

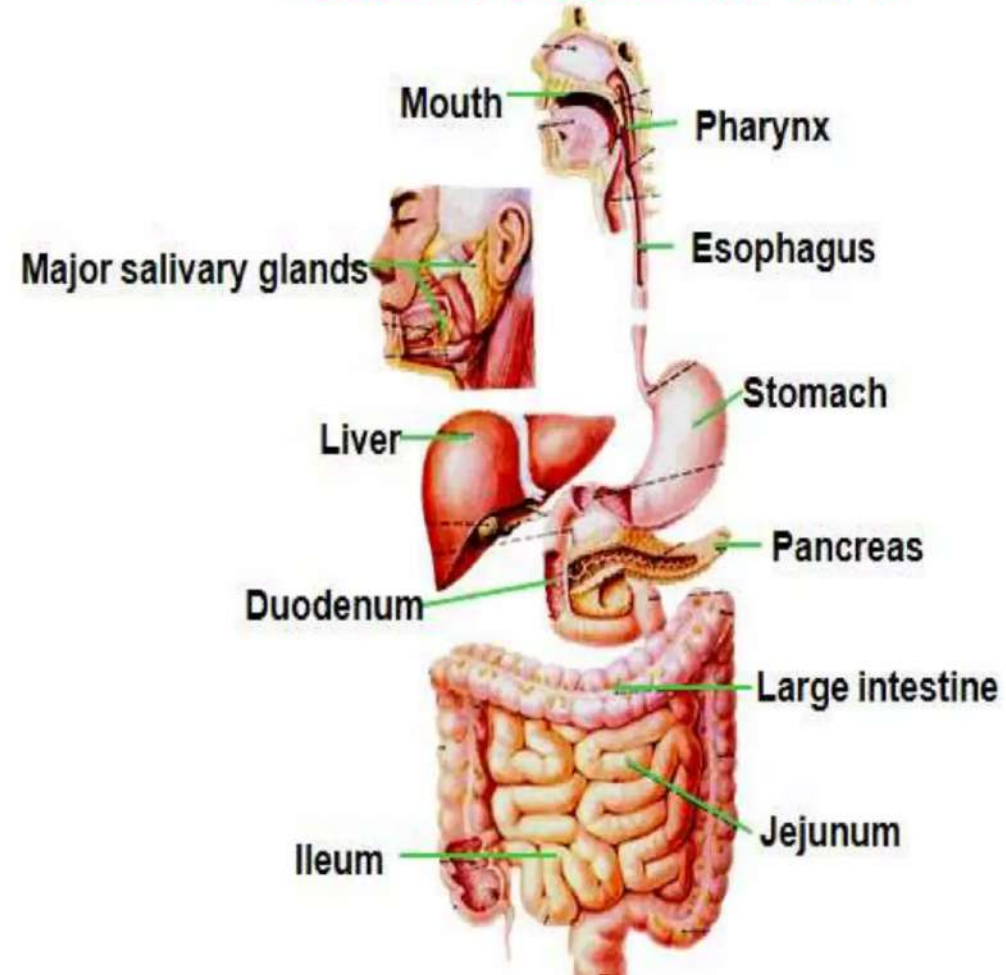


Round : Radiology

Group no : A4

Done By : Batool ALzubaidi

GASTROINTESTINAL TRACT RADIOLOGY



- Dr. Araa Bani-Melhem

General Anatomy:

- The largest cavity of the body,
- Bounded
 - ❖ *Anteriorly* - by abdominal wall muscles
 - ❖ *Posteriorly* - by the vertebral column and posterior wall muscles
 - ❖ *Laterally* - by lower ribs and parts of muscles of abdominal wall
 - ❖ *Superiorly* - by the diaphragm
 - ❖ *Inferiorly* - by pelvic cavity

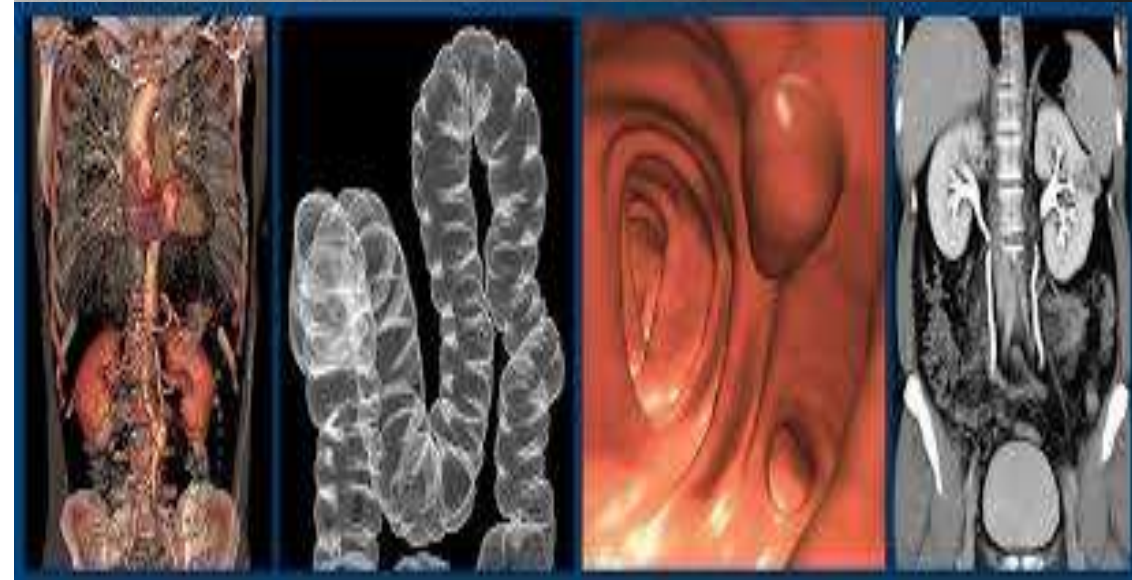
IMAGING MODALITIES IN GIT

1. Plain X-rays:
 - **Supine**
 - **Erect**
 - **Decubitus**

✦ If the patient can not stand you perform supine and left lateral decubitus ? ✨

✦ ليش left مش right لانه الهدف نشوف ال air/gases ف الشمال اسهل انه نشوفهم من عند ال stomach ✨
2. Barium studies:
 - a. Barium **Swallow**
 - b. Barium **Meal**
 - c. Barium **Follow through**
 - d. Barium **Enema**

✦ liver and spleen ما يكون مغطي الرؤية ✨
3. Ultrasound Abdomen
4. **CT Scan**
5. **MRI Abdomen**
6. **ERCP**
7. Cholangiography.
8. Angiography and Nuclear Medicine



1. PLAIN ABDOMINAL X - RAY:

✦ Plans used to divide abdomen » longitudinal and transverse
التقسمة بتكون حسب ال umbilicus على level upper end plate of L5

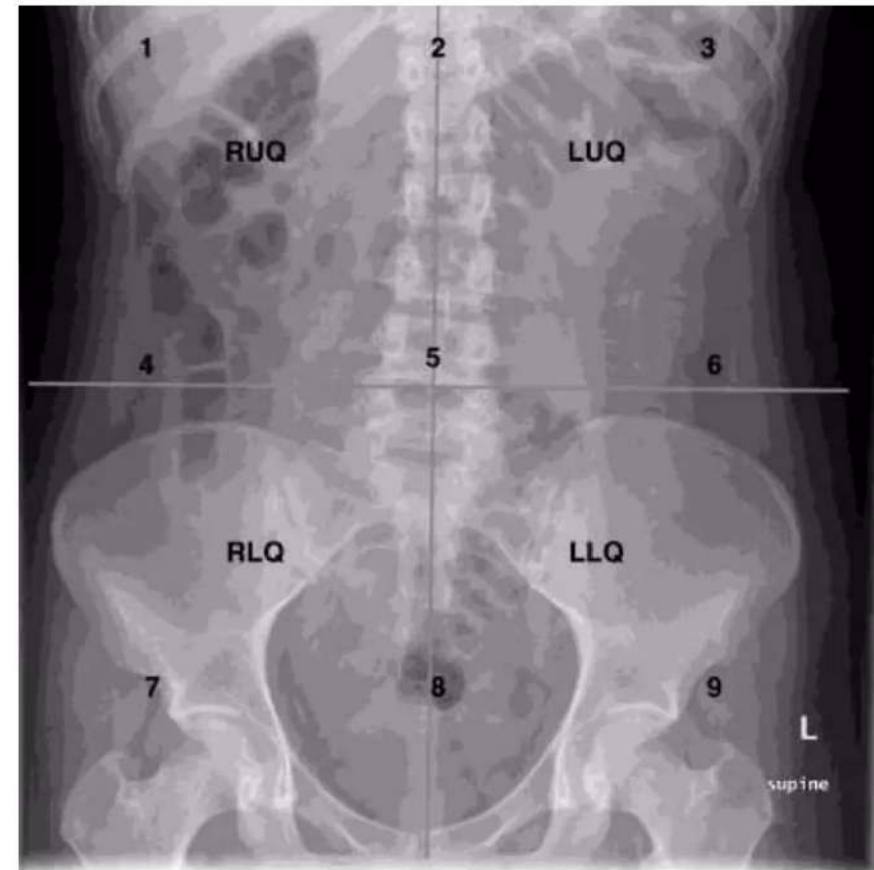
Basic Principles:

➤ Five Radiographic Densities:

- Gas / Air: Black
- Fat: Dark grey
- Soft Tissue / Water: Light grey
- Bone/Calcium: White
- Metals: Intense white

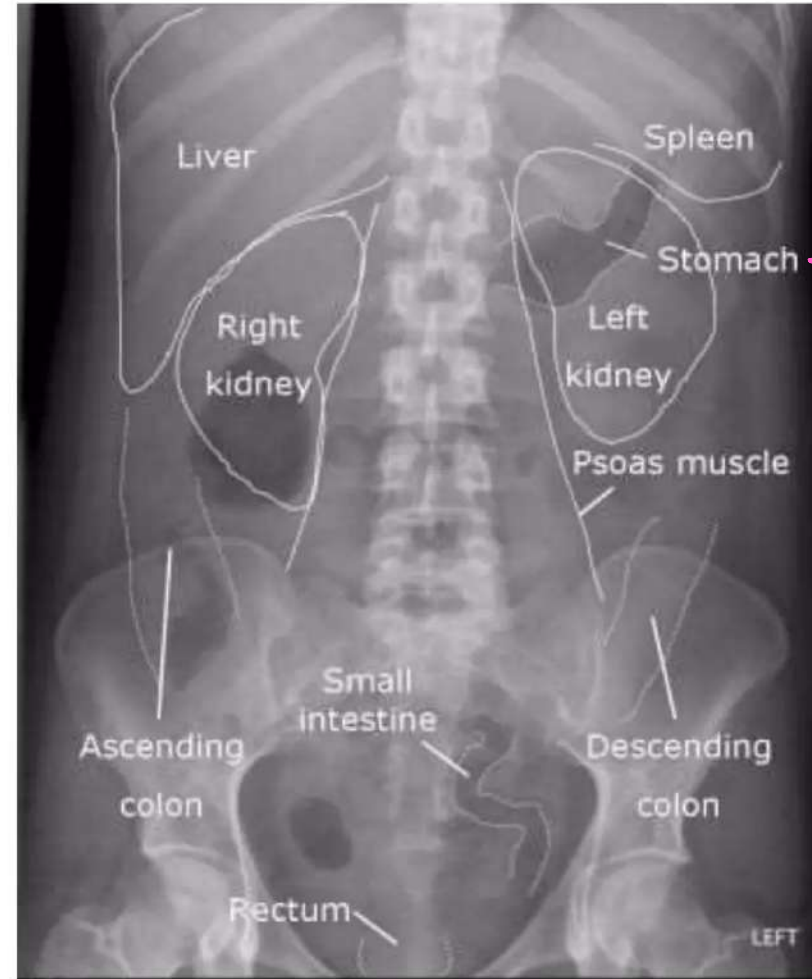
✦ الاشياء التي بخليك تميز ال
borders تاعت كل organ و الثاني
هي اختلاف ال densities

- Interface/line only visible when two of these densities interface with each other



Abdominal X-Ray

Ascending colon



عرفناها من ال gas

Abdominal Plain Film

- Convenient and useful initial investigation .

- What to look for ??

Check list for any abdominal x-ray

1- Gas pattern / Extra luminal air

2- Solid abdominal organs / Soft tissue masses

3- Calcifications

We look for contour, size, masses

4- Skeletal abnormalities

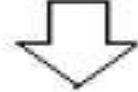
We should know the site, organ, extent.

5- the visualized lung bases.

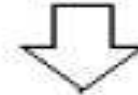
For bone metastasis for example

Pleural effusion, consolidation

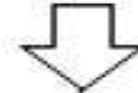
Check patient demographics and the **date of the film**



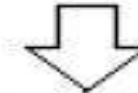
Review the bowel gas **pattern** and check for free gas



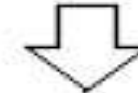
Individually review each of the solid intra-abdominal organs looking for enlargement, abnormal outlines, calcifications or intraparenchymal air



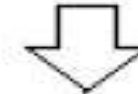
Scrutinise the film for abnormal calcifications and confirm the origin of each.



Analyse the visualised skeleton

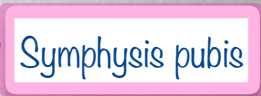


Check the visualised lung bases



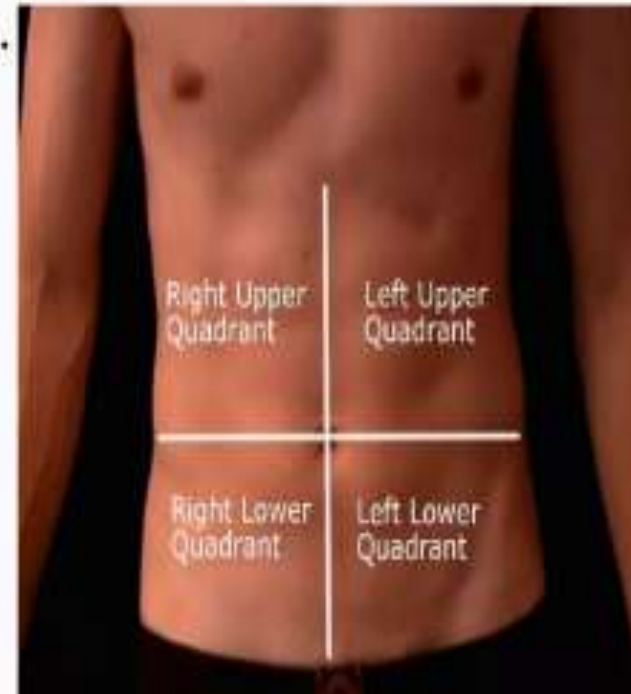
Document your findings in the medical notes

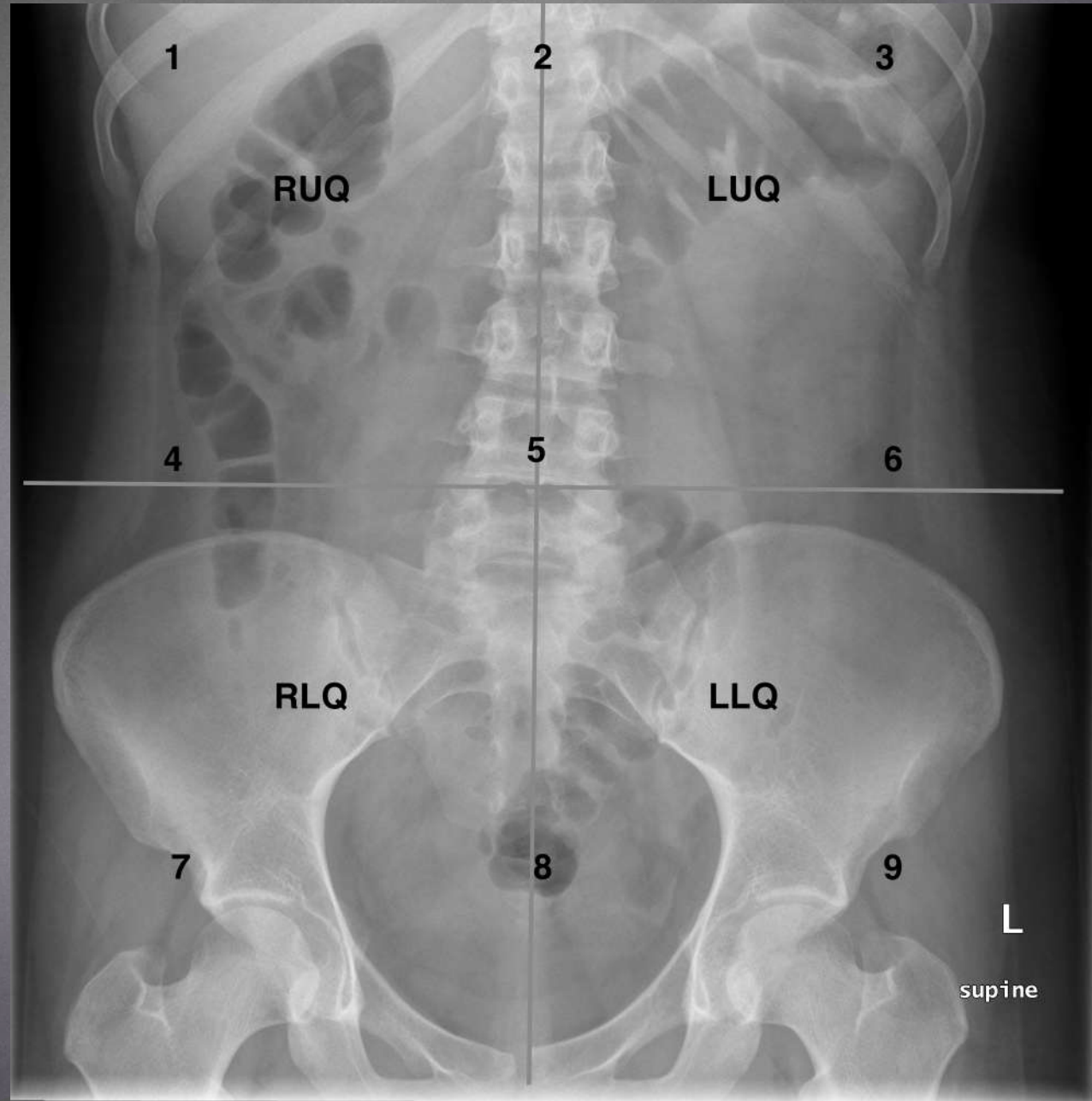
INTERPRETATION

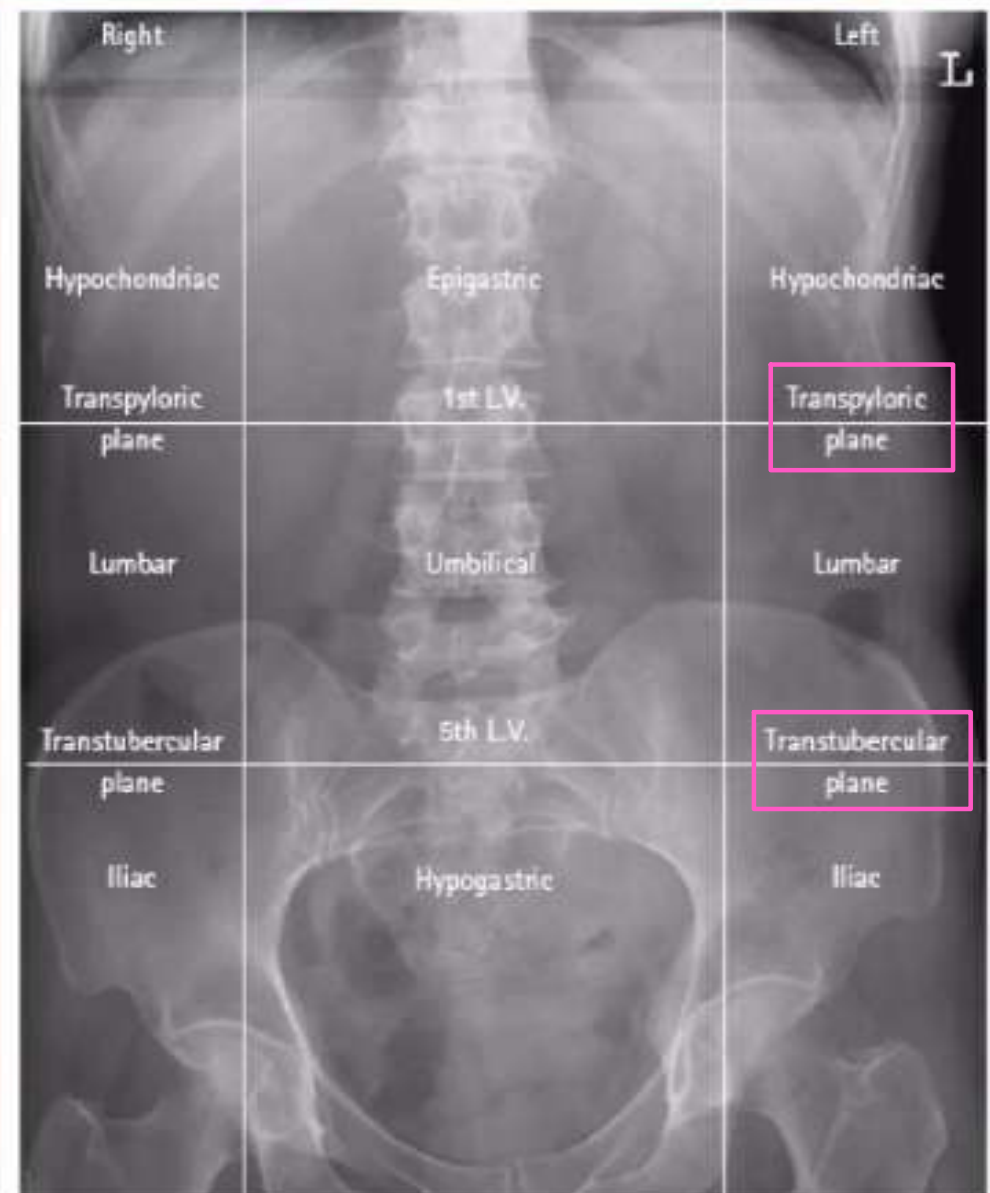
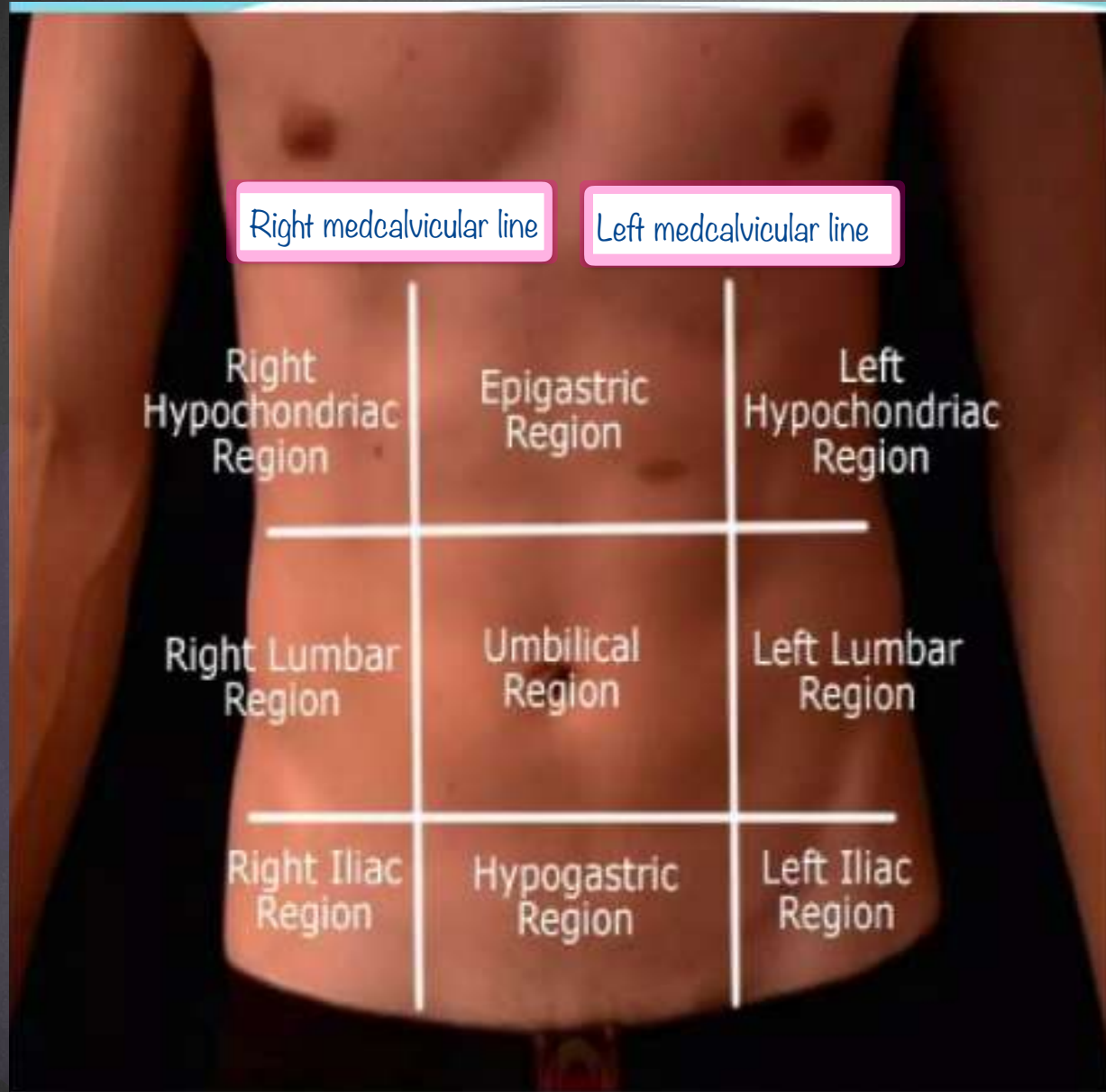
- The standard abdominal radiograph should extend from the diaphragm to the inferior pubic rami, and include the lateral abdominal wall musculature.  
- This results in a standard 'portrait' radiograph.
- Failure to image the entire abdomen can lead to a misdiagnosis.

Planes and regions:

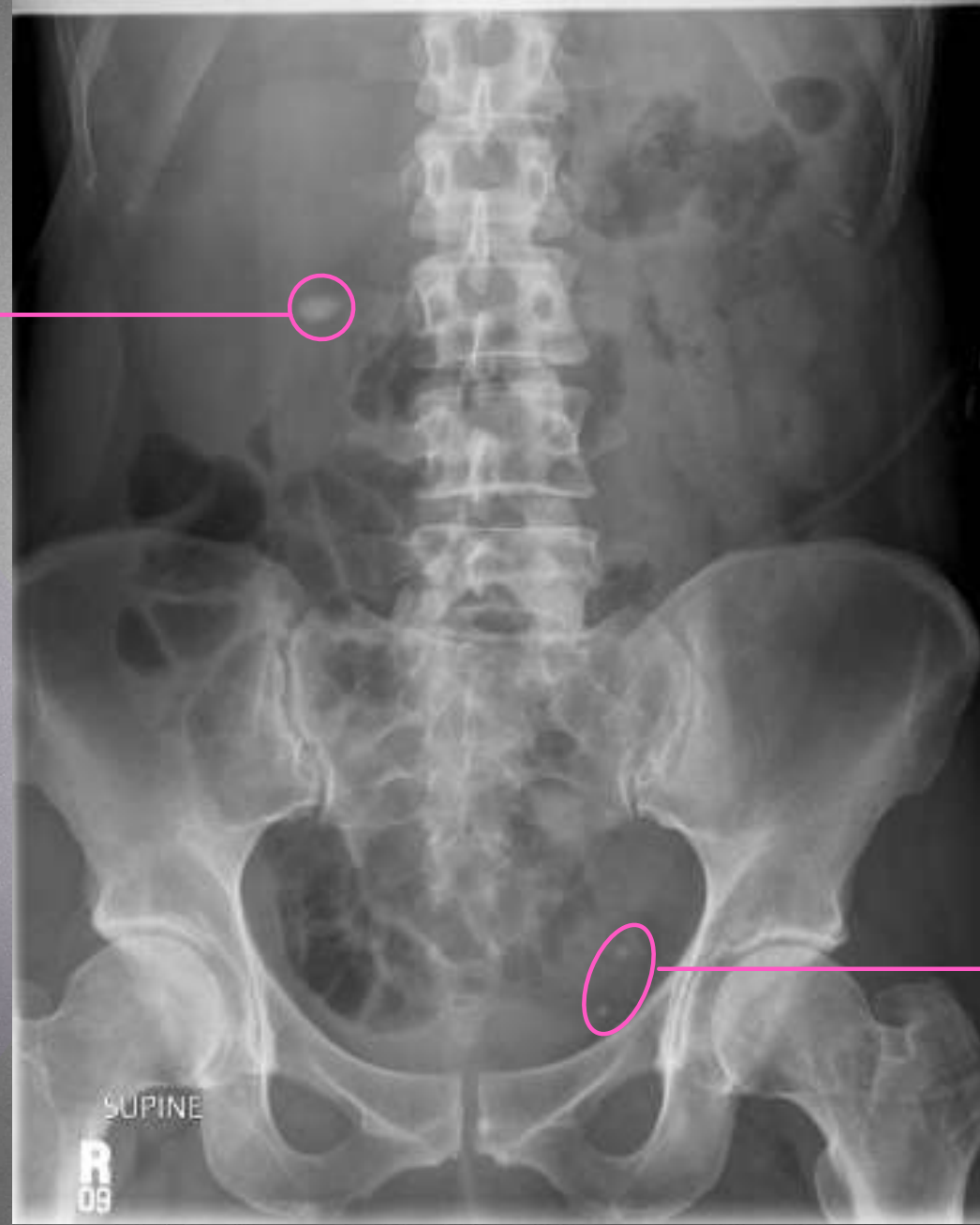
- Divided either into four quadrants or nine regions
- Divided into four quadrants by a transverse and a mid sagittal plane that intersect at the umbilicus.
- Right Upper Quadrant (RUQ),
- Right Lower Quadrant (RLQ),
- Left Upper Quadrant (LUQ), and
- Left Lower Quadrant (LLQ).







Most likely in gallbladder



- Plane abdominal X-ray
- Frontal view
- Normal gas pattern
- Calcifications

Could be in vessels, bladder or ureters

Gas shadows

Normal:

- i. Stomach
- ii. Colon
- iii. Small Bowel.

Abnormal:

- i. Within the Lumen:
 - Dilated bowel
 - ? Obstruction
- ii. Outside the Lumen:
 - Free ? perforation
 - In a cavity ? abscess

✦ Hepatic flexure



Recognizing small and large bowels

Large bowel

- . Peripherally located.
- . Haustral markings do not extend across the wall.
- . Spaced widely apart than valvulae conniventes

Small bowel

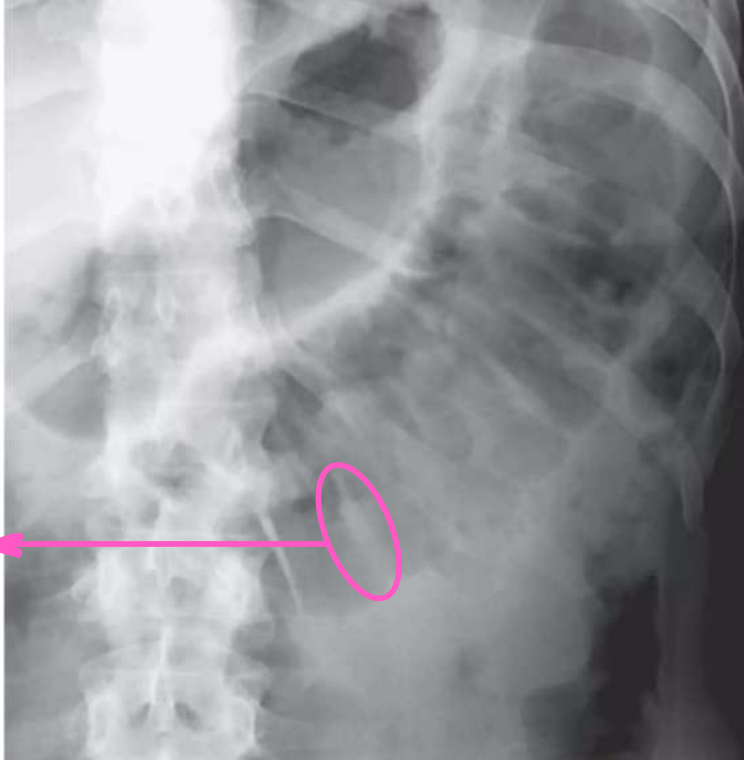
- . Centrally located
- . Valvular marking extends across the lumen
- . Spaced much closer

Small bowel Large bowel Cecum

A rough rule of **3-6-9** is followed to determine the diameter of small and large bowel.

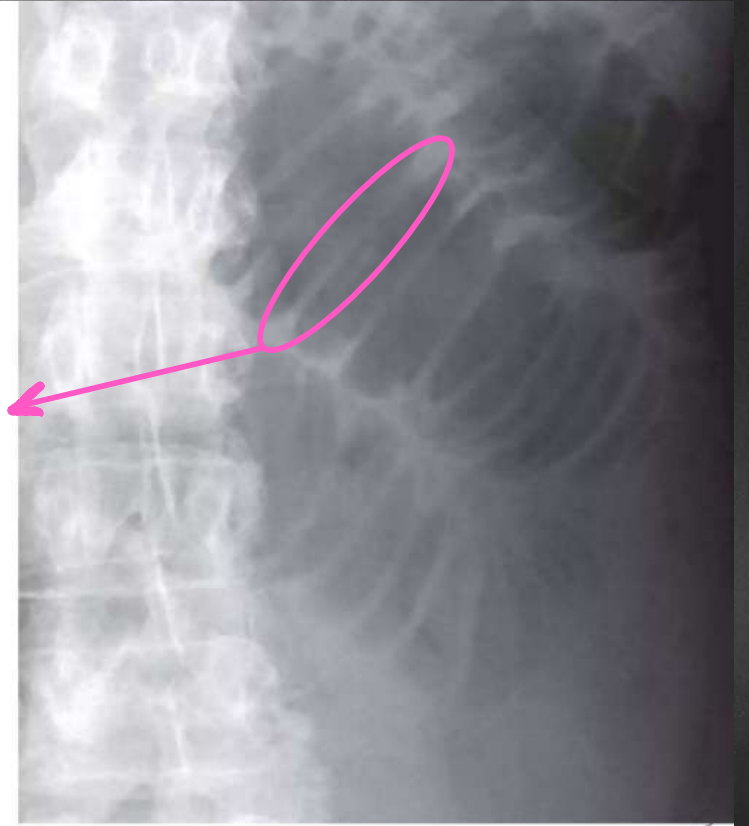
Large Bowel

✦ The line
doesn't cross
the whole
lumen



Small Bowel

✦ The line crosses
the whole lumen



Plain Films: Abdominal X-Ray (AXR)

Findings: Small (SBO) vs. Large Bowel Obstructions (LBO)

- Look at caliber, lines, and location to differentiate SBO vs LBO
- Air fluid levels on upright x ray are neither specific nor sensitive and cannot help distinguish ileus, enteritis, or partial from complete SBO



Small Bowel Obstruction

SMALL	LARGE
3cm max diameter	6cm max diameter
Lines all the way across the bowel (Plicae Circulares)	Lines not fully across (Haustra)
Central	Peripheral



Large Bowel Obstruction

Abnormal gas patterns

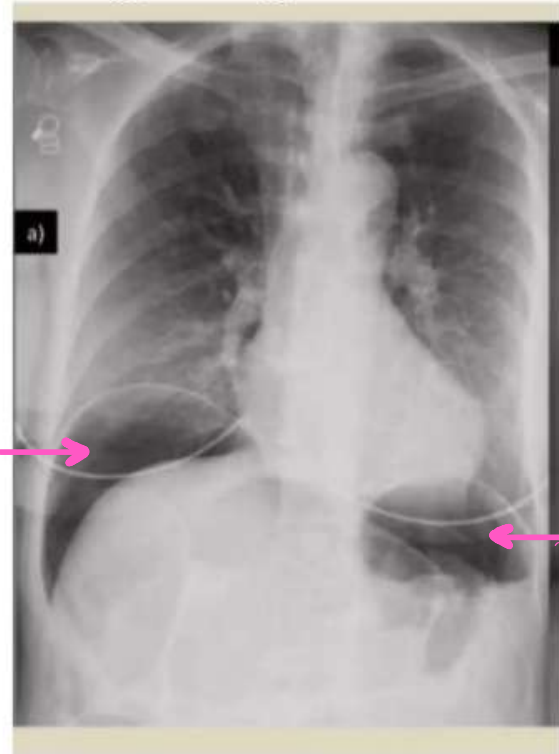
Causes of Extra-luminal gas:

- **Post Abdominal Surgery/ERCP** → Normal up to a week
- **Perforation of viscus** (eg. bowel, stomach)
- **Gallstone ileus** ↪ Number one differential
- **Cholangitis** (infection with gas forming organisms)
- **Abscess**

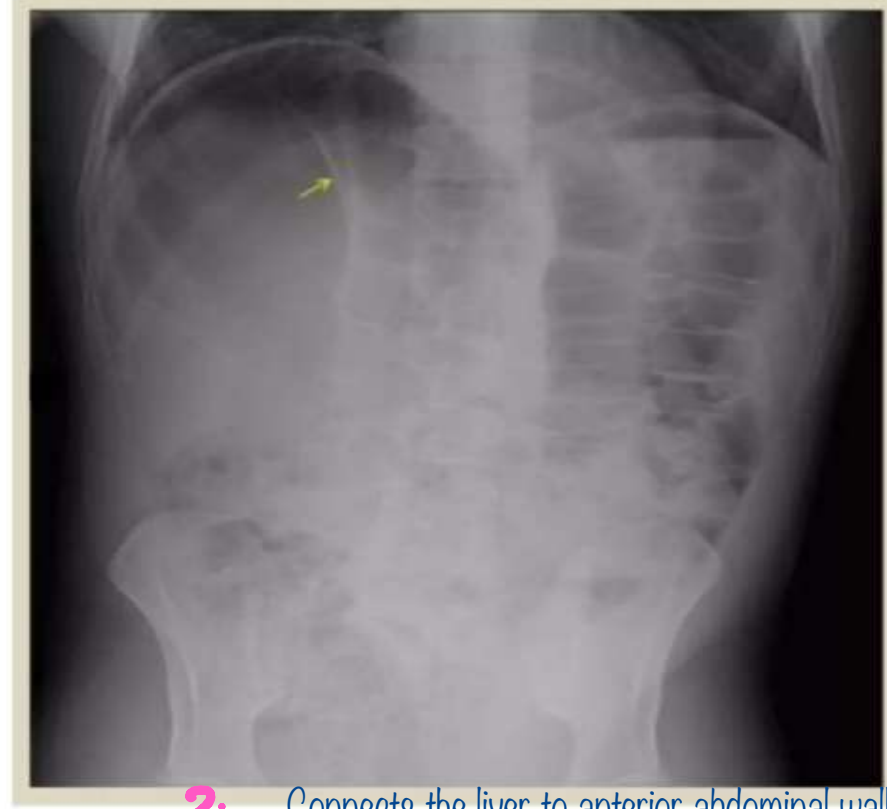
Pneumoperitoneum

An erect CXR (not AXR) is the best projection to diagnose a pneumoperitoneum (gas in the peritoneal cavity).

Recognizing abnormal Air



Pneumoperitoneum (crescent sign)



2. Connects the liver to anterior abdominal wall
Falciform ligament sign

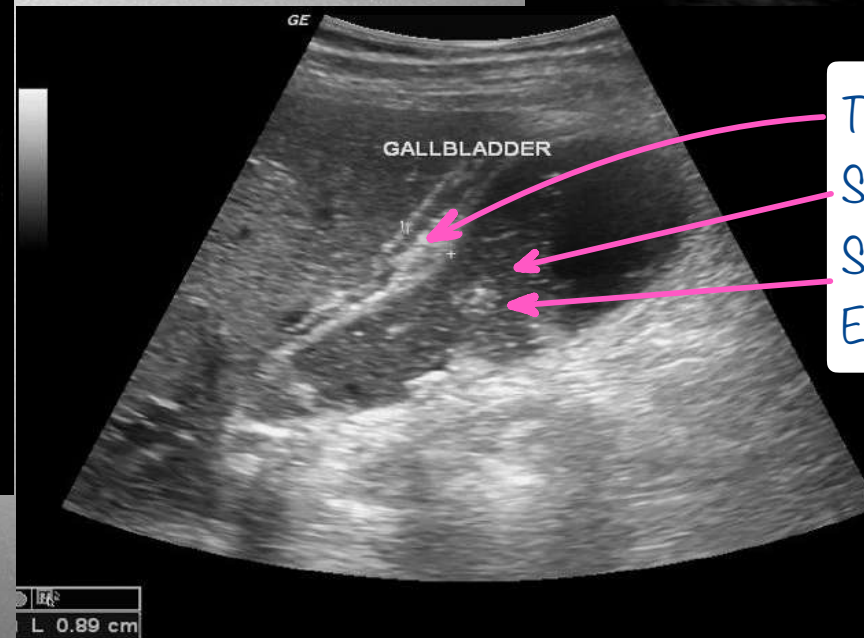
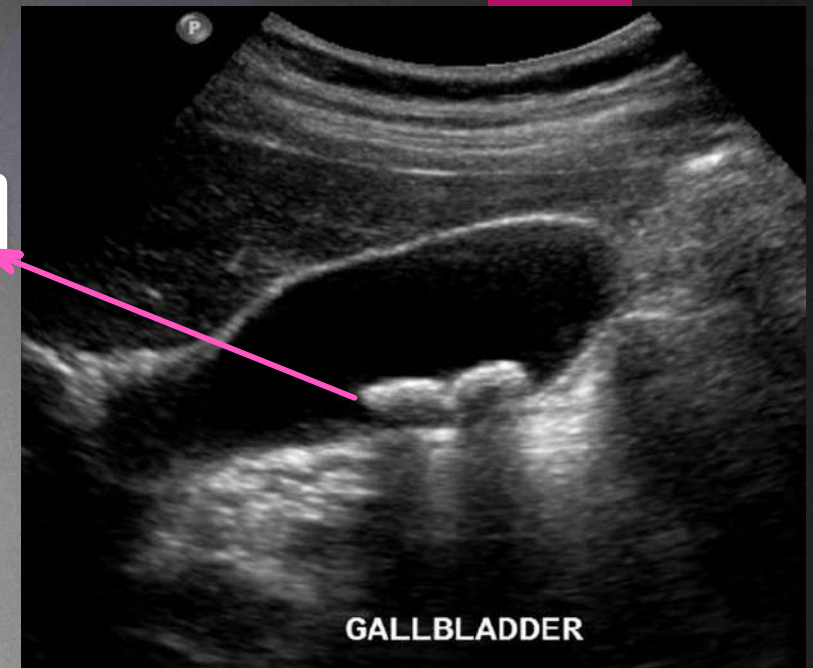
ultrasound

- Gas, stone » white
- Fluid » black
- Soft tissue » grey

- High-frequency sound waves to characterize tissue.
- Readily Available.
- Flexible
- Convenient and less costly.
- It is particularly useful for the assessment of solid organs and fluid-filled structures.

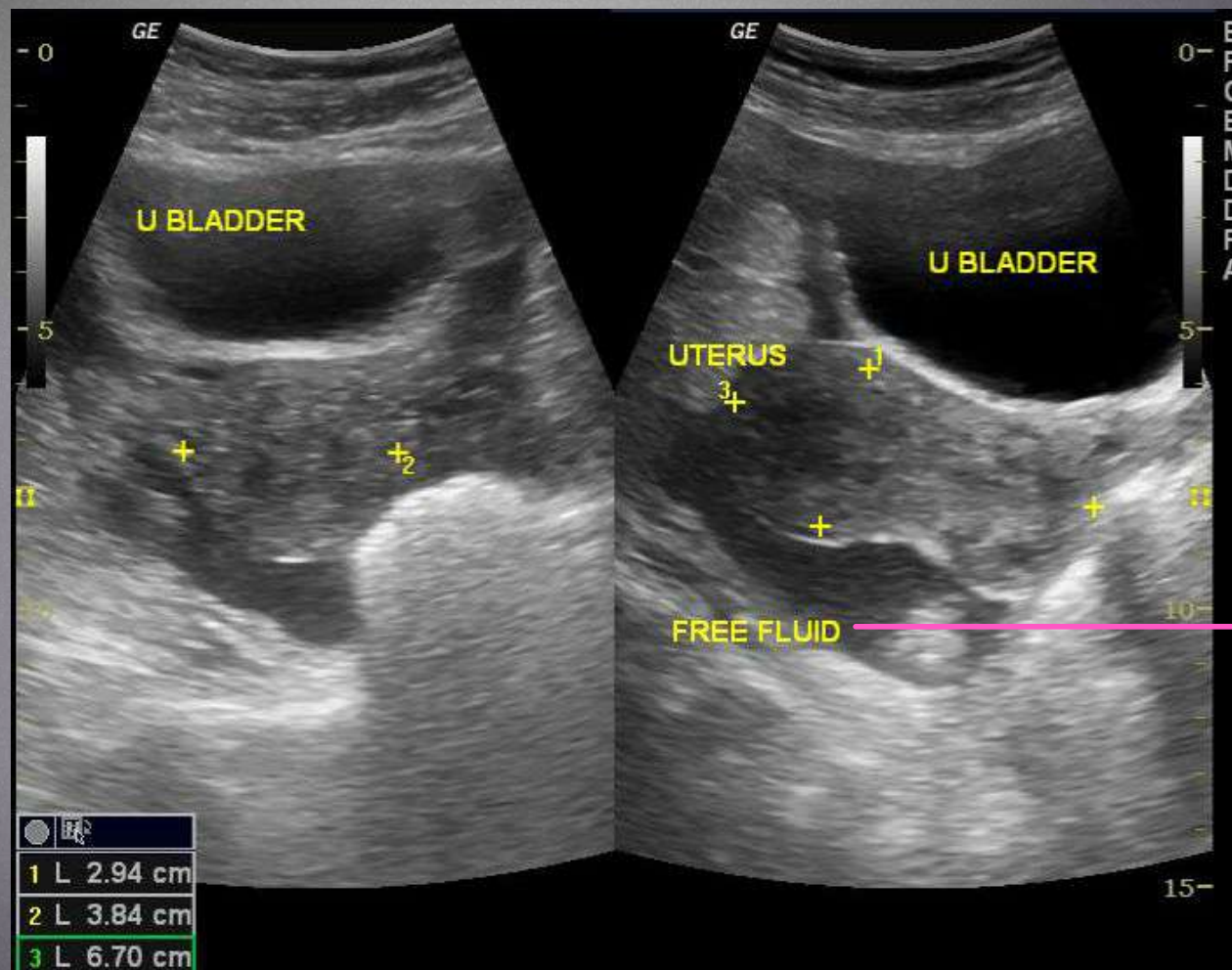


Gallbladder stone with acoustic shadow



Thickening in the wall > 3mm
Sludge
Stone
Edema

✿ Pelvic ultrasound ✿



Barium studies

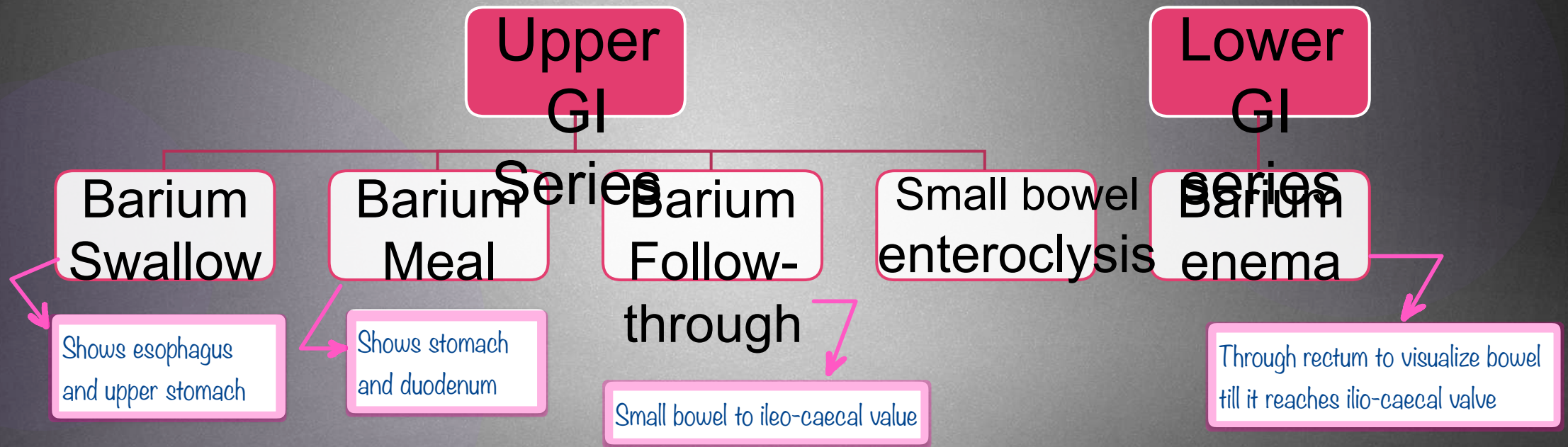
- Diagnostic tests used to assess GI system using X-ray imaging in the setting of administration of contrast agents .

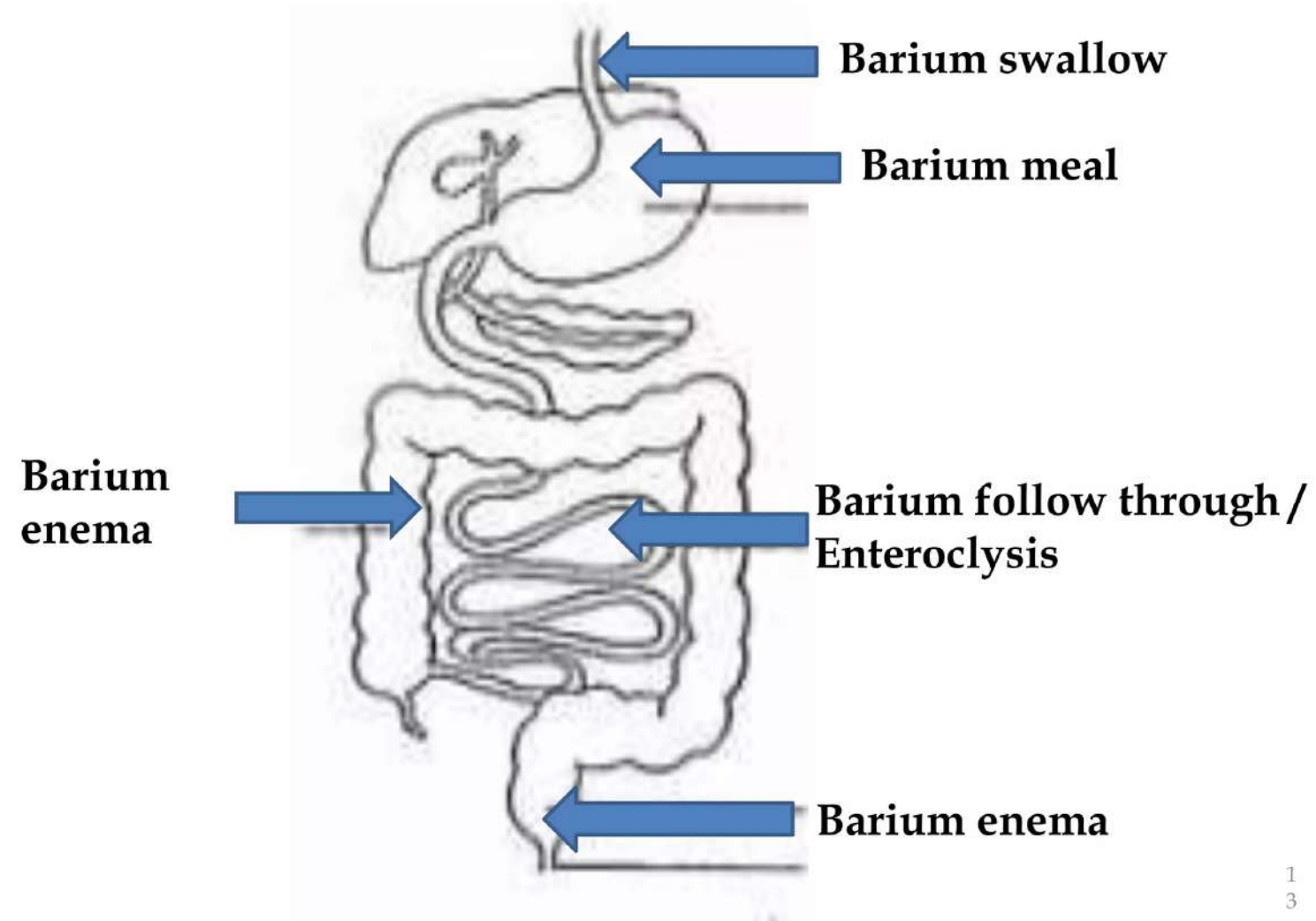
Contrast Medium for GI

Water Soluble

- Ionic (gastrografin) Can lead to pulmonary edema if aspirated.
- Non- Ionic (Low Osmolar) Relatively safer if aspirated.
- Gadolinium (MRI)

- Barium (Non-water soluble)
- Can cause severe peritonitis and fibrosis in perforation or leakage.

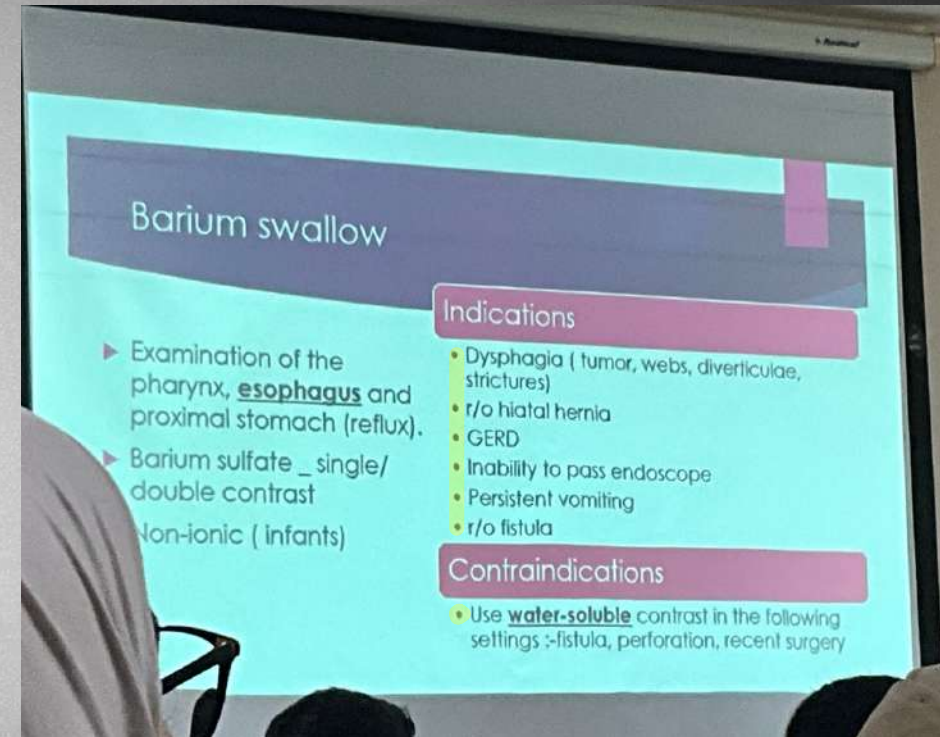




Barium swallow

- Examination of the **pharynx**, **esophagus** and proximal **stomach** (reflux).
- Barium sulfate _ **single/ double** contrast
- Non-ionic (infants)

Barium & air



هاي الصورة negative لانه ال barium لونه اسود
بس بتنعكس ل positive و بصير لون ابيض

Normal swallow

- Smooth outline
- No focal dilation or stenosis
- No Outpouchings
- No filling defects
- Smooth tapering
- Gastroesophageal junction
- No Reflux
- No Leak



Barium Esophagram:

Anterior-Posterior View

made with
flixier



Pathologies to look for in barium swallow

Achalasia

a failure of organized esophageal peristalsis that causes impaired relaxation of the lower esophageal sphincter, resulting in food stasis and often marked dilatation of the esophagus.

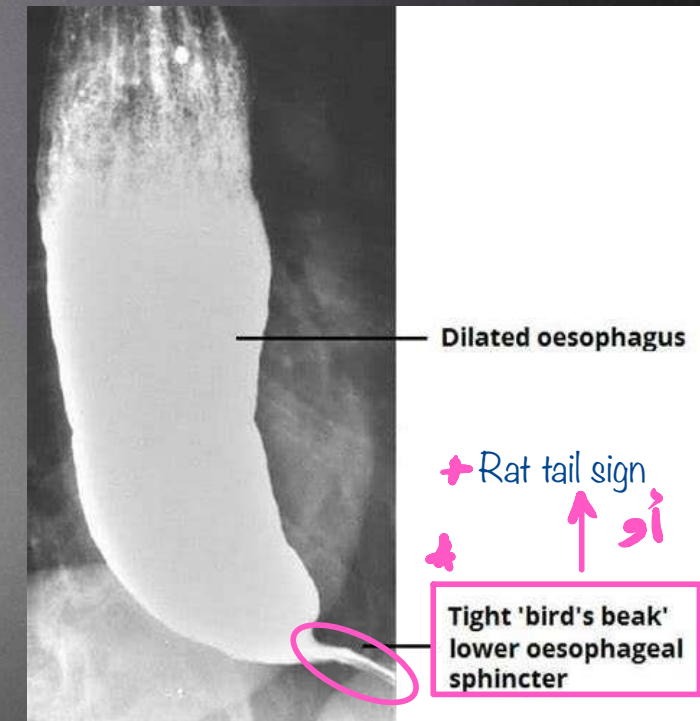
Dreaded Complications: esophageal carcinoma

- thought to occur because of chronic irritation of the mucosa by stasis of food and secretions

aspiration pneumonia:

the chronic presence of fluid debris in the esophagus makes patients very prone to aspiration

candida esophagitis





Malignant Stricture

➤ Abrupt narrowing with irregular mucosa

➤ The prominent shoulders are characteristic of tumor

Shouldering sign or apple core sign

Barium meal

- Examination of the stomach and duodenum .
- -Single contrast .
- -Double contrast is obtained by introduction of gas into the stomach using effervescent powders and barium. (Mucosal details)
- **Indications :**
 - Gastro esophageal reflux
 - Gastric or duodenal ulcer
 - Hiatus hernia
 - Suspected gastric tumor
- **Contraindications: (Water-soluble contrast used)**
 - Suspected perforation.
 - Completely bowel obstruction.
 - Suspected Fistula. ● Recent surgery

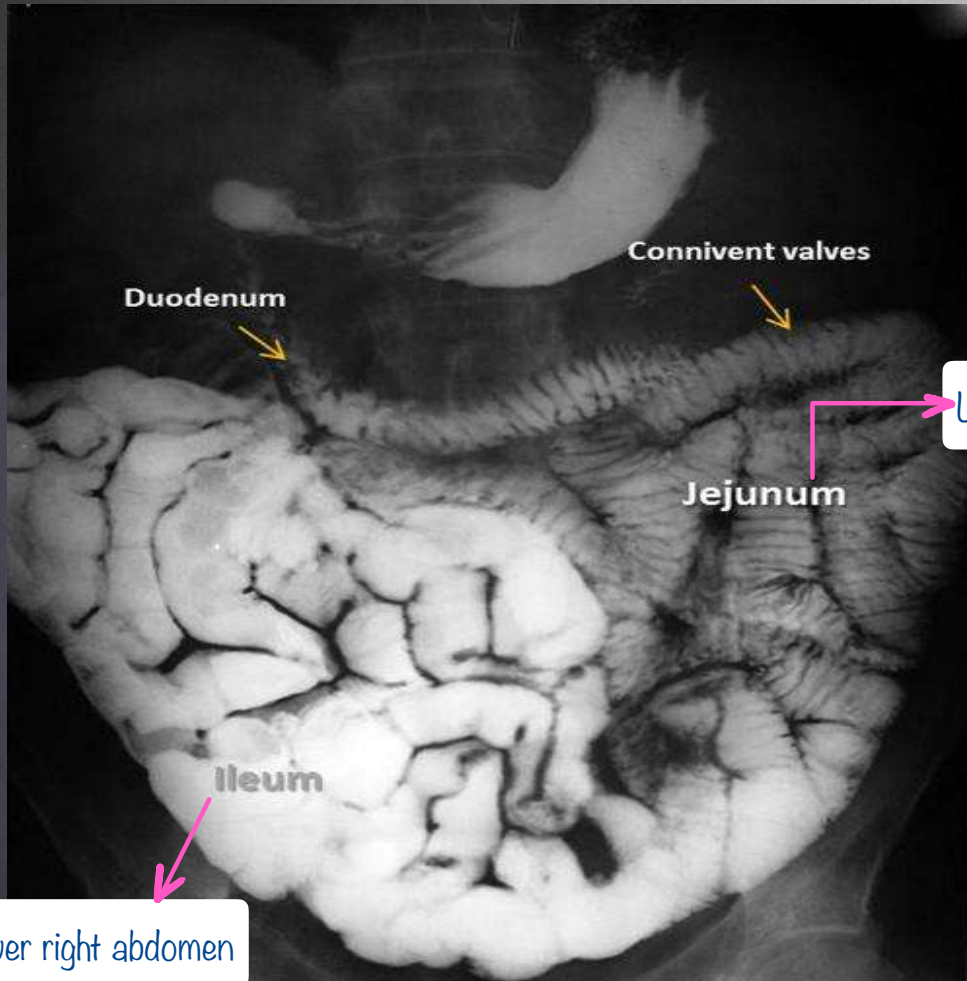
No mucosal details

Mucosal details

Barium meal (Single & Double)



Barium follow-through



- Examination of the small bowel with contrast traversing through the small bowel into the large bowel.

Indications:

- Small bowel pathologies as :
tumors, inflammatory bowel diseases, obstruction.

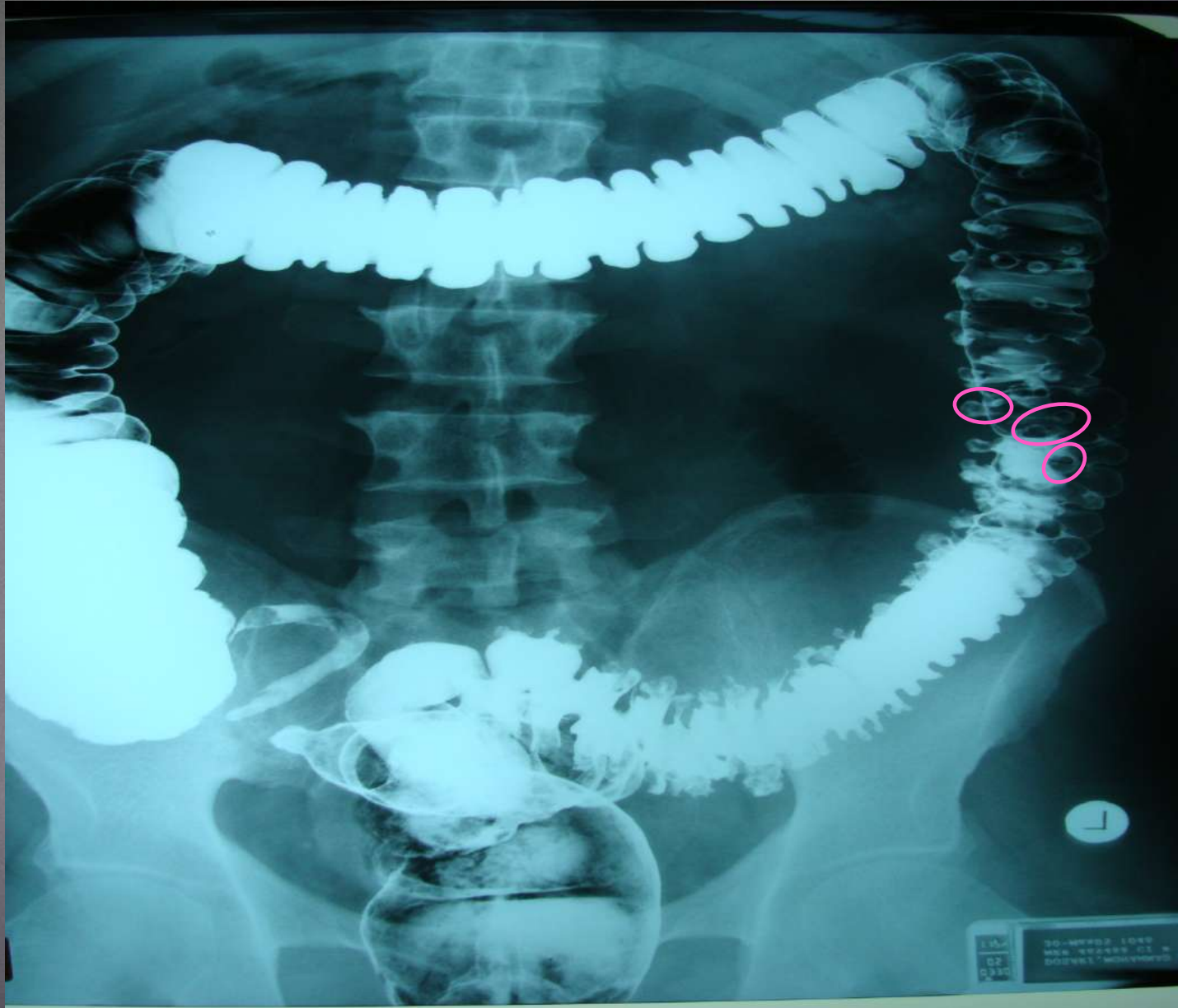
Barium enema

- Examination of the large bowel with double contrast (Barium and air).
- Introduction of contrast into the rectum through a Foley's catheter .

Indication :

- Investigation of abdominal mass
- Large bowel obstruction / volvulus.
- Diverticular disease
- Suspected colonic tumor

Barium enema,
double contrast



ال diagnosis هو ال
diverticulosis لانه بنشوف
outpouching فيها enema

لما تصور CT ممكن المادة الي بتضوي نعطيها oral or IV اذا اعطيناه oral راح اشوف ال abdominal organs زي ال stomach, bowel اما لو IV راح يضوي ال liver, kidneys, spleen, vessels

Ct of the abdomen

- An imaging modality that uses x-rays to build cross-sectional images ("slices") of the body.

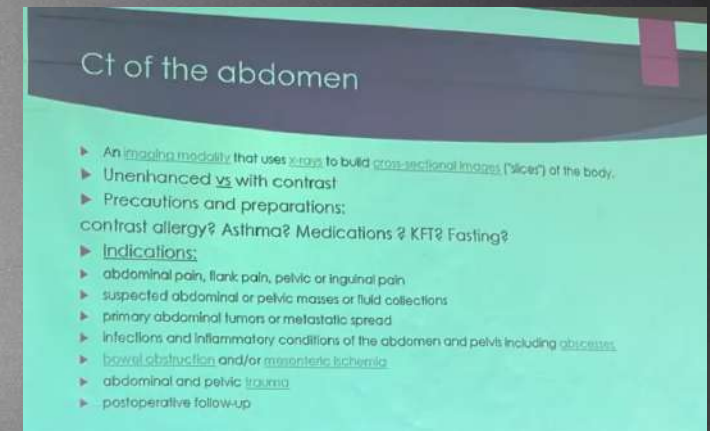
- Unenhanced vs with contrast

- Precautions and preparations:

contrast allergy? Asthma? Medications ? KFT? Fasting?

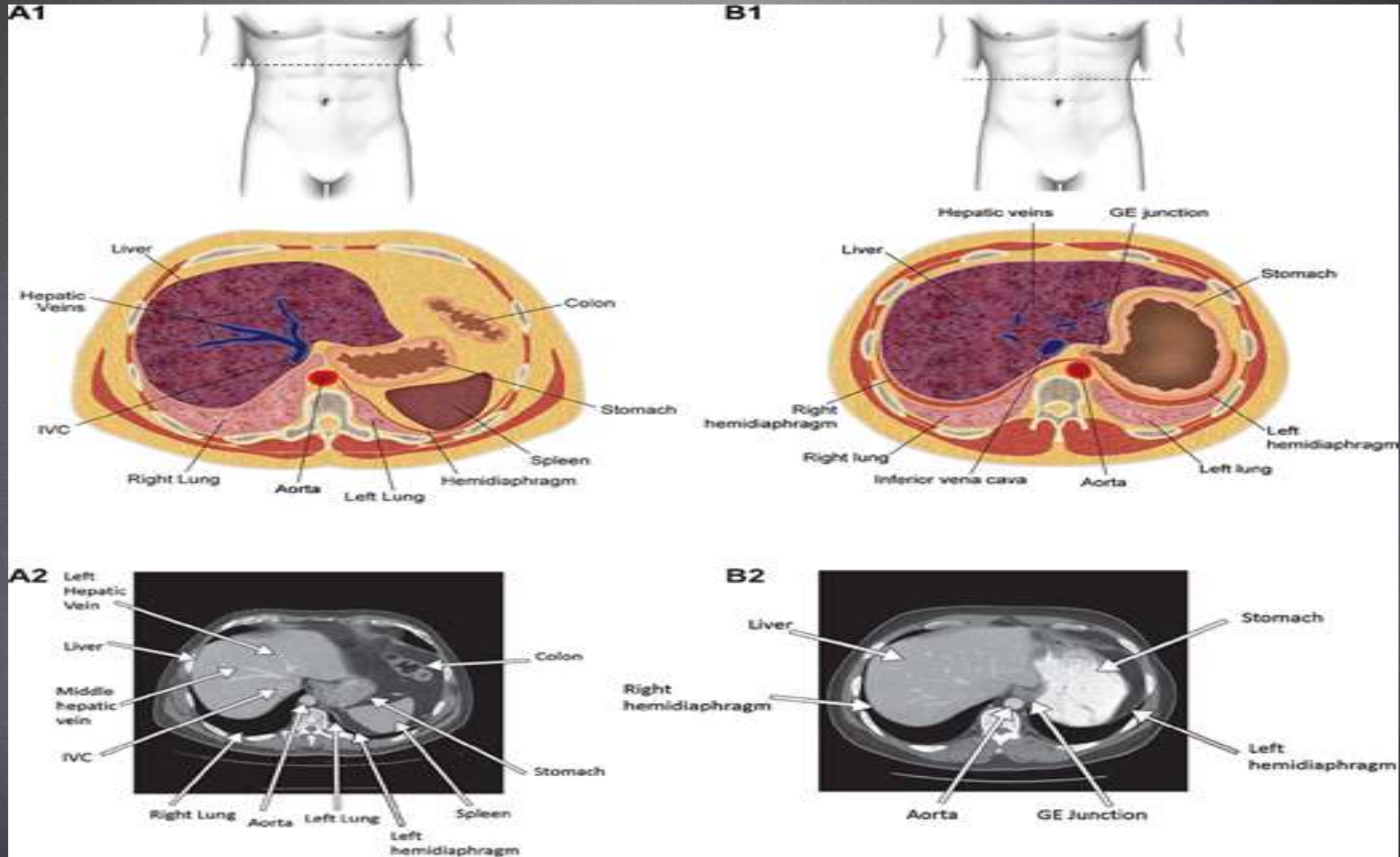
- Indications:

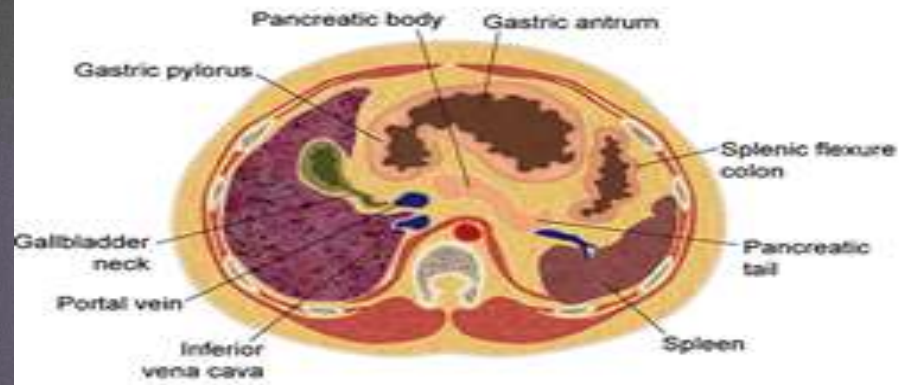
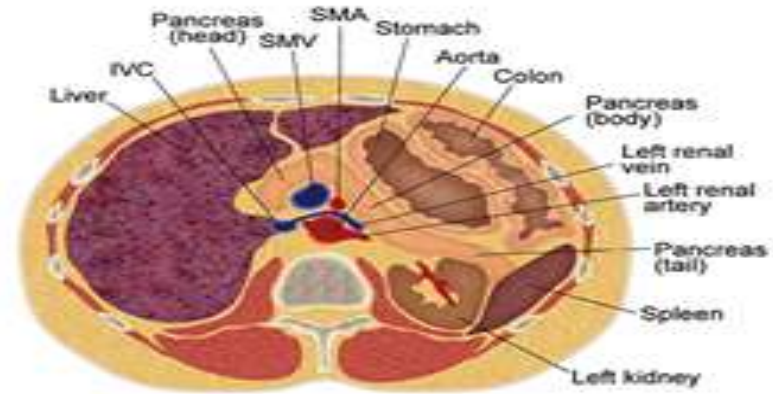
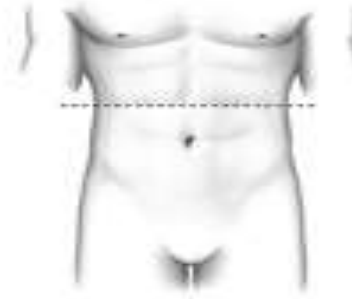
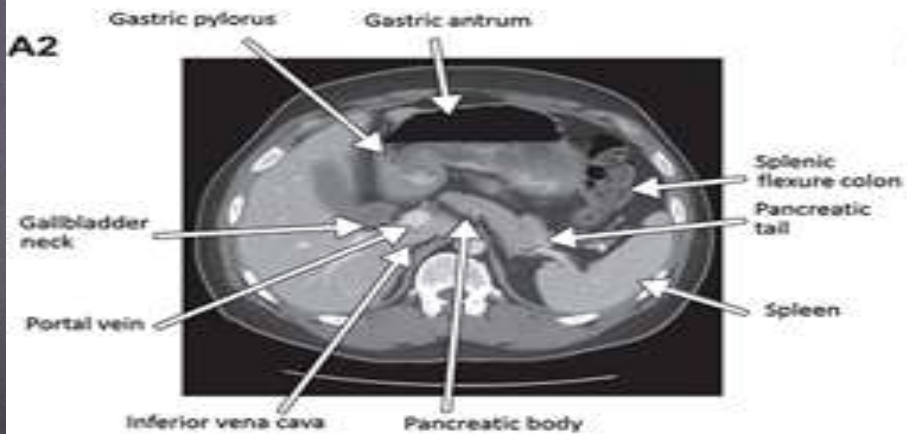
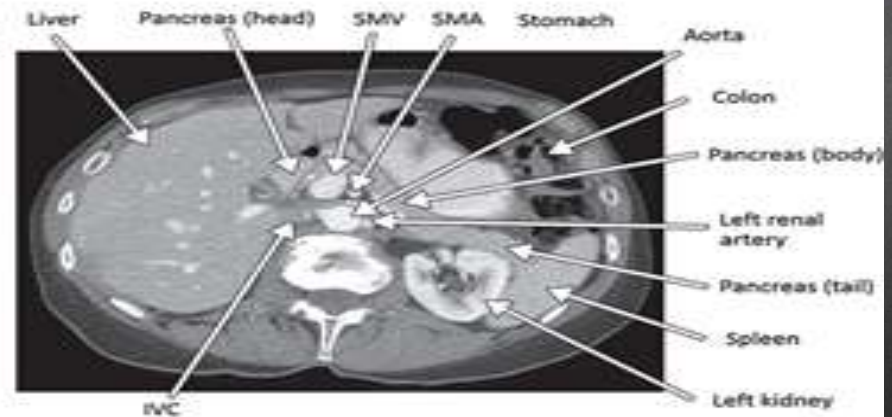
- abdominal pain, flank pain, pelvic or inguinal pain
- suspected abdominal or pelvic masses or fluid collections
- primary abdominal tumors or metastatic spread
- infections and inflammatory conditions of the abdomen and pelvis including abscesses

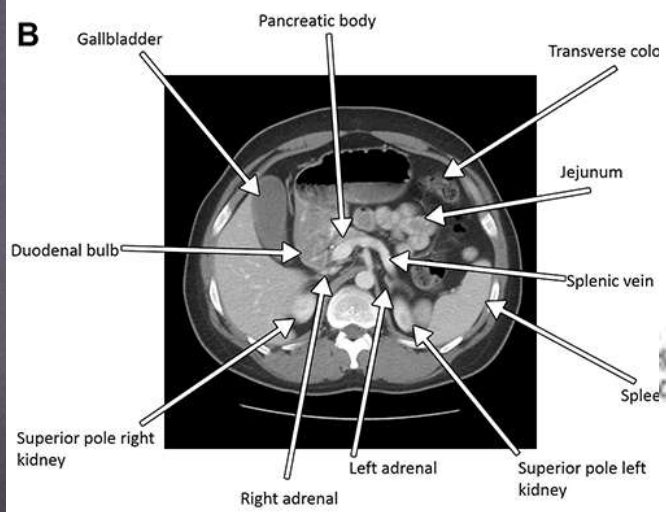
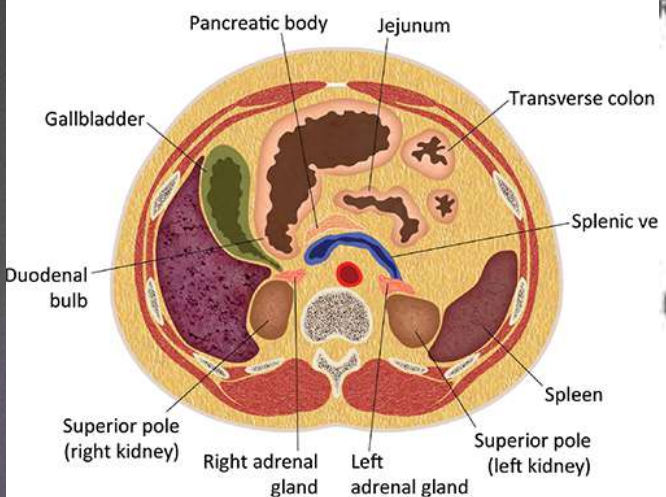
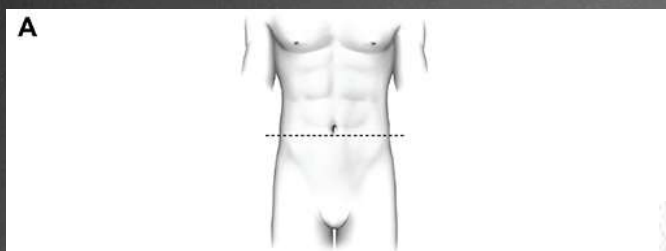


- Bowel obstruction / mesenteric ischemia
- Abdominal / pelvic trauma
- Post operation follow up

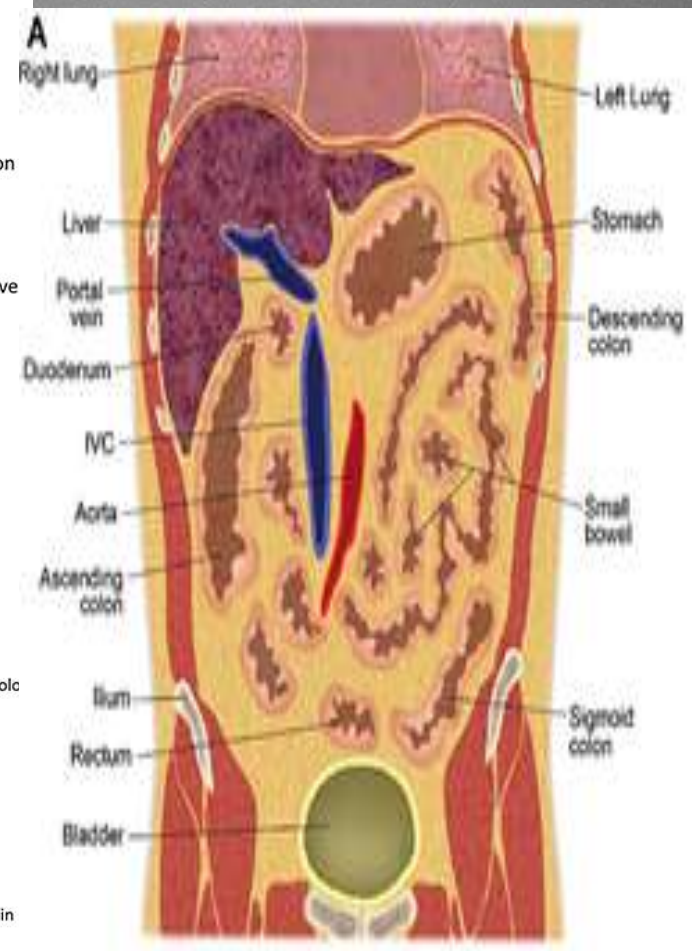
Ct anatomy of GIT



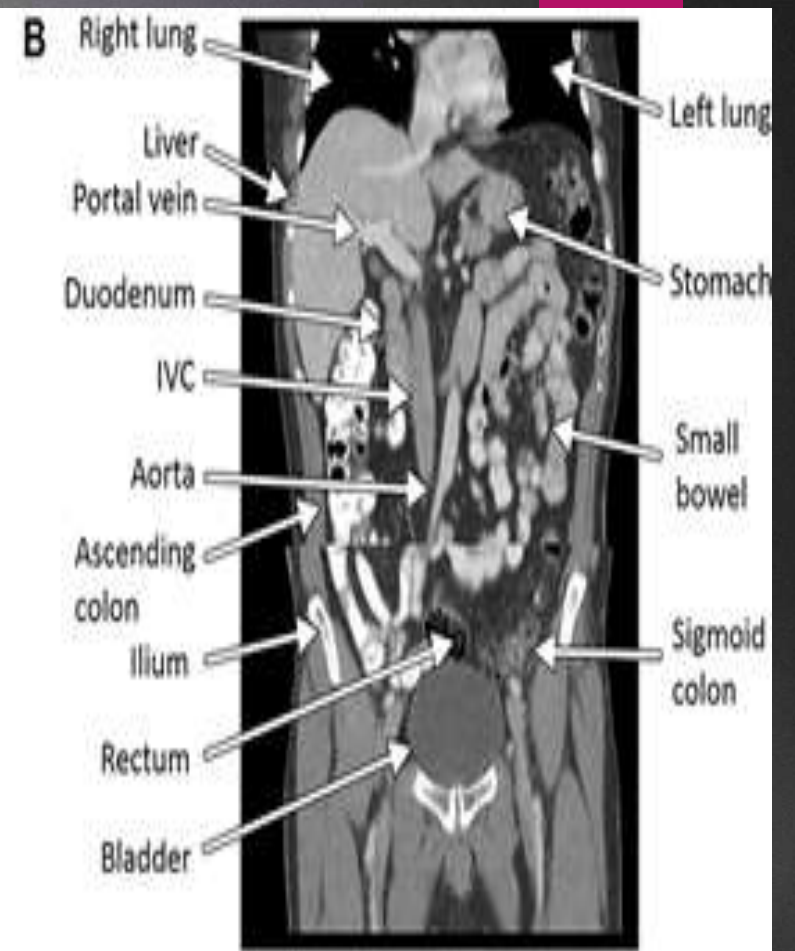
A1**B1****A2****B2**



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MRI of the abdomen

- Outstands CT , with less risk of radiation for assessment of several solid abdominal and pelvic organs
- Assessment of vessels (MRA)
- Assessment of biliary tree (MRCP)

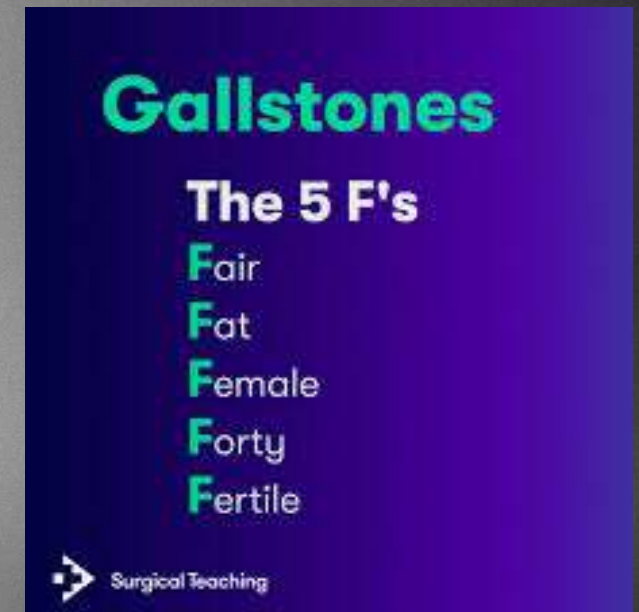
Gallbladder & Biliary system

بس 10-20% من ال gallstones بيبنوا على ال X-ray عشان هيك ال ultrasound احسن اما ال renal stones تقريبا 80% منهم بشوفهم على ال X-ray .. ال pigment and mixed gallstones appear on X-ray لانهم بيحتوا على كالسيوم اما ال cholesterol ما في كالسيوم ما بتبين

- Gallstones:

- **Types of gallstones:**

- Cholesterol gallstones: are the most common, accounting for more than 80 % of cases.
- Pigment gallstones: usually form when there is excess bilirubin and calcium salts in bile.
- Mixed stones: are mixture of cholesterol and calcium salts.

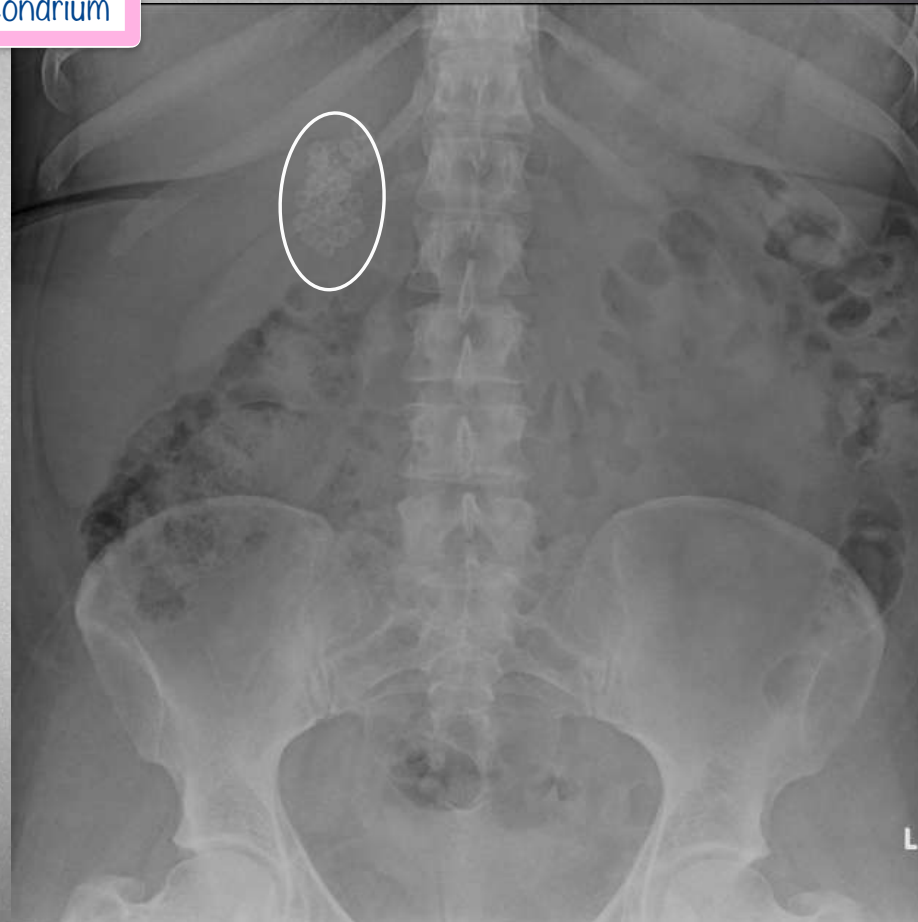


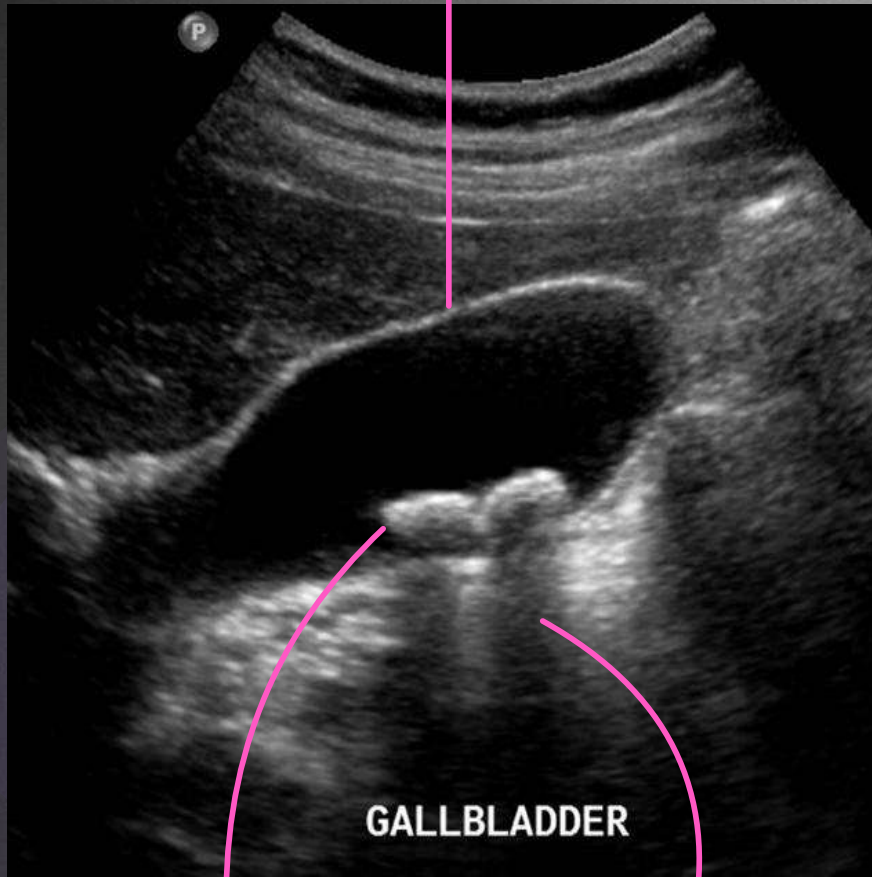
Radiological features of gallstones

Plane abdominal x- Ray, frontal view .. finding: multiple stones in right hypocondrium

- Plain film reveal approximately 10 to 20% of calculi as they are radio-opaque.
- Ultrasound is the best test for gallstones, which is non-invasive and very accurate.
- A gallstone on ultrasound is echogenic, it appears as a white structure that casts a dark shadow behind it.

إذا ما شفت shadow هاد دليل انها مش stone ممكن تكون polyp or mass



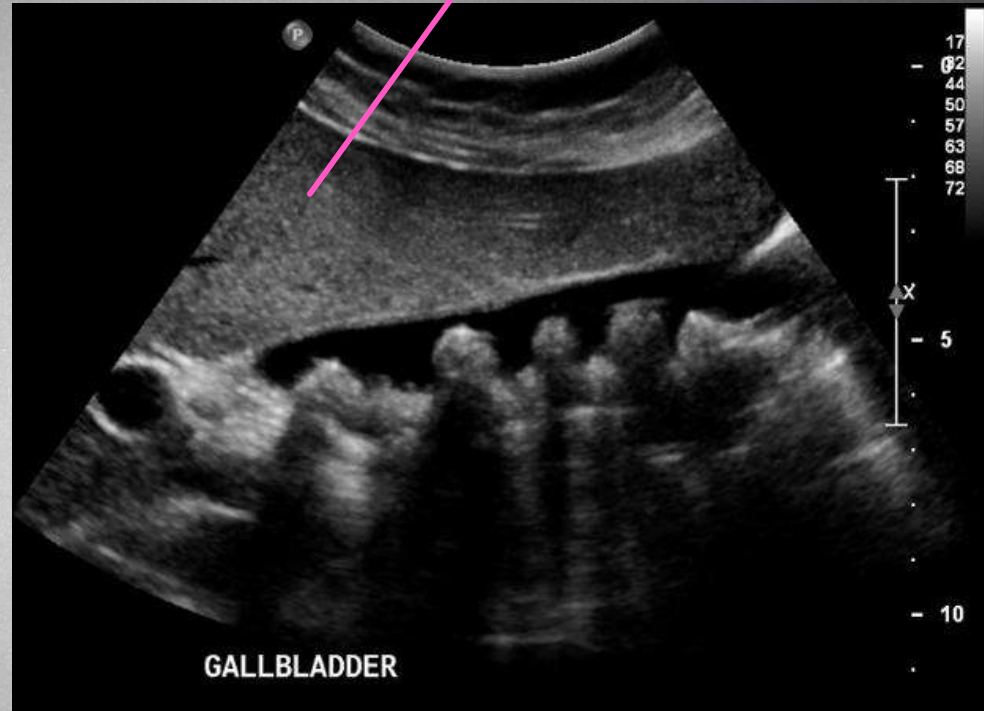


Thin wall

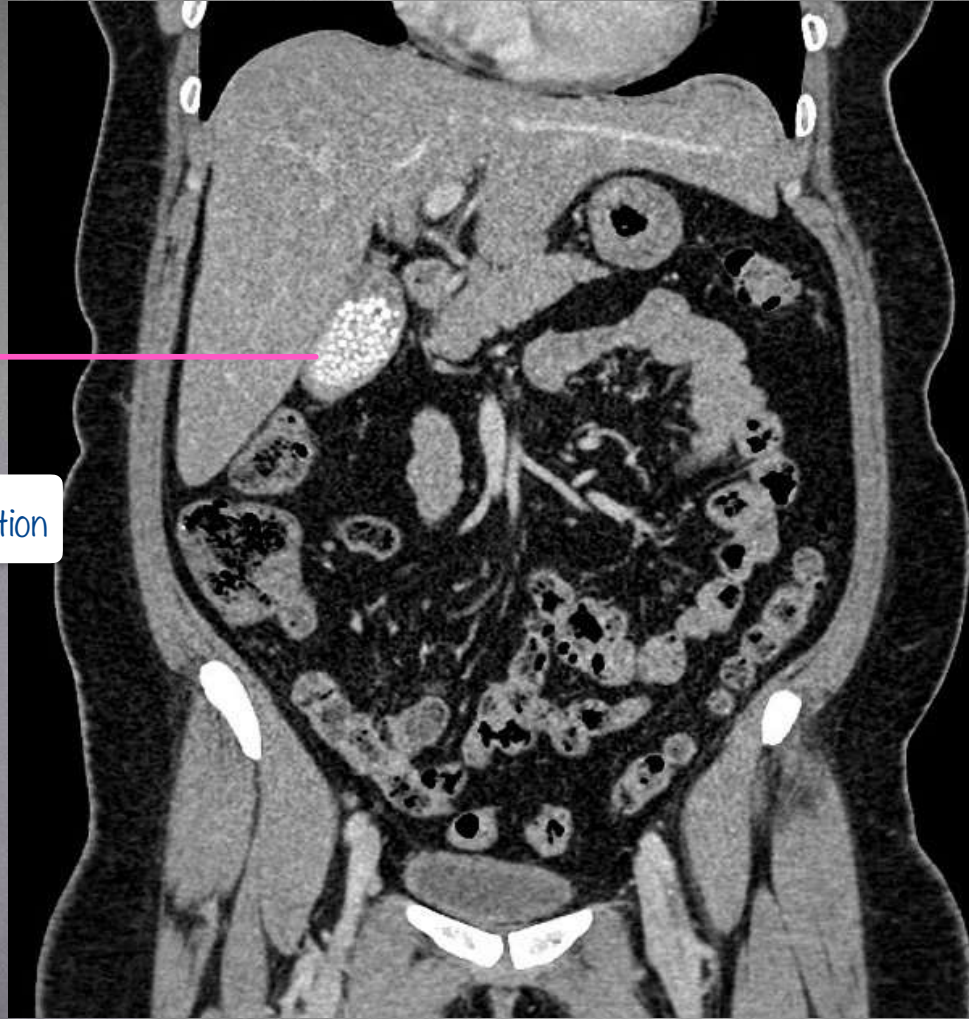
No signs of inflammation

Stones

Shadow



Liver



Multiple gallbladder stones

Simples, non complicated, no signs of inflammation

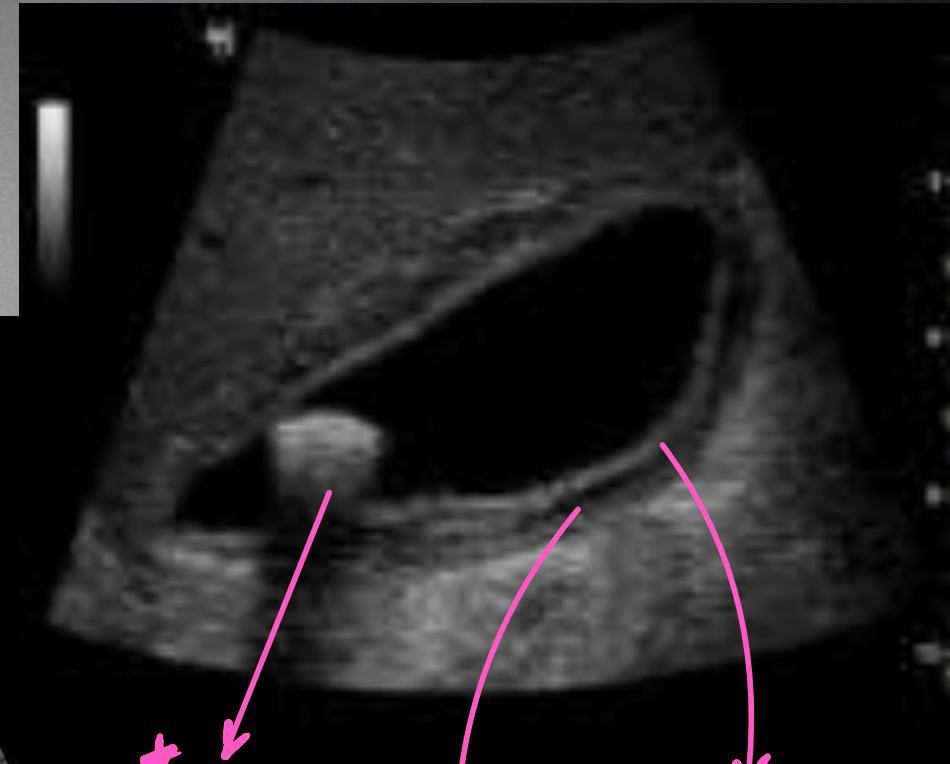
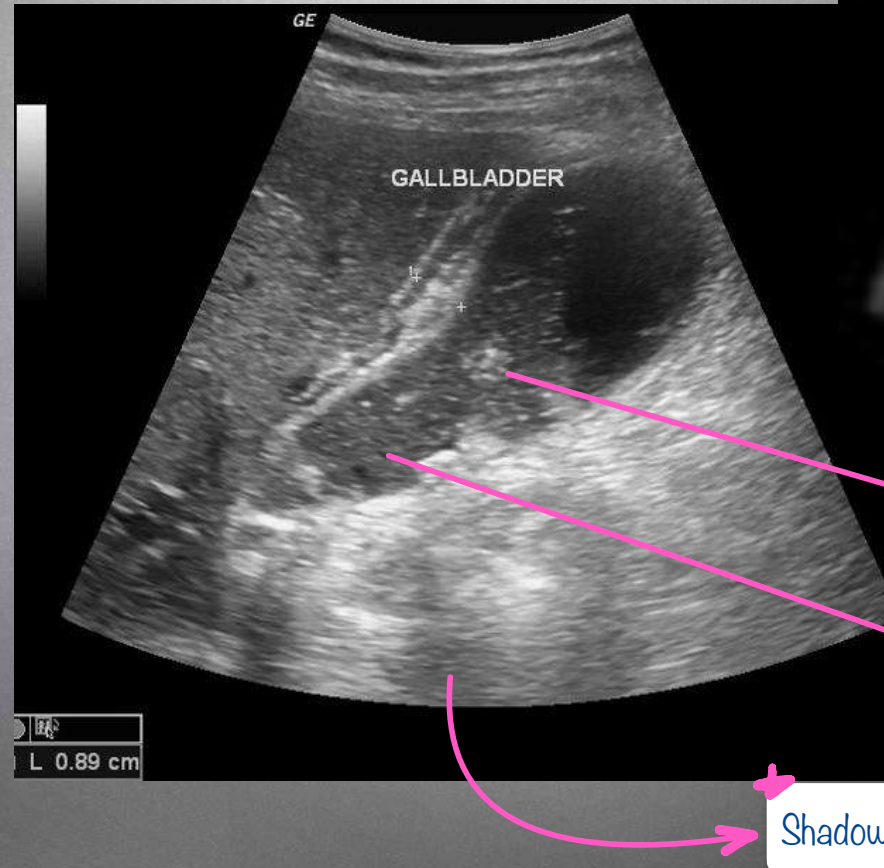
cholecystitis

- any form of inflammation involving the gallbladder and has many forms, including:

Acute calculous cholecystitis

Ultrasound features are:

- ❖ Distended gallbladder with gallstones.
- ❖ The gallbladder wall is thickened (greater than 3 mm) and edematous
- ❖ Pericholecystic fluid, and in some complicated cases pericholecystic abscess.



Stone

Sludge

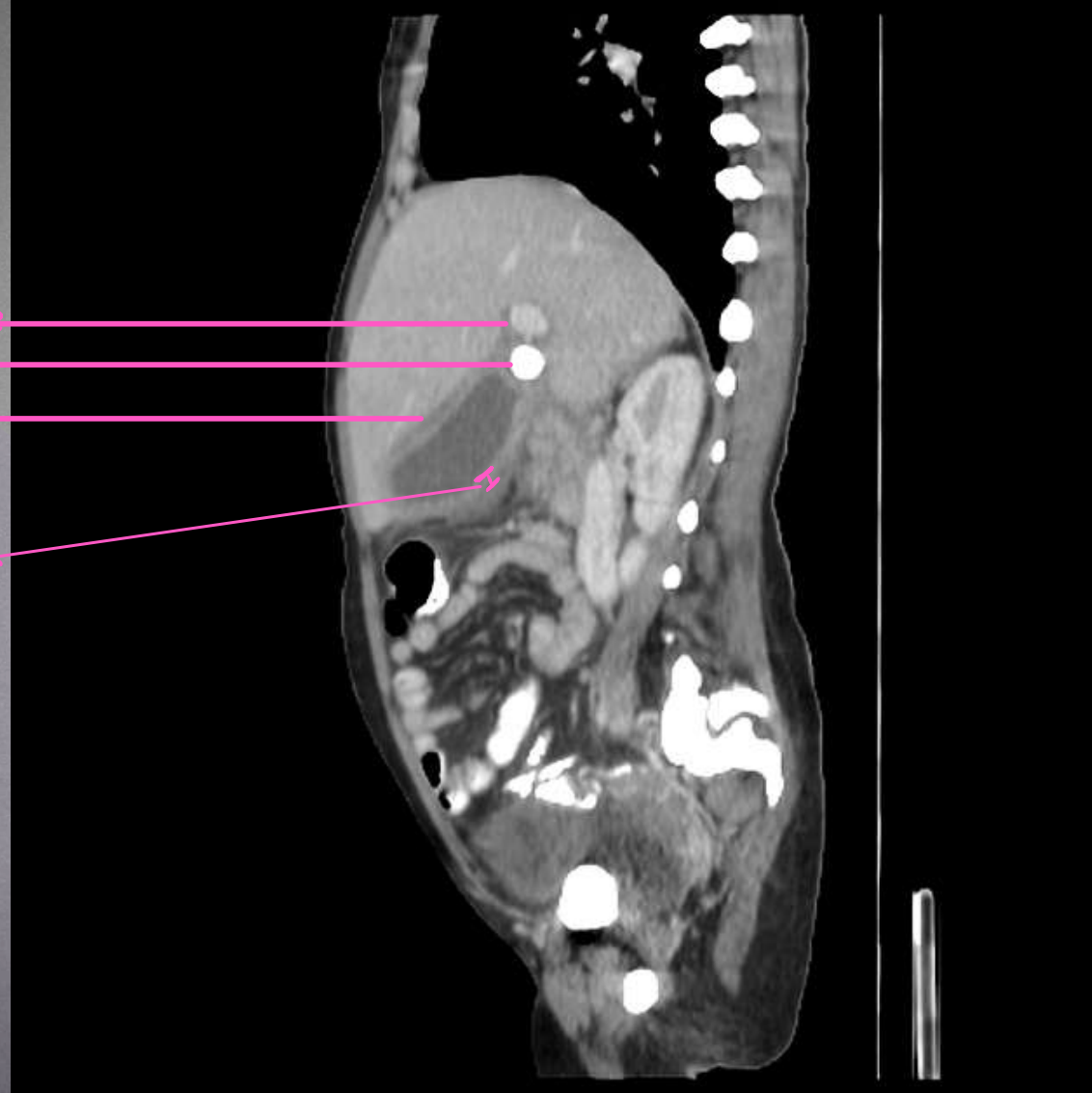
Shadow

Increased wall thickness

Fluid (edema)

Abdominal CT, saggital view

- Portal vein
- Stone
- Fluid
- Thick wall



- **Porcelain GB:**

- Curvilinear calcifications within chronically inflamed and fibrotic muscular wall.
- 90% associated with gallstones.
- Wall is thickened and gallbladder is contracted.
- Increased incidence of malignancy.



Complete calcification of the wall » increased risk of malignancy



ENDOSCOPIC RETROGRADE CHOLANGIOPANCREATOGRAPHY

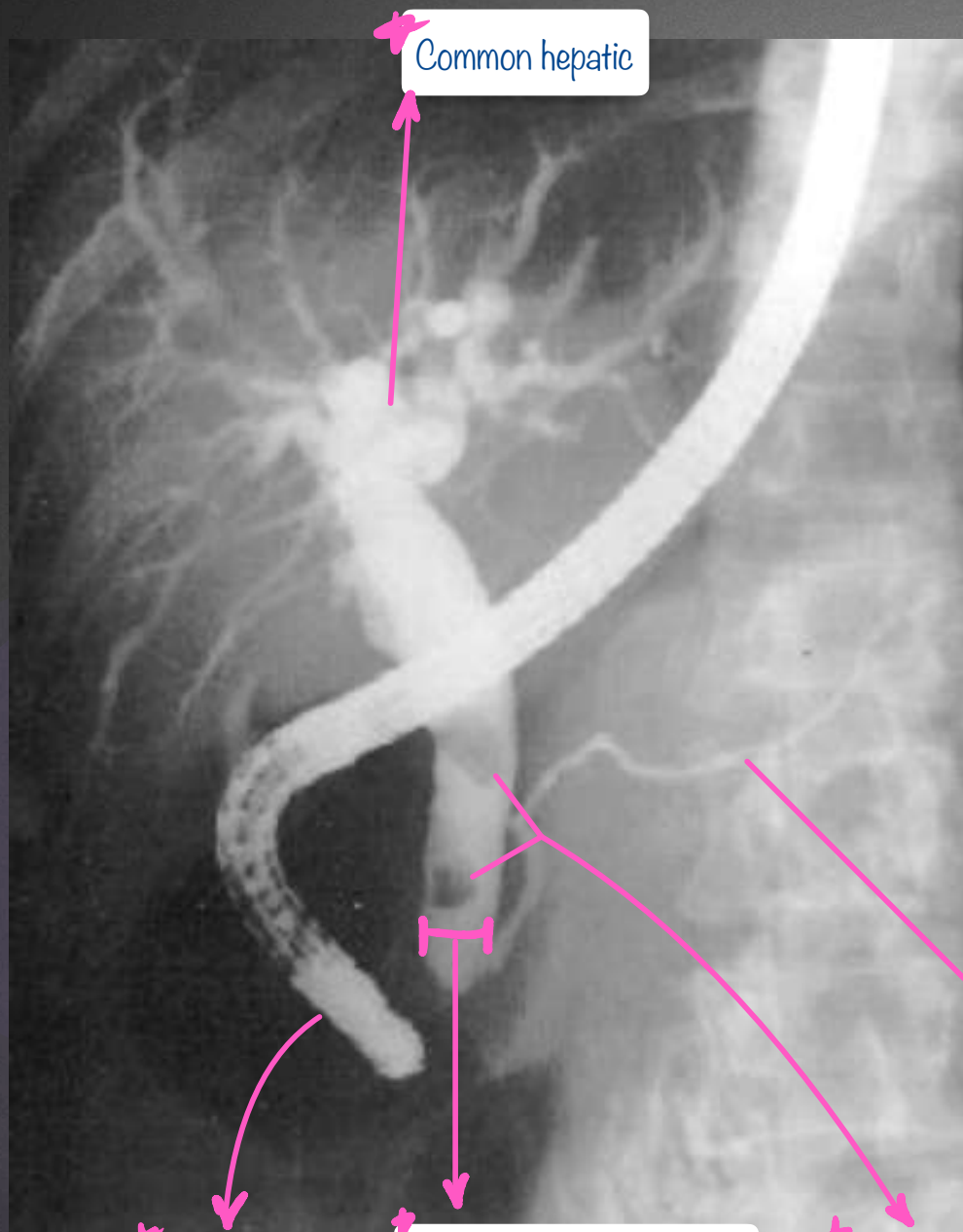
(ERCP) → X-ray radiation is used

✦ MRCP » only diagnostic, it's non-invasive, less radiation

Indication: Diagnostic and therapeutic

- Obstructive jaundice
 - Removal of known CBD stones
 - Pancreatic tumors, that cause bile duct obstruction and jaundice
- An endoscope is introduced and advanced through the mouth into the duodenum, with injection of contrast into the ampulla of Vater, to demonstrate both the bile ducts and the pancreatic ducts.
- CBD stones can be removed through the endoscope by insertion of a catheter with a basket or balloon. → Filling defect is on indication of obstruction like stone
- Malignant CBD strictures can also be stented.

✦ Biliary tree

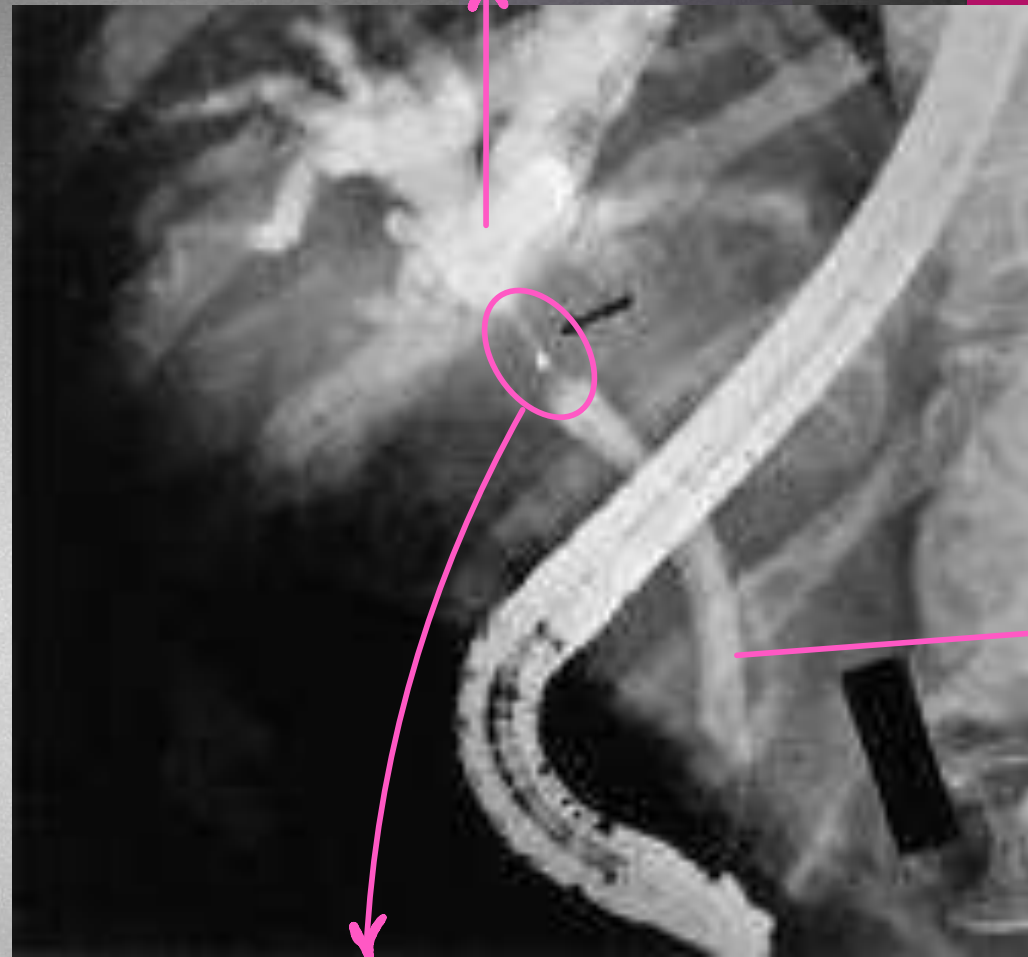


Common hepatic

Endoscope

Common bile duct dilation

Filling defects



Bifurcation

Stenosis in common hepatic duct

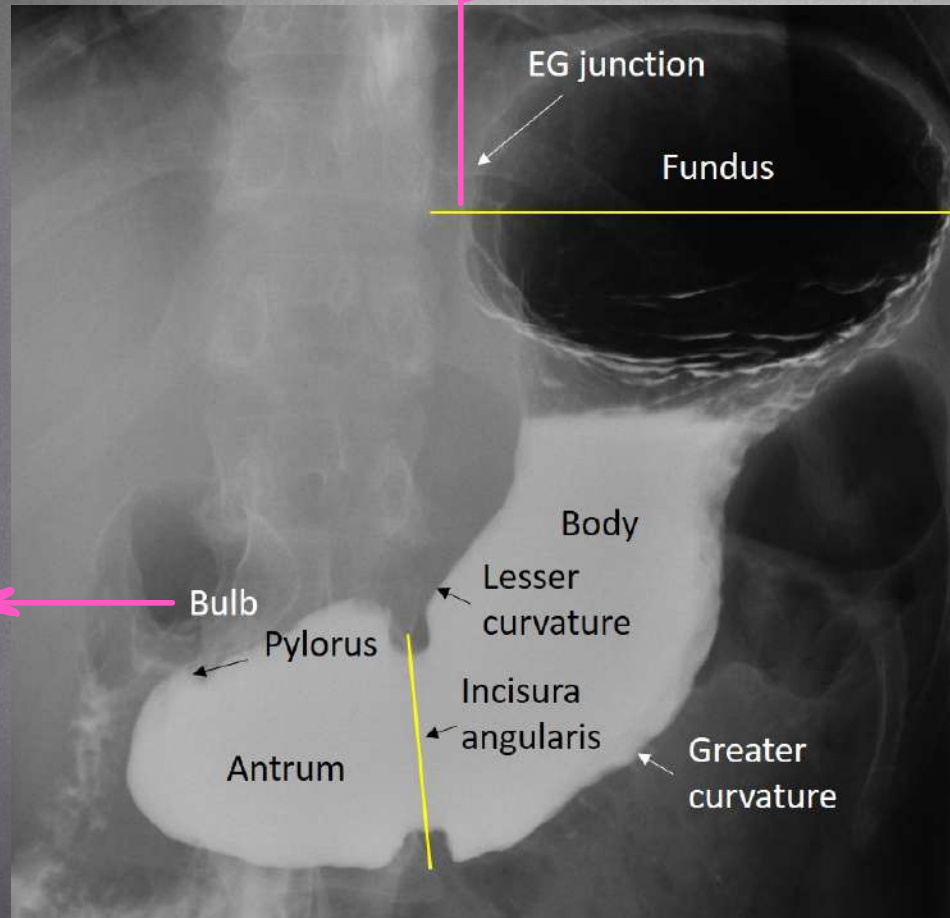
Pancreatic duct is prominent

Common bile duct caliber is normal

Type of study » barium meal

Stomach

Between fundus and body of stomach

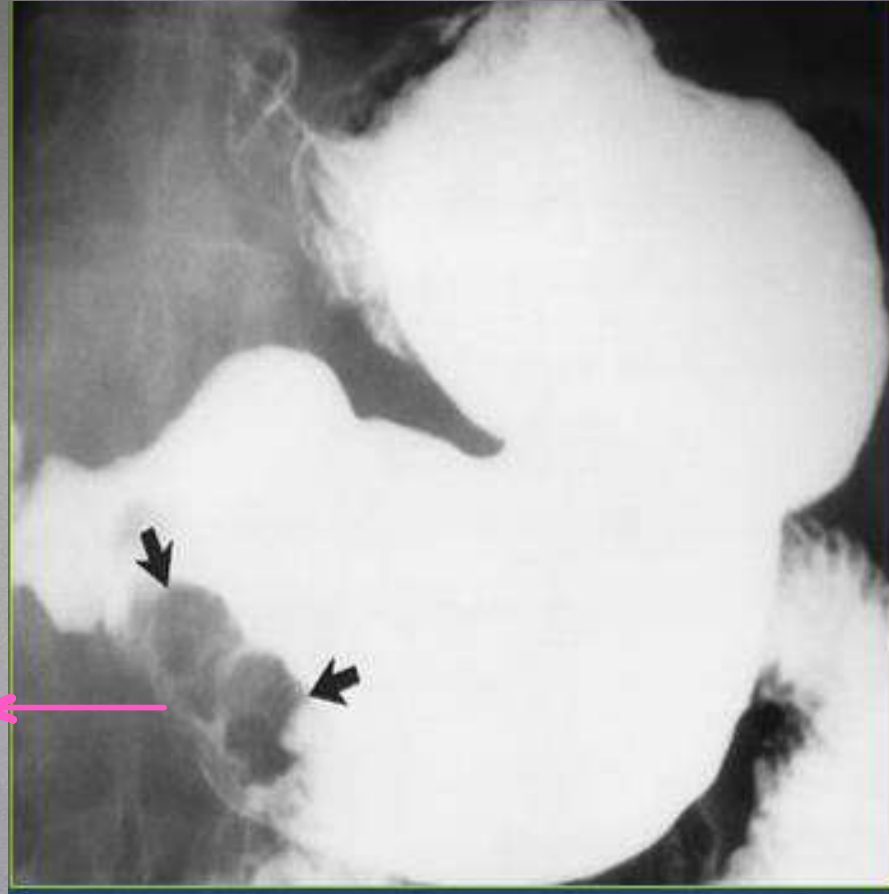


First part of the duodenum

Ampulla of Vater opens in medial wall of the duodenum

GASTRIC CARCINOMA

- MC gastric malignancy.
- UGIS- Lobulated filling defects .
- CT abdomen –
 - Diffuse / local wall thickening.
 - Lobular mass
 - +/- Ulceration
 - Enhancement
 - Local lymphadenopathy
 - Distant metastasis



Filling defect in antrum

Type of study » barium meal



CT abdomen , axial view, with contrast



CT abdomen , coronal view



Diffused gastric wall thickness, more than 10 mm



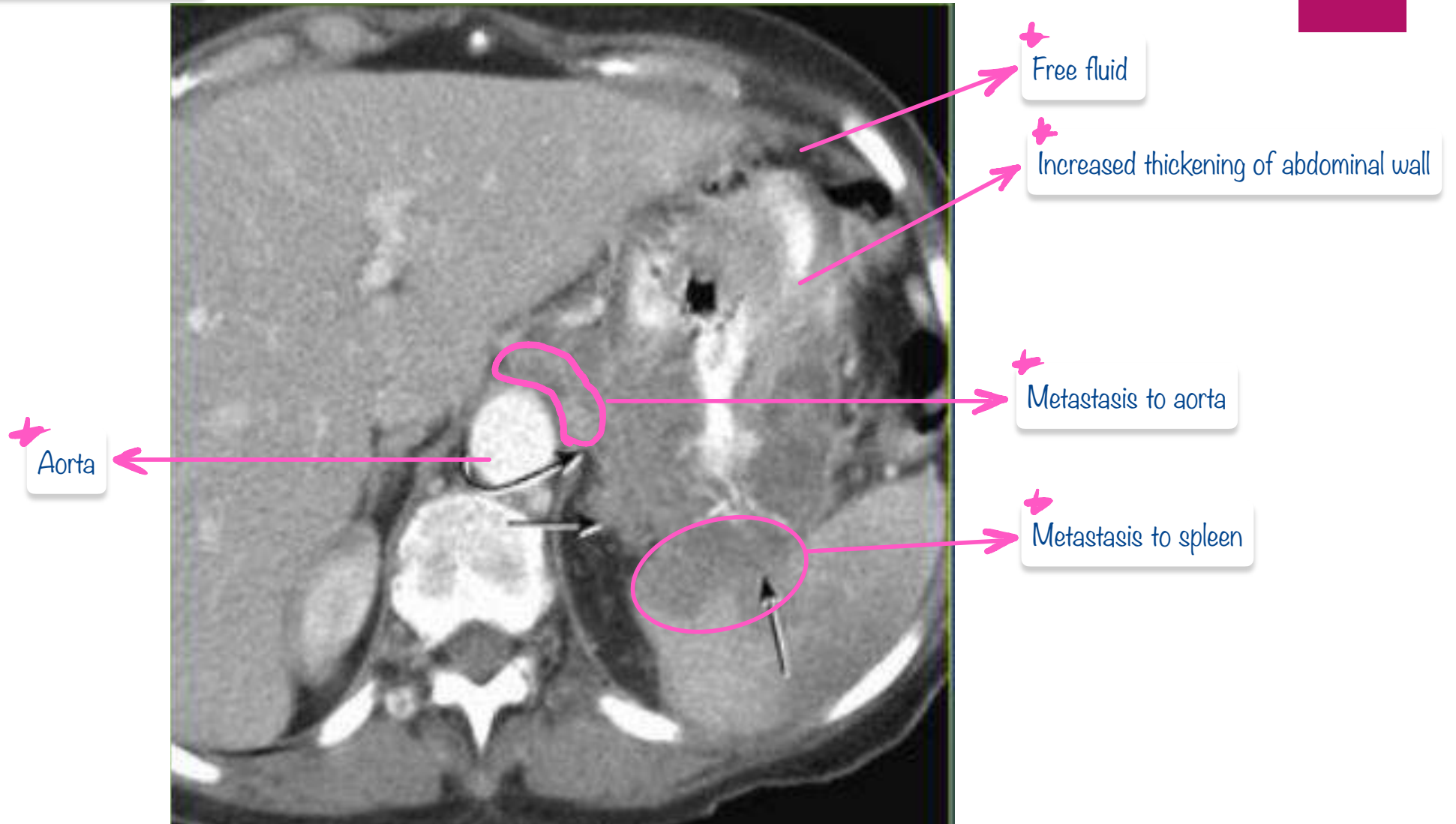
Narrowing of the lumen



Next step » endoscopy with biopsy

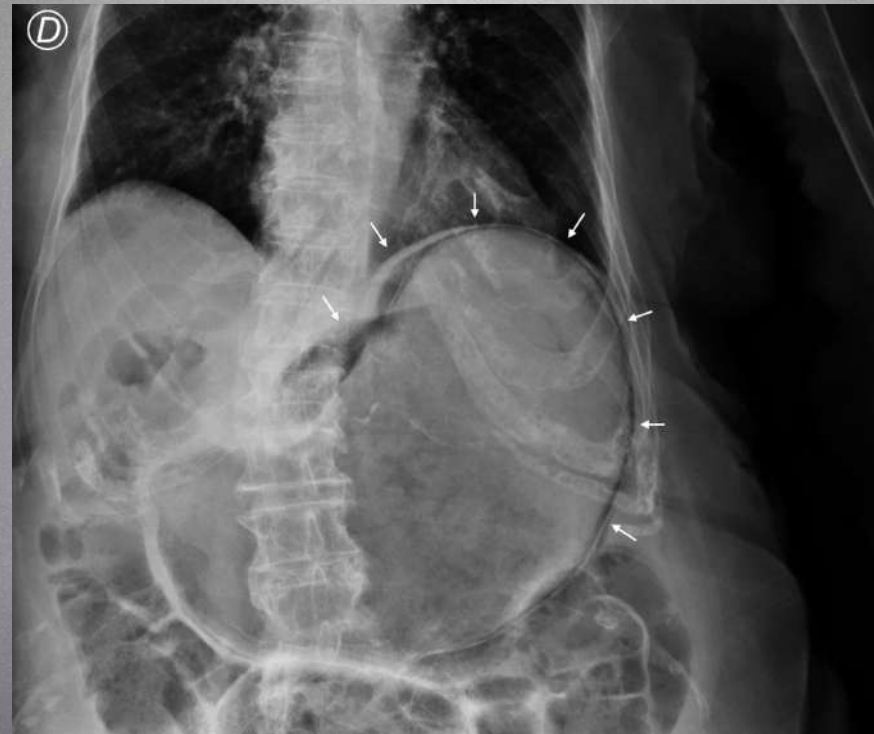
✦
Diagnosis » gastric cancer due to metastasis

✦
CT abdomen , axial view, with contrast



EMPHYSEMATOUS GASTRITIS

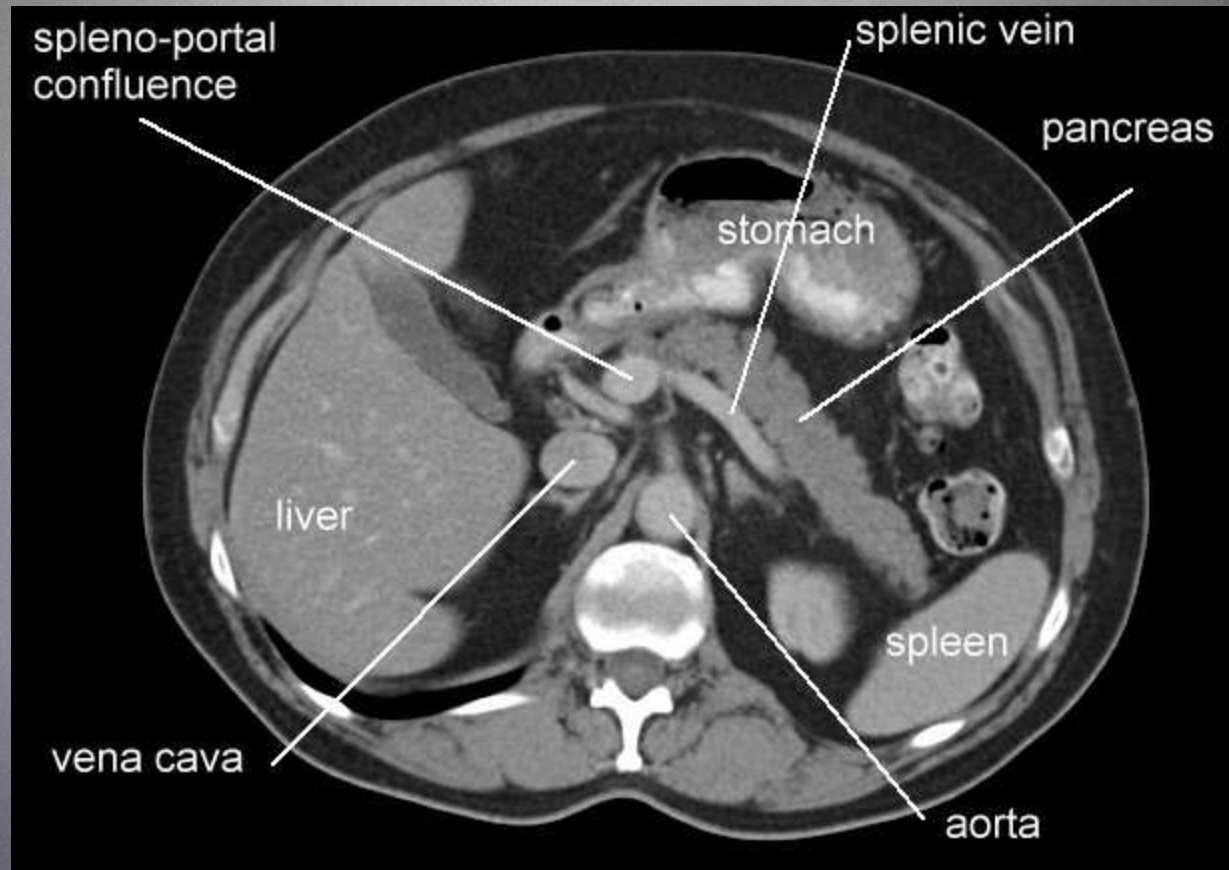
- **Emphysematous gastritis** is a cause of gastric emphysema.
- Most cases are brought about by caustic ingestion, alcohol abuse, surgery, trauma, or ischemia



Pancreas

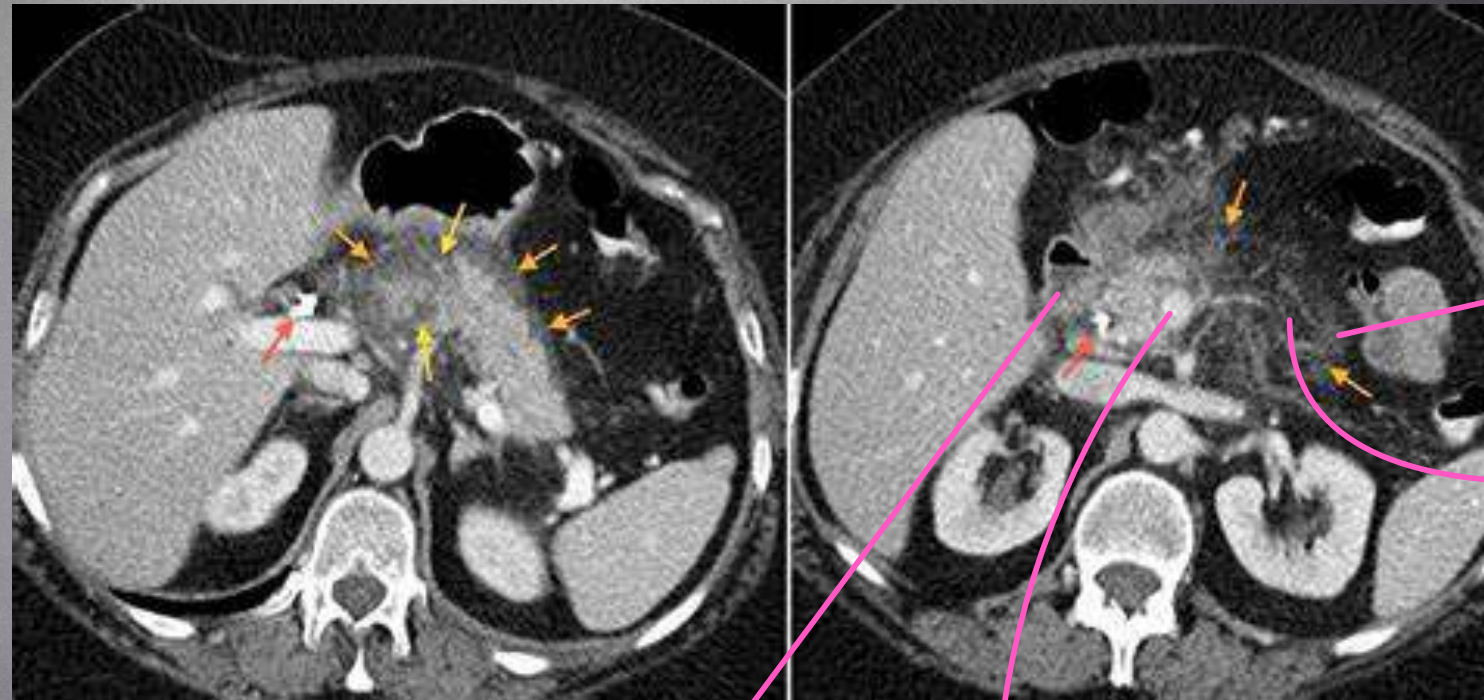
- Pancreatitis-
- US, CT, MRCP, and ERCP are all used in the diagnosis and evaluation of inflammatory diseases of the pancreas.
- The role of diagnostic imaging in **acute pancreatitis** is quite different from its role in chronic pancreatitis.
- In cases of suspected pancreatitis, imaging is used to **establish an etiology** (gallstones, etc), and assess **for possible complications** that would require intervention.
- In **chronic pancreatitis**, imaging allows for the classification of the morphological changes, which determines prognosis and potential interventions.

Normal pancreas



Acute pancreatitis

Common causes of pancreatitis include alcohol abuse, choledolithiasis, hypertriglyceridemia, and hypercalcemia.



Duodenum

Head of pancreas

Fatty stranding

Inflammation

Chronic pancreatitis

↪ = calcifications

- Chronic pancreatitis presents with different diagnostic and therapeutic challenges compared to acute pancreatitis; the role of imaging may be interventional as well as diagnostic.
- Chronic pancreatitis is characterized by parenchymal atrophy, ductal calcifications, and ductal dilatations and strictures.





Ductal stricture

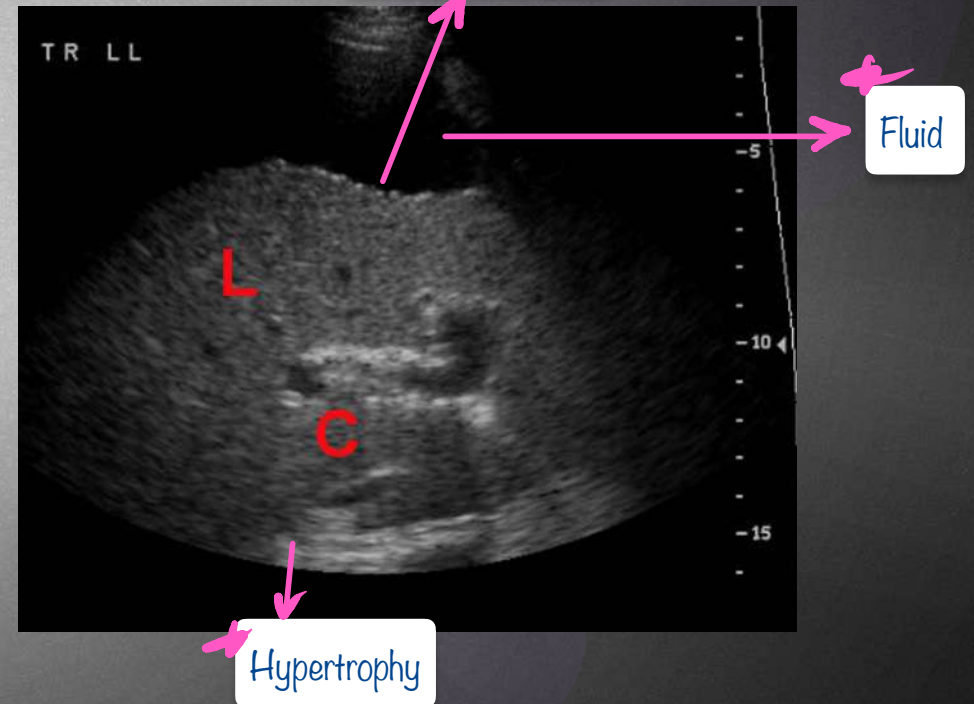
- Irregular duct contours
 - Alternating areas of stricture & dilatation
 - Intraductal calcifications

LIVER

- Cirrhosis
 - Causes of cirrhosis include:
 - a) alcohol, b) alpha1-antitrypsin, c) postnecrotic (hepatitis), d) metabolic disease: Wilson, hemochromatosis, glycogen storage disease, e) PBC, PSC, f) congestive heart failure.
 - Cirrhosis increases risk of developing hepatocellular carcinoma

Imaging findings in cirrhotic liver

- U/S: advanced cirrhotic liver appears to be nodular, irregular, and contracted with relatively enlarged caudate lobe
- (Normal vs cirrhotic liver)



- Noncontrast CT: depending on the extent of fatty infiltration, fibrosis, and regenerating nodules, the hepatic parenchyma may have either homogeneous or heterogeneous decreased attenuation.
- Contrast CT: areas of fibrosis and regeneration may become isodense to parenchyma. The surface of the liver may be very nodular in cirrhosis.

Irregular margins

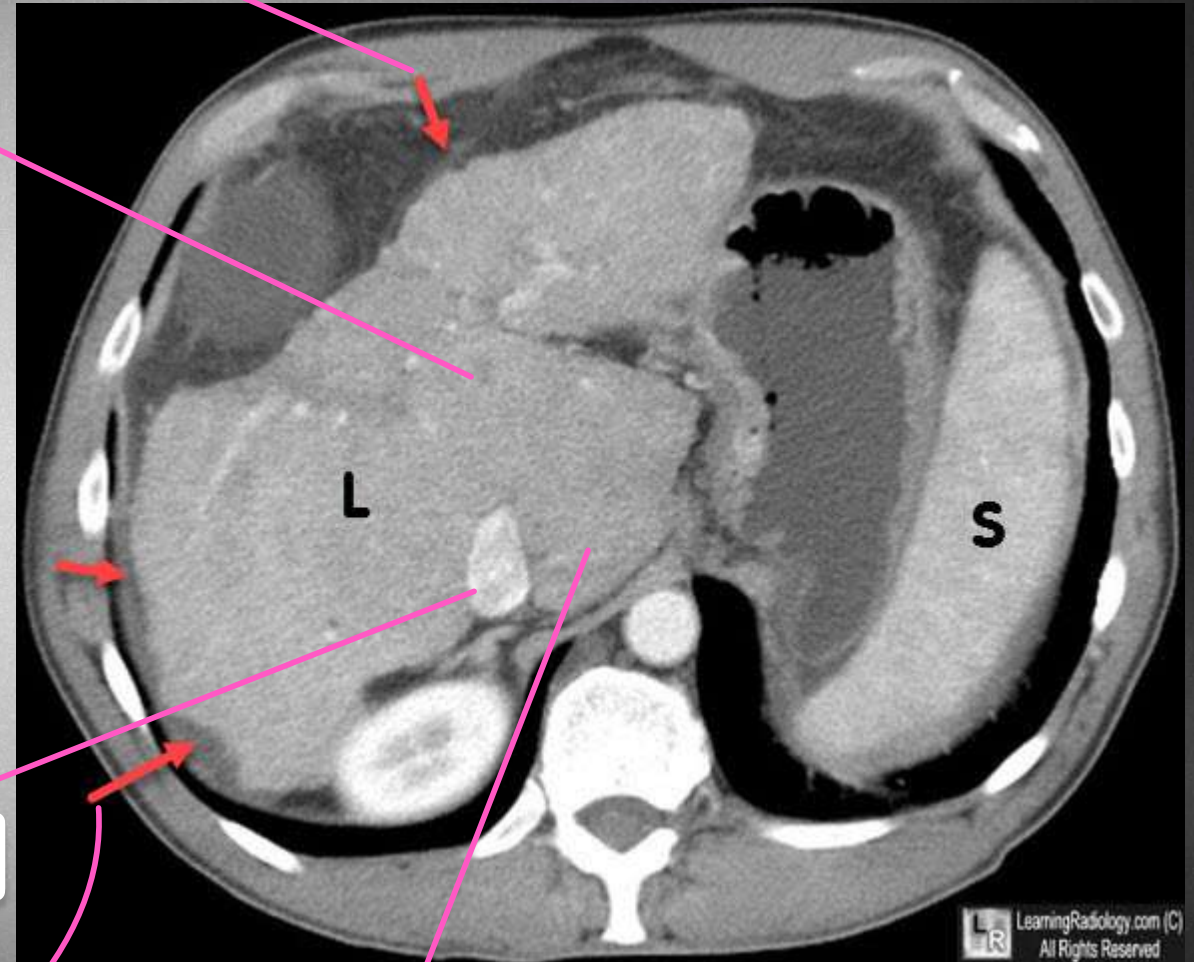
Contrast CT

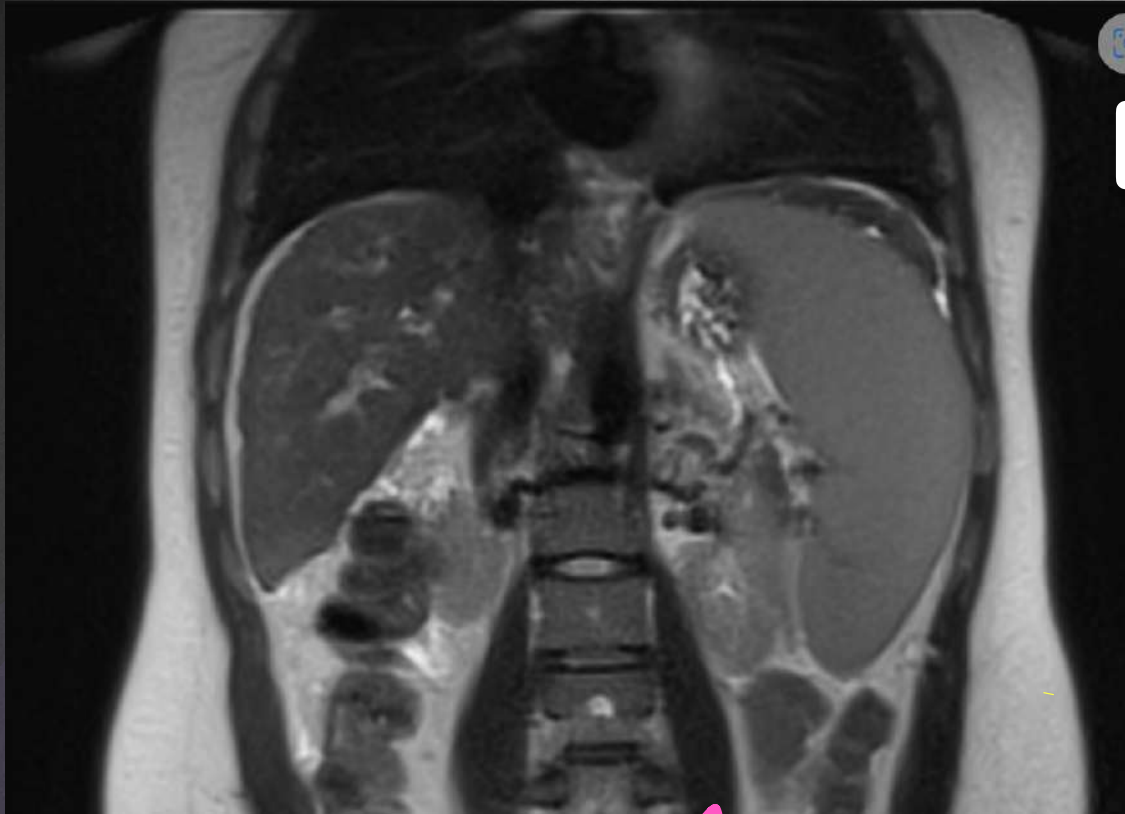
Portal vein

Inferior vena cava

Fluid

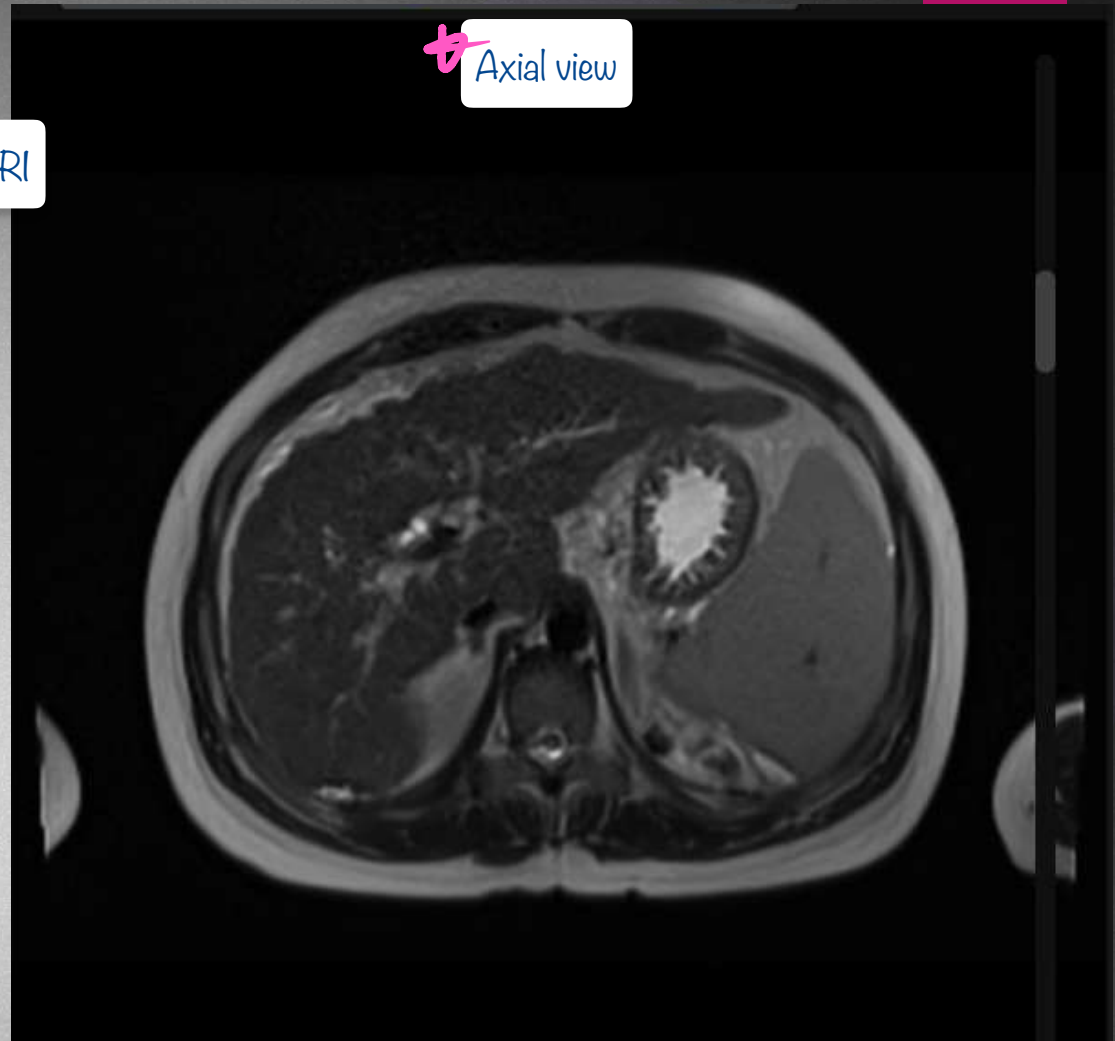
Caudate lobe » enlarged = hypertrophy





MRI

Coronal view



Axial view

Shrunk liver, splenomegaly, irregular liver wall

- Small liver with a lobulated border and hypertrophy of the caudate lobe.
- Splenomegaly

Small bowel

Normal Small Bowel

+
Barium follow through

Smooth
appearance
of ileum

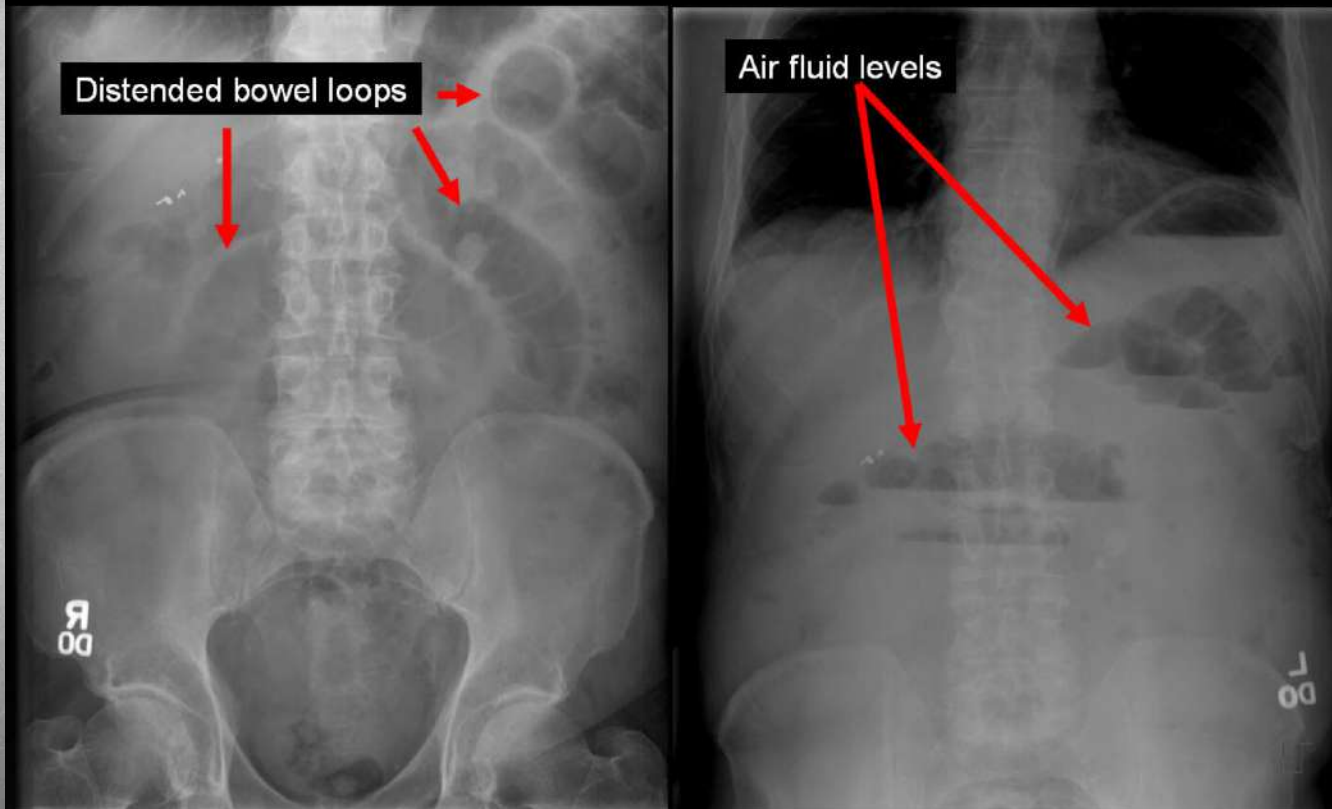


"Feathery-
appearance" of
jejunum

Small bowel obstruction

- Small bowel obstruction
- The upper limits of normal for the diameter of the small bowel lumen is **3 cm**. When the luminal diameter is larger than this, it is **DILATED**.
- The differential diagnosis for a dilated bowel lumen is **mechanical small bowel obstruction vs. adynamic ileus**.
- **Ninety percent (90%)** of SBO are caused by adhesions or hernias. Less common causes include volvulus, intussusception, and

Bowel obstruction (small bowel)



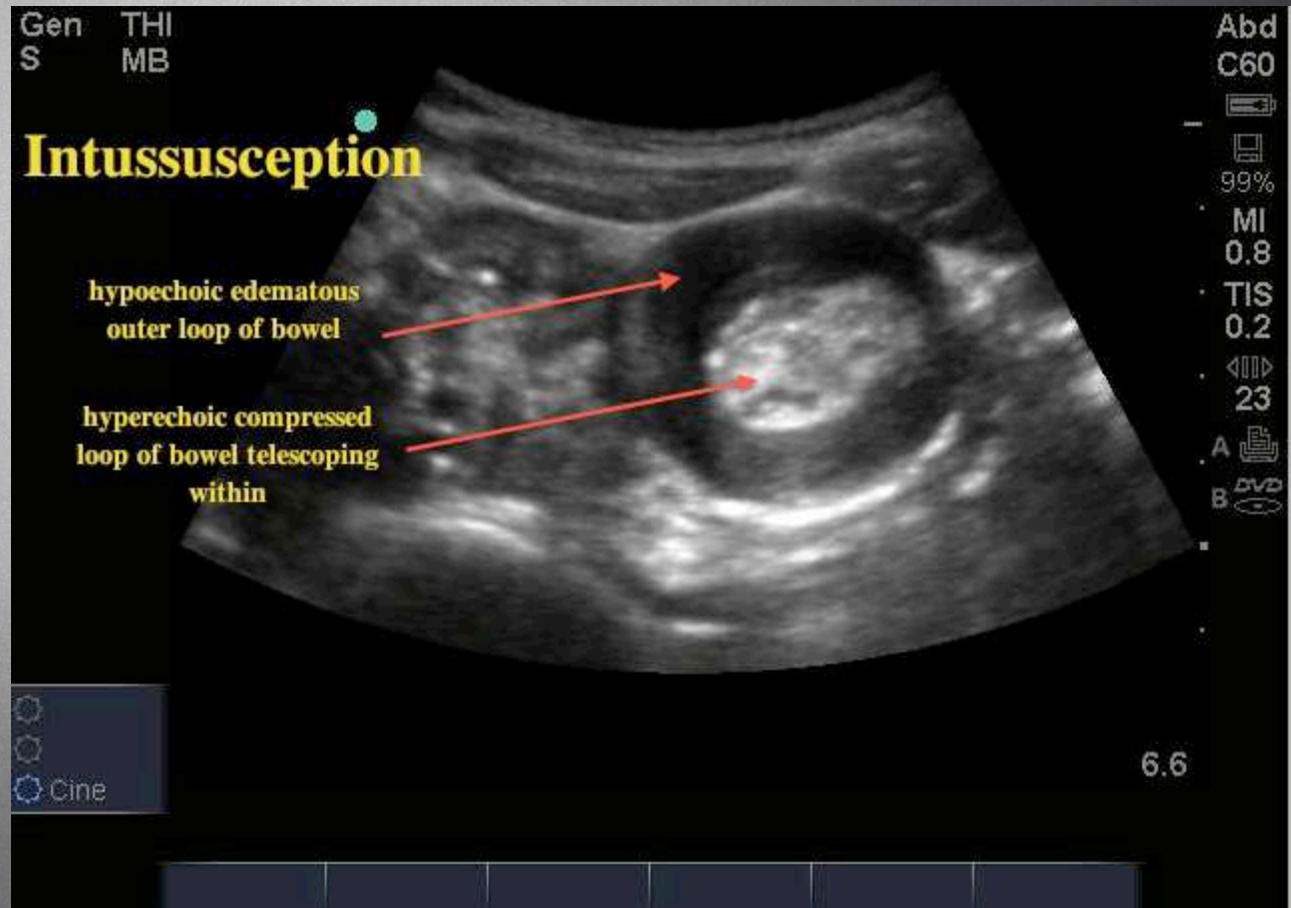


Intussusception

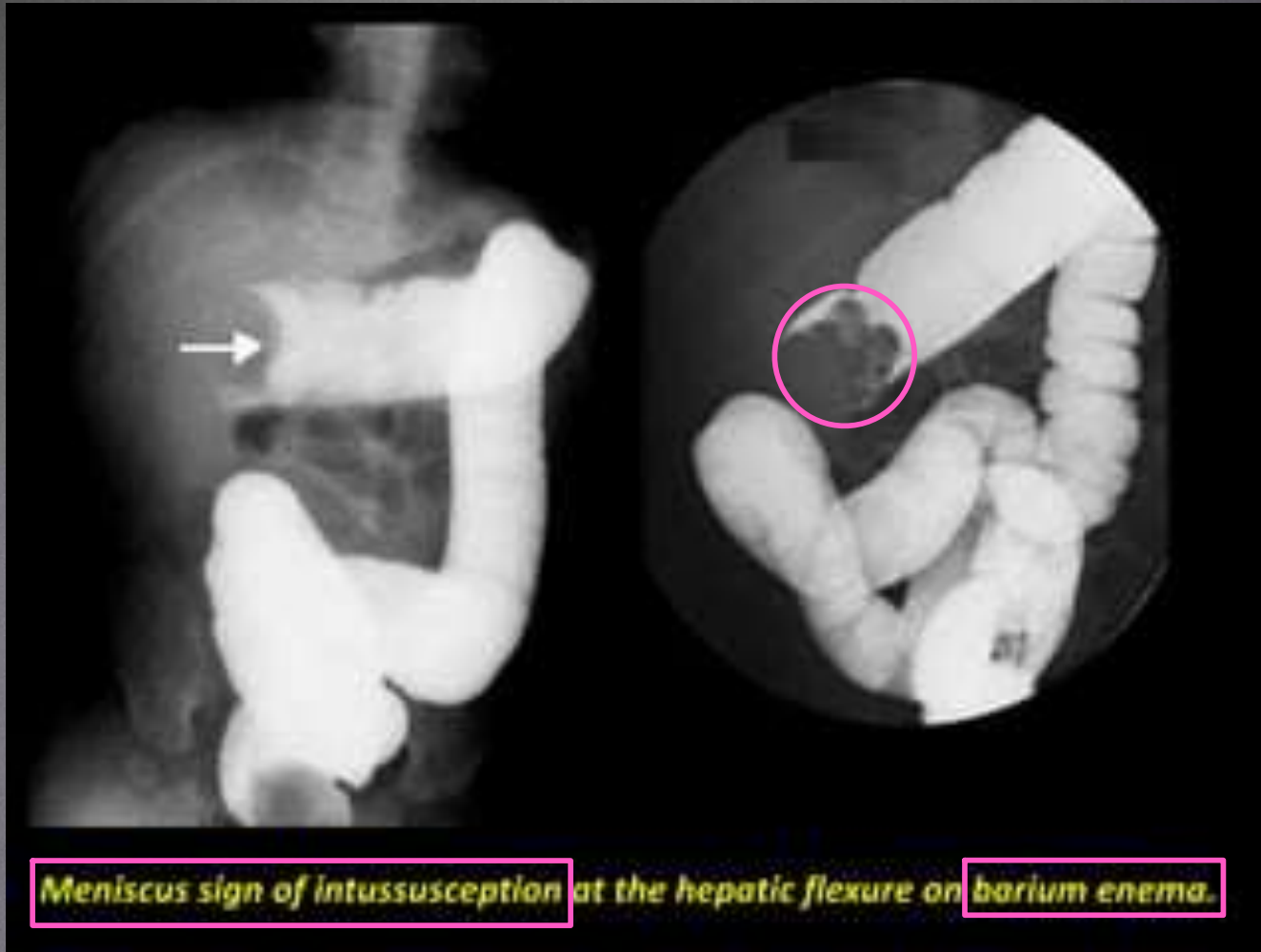
Target sign or psuedo-kidney sign

- Intussusception is the telescoping of bowel to form inner loop (intussusceptum) and outer loop (intussusciens). It is much more common in young children, usually idiopathic in nature. In adults, the lead point is often a mass.

Most common type » ileo-caecal









Large bowel obstruction

- Bowel obstruction may be complete or incomplete 6:
- complete or high grade obstruction means that no fluid or gas can proceed beyond the obstruction
- incomplete, low grade or partial obstruction means that fluid or gas are still able to proceed



Diffusely dilated bowel loops

The large bowel is gas filled and distended down to the level of the distal descending colon-sigmoid.
Small bowel collapsed.

Large vs small bowel obstruction

Plain Films: Abdominal X-Ray (AXR)

Findings: Small (SBO) vs. Large Bowel Obstructions (LBO)

- Look at caliber, lines, and location to differentiate SBO vs LBO
- Air fluid levels on upright x ray are neither specific nor sensitive and cannot help distinguish ileus, enteritis, or partial from complete SBO



Small Bowel Obstruction

SMALL	LARGE
3cm max diameter	6cm max diameter
Lines all the way across the bowel (Plicae Circulares)	Lines not fully across (Haustra)
Central	Peripheral



Large Bowel Obstruction

Volvulus

- **Sigmoid volvulus** is a cause of [large bowel obstruction](#) and occurs when the [sigmoid colon](#) twists on its mesentery, the [sigmoid mesocolon](#).
- Abdominal radiographs will show a large, dilated loop of the colon, often with a few [gas-fluid levels](#). Specific signs include:
- [coffee bean sign](#) ⁵
- [Frimann-Dahl sign](#) - three dense lines converge towards the site of obstruction
- **absent rectal gas** ⁵
- [liver overlap sign](#)

Coffee bean sign » sigmoid volvulus



Markedly dilated loop of colon with a coffee-bean shape. Its apex points toward the right upper quadrant.

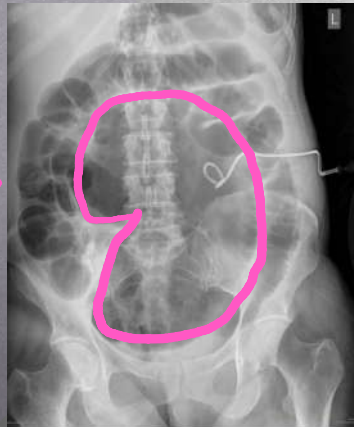


- Volvulus of the distal sigmoid colon, best appreciated on the coronal images.

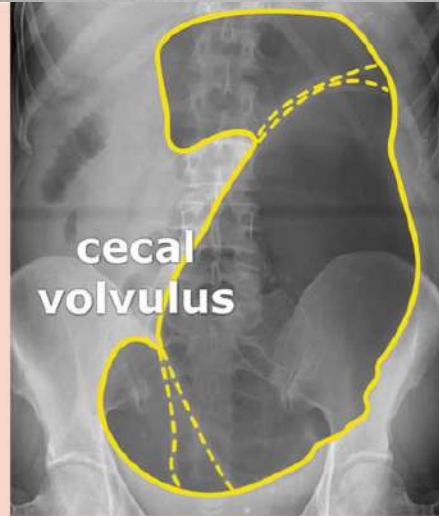
Cecal volvulus

- **Cecal volvulus** describes torsion of the cecum around its mesentery which often results in obstruction.
- If unrecognized, it can result in bowel perforation and fecal peritonitis.

Comma sign



Abdominal X-Ray Appearance



Site

RLQ ↗ LUQ

LLQ ↗ ↖ RUQ

← **Haustra**

+

-

Coffee-Bean sign

±

+++

Obstruction

± SBO

± Colonic obstruction

Air-Fluid levels

1 (if seen)

Few (if seen)

بشكل عام اهي بتقل كل
ما بعدنا عن ال caecum

PNEUMOPERITONEUM

- Describes gas within the [peritoneal cavity](#), often due to critical illness.
- The most common cause of pneumoperitoneum is the disruption of the wall of a hollow viscus, mc perforated ulcer.

Pneumoperitoneum

(Air in the Peritoneal Cavity)

Causes of a Perforation

- Gastric or duodenal ulcer
- Bowel dilation (SBO, LBO, ileus)
- Bowel ischemia
- Perforated diverticulitis, appendicitis
- Trauma
- Iatrogenic (injury during surgery, endoscopy, colonoscopy)

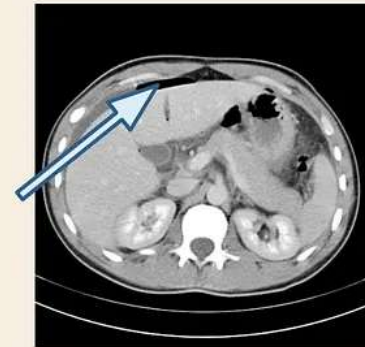
What to Look for on Imaging to Diagnose

- Air outside the lumen of the GI tract (air is black on Xray & CT)
- Air will be in **anti-dependent** (anterior when the patient is lying flat, superior when upright, i.e. under the diaphragms)

X-ray Findings



CT Scan Findings



Images from Radipaedia.

signs

- Rigler sign

Gas inside and outside the wall

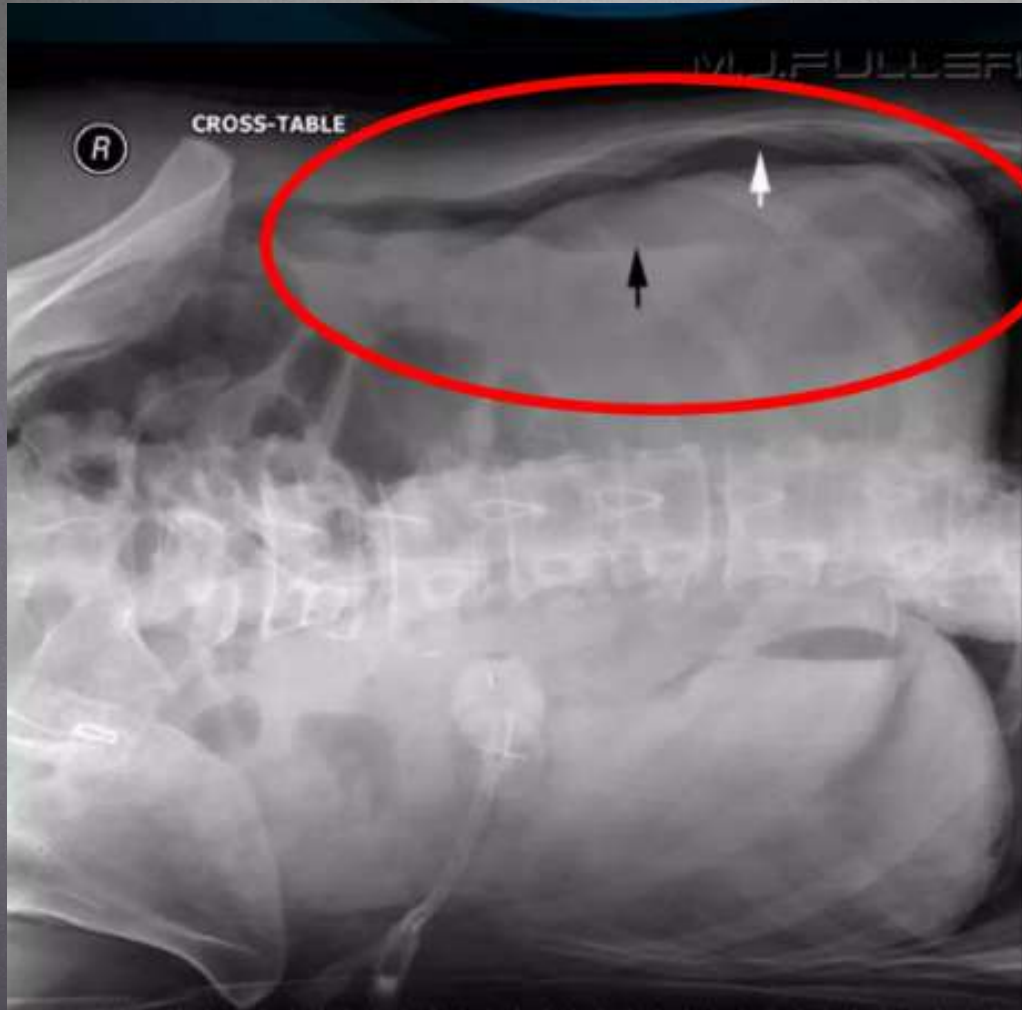


- Supine
- Bowel wall **outlined by intraluminal & extraluminal air** (extraluminal = free peritoneal gas)
- **Both sides** of bowel wall can be seen (red arrows)



2.

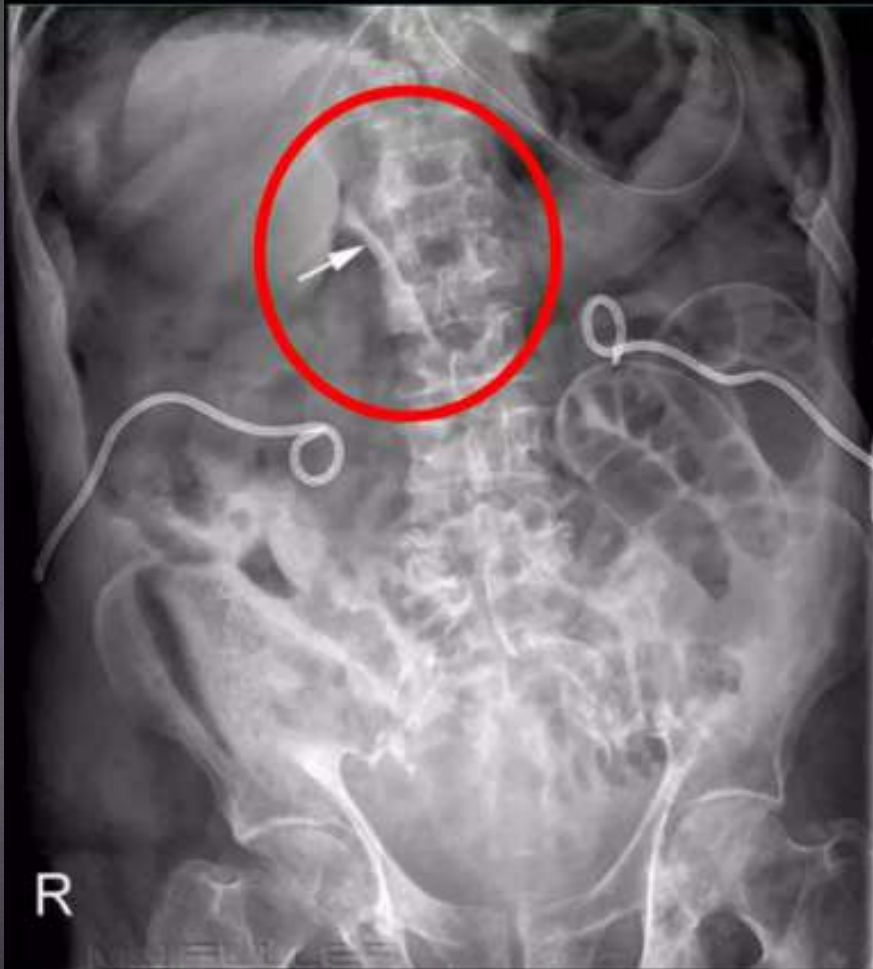
Decubitus abdomen sign



- Left lateral decubitus
- Air-fluid level
- **White arrow = free air** between the abdominal wall and the liver
- **Black arrow = free fluid** in the peritoneum

3.

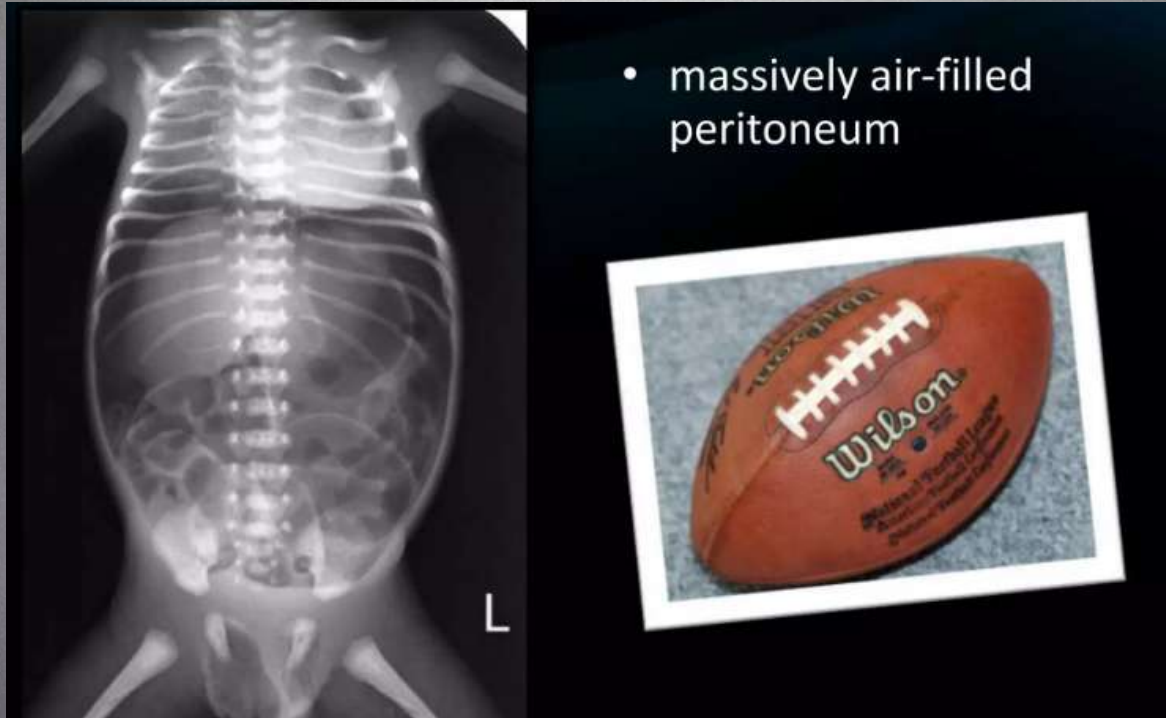
Falciform ligament sign



- Supine
- Falciform ligament
 - connects the anterior abdominal wall to the liver
 - extends inferiorly beyond the liver → becomes round ligament
 - becomes **outlined with air** in a patient with free abdominal gas

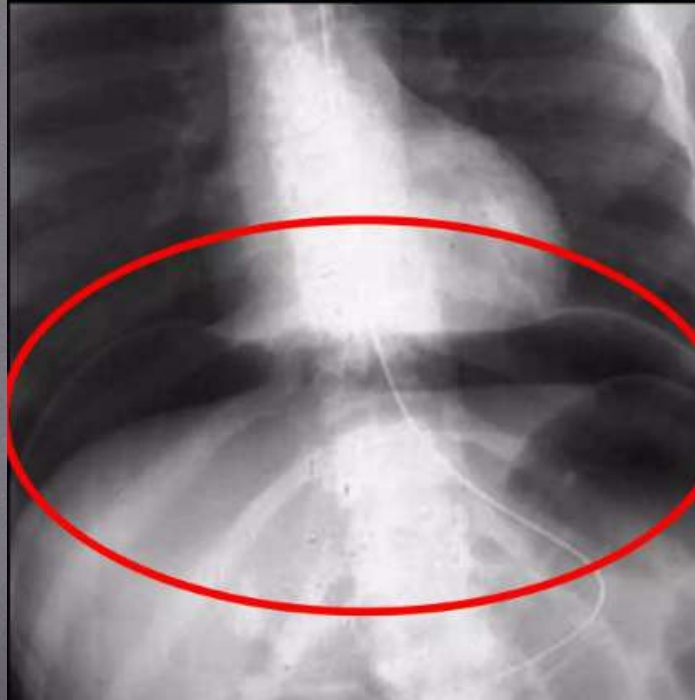
4.

Football sign



5.

Continuous diaphragm sign



- massive pneumoperitoneum → sufficient air beneath the diaphragm
- left & right hemidiaphragms contrasted by the free gas appear as a **continuous structure**

