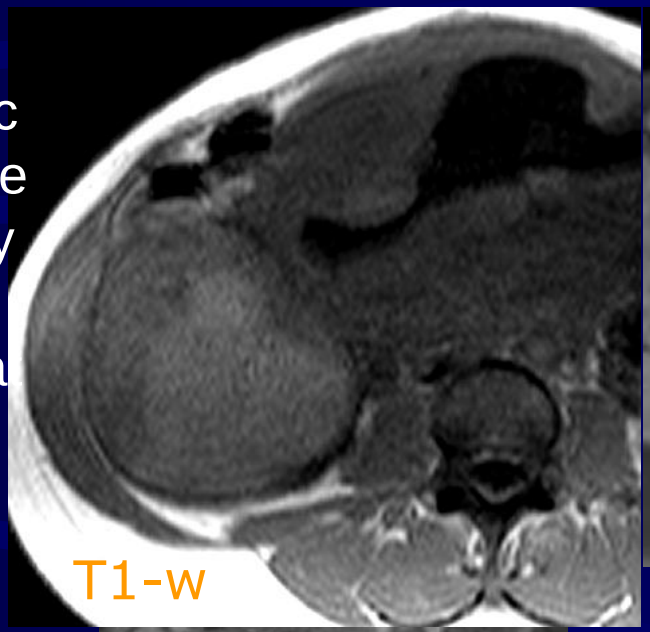
# 6) Hemorrhagic degeneration Leiomyoma

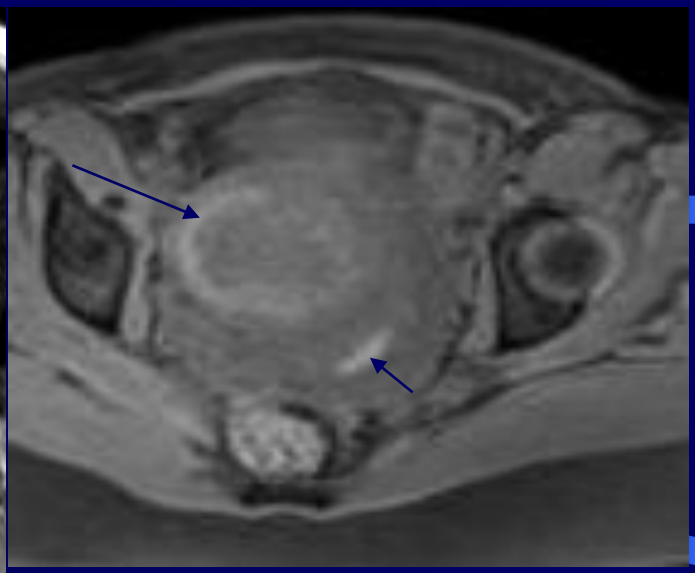
- Hemorrhagic degeneration occurs in 5-8% of fibroids during pregnancy.
- Red degeneration of uterine leiomyoma involves massive hemorrhagic infarction as a result of the obstruction of peripheral drainage veins

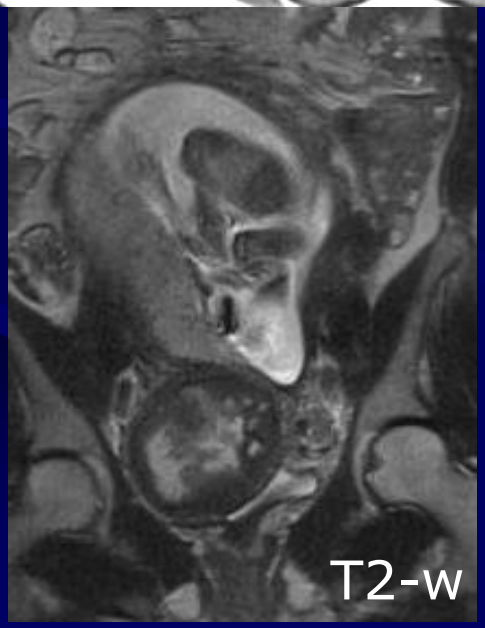
The diagnosis is made with sonography; in complicated cases MR can be helpful

# MR Findings

Fibroids undergoing hemorrhagic degeneration demonstrate diffuse or peripheral high signal intensity on T1-weighted that may correspond to obstructed veins a the periphery of the mass

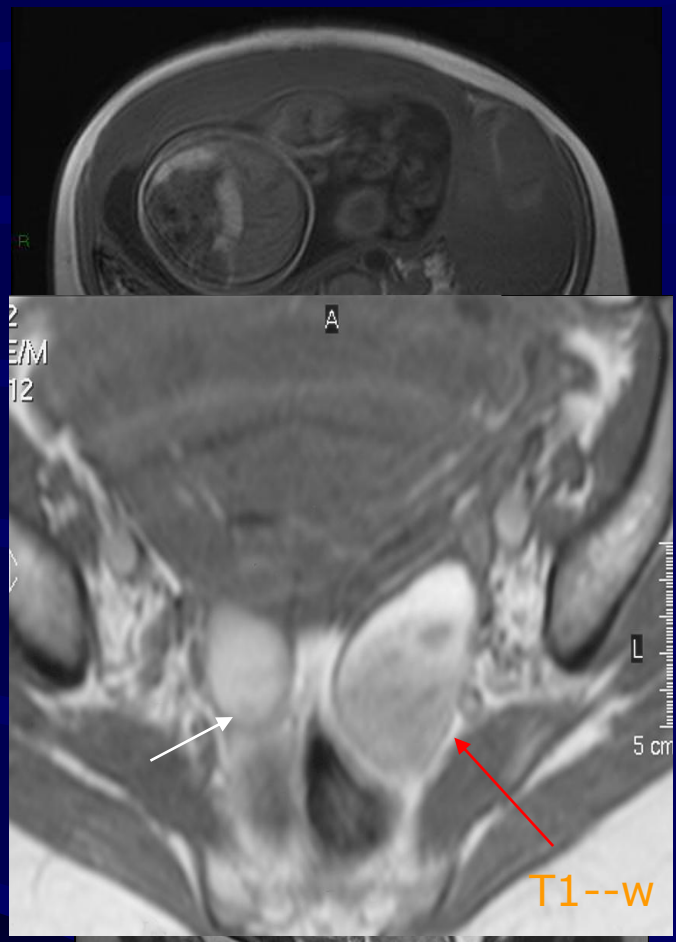


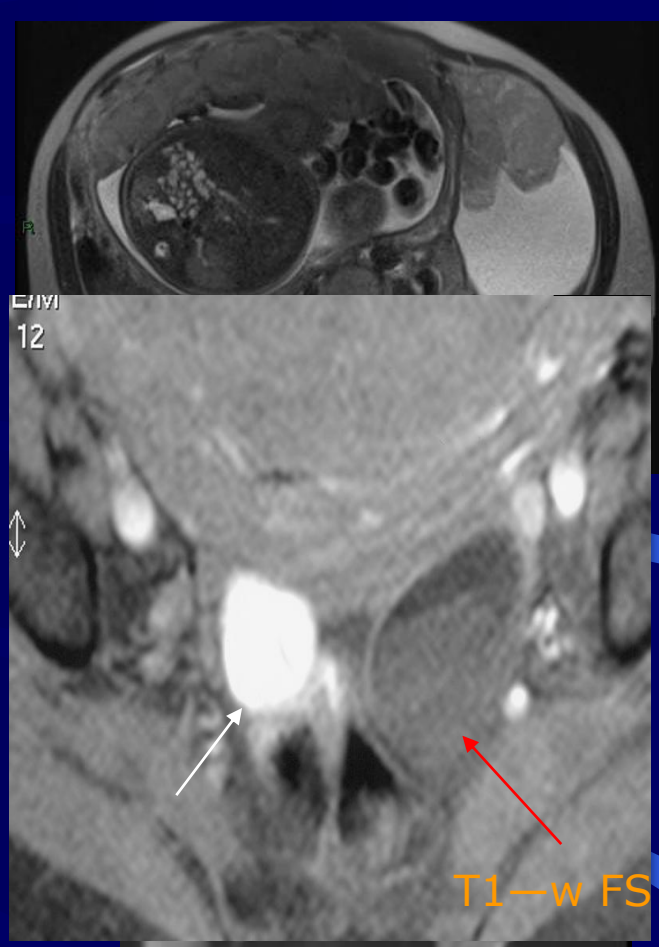



# 7) Ovarian Mass

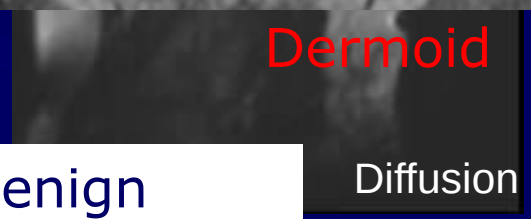
MRI used for further characterization of mass after US.



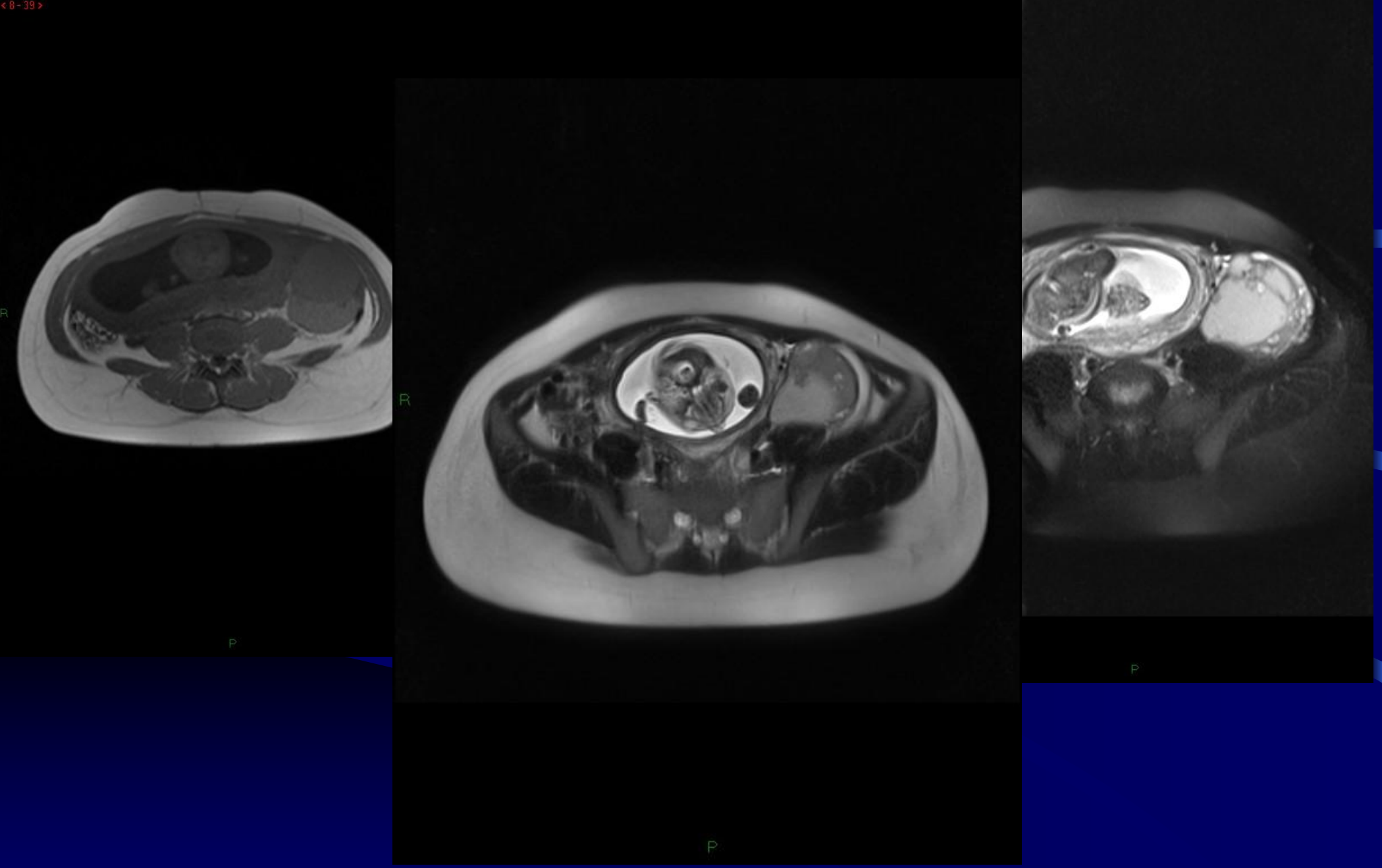

Hemorrhagic cyst




Dermoid




MRI is useful to distinguish if more likely malignant or benign
Impacts clinical management of mother and fetus.


8-39
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# Causes of non gynaecologic pain in pregnancy

1. Appendicitis
2. Bowel obstruction-Inflammation
3. Hydronephrosis
4. Pyelonephritis
5. Deep venous thrombosis

# 1) Appendicitis

- Accounts for 25% of the operative indications for non-obstetric surgery antepartum.
- Incidence is approximately equal in all three trimesters.
- Delayed diagnosis is associated with increased fetal mortality.

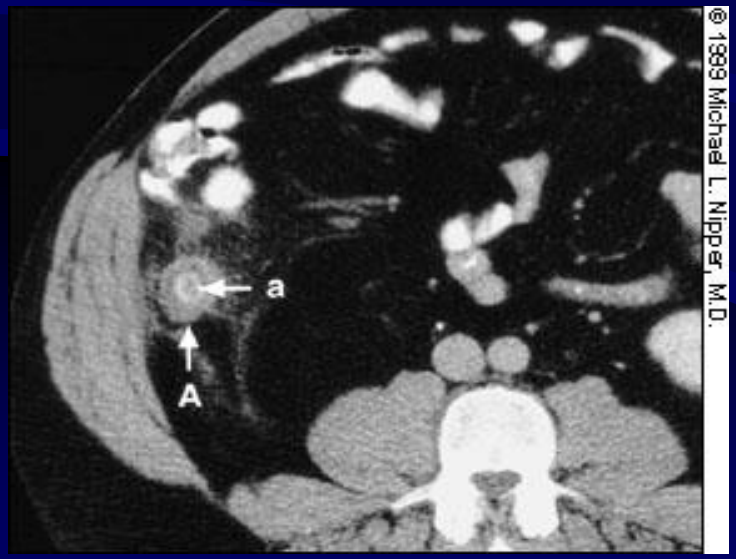
**Graded compression U/S**

80% sensitive: non-perforating appendicitis
28% sensitive: perforated appendicitis
3rd trimester accuracy is lower due to technical difficulties.

# 2nd Line Imaging for Appendicitis

CT

- 94% sensitivity
- 94% specificity



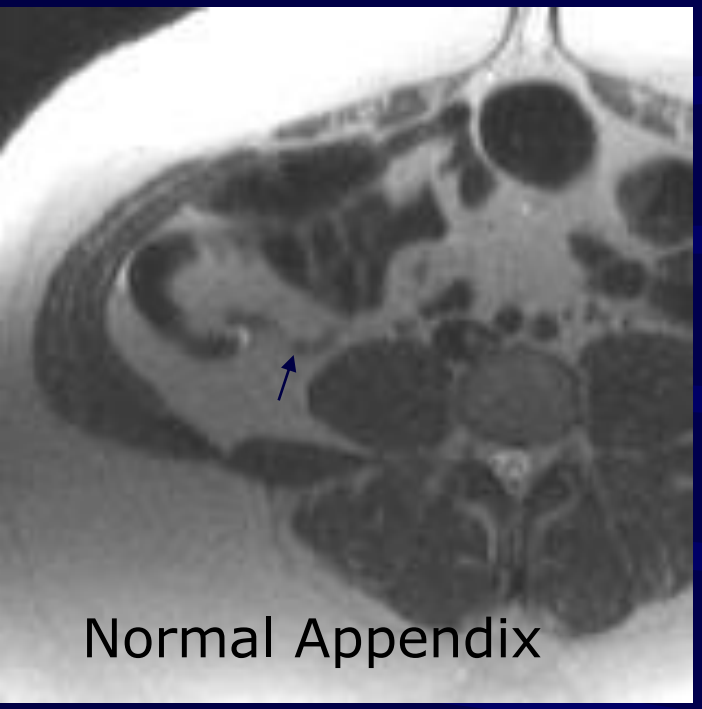

MRI

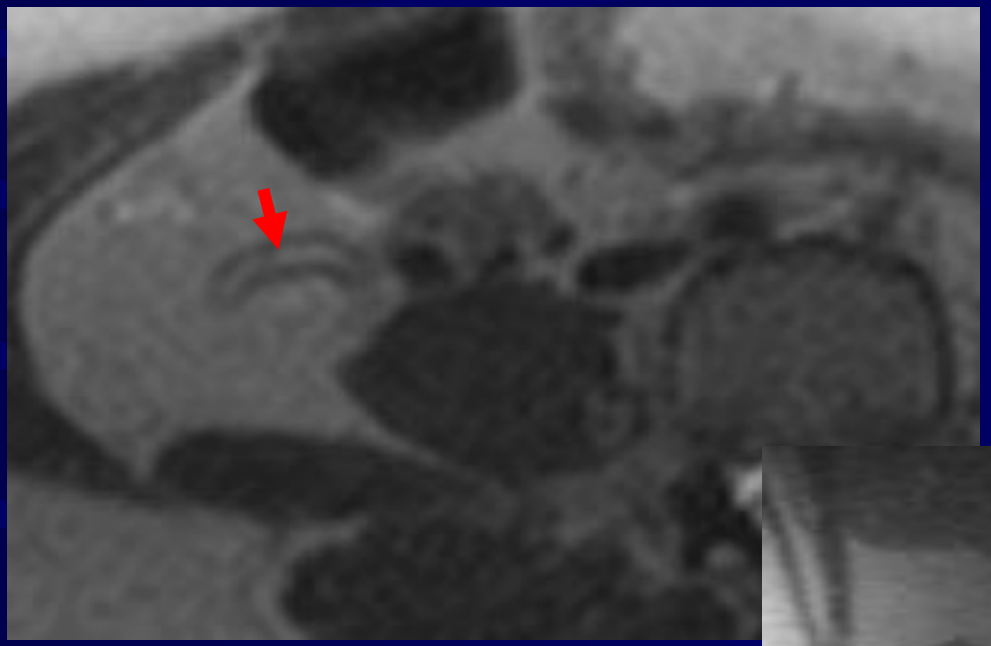
- Up to 100% sensitivity*
- 96% specificity*
- No known adverse effects on fetus, but cost and availability should be considered.

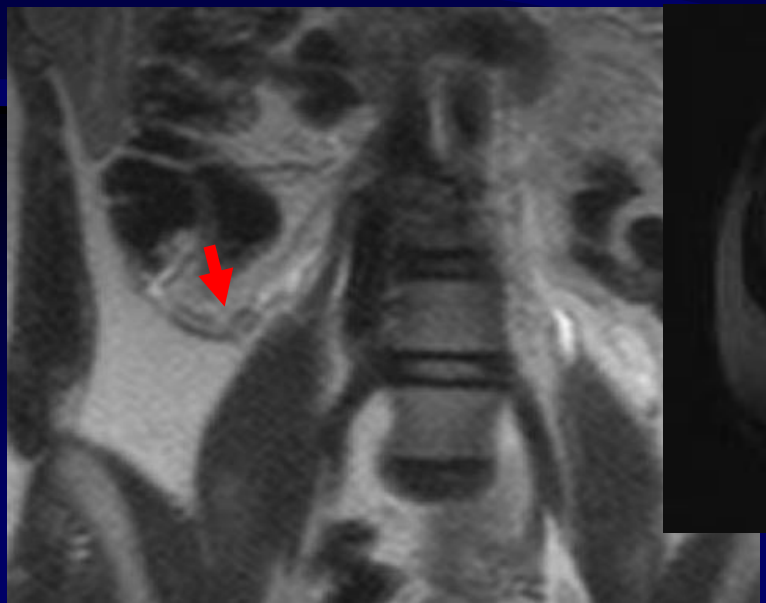
*Values are from small study of 45 pregnant pts.

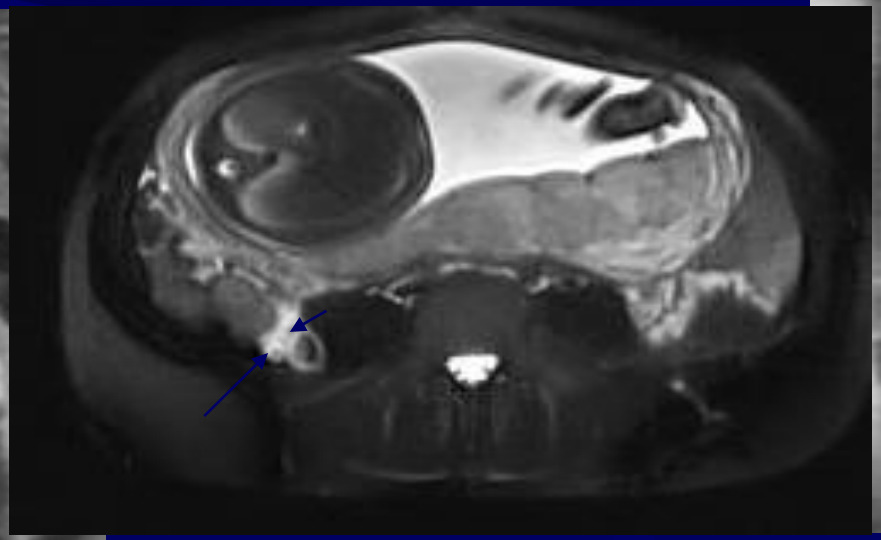
Pedrosa et al Radiology 2008

# Mild Appendicitis



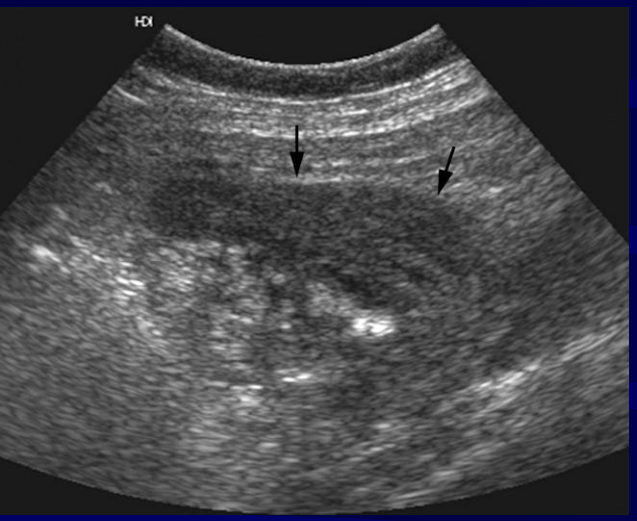







Pedrosa et al Radiology 2008

# Perforated Appendicitis



27 wks

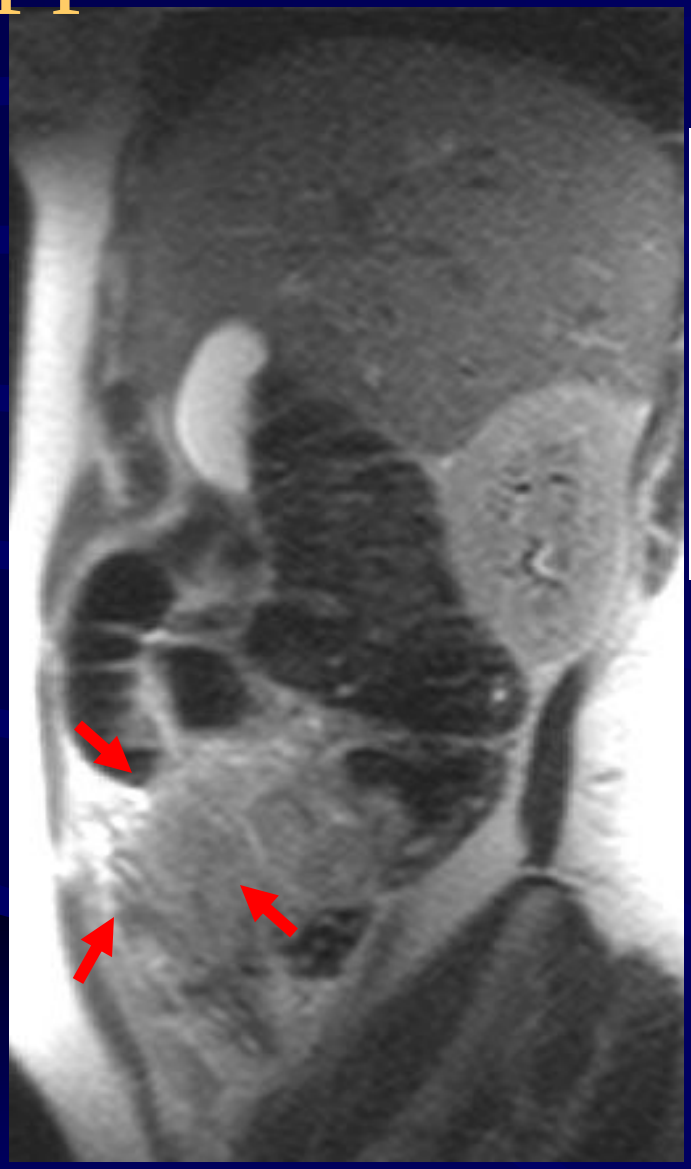


Table 1. Performance of MR in the diagnosis of acute appendicitis

| MR | Clinical outcome | |
|---|---|---|
| | Acute appy + | Acute appy – |
| Acute appendicitis + | 9 | 2 |
| Acute appendicitis – | 1 | 106 |
| Sensitivity | 0.900 | |
| Specificity | 0.981 | |
| Accuracy | 0.975 | |
| PPV | 0.818 | |
| NPV | 0.991 | |

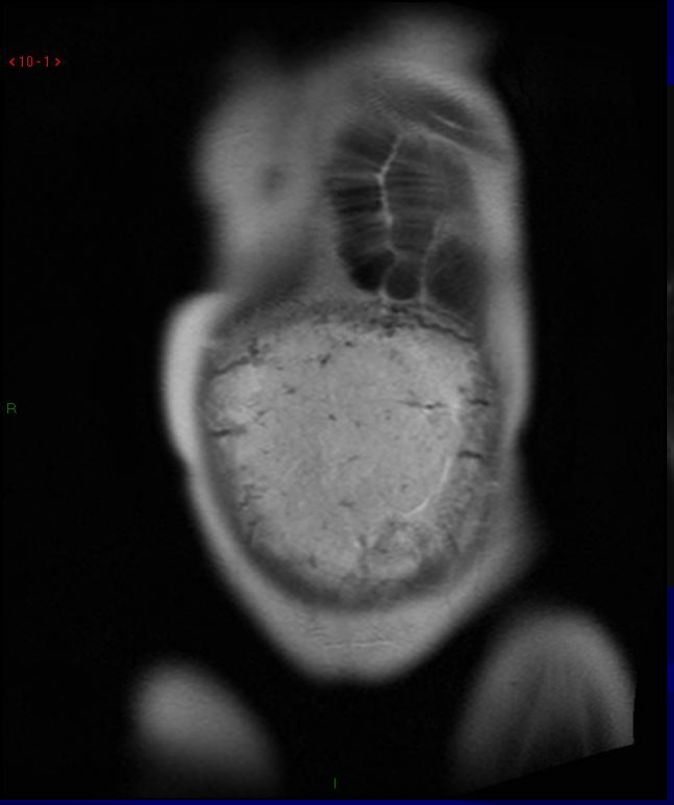
Oto et al Abd Imaging 2009

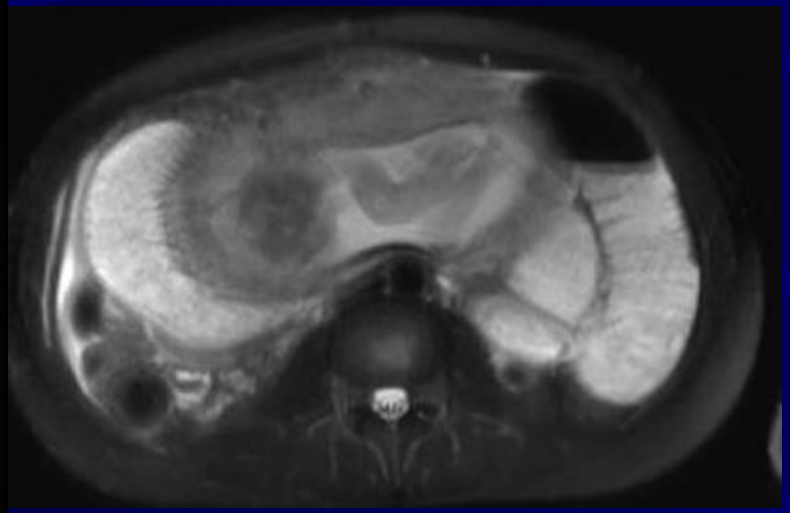
US is accurate in 1-2 trimesters.
Perform MRI in patients with inconclusive or negative US.

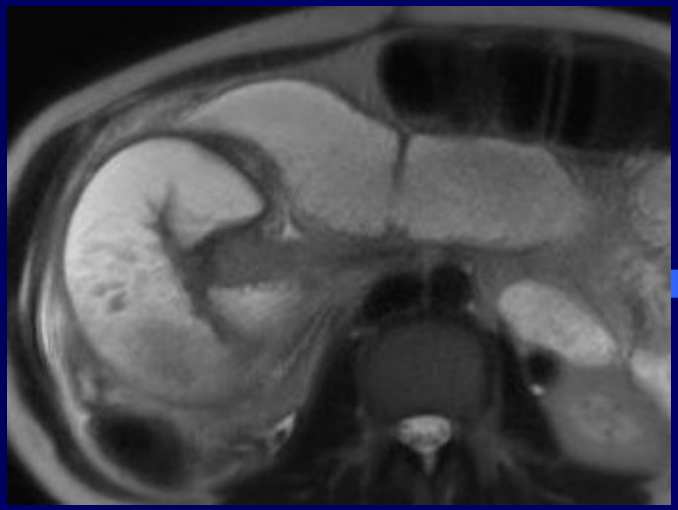
# 2)Bowel obstruction and Inflammation

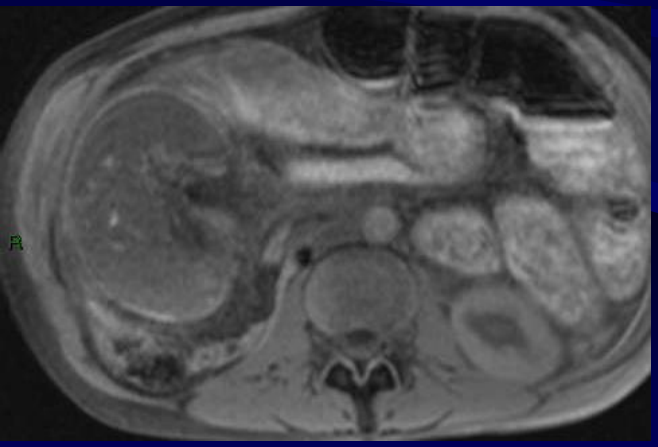
- ✓ Bowel obstruction in pregnancy is an uncommon complication occurring in 1 in 2500 deliveries.
- ✓ The most common cause is adhesions accounting for 60-70% of cases.
- ✓ Patients with Crohn's disease and abdominal pain may be particularly difficult to assess during pregnancy because ileitis may mimic appendicitis.

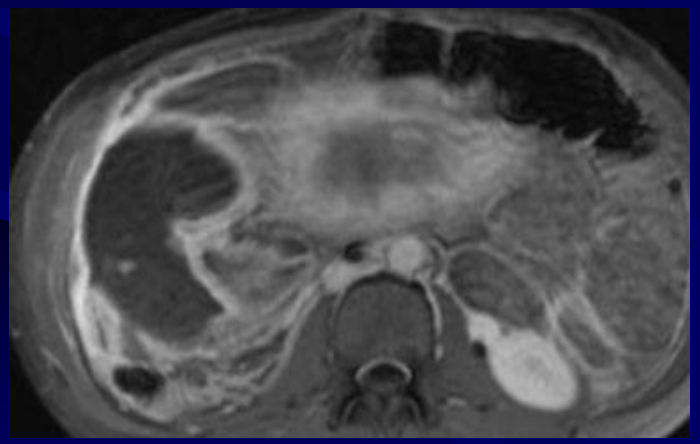
Masselli et al Abd Imaging 2011







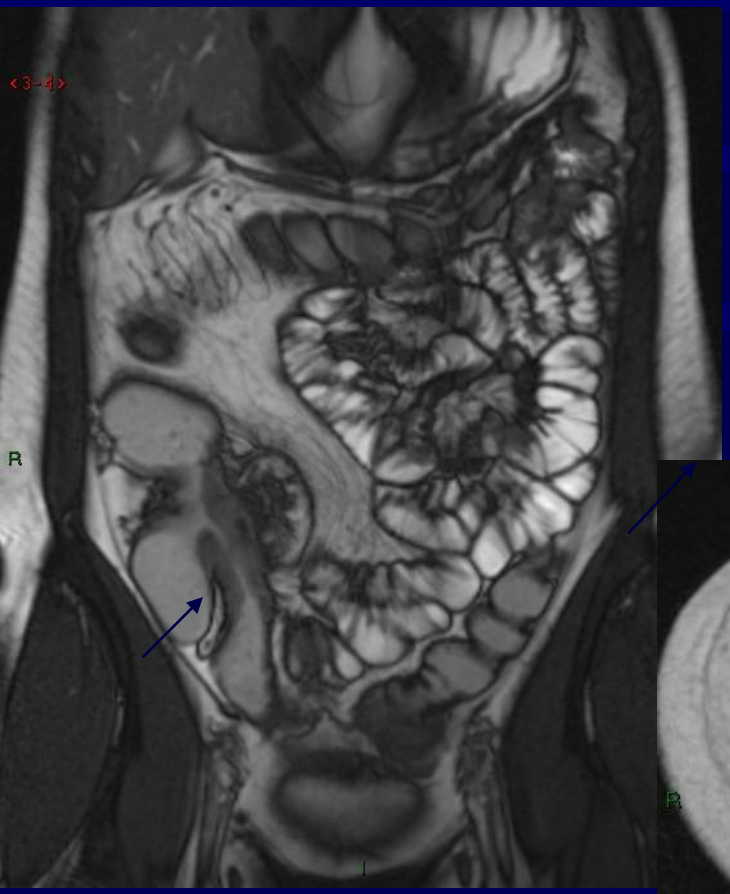


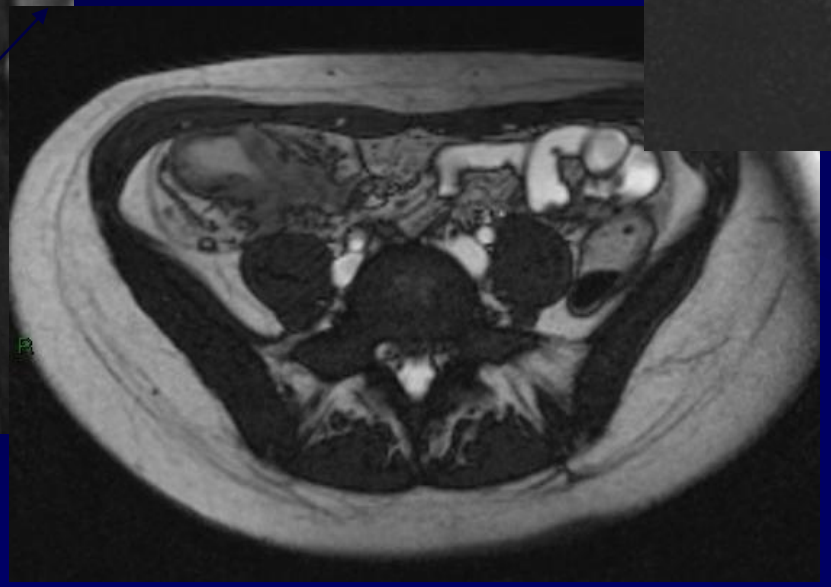


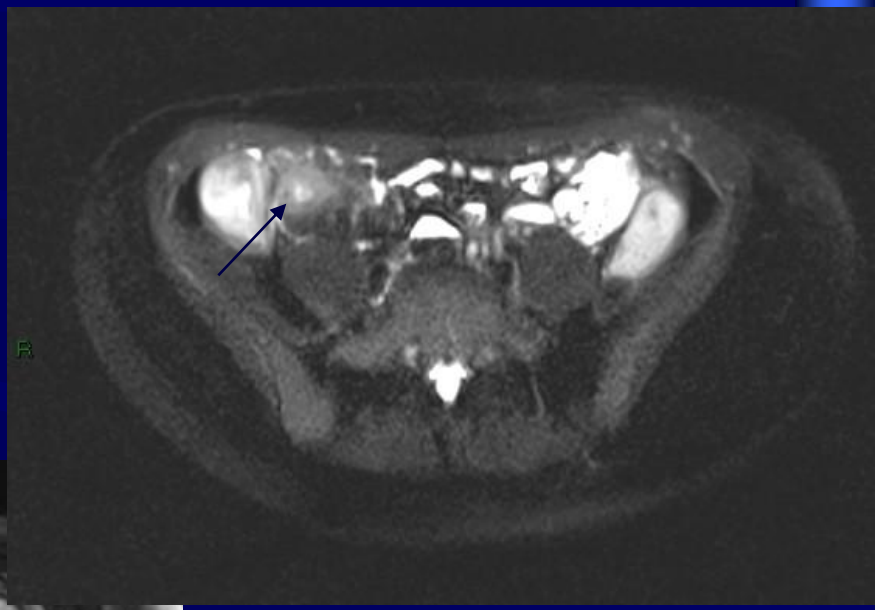
Bowel obstruction due to adhesions

Masselli et al Abd Imaging 2011

# Crohn’s disease







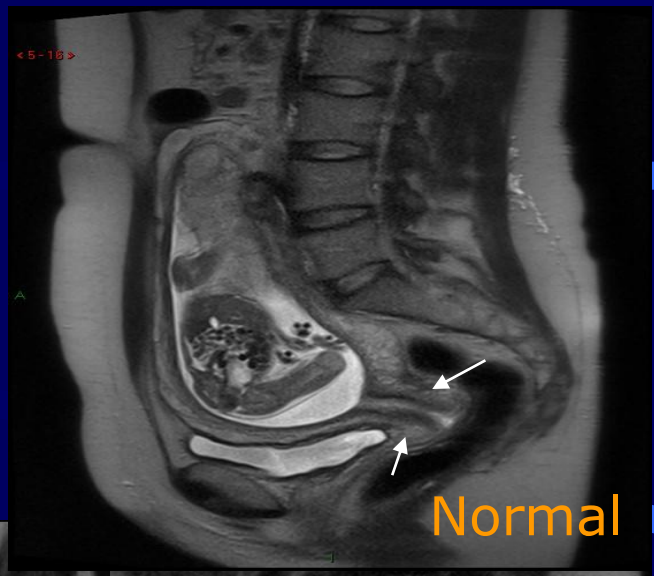
# 5) Preterm delivery

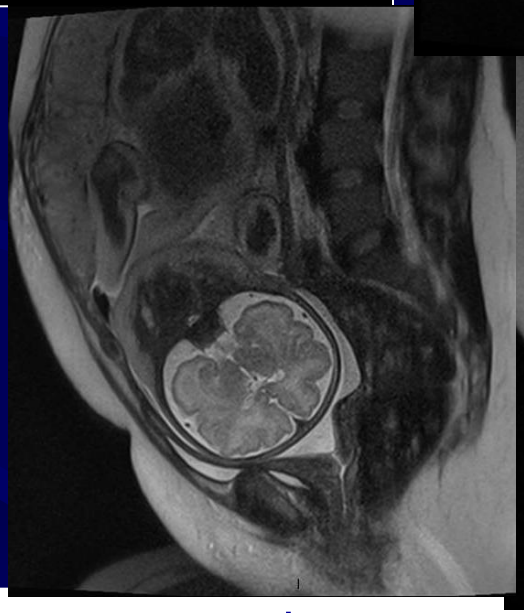
- **Uterine contractions** (4 in 20 min or 8 in 1h)

  between 22 and 37 weeks of gestation with progressive cervical changes

- **Cervical dilatation** (± 2 cm)

- **Premature Rupture of Membranes** (PROM)




MR is not indicated for patients with incompetent cervix, the analysis of cervical signal intensity could be useful

# 3) Hydronephrosis

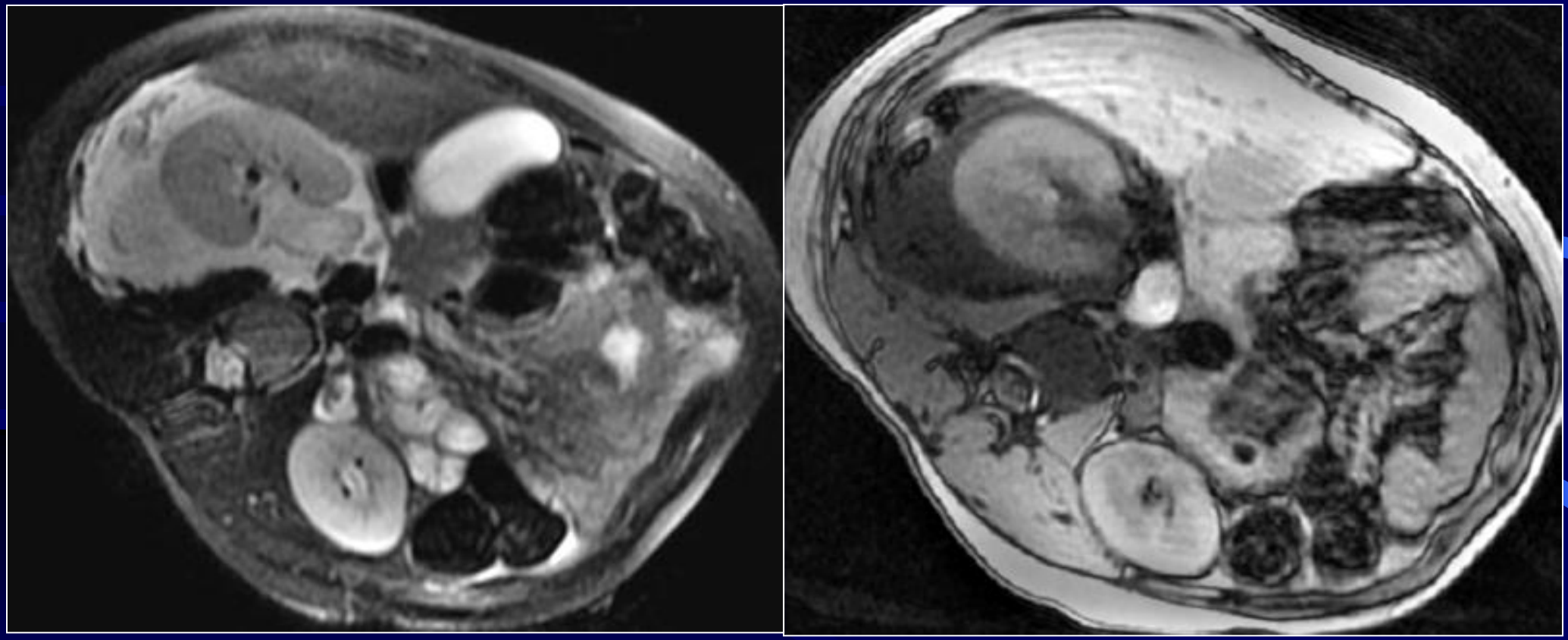
# Painful Hydronephosis

- MR can differentiate physiologic and calculus obstruction
- Physiologic: extrinsic compression middle third of ureter, collapsed below
- Stone: filling defect at UVJ or mid-ureter
  - If UVJ stone, pelvic ureter dilated
- MRU: heavily T2w echo train spin-echo
- flow artifacts may be confused with calculi

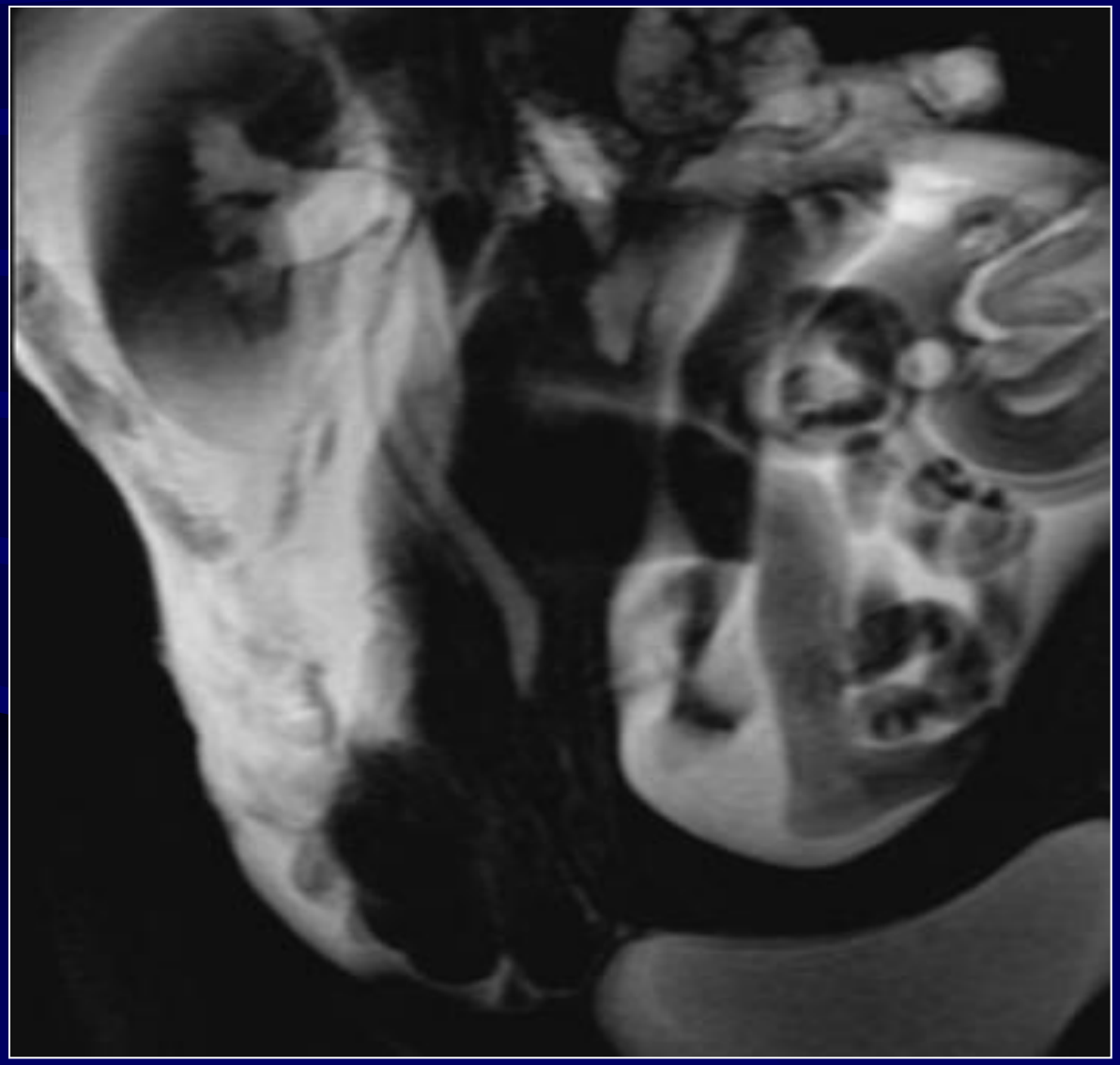
low-dose CT protocol

Brown et al. AJR 2005

25 yo, pregnant with right abdominal and pelvic pain s/p nephrostomy removal



# Urinoma

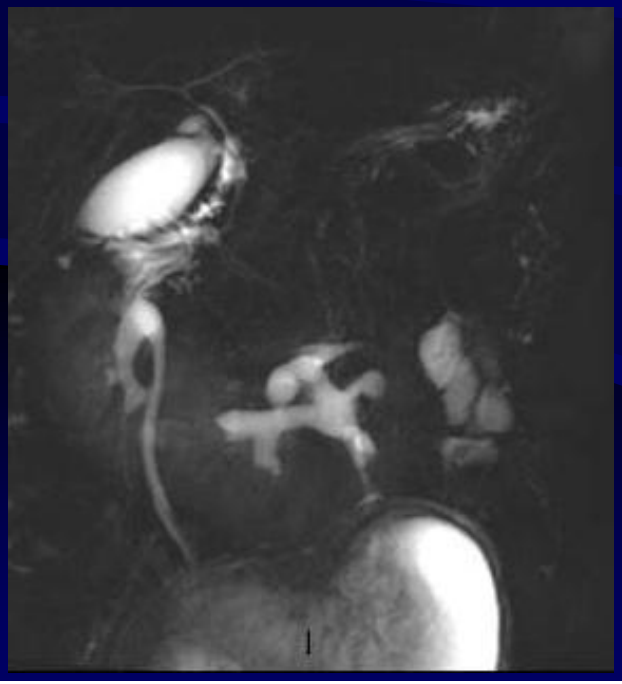


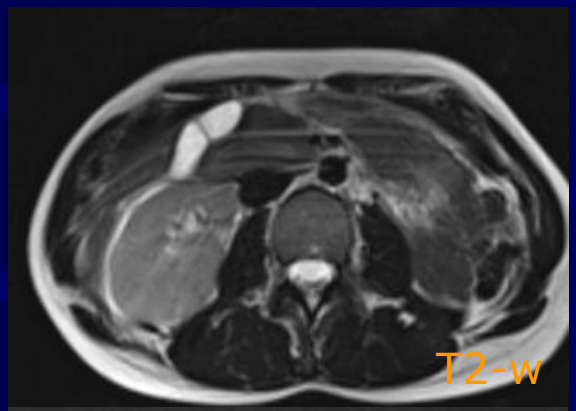
# 4) Urinary tract infections

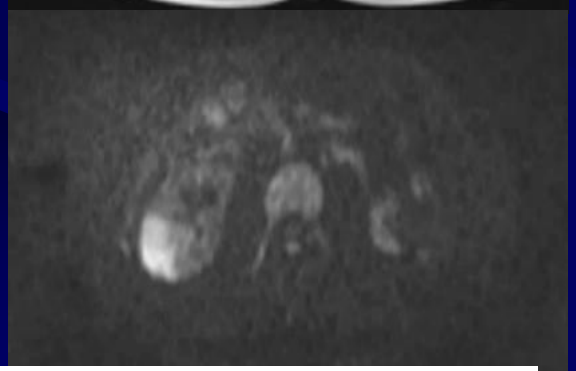
Very common during pregnancy.

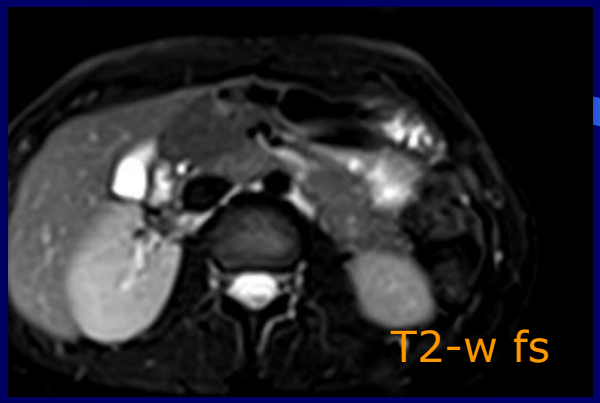
On MR imaging, pyelonephritis is visualized as an enlarged edematous appearing kidney.

Focal areas of higher signal intensity on T2-weighted imaging can be due to focal pyonephrosis.







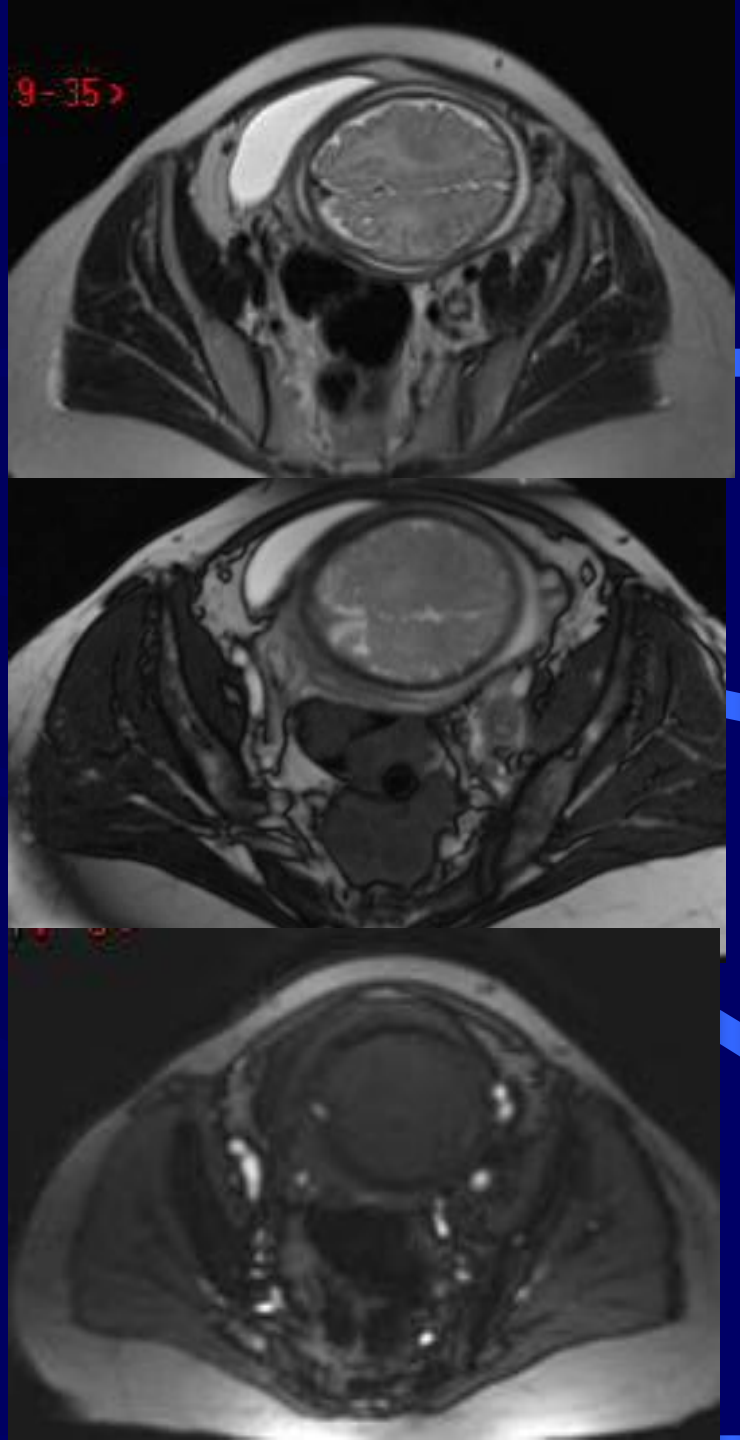

Diffusion sequence is accurate in detecting focal pyelonephritis

DWI

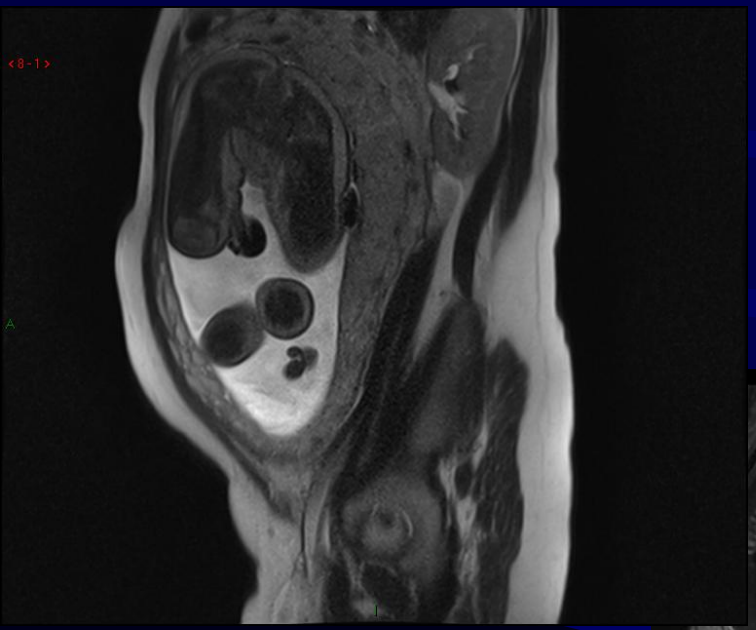
ADC

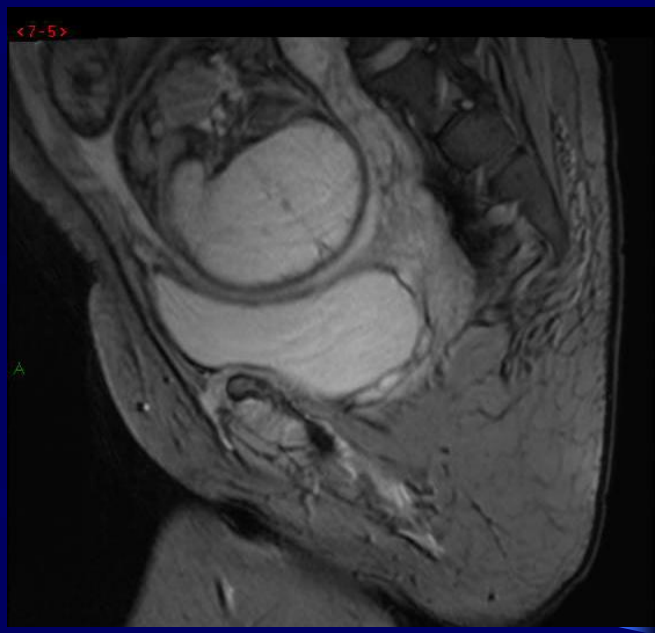
# 5) Deep venous thrombosis

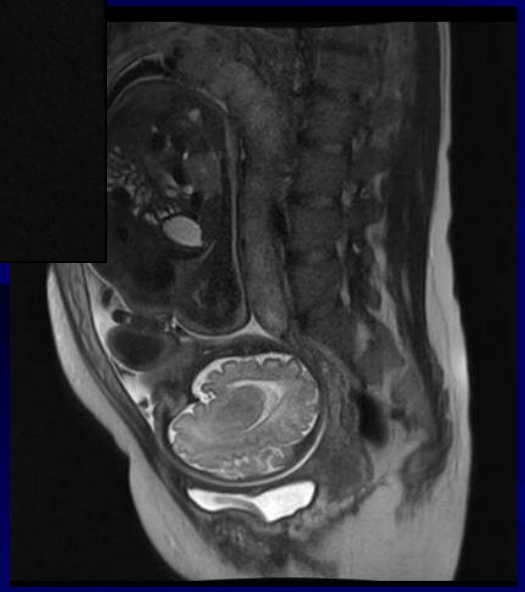
- ✓ Ovarian and Pelvic vein thromboses are uncommon complications of pregnancy
- ✓ MRI – Acutely thrombosed vessels are enlarged and contain low signal intensity thrombus
- ✓ Septic thrombus can cause streaky low intensity fat stranding on T1W images

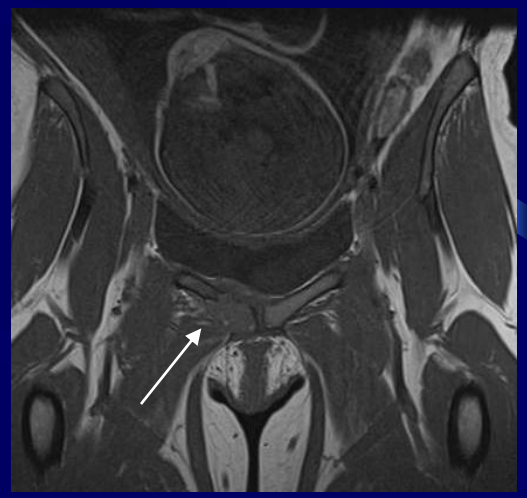


29 years old in third trimester who presented at the emergency department with pelvic pain and nondiagnostic US

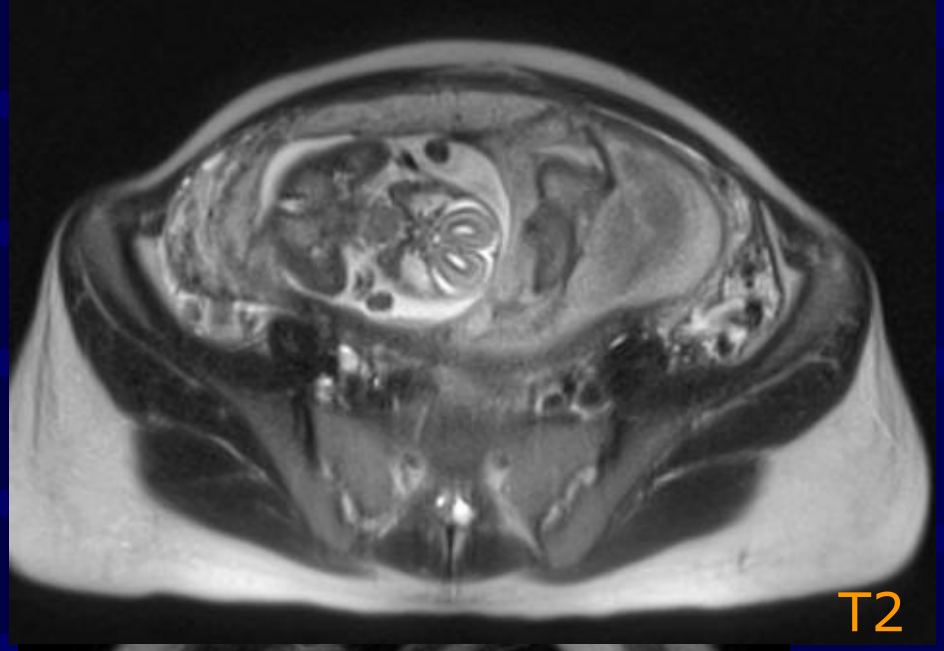


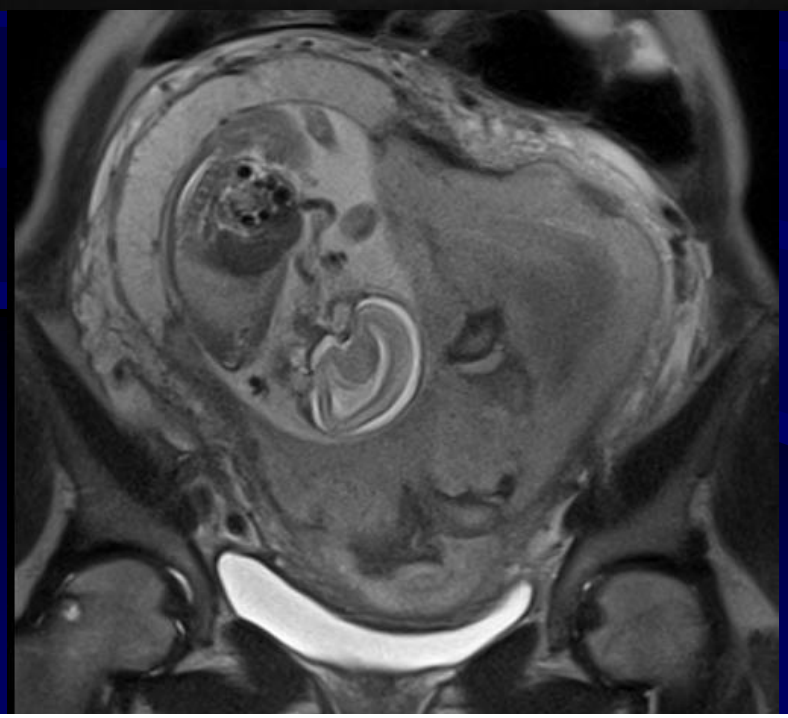


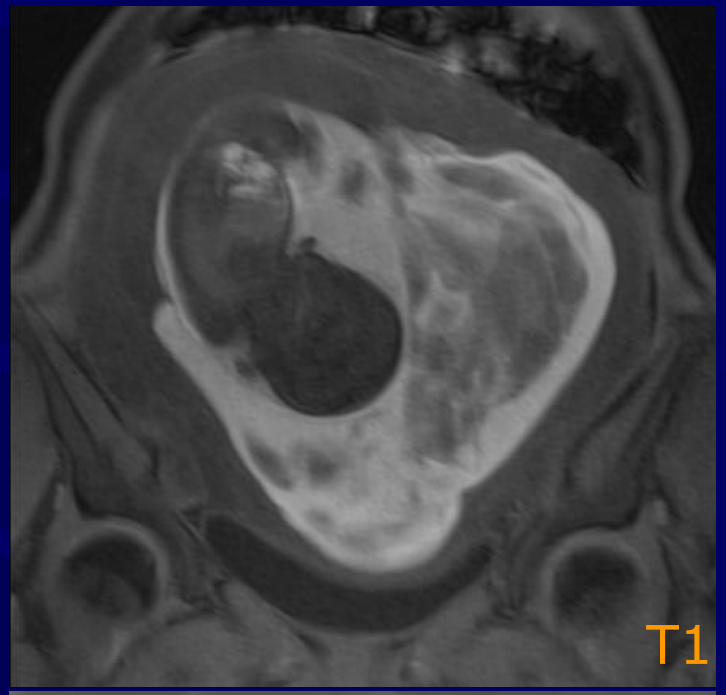


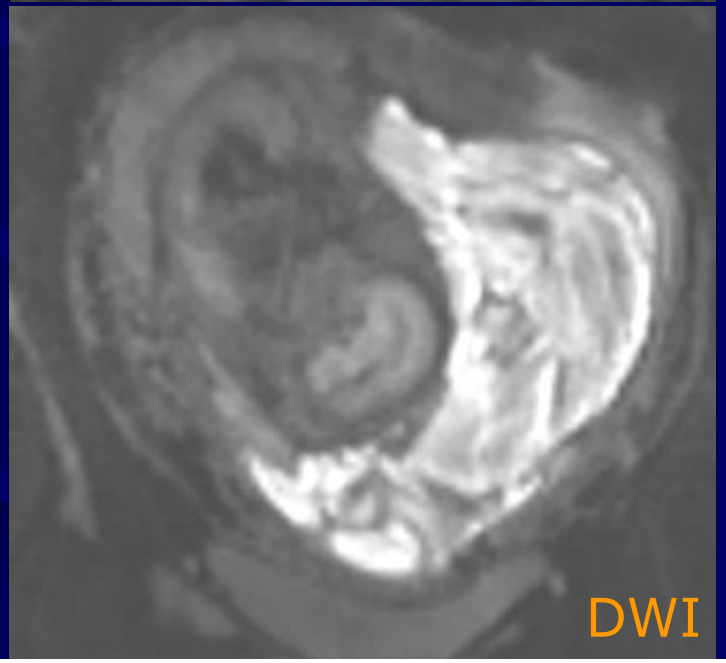


Gynaecologic
Abdominal
Skeletal

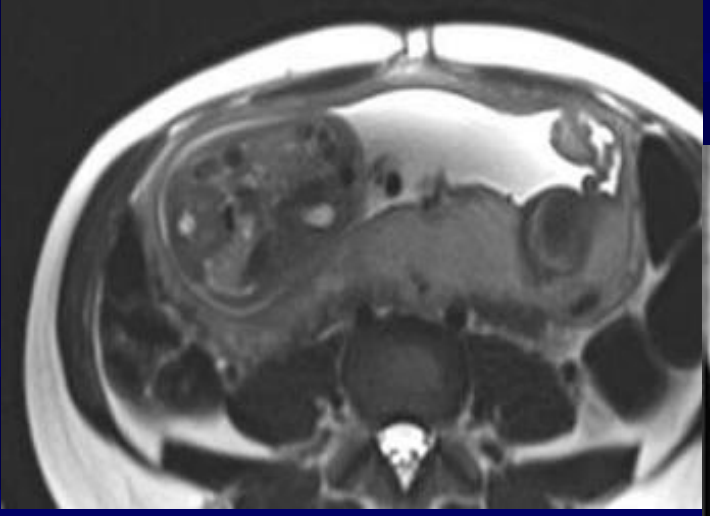


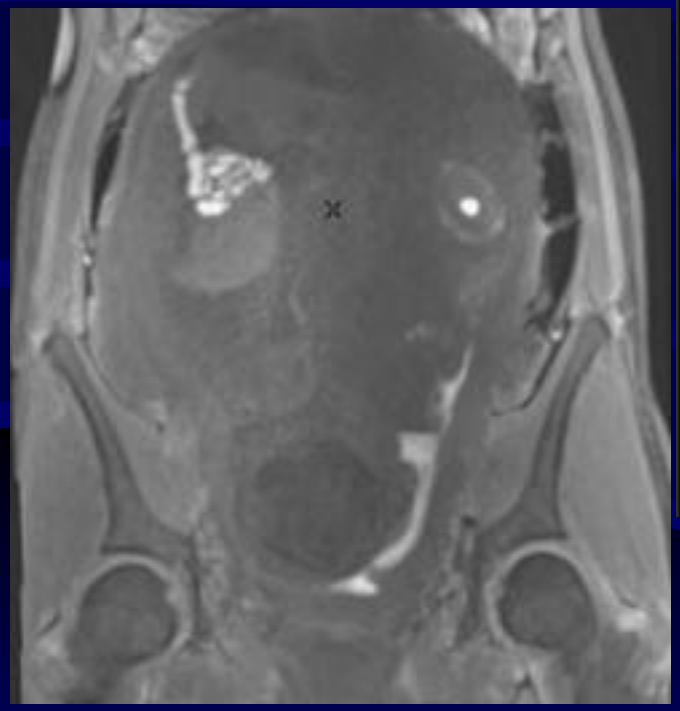



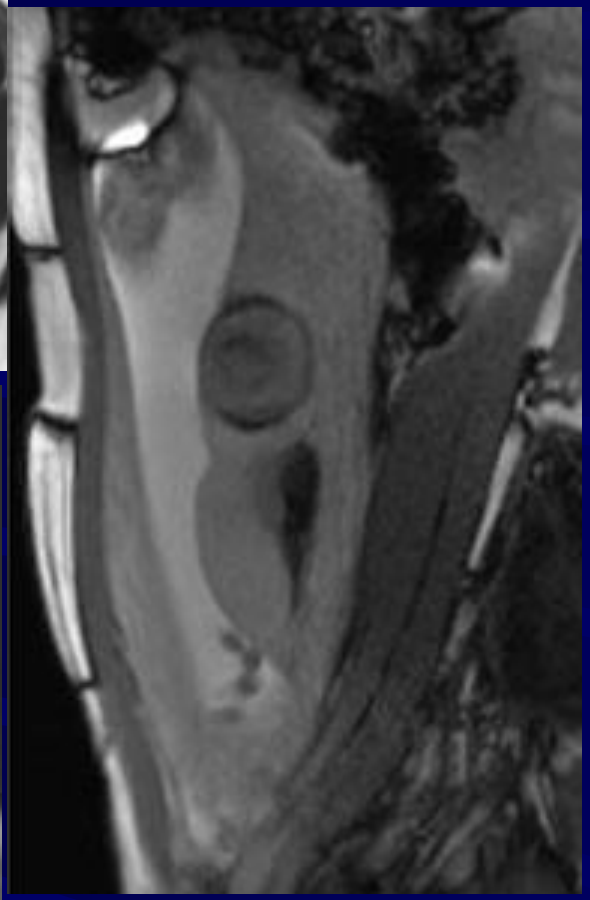



MR is accurate modality and can aid in clinical management of patients with abruption.





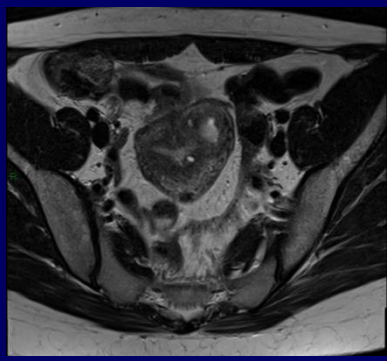


MRI is an extremely accurate investigation that identifies, with an excellent inter-observer agreement, the origin of second and third trimester uterine bleeding.

Masselli G Eur Radiol. 2011 Sep;21(9):1841-9.

# Summary

- US and MR imaging, should be the preferred examinations for evaluating an acute condition in a pregnant patient.
- Ectopic pregnancy, US is accurate. MRI is useful in identifying complicated ruptured cases that require precise evaluation (Interstitial, Cervical and Abdominal)
- Placenta Abruption: US is not accurate MR imaging is more accurate.
- Placenta Percreta: MR>US posterior
- Ovarian Torsion: MR useful in evaluating infarction



# Guidelines

- Non gynecological causes
- When an ultrasound exam is inconclusive, MRI should be used to make the diagnosis

- MR imaging can reduce diagnostic delay and impact patient care in a cost-effective manner

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UROGENITAL

## Acute abdominal and pelvic pain in pregnancy: ESUR recommendations

**Gabriele Masselli · Lorenzo Derchi · Josephine McHugo · Andrea Rockall · Peter Vock · Michael Weston · John Spencer · ESUR Female Pelvic Imaging Subcommittee**

Received: 9 May 2013 / Revised: 10 July 2013 / Accepted: 13 July 2013 / Published online: 30 August 2013


**Abstract** Acute abdominal pain in pregnancy presents diagnostic and therapeutic challenges. Standard imaging techniques need to be adapted to reduce harm to the fetus from X-rays due to their teratogenic and carcinogenic potential. Ultrasound remains the primary imaging investigation of the pregnant abdomen. Magnetic resonance imaging (MRI) has been shown to be useful in the diagnosis of gynaecological and obstetric problems during pregnancy and in the setting of acute abdomen during pregnancy. MRI overcomes some of the limitations of ultrasound, mainly the size of the gravid uterus. MRI poses theoretical risks to the fetus and care must be taken to minimise these with the avoidance of contrast agents. This article reviews the evolving imaging and clinical literature on appropriate investigation of acute abdominal and pelvic pain during established intrauterine pregnancy, addressing its common causes. Guidelines based on the current literature and on the accumulated clinico-radiological experience of the European Society of Urogenital Radiology (ESUR) working group are proposed for imaging these suspected conditions.

Key Points

- *Ultrasound and MRI are the preferred investigations for abdominal pain during pregnancy.*
- *Ultrasound remains the primary imaging investigation because of availability and portability.*
- *MRI helps differentiate causes of abdominopelvic pain when ultrasound is inconclusive.*
- *If MRI cannot be performed, low-dose CT may be necessary.*
- *Following severe trauma, CT cannot be delayed because of radiation concerns.*

**Keywords** Acute abdominal pain · Pregnancy · Guidelines · Ultrasound · Magnetic resonance

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### Introduction

Acute abdominal pain in pregnancy presents diagnostic and therapeutic challenges [1, 2]. A wide variety of diseases—including disorders of the obstetric, genitourinary, gastrointestinal, hepatobiliary and vascular systems—may present with pain during pregnancy [2, 3]. The diagnosis is confounded by several common features of normal pregnancy including non-specific pain, nausea and vomiting. Clinical examination is more difficult and there is displacement of abdominal and pelvic structures by the gravid uterus [4–7]. Leukocytosis is a normal finding in pregnancy and levels of C-reactive protein are higher than in non-pregnant women [2].

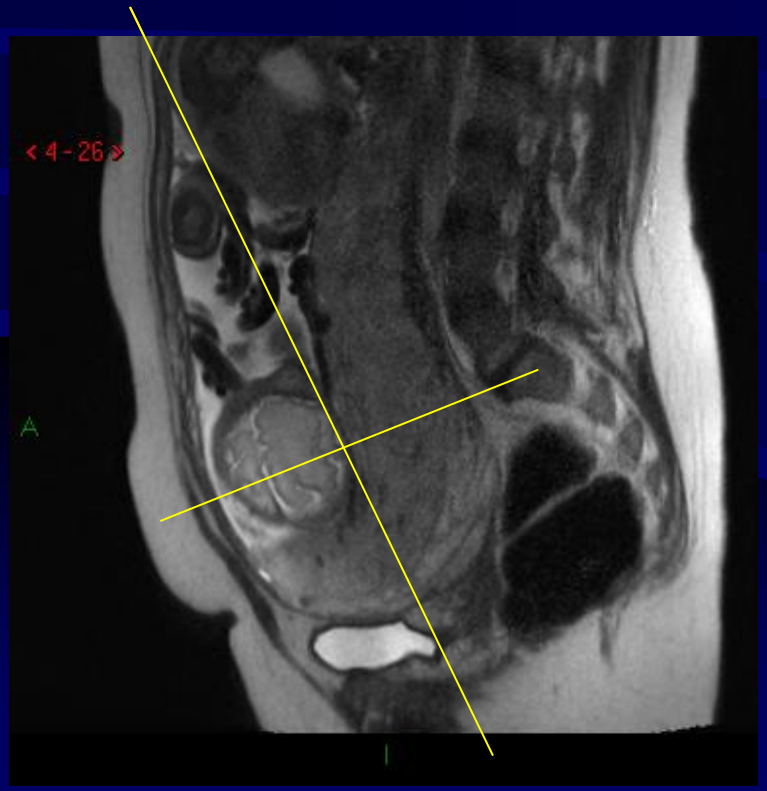
Prompt diagnosis and treatment are essential for the well-being of the mother and the fetus, and imaging is commonly

# Summary

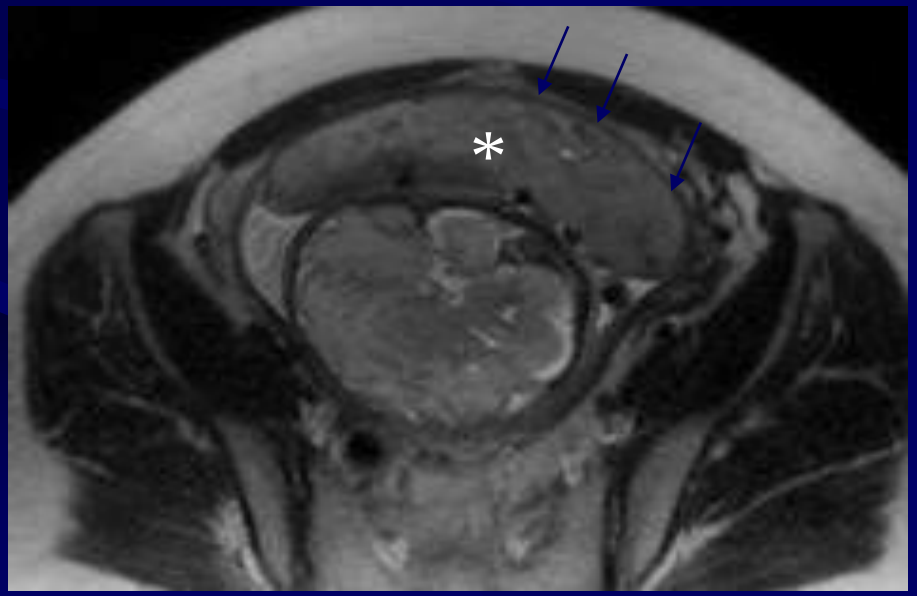
- US and MR imaging, should be the preferred examinations for evaluating an acute condition in a pregnant patient.
- Placenta Abruption: US is not accurate MR imaging is more accurate.
- Placenta Percreta and Uterin Rupture: MR>US posterior
- Non gynecological causes When an ultrasound exam is inconclusive, MRI should be used to make the diagnosis

MR imaging can reduce diagnostic delay and impact patient care in a cost-effective manner

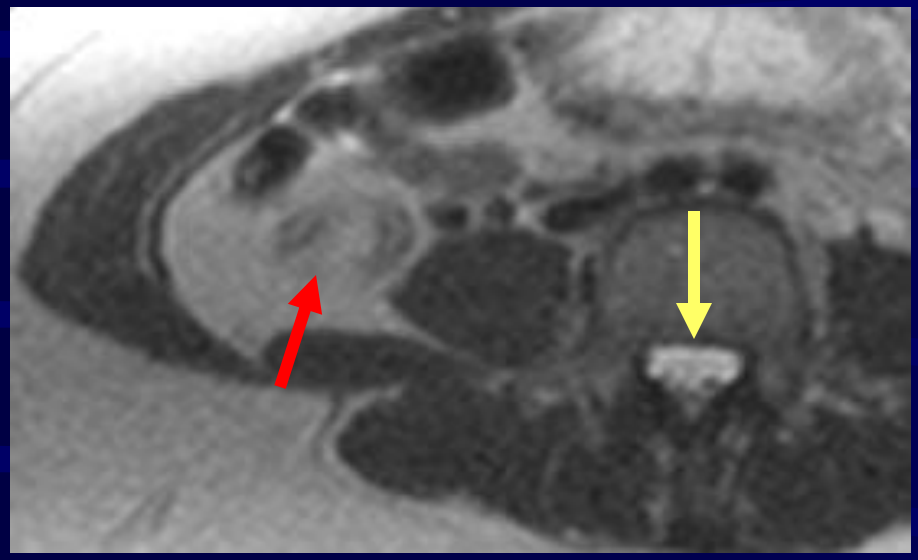
- The distinction between the myometrium and the placenta can be difficult.
- The myometrium is of intermediate signal intensity on T2-weighted images and may “blend” into placenta.
- Partial volume averaging makes assessment difficult.

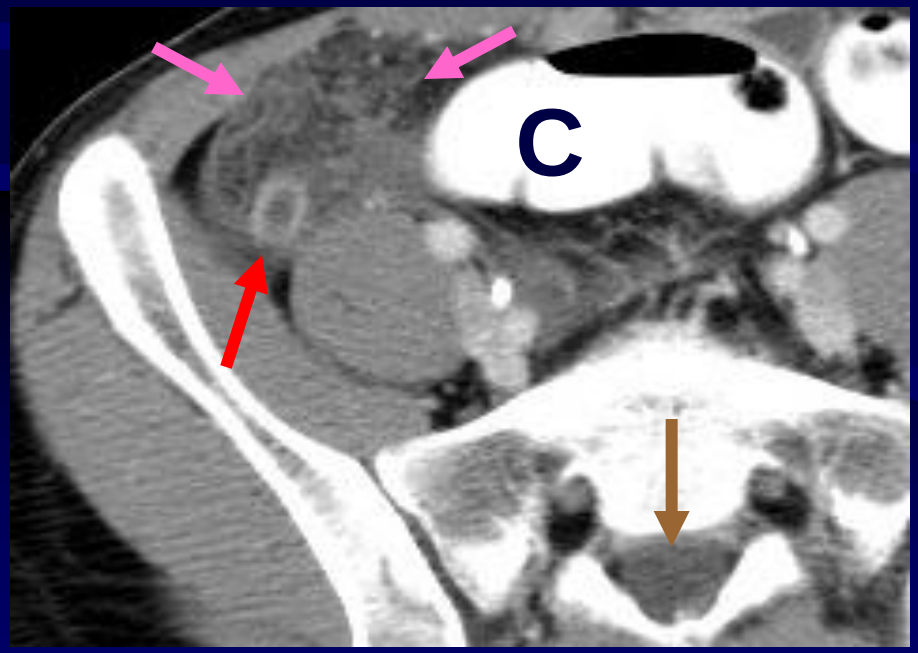


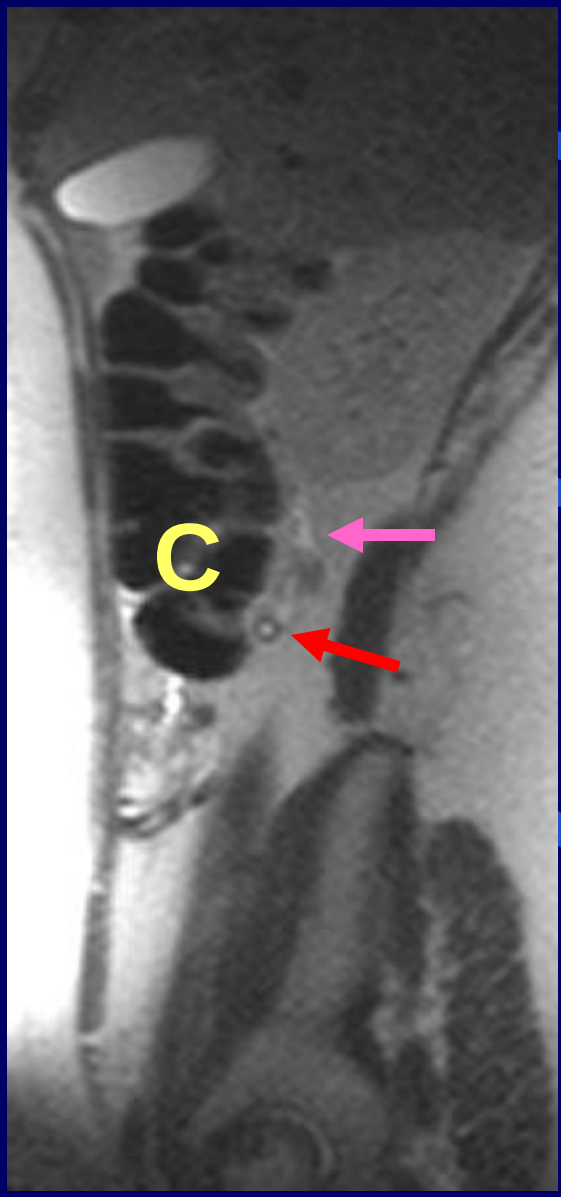

Use thin section (3-4 mm thickness)
The sequence should be perpendicular to Myometrium-placenta border.



# MR criteria for appendicitis





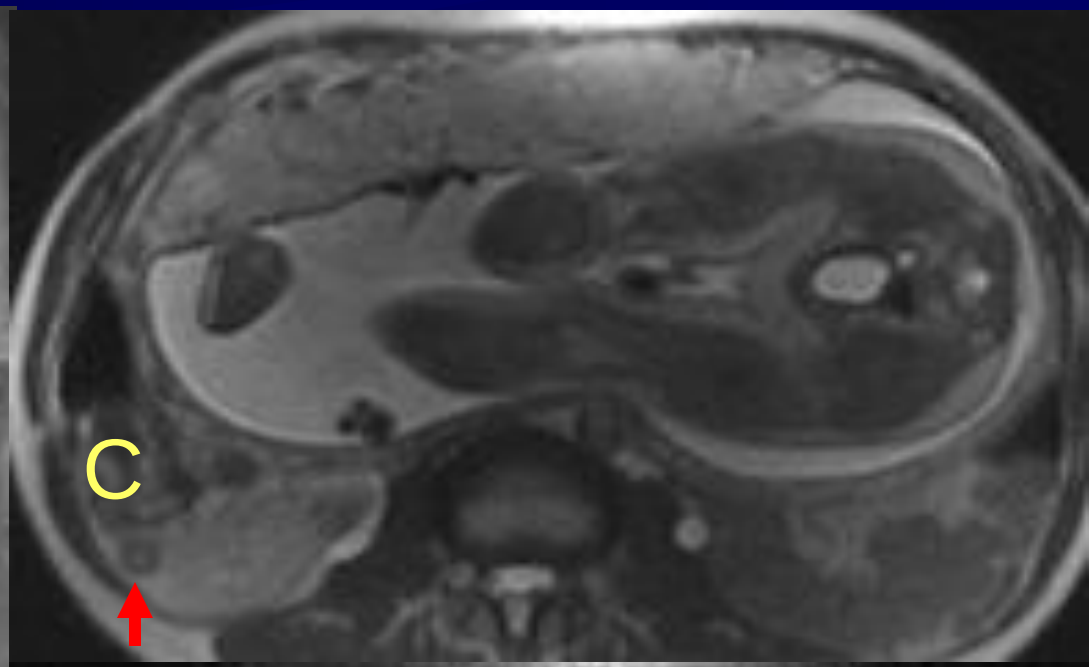



MR signs of acute or recent bleeding within a hematoma indicate a potentially unstable abruption while hematomas with late subacute bleeding are stable.

| Stages | T1-weighted MR Imaging | T2-weighted MR Imaging | Diffusion-weighted MR Imaging |
|---|---|---|---|
| Hyperacute | Iso- to hypointense | Hyperintense | Hyper- to hypointense |
| Acute | Iso- to hypointense | Hypointense | Hypointense |
| Early subacute | Hyperintense | Hypointense | Hypointense |
| Late subacute | Hyperintense | Hyperintense | Hyperintense |
| Chronic | Hypointense | Hypointense | Iso- to hypointense |

| Parameter | Patients with Stable Abruption ($n = 21$)* | Patients with Progression to Grade II ($n = 8$)* | *P* Value |
|---|---|---|---|
| Hematoma stage at MR imaging | | | |
| Hyperacute | 0 | 2 | .120 |
| Acute | 0 | 4 | .004 |
| Early subacute | 1 | 2 | .152 |
| Late subacute | 20 | 0 | <.001 |
| Hematoma volume (mL)† | 45 ± 20 (15–70) | 55 ± 27 (23–95) | .284 |

Masselli G et al. Radiology 2011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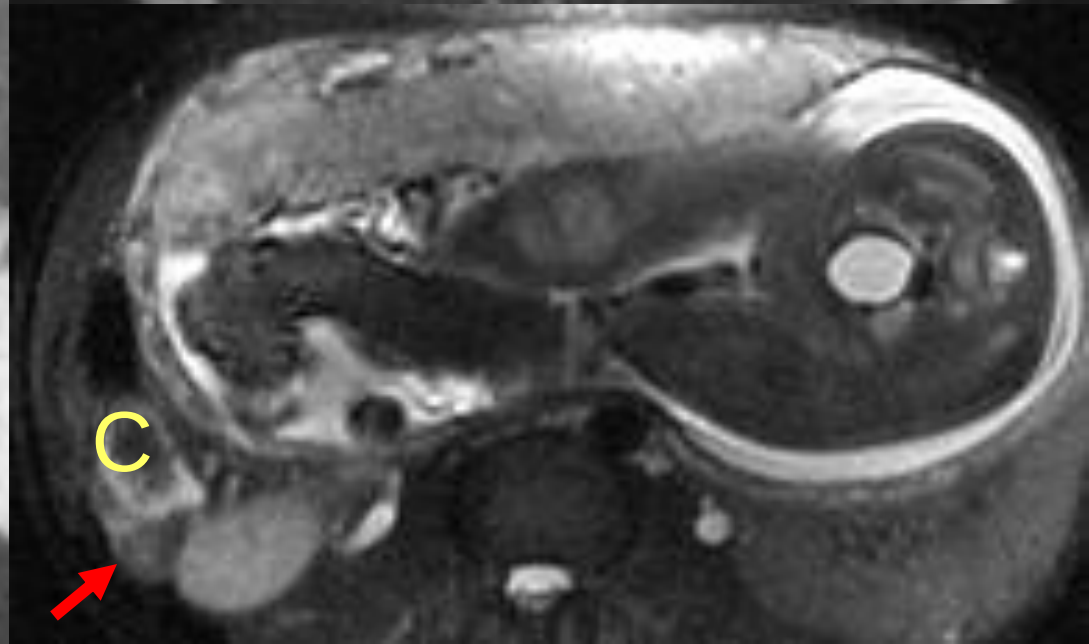
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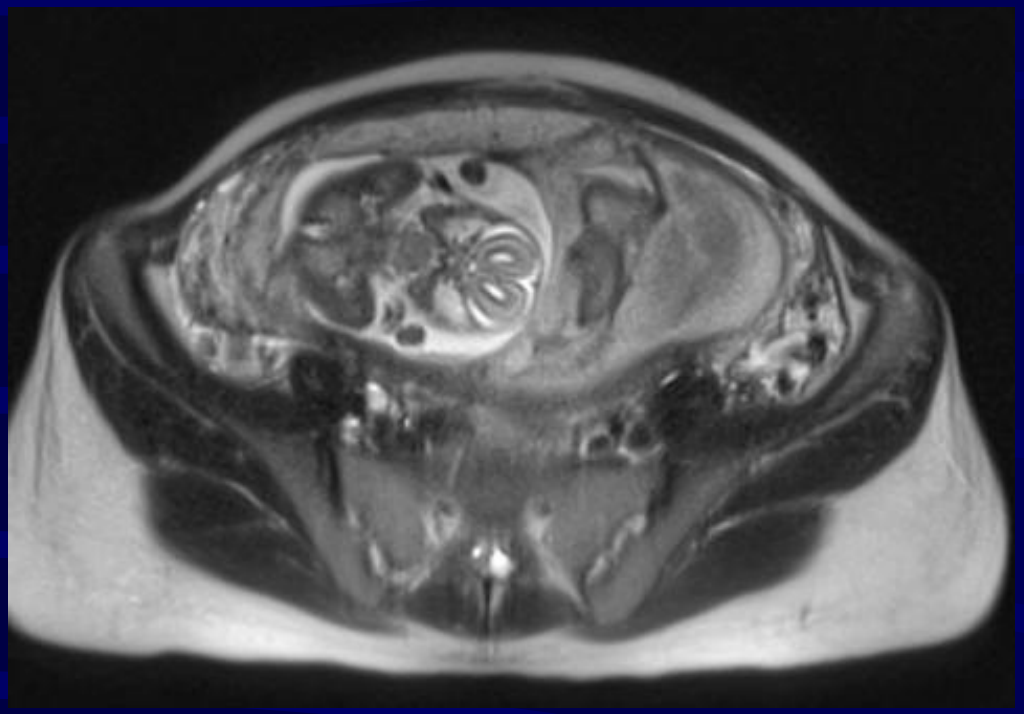
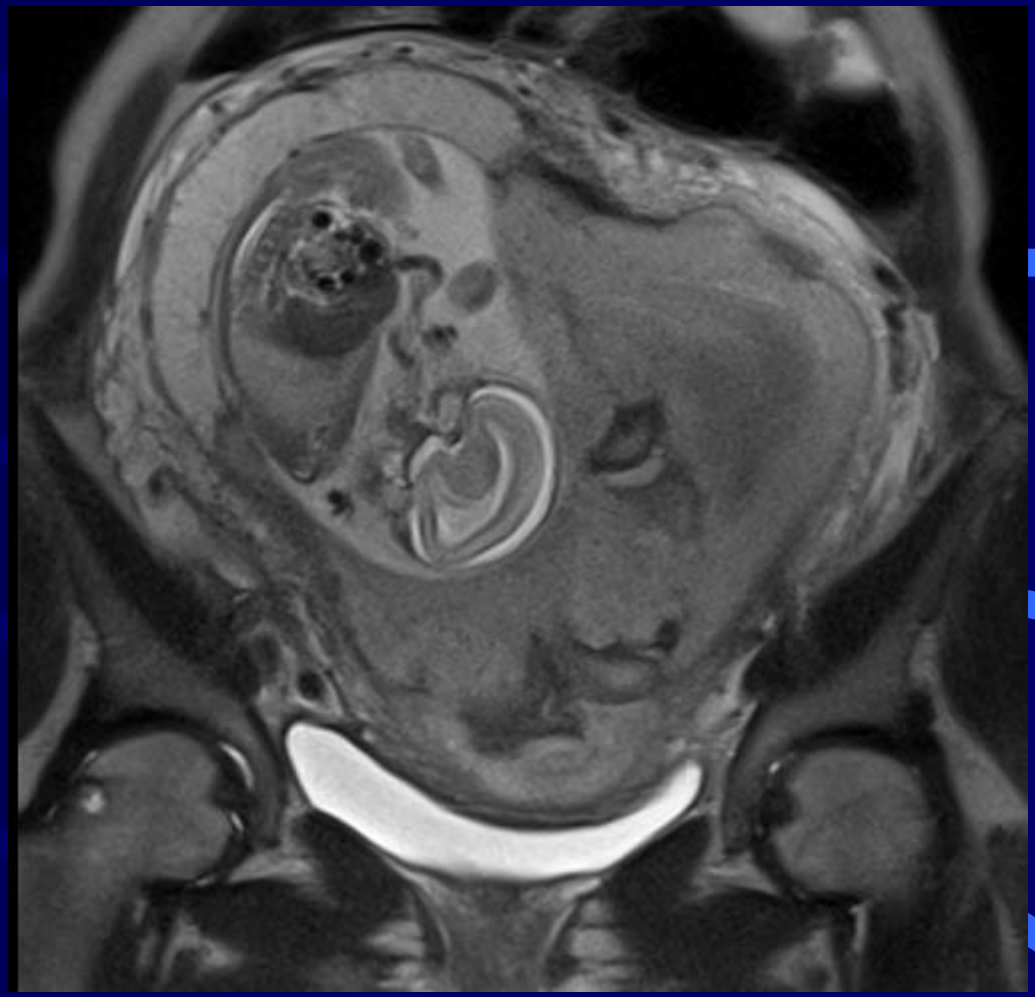
# 1st Line Imaging for Appendicitis

- **Graded compression U/S**
  - 80% sensitive: non-perforating appendicitis
  - 28% sensitive: perforated appendicitis
  - 3rd trimester accuracy is lower due to technical difficulties.


* Doris et al (meta-analysis).

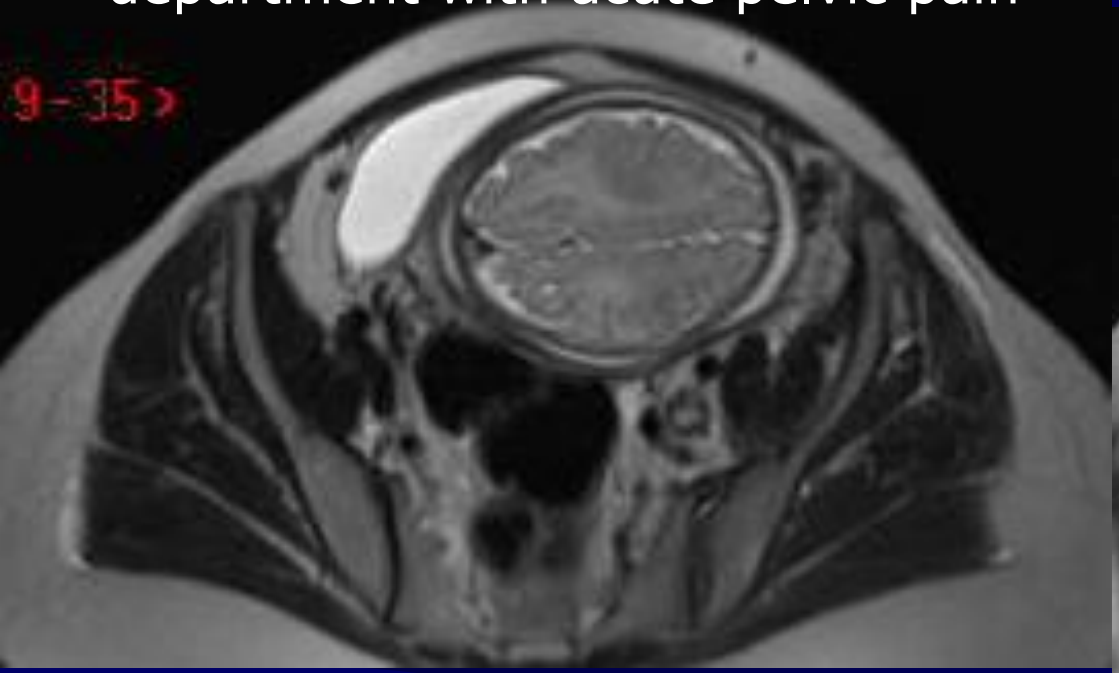


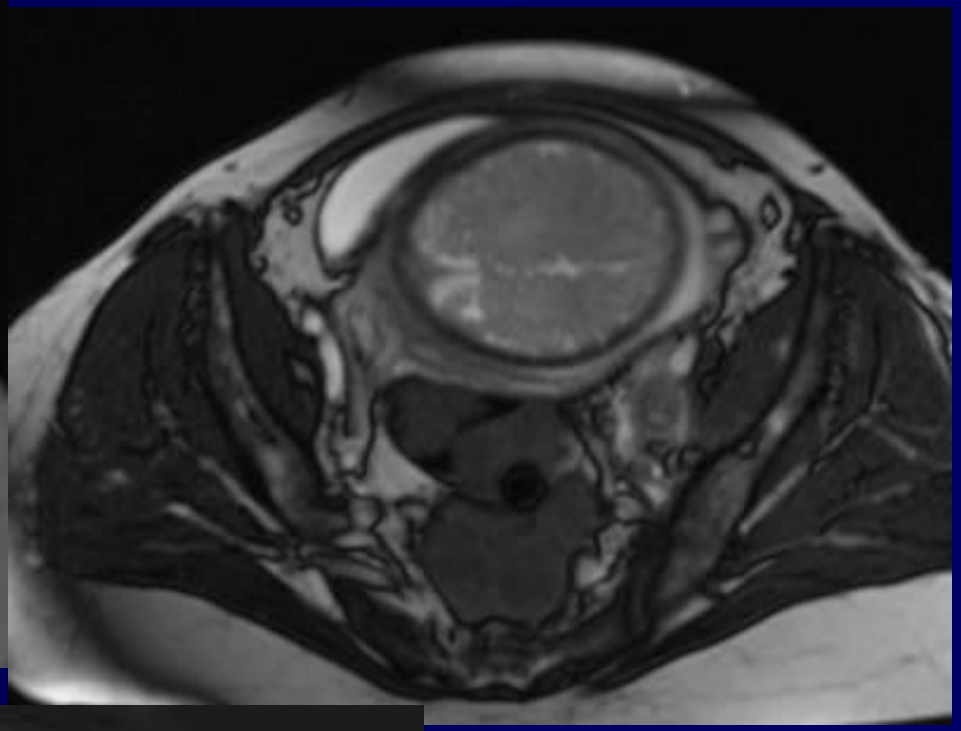


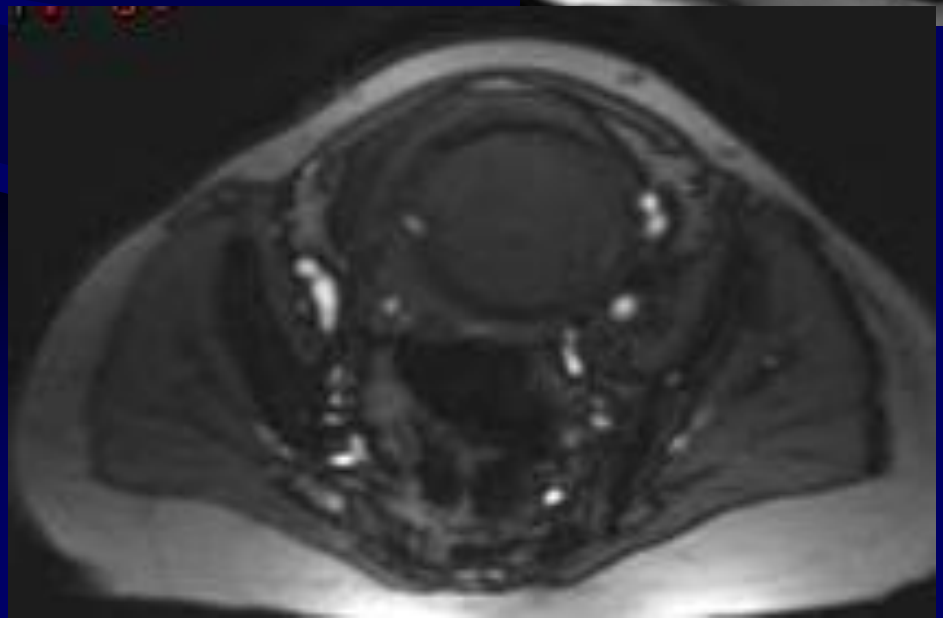
MR signs of acute or recent bleeding within a hematoma indicate a potentially unstable abruption while hematomas with late subacute bleeding are stable.

MR is accurate modality and can aid in clinical management of patients with abruption.

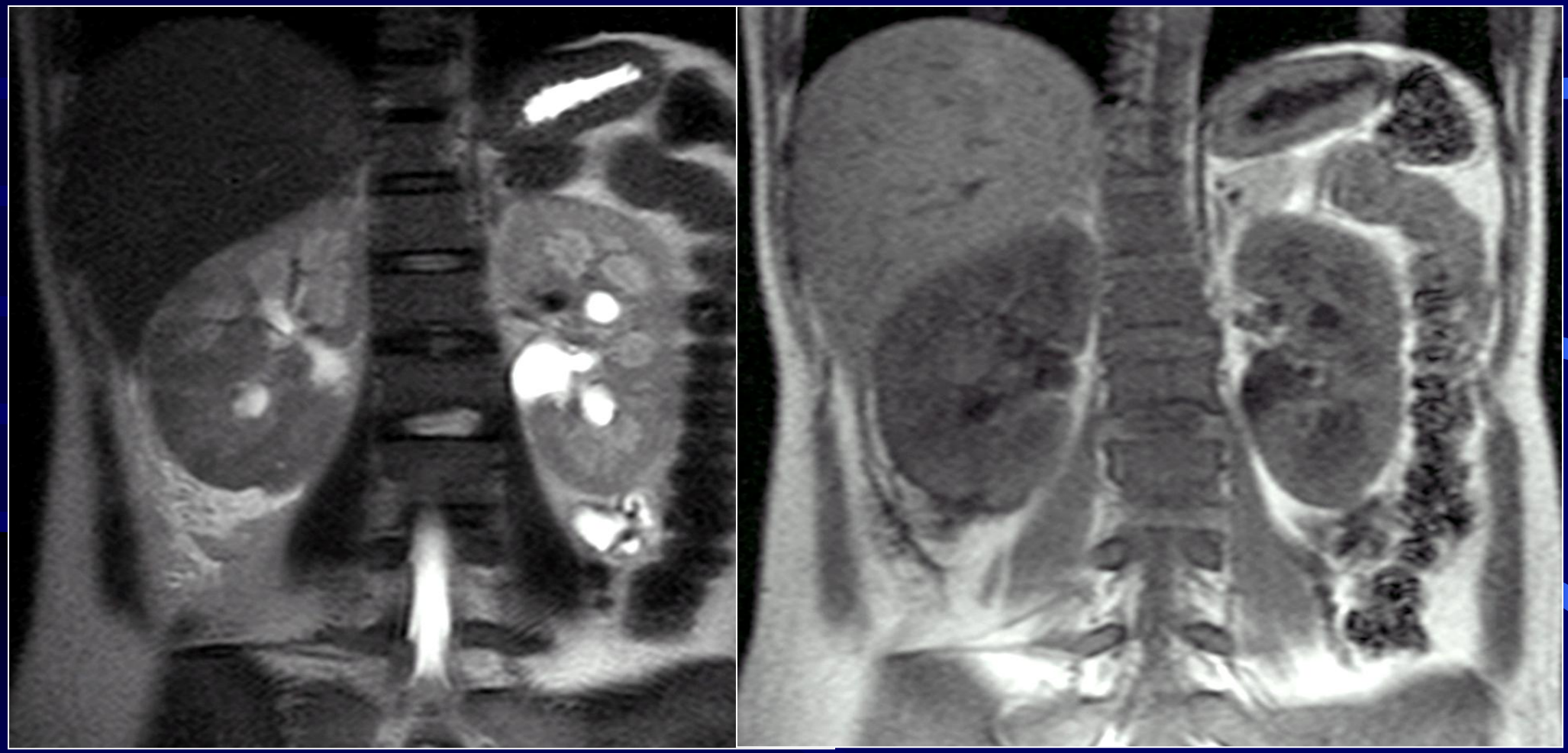
25 years old in third trimester who presented at the emergency department with acute pelvic pain



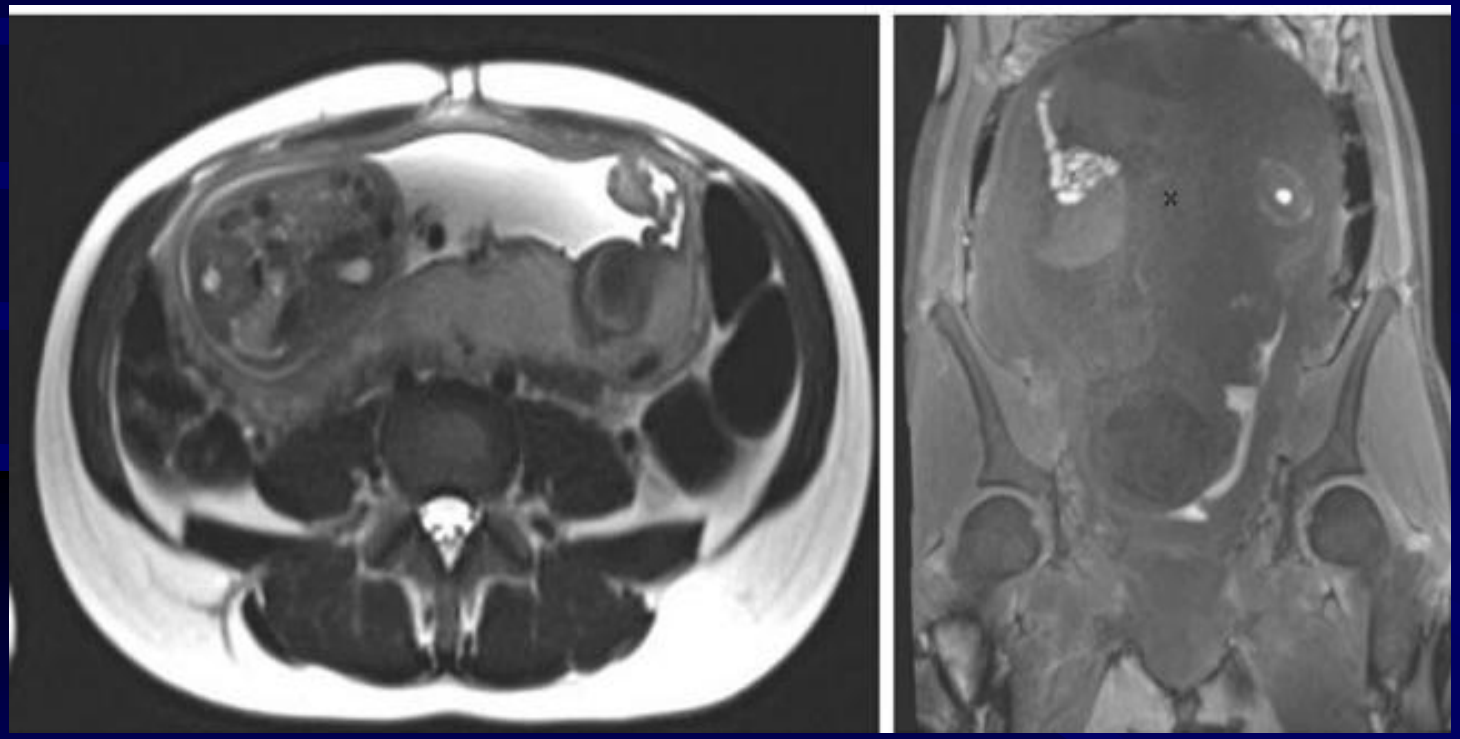



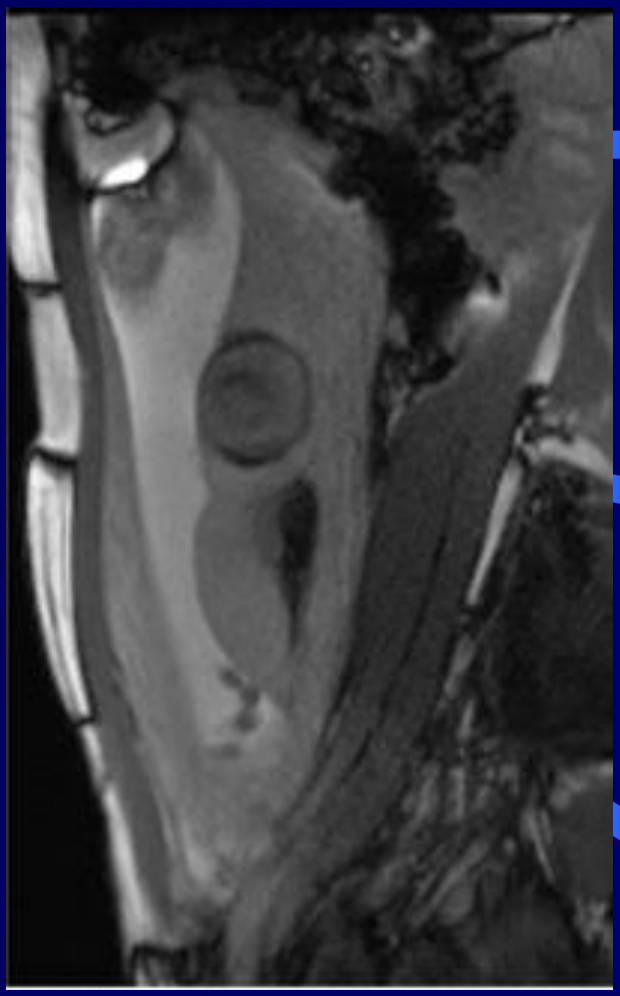


# Pyelonephritis



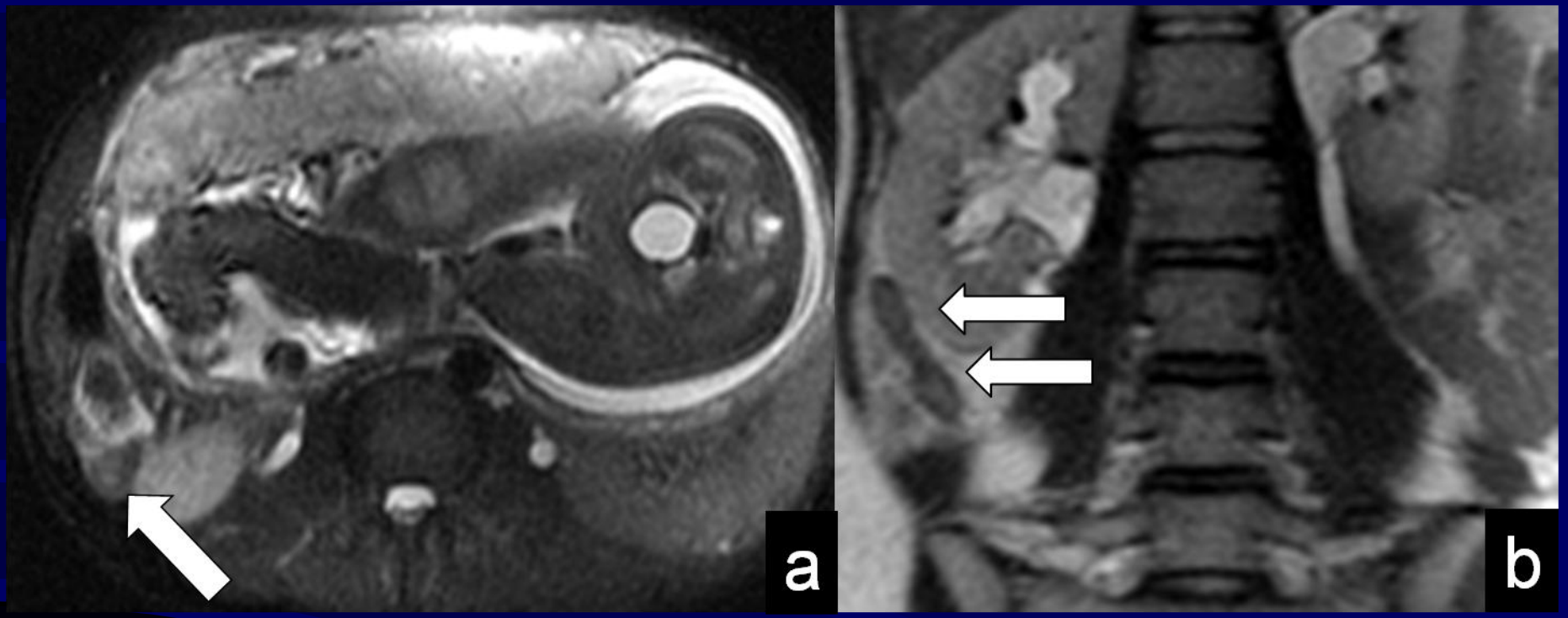
19 yo pregnant woman with right-sided pain and fever

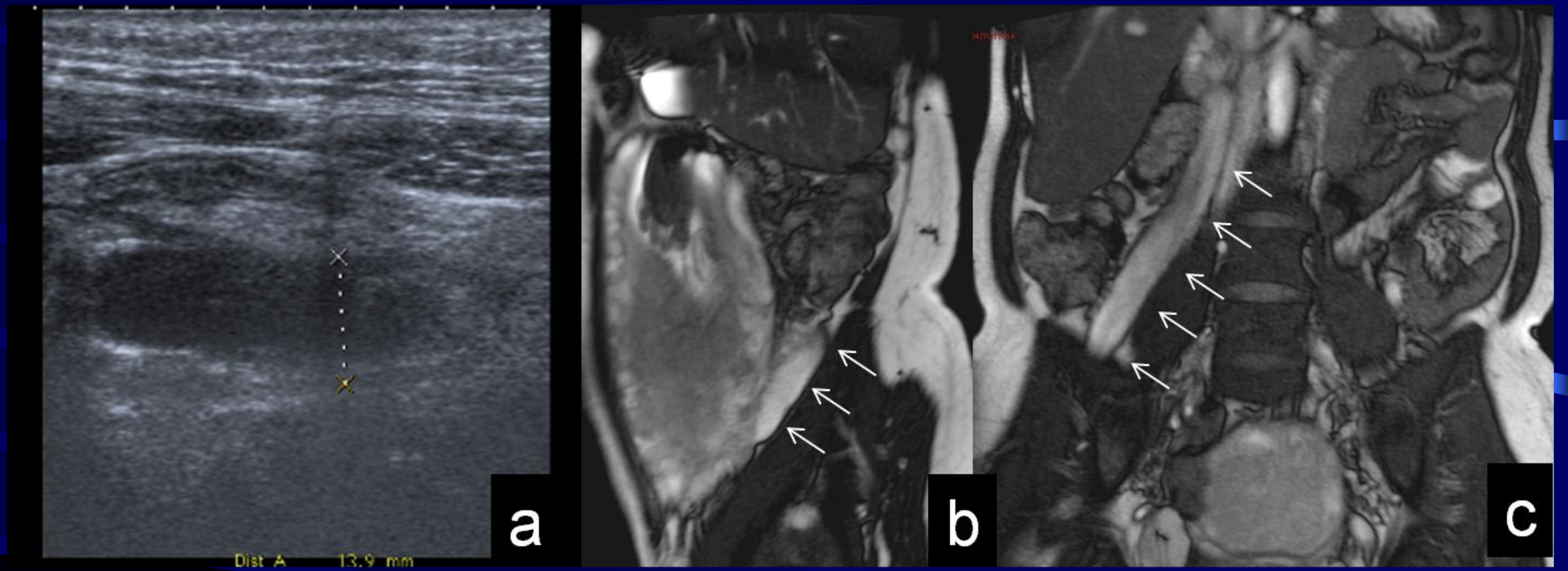




# Preparation & Positioning

- NPO x 4 hours
- Supine or decubitus position
  - LLD: better for IVC compression
  - RLD: clinical indication (L ureter)
- Phased array coil


a
b


Dist A 13.9 mm
a
b
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