Lecture 1

Radiology of the Abdomen

Color code:

- Important.
- Doctors notes.
- Extra explanation.

Please check this link frequently for any additions or corrections.

Reference:

- Male slides only.
- WebMD.

Objectives:

- To know radiology modalities used in abdomen imaging mainly GI tract.
- To know advantages and disadvantages of each modality.
- To know indications and contraindications of each modality.
- Overview on normal abdomen appearance and common pathologies including:
  - Pneumoperitomium.
  - Bowell obstruction.
  - Inflammatory bowel disease.
  - Large bowel masses/malignancies.

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Radiology basics

Radiological modalities:

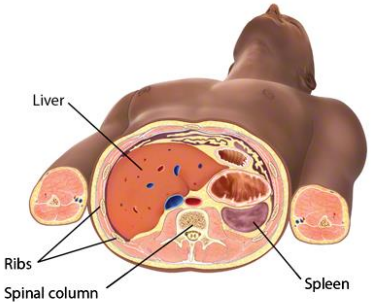
- **US.**
- **X-Ray.**
- **Fluoroscopy.**
- **CT.**
- **MRI.**
- PET.
- Angiography.

Are the highest diagnostic value for the abdomen especially in emergencies.

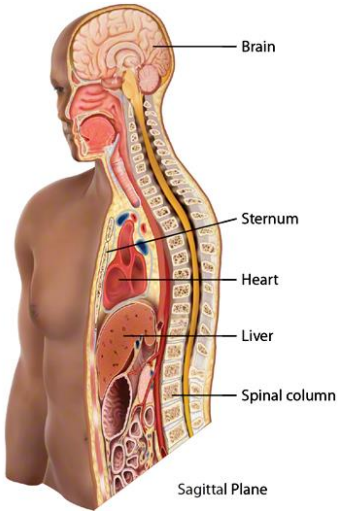
In this lecture the most important are the **X-Ray** & **CT**

Body sections:

- Coronal (frontal) plane.
- Midsagittal (median) plane.
- Transverse (horizontal) plane.



Transverse Plane



Sagittal Plane

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X-Ray

X-ray is a form of radiation, that are focused into a beam that can pass through most objects including the human body. When X-rays strike a piece of photographic film, they make a picture.

Advantages	- Widely available. - Cheap. - **Excellent** in diagnosing **free air** in the abdomen. Other imaging don.t recognize free air. - **Good** in diagnosing **bowel obstruction** & **stones/calcifications**.
Disadvantages	- Radiation. - Poor soft tissue details. So if we want to differentiate the spleen, liver or any other organ it will be hard to find the edges or borders.
Indications	- Abdominal pain. (If there's abdominal pain and you suspect one of the following we should use X-ray). - Bowel obstruction. - Stones. - Masses. - Trauma. - Others, foreign body, supportive lines. Etc
Contraindication	- pregnancy.

White → bone and calcification.
Grey → soft tissue.
Black → air.

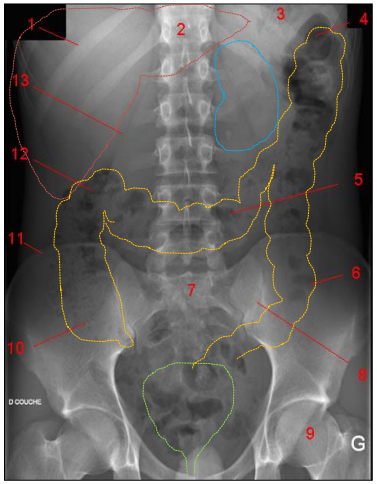
❖First step in reading an abdominal X-ray is assessing gas pattern:

What structures normally has gas?

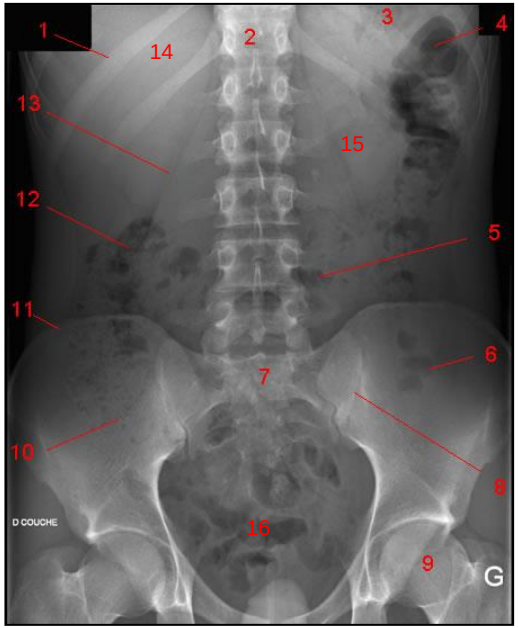
Stomach.
- Almost always has air.

Small bowel.
- Usually small amount of air in 2 or 3 loops. Almost invisible.

Large bowel.
- Almost always air in rectum and sigmoid.
- Varying amount of gas in rest of large bowel.



To help you imagen! ☺



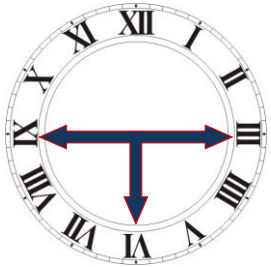
1- 11th rib.
2- T12.
3- Gas in the stomach.
4- Splenic flexure.
5- Transvers colon.
6- Gas in the sigmoid.
7- Sacrum.
8- Sacroiliac joint.
9- Femoral head.
10- Gas in caecum.
11- Iliac crest.
12- Hepatic flexure.
13- Psoas margin.
14- Liver.
15- Left kidney.
16- Bladder.

❖ 3,6,9 rule

Maximum normal diameter of bowel.

When it exceeds it's value it's abnormal.

Small bowel	3cm
Large bowel	6cm
caecum	9cm



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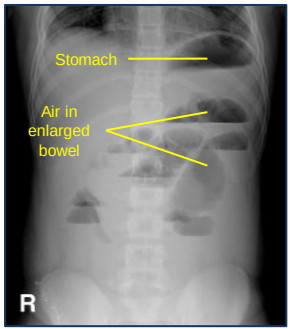
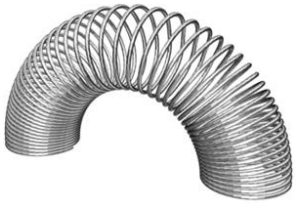
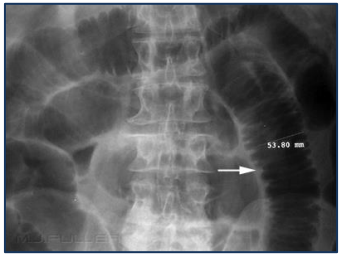
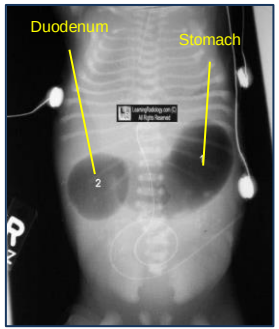
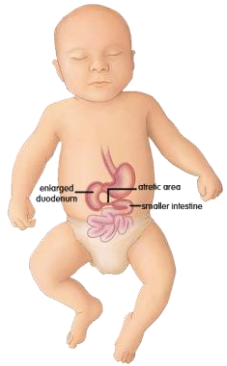
Mechanical Small Bowel Obstruction

Causes:

- Adhesion التصاقات from previous abdominal surgery (**most common cause**).
- Hernias containing bowl.
- Neoplasm.

Important to know these especially if you want surgery!

Special radiological signs:

Step Ladder Appearance	Coil Spring	Double Bubble Sign
• Dilated bowel loops. • Air fluid levels. It happens when there's fluid and on top of it there's air compressing it.  	 	• Indicates duodenal atresia (duodenum fails to form). 2 pockets of air bubble where duodenum supposed to be.  

Mechanical Large Bowel Obstruction

- Colon dilates from point of obstruction backwards.
- Little/no air fluid levels (colon reabsorbs water).
- Little or no air in rectum/sigmoid.

Its basically twisting of the intestine that will cause blockage.

Causes:

- Tumor (carcinoma)
- Hernia.
- Volvulus. An obstruction caused by twisting of the stomach or intestine.
- Diverticulitis. Is a condition that develops when pouches (diverticula) form in the wall of the colon.
- Intussusception. is a condition in which part of the intestine folds inward and into itself, like a telescope.

Special radiological signs:

Coffee Bean Sign

- Indicates sigmoid volvulus (massively dilated sigmoid loop).

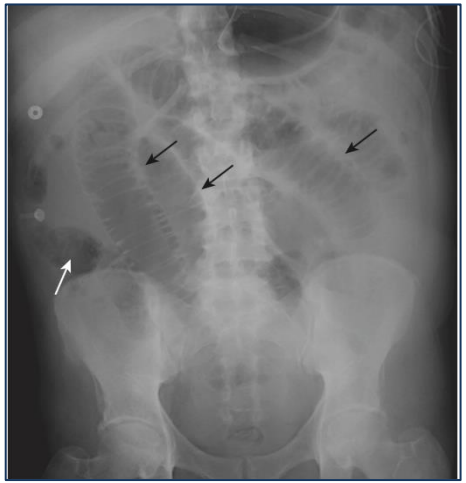
There are very little air bubble compared to the small bowel obstruction.

ThumbPrinting

- The distance between loops of bowel is increased due to thickening of the bowel wall.
- The haustral folds are very thick, leading to a sign known as 'thumbprinting.

The difference between small and large bowel on X-ray

- The small bowel is centrally placed in the abdomen.
- Valvular markings typically extend across the lumen of the small bowel from one wall to the other, The valvulae are spaced much closer together.
- The small bowel can achieve a maximum diameter, when abnormally dilated, of about 5 cm, The large bowel can dilate to many times that size.
- Normally small intestine are difficult to visualize.
- In this image there's an obstruction (coil string appearance), its very difficult to see the colon because of the obstruction in the small bowel.
- So if any thing distal to the obstruction looses air, as you can see there is a very little amount of air in the rectum and colon (almost impossible to see it).



❖Second step in reading an abdominal X-ray is assessing for extra luminal air:

- **Pneumoperitoneum.** is gas or air trapped within the peritoneal cavity, but outside the lumen of the bowel. Pneumoperitoneum can be due to bowel perforation, or due to insufflation of gas (CO2 or air) during laparoscopy.

Air is normal inside the bowel, but if it gets outside it's a pathology.

If you don't spot this the patient could die!

❖ Upright film best, WHY?

The patient should be positioned sitting upright for **10-20 minutes** prior to acquiring the erect chest X-ray image.

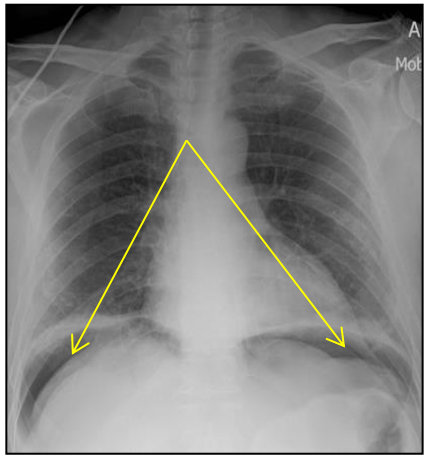
This allows **any free intra-abdominal gas to rise up**, forming a crescent beneath the diaphragm. It is said that as little as **1ml** of gas can be detected in this way.

❖ Signs of free air:

- Crescent sign..
- Riglers sign.
- Football sign.
- Falciform ligament sign.

Crescent Sign

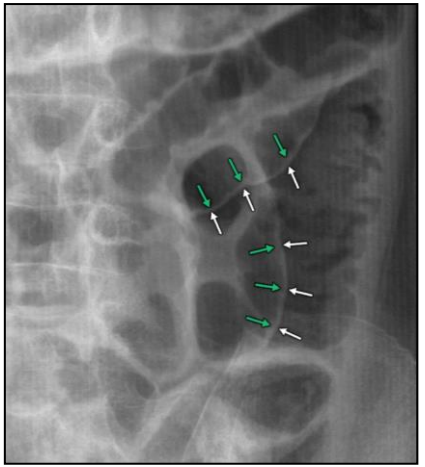
- Free air under the diaphragm normally should not be seen.
- Best demonstrated on upright chest x rays or left lat decub
- Easier to see under **right** diaphragm, because the stomach is on the left and it normally has gas.

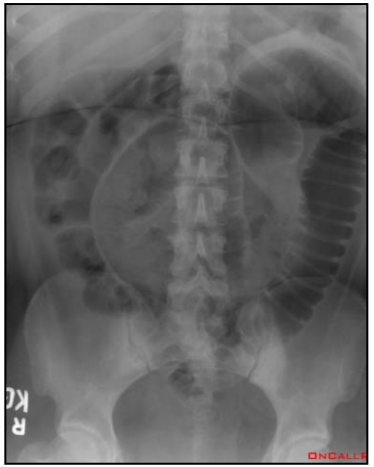


If you see a patient like this send him to the OR!

Rigler's Sign

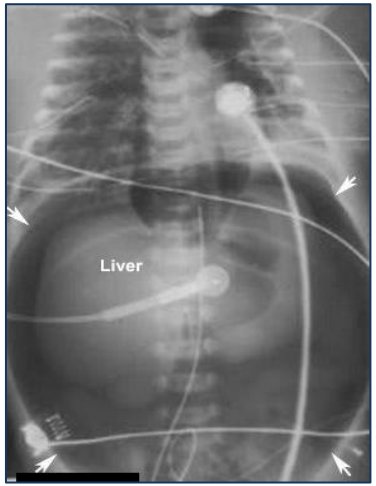
- Bowel wall visualized on both sides due to intra and extra-luminal air
- Usually **large** amounts of free air. So the abdomen will be severely extended.
- May be confused with overlapping loops of bowel, confirm with upright view.





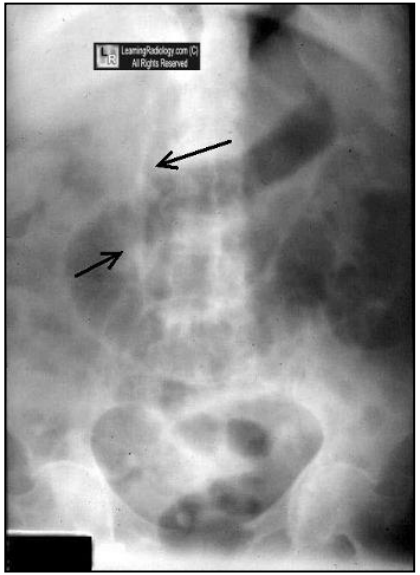
Football Sign

- Seen with massive pneumoperitoneum
- Most often in children with necrotizing enterocolitis
- In supine position air collects anterior to abdominal viscera

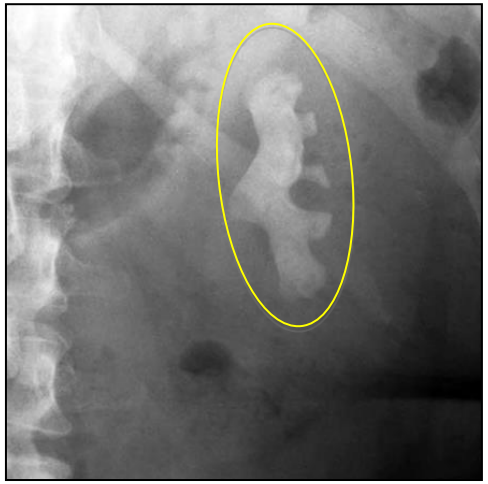
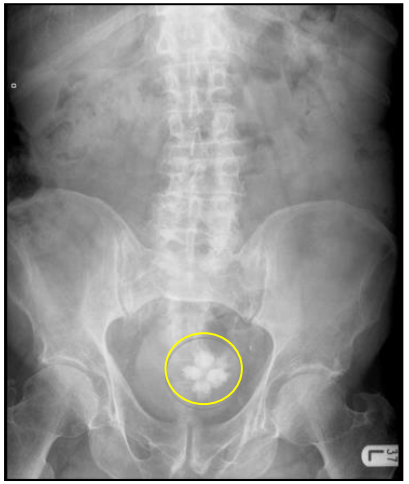


Falciform ligament sign

- Normally invisible.
- Supine film, free air rises over anterior surface of liver



❖**Third step in reading an abdominal X-ray is checking for calcifications:**

Renal Calculi	Staghorn Calcification	Bladder Calculi
		

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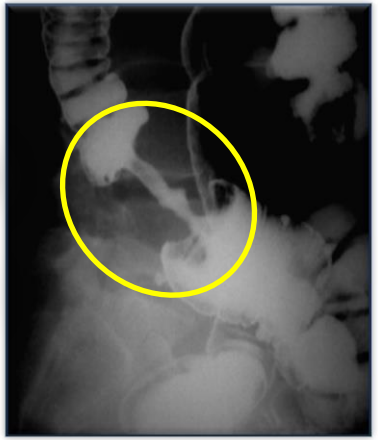
Fluoroscopy

Fluoroscopy is basically a X-ray + contrast.

Advantages	- Available. - Relatively cheap. - **Excellent** in evaluation the bowel **lumen** and **mucosa**. like in ulcers we will consider using it.
Disadvantages	- Radiation **highest** of all modalities. Almost 4 times more. - Poor in evaluating **extra** luminal pathologies.
Indications	- Assessing the mucosal outline. - Abdominal pain. - Gastro esophageal reflux. - Masses. - Inflammatory bowel diseases. - Post surgical, leak .
Contraindication	- Pregnancy. - Bowel obstruction. - **Bowel perforation** (with barium type of contrast).

Apple core appearance (colon mass/malignancy)



Types of contrast

Barium swallow	Barium meal	Barium follow through	Barium enema
Will show us the **Esophagus**.	Will show us the **Stomach**.	Will show us the **Small bowel**.	Will show us the **Large bowel**. It involves the barium inserted into the rectum.
			

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CT

Advantages	- Available. - Short scan time. - Much more soft tissue and bone details. - Excellent in diagnosing **extra**-luminal lesions. - **Excellent** in diagnosing the **cause** of bowel obstruction. The X-ray will tell us whether or not there's an obstruction, but if we want to know the **cause** the obstruction we'll order CT.
Disadvantages	- Radiation. - Some times need intra venous contrast (**renal disease**). - Relatively expensive.
Indications	- Abdominal pain. - To look for bowel obstruction cause. - To diagnose intra-abdominal masses. - Trauma.
Contraindication	- Pregnancy. - No IV contrast in renal failure. - Unstable patients (severe trauma/ICU).

1- Rectum.

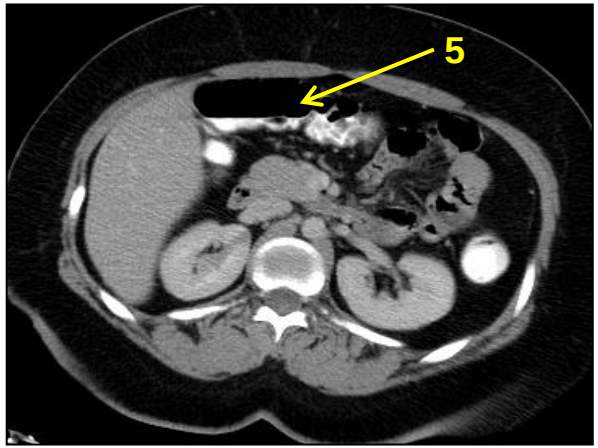
2- Sigmoid colon.

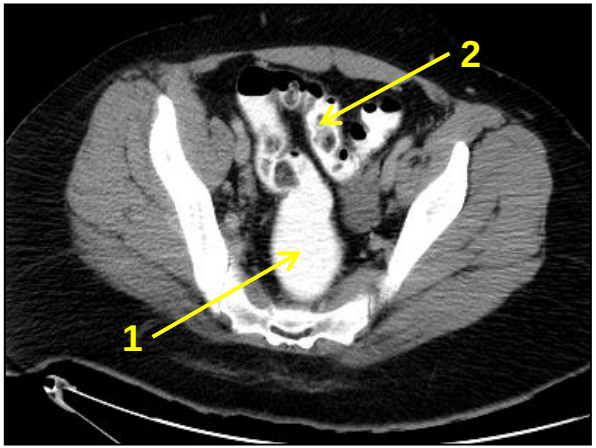
3- Descending colon.

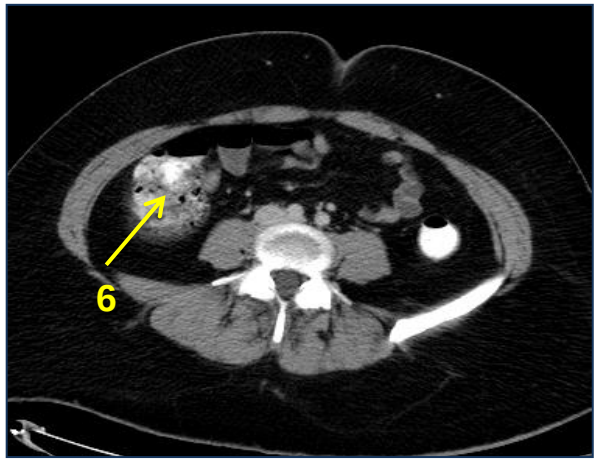
4- Ascending colon

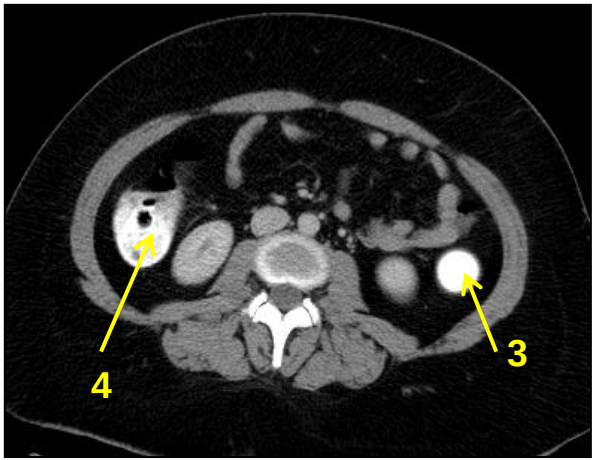
5- Transverse colon.

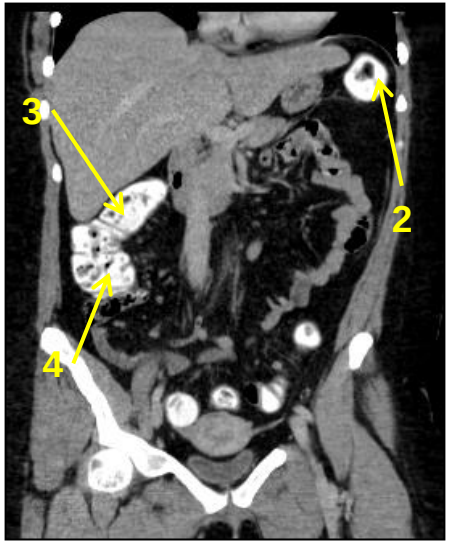
6- Cecum.

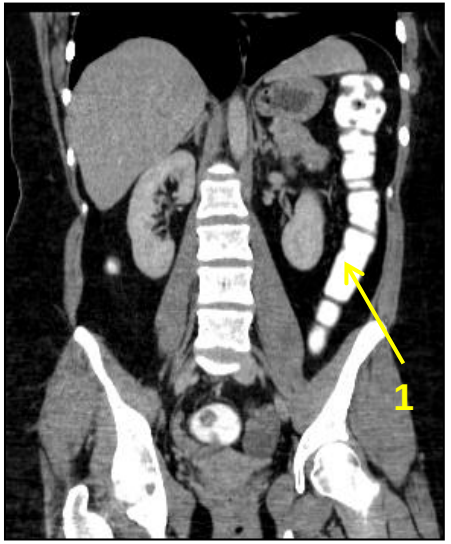












1- Descending colon.

2- Splenic flexure.

3- Hepatic flexure.

4- Ascending colon

5- Cecum.

6-Sigmoid colon.

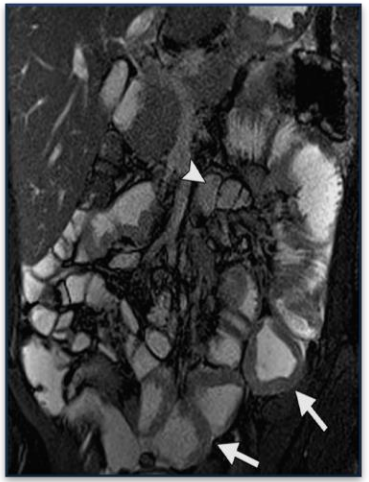
MRI

Advantages	- Relatively safe in pregnancy (no radiation). - Give much more soft tissue details. Not commonly used for the abdomen. - Excellent in diagnosing abdominal solid organ lesion: liver, spleen, kidneys.
Disadvantages	- Expensive. - Long scanning time. Some times we need to sedate the patient especially if they are children. - Sensitive to motion.
Indications	- Abdominal **solid** organ masses. - Inflammatory bowel disease.
Contraindication	- uncooperative patients. - Early pregnancy (relative contraindication). - No IV contrast renal failure (relative contraindication). - **Pacemaker or metallic prosthesis.**

Normal.

Inflammatory bowel disease.

- Bowel wall thickening.



Thanks for checking our team!

For any suggestions or questions please don't hesitate to contact us on:

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شكر خاص لزميلنا هشام الغفيلي.

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