RADIOLOGY
TEAM 435

Radiological anatomy and investigation of the GIT

[Color index: Important | Notes | Extra]

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• Objectives:

1. To know various radiological investigations used for GIT.
2. To understand step wise approach in requesting GIT radiology investigations.
3. To be familiar with radiological appearance (anatomy)
4. To interpret plan x-ray radiograph of abdomen with common pathologies.

• Resources:

- 435 Slides
- 434 Team
- 435 Notes
- Notes from Diagnostic imaging book

• Done by:

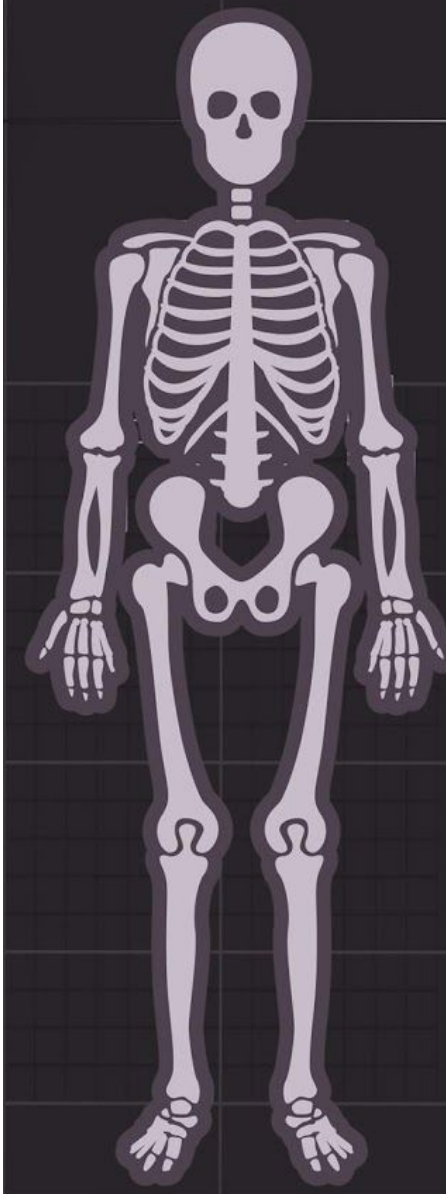
- Abdullah Almushawah

• Team Leader:

- Amjad Alduhaish
- Mohammed Alsahil

- Revised by:

- Luluh Alzeghayer



Introduction

Radiological Modalities					
Plain X-Ray	Fluoroscopy[1]	CT	Nuclear Medicine	MRI	Ultrasound
Ionizing Radiation			Minimal Ionizing radiation	Non-Ionizing Radiation	

❖ **What is peculiar about GIT? GIT Characteristics:**

1) Hollow viscus (Not solid)
2) Usually filled with gas
3) Motility

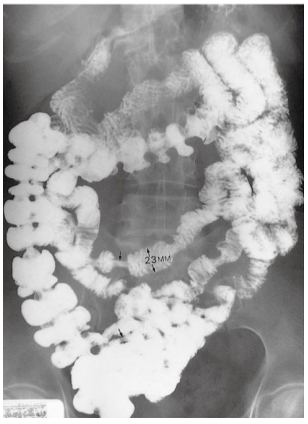
1)X-ray (plain radiography):

- 1895
- often used as first imaging modality
- Cheap
- Fast
- Can be done bedside (portable)
- Useful for free gas and bowel obstruction

Note: We are able to know different types of tissues by seeing different densities:
Bone ->high density (white)
Gas ->Low density (black)
Soft Tissue ->medium density (gray)

2) Fluoroscopy (contrast study):

- Can be used as first imaging modality
- Cheap
- Use of contrast (fluoroscopy = Xray + contrast)
- Recently replaced by CT & MRI
- Useful for intraluminal pathology
- Can give clue about motility (function)



3)Ultrasound:

- Discovered after world war II, started in medical field in 1950
- Relatively cheap
- No radiation
- Limited use in gas filled structures > (abdominal distended)
- Used in pediatrics and pregnant ladies

Picture: Pyloric stenosis. Ultrasound scan in a neonate showing a thickened, elongated pyloric canal

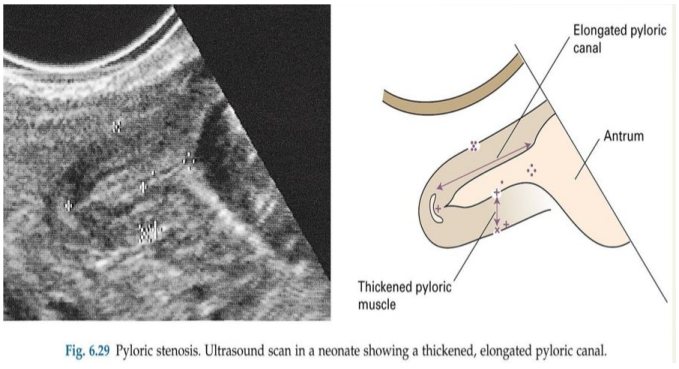


Fig. 6.29 Pyloric stenosis. Ultrasound scan in a neonate showing a thickened, elongated pyloric canal.

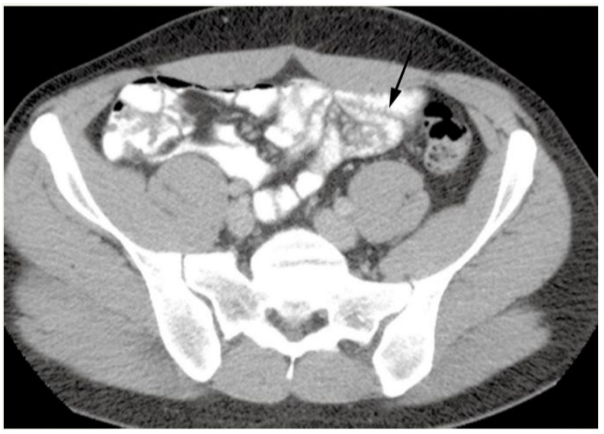
[1] In esophagus > swallow, stomach > meal, small bowel > follow through, large bowel > enema

4) CT :

- Started in 1970
- Expensive
- More radiation
- Fast
- Contrast (IV, Oral, rectal) usually used
- Used in emergency department

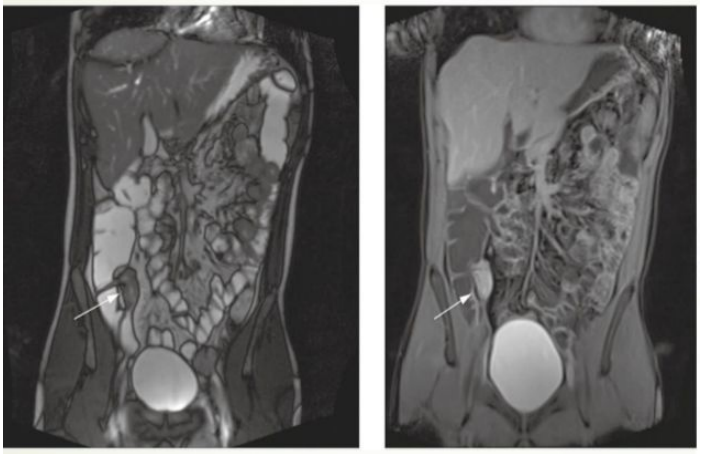
How to differentiate between Bone, soft tissue, fat and air in CT?
A: by different densities (Same as X-ray)

We don't use barium in CT because it'll cause artifacts (errors that can mimic pathology).



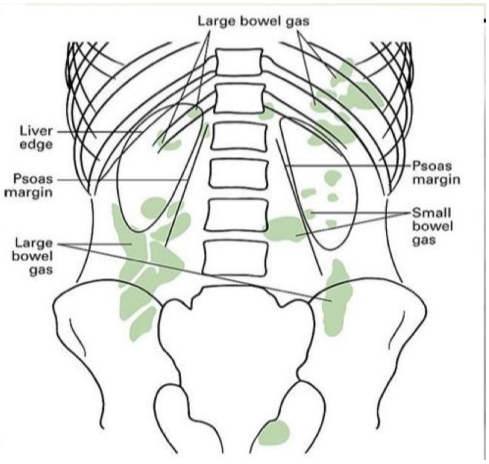
5) MRI :

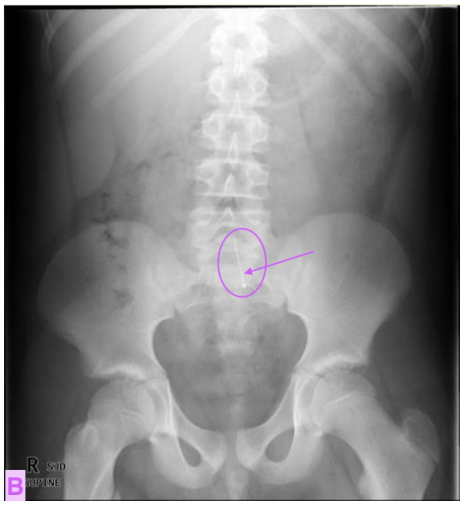
- Started at the beginning of 1980
- More expensive than CT
- No radiation
- Slow and affected by artifacts (Like motion or bowel movements)
- Excellent for soft tissue.
- Can't be reformat.



MRI of Crohn's disease. (first pic) Coronal T2 and (second pic) coronal T1 post contrast images demonstrating mucosal thickening and enhancement involving the terminal ileum (arrows), characteristic of Crohn's disease

Radiological appearance of the GIT



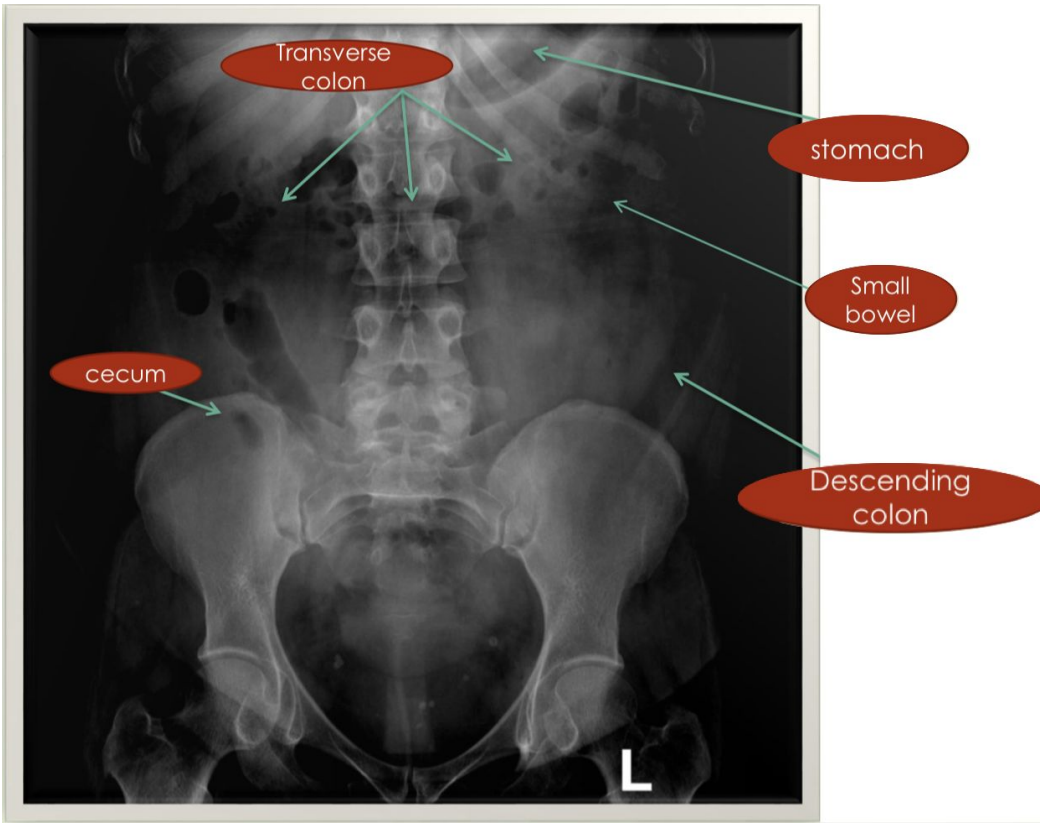


Normal plain abdominal film.

(a) Normal abdomen. The arrows point to the lateral borders of the psoas muscles. The renal outlines are obscured by the overlying colon.

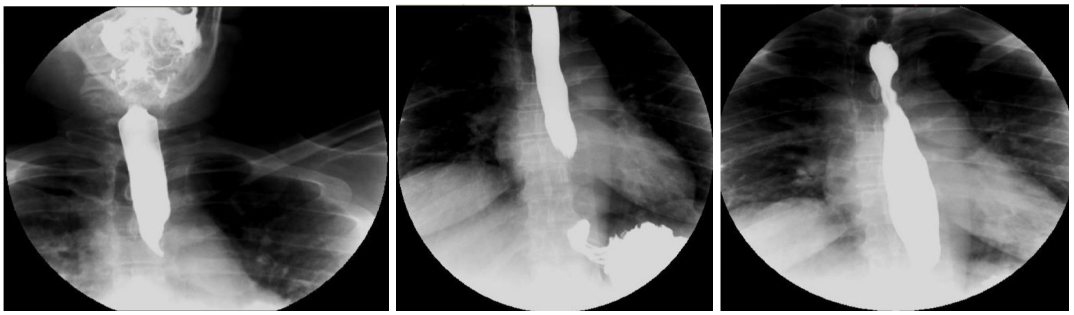
(B) the white line(metal density) in the pink circle is umbilical piercing.+ you can see liver edge (contrast between fat and liver)

(c) Normal extraperitoneal fat stripe. Part of the right flank showing the layer of extraperitoneal fat (arrows), which indicates the position of the peritoneum.



Esophageal Barium Swallow

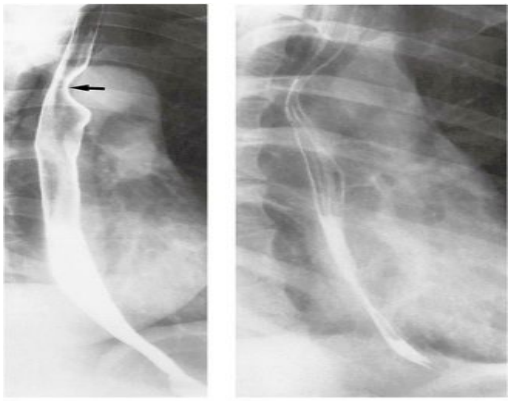
In this image we can't see the esophagus because we didn't use contrast



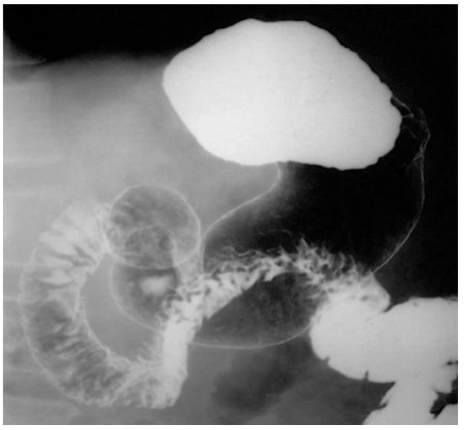
but if we fill it with contrast, it'll appear denser (like in the other images).

- **to study the upper GI (esophagus, stomach and <u>first part</u> of duodenum). We used contrast x-ray (fluoroscopy), and we ask the patient to swallow a barium (contrast). This imaging can be used to evaluate upper GI by:**

➔ evaluating the motility of the esophagus.
➔ evaluating the transit time of the contrast
➔ evaluating obstruction / stricture

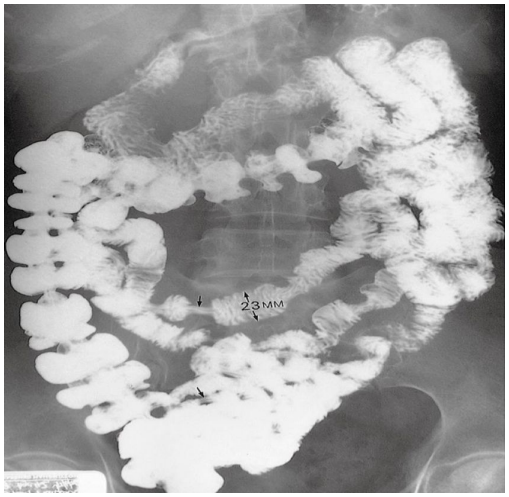


Esophagus: the arrow pointing to a normal narrowing due to the <u>aortic arch.</u> There is no bulging or any other abnormality like strictures.



Stomach : The contrast is shown in the fundus smooth mucosa, no filling defect.

Barium follow-through "rare"

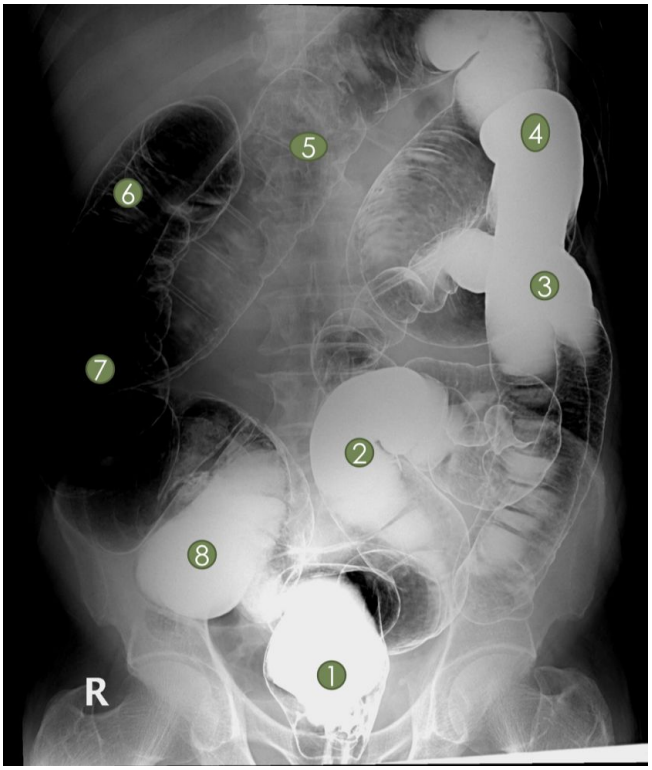


Normal barium follow-through. The small intestine, ascending and transverse colon are filled with barium. The small intestine, ascending and transverse colon are filled with barium. The jejunum in the left side of the abdomen has a much more marked mucosal fold

They do this study by **inserting a tube** into the **stomach ,duodenum** and then when it reach jejunum they will inject a contrast + fluid. Normal enteroclysis (small bowel enema). This technique gives good mucosal detail. The arrow points to the terminal ileum. Note that a tube has been passed

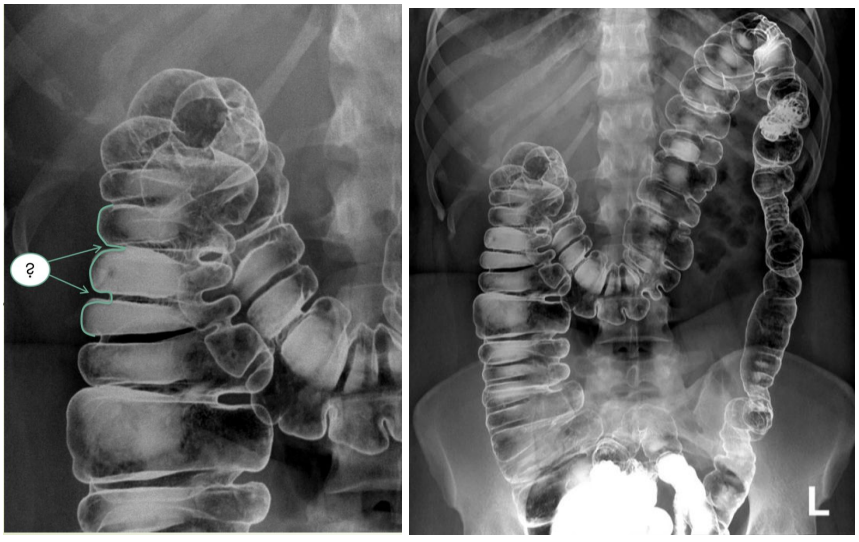
pattern than the ileum, which is lying in the pelvis. When a peristaltic wave contracts the bowel, the mucosal folds lie longitudinally (arrows). Note the way of measuring the diameter of the bowel. In the pelvis the loops overlap and details of the bowel become hidden.	through the stomach into the jejunum.

- Large bowel will be seen in the lateral of the picture frame while in the center we can see the small bowel.
- The contrast in large bowel will fill the whole diameter. on the other hand, the contrast in small bowel will fill part of the diameter.



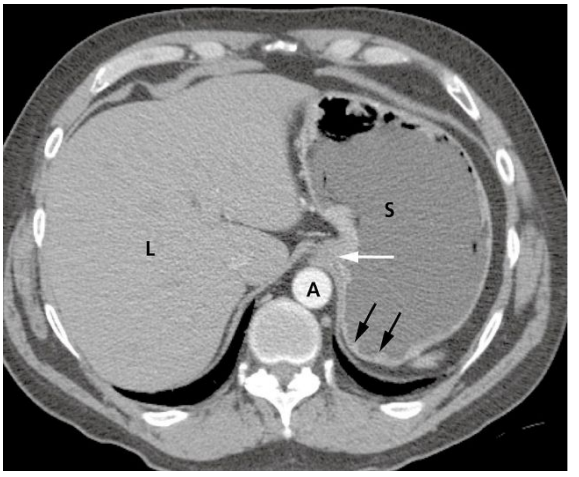
1) Rectum
2) Sigmoid Colon
3) Descending Colon
4) Splenic Flexure
5) Transverse Colon
6) Hepatic Flexure
7) Ascending Colon
8) Cecum

In this image they give the contrast per rectum (enema).



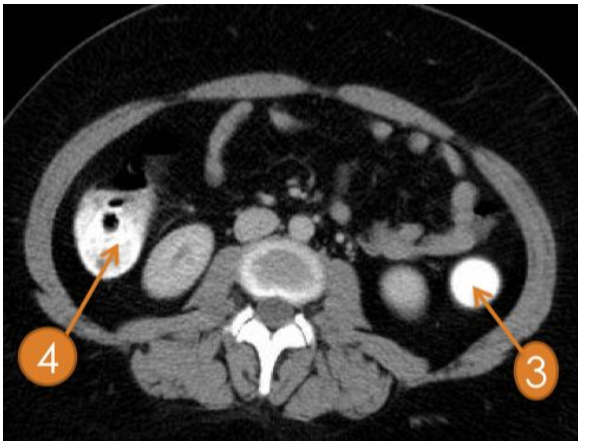
- The light green line is the Hustra
- This is a double contrast of the large bowl : first they inject the barium and the barium will make the outline clear. After that the patient will pass the barium out then we will inflate gas which will make the outline more clear.

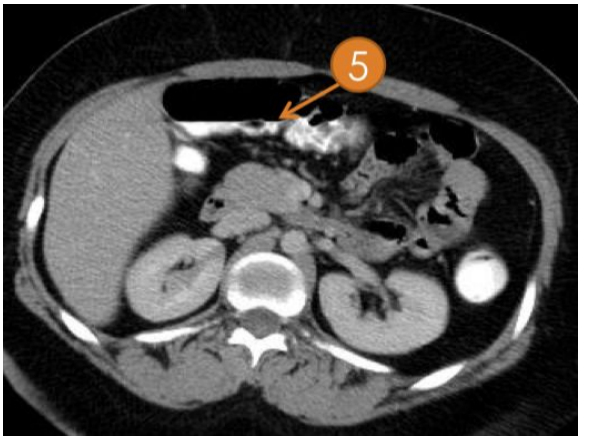
CT

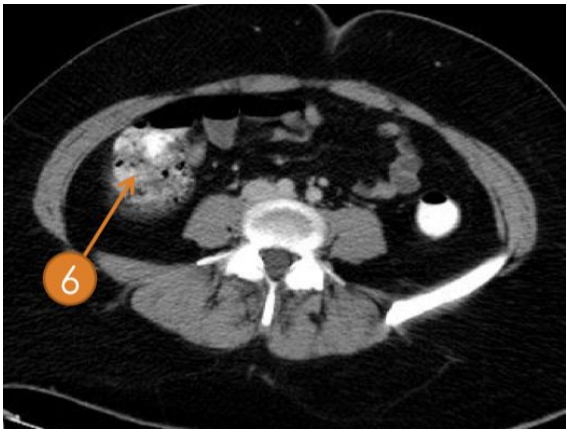


CT + angio contrast

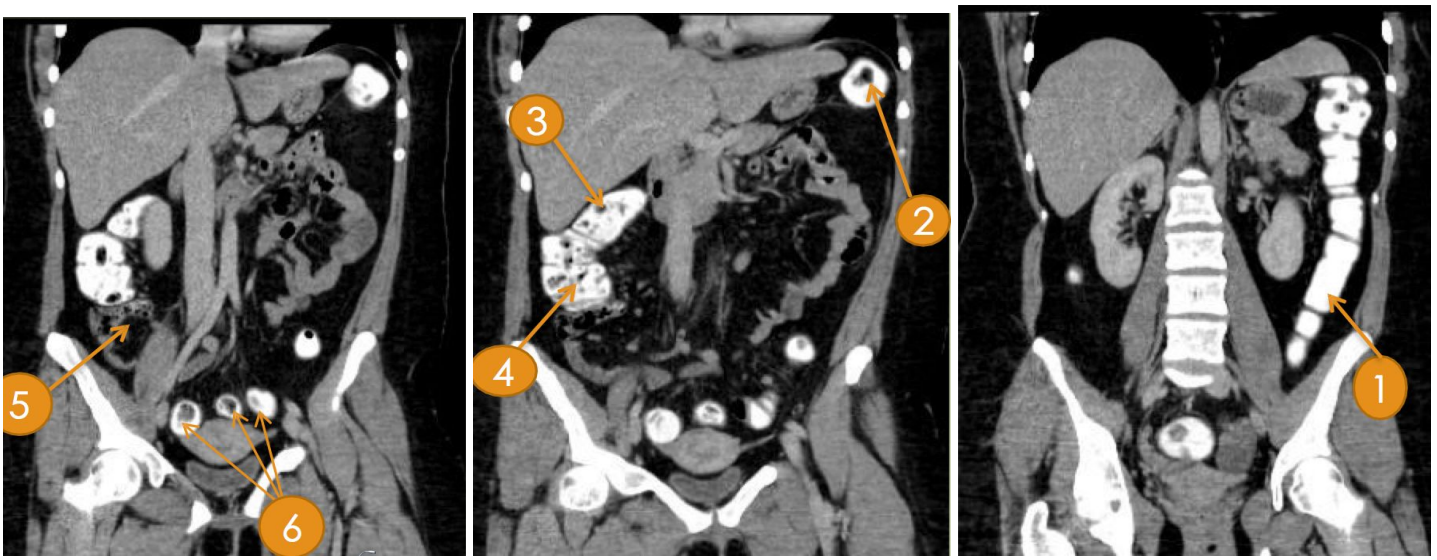
- ➢ **S**tomach
- ➢ **L**iver
- ➢ **A**orta
- ★ and the use of an intravenous smooth muscle relaxant. Some normal rugal folds are still visible (black arrows). Note the gastro-oesophageal junction (white arrow).





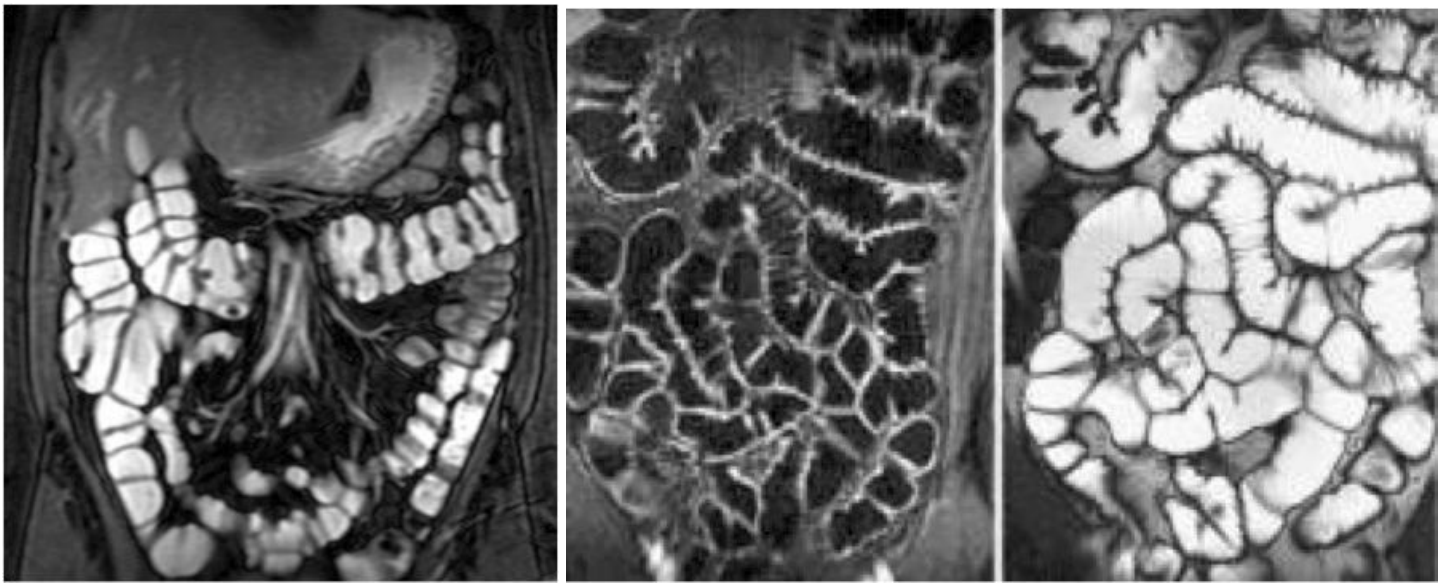


1/Rectum **2/**Sigmoid Colon **3/**Descending Colon **4/**Ascending Colon **5/**Transverse Colon **6/**Cecum



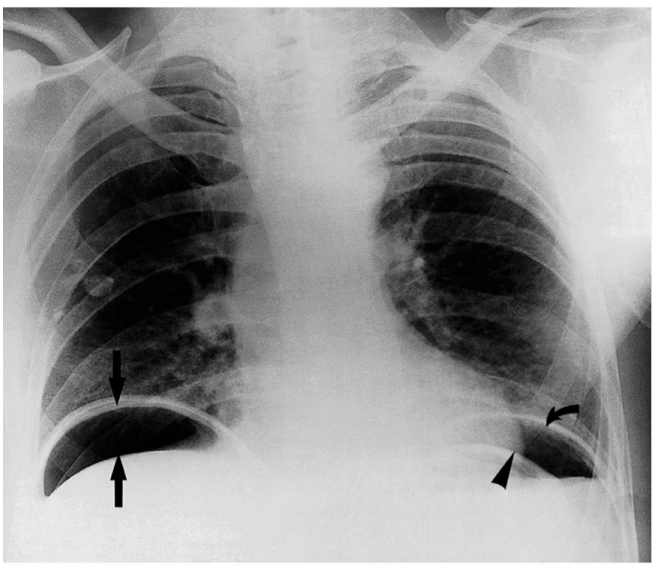
1/Descending Colon **2/**Splenic Flexure **3/**Hepatic flexure **4/**Ascending Colon **5/**Cecum **6/**Sigmoid Colon.

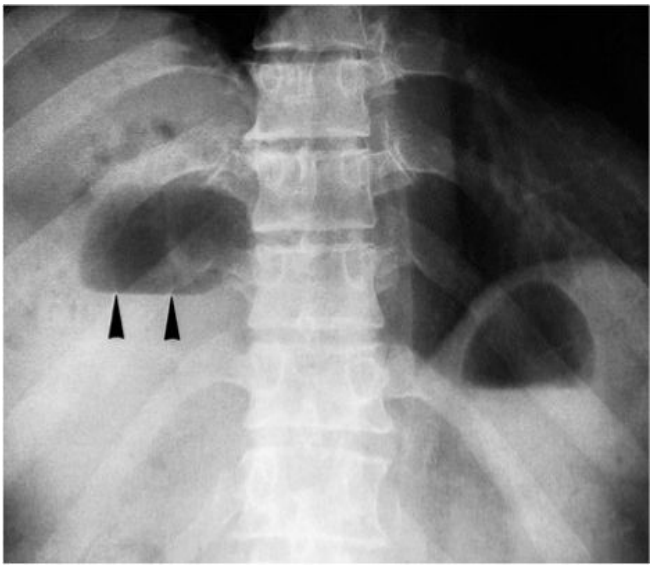
MRI enterography



- Used mainly to diagnose IBD (inflammatory bowel disease) and (Crohn's disease)
- Is now replacing the fluoroscopy by doing functional study. Fluid is used to distend the intestine.

Common plain X-ray abdomen radiograph findings





Left pic: "Pneumoperitoneum" due to perforation of viscus like peptic ulcer that give meniscus shaped free gas in abdomen. **The air–fluid level under the left hemidiaphragm is normal. It is in the stomach.**

On this chest radiograph, air can be seen under the domes of both hemidiaphragms. The curved arrow points to the left hemidiaphragm and the arrow head to the wall of the stomach. The two vertical arrows point to the diaphragm and upper border of the liver.***from the book***

Right pic: Gas in a right subphrenic abscess presenting as fluid level (arrowheads).

The air–fluid level under the left hemidiaphragm is normal. It is in the stomach.

❖ Why did the radiologist apply chest X-ray rather than abdominal X-ray?

- To exclude lower lobe pneumonia that caused by legionella which the abdominal pain is one of it's symptoms.

❖ What are the findings?

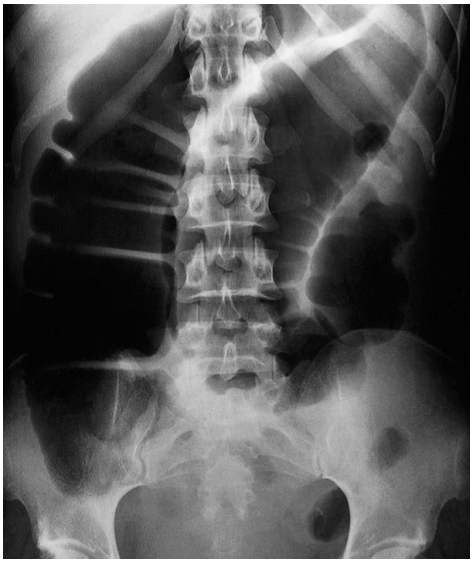
- Black arrows pointing to the air bubbles
- If the air bubble was at the site of stomach, it would be normal bubble (left side).
- While if it was on the right side, it indicates the perforation due to peptic ulcer.
- We can see normal air fluid level in the stomach and cecum as well as small intestines sometimes when they're full (after meal), but without distension of the intestines (which would indicate small bowel obstruction).

❖ **These two images are taken in two different positions, name them and tell the changes for each position.** Both: **"Small bowel obstruction"**

Erect position :
(the air fluid level + abnormally dilated bowel) air will be at the upper area while fluid will accumulate at the lower area.The jejunum is recognized by the presence of valvulae conniventes.

Supine position:
there is no air fluid level because air is projecting over fluid
• Stack of coin appearance
well demonstrated in the supine film. Note the large bowel contains less gas than normal.

- This is radiographic image shows gas filled structure(small bowl markedly dilated) > center of the abdomen and shows air-fluid levels in the erect film. And this presentation is due to small bowel obstruction.
- We do abdominal erect and supine film in bowel obstruction. To investigate the cause of obstruction (e.g. mass, stricture) we do CT
- What is the difference between these 2 images?
  Air-fluid level.
- Why it's only seen in one image although it's the same patient at the same moment?
  one of them erect and the other supine position. In supine air will be front and fluid go back, while in erect position air will be above and fluid go down so we will see air fluid level. it's there even in supine position but we can't see it.



Large bowel obstruction (megacolon) due to carcinoma at the splenic flexure. There is marked dilatation of the large bowel from the caecum to the splenic flexure.

Paralytic ileus:There is considerable dilatation of the whole of the large bowel extending well down into the pelvis. Small bowel dilatation is also seen.

(1)

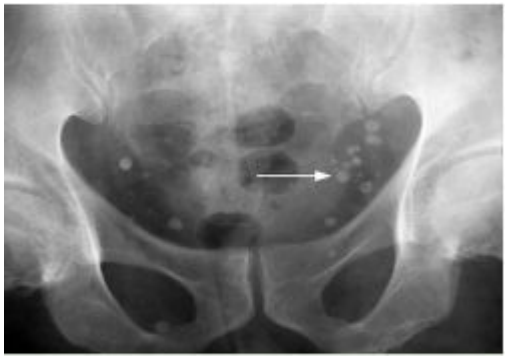
(2)

Abdominal x ray (erect position) show markedly decreased gases (opacity)

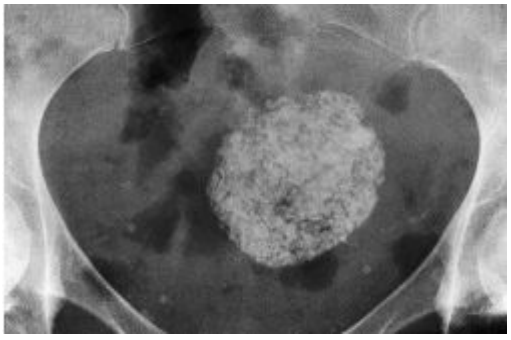
(1) Mass > **Displacement** of gut toward left side, and there's opacity (soft tissue mass)> most likely ovarian mass. Abdominal mass (opacity) displacing the bowel to the upper left side **(1)**. This mass is cystadenocarcinoma of the ovary

(2) Less gas than pic1 and it's **distributed** with adding density > ascites. In ascites **(2)** we can see scanty gas and the bowel is in the same location. Ascites. Note how the gas in the ascending and descending colon (arrows) is displaced by the fluid away from the side walls of the abdomen.

Calcification of the abdomen

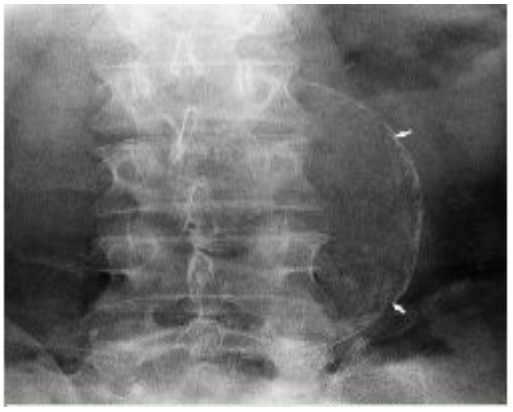


Calcification within the pelvic base (phleboliths[2])
Commonest, low dentistry center



Calcified mass lesion this is uterine fibroid (leiomyoma)

Calcification in the pancreas (chronic pancreatitis)

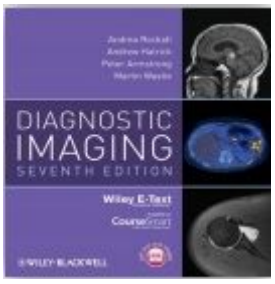


This is calcified abdominal aortic aneurysm
The aneurysm measured 8 cm in diameter on the lateral view.

[2] calcification within the venous system of the pelvis mimicking ureteric stone (common with aging)

Calcified mesenteric lymph nodes from old tuberculosis (arrows).

Extra: Notes from Diagnostic imaging book



• 1- The standard plain film of the abdomen is a supine antero-posterior (AP).
• 2- Erect films offer little further diagnostic information at the expense of increased radiation exposure to the patient.
• 3- Free intraperitoneal air can be seen on an erect chest radiograph (CXR), which is usually performed at the time of the abdominal x-ray.
• 4- in patients who are unable to sit or stand, a lateral decubitus view (i.e. an AP film with the patient lying on his or her side) is performed using a horizontal x-ray beam as a means of detecting free intraperitoneal air.

• There are a number of points to be considered when looking at a plain abdominal film:

• Analyze the intestinal gas pattern and identify any dilated portion of the gastrointestinal tract.
• Look for gas outside the lumen of the bowel.
• Look for ascites and soft tissue masses in the abdomen and pelvis.
• If there are any calcifications, try to locate exactly where they lie.
• Assess the size of the liver and spleen

•Intestinal gas pattern: Relatively large amounts of gas are usually present in the stomach and colon in a normal patient. The stomach can be readily identified by its location above the transverse colon

• Dilatation of the bowel: the pattern of dilatation is the key to the radiological distinction between small and large bowel obstruction

• small bowel obstruction: the small intestine is dilated down to the point of obstruction and the bowel beyond this point is either empty or of reduced caliber

•large bowel obstruction: the large bowel is dilated down to the level of obstruction.

❖ Pneumoperitoneum :

• The radiological diagnosis of perforation of the gastrointestinal tract is based on recognizing free gas in the peritoneal cavity.

• The most common cause of spontaneous pneumoperitoneum is a perforated peptic ulcer
• The largest quantities of free gas are seen after colonic perforation, and the smallest amounts with leakage from the small bowel.
• Pneumoperitoneum under the right hemidiaphragm is usually easy to recognize on an erect CXR as a curvilinear collection of gas between the line of the diaphragm and the opacity of the liver.
• Free gas under the left hemidiaphragm is more difficult to identify because of the overlapping gas shadows of the stomach and the splenic flexure of the colon.

Gas in an abscess

• Gas in an abdominal (slide 10) or pelvic abscess produces a very variable pattern on plain films. It may form either small bubbles or larger collections of air, both of which could be confused with gas within the bowel.
• Fluid levels in abscesses may be seen on a horizontal x-ray lm.
• As abscesses are mass lesions, they displace the adjacent structures; for example, the diaphragm is elevated with a subphrenic abscess, and the bowel is displaced by pericolic and pancreatic abscesses.
• A pleural effusion or pulmonary collapse/ consolidation are very common in association with sub-phrenic abscess
• Ultrasound and CT are extensively used to evaluate abdominal abscesses

Gas in the wall of the bowel

• Numerous spherical or oval bubbles of gas are seen in the wall of the large bowel in adults in the benign condition known as pneumatosis coli.
• Linear streaks of intramural gas have a more sinister significance as they usually indicate infarction of the bowel wall.
• Gas in the wall of the bowel in the neonatal period, whatever its shape, is diagnostic of **necrotizing enterocolitis**, a disease that is fairly common in premature babies with respiratory problems.

❖ Ascites:

・Small amounts of ascites cannot be detected on plain films. Larger quantities separate the loops of bowel from one another and displace the ascending and descending colon from the fat stripes
・indicate the position of the peritoneum along the lateral abdominal walls
・Ascites is readily recognized at ultrasound or CT

Abdominal calcification:

the pattern or shape of the calcification will usually limit the diagnosis to just one or two choices

Calcifications in the abdomen are likely to be one of the following:

・Pelvic vein phleboliths are very common
・Calcified mesenteric lymph nodes: caused by old tuberculosis
・Vascular calcification: occurs in association with atheroma, and generally has a curvilinear appearance. Calcification is frequently present in the walls of abdominal aortic aneurysms, if suspected, further evaluation should be undertaken with ultrasound
・Uterine fibroids: may contain numerous irregularly shaped, well-defined calcifications

Causes of abdominal calcification:

・Pelvic vein phleboliths
・Calcified mesenteric lymph nodes
・Vascular calcification
・Uterine fibroids
・Soft tissue calcification
・Ovarian masses
・Adrenal calcification
・Liver calcification
・Gall stones
・Splenic calcification

- Pancreatic calcification
- Faecoliths
- Renal stones and other calcifications of the urinary tract

Calcified mesenteric lymph nodes from old tuberculosis (arrows).

Adrenal calcification (arrow).

• **Soft tissue calcification** in the buttocks may be seen following injection of certain medicines. These shadows can at times be confused with intra-abdominal calcifications.

• **Malignant ovarian masses** occasionally contain visible calcium. The only benign ovarian lesion that is visibly calcified is the dermoid cyst, which may contain various calcified components, of which teeth are the commonest • **Adrenal calcification** occurs after adrenal haemorrhage, after tuberculosis and occasionally in adrenal tumours. However, the majority of patients with adrenal calcification are asymptomatic healthy people in whom the cause of the calcification is unclear. Only a minority of patients with Addison's disease have adrenal calcification.

• **Liver calcification** occurs in hepatomas and rarely in other liver tumours. Hydatid cysts, abscesses and tuberculosis may also calcify over time.

• **Splenic calcification** is rarely of clinical significance. It is seen in cysts, infarcts, old haematomas and following tuberculosis.

• **Pancreatic calcification** occurs in chronic pancreatitis. The calcifications are mainly small calculi within the pancreas. The position of the calcification usually enables the diagnosis to be made without difficulty

• **Faecoliths. Calcified faecoliths** may be seen in diverticula of the colon or in the appendix. Appendiceal faecoliths are an important radiological observation, as the presence of an appendolith is a strong indication that the patient has acute appendicitis, often with gangrene and perforation. However, only a small proportion of patients with appendicitis have a radiologically visible appendolith.

❖ Liver and Spleen:

• Substantial enlargement of the liver has to occur before it can be recognized on a plain abdominal film. As the liver enlarges it extends well below the costal margin, displacing the hepatic flexure, transverse colon and right kidney downwards and displacing the stomach to the left. The diaphragm may also be elevated.

• As the spleen enlarges, the tip becomes visible in the left upper quadrant below the lower ribs. Eventually, it may fill the left side of the abdomen and even extend across the midline into the right lower quadrant. The splenic flexure of the colon and the left kidney are displaced downwards and medially, and the stomach is displaced to the right.

❖ Abdominal and Pelvic masses:

• Attempting to diagnose the nature of an abdominal mass on a plain film is notoriously difficult, and ultrasound, CT or magnetic resonance imaging (MRI) are the appropriate imaging modalities.

• The site of the mass, the displacement of adjacent structures and the presence of calcification are important diagnostic signs but plain films are unable to distinguish between solid and cystic masses.

• An enlarged bladder can be seen as a mass arising from the pelvis, displacing loops of bowel. In females, uterine and ovarian enlargements also appear as masses arising from the pelvis. Ovarian cysts can become very large, almost filling the abdomen and displacing the bowel to the sides of the abdomen