



431

## Radiology Team

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## Lecture 11: Radiological Anatomy & investigation of The GIT



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◆ Important    ◆ Doctor's notes    ◆ Team's notes

\*We thank 430 Team for their helpful notes\*

## Objectives:

- To know radiology modalities used in GI tract imaging.
- To know advantages and disadvantages of each modality.
- To know indications and contraindications of each modality.
- To know the radiological anatomy of the GI tract.

## Anatomy of GIT:

- Esophagus.
- Stomach: fundus, body, antrum, LCS, GCS.
- Duodenum.: 1<sup>st</sup> to 4<sup>th</sup> portion.
- Small intestine: jejunum a LUQ, ileum at RLQ.
- Colon: cecum, appendix, AC, TC, DC, SC, rectum.

**Upper GI:** esophagus, stomach, and duodenum.

**Lower GI:** jejunum, ileum and colon.



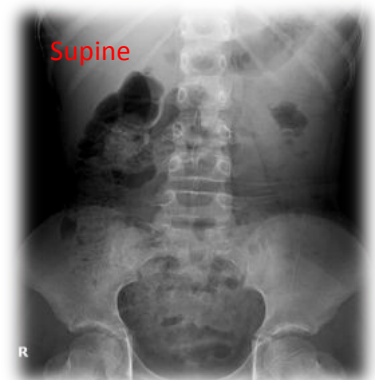
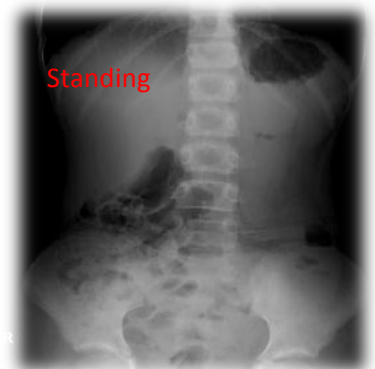
## Studies that can be done include:

- Plain radiograph of abdomen (KUB).
- Barium study.
- Ultrasound.
- CT.
- MRI.
- Angiography.

## 1] Abdominal X-Ray

### How To Assess The Film:

- **Basic Details:** name, age, gender, date and appearance of the image (well or poorly penetrated).
- Establish the **projection** of the film (AP) and whether it is **supine** or **erect**. (It is important to choose the appropriate x-ray position because—for example- in the erect position we can see if there is air under the diaphragm, which indicates perforation. In such cases we should ask for KUB or abdominal x-ray + chest x-ray)
- Check **left** and **right**.
- **Check** Bone, Soft tissue/Solid Organs, Calcification, Gas pattern & Artefacts.



### How to Assess The Film: Gas (Focus on this)

- \*Essentially you're looking at the bowels here.
- \*Before you start, **check** if there is **gas under the diaphragm** (if it is visible).
- \*Look at small bowel and large bowel.

### A) Small bowel:

- \*Because of peristalsis the outline of the gas in the normal small bowel is often **broken up into many small pockets** (not fully filled with gases or solids).
- \*It is generally central in the abdomen
- \***Jejunum has 'valvulae conniventes'** (feathery appearance). **Ileum is characteristically featureless**
- \*The calibre of the normal small bowel **should not exceed 2.5–3 cm**. (If it exceeds 3 cm → dilated)
- \*If small bowel is **not visible at all**, it suggests that it is **abnormal**.

How can we differentiate between erect and supine position on an image?

In the erect position, air-fluid level can be seen in the stomach or bowel loops.

## B) Large bowel:

- \*The caecum normally contains semifluid material containing multiple pockets of gas and, like much of the right side of the bowel, assumes a granular appearance on X-rays, creating mottled areas of gas seen best against the background of the iliac bone.
- \*When visible the haustral folds of the colon may be seen, only partially visualized across part of the large bowel lumen.

**How to Assess The Film: Bone** "It's very important to assess the bone, I will not talk in details about the bone, but you can see generally the vertebral column, the iliac, the sacroiliac joint and the hip joints."

- \*Ribs, spine, sacrum, pelvis & hips
- \*Bones may show evidence of malignant disease
- \*Sacro-iliitis may be associated with intestinal problems such as Crohn's disease
- \*Excessively sclerotic bones may hint at other diseases e.g. Paget's (which can present as abdominal pain) or GI ulcers (which are associated with sclerotic bone lesions)
- \*Don't forget to check the spine for conditions such as ankylosing spondylitis

## How to Assess The Film: Soft Tissue

- \*Trace soft tissue outline for any clues as to pathology (e.g. obesity, trauma sites, abdo drains etc)

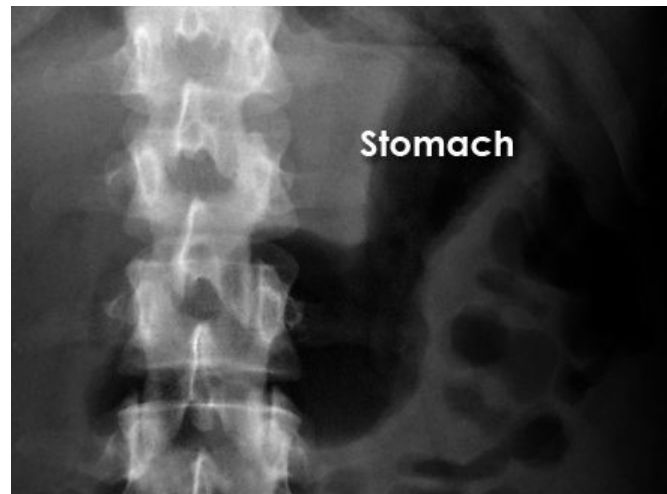
### Also look for:

- \*Psoas muscles
- \*Kidneys (left is higher and slightly bigger than the right)
- \*Liver (difficult to see but may be identifiable by lack of bowel in RUQ)
- \*Spleen (difficult to see)
- \*Bladder (visible if full, not always visible if empty) – a full bladder may hint that you are looking for an acute problem, rather than a chronic one
- \*Uterus (causes a dent in the top of the bladder on IVU).

How to differentiate between air in the stomach and perforation?

1- air-fluid level + left side + the air is contained not spreading here & there >>> means this is the stomach

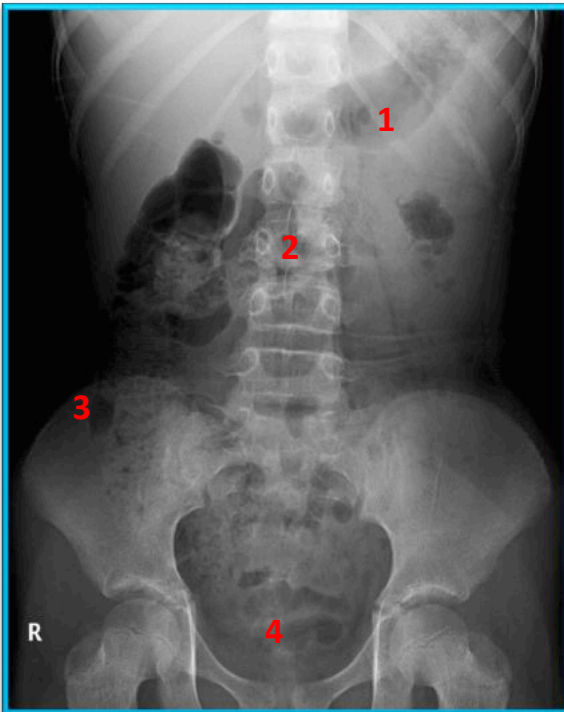
2- if the air is extending here & there >> means perforation



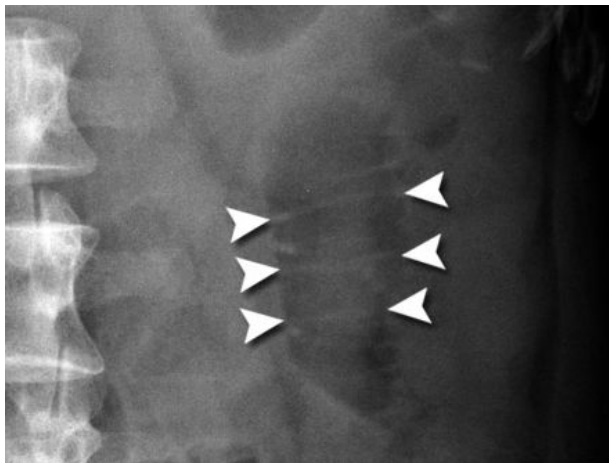
### Normal stomach

If the stomach contains air it may be visible in the left upper quadrant of the abdomen. The lowest part of the stomach crosses the midline.





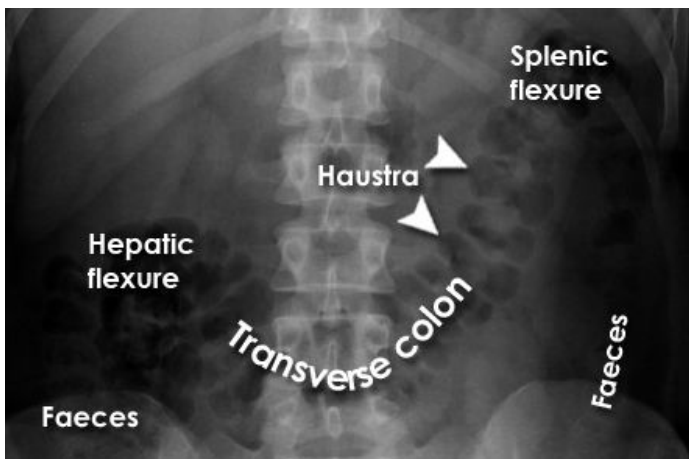
- 1) Stomach
- 2) Small bowel
- 3) Large bowel
- 4) Rectum



### Normal small bowel

Identified by -

- Central position in the abdomen
- Valvulae conniventes - mucosal folds that cross the full width of the bowel (arrowheads)



### Normal large bowel

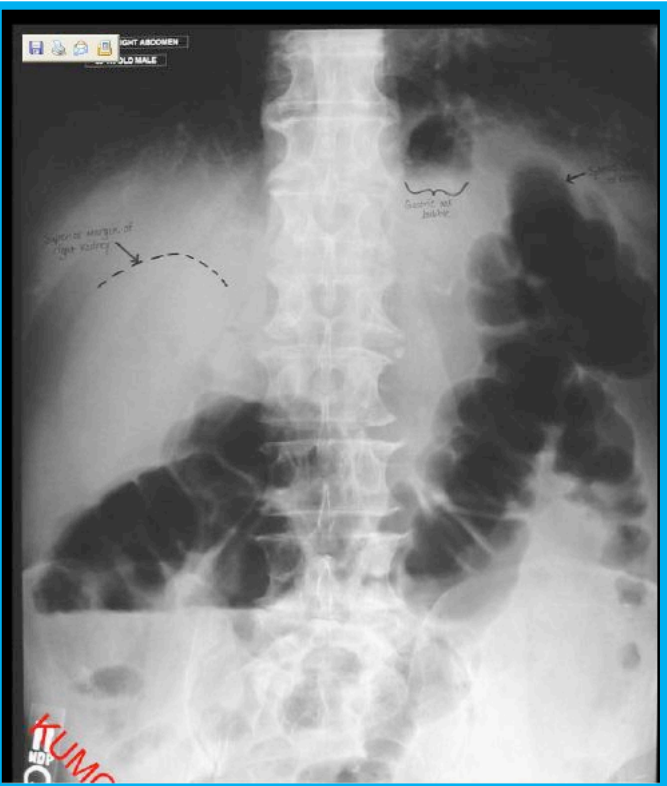
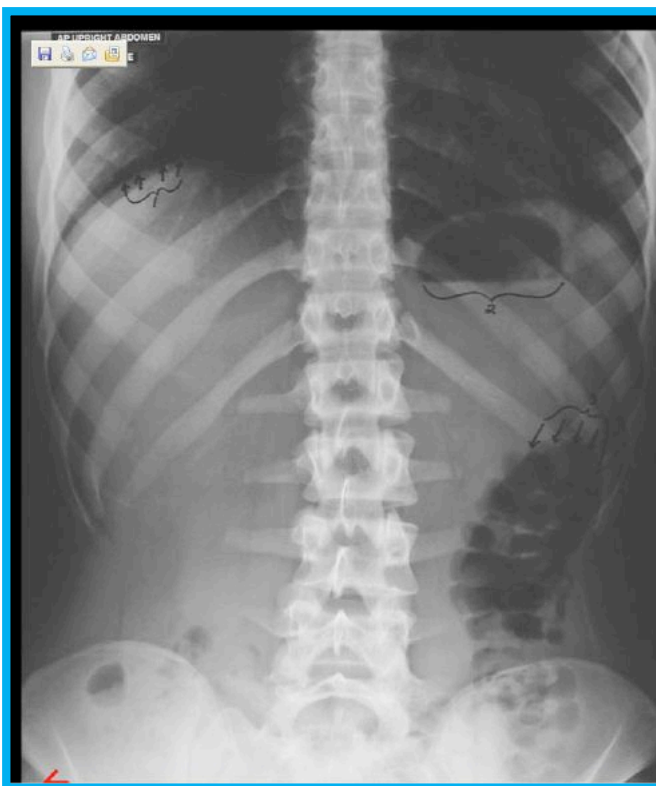
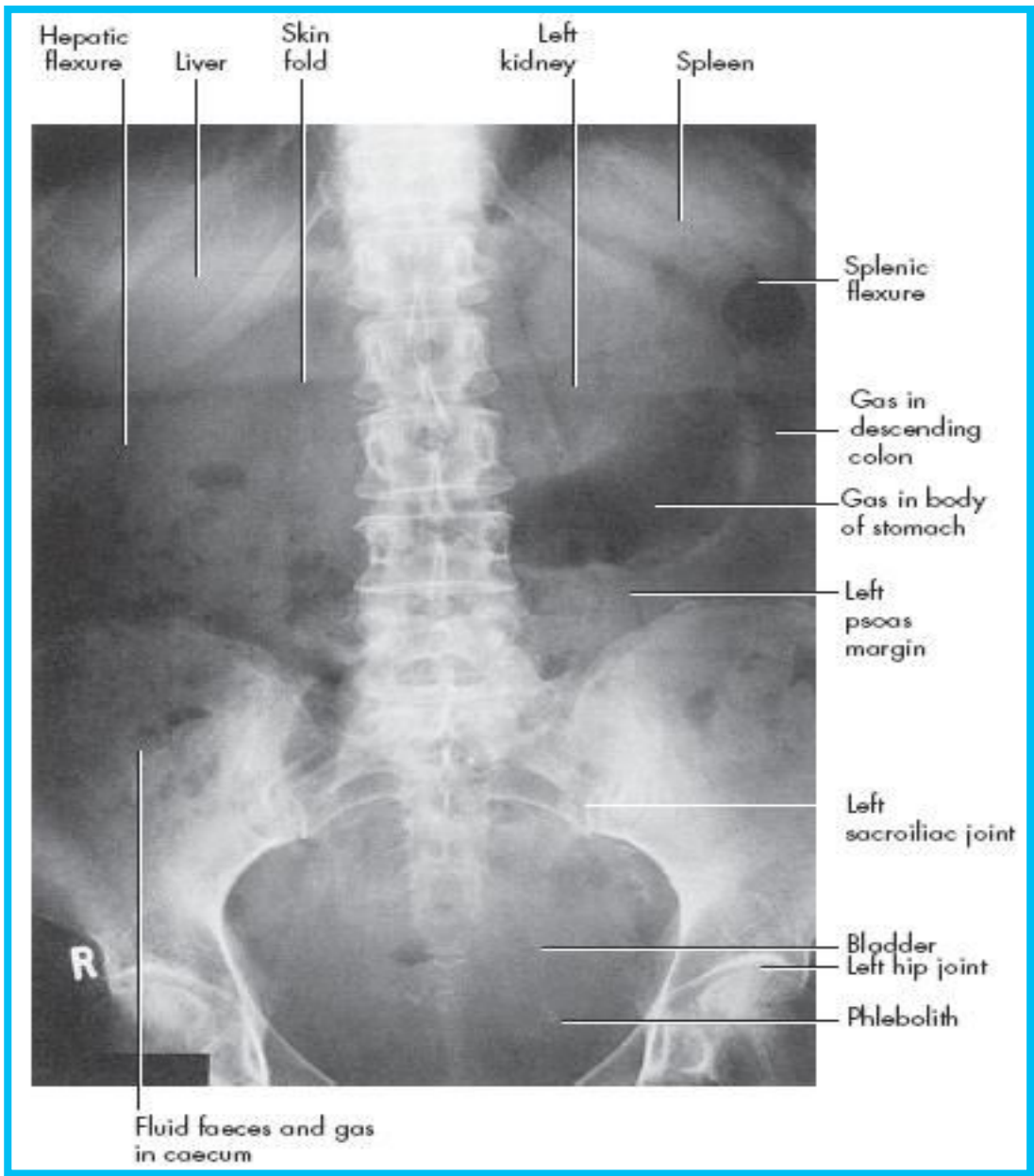
Normal large bowel may be identified by -

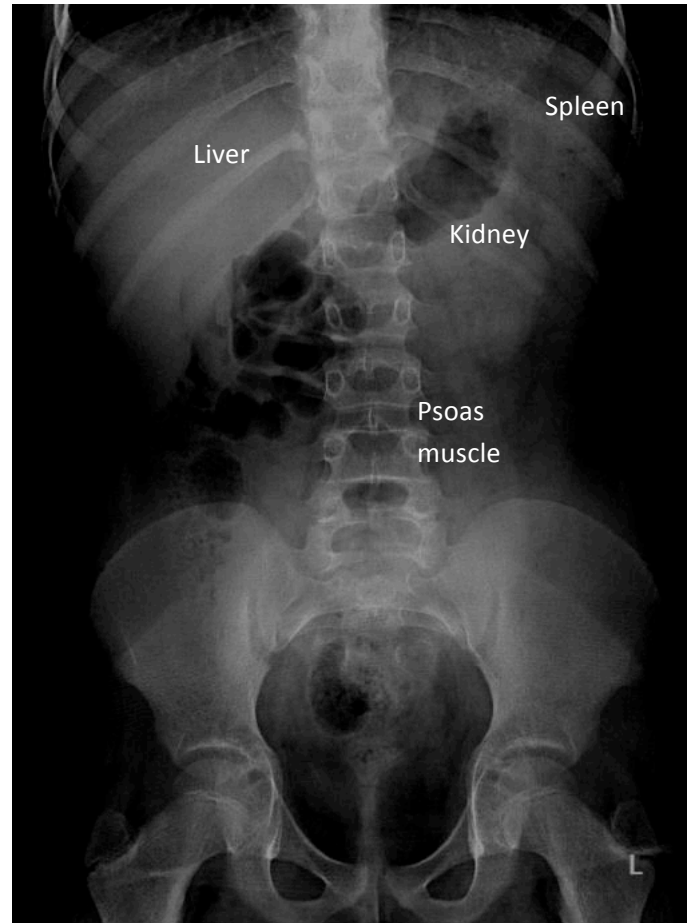
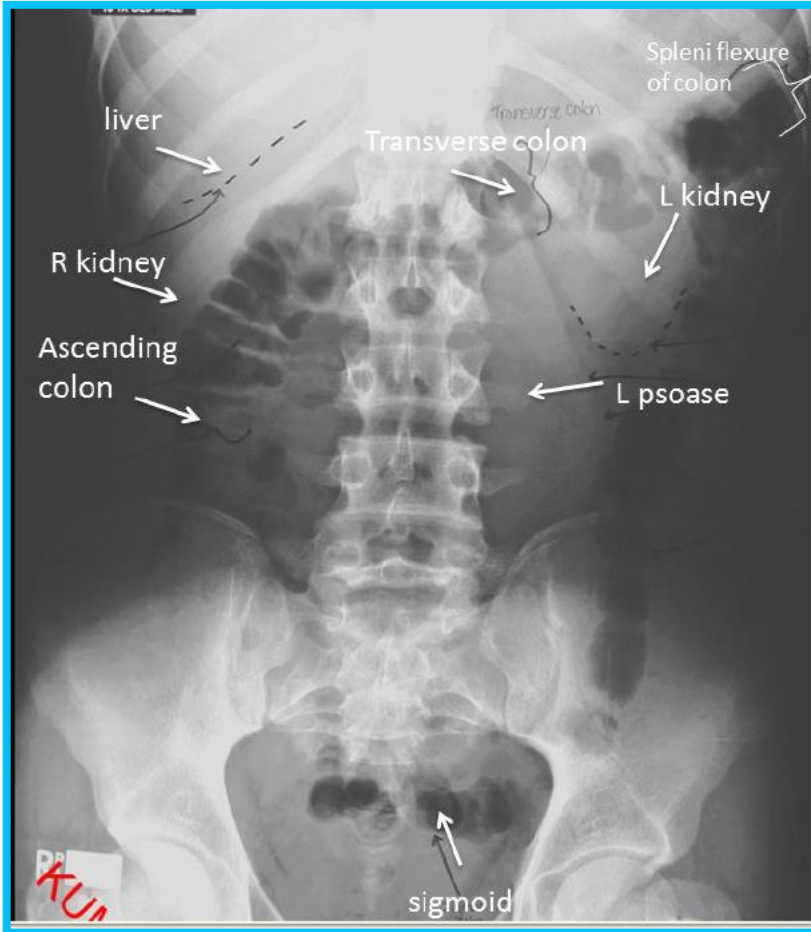
- Peripheral position in the abdomen (the transverse and sigmoid colon occupy very variable positions)
- Haustra (arrowheads)
- Contains faeces



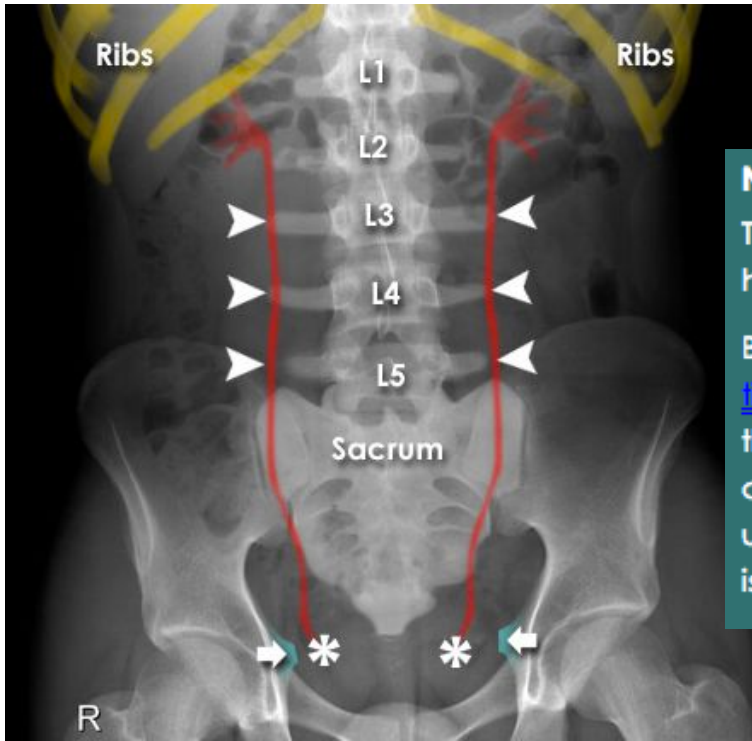
### Navel jewellery artifact

Ideally all jewellery that overlies anatomically important structures should be removed prior to acquiring an X-ray

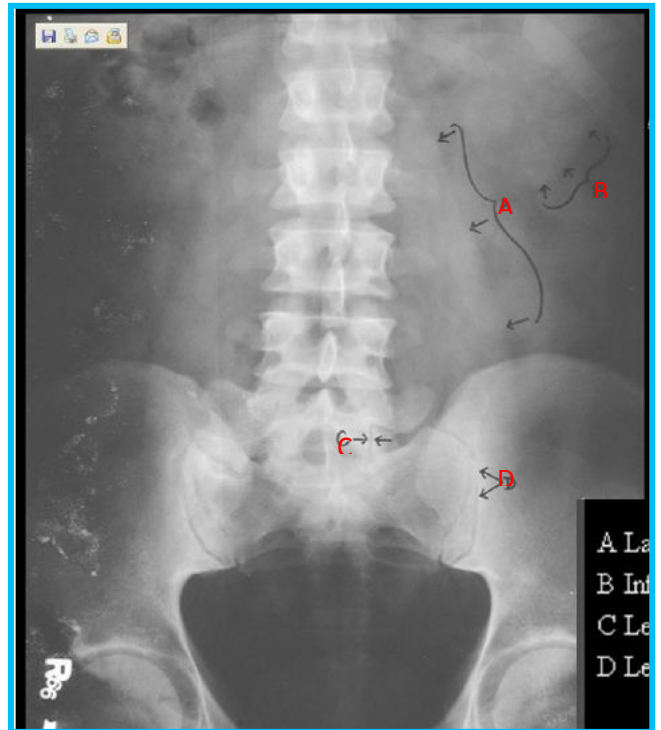








**Normal bones on abdominal X-ray**  
 The lower ribs, lumbar vertebrae and sacrum are highlighted.  
 Bones can be used as landmarks for invisible soft tissue structures. Note the transverse processes of the lumbar vertebrae act as landmarks for the course of the ureters (arrowheads). The vesico-ureteric junctions(\*) are located at the level of the ischial spines (arrows).



- Right transverse process of L3
- Psoas major muscle
- Ala of sacrum
- Left sacroiliac joint
- Coccyx
- Ischial spine
- Left 12th rib
- Iliac crest

- A) Lateral margin of the psoas muscle.
- B) Inferior pole of the left kidney.
- C) Left L5-S1 facet joint
- D) Left sacroiliac joint

## How to Assess The Film: Calcification

Calcification occurs in:

- \***Calculi:** look in kidney, ureters & bladder.
- \***Phleboliths:** usually within pelvis, look like silt.
- \***Appendicoliths:** caused by faeces in appendix, may suggest appendicitis.
- \***Lymph nodes.**
- \***Aortic calcification:** aortic calcification is normal as age increases but you must check the aorta as asymmetry of the walls suggests aortic aneurysm.

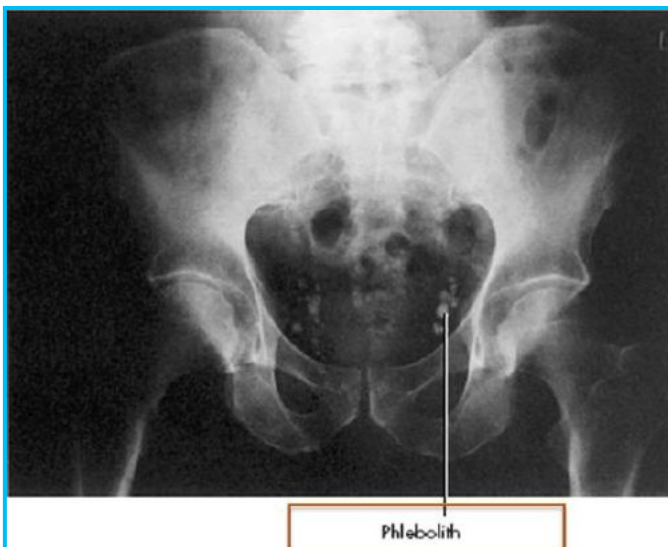
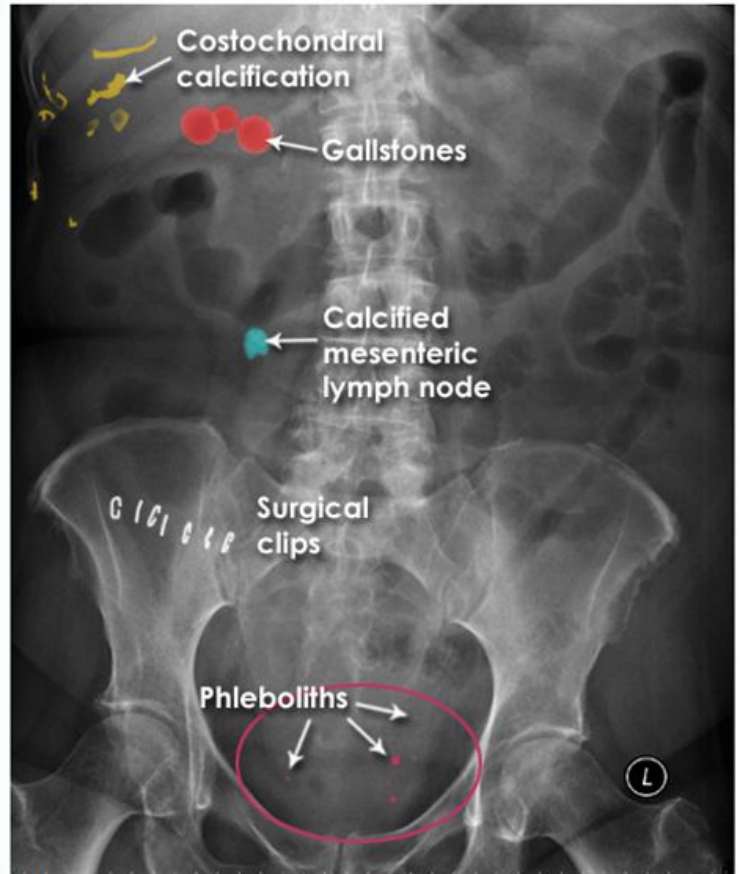
### Calcified structures

Hover over image to show findings

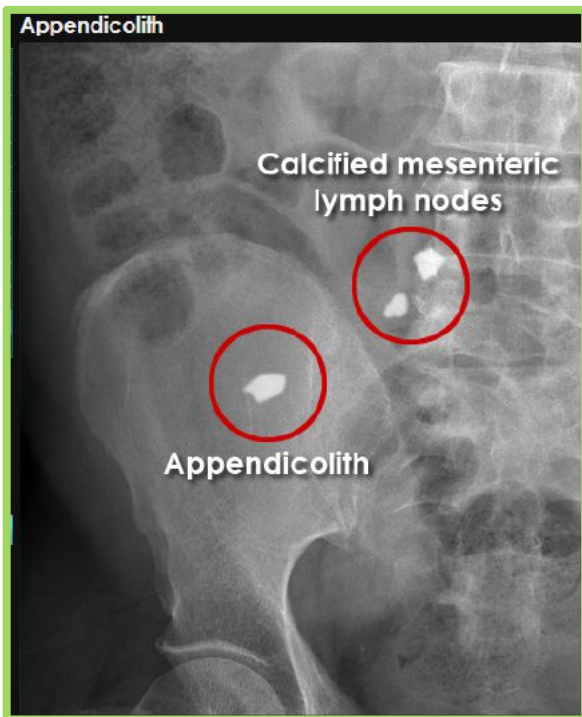


### Calcified structures

Hover over image to show findings







(Calcification of aorta and iliac vessels)

## 2] Contrast Study: (Main Indication: Dysphagia)

**Fluoroscopy:** an x-ray examination of the upper GI using barium as a contrast material.

- \*Single contrast study is mainly used to look at the esophagus
- \*Liquid barium is swallowed in an upright and prone position and radiographs are taken during the esophageal phase of transit
- \*We use single contrast: looking for GROSS things e.g. mass, obstruction, narrowing.
- \*We use double contrast: looking for details e.g. ulcers, better evaluation of the mucosa.
- \*Indications of barium swallow: Ulcers, perforation, obstruction, narrowing, reflux.
- \*Indications of barium meal: obstruction, narrowing of duodenum, masses, peptic ulcer and pyloric stenosis in pediatrics.
- \*For reflux we give barium swallow & barium meal.

\*Barium swallow → esophagus + fundus of the stomach

(Main indication: dysphagia)

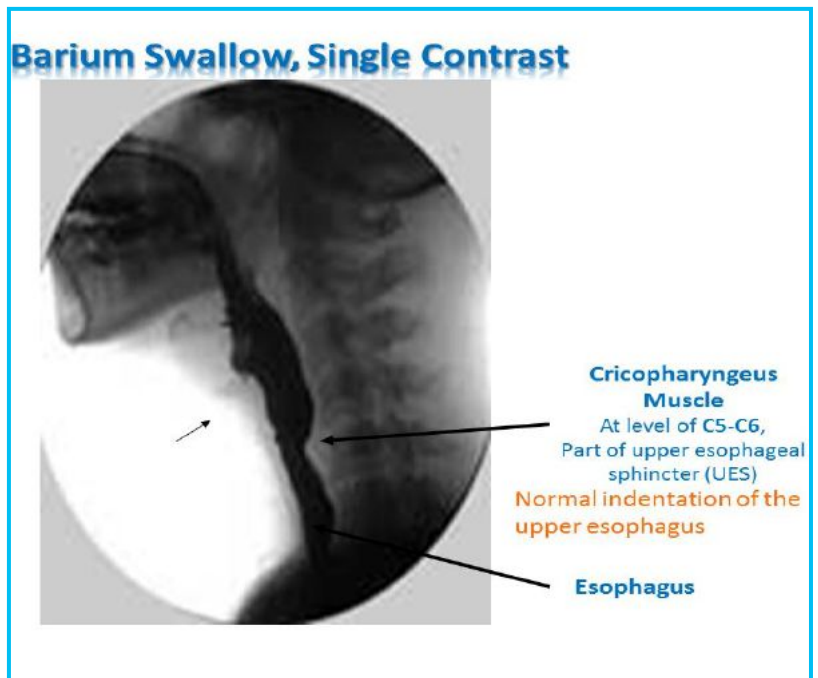
\*Barium meal → stomach + lower part of esophagus, gastroesophageal junction and duodenum

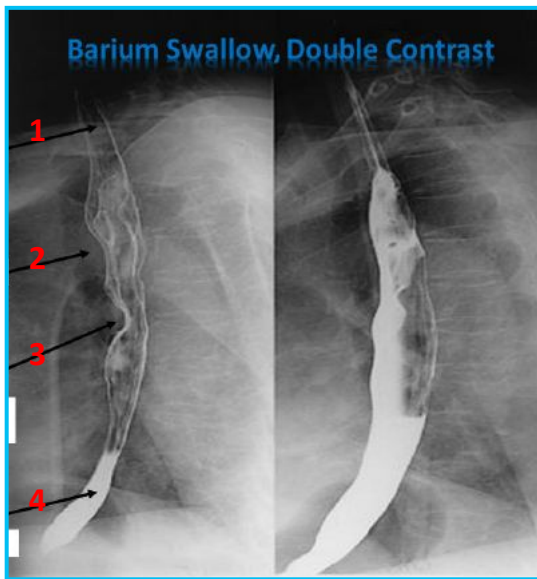
\*Barium follow through → Small bowel

Normal indentation:

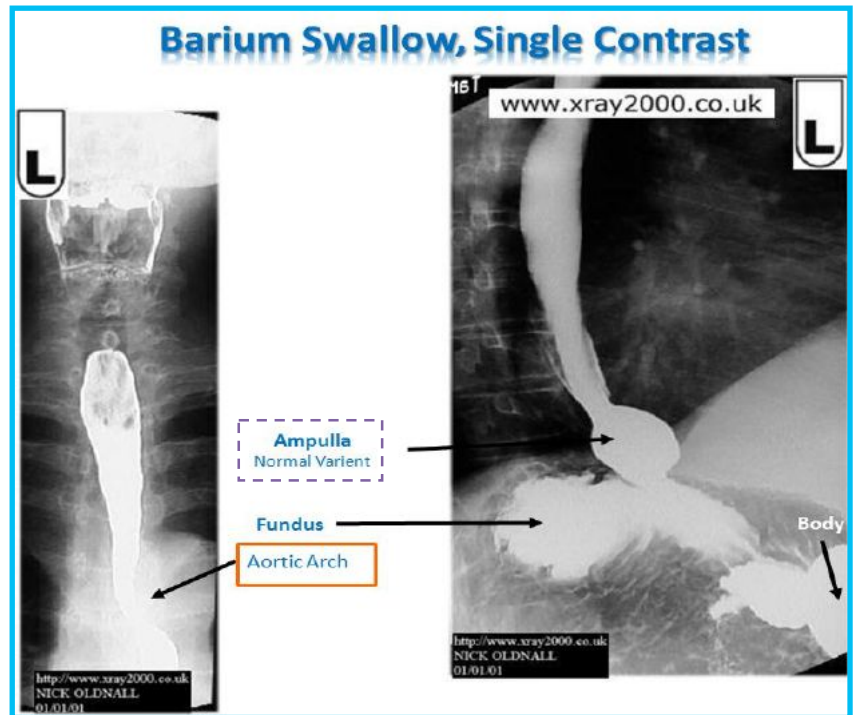
Aortic arch – Left atrium – Left ventricle  
Left main bronchus

Don't mistaken them with abnormalities

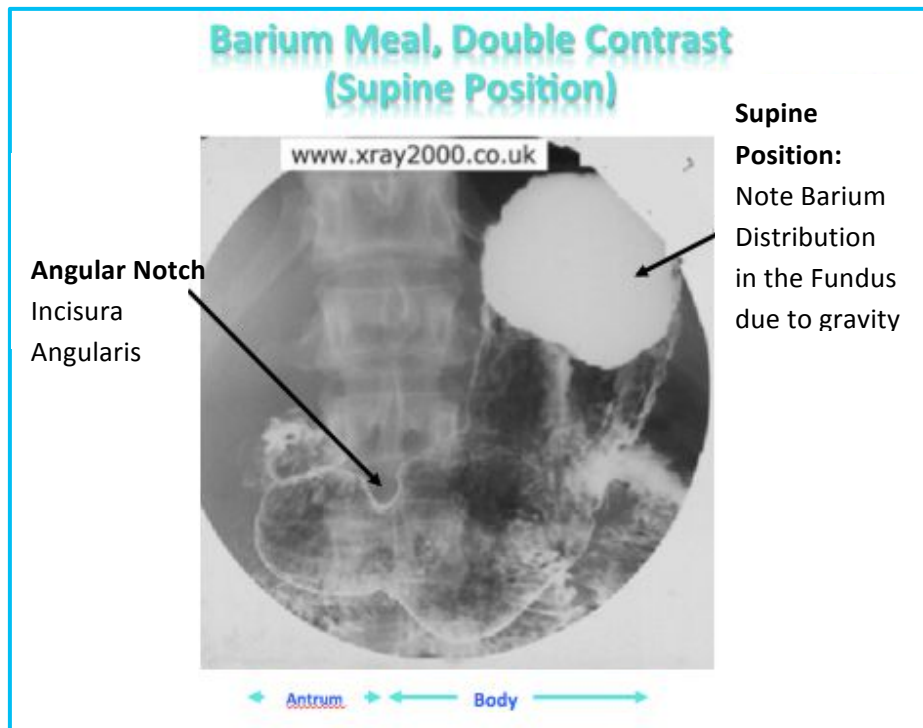
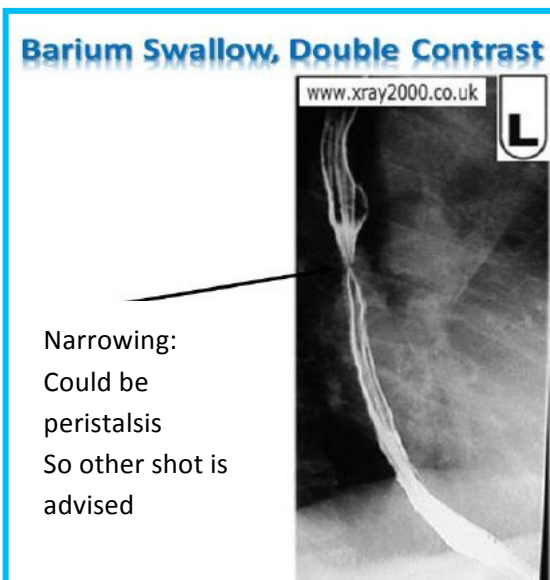
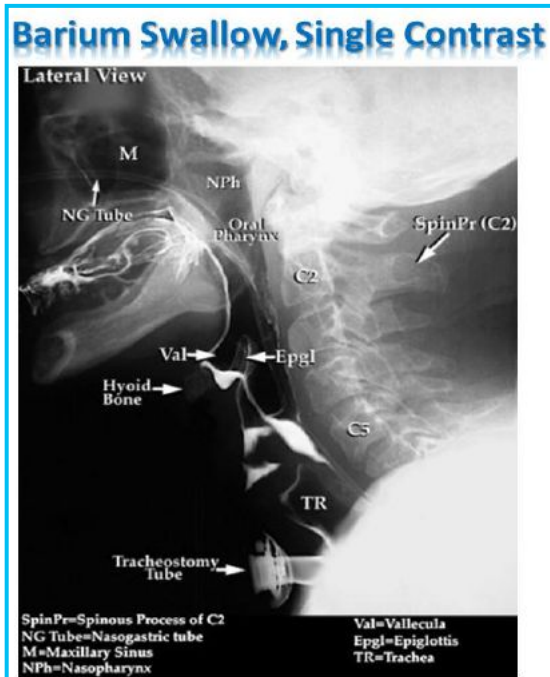


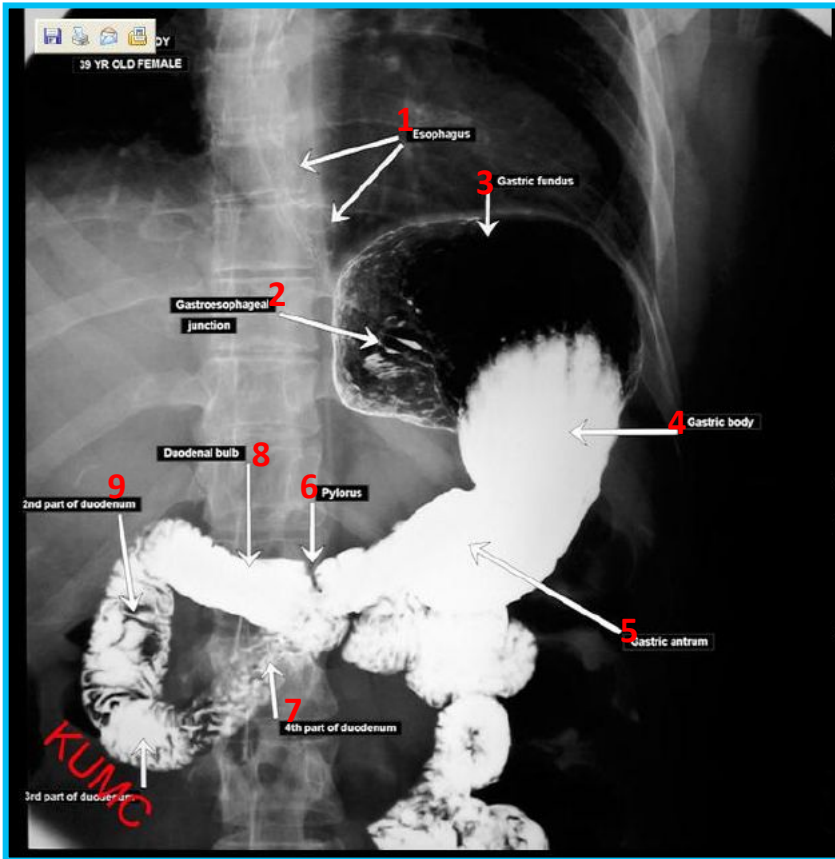


- 1) Double contrast.
- 2) Indentation of aortic arch
- 3) Indentation of left main bronchus.
- 4) Single contrast.



Ampulla is a normal variant that can mimic hernia. So look carefully to not make a mistake. We can differentiate by looking at the mucosa with double contrast.





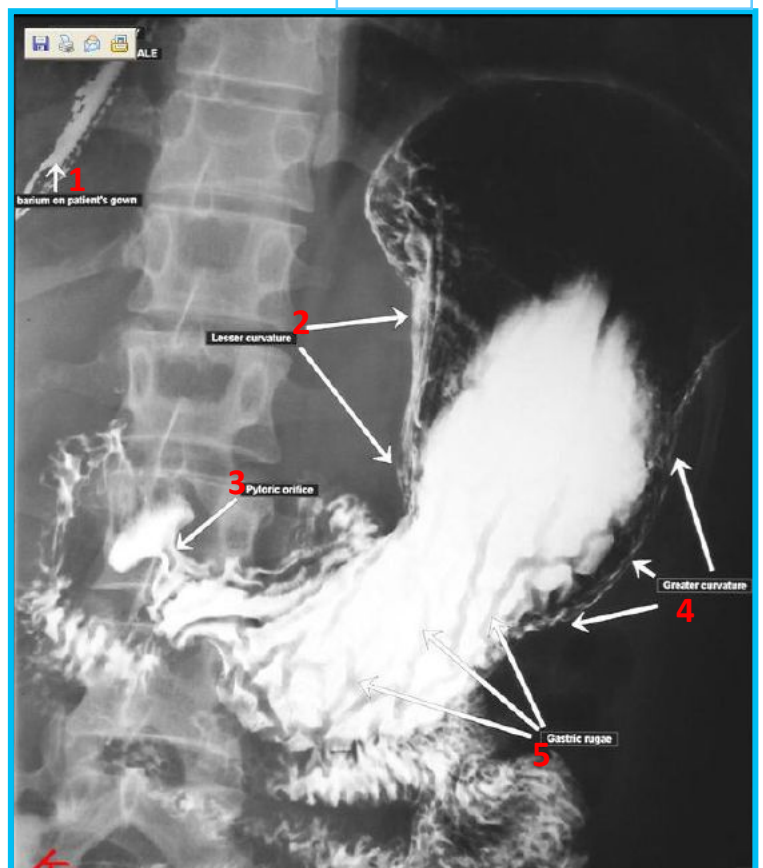
Standing (erect) position.

- 1) Esophagus.
- 2) Gastro esophageal junction.
- 3) Gastric fundus.
- 4) Gastric body.
- 5) Gastric antrum.
- 6) Pylorus.
- 7) 4<sup>th</sup> part of duodenum.
- 8) Duodenal bulb.
- 9) 2<sup>nd</sup> part of duodenum.

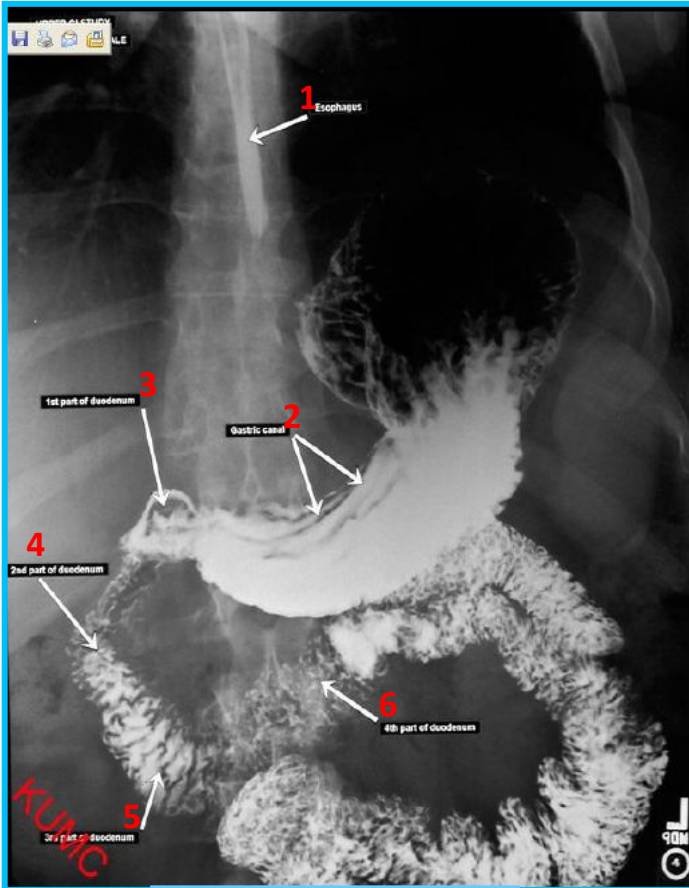
- 1) Barium of patient's gown.
- 2) Lesser curvature.
- 3) Pyloric orifice.
- 4) Greater curvature.
- 5) Gastric rugae.



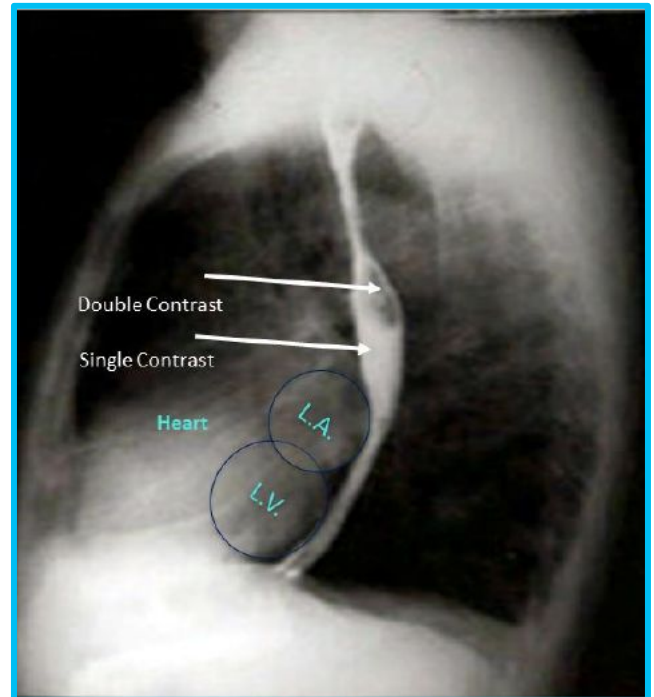
Barium residual in the large bowel







- 1) Esophagus
- 2) Gastric canal
- 3) 1<sup>st</sup> part of duodenum.
- 4) 2<sup>nd</sup> part of duodenum.
- 5) 3<sup>rd</sup> part of duodenum.
- 6) 4<sup>th</sup> part of duodenum.



### Barium Follow-Through:

Barium follow-through; patient is drinking the contrast and we take the images later on.

- \*Used to examine **duodenum, jejunum and ileum**
- \*Like a barium swallow but images taken every 20 minutes or so for 2-3 hours
- \*Small bowel follow-through may reveal evidence of disorders such as **Crohn's disease, coeliac disease or small bowel tumors.**

How can we differentiate between jejunum and ileum?

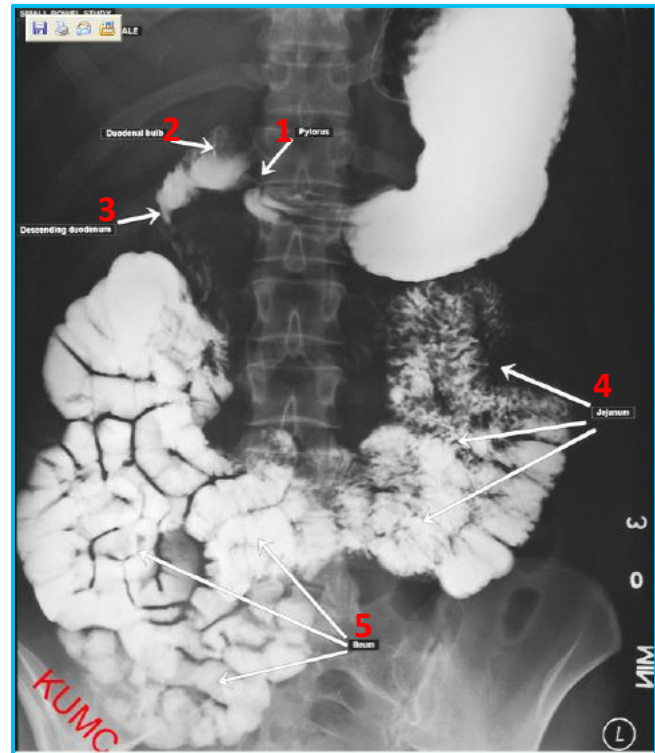
- 1- By the position; jejunum is in the left side while ileum is in the right side.
- 2- By the appearance; Jejunum has feathery shape. 'valvulae conniventes' ileum is characteristically featureless

## Barium Follow-Through to Cecum (Erect Position)



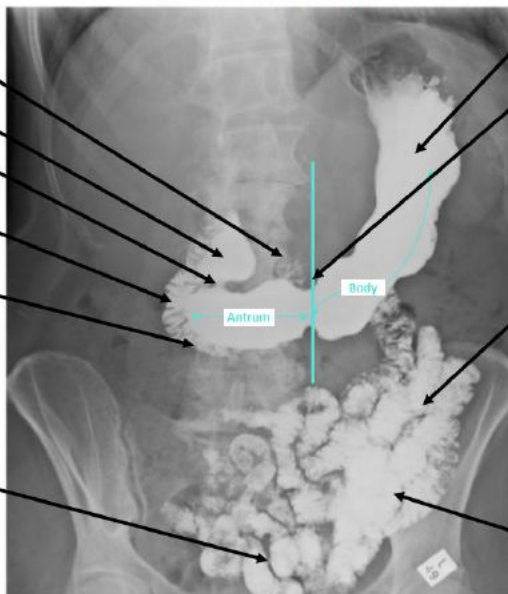
2<sup>nd</sup> Part of Duodenum  
3<sup>rd</sup> Part of Duodenum

DJJ:  
Normal Position= Left side



- 1) Pylorus.
- 2) Duodenal bulb.
- 3) Descending duodenum.
- 4) Jejunum.
- 5) Ilium.

## Barium Meal + Follow-Through (Erect Position)



DJJ:  
Normal Position= Left side

Duodenal Cap  
Pyloric Canal  
2<sup>nd</sup> Part of Duodenum  
3<sup>rd</sup> Part of Duodenum

Barium Meal  
Angular Notch  
Incisura Angularis

Jejunum:  
Plicae Circulares on the outer border

Barium Follow-Through

## Small Bowel Enema:

\*A Modified Barium Follow Through.

\*Note that the bowel is more distended here.

\*This procedure involves **inserting a thin tube** through the mouth, esophagus and past the stomach to inject barium, methylcellulose and water into the small bowel. **This allows for better visualization** of the small bowel than can be seen during a small bowel follow-through. (So we control the contrast here)



## Large Bowel Barium Enema:

\*Single or double contrast study. (Administered per rectum)

\*Double contrast means air fired up after barium – pictures may show coating on the outline of the bowel rather than a white bowel (right)

Patient has to have:

\*Low residue diet for three days before the procedure

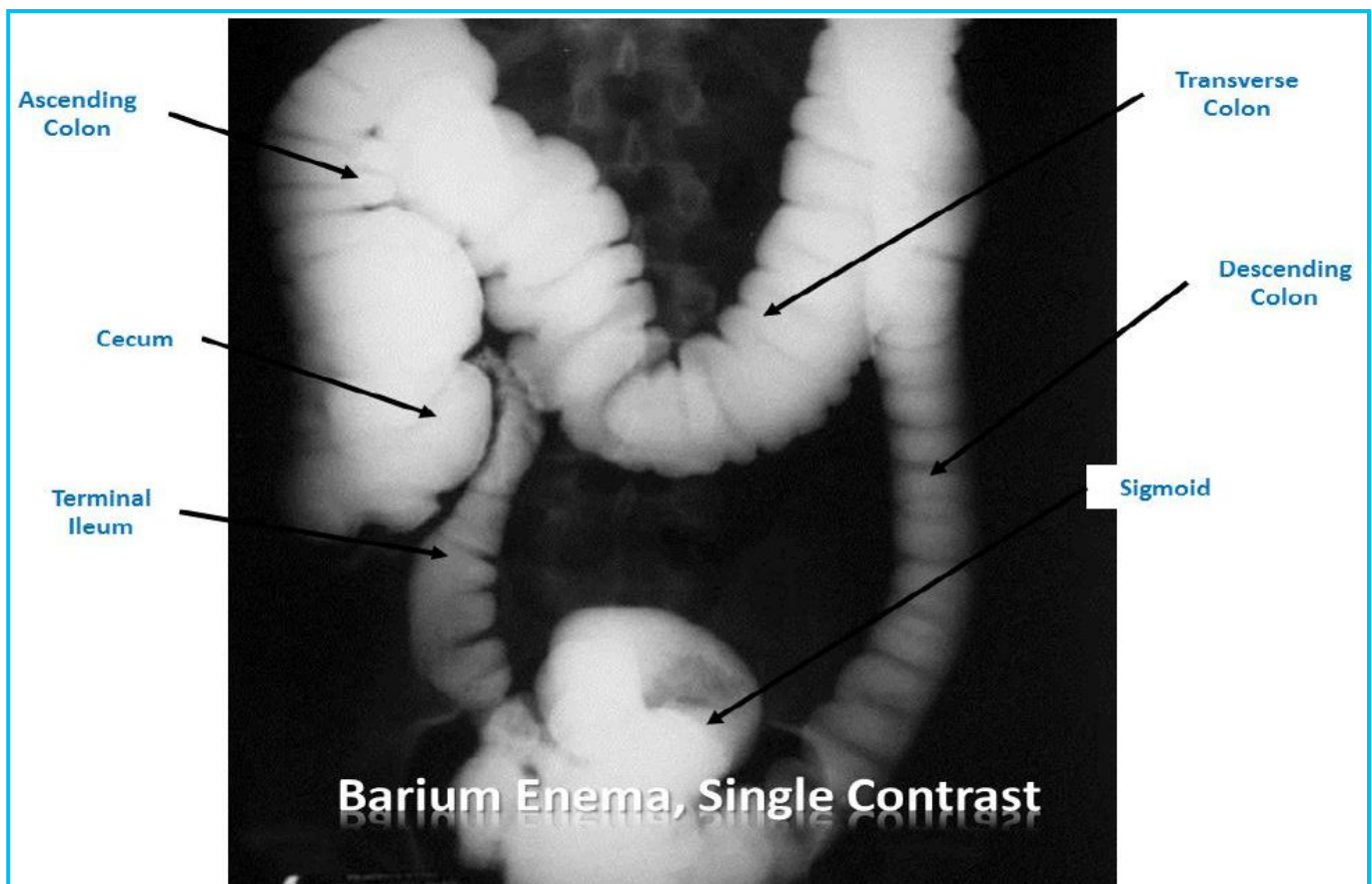
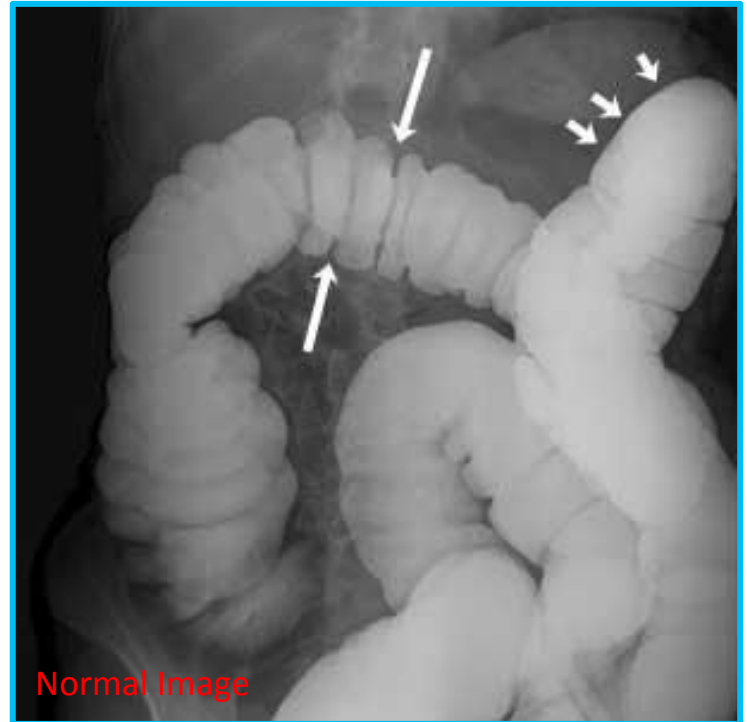
\*Laxatives 24 hr before

\*Bowel prep just before

\*Barium up the bum, patient has to move into different positions to coat to the whole colon. Often the table moves about to help the passage of barium. Serial X-rays are taken

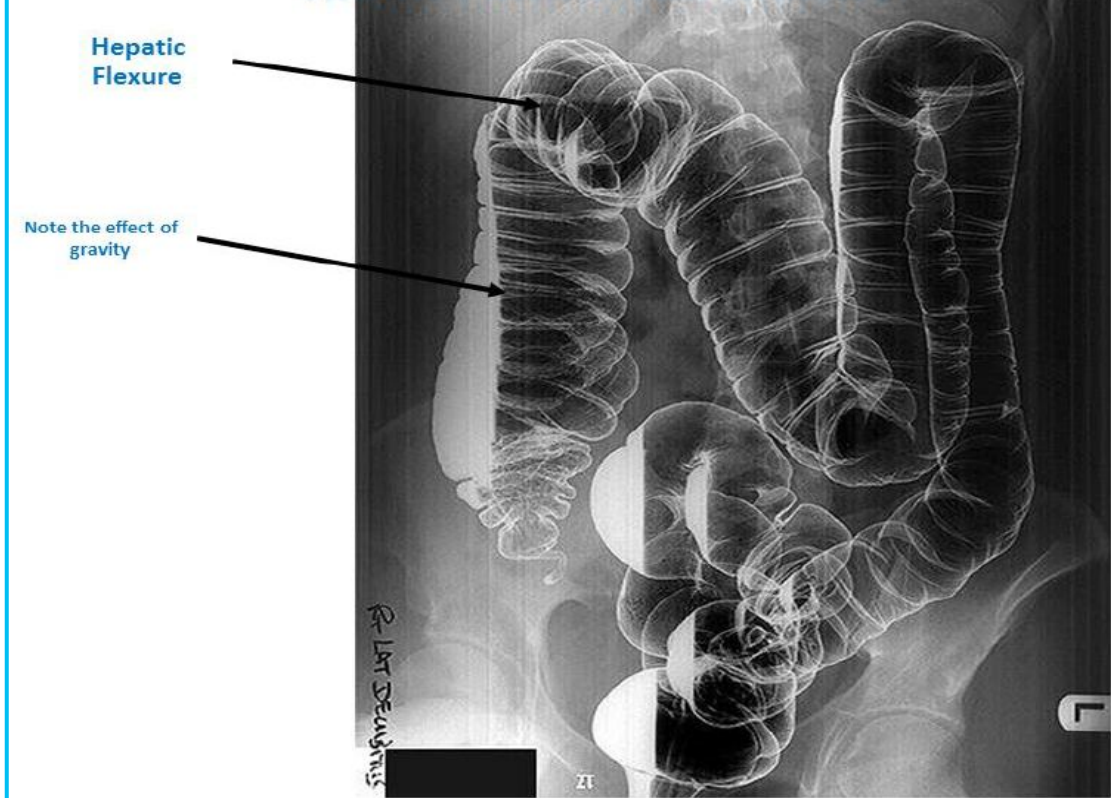
\*Films can be small and only cover a small area of bowel

\*Indications: inflammation, obstruction, infection, tumors...etc.

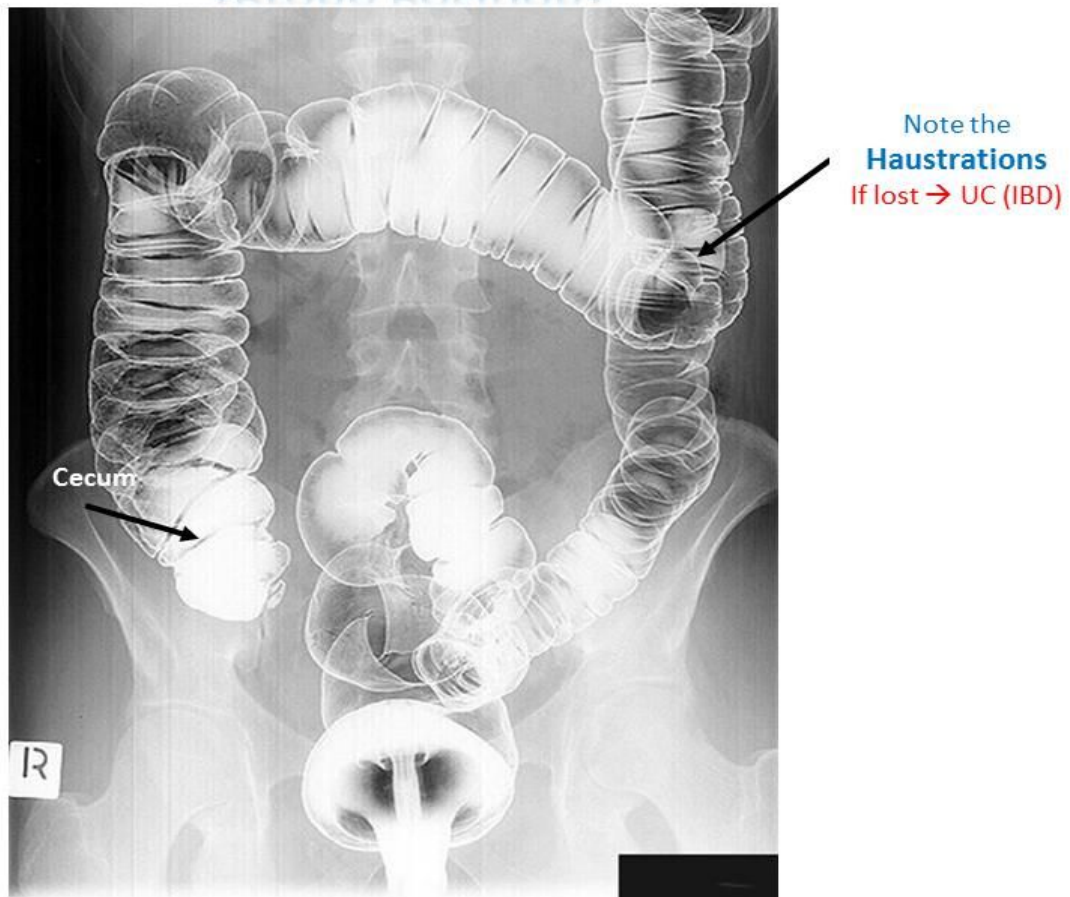


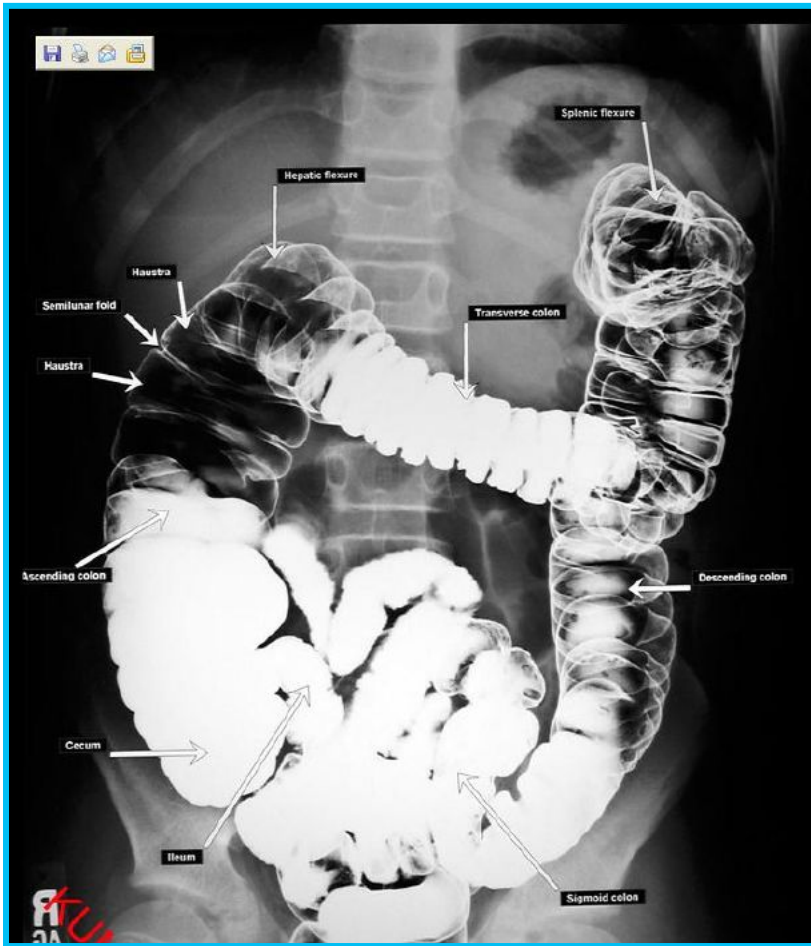


## Barium Enema, Double Contrast (Right Lateral Decubitus)

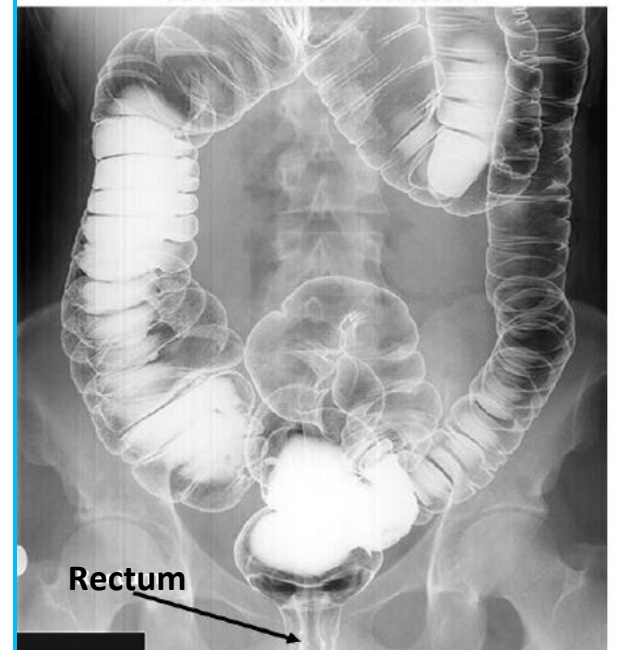


## Barium Enema, Double Contrast (Prone Position)



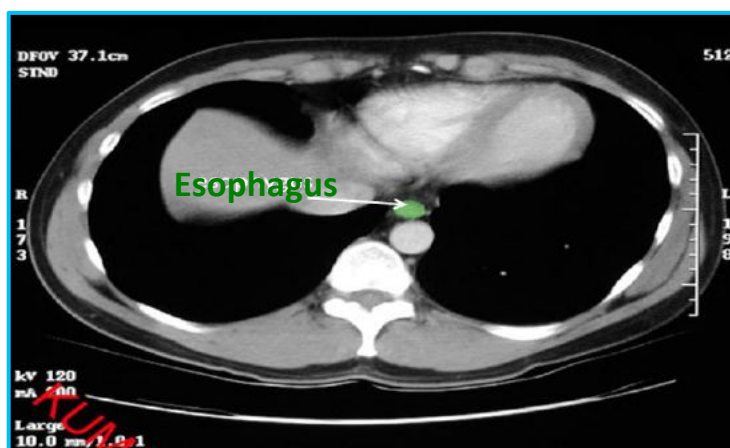


## Barium Enema, Double Contrast (Supine Position)

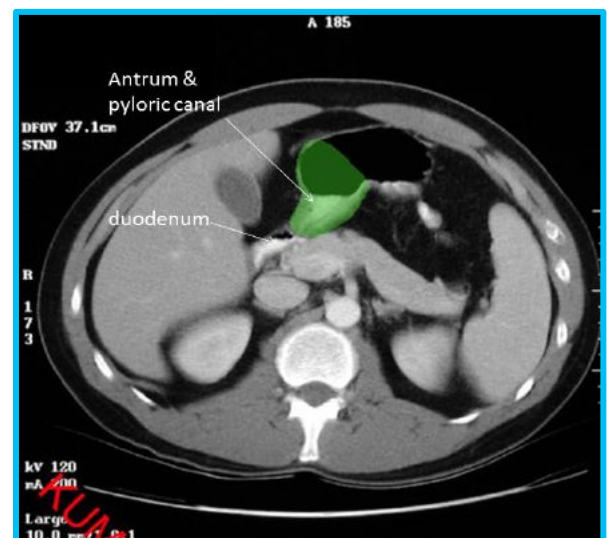


### 3] Computed Tomography:

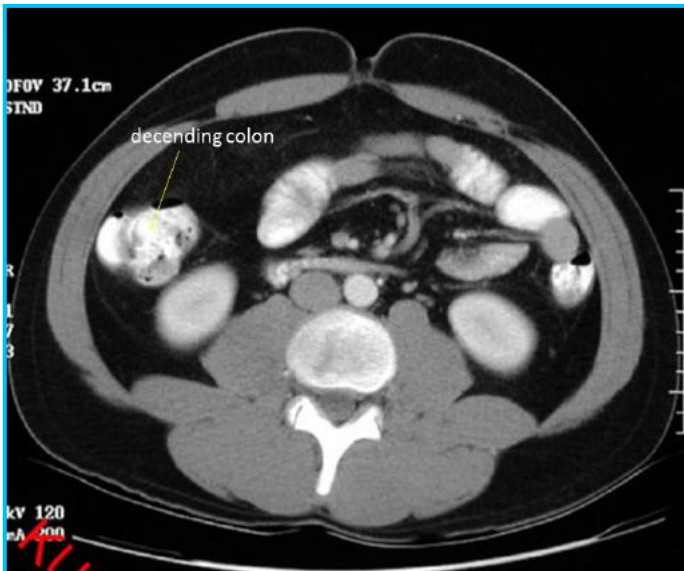
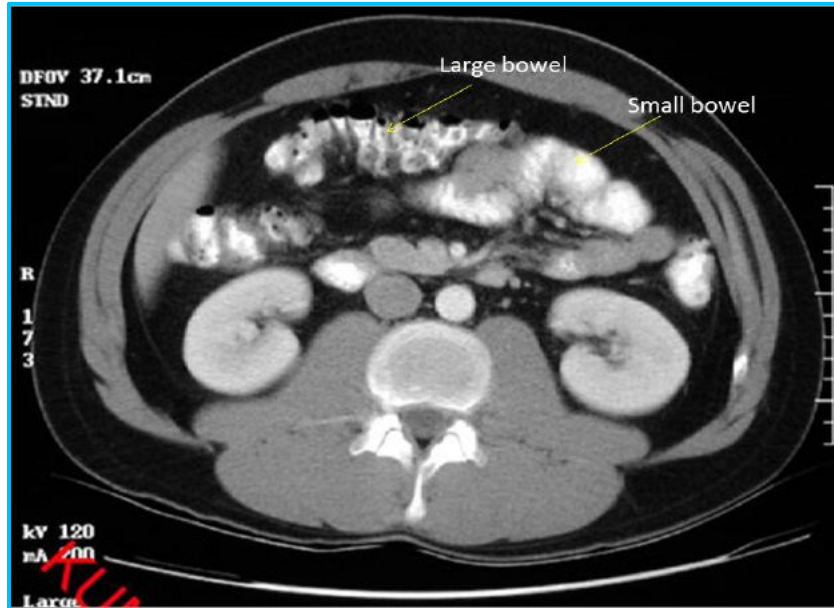
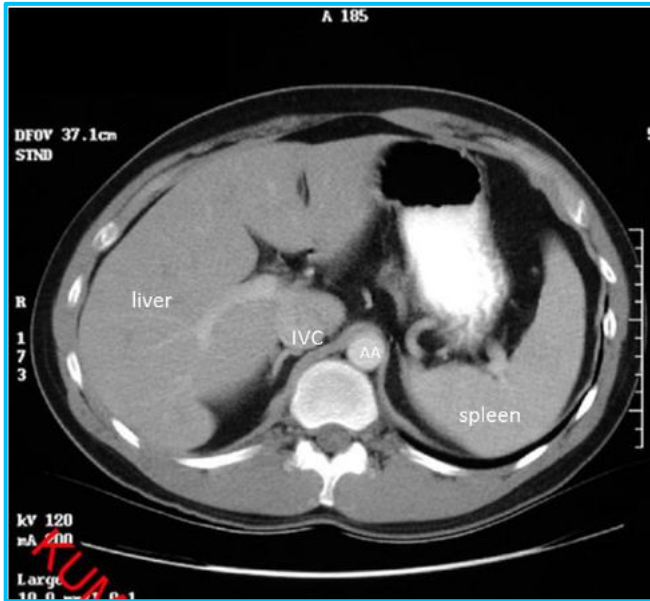
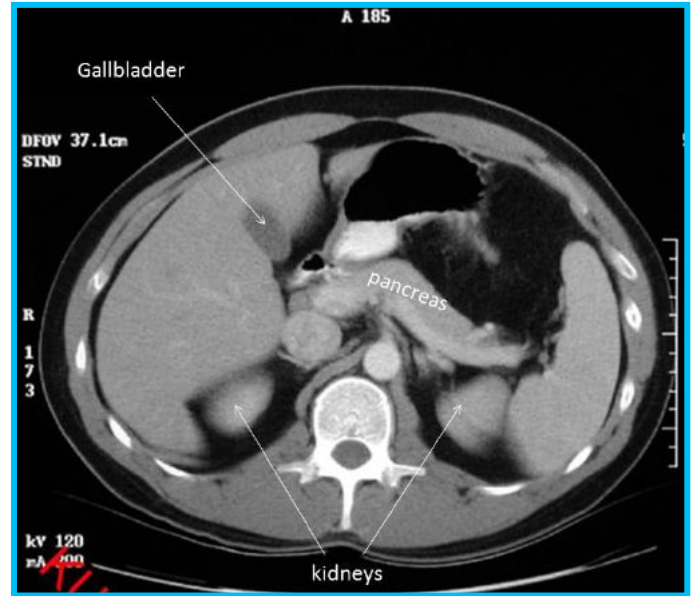
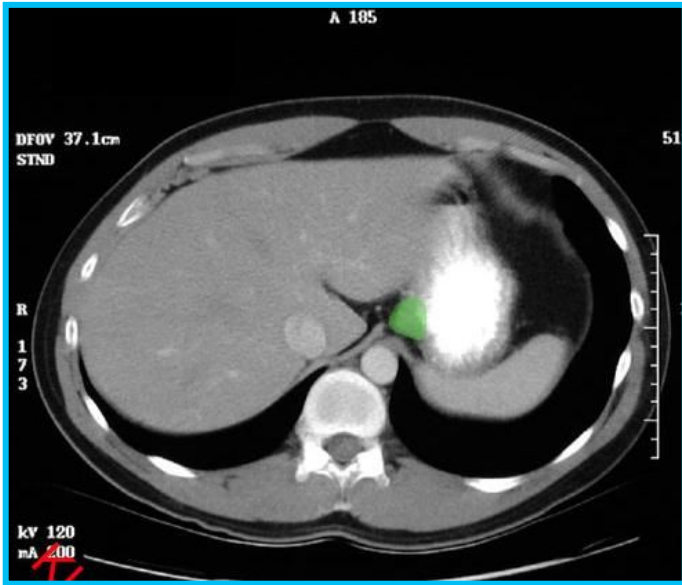
- \*CT provides cross-sectional images of abdominal organs and structures. Multiple x-ray images are taken from many different angles, digitized in the computer, reconstructed, and then viewed on a computer monitor.
- \*Indications for abdominal CT scanning include diseases of the liver, spleen, kidney, pancreas, and pelvic organs. It is a valuable tool in detecting and localizing many inflammatory conditions in the colon, such as **appendicitis**, **diverticulitis**, **regional enteritis**, and **ulcerative colitis**.
- \*Instruct the patient not to eat or drink for 6 to 8 hours before the test.
- \*If the patient is prescribed with intravenous or oral contrast agents, question the patient about contrast dye allergies.
- \*Schedule barium studies after CT scanning, so as not to interfere with imaging.



The esophagus is anterior to the aorta









GIT ANATOMY & INVESTIGATION



Barium follow through



CT

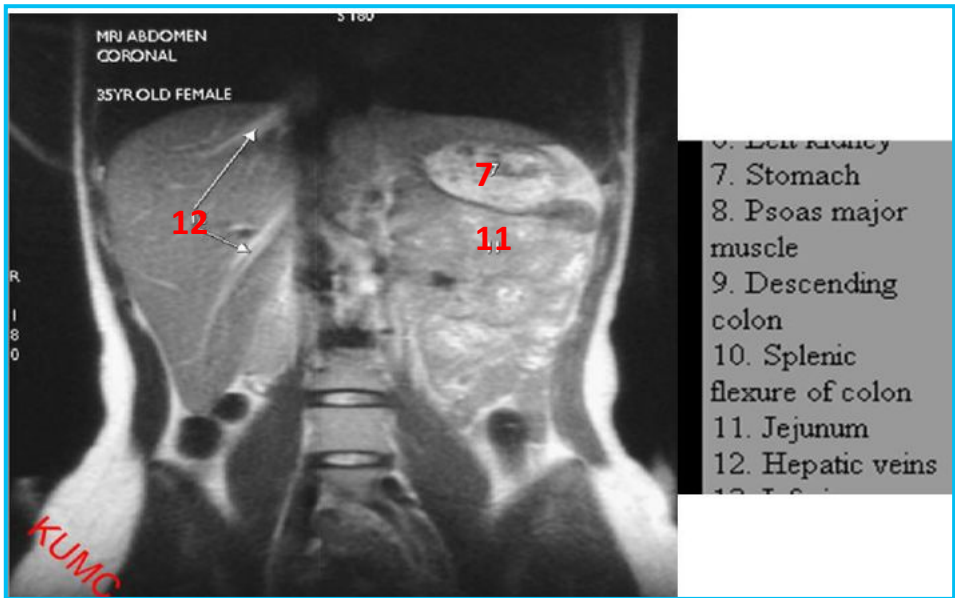
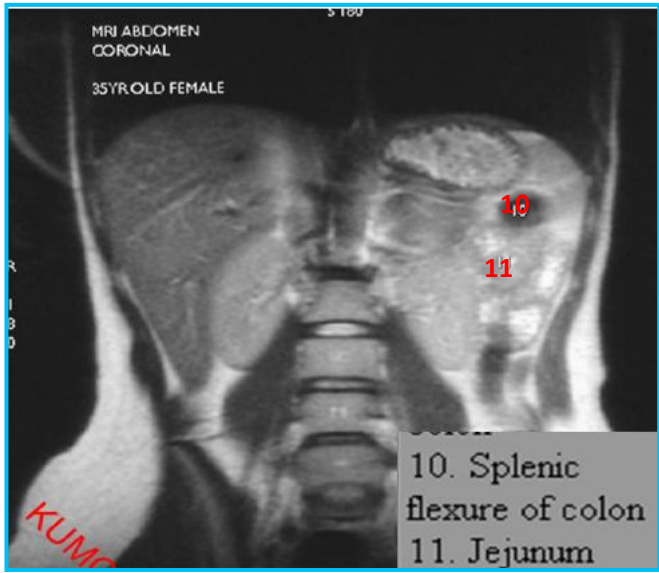
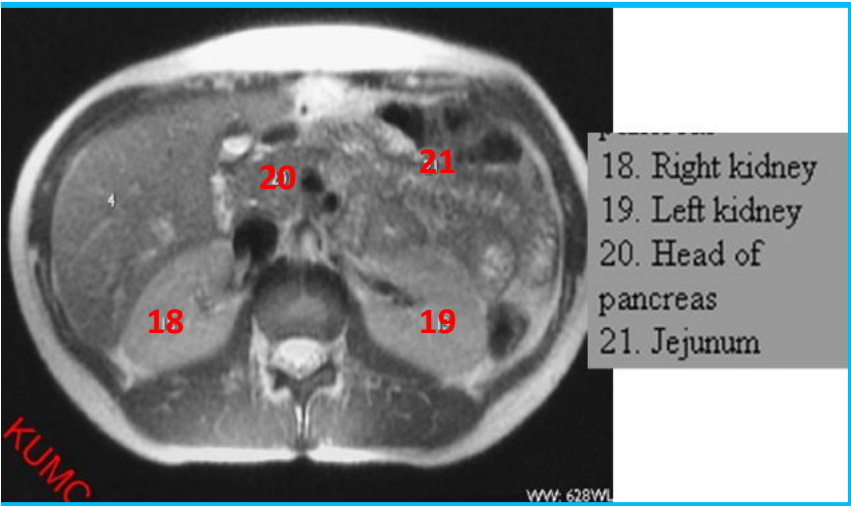
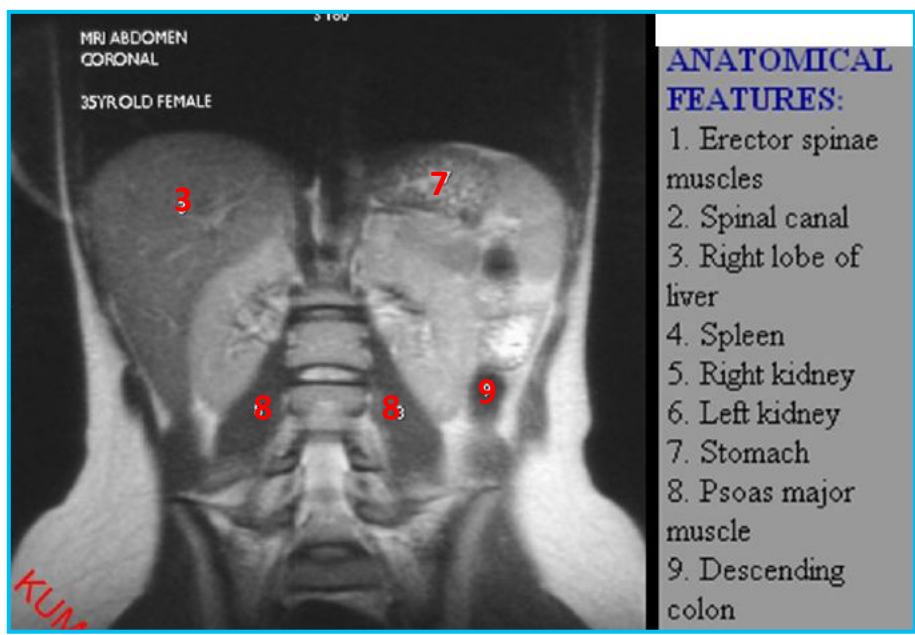


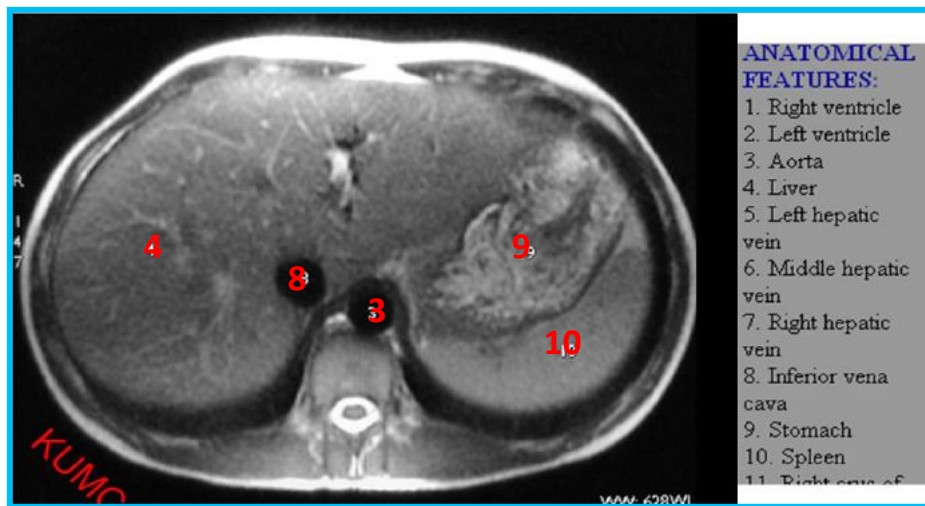
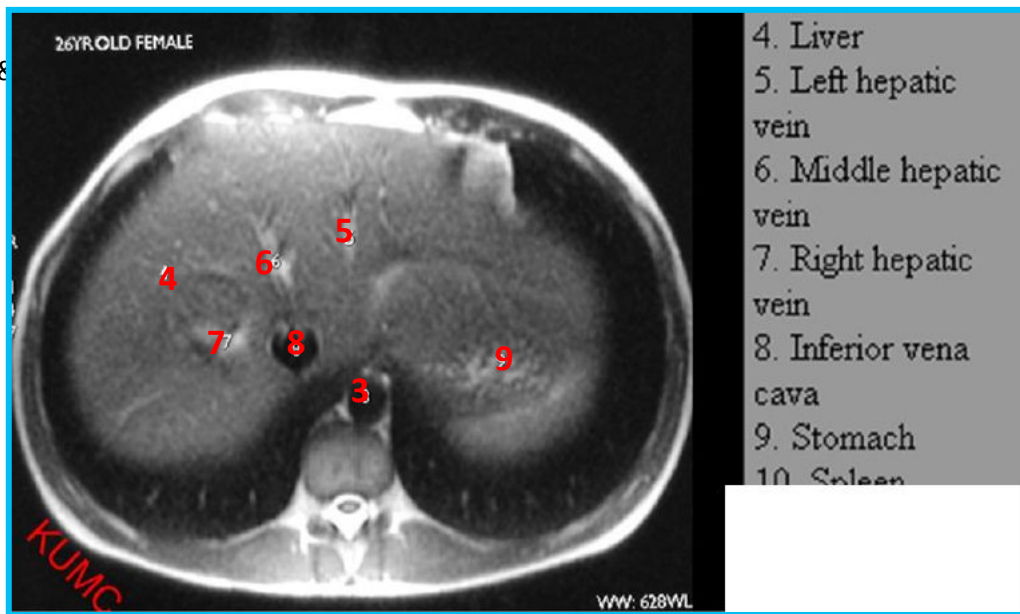
MRI



4] MRI:

MRI is useful in evaluating abdominal soft tissues as well as blood vessels, abscesses, fistulas, neoplasms, and other sources of bleeding.



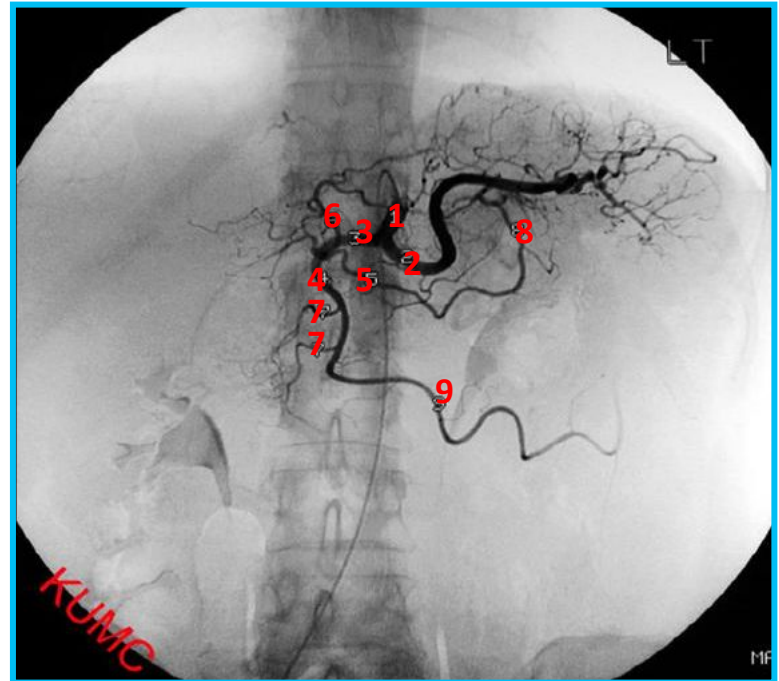
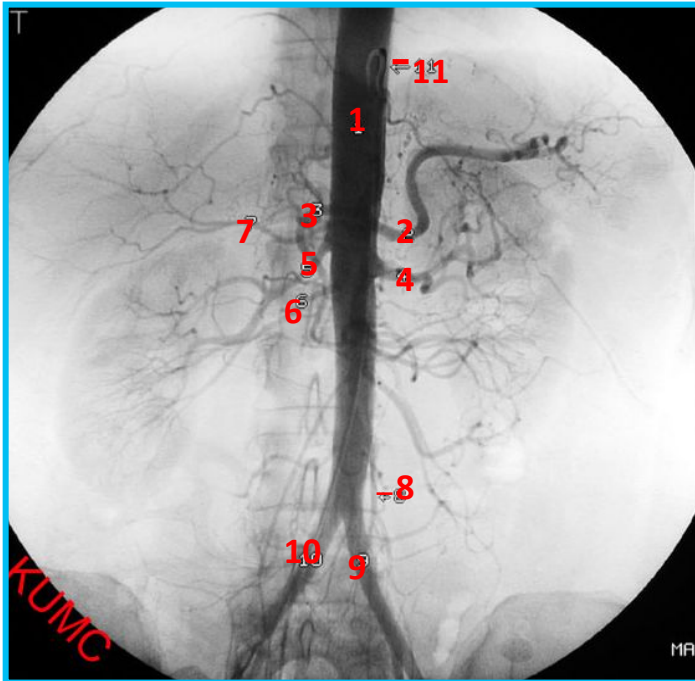






**5] Angiography:**

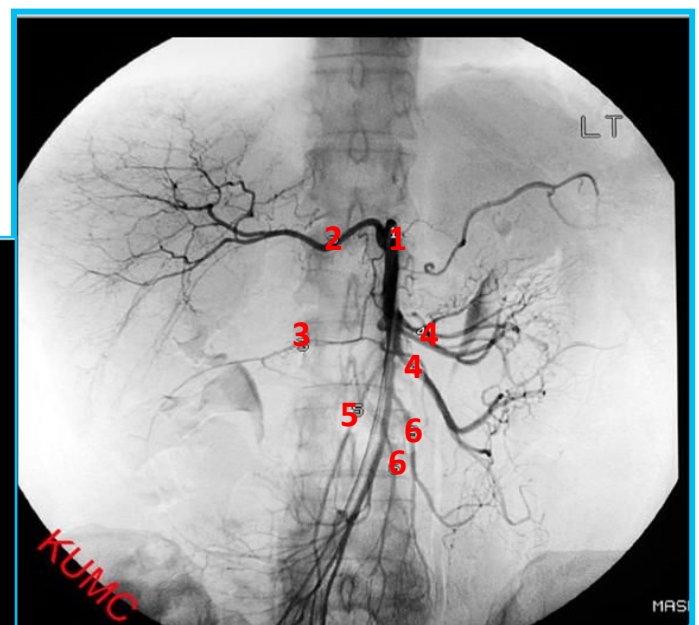
Used to assess the blood vessels. Findings include stenosis, obstruction, atherosclerosis & thrombosis.

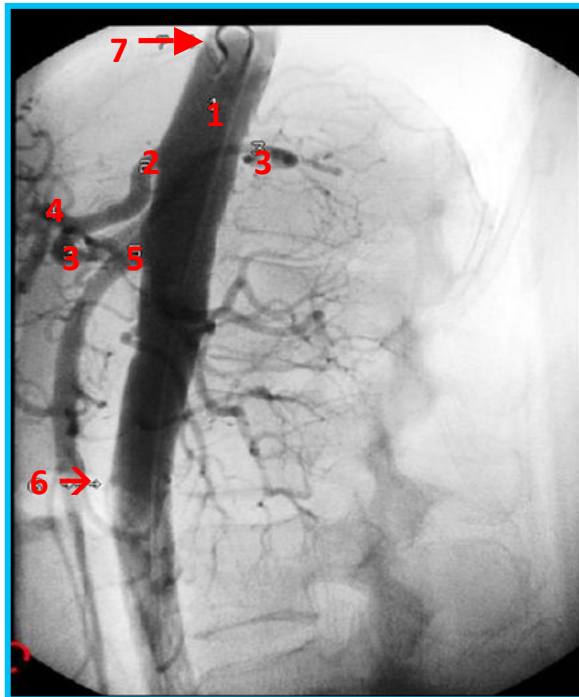


- 1 Abdominal aorta
- 2 Splenic artery
- 3 Common hepatic artery
- 4 Left renal artery
- 5 Right renal artery
- 6 Accessory right renal artery
- 7 Right hepatic artery
- 8 Inferior mesenteric artery
- 9 Left iliac artery
- 10 Right iliac artery
- 11 Catheter in lumen of aorta

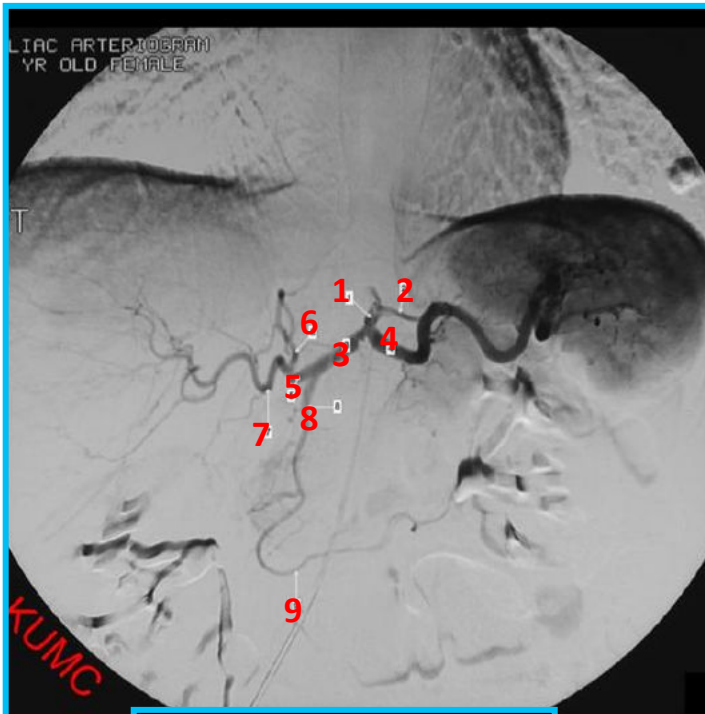
- Right hepatic artery is replaced and originates off of SMA (normal variant)
- 1 Celiac trunk
  - 2 Splenic artery
  - 3 Common hepatic artery
  - 4 Gastroduodenal artery
  - 5 Right gastric artery
  - 6 Left hepatic artery
  - 7 Pancreaticoduodenal arteries
  - 8 Left gastric artery (origin off celiac not visualized)
  - 9 Right gastroepiploic artery

- 1 Superior mesenteric artery (SMA)
- 2 Replaced right hepatic artery
- 3 Right colic artery
- 4 Jejunal (intestinal) arteries
- 5 Ileocolic artery
- 6 Ileal (intestinal) arteries

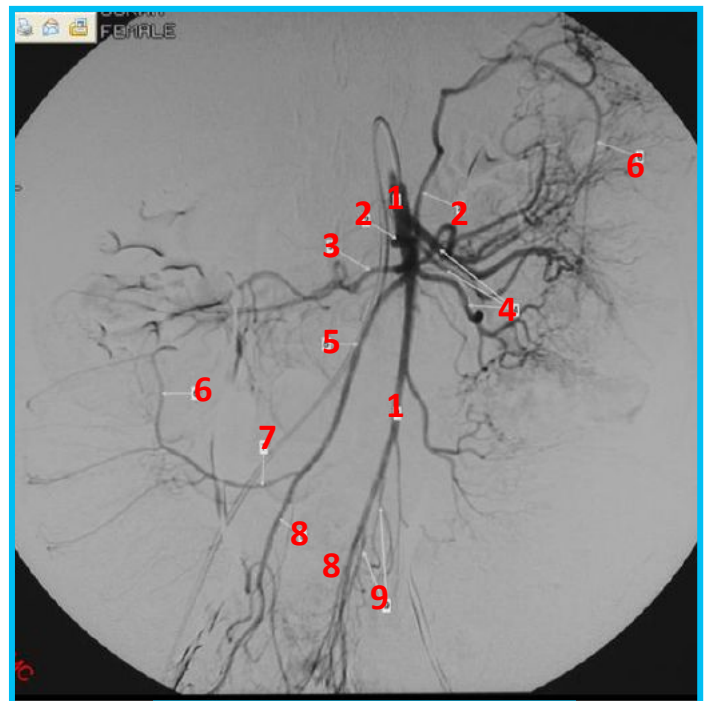




- 1 Abdominal aortal
- 2 Celiac trunk
- 3 Splenic artery
- 4 Common hepatic artery
- 5 Superior mesenteric artery
- 6 Inferior mesenteric artery
- 7 Catheter in lumen of aorta



- 1 Celiac artery (trunk)
- 2 Left gastric artery
- 3 Common hepatic artery
- 4 Splenic artery
- 5 Hepatic artery proper
- 6 Left hepatic artery
- 7 Right hepatic artery
- 8 Gastroduodenal artery
- 9 Right gastroepiploic artery



- 1 Superior mesenteric artery
- 2 Middle colic artery
- 3 Right colic artery
- 4 Jejunal arteries
- 5 Ileocolic artery
- 6 Marginal artery
- 7 Colic branch of ileocolic artery
- 8 Ileal branch of ileocolic artery
- 9 Ileal arteries



### Comparison between different GI imaging modalities

	Advantages	Disadvantages	Indications	Contraindications
X-Ray	<ul style="list-style-type: none"> <li>▪ Widely available.</li> <li>▪ Cheap.</li> <li>▪ <b>Excellent</b> in diagnosing <b>free air</b> in the abdomen.</li> <li>▪ <b>Good</b> in diagnosing <b>bowel obstruction &amp; stones/calcifications</b>.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Radiation.</li> <li>▪ Poor soft tissue details.</li> </ul>	<ul style="list-style-type: none"> <li>• Abdominal pain.</li> <li>• Bowel obstruction.</li> <li>• Stones.</li> <li>• Masses.</li> <li>• Trauma.</li> <li>• Others, foreign body, supportive lines.</li> </ul>	<ul style="list-style-type: none"> <li>• Pregnancy.</li> </ul>
Fluoroscopy	<ul style="list-style-type: none"> <li>▪ Available.</li> <li>▪ Relatively cheap.</li> <li>▪ <b>Excellent</b> in evaluation the bowel <b>lumen and mucosa</b>.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Radiation</li> <li>▪ Poor in evaluating extra luminal pathologies</li> </ul>	<ul style="list-style-type: none"> <li>▪ Assessing the mucosal outline</li> <li>▪ Abdominal pain</li> <li>▪ Gastro esophageal reflux</li> <li>▪ Masses</li> <li>▪ Inflammatory bowel diseases</li> <li>▪ Post surgical leak</li> </ul>	<ul style="list-style-type: none"> <li>▪ Pregnancy</li> <li>▪ Bowel obstruction</li> <li>▪ Bowel perforation (with barium type of contrast)</li> </ul>
CT	<ul style="list-style-type: none"> <li>▪ Available.</li> <li>▪ Short scan time.</li> <li>▪ Much more soft tissue and bone details.</li> <li>▪ <b>Excellent</b> in diagnosing <b>extra-luminal lesions</b>.</li> <li>▪ <b>Excellent</b> in diagnosing the <b>cause of bowel obstruction</b>.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Radiation</li> <li>▪ Some times need intra venous contrast (renal disease)</li> <li>▪ Relatively expensive</li> </ul>	<ul style="list-style-type: none"> <li>▪ Abdominal pain</li> <li>▪ To look for bowel obstruction cause</li> <li>▪ To diagnose intra-abdominal masses</li> <li>▪ Trauma</li> </ul>	<ul style="list-style-type: none"> <li>▪ Pregnancy</li> <li>▪ No IV contrast in renal failure</li> <li>▪ Unstable patients (severe trauma/ICU)</li> </ul>
MRI	<ul style="list-style-type: none"> <li>▪ <b>Relatively safe in pregnancy</b> (no radiation)</li> <li>▪ Give much more soft tissue details</li> <li>▪ <b>Excellent</b> in diagnosing <b>abdominal solid organ lesion</b>: liver, spleen, kidneys</li> </ul>	<ul style="list-style-type: none"> <li>▪ Expensive</li> <li>▪ Long scanning time</li> <li>▪ Sensitive to motion</li> </ul>	<ul style="list-style-type: none"> <li>▪ Abdominal <b>solid organ masses</b></li> <li>▪ Inflammatory bowel disease</li> </ul>	<ul style="list-style-type: none"> <li>▪ Uncooperative patients</li> <li>▪ Early pregnancy (relative contraindication)</li> <li>▪ No IV contrast renal failure (relative contraindication)</li> </ul>

Good  
Luck!

