

GASTROINTESTINAL SYSTEM

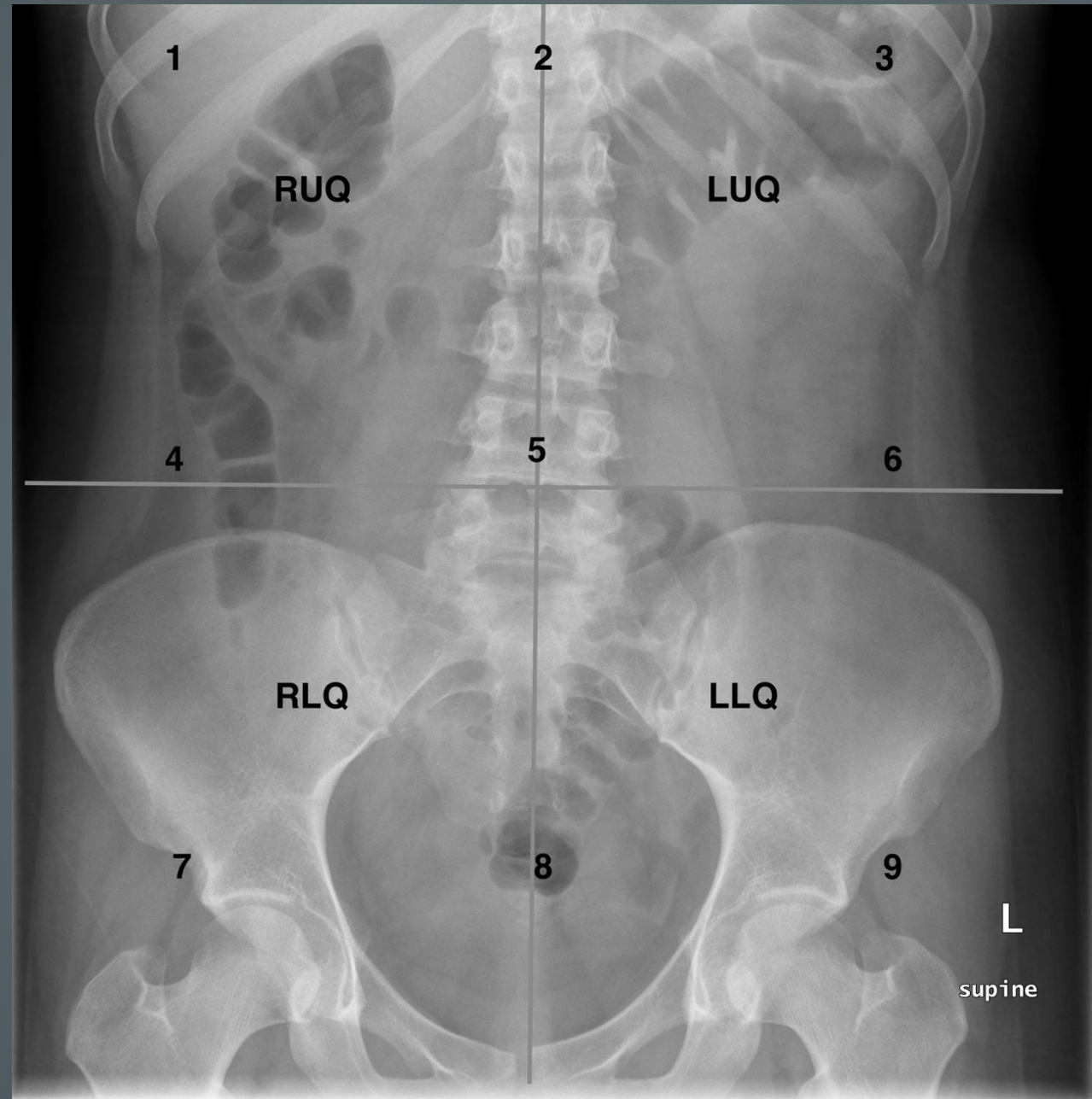
Dr. SHATHA TARAWNEH
MD, JBR

IMAGING MODALITIES

- Plain X-rays (Supine, erect, lateral decubitus)
- Barium Studies (Swallow, Meal, Follow-through, Enema)
- Ultrasound
- CT of the abdomen
- MRI of the abdomen
- ERCP, Cholangiography
- Angiography
- Nuclear Medicine

ABDOMINAL PLAIN FILM

- Convenient and useful initial investigation .
 - What to look for ??
- 1- Gas pattern
 - 2- Extra luminal air
 - 3- Signs of intestinal obstruction
 - 4- Radio-opaque stones or calcification
 - 5- Skeletal abnormalities





GAS SHADOWS



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

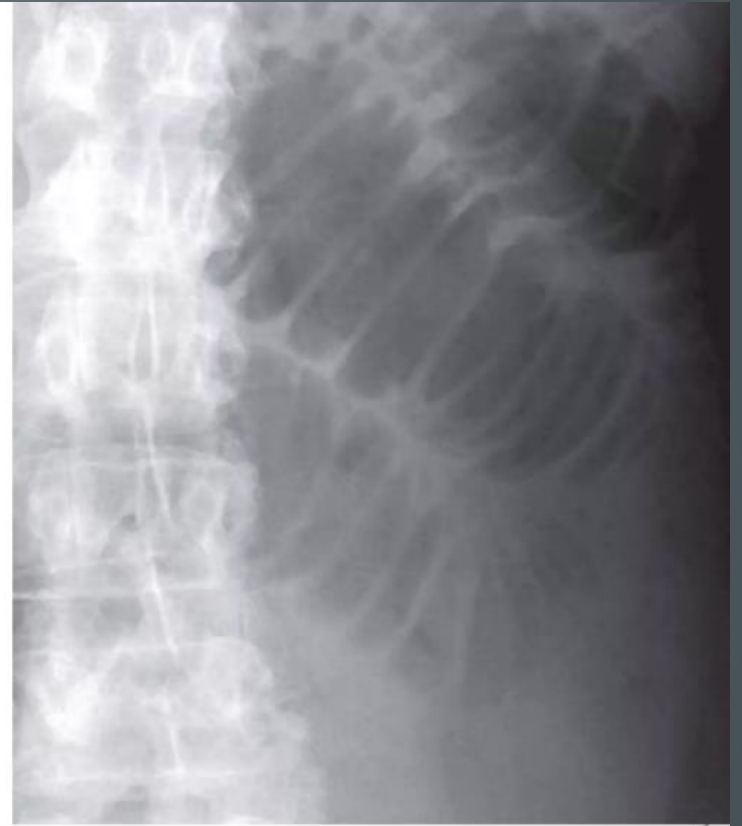
- .Centrally located
- .Valvular marking extends across the lumen
- .Spaced much closer

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

Large Bowel



Small Bowel



ABNORMAL GAS PATTERNS

Causes of Extra-luminal gas:

- Post Abdominal Surgery/ERCP
- Perforation of viscus (eg. bowel, stomach)
- Gallstone ileus
- 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).

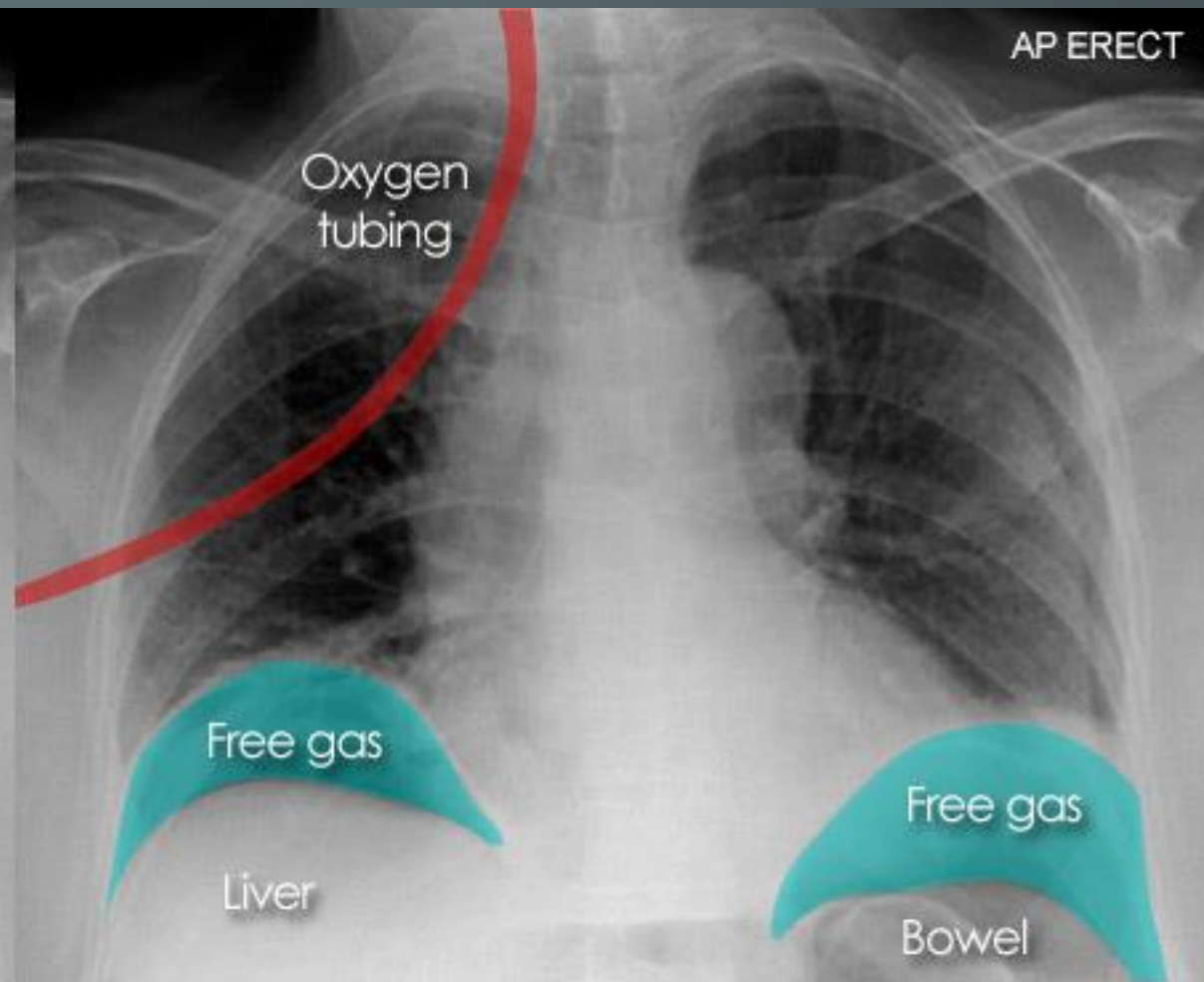
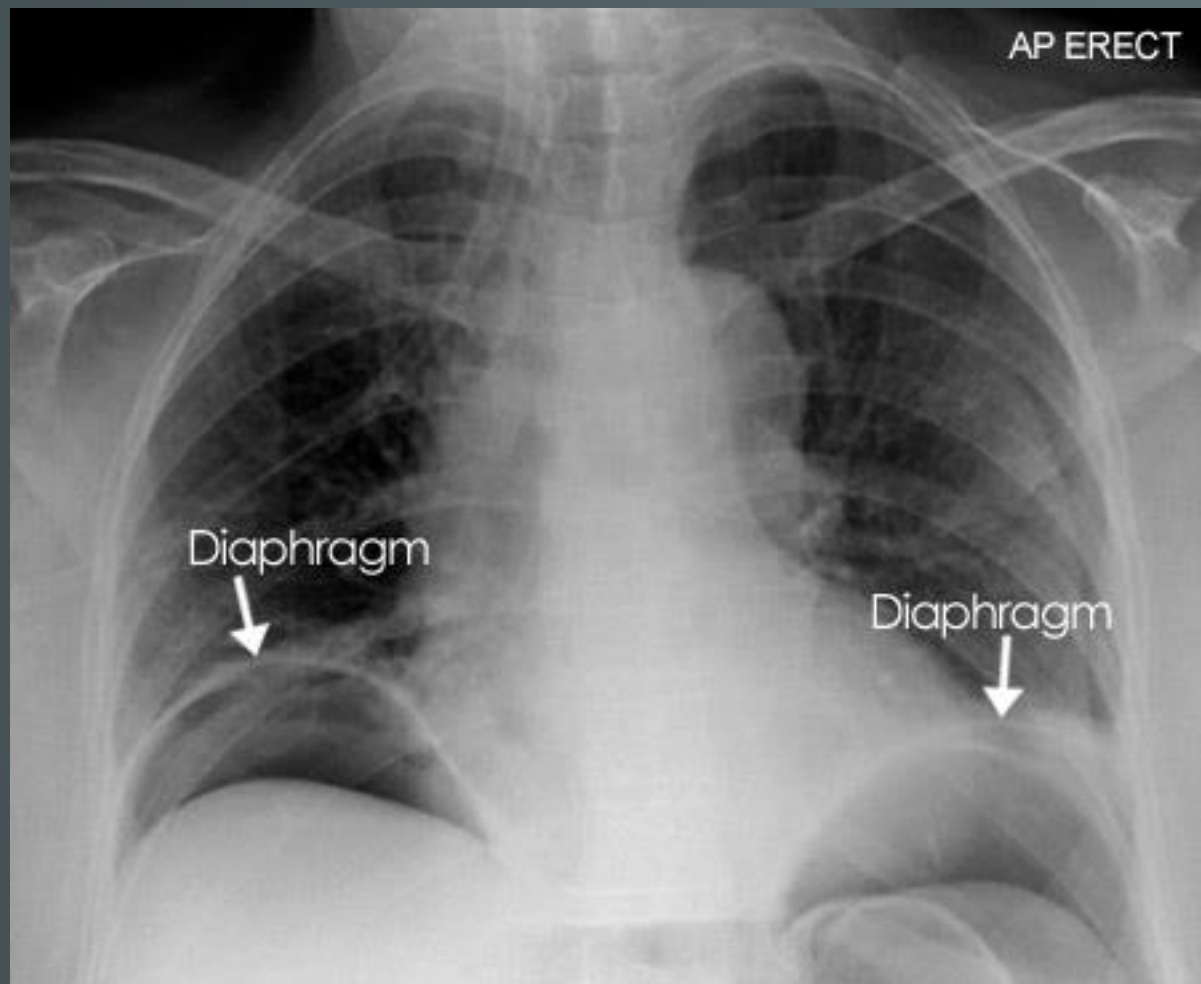
Recognizing abnormal Air



Pneumoperitoneum(crescent sign)



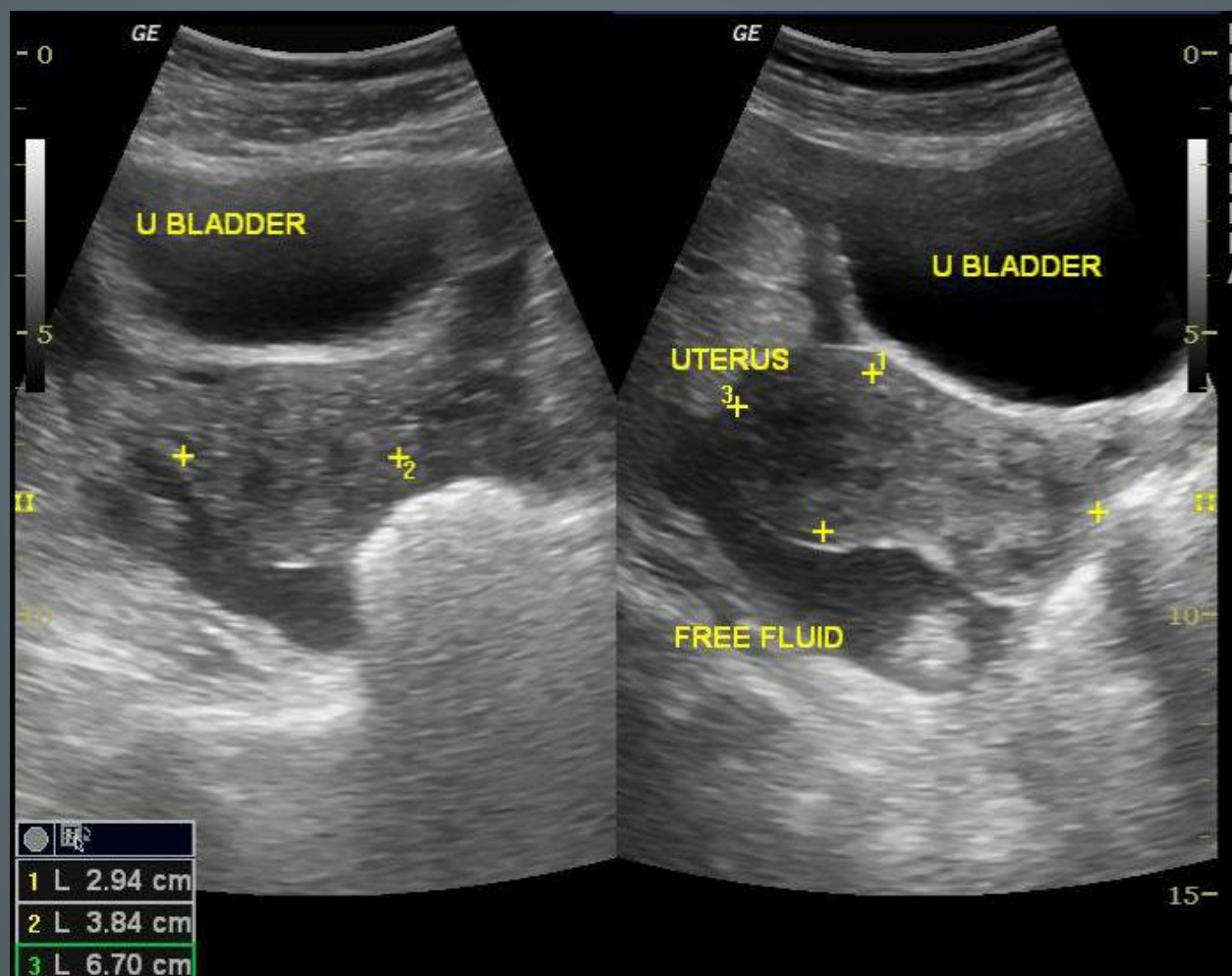
Falciform ligament sign



ULTRASOUND

- High-frequency sound waves to characterize tissue.
- Available readily.
- Flexible
- Convenient and less cost.





BARIUM STUDIES

- Diagnostic tests used to assess GI system using X-ray imaging in the setting of administration of contrast agents .
- Contrast agents commonly used:
 - Barium sulfate
 - Gastrografin (water-soluble)
 - Non-ionic contrast

Upper GI Series

Barium Swallow

Barium Meal

Barium Follow-through

Small bowel enteroclysis

Lower GI series

Barium enema

BARIUM SWALLOW

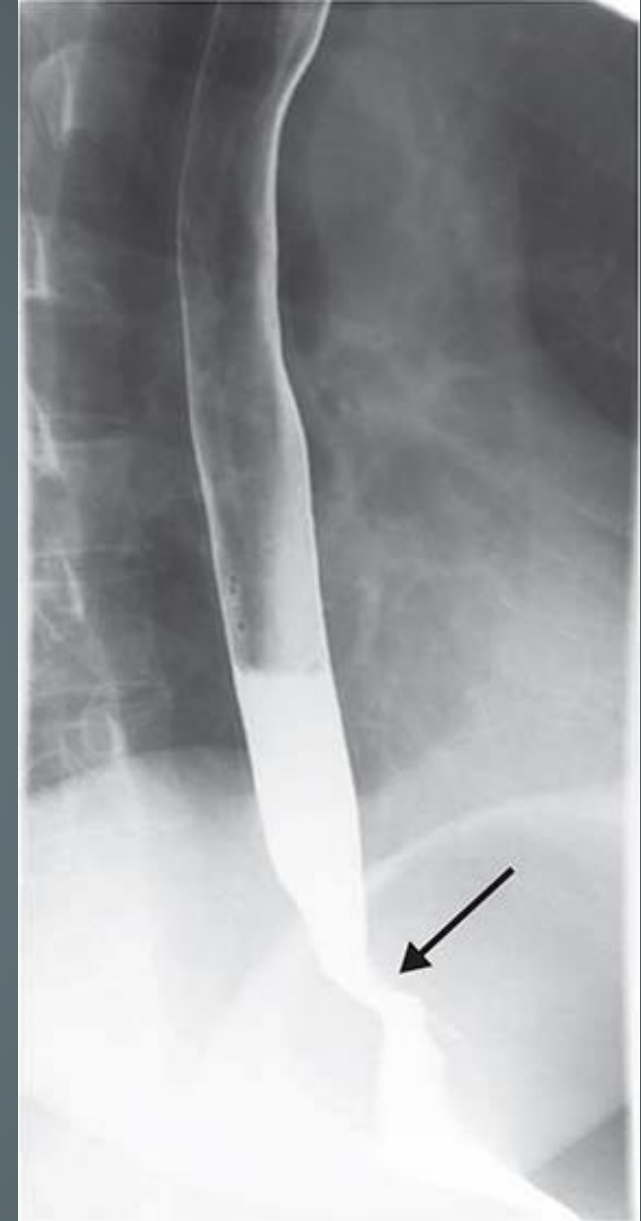
- Examination of the pharynx, esophagus and proximal stomach (reflux).
- Barium sulfate _ single/double contrast
- Non-ionic (infants)

Indications

- Dysphagia (tumor, webs, diverticulae, strictures)
- r/o hiatal hernia
- GERD
- Inability to pass endoscope
- Persistent vomiting
- r/o fistula

NORMAL SWALLOW

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



Source: Khaled M. Elsayes, Sandra A. A. Oldham:
Introduction to Diagnostic Radiology:
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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:](#)

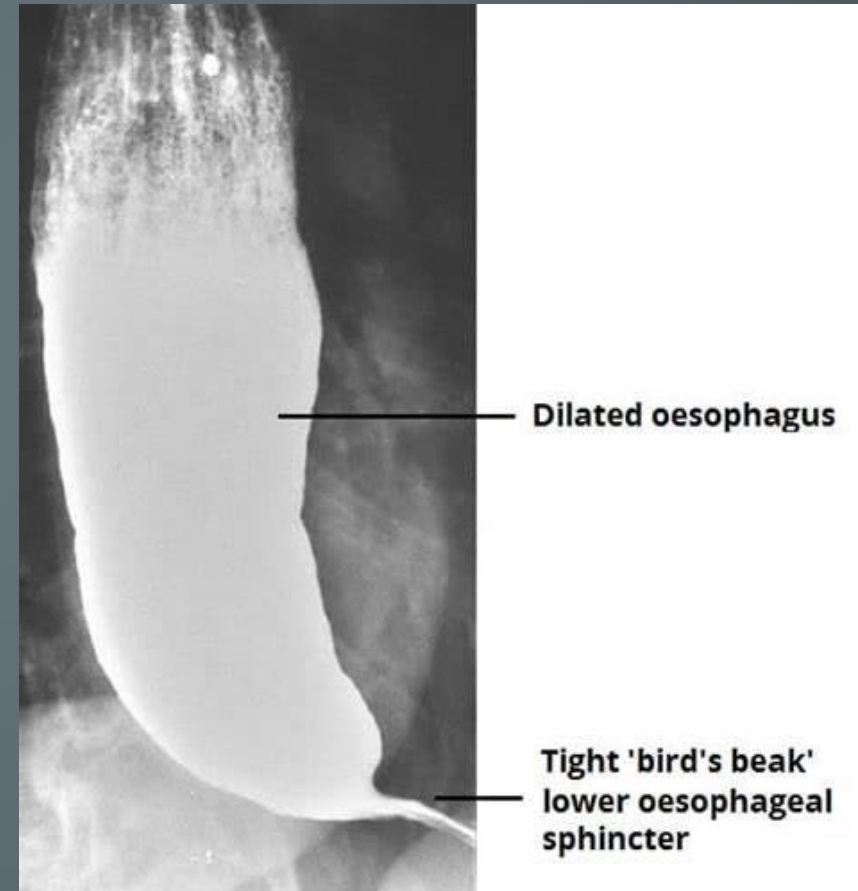
- [esophageal carcinoma](#)

- 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

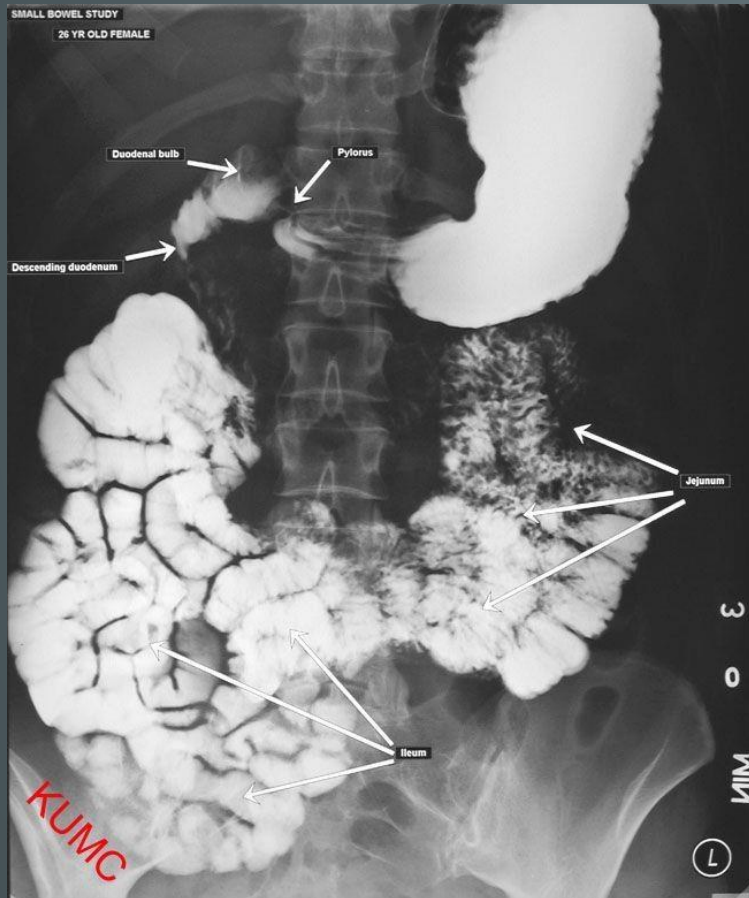
BARIUM MEAL

- 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

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

Hirschsprung's disease

- Barium enema

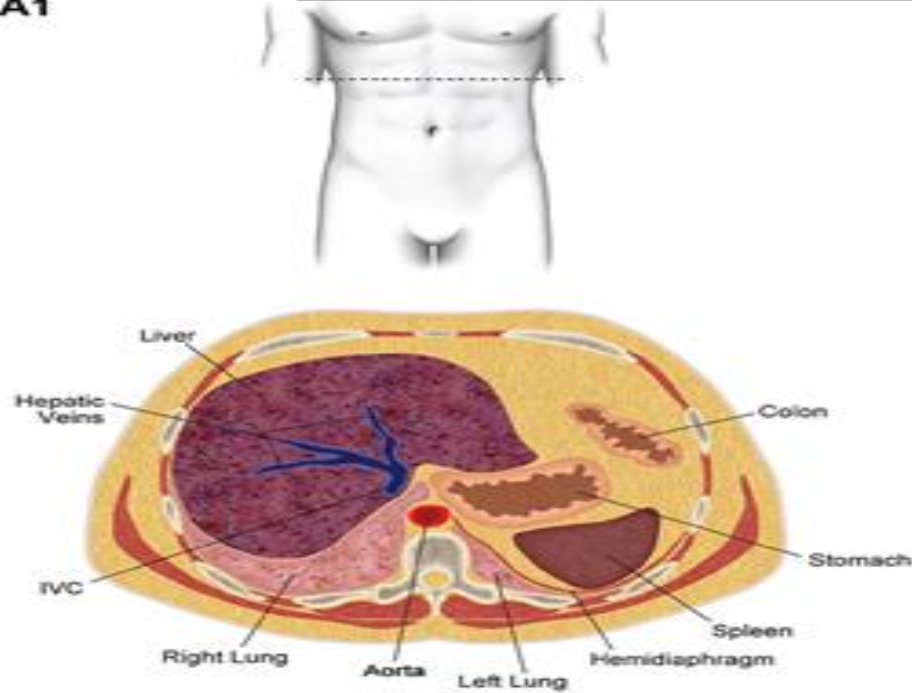


CT OF THE ABDOMEN

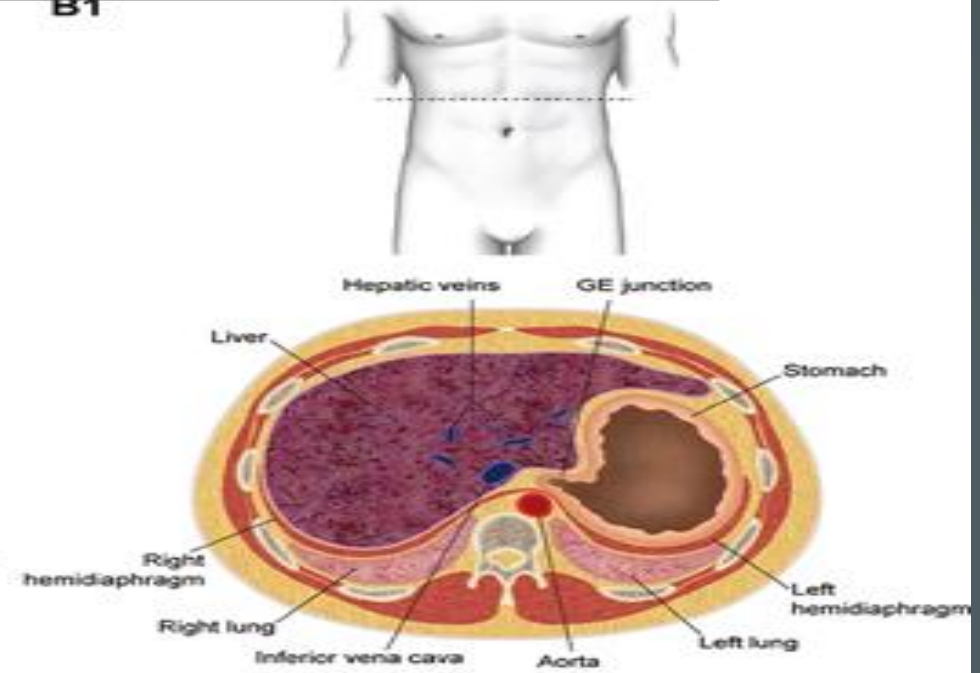
- An [imaging modality](#) that uses [x-rays](#) to build [cross-sectional images](#) ("slices") of the body.
- Unenhanced / with contrast
- Precautions and preparations: contrast allergy? Asthma? Medications ? KFT? Fasting?
- Indications:
 - abdominal pain, flank pain, pelvic or inguinal pain
 - suspected 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](#) and/or [mesenteric ischemia](#)
 - abdominal and pelvic [trauma](#)
 - postoperative follow-up

CT ANATOMY OF GIT

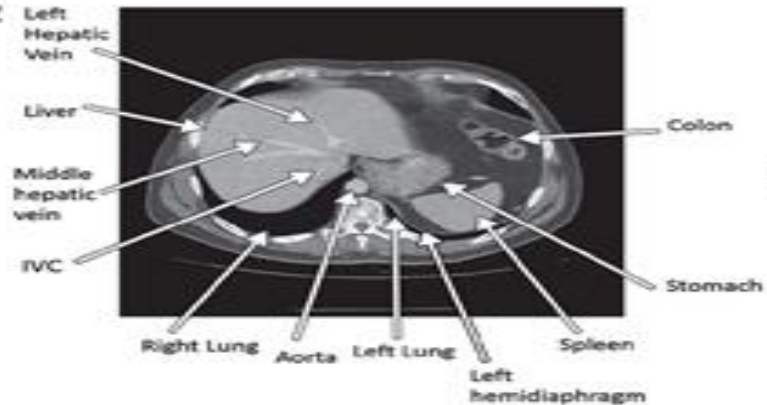
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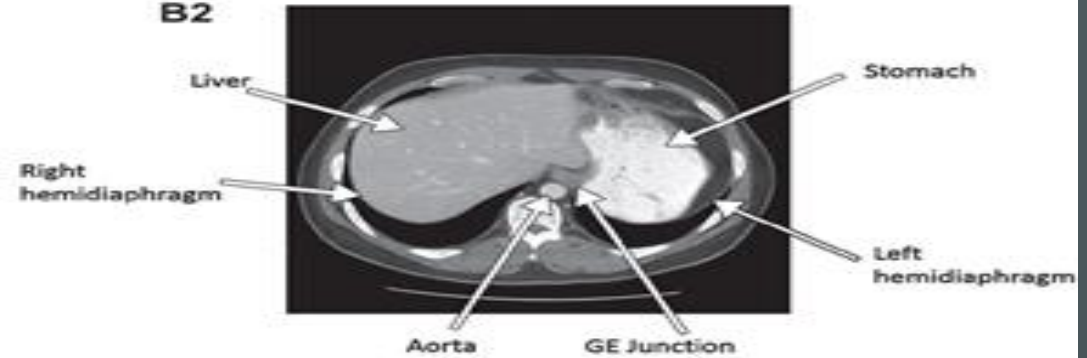
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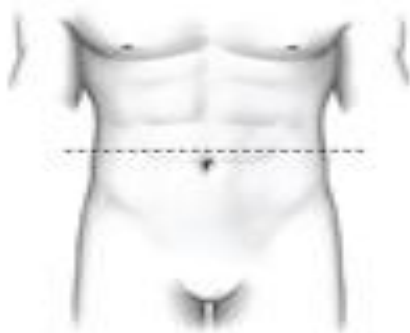
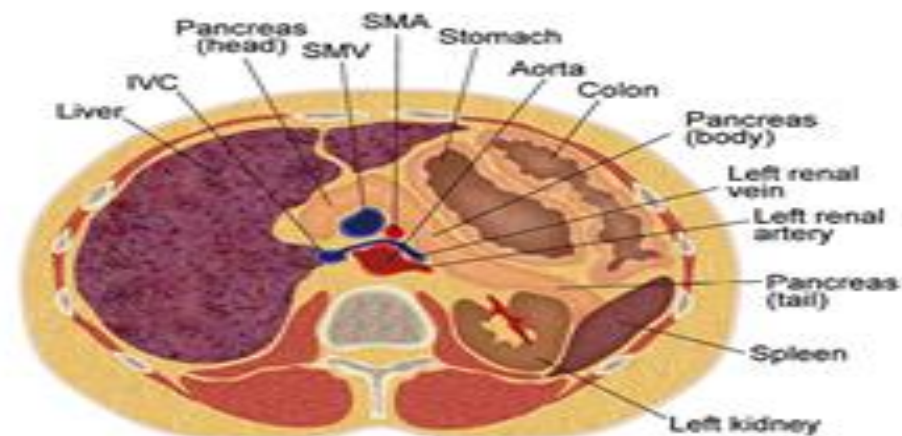
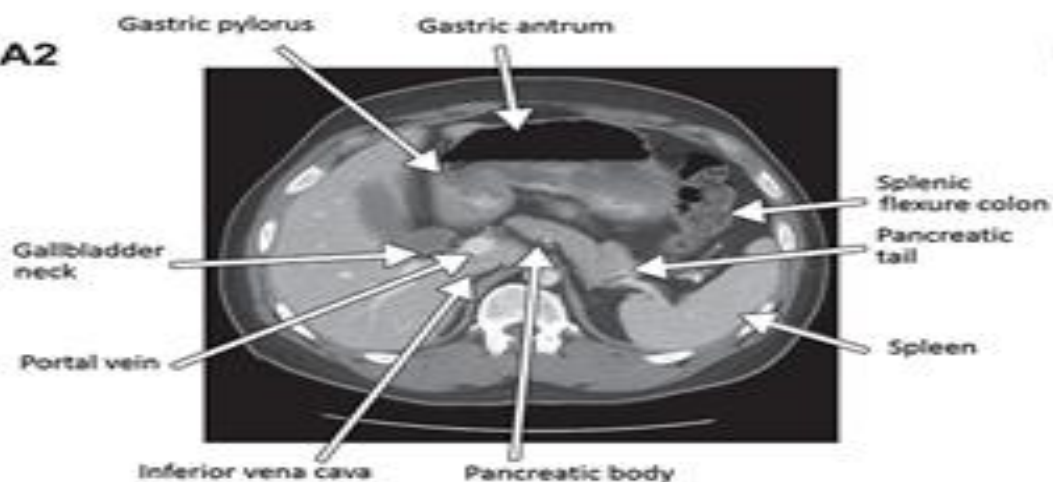
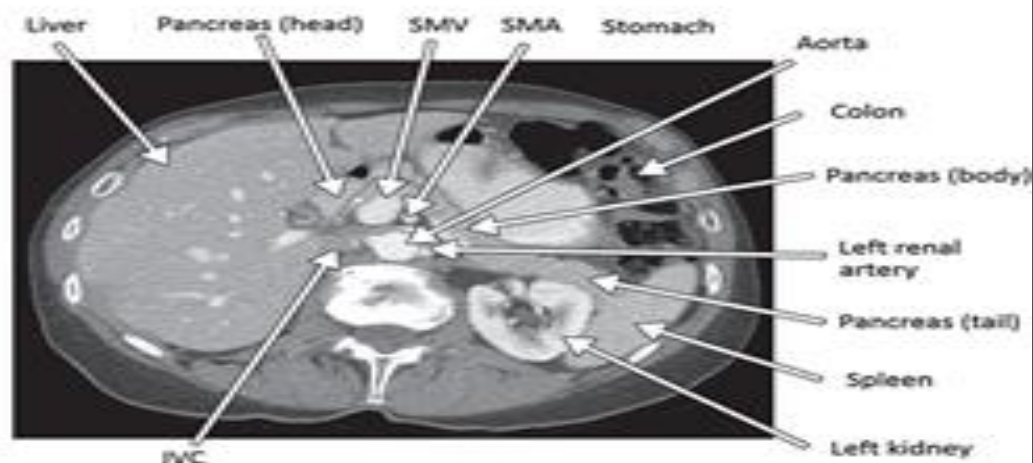


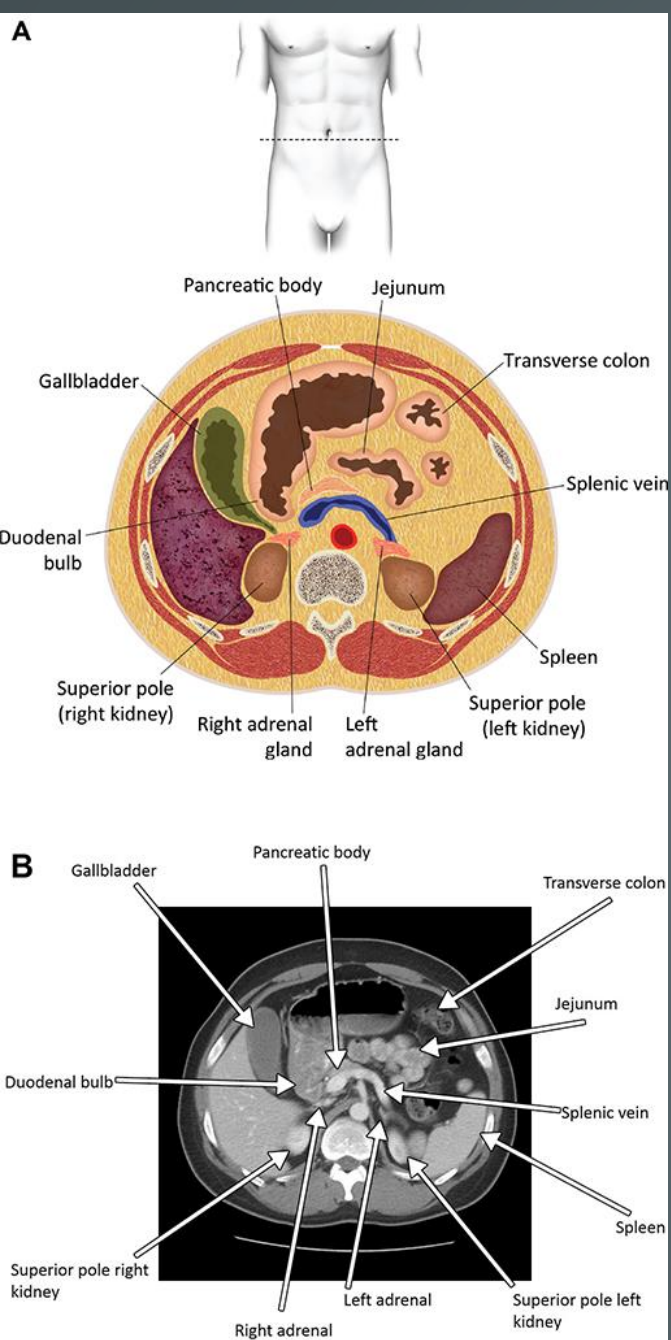
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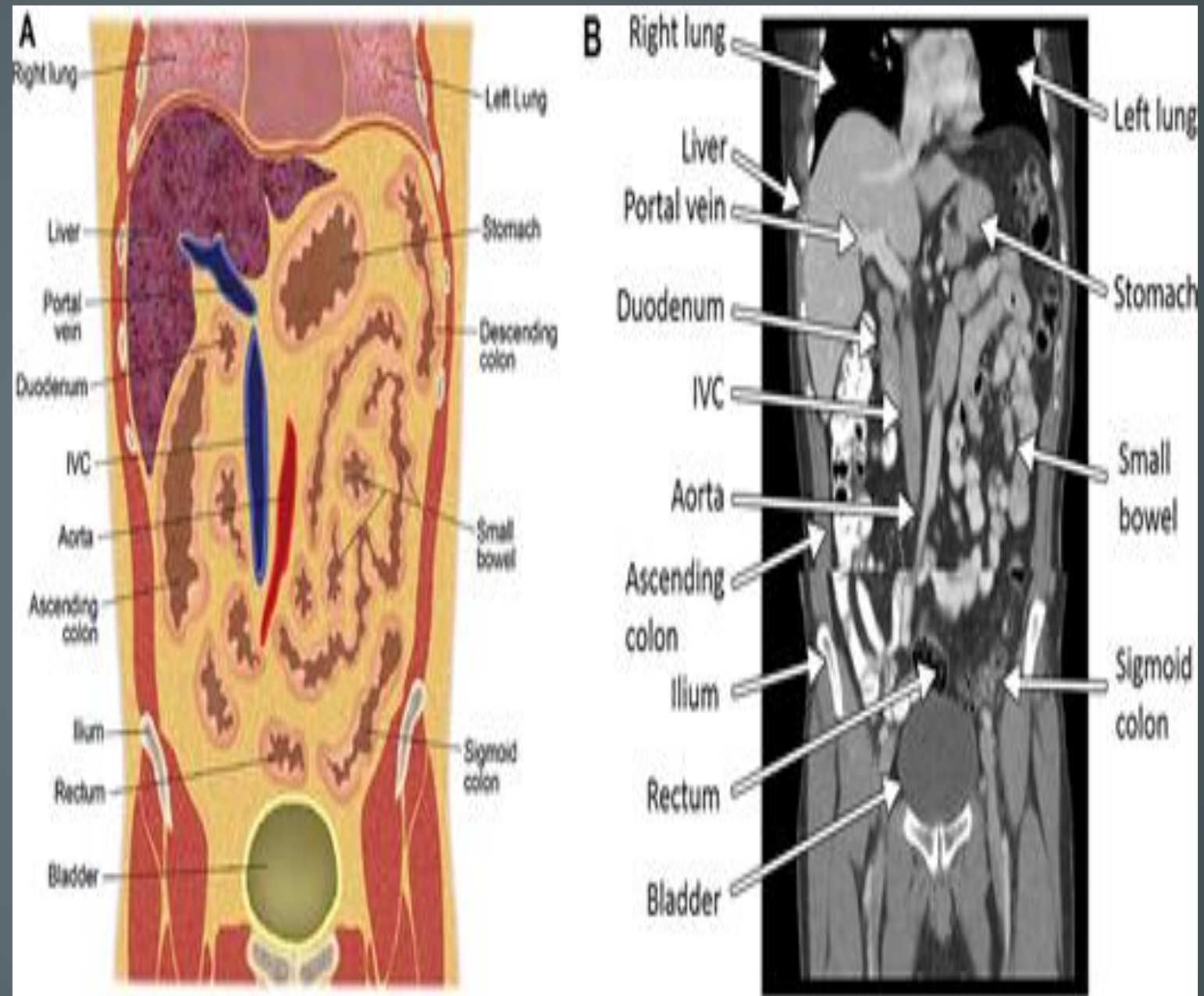
B2



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

- 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.

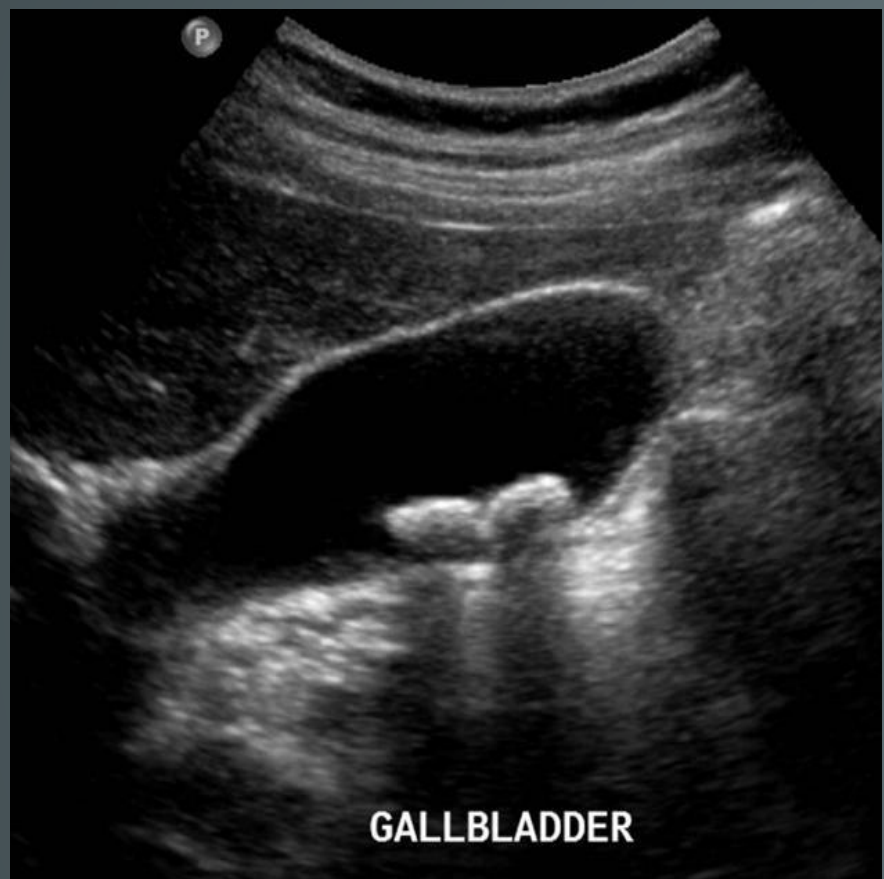
- The predisposing causes include:

- Obesity, diabetes, liver cirrhosis, and blood disorders such as sickle-cell anemia.

GALLSTONES

- 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.







CHOLECYSTITIS

- any form of inflammation involving the [gallbladder](#) and has many forms, including:

Acute calculous cholecystitis

Ultrasound features are:

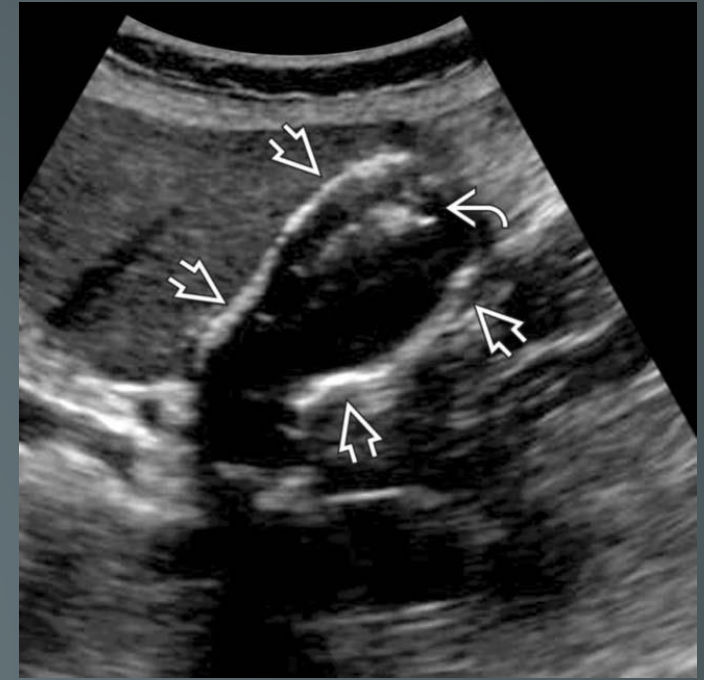
- ❖ Distended gallbladder with gallstones.
- ❖ The gallbladder wall is thickened (greater than 3 mm) and edematous
- ❖ Pericholecystic fluid, and in some complicated cases pericholecystic abscess.





- 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.

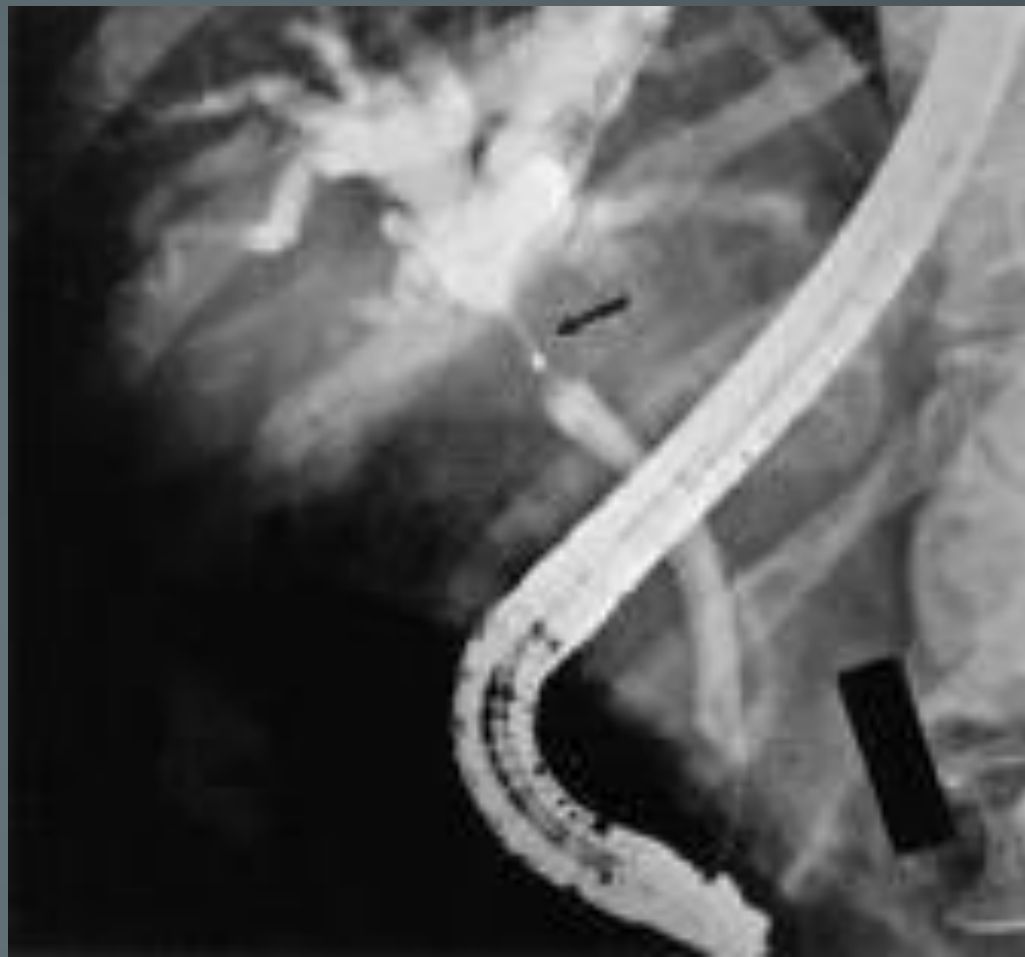


ENDOSCOPIC RETROGRADE CHOLANGIOPANCREATOGRAPHY

(ERCP)

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 ampula 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.
 - Malignant CBD strictures can also be stented.



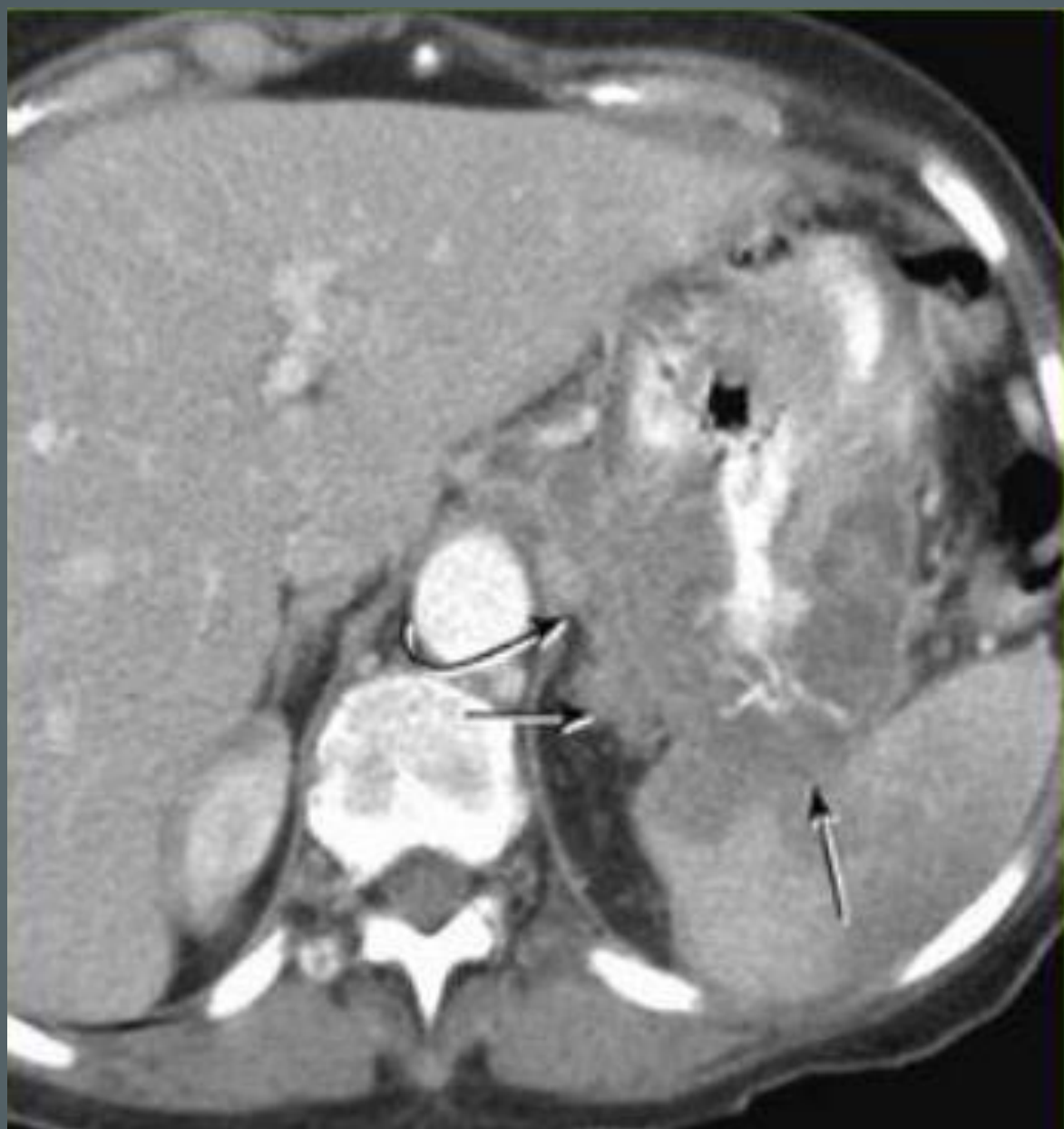
STOMACH

GASTRIC CARCINOMA

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



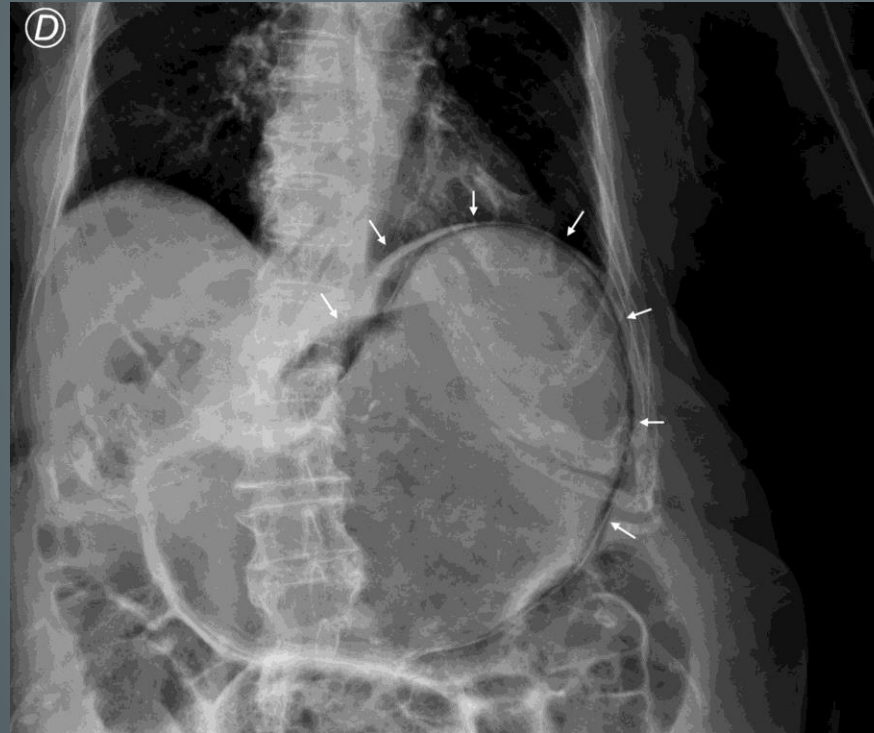






EMPHYSEMATOUS GASTRITIS

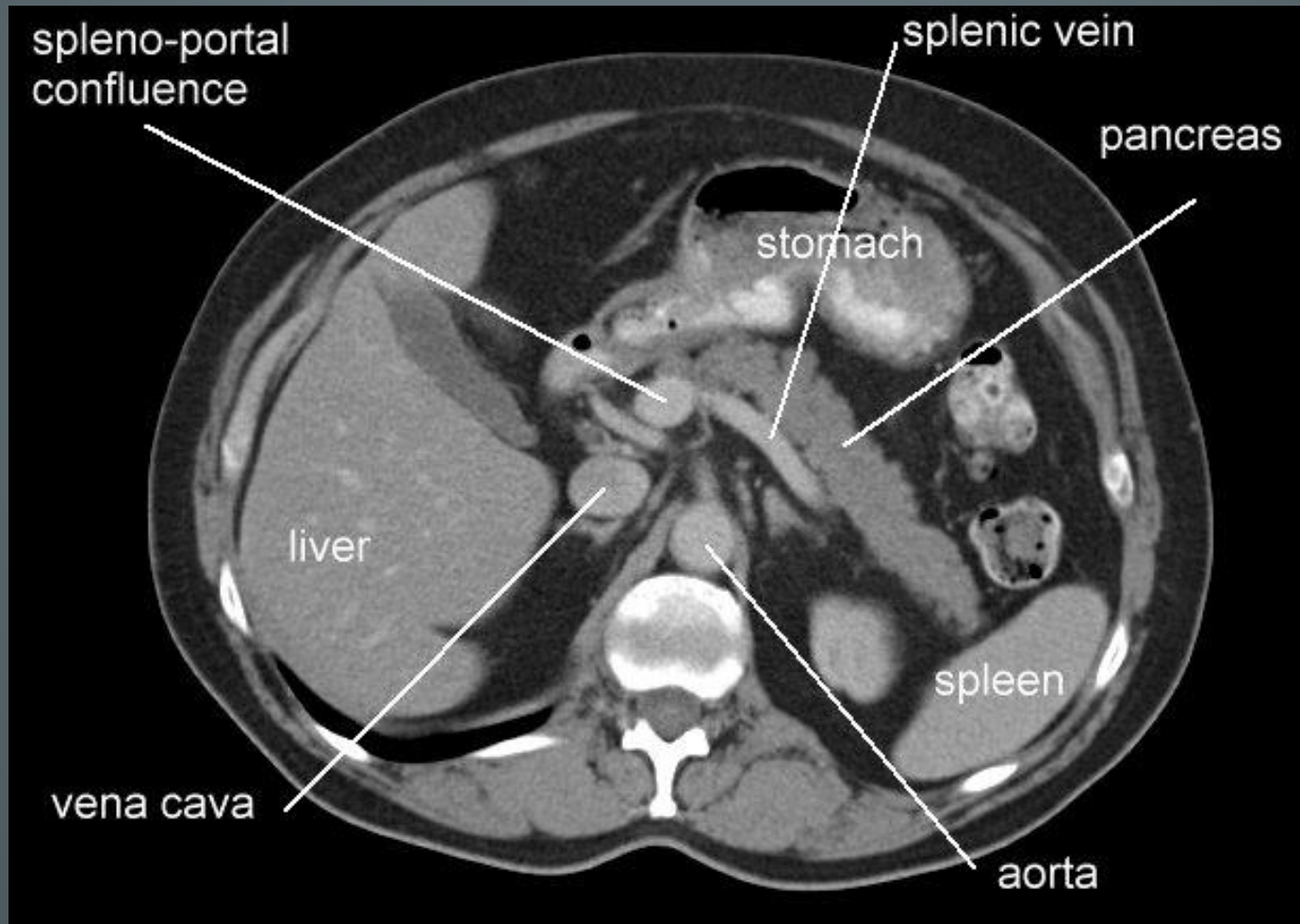
- Emphysematous gastritis is a cause of [gastric emphysema](#).
- Most cases are brought about by caustic ingestion, alcohol abuse, surgery, trauma, or ischemia



PANCREAS

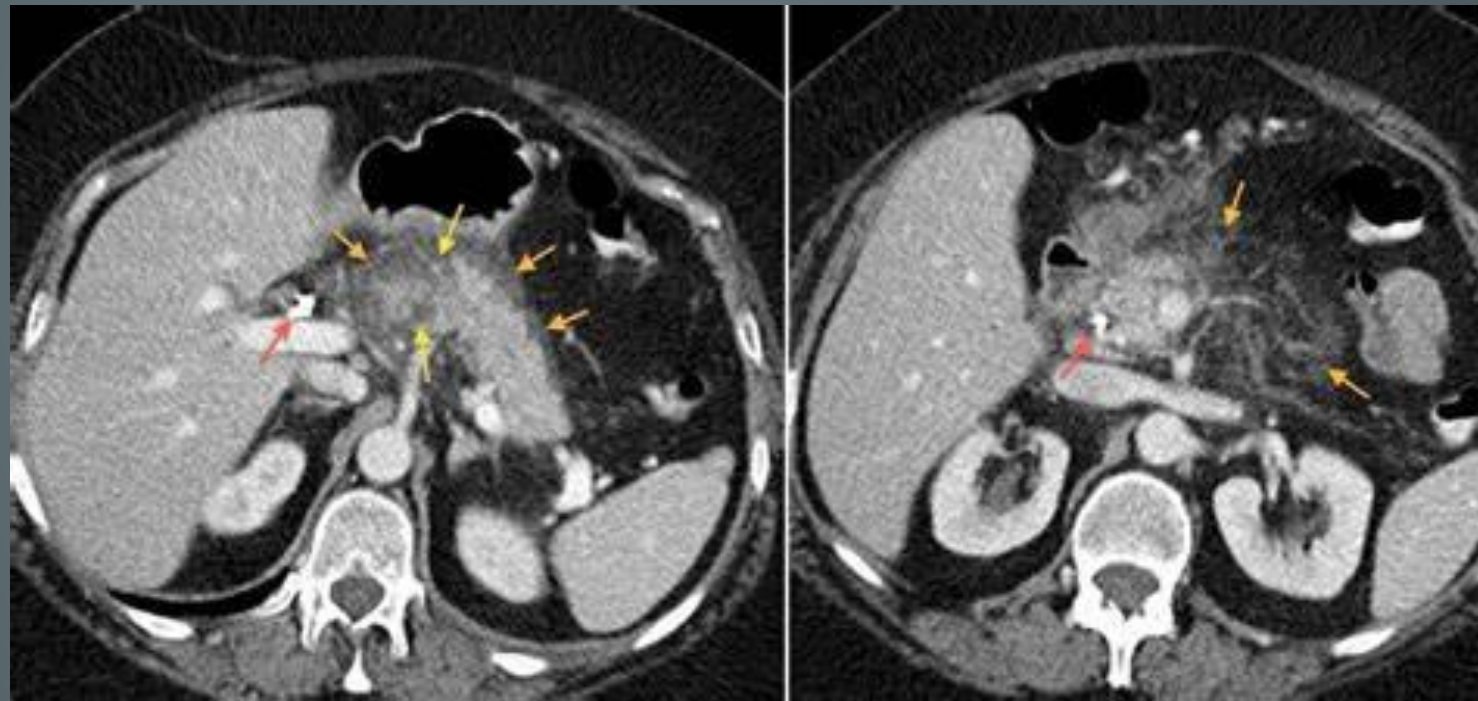
- Pancreatitis-
- US, CT, MRCP, and ERCP are all used in the diagnosis and evaluation of inflammatory diseases of the pancreas.
- The role of diagnostic imaging in **acute pancreatitis** is quite different from its role in chronic pancreatitis. In cases of suspected pancreatitis, imaging is used to establish 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.



CHRONIC PANCREATITIS

- 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.







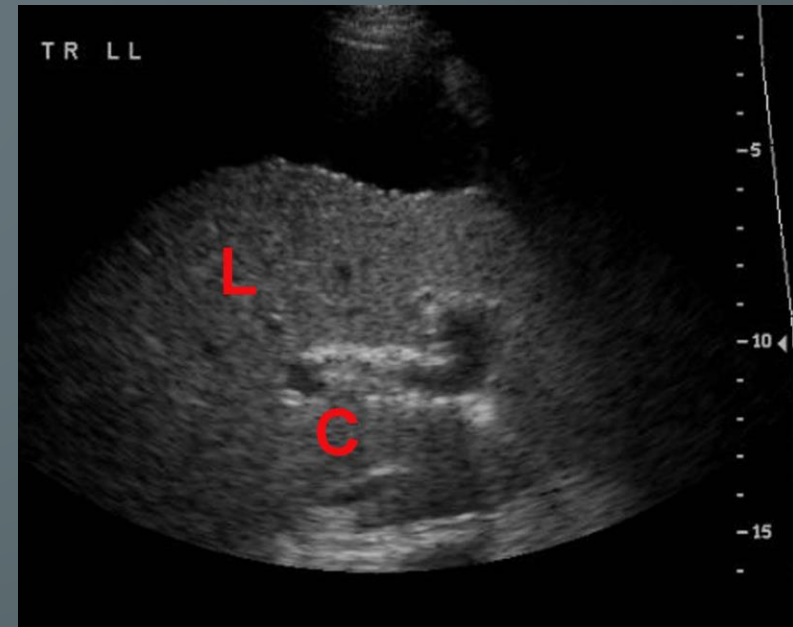
- Irregular duct contours
 - Alternating areas of stricture & dilatation
 - Intraductal calcifications

LIVER

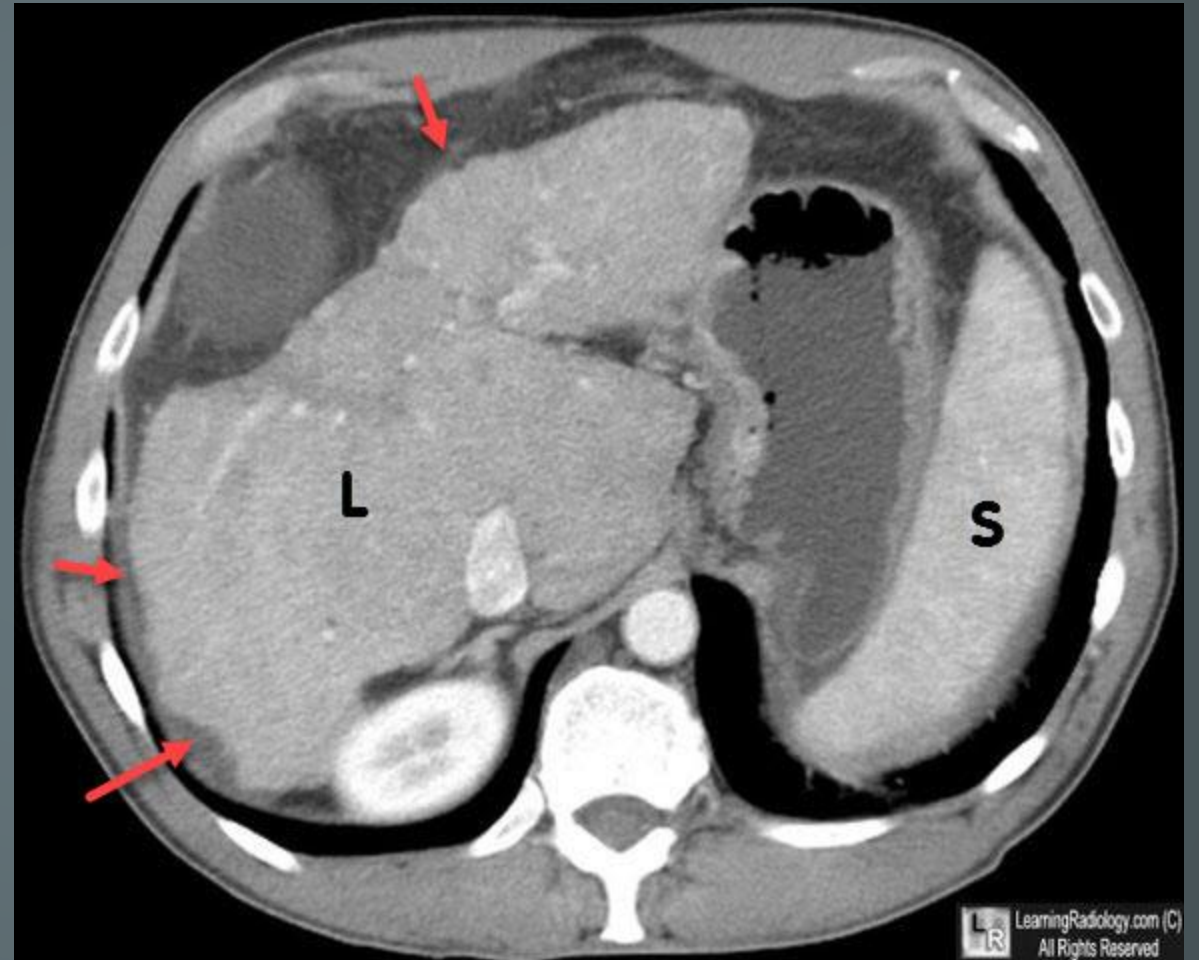
- Cirrhosis
 - Causes of cirrhosis include: a) alcohol, b) alpha1-antitrypsin, c) postnecrotic (hepatitis), d) metabolic disease: Wilson, hemochromatosis, glycogen storage disease, e) PBC, PSC, f) congestive heart failure.
 - Cirrhosis increases risk of developing hepatocellular carcinoma

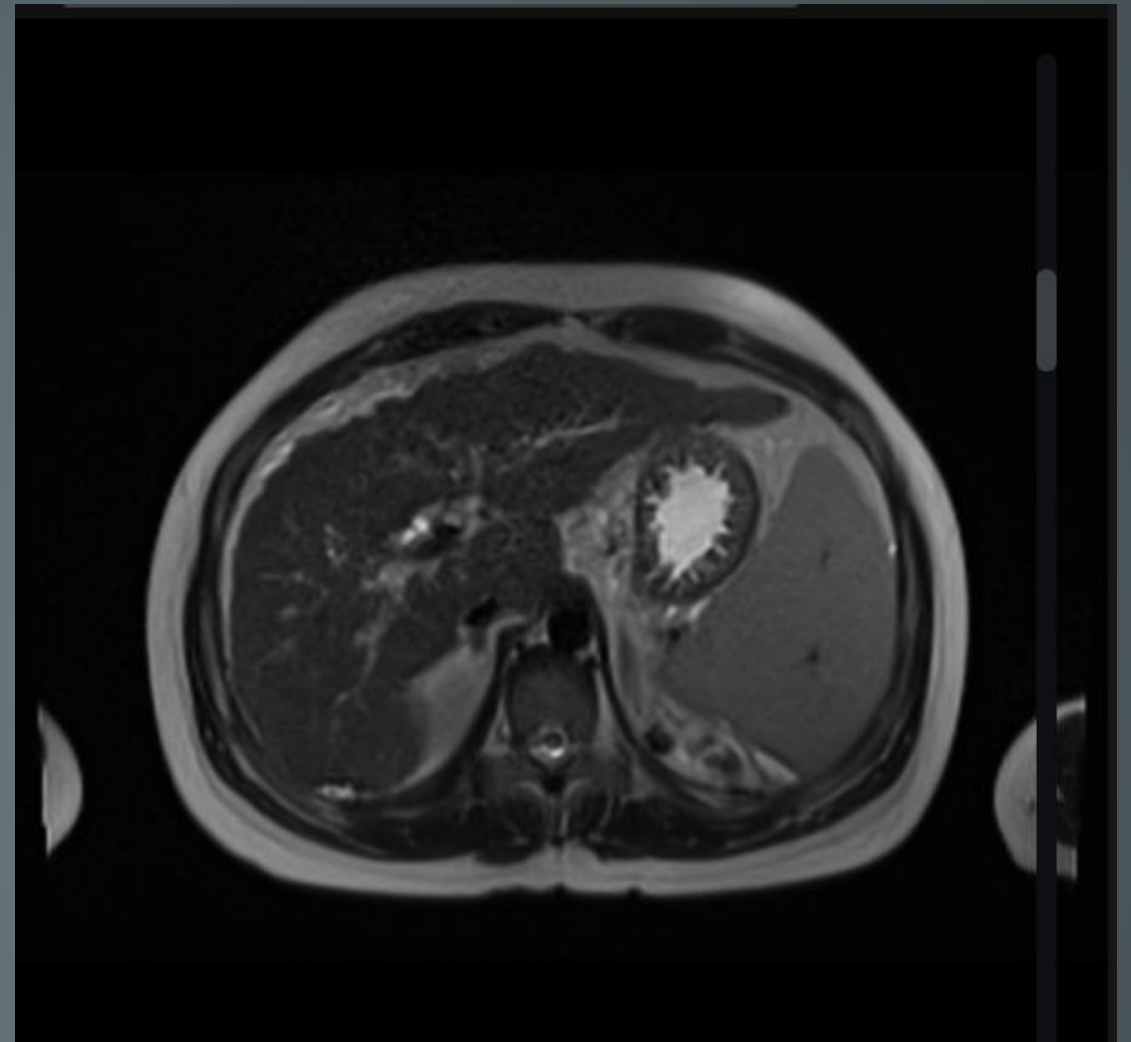
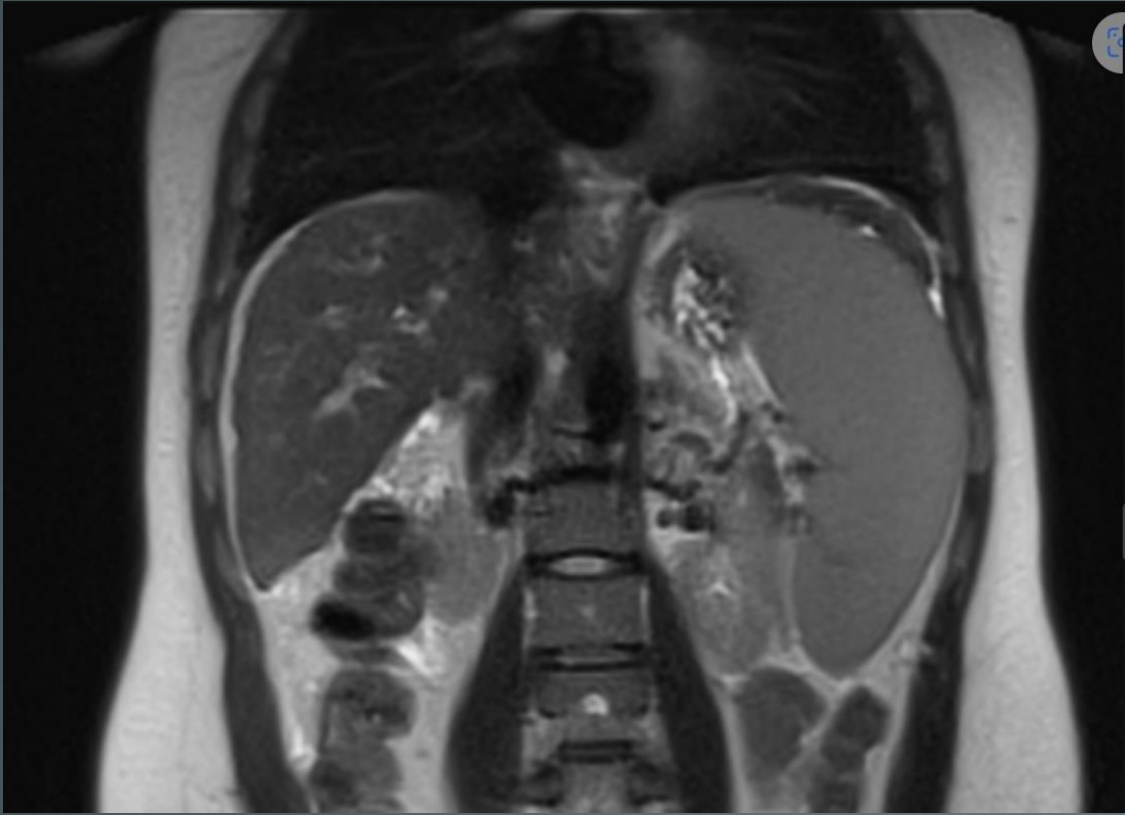
IMAGING FINDINGS IN CIRRHOTIC LIVER

- 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.





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

SMALL BOWEL

Normal Small Bowel

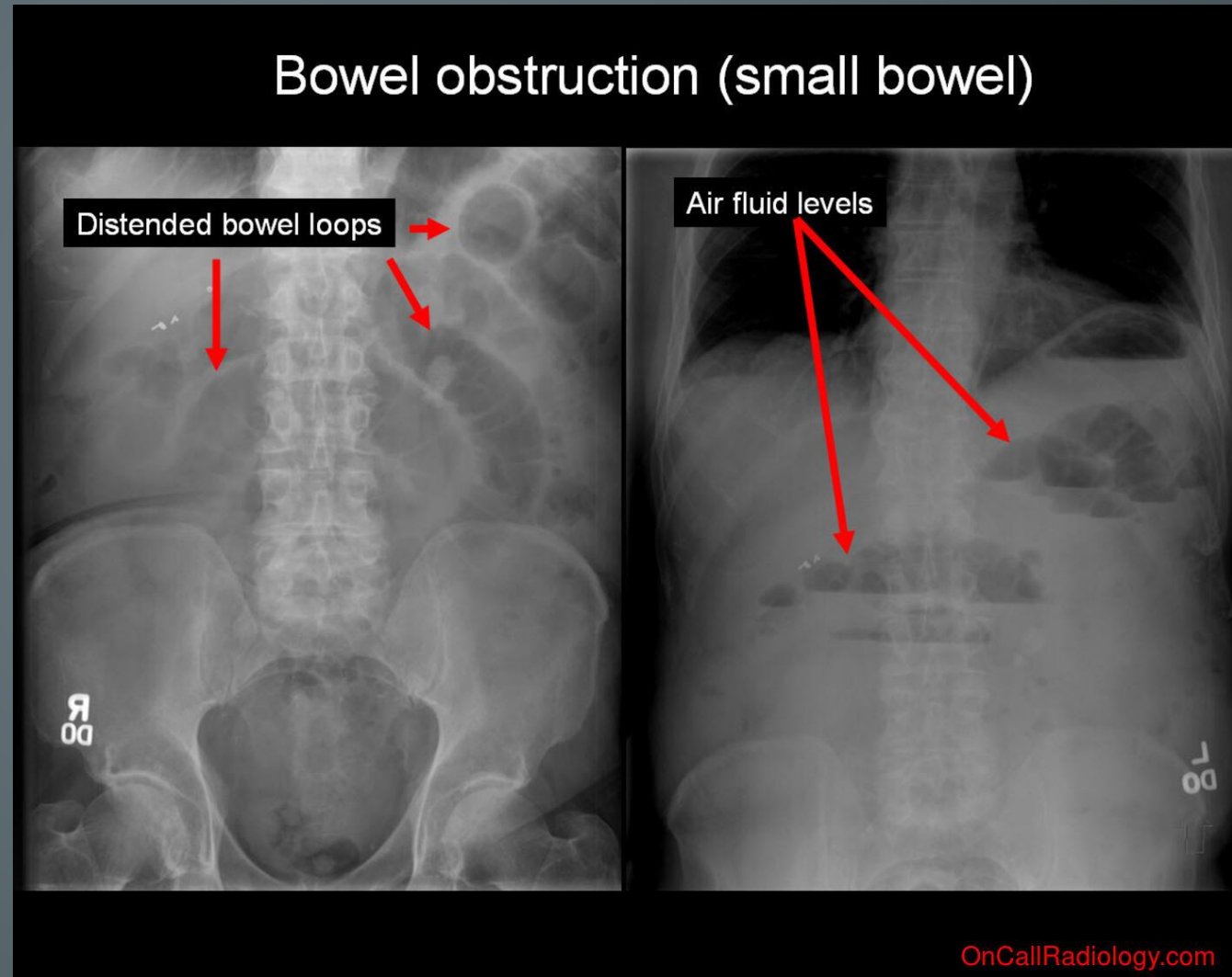


"Feathery-
appearance" of
jejunum

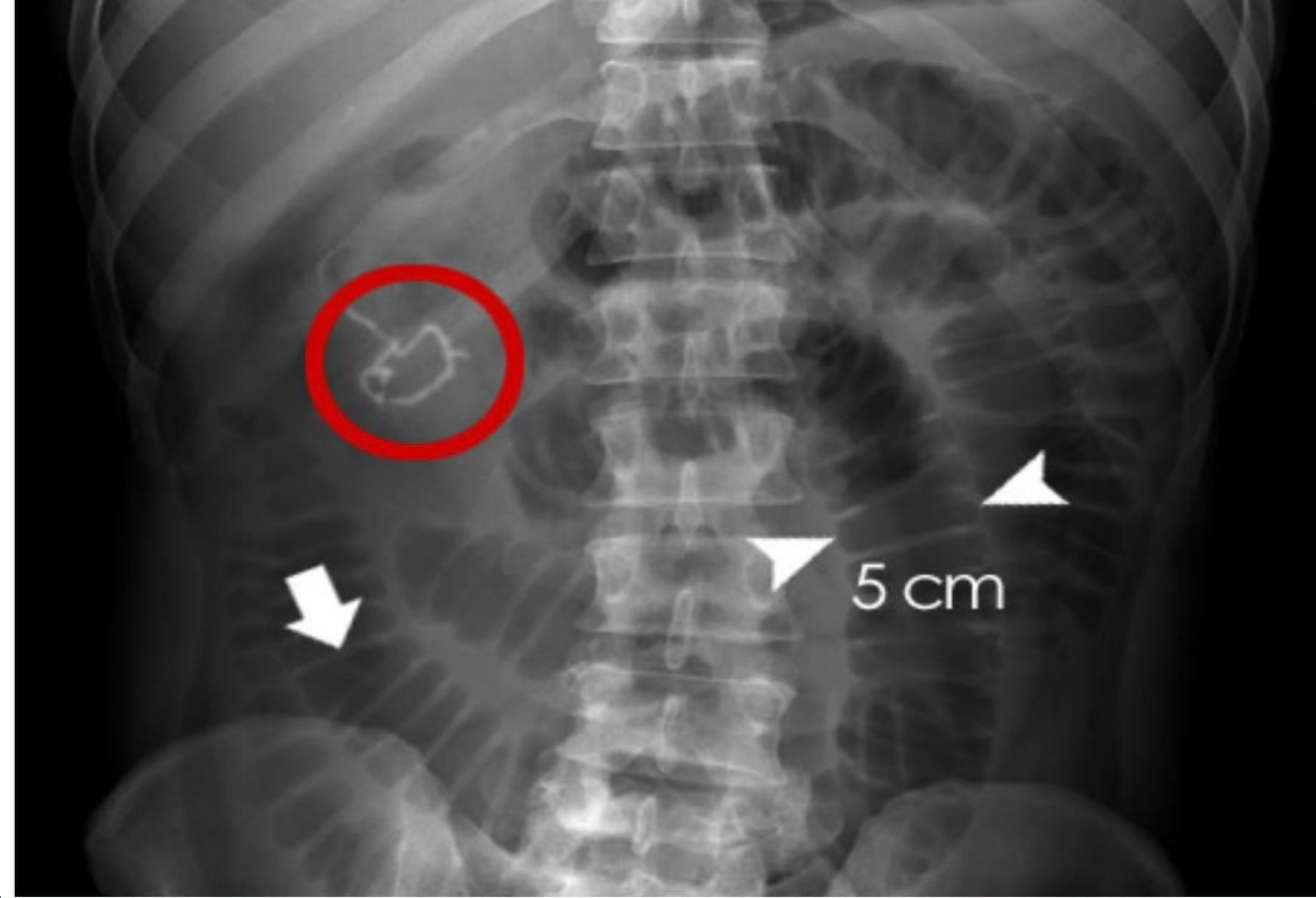
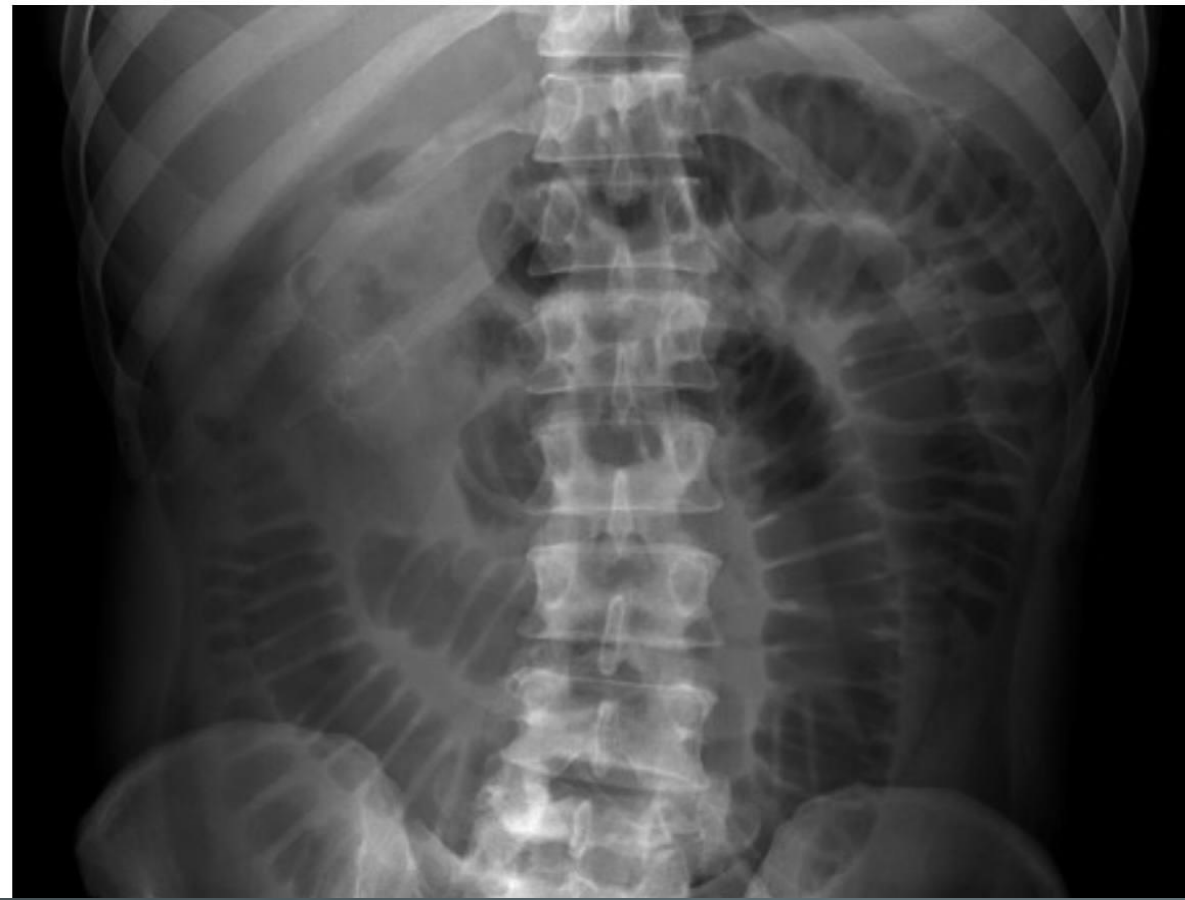
Smooth
appearance
of ileum

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 wall lesions such as masses or strictures.





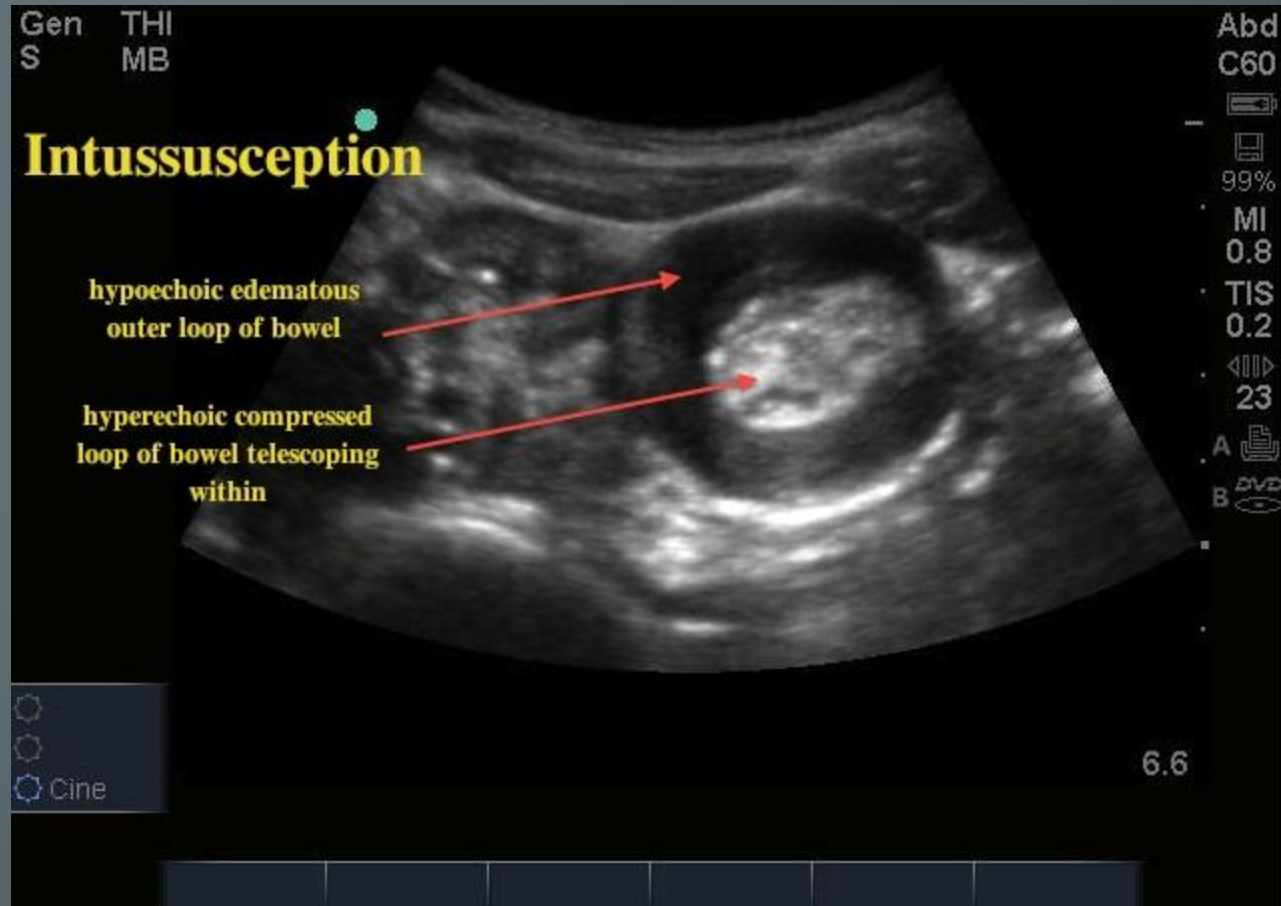


Small bowel obstruction - features

- ◆ Centrally located multiple dilated loops of gas filled bowel (**arrowheads**)
- ◆ Valvulae conniventes (**arrow**) are visible - confirming this is small bowel
- ◆ Evidence of previous surgery - note the anastomosis site (**red ring**) - this suggests adhesions is the likely cause of obstruction (confirmed at surgery)

INTUSSUSCEPTION

- 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.





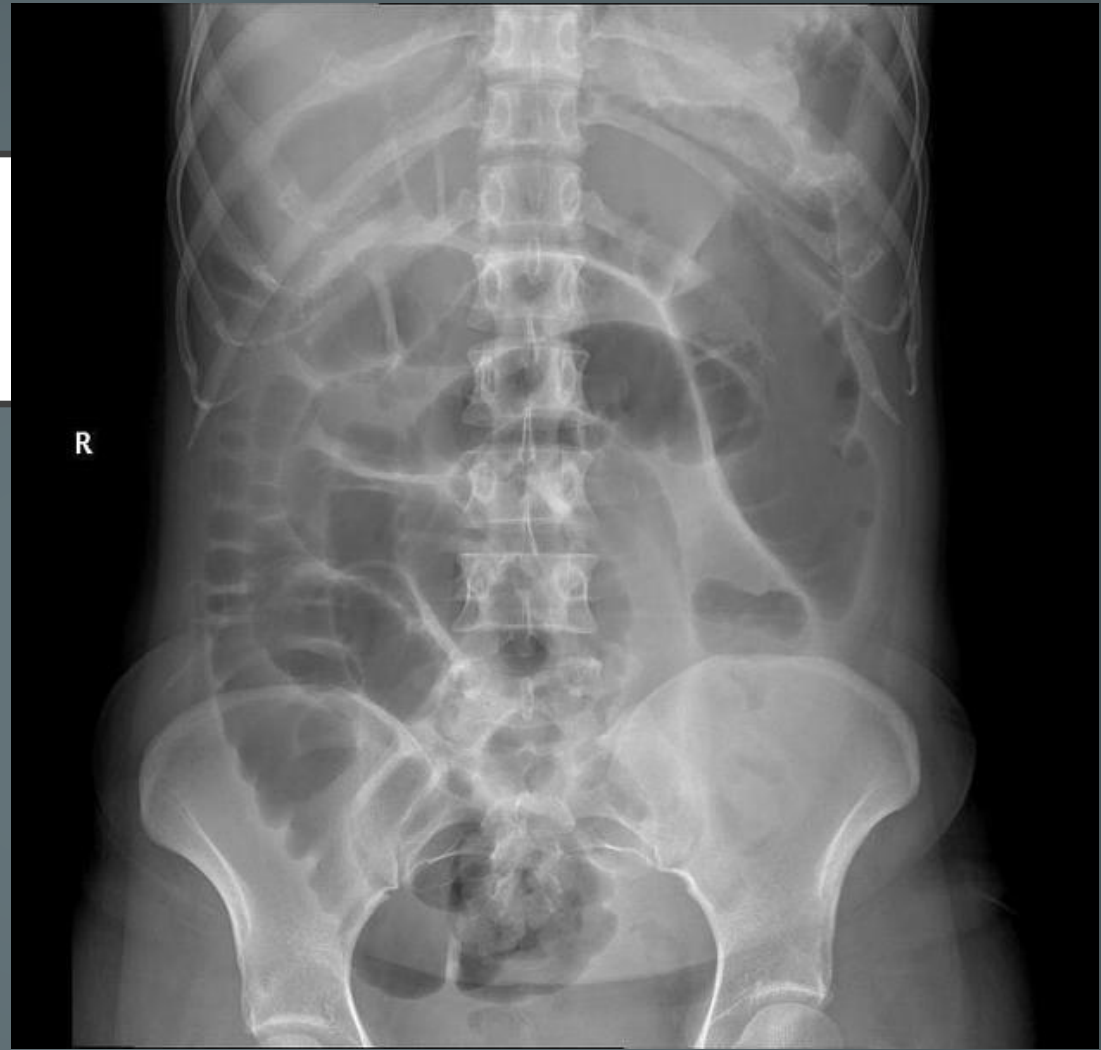


Meniscus sign of intussusception at the hepatic flexure on barium enema.

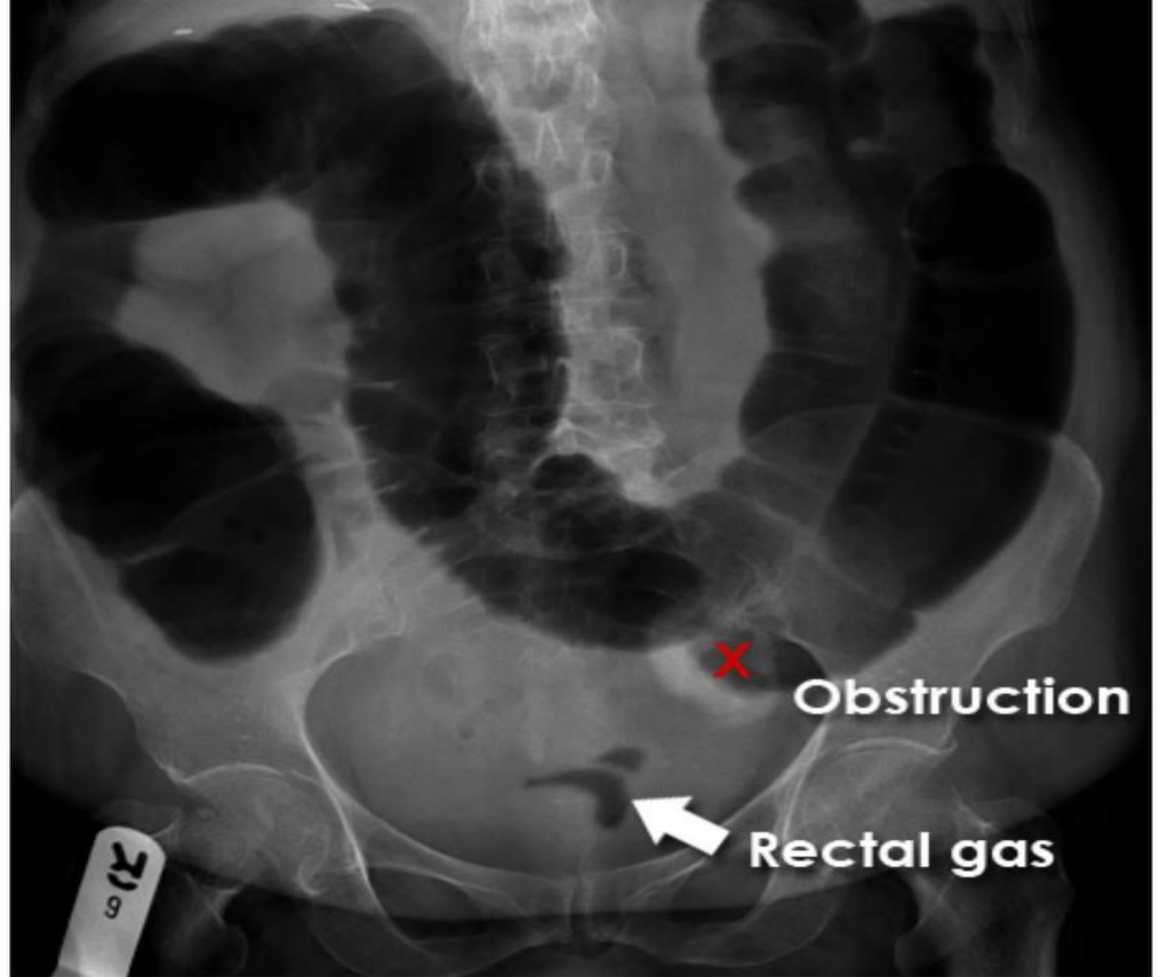


LARGE BOWEL OBSTRUCTION

- Bowel obstruction may be complete or incomplete :
- 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



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



Large bowel obstruction

- ◆ Here the colon is dilated down to the level of the distal descending colon. There is the impression of soft tissue density at the level of obstruction (X). No gas is seen within the sigmoid colon.
- ◆ Obstruction is not absolute in this patient as a small volume of gas has reached the rectum (arrow).
- ◆ An obstructing colon carcinoma was confirmed on CT and at surgery.

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



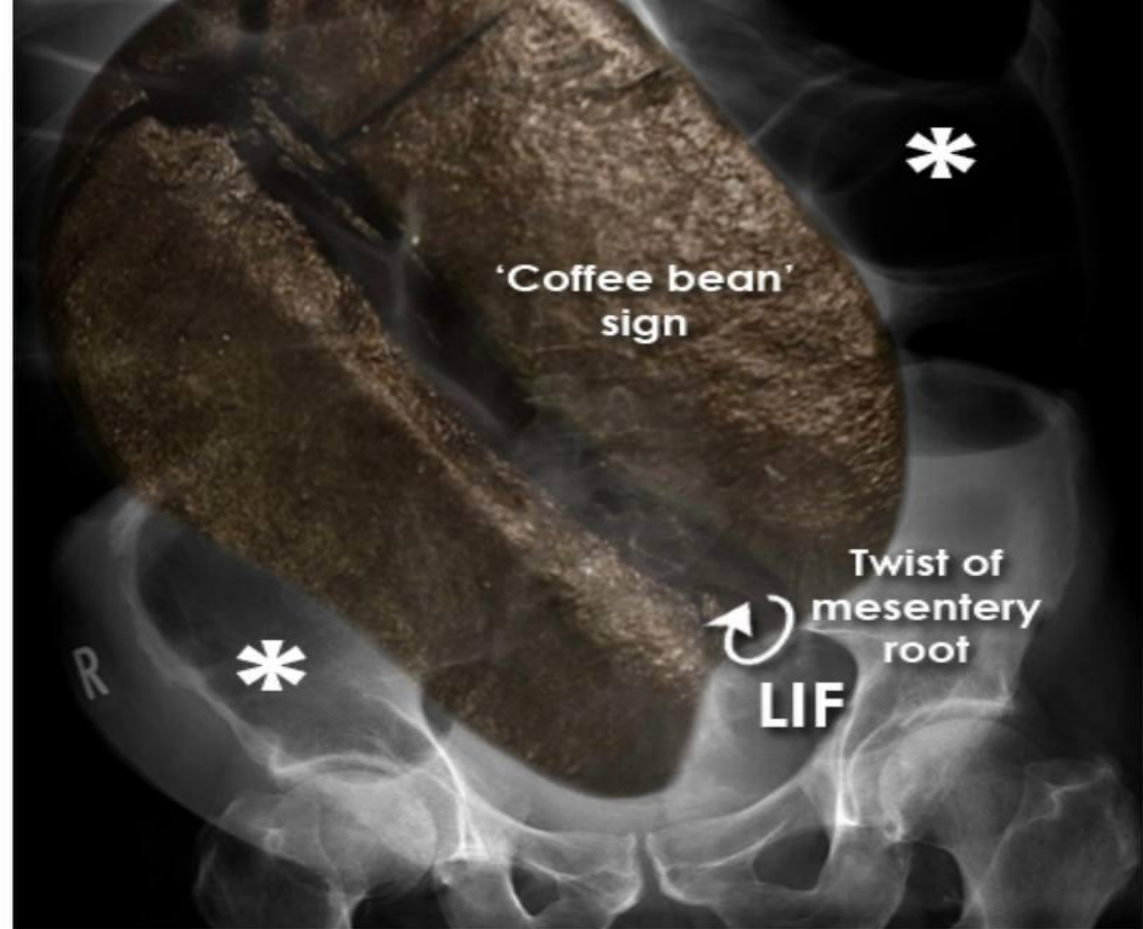
Large Bowel Obstruction

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](#)



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



Sigmoid volvulus - 'coffee bean' sign

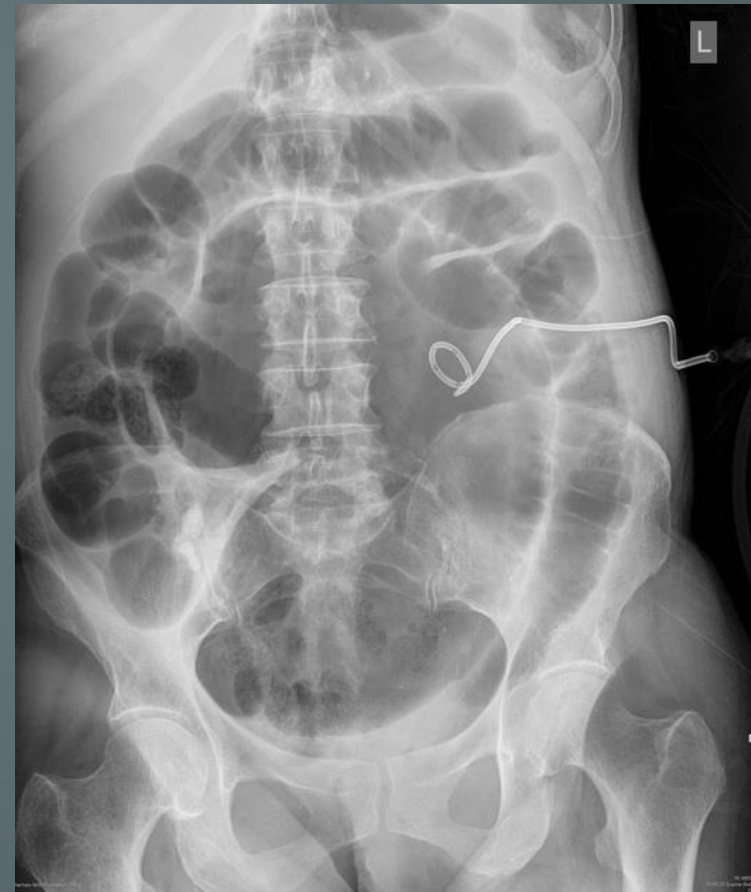
- ◆ The sigmoid colon is very dilated because it is twisted at the root of its mesentery in the left iliac fossa (**LIF**). The proximal large bowel is also dilated (**asterisks**).
- ◆ The twisted loop of sigmoid colon is said to resemble a coffee bean. As in this case the loop of dilated sigmoid colon - or 'coffee bean' - usually points upwards towards the diaphragm.
- ◆ This patient is at high risk of perforation and/or bowel ischaemia.

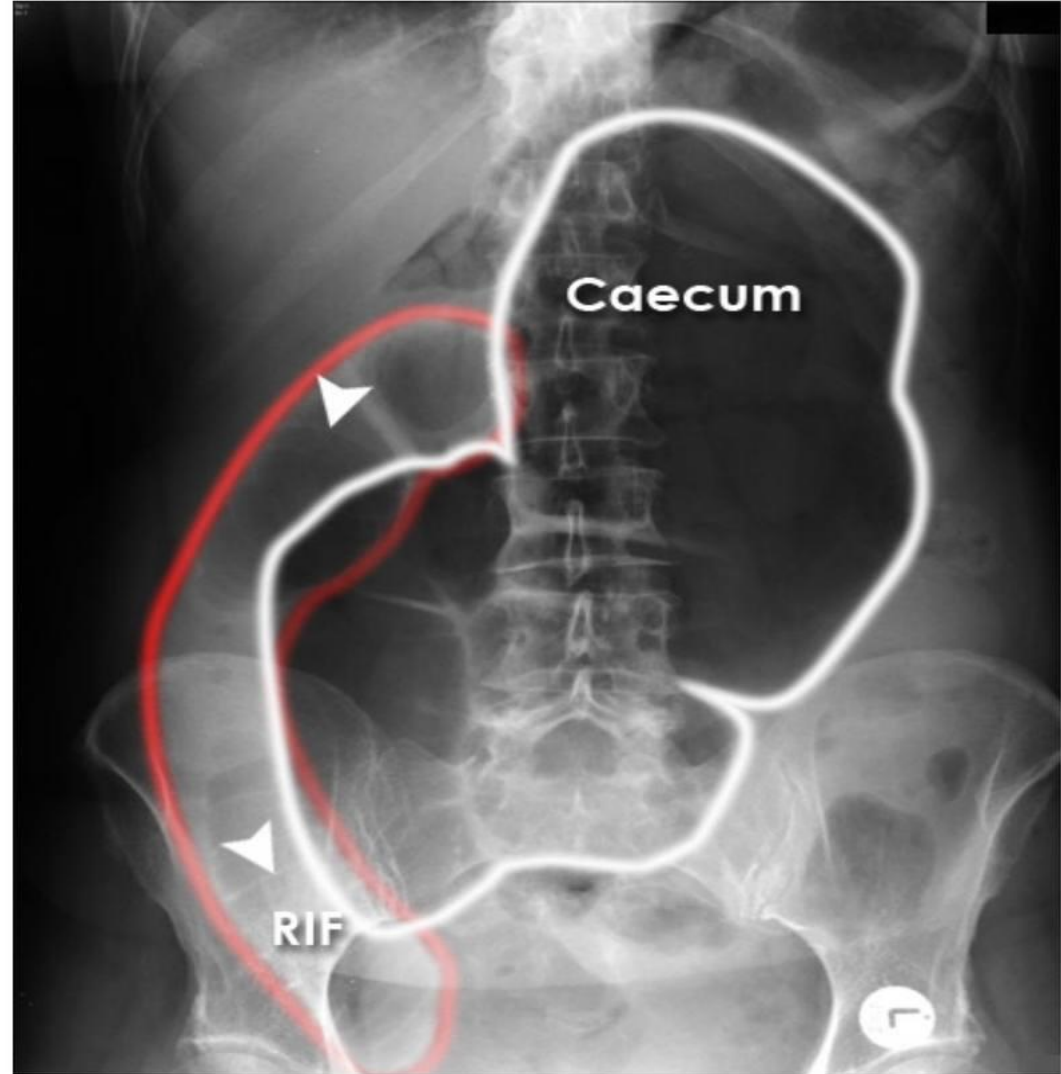


- Volvulus of the distal sigmoid colon, best appreciated on the coronal images.

CECAL VOLVULUS

- Cecal volvulus describes torsion of the [cecum](#) around its [mesentery](#) which often results in [obstruction](#). If unrecognised, it can result in [bowel perforation](#) and [fecal peritonitis](#).





Caecal volvulus

- ◆ The massively dilated caecum no longer lies in the right iliac fossa (**RIF**). Rather this is occupied by small bowel (**red outline**). The small bowel is identified by the valvulae conniventes - mucosal folds that cross the full width of the bowel (**arrowheads**). Caecal volvulus was confirmed at laparotomy.

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.

SIGNS

- Rigler sign



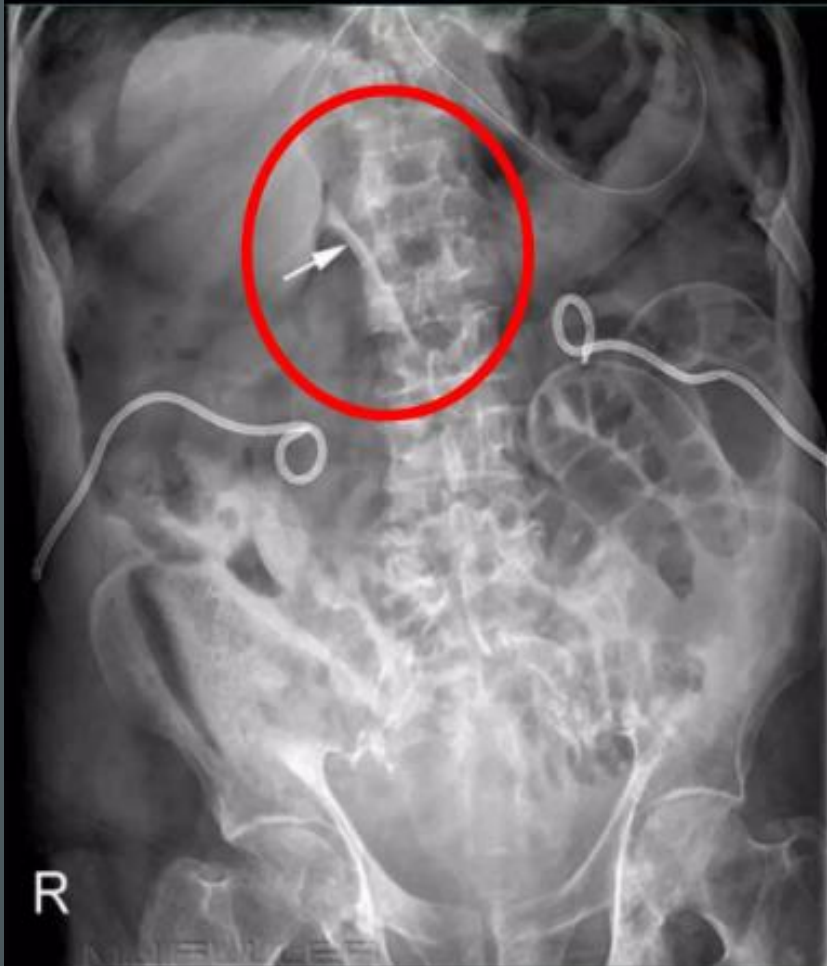
- Supine
- Bowel wall **outlined by intraluminal & extraluminal air** (extraluminal = free peritoneal gas)
- **Both sides** of bowel wall can be seen (red arrows)



DECUBITUS ABDOMEN SIGN



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

FOOTBALL SIGN



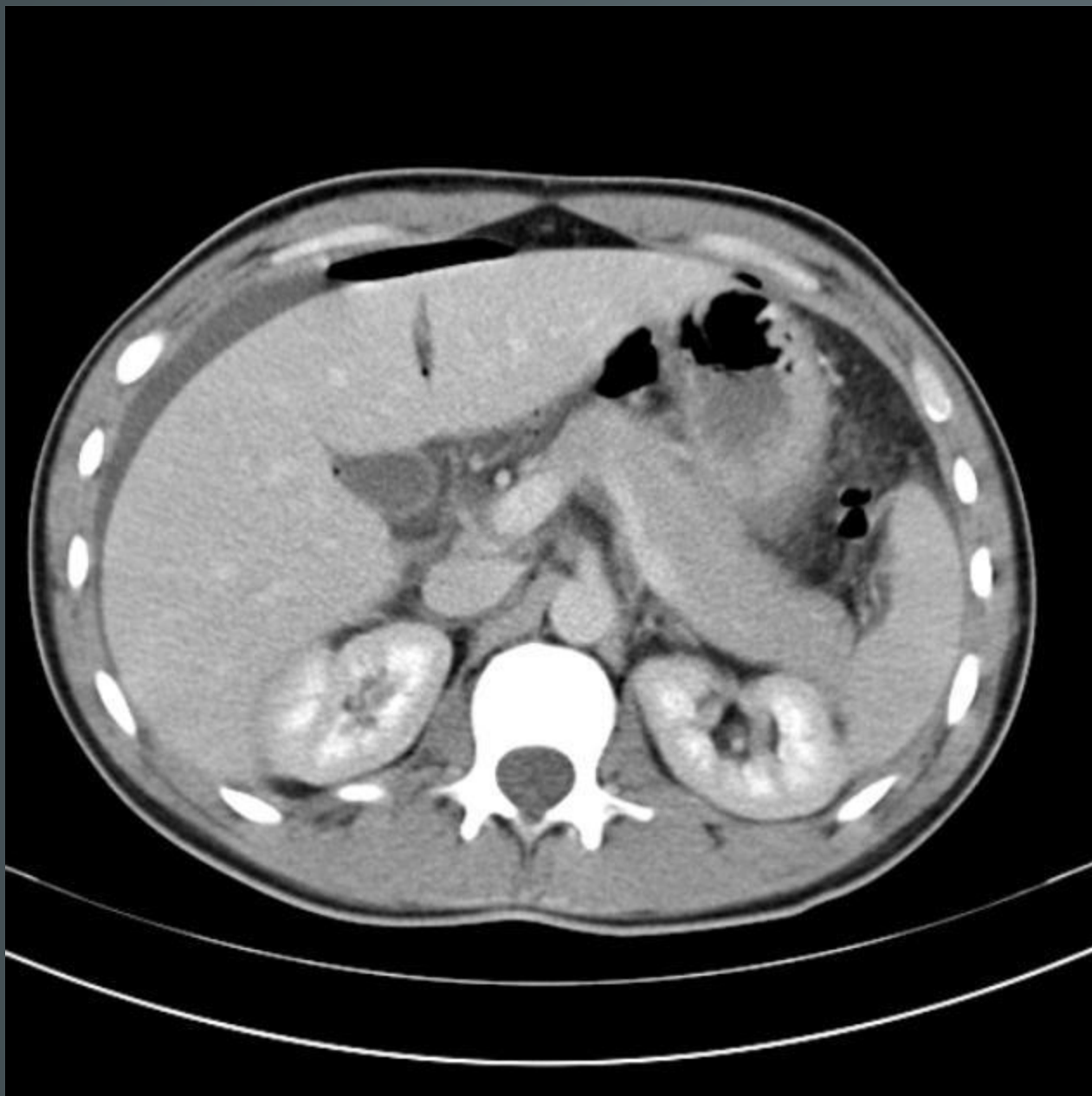
- massively air-filled peritoneum



CONTINUOUS DIAPHRAGM SIGN



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



ABDOMINAL PLAIN FILM CASES

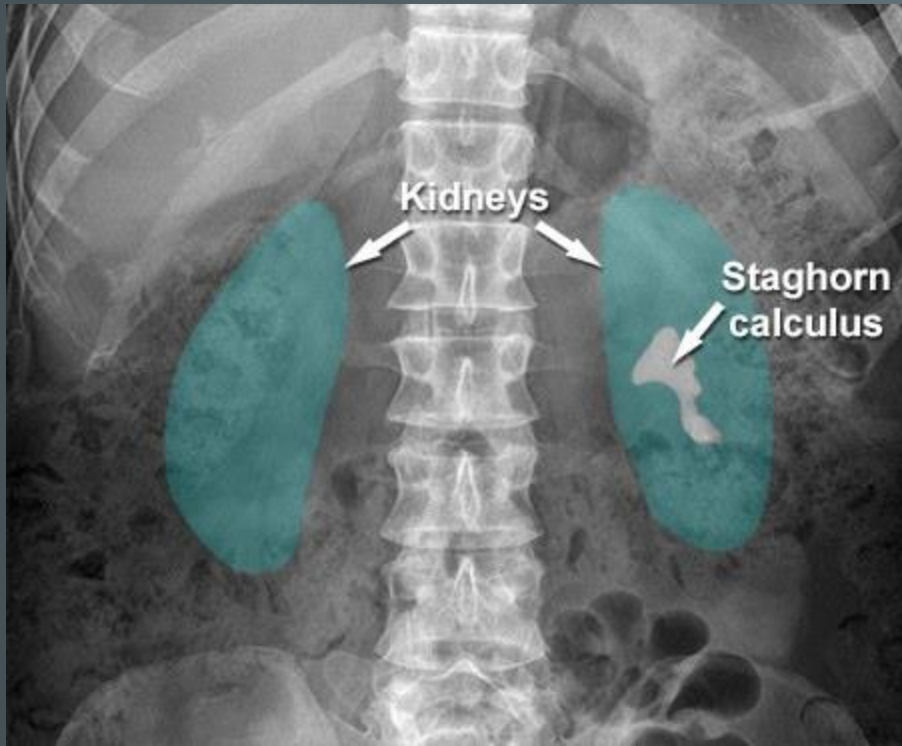
CASE 1



What is the cause of the abnormal calcification?

- ☐ Adrenal calcification
- ☐ Appendicolith
- ☐ Gallstones
- ☐ Pancreatic calcification
- ☒ Staghorn renal calculus

CASE 1



An irregularly shaped calcified area is located over the left kidney. It resembles a staghorn, hence 'staghorn calculus'

CASE 2



Patient with severe abdominal pain. What does the image show?

☐

Ascites

☐

Lead pipe colon

☐

Normal gas pattern

☐

Rigler's/ double wall sign

☐

Thumbprinting

CASE 2

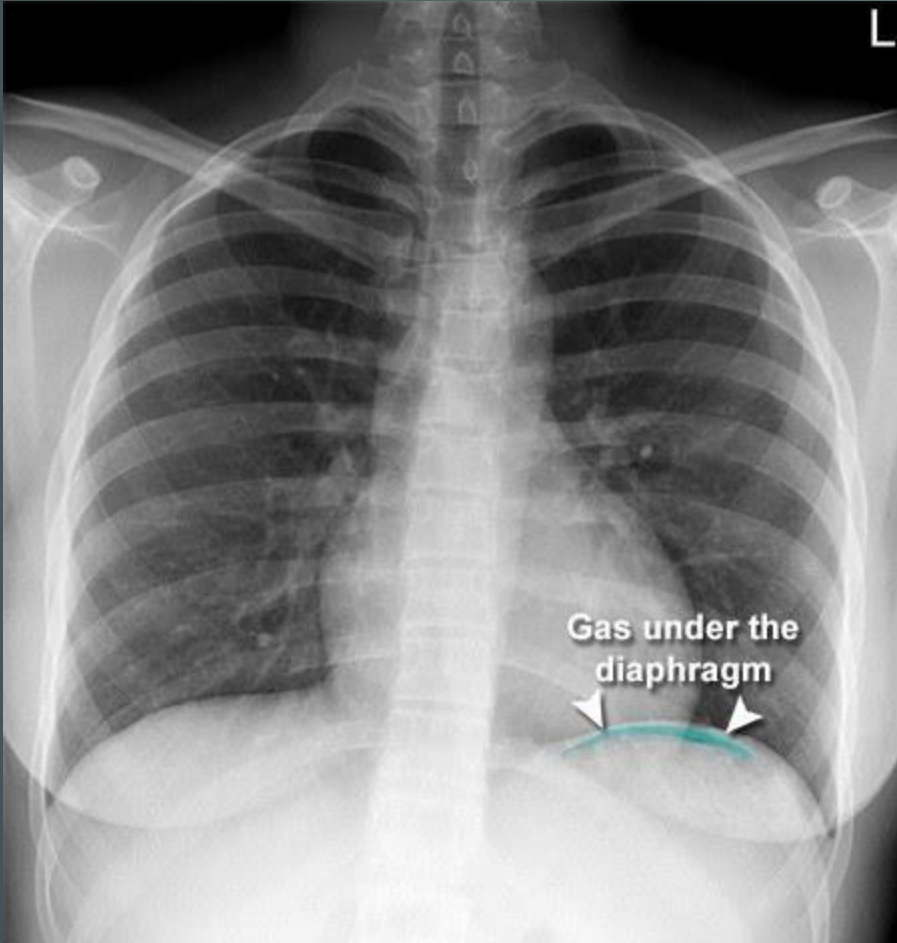


Free gas (pneumoperitoneum) can be seen on both sides of the bowel wall. This is Rigler's sign or the double wall sign.

CASE 3



CASE 3



An erect chest X-ray is more sensitive for detection of free gas than an abdominal X-ray. This image shows a small volume of free gas under the left hemidiaphragm. This may be seen following abdominal surgery, but in the context of a patient presenting with abdominal pain this finding indicates perforation.

CASE 4



What is the cause of the abnormal calcification?

☐

Appendicolith

☐

Adrenal calcification

☐

Gallstones

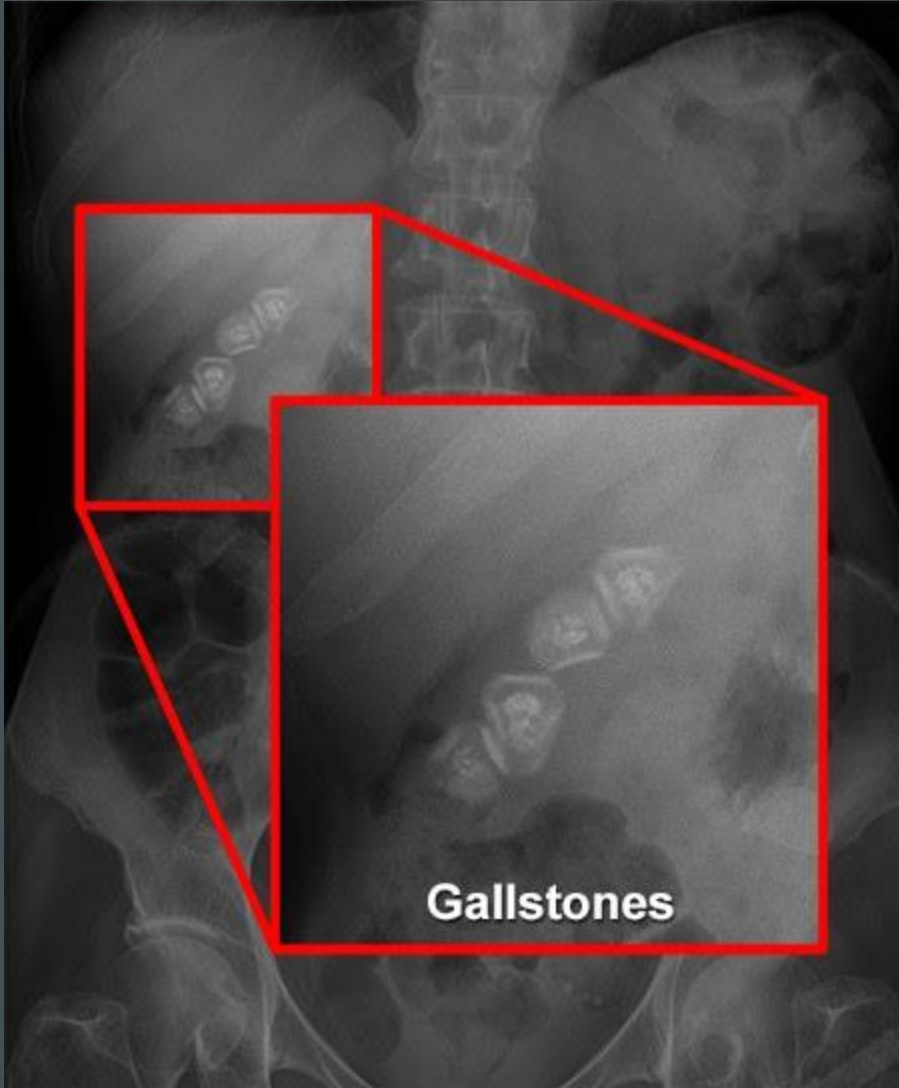
☐

Pancreatic calcification

☐

Staghorn renal calculus

CASE 4



10-15% of gallstones are calcified sufficiently to be visible on an abdominal X-ray. They have very varied appearances and are frequently asymptomatic – as was the case in this patient.

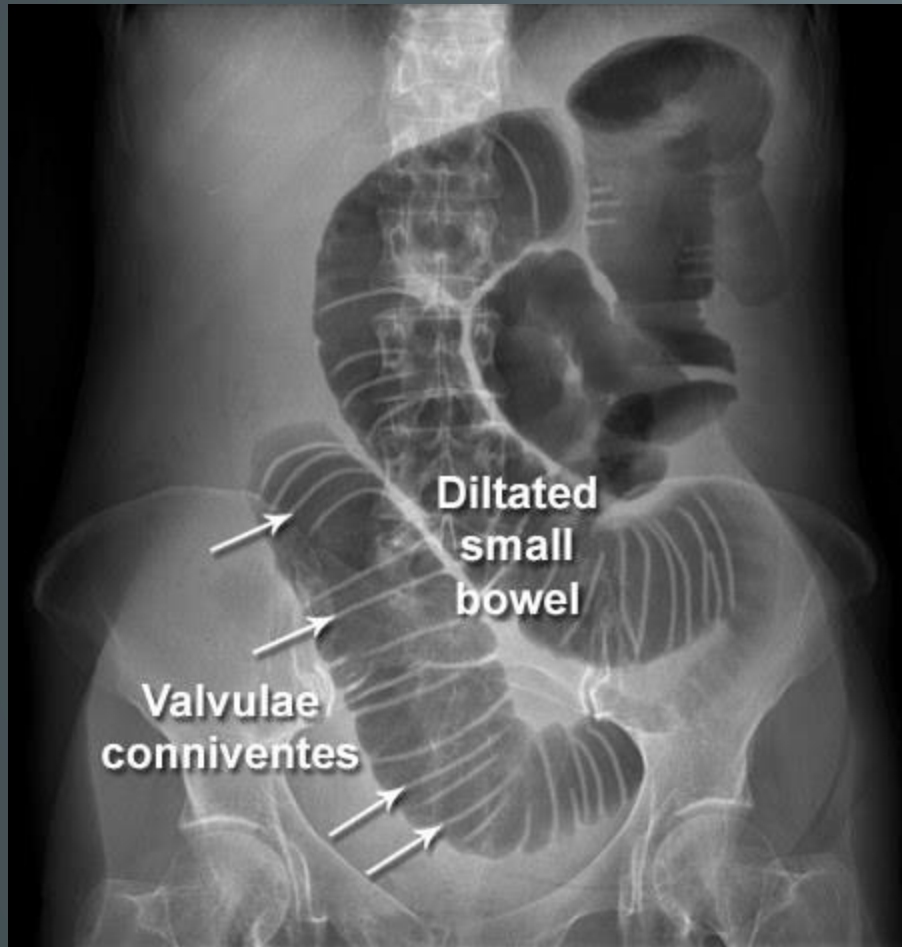


CASE 5

24-year-old patient with suspected appendicitis. What does the image show?

- ☐ Caecal volvulus
- ☐ Normal appearances
- ☐ Pneumoperitoneum
- ☐ Small bowel obstruction
- ☐ Toxic megacolon

CASE 5



Dilated loops of bowel with valvulae conniventes – lines crossing the full width of the bowel – indicates small bowel obstruction.

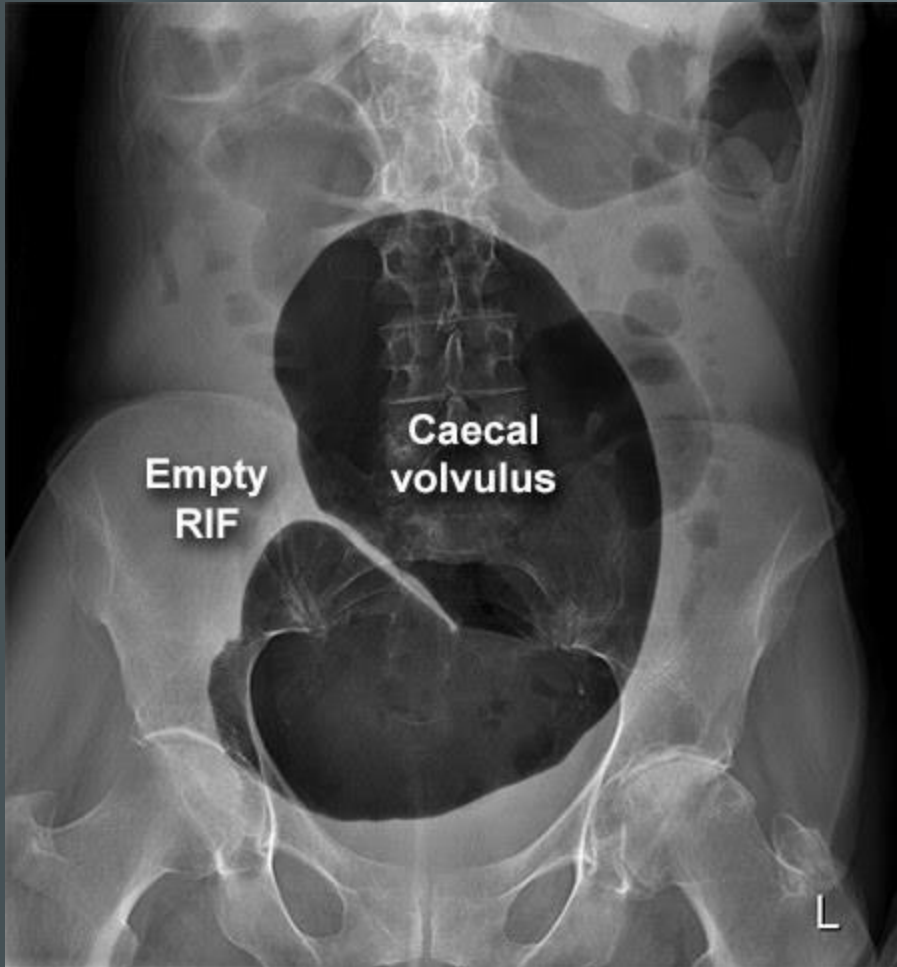


CASE 6

Patient with severe abdominal pain. What is the cause of pain demonstrated on this abdominal X-ray?

- ☐ Caecal volvulus
- ☐ Normal appearances
- ☐ Pneumoperitoneum
- ☐ Small bowel obstruction
- ☐ Toxic megacolon

CASE 6



There is a segment of very dilated gas-filled bowel. The right iliac fossa (RIF) is empty indicating displacement of the caecum. These are typical appearances of caecal volvulus.

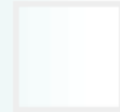
CASE 7



What is the artifact shown in this image?



Biliary stent



Colonic stent



External tubing

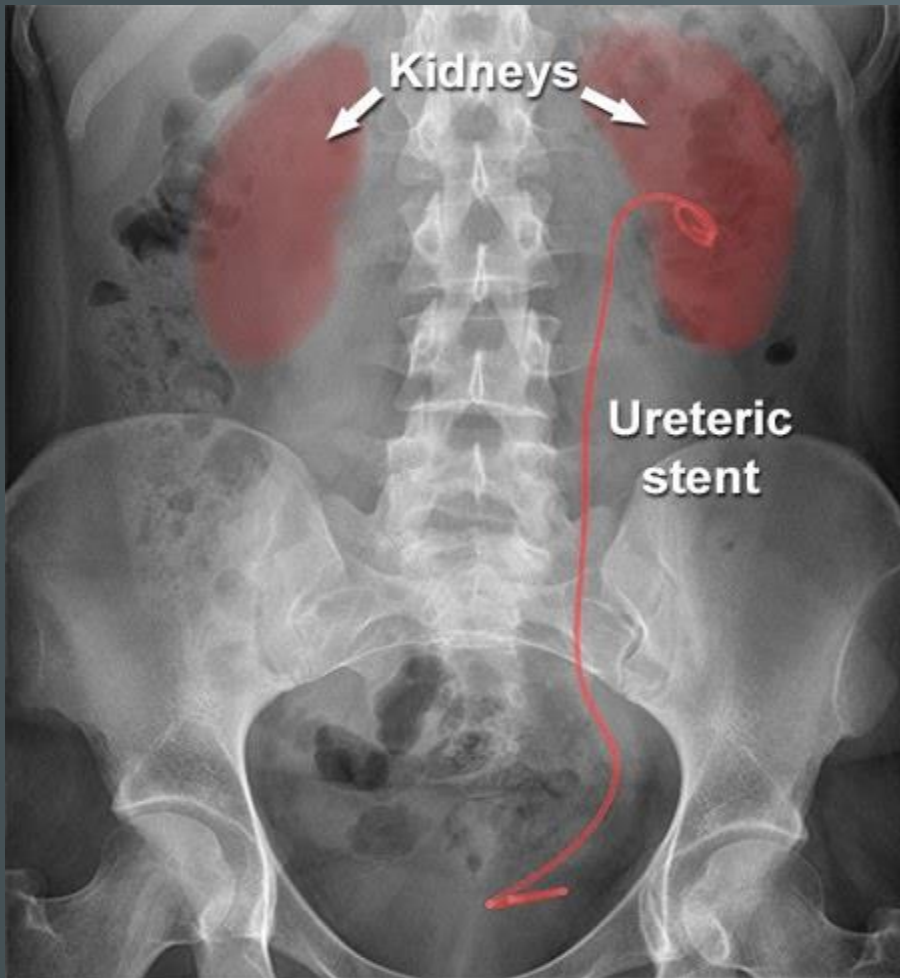


Percutaneous nephrostomy tube



Ureteric stent

CASE 7



This patient presented with an obstructed left ureter due to a renal stone. A ureteric stent was inserted – also known as a JJ-stent or a pig-tail catheter– which passes from the renal pelvis to the bladder. Percutaneous nephrostomy tubes pass through the abdominal wall to the renal pelvis.

CASE 8



Patient with abdominal pain. What does the image show?

☐

Ascites

☐

Bone metastases

☐

Pneumoperitoneum

☐

Poor quality image which should be repeated

☐

Thumbprinting

CASE 8



The bones should be checked whenever viewing an abdominal X-ray. In this image the bones of the spine and pelvis are much too dense.

These are the typical appearances of sclerotic bone metastases. In this case the patient had metastatic prostate cancer.

CASE 9



Patient with history of ulcerative colitis. What radiological finding is shown?

- ☐ Coffee bean sign
- ☐ Large bowel obstruction
- ☐ Normal appearances
- ☐ Rigler's/ double wall sign
- ☐ Thumbprinting

CASE 9



Inflammation of the bowel wall leads to thickening of the haustral folds. This results in the radiological sign of thumbprinting, a characteristic finding in patients with active ulcerative colitis.

THANK YOU