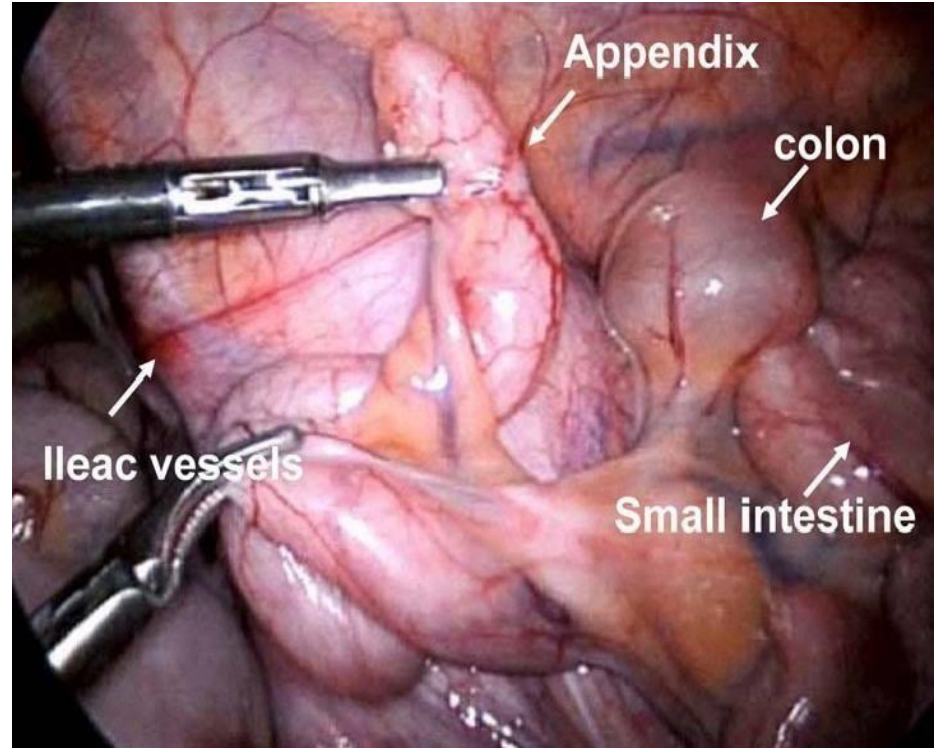


Gastrointestinal surgery

Malrotation: normally, the duodenojejunal junction is to the left of the spine. In malrotation it is to the right of the spine.

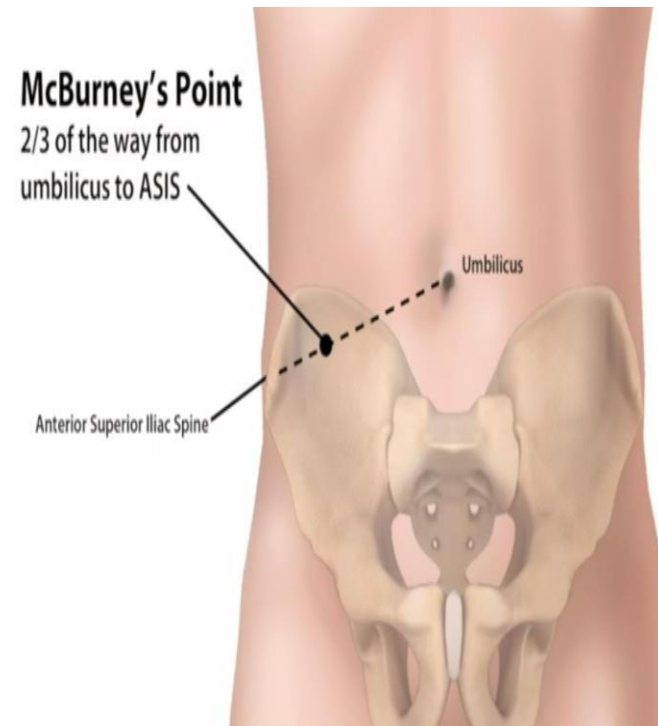




Gross appendicitis: As noticed by:
Enlarged appendix and engorged blood vessels on it.

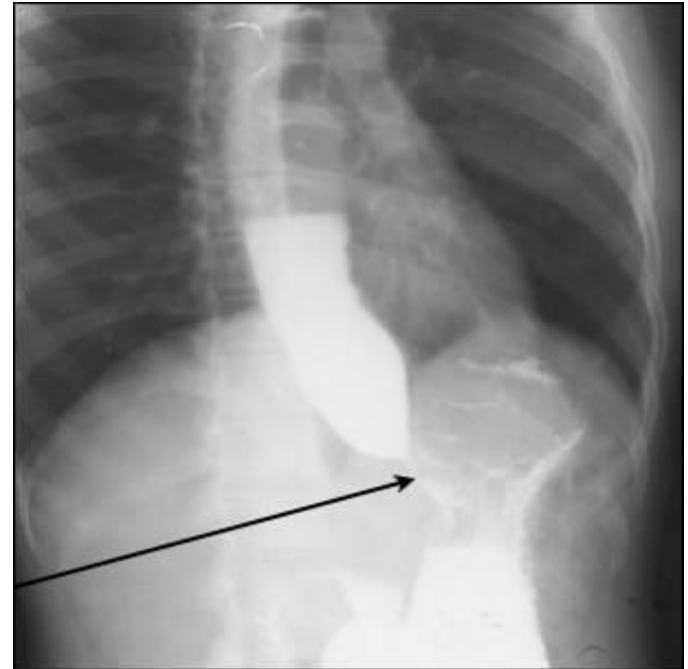
Acute appendicitis

- Sx: Pain (referred to periumbilical area) >> Nausea and vomiting >> Anorexia >> Pain migrates to the RLQ (constant and intense, usually <24 hours).
- Tenderness maximally at **McBurney's point**.
- Obturator sign, psoas sign, Rovsing's sign, Valentino's sign.
- **Appendectomy** is the most common cause of emergent abdominal surgery.
- Dx of ruptured appendix: fever >39, high WBC, rebound tenderness, peri appendiceal fluid collection on ultrasound.
- If normal appendix is found upon exploration, take it out (even in Crohn's).
- Appendiceal abscess: percutaneous drainage, antibiotics, elective surgery 6 weeks later.



Achalasia

- **On manometry (the definitive diagnostic test):** Failure of the LES to relax during swallowing, aperistalsis of the esophageal body.
- **Symptoms:** progressive dysphagia for both solids and liquids (worse for liquids), regurgitation.
- **Treatment:** upper endoscopy and balloon dilation of the LES, laparoscopic Heller's myotomy.
- **Complications:** aspiration pneumonia, weight loss, esophageal CA secondary to Barrett's esophagus from food stasis.



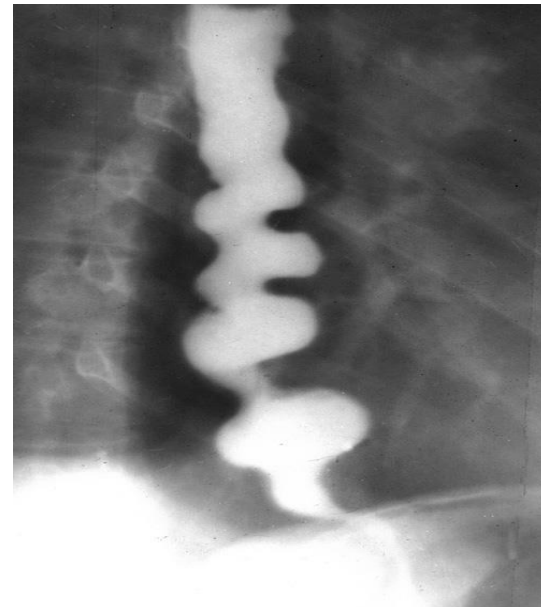
- **Barium swallow (best initial test):** bird's beak sign & dilation of the proximal esophagus.

Diffuse esophageal spasm & Nut-Cracker esophagus

- **Manometry (the most accurate test):** intermittent contractions with high amplitudes.
- **Symptoms:** intermittent dysphagia for both solids and liquids, atypical chest pain that may mimic MI (not related to exercise, increases with cold liquids).
- **1st line treatment:** calcium channel blockers (diltiazem or nifedipine) and nitrates.
- **Barium swallow:** corkscrew appearance.

Used to differentiate between DES & Nut-Cracker:

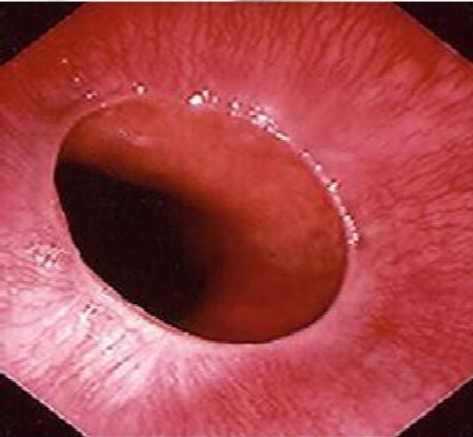
- DES: non-peristaltic contractions.
- Nut-Cracker: peristaltic contractions.





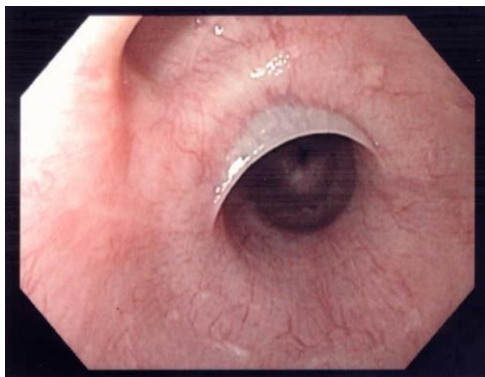
Schatzki ring (lower esophageal ring)

- Usually at the squamo-columnar junction.
- **Symptoms:** **intermittent** dysphagia for **solids** only, no pain.
- Associated with hiatal hernia.
- **Diagnosis:** barium swallow and endoscopy.
- **Treatment:** dilation by bougie tube or through scope hydrostatic balloon. Patients placed on PPI after dilation.



Esophageal webs

- More proximal, usually in the hypopharynx.
- Same symptoms as Schatzki ring.
- E.g. **Plummer-Vinson syndrome.**
- **Diagnosis:** barium swallow and endoscopy.
- **Treatment:** dilation.

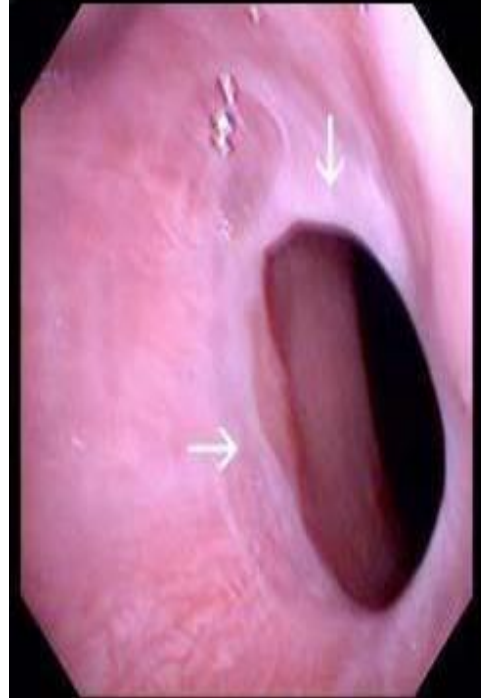


Plummer-Vinson syndrome:

1. Esophageal web
2. Iron-deficiency anemia
3. Dysphagia.
4. Spoon-shaped nails
5. Atrophic oral and tongue mucosa.

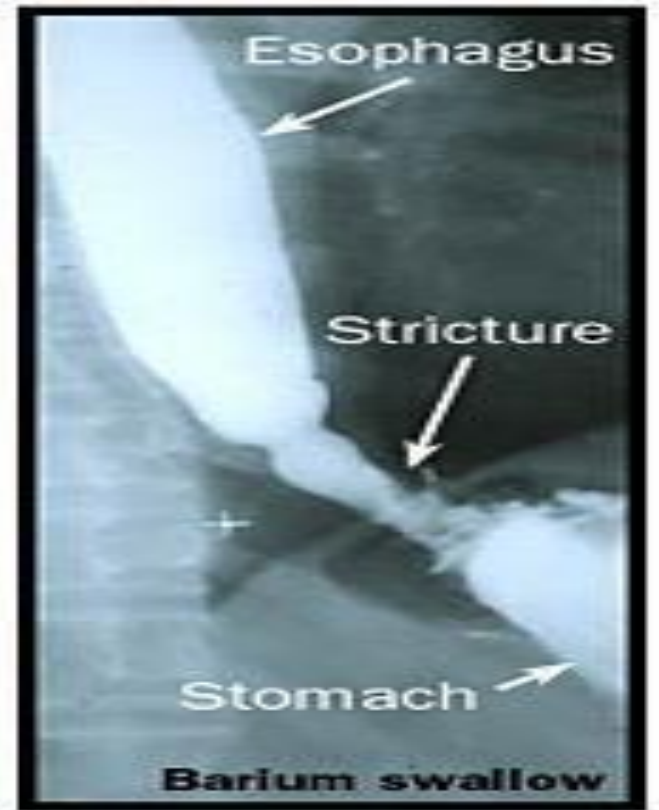
- Especially occurs in elderly women, 10% develop squamous cell carcinoma.

- May respond to treatment of IDA.



Esophageal stricture

- **Symptoms:** constant & slowly progressive dysphagia for solids then liquids.
- **Causes:** long history of incomplete treated reflux, prolonged NG tube placement, lye ingestion.
- **Diagnosis:** barium swallow.
- **Treatment:** dilation.



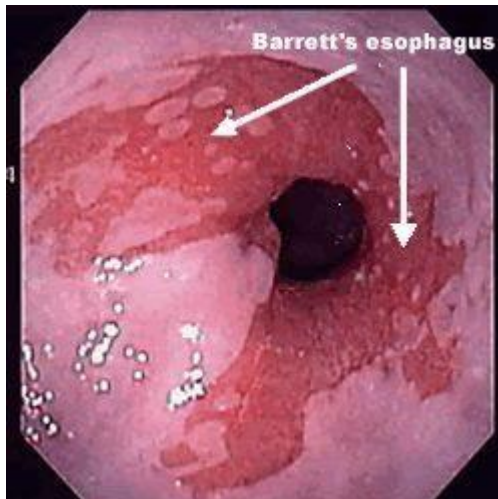
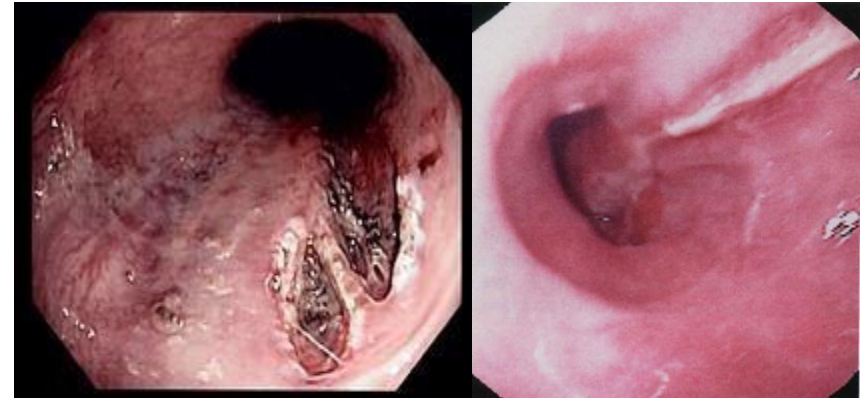
Zenker's diverticulum

- It is a false diverticulum (not involving all layers of the esophageal wall).
- Outpouching of the upper esophagus (between the thyropharyngeus & cricopharyngeus muscles).
- **Symptoms:** halitosis, food regurgitation, dysphagia for **solids only** (difficulty initiating swallowing), posterior neck mass.
- Elderly.
- **Diagnosis:** barium swallow. Endoscopy and NG tube are **contraindicated** (risk of perforation).
- **Treatment:** surgical resection.



Mallory Weiss tear syndrome

- **Partial thickness** lacerations at gastroesophageal junction.
- **Symptoms:** painful hematemesis preceded by vomiting. No dysphagia.
- **Diagnosis:** history and upper endoscopy.
- **Treatment:** resolves spontaneously.



Barrett's esophagus

- Change of cell type from esophageal squamous to specialized intestinal columnar (metaplasia).
- **Cause:** chronic GERD (most common), achalasia.
- **Diagnosis:** endoscopy.
- **Treatment:** PPI and follow up (if high grade dysplasia, do radiofrequency ablation or esophagectomy).
- **Complication:** increases the risk of adenocarcinoma.

Esophageal varices

- They are most often a consequence of portal hypertension, commonly due to cirrhosis.
- **Cause:** porto-systemic collateral between the left gastric vein (portal circulation) and the azygous vein (systemic circulation) through the esophageal veins.
- **Complication:** the most feared complication is bleeding. The mortality rate from acute esophageal variceal bleeding is 50%.

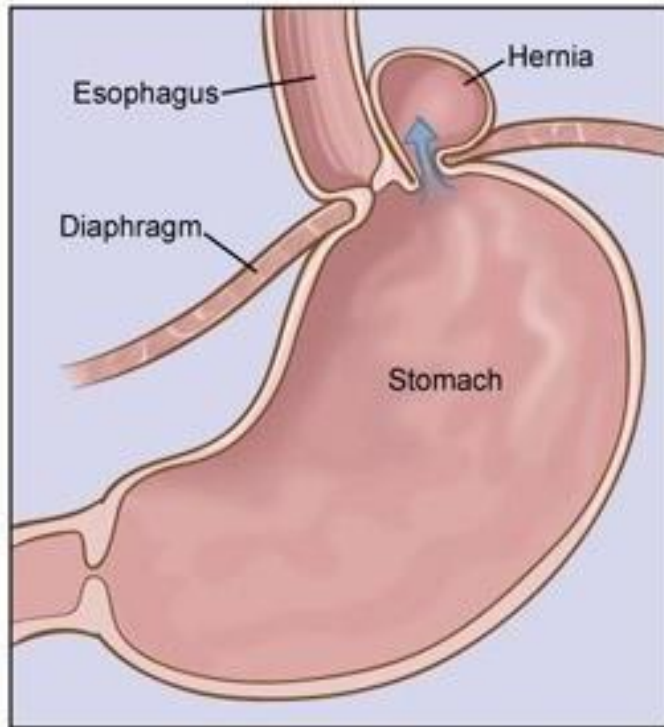


Management of esophageal varices

- 1. Management of active bleeding:** Resuscitation & urgent endoscopy (both diagnostic & therapeutic). The main 2 therapeutic approaches are variceal banding & sclerotherapy.
- 2. Prevention of rebleeding:** A combination of medical (non-selective β -blockers [propranolol]), endoscopic (banding every 2 weeks), & surgical (surgical shunts) measures.
- 3. Prophylactic measures to prevent the first bleeding:** Non-selective β -blockers (propranolol).

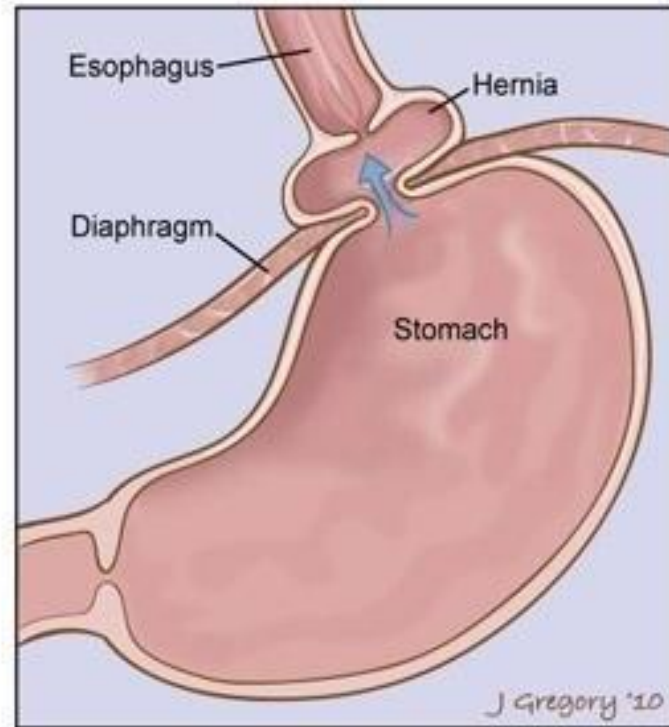
Hiatal hernia

Paraesophageal Hernia



Type 2 (<5%)

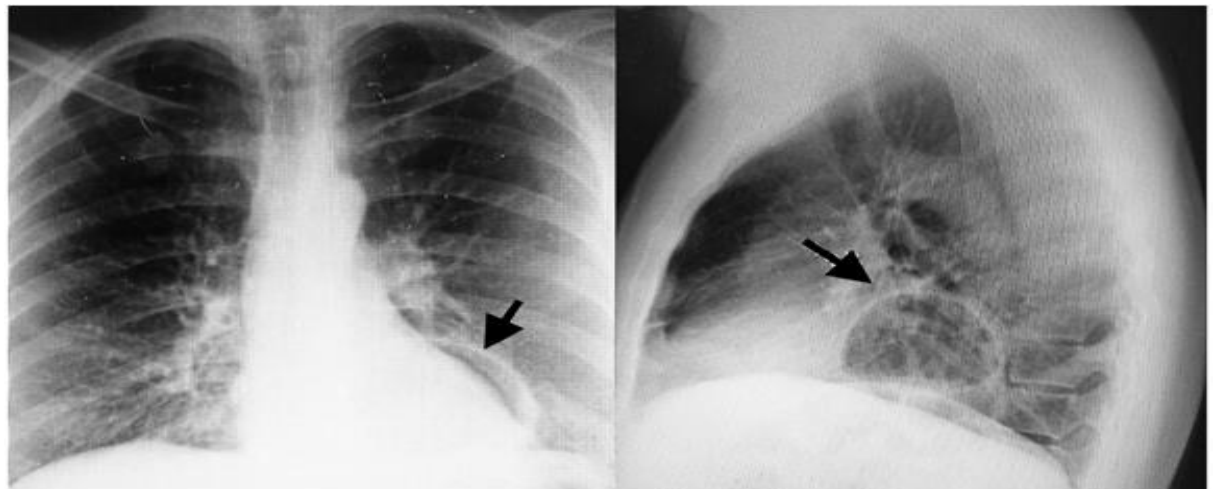
Sliding Hernia



Type 1 (>90%)

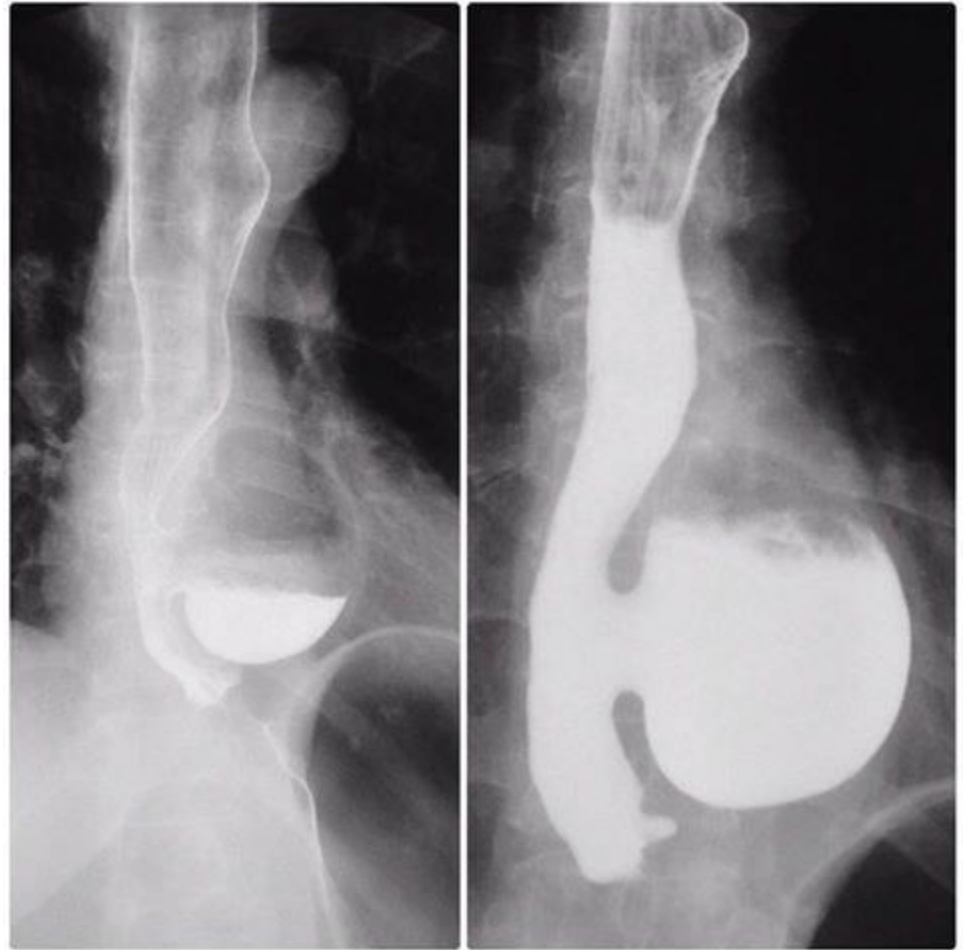
Sliding hernia (type 1)	Paraesophageal hernia (type 2)
Mostly asymptomatic but can cause GERD.	Mostly asymptomatic but can cause dysphagia & stasis gastric ulcer. No reflux
Complications: <ul style="list-style-type: none"> • Reflux > esophagitis > Barrett's esophagus > cancer. • Aspiration pneumonia 	Complications: <ul style="list-style-type: none"> • Hemorrhage. • Obstruction. • Strangulation.
Treatment: <ul style="list-style-type: none"> • Medical (85%): With antacids, PPI, H₂ blockers. • If failed, surgical (15%): Nissen's fundoplication. 	Treatment: Surgical only.

- Note the gastric bubble in the thoracic cavity.



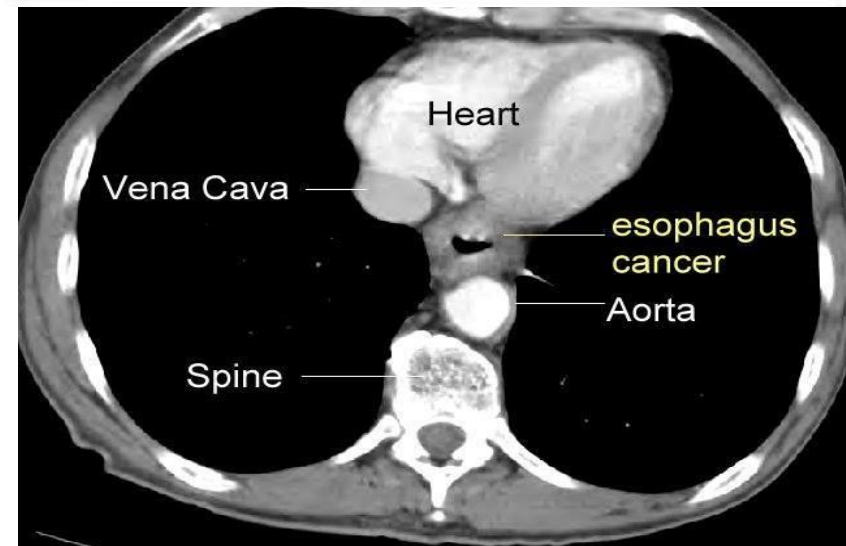
Epiphrenic diverticulum

- **Symptoms:** dysphagia to **solid food**, upper abdominal discomfort.
- Often associated with hiatal hernia.



Esophageal cancer

- Is more after the age of 50, mostly between 60-70. More in males.
- **Risk factors:** smoking, alcohol, hot beverages, radiation, poor nutrition.
- **Relevant Hx:** GERD and Barrett's, stricture, Plummer-Vinson syndrome, Celiac disease, esophageal achalasia, & diverticulum.
- **Symptoms:** **constant & rapidly progressive** dysphagia for **solids then liquids**, reflux, loss of appetite, weight loss, fistulas, bleeding, & mediastinal invasion symptoms (Horner syndrome, hoarseness).



Adenocarcinoma

- Distal $\frac{1}{3}$ of the esophagus.
- Associated with Barrett's esophagus (most important risk factor).
- In endoscopy, lesions are similar to Barrett's esophagus.
- Spared to lymphatics around the stomach, porta hepatis, & celiac lymph nodes.

Squamous cell carcinoma

- Proximal $\frac{2}{3}$ of the esophagus.
- Most common type worldwide.
- Smoking & alcohol are the most important risk factors.
- In endoscopy, it appears as polypoid, plaques, or scar like lesions.
- Invades regional lymph nodes early. The trachea & aorta could be invaded as well.
- $\frac{1}{3}$ of cases show metastasis to the liver, bones, & lungs.

- **Treatment:**

1. **Stage 1:** Surgical resection.

2. **Stage 2 & 3:** Neoadjuvant chemotherapy or radiotherapy then surgery.

3. **Stage 4:** Chemotherapy or palliative surgery.

Easy mnemonic to remember esophageal CA risk factors
ABCDEFGH:

A- Achalasia/Alcohol

B- Barrett's esophagus

C- Cigarettes

D- Diverticula

E- Esophageal web, stricture

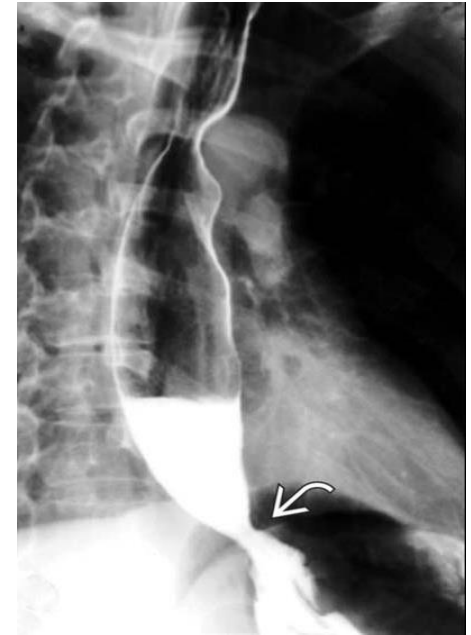
F- Fat/Family hx

G- GERD

H- Hot liquid

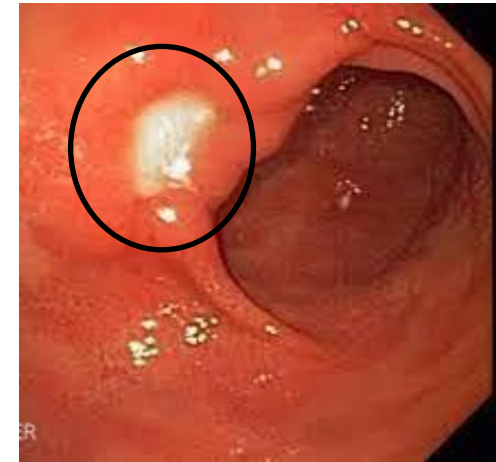
Scleroderma esophagus

- Scleroderma causes atrophy of the esophageal wall smooth muscles >> weak esophageal contractions & the LES is wide open >> reflux >> fibrosis leading to strictures of the distal esophageal wall.
- **Symptoms:** **progressive**, painless dysphagia for **solids then progresses to liquids**.
- **Diagnosis:** **barium swallow** (shows dilated esophageal wall with distal narrowing (strictures), the LES is wide open, air-fluid level indicating delayed emptying).
- **Treatment:** treat the reflux with PPI & follow up every 2-3 months.



Peptic ulcer disease

- **Has 2 types:** **duodenal** (more common, with the anterior wall being the most common site) & **gastric**.
- **Causes:** H. pylori (the most common), NSAIDs (second most common), acid hypersecretion (more likely to cause duodenal ulcers), smoking.
- **Symptoms:** usually asymptomatic. Might cause burning/gnawing epigastric discomfort that's either relieved (duodenal) or exacerbated (gastric) by food. Nausea, vomiting, weight loss, upper bleeding.
- **Complications:** bleeding (the most common site **for bleeding** in a duodenal ulcer is the posterior wall from the gastroduodenal artery), perforation, obstruction.
- **Diagnosis:** flexible upper endoscopy to confirm the diagnosis, then we look for the cause.
- **Treatment:**
 - 1. Medical:** eradicate H. pylori (1 PPI + 2 antibiotic for 10-14 days), stop NSAIDs, smoking cessation, follow up with endoscopy.
 - 2. Surgical:** vagotomy.



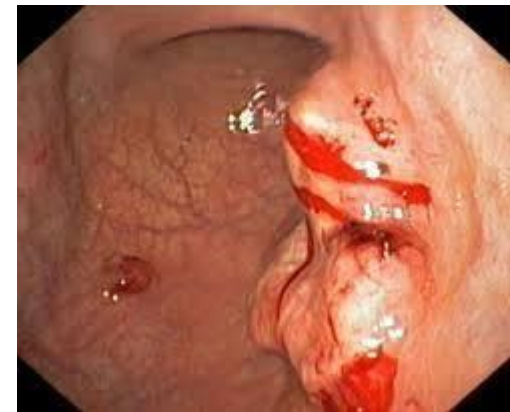
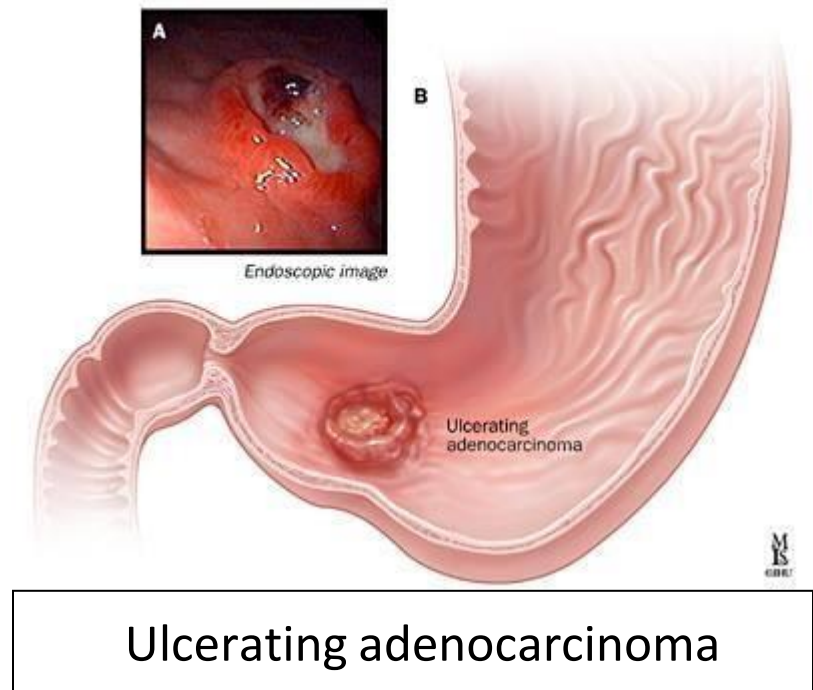
Indications for surgery:

1. Non-healing ulcers.
2. Perforated ulcers.
3. Bleeding ulcers.
4. Gastric outlet obstruction.
5. Malignant ulcers.

Gastric cancer

1. Adenocarcinoma

- Most common type (95%).
- **Risk factors:** male gender, diet (smoked meat, high nitrates, low fruits & vegetables), smoking, family history, blood group type A, *H. pylori*, previous partial gastrectomy, adenomatous gastric polyps, atrophic gastritis, P53 mutation in 50%.
- **Subtypes:**
 - **Diffuse type:** 30%, from lamina propria, proximal stomach, **worse than intestinal type**, invasive & Metz (by lymphatics), in younger age.
 - **Intestinal type:** 70%, from gastric mucosa, distal stomach, **associated with *H. pylori***, well-formed glandular structures.



Intestinal type

- **Symptoms:** weight loss, early satiety, anorexia, epigastric pain, obstruction, nausea. (WEAPON)
- Classical physical findings that represent Metz & incurable disease:

1. **Virchow's node:** enlarged left supraclavicular lymph node.
2. **Blumer's shelf:** fullness of the pelvic Cul-Du-Sac (solid peritoneal deposits anterior to the rectum, forming a shelf palpated on PR).
3. **Krukenberg's tumour:** enlarged ovaries on pelvic examination (Metz to the ovaries).
4. **Sister Mary Joseph's nodules:** infiltration of the umbilicus.
5. **Irish's node:** left axillary lymphadenopathy.
6. **Hepatosplenomegaly:** with ascites & jaundice.
7. **Cachexia.**





Blumer's shelf

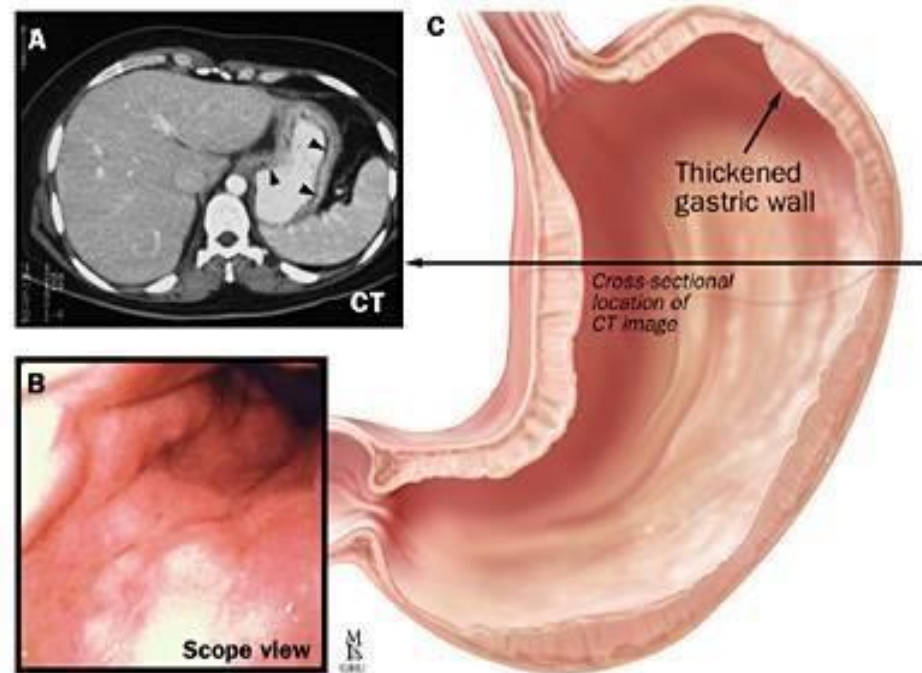


Irish's node

- **Diagnosis:** the investigation of choice is flexible upper endoscopy with biopsy (take at least 7 biopsies from the edges of the ulcer).
- **Treatment:**
 1. **Stage 1:** Surgical resection.
 2. **Stage 2 & 3:** Neoadjuvant chemotherapy or radiotherapy then surgery.
 3. **Stage 4:** Chemotherapy or palliative surgery.

The surgery has 2 goals:

1. Resect the tumour with clear margins (>5 cm).
 - If the tumour is proximal or midbody: **total** gastrectomy & Roux-en-y anastomosis.
 - If the tumour is distal: **subtotal** gastrectomy & Roux-en-y anastomosis.
2. Lymph nodes dissection.

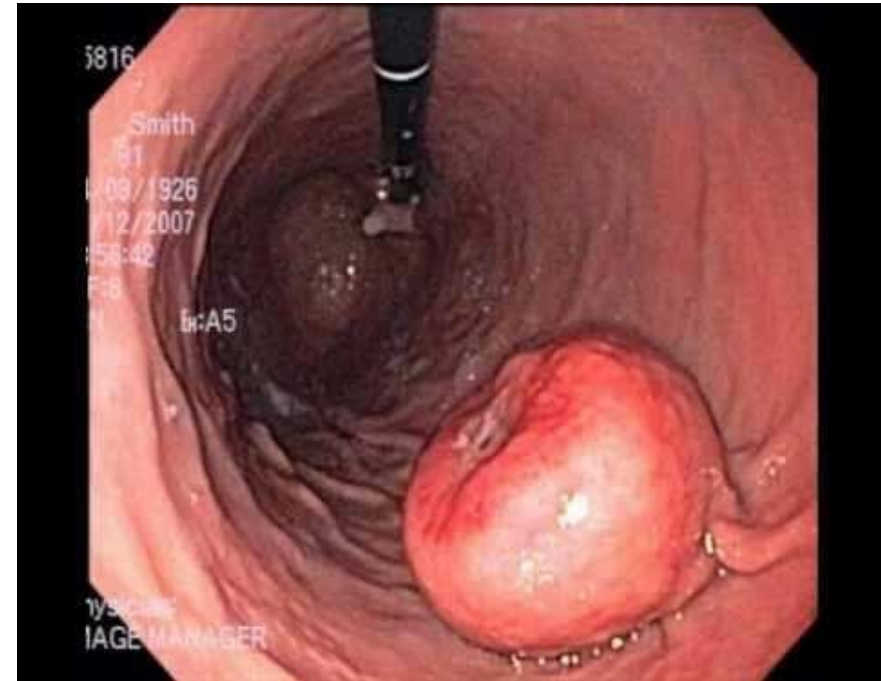


A: a CT image of Linitis plastica (arrows denote a thickened gastric wall).

Linitis Plastica (leather bottle): when the entire stomach is involved and looks thickened.

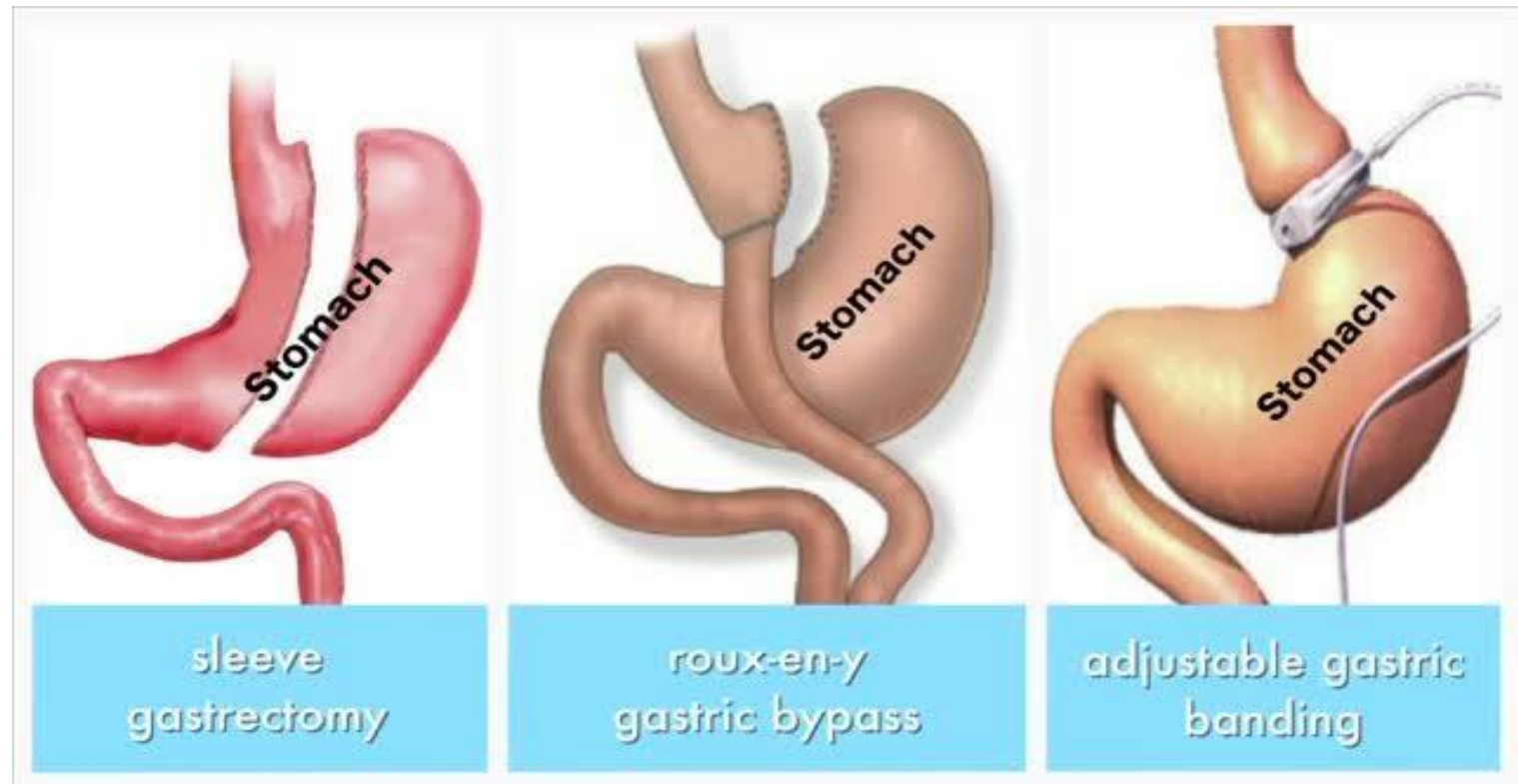
2. Gastrointestinal stromal tumours (GIST)

- 3% of gastric tumours. Previously known as leiomyosarcoma.
- **Cells of origin:** interstitial cells of Cajal.
- Found anywhere from the esophagus to the rectum, most common in the stomach (60%).
- **Tumour marker:** C-KIT.
- **Symptoms:** abdominal pain, nausea, abdominal mass & distention, occult GI bleeding.
- **Diagnosis:** endoscopy & FNA biopsy, CT.
- **Treatment:** surgical resection with clear margins (2 cm) + adjuvant chemotherapy with C-KIT inhibitor imatinib (tyrosine kinase inhibitor).



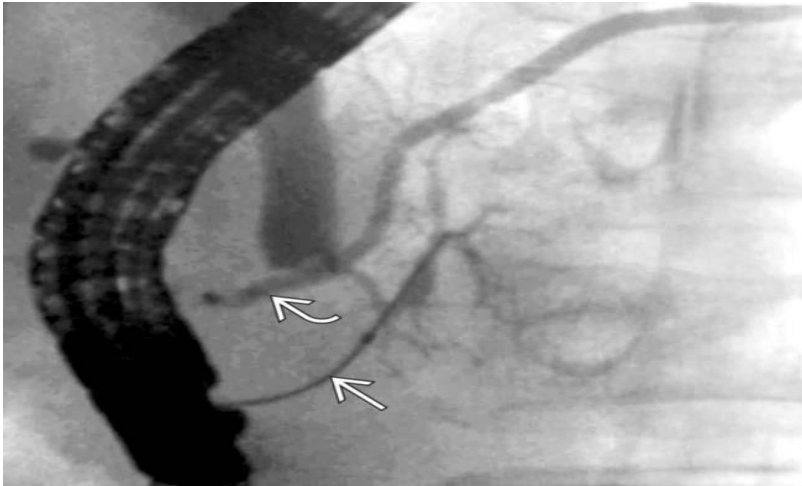
Bariatric surgery

- Weight reduction surgery for the morbidly obese.
- **Morbid obesity:** BMI >40 or BMI >35 with a medical problem related to morbid obesity (**Respiratory:** obstructive sleep apnea (most common comorbidity). **GI:** GERD, constipation, colon cancer. **CVS:** hypertension, DM, heart failure, hyperlipidemia. **MSS:** osteoarthritis, disc prolapse. **GUS:** PCOS, urge/stress, incontinence. **CNS:** pseudomotor cerebri, depression.)



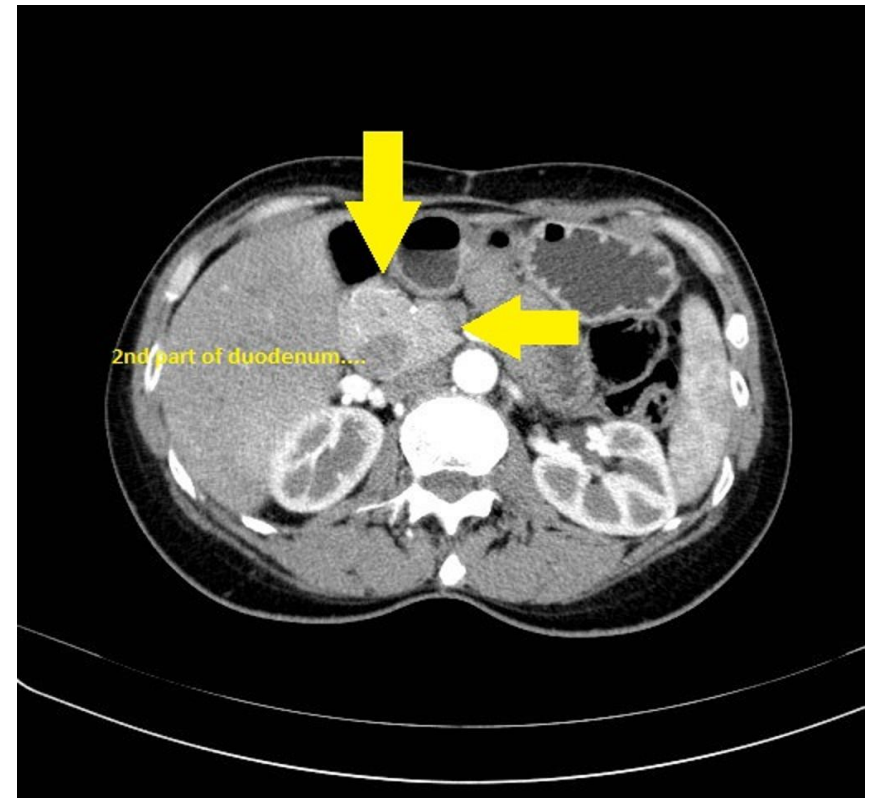
Pancreatic divisum

- Most common congenital anomaly of the pancreas.
- Failure of the pancreatic ducts to fuse.
- **Complications:** obstructive pain or pancreatitis.
- **Diagnosis:** ERCP, MRCP.
- **Treatment:** endoscopic sphincterotomy to relieve the symptoms. Treat with sphincteroplasty, pancreatojejunostomy, or resection of the pancreatic head.



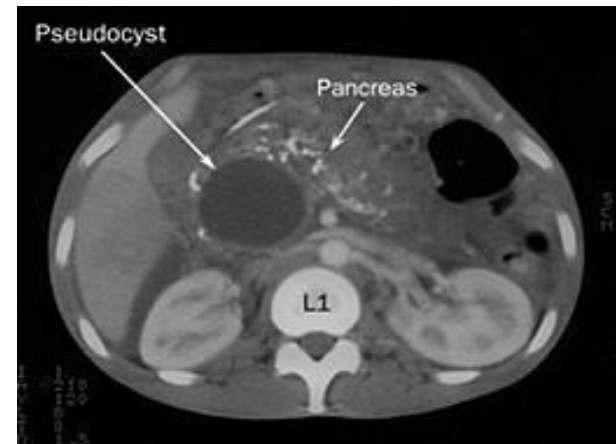
Annular pancreas

- A ring of pancreatic tissue that encircles the duodenum.
- **Symptoms:** typically causes vomiting in neonates, may cause pancreatitis later in life.
- **Diagnosis:** abdominal US, CT scan.
- **Treatment:** duodenojejunal bypass.



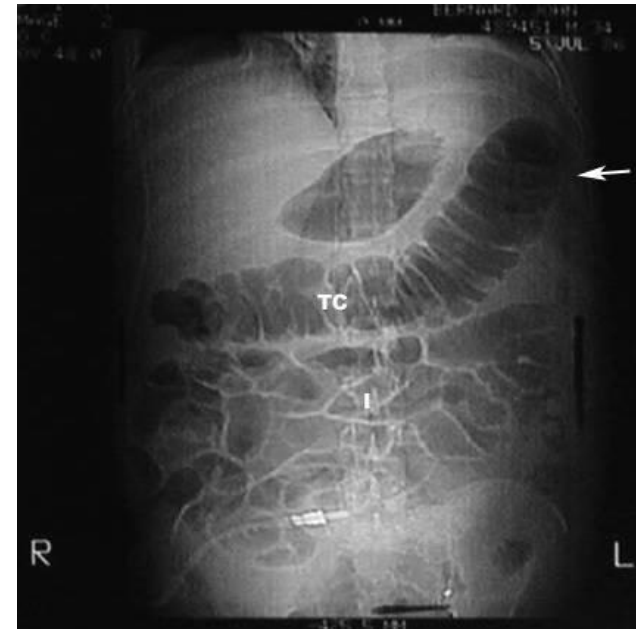
Pancreatic pseudocyst

- **Risk factors:** acute pancreatitis (most common), chronic pancreatitis, pancreatic trauma.
- **Symptoms:** abdominal pain, nausea, vomiting, mild fever, weight loss, epigastric mass.
- **Complications:** infection (5-20%) Fistula, bleeding into the cyst, ascites, obstruction, rupture.
- **Diagnosis:**
 - **Labs:** leukocytosis, increased amylase & lipase, increased LFT.
 - **Radiology:** CT (method of choice), US, ERCP, EUS.
- **Treatment:** endoscopic drainage (into the gastric or duodenal lumen), or ERCP & transpapillary stent (in communicating pseudocysts), or operative drainage (internal or external drainage, excision).
 - interventions are advised if the pseudocyst doesn't resolve within 6 weeks.
 - **Indications for treatment:** Size >5 cm, calcified wall or Thick wall.



Acute Pancreatitis

- **Reversible** inflammation of the pancreas.
- **Causes:** (I GET SMASHED) with the most common being gallstones.
- **Symptoms:** epigastric pain (radiating to the back, continuous for hours or days, relieved when leaning forward, refractory to analgesia), nausea, vomiting, fever.
- **Complications:**
 - **Early** (shock, renal failure, ascites, pleural effusion, ARDS, sepsis, hypocalcemia, thrombosis of neighboring veins).
 - **Late** (necrosis, abscess, infection, hemorrhagic pancreatitis, fistula, pseudocyst, DM).
- **Diagnosis:**
 - **Labs:** high amylase (sensitive) & lipase (specific), leukocytosis, high ALP in gallstones pancreatitis, AST>ALT in alcoholic pancreatitis.
 - **Radiology:** AXR (transverse colon cutoff, sentinel loop), US, CT, ERCP.
- **Treatment:** conservative (90% resolve spontaneously). Cholecystectomy if the cause is gallstones.



White arrow: colon cutoff sign.
TC: transverse colon.
I: represents small bowel loops with air suggestive of ileus.

Acute pancreatitis, in severe cases (hemorrhagic pancreatitis)



Cullen's sign:
superficial edema &
bruising in the
subcutaneous fatty
tissue around the
umbilicus.



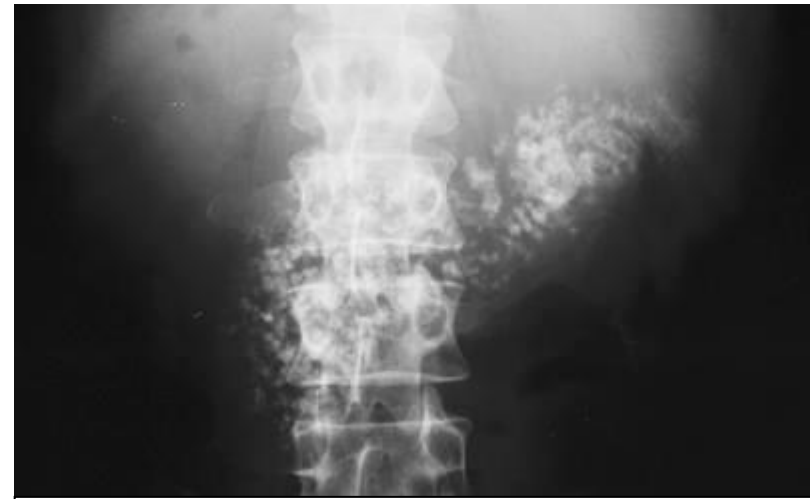
Grey-Turner's sign:
bruising of the flanks.



Fox's sign: bruising
over the inguinal
ligament.

Chronic Pancreatitis

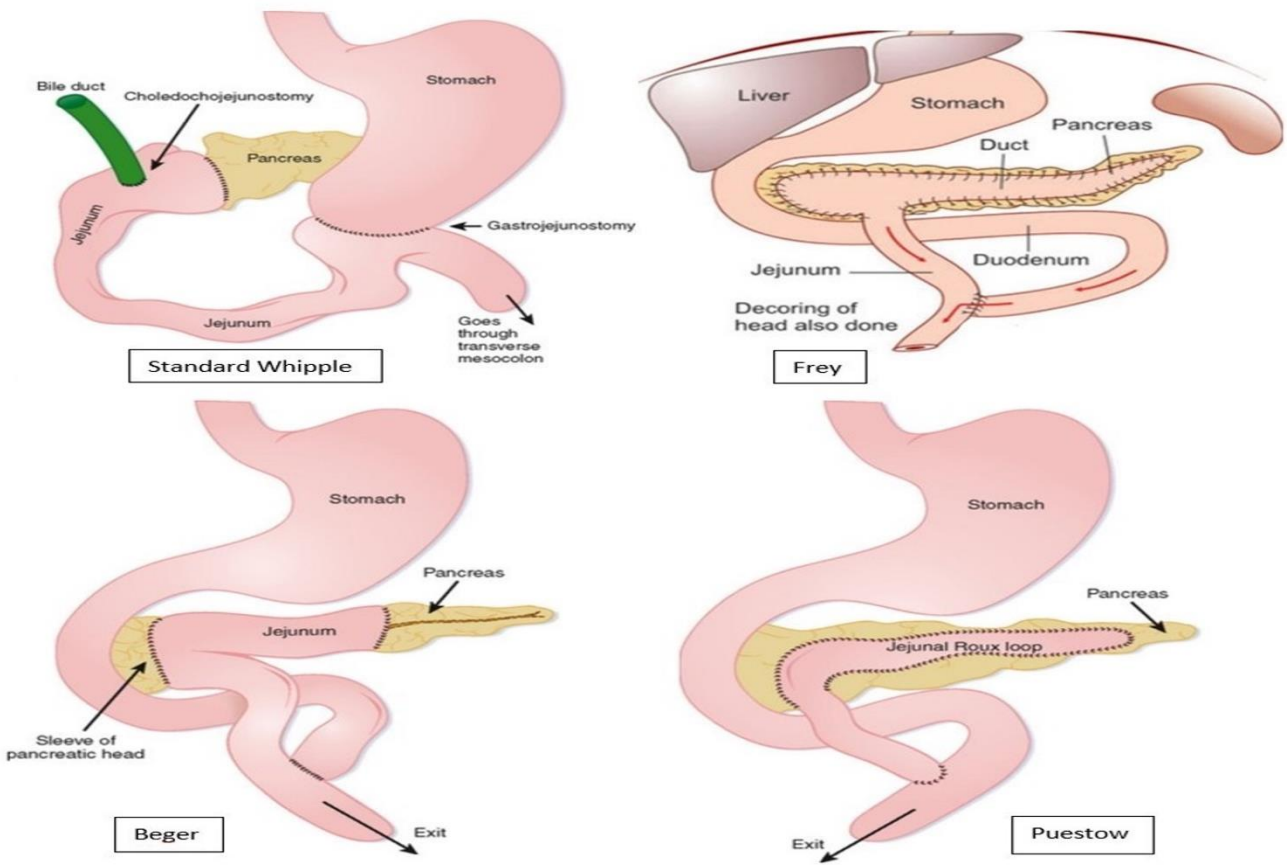
- Persistent inflammation of the pancreas with **irreversible changes**, **recurrent abdominal pain**, & **loss of exocrine & endocrine functions**.
- **Causes:** alcohol (most common, 60-70%), idiopathic (30%), obstructive, metabolic, familial, trauma, iatrogenic, gallstones.
- **Symptoms:** epigastric pain (intermittent attacks, occur either after or independent of meals radiating to the back), weight loss, steatorrhea.
- **Complications:** DM, malabsorption of lipid soluble vitamins, splenic vein thrombosis, splenic artery pseudoaneurysm, obstruction, fistula, pseudocyst, cancer.
- **Diagnosis:**
 - **Labs:** high amylase & lipase, pancreatic secretin stimulation test, glucose tolerance test.
 - **Radiology:** **AXR** (calcification), **CT & MRI** (shows masses), **ERCP** (will identify biliary obstruction).



Calcification of the pancreas

● **Treatment:**

- 1. **Life style changes:** stop alcohol & smoking.
- 2. **Medical:** analgesia, vitamins supplements, exocrine replacement (Creon), control DM, tube thoracostomy for pleural effusion.
- 3. **Endoscopy:** sphinterotomy & stenting. Celiac plexus block may improve symptoms.
- 4. **Surgical:** choices include: Puestow operation, Frey procedure, Beger procedure, pancreatectomy.



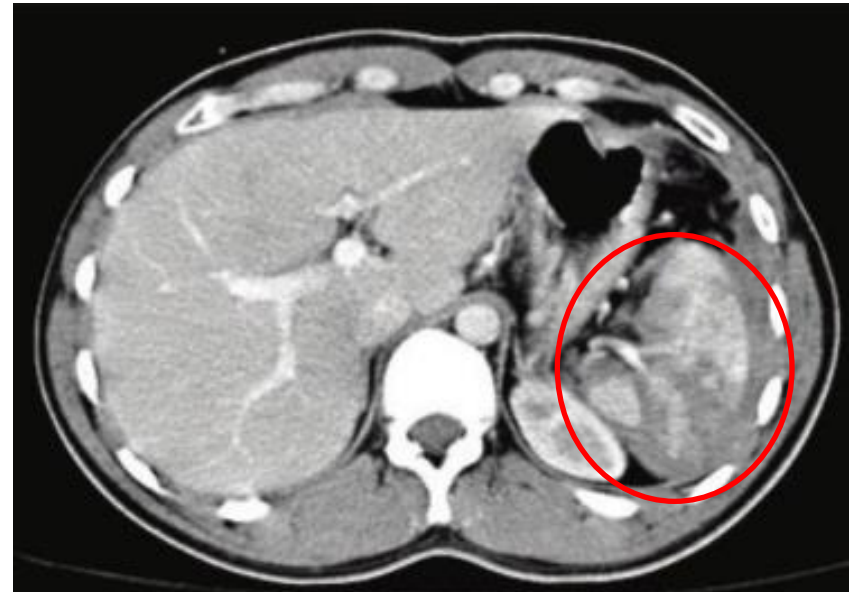
Pancreatic necrosis

- **Diagnosis:** abdominal CT with contrast.
- Dead pancreatic tissue doesn't take up the contrast.



Splenic trauma

- Blunt or iatrogenic trauma causing injury to the spleen.
- **Symptoms:** LUQ pain.
- **Signs:** **Kehr's sign** (left shoulder pain from diaphragmatic irritation), **Ballance sign** (LUQ dullness to percussion), **Seagesser's sign** (phrenic nerve compression causing neck tenderness).
- **Complications:** missed injury, delayed rupture, splenic pseudocyst.
- **Diagnosis:**
 - **If stable:** CT.
 - **If unstable:** FAST & DPL.
- **Treatment:**
 - **If stable:** non-operative treatment.
 - **If unstable or signs of peritonitis:** operative (splenectomy or splenorrhaphy).



splenic trauma management according to AAST

Grading (According to AAST)	Initial manegment
I	admit for minimum of > 24 hours with serial exams and Hcts
II	admit for minimum of > 24 hours with serial exams and Hcts
III	admit ICU, serial Hcts (every 4 -6 hrs) for a minimum of 3 times and until stable
IV	Splenic artery emobalization ASAP with goal to be within 2 hours
V	to OR in most circumstances
I-V that show CT evidence of blush/pseudoaneurysm or extravasation	Splenic artery emobalization ASAP with goal to be within 2 hours.

Gallbladder stones (Cholelithiasis)

- **Types of stones:**

- **Mixed:** most common, **small & multiple**.
- **Pure cholesterol:** due to increased cholesterol, **large & solitary**.
- **Pigmented:** **small & multiple**, black (caused by hemolysis & cirrhosis) or brown (caused by infections).

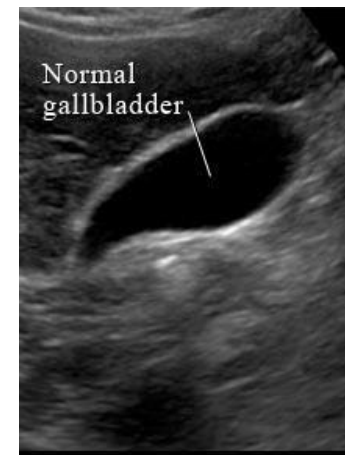


Figure 1



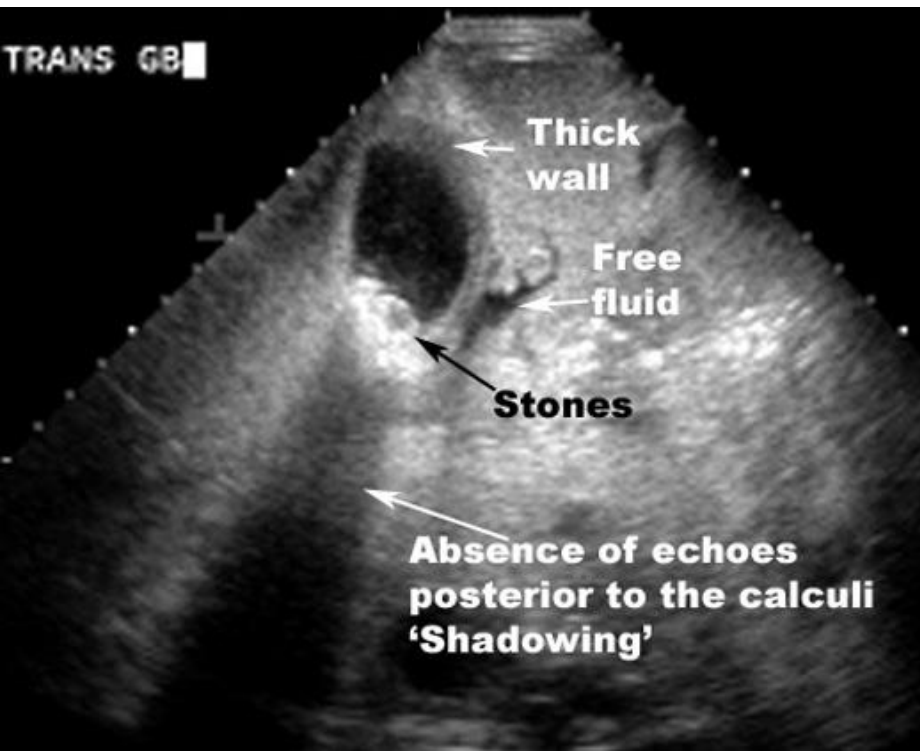
Figure 2

Acoustic shadow

- **Risk factors:** 5F's (female, fat, forty, fertile, fair [lightest natural shade of skin]).
- **Symptoms:** 80% are asymptomatic. Might cause biliary colic (RUQ pain, radiates to the back, worsens after eating, associated with nausea & vomiting), **Boas' sign** (right subscapular pain).
- **Complications:** acute & chronic cholecystitis, CBD stones, gallstones pancreatitis, cholangitis, mucocele, gall bladder carcinoma.
- **Diagnosis:** **US** (detects 98% of gallstones)
- **Treatment:** cholecystectomy if: symptomatic, complicated, or asymptomatic in the following cases (porcelain GB, GB polyps, sickle cell disease, DM, immunosuppression, females predicting pregnancy, pediatric patients).

Acute cholecystitis

- Differs from gallstones in that pain doesn't resolve, has elevated WBC, fever, & signs of acute inflammation on US.
- **Types:** calculous (95%), acalculous, emphysematous, xanthogranulomatous.
- **Symptoms:** pain, nausea, vomiting, anorexia, **positive Murphy's sign**, mild jaundice.
- **Complications:** empyema, abscess, perforation, gangrene, fistula, gallstone ileus.
- **Diagnosis:** **US** (method of choice), **HIDA scan** (most accurate).
- **Treatment:** cholecystectomy.

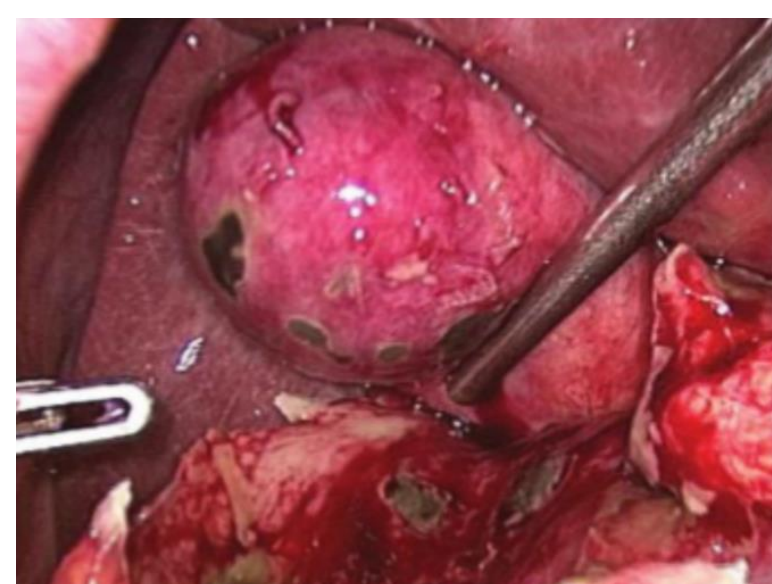


Sonographic findings in acute cholecystitis

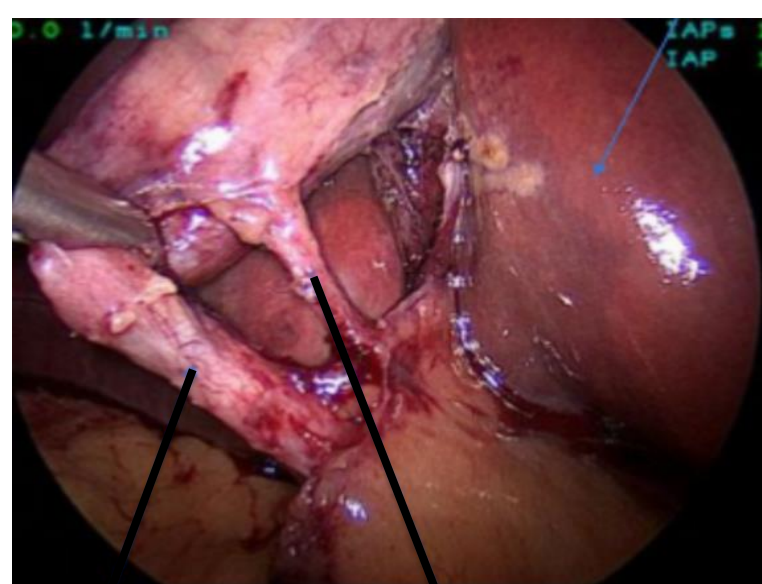
- **Impacted stone in cystic duct or GB neck**
- **Positive sonographic Murphy's sign**
- Thickening of GB wall (**>3 mm**)
- Distention of GB lumen (**> 4 cm**)
- Pericholecystic fluid collections (frequent)
- Hyperemic GB wall on color Doppler (**supportive test**)

None of above signs pathognomonic

Combination of multiple signs make correct diagnosis

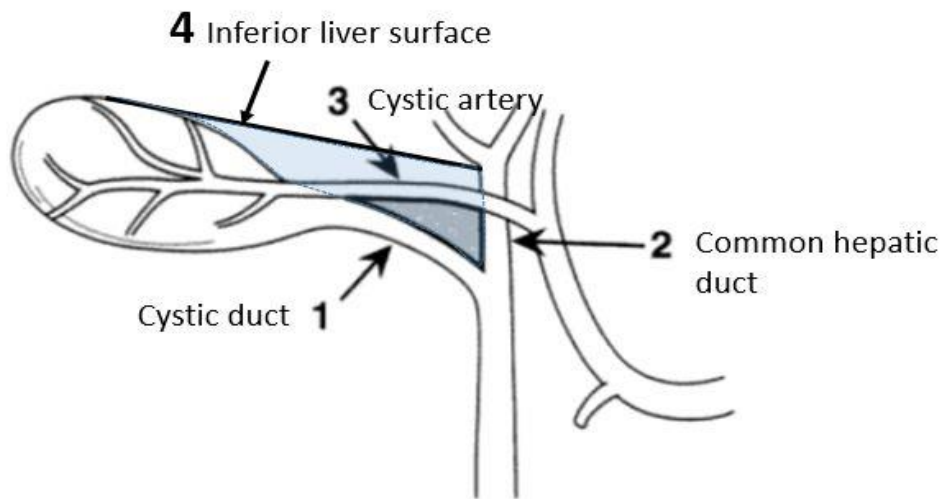


Intraoperative view of acute cholecystitis.



Cystic duct

Cystic artery



Callot's triangle borders:

1. Cystic duct
2. Common hepatic duct
3. Cystic artery

Emphysematous cholecystitis

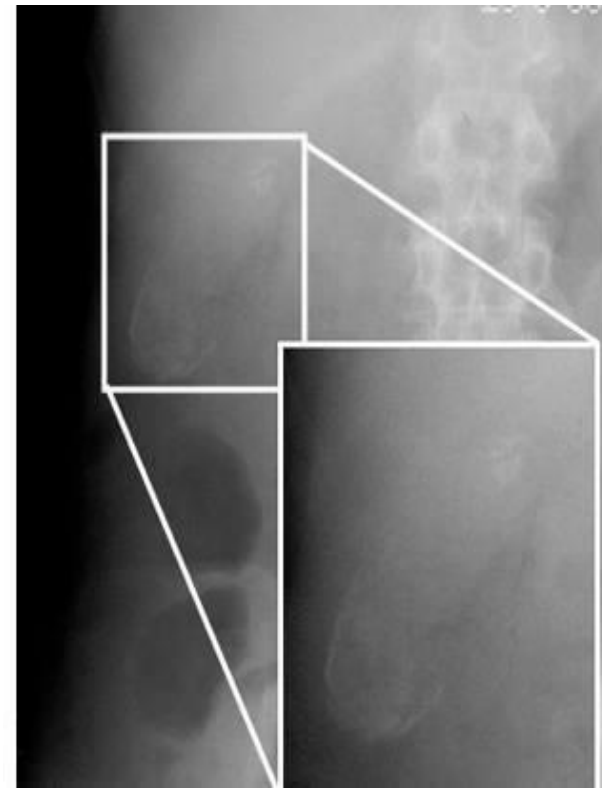
- Gas forming bacteria (E. coli).
- Often results in perforation.
- Usually in males, elderly, DM.



Gas is present in the GB wall.

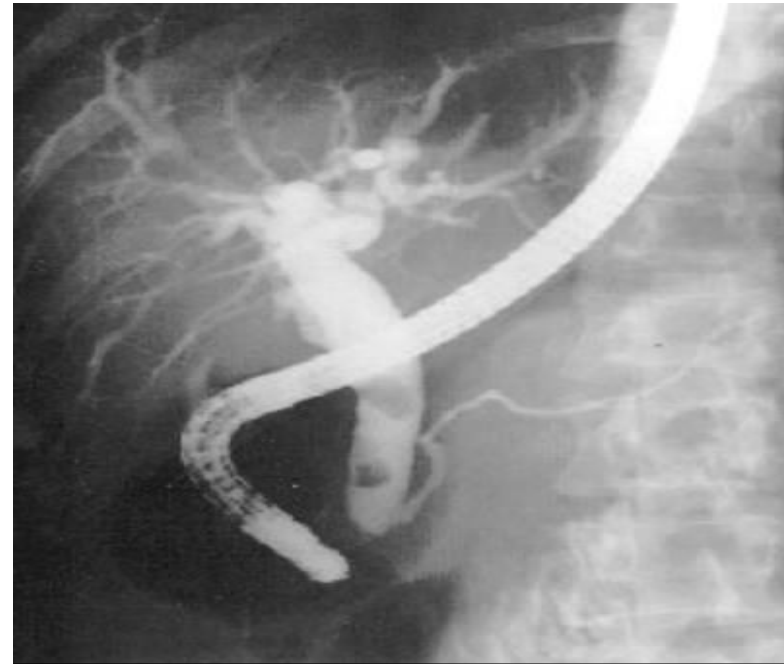
Porcelain gallbladder

- The radiograph reveals a pyriform opaque mass with curvilinear calcification in the right upper quadrant from a porcelain gallbladder.
- Gallbladder wall may be diffusely calcified or have irregular stippled calcifications.
- This is usually an incidental finding in asymptomatic patients.
- Although it was originally thought that there was a high association between porcelain gallbladder and adenocarcinoma, more recent research has revealed a much weaker association. & in patients with diffuse calcification there is no increased risk for cancer.



Cholelithiasis

- Common bile duct stones, either primary or secondary (more common).
- **Symptoms:** pain, jaundice, steatorrhea, dark urine, pruritus (these symptoms are due to obstruction). Fever, chills, rigors (due to infections caused by stasis).
- **Complications:** liver dysfunction, white bile formation, pancreatitis, cholangitis.
- **Diagnosis:**
 - **Labs:** high ALP, high direct & total bilirubin.
 - **ERCP** (gold standard. It's also therapeutic).
- **Treatment:** ERCP (sphincterotomy & stone extraction). If ERCP fails, then CBD is opened surgically & stones are removed.



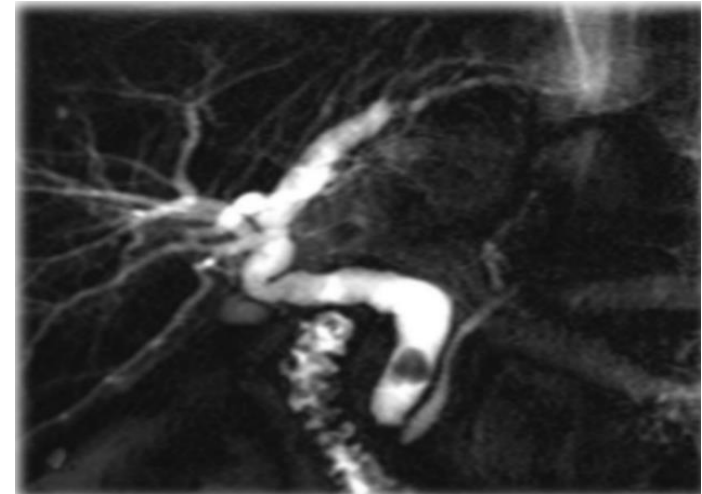
Findings seen in the ERCP:

- A stone impacted in the CBD.
- Dilation of the CBD.

Cholangitis

1. Ascending cholangitis.

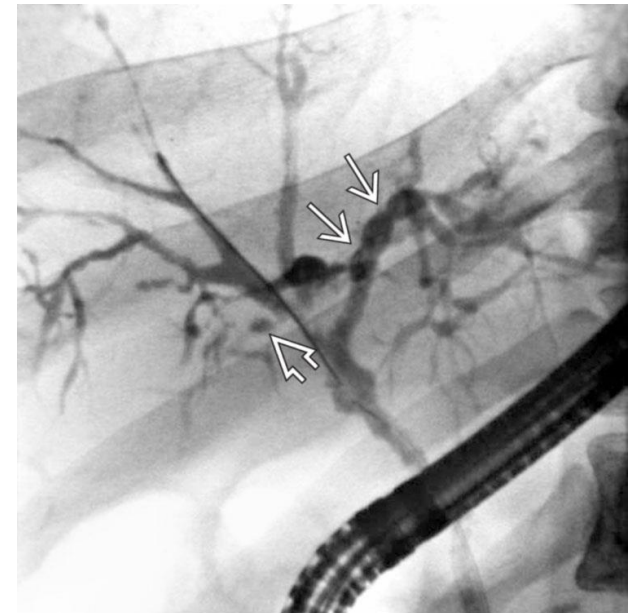
- **Infections** of the biliary tract caused by **obstruction**.
- **Causes of obstruction:** choledocholithiasis (most common), strictures, neoplasms, iatrogenic, extrinsic compression.
- **Pathogens that commonly cause cholangitis:** E. coli, Klebsiella, Enterococci.
- **Symptoms:** fever, RUQ pain, jaundice (**Charcot's triad**). If there was pus production (suppurative cholangitis), there might also be altered mental status & shock (**Reynolds' pentad**).
- **Diagnosis:** high WBC, high ALP, high bilirubin. **US** (initial study, shows the stone, dilated biliary tract, thickened GB wall), **ERCP & PTC** (definitive studies).
- **Treatment:** give IV fluids & antibiotics, then if:
 - **Non-suppurative:** cholecystectomy.
 - **Suppurative:** decompression by ERCP with sphincterotomy.



MRCP showing choledocholithiasis. Diagnosis of cholangitis is made based on radiological findings (obstruction), lab findings, & clinical features (so read the question carefully).

2. Primary sclerosing cholangitis.

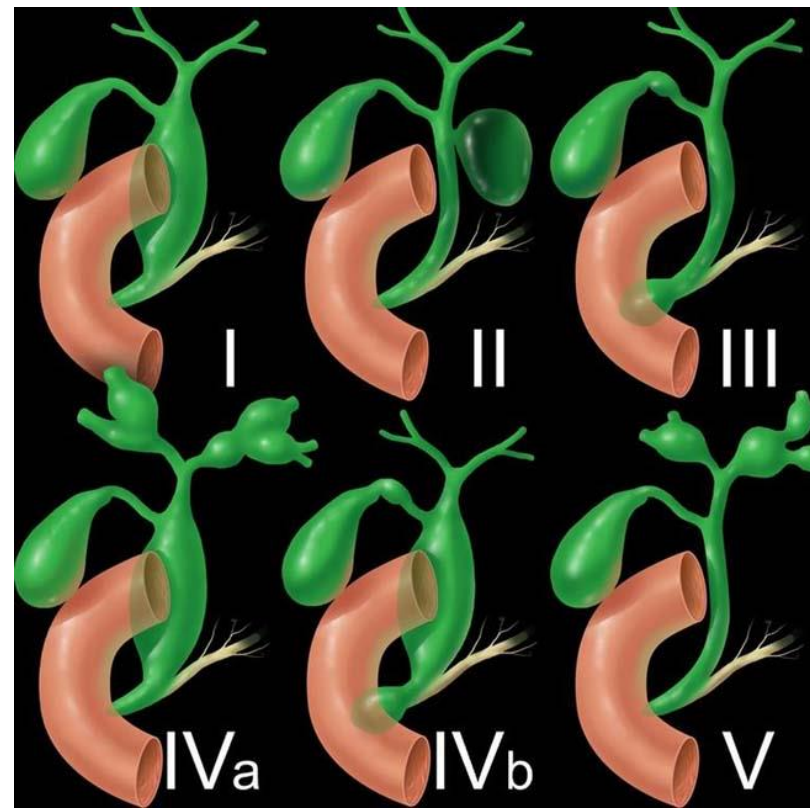
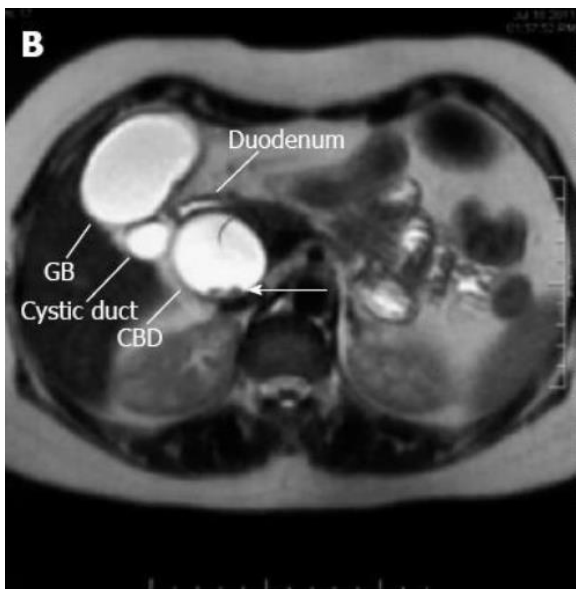
- **Autoimmune** progressive fibrous obliteration of the bile duct.
- **Risk factors:** young, male, associated with IBD (60%).
- **Symptoms:** RUQ pain, jaundice, hepatosplenomegaly, pruritus, dark urine, clay coloured stool, weight loss.
- **Complications:** liver failure, cholangitis, cholangiocarcinoma.
- **Diagnosis:** high ALP, positive P-ANCA. **ERCP & PTC** (beads on a string appearance).
- **Treatment:** balloon dilatation & stenting. Liver transplant (definitive).



ERCP showing beads on a string appearance.

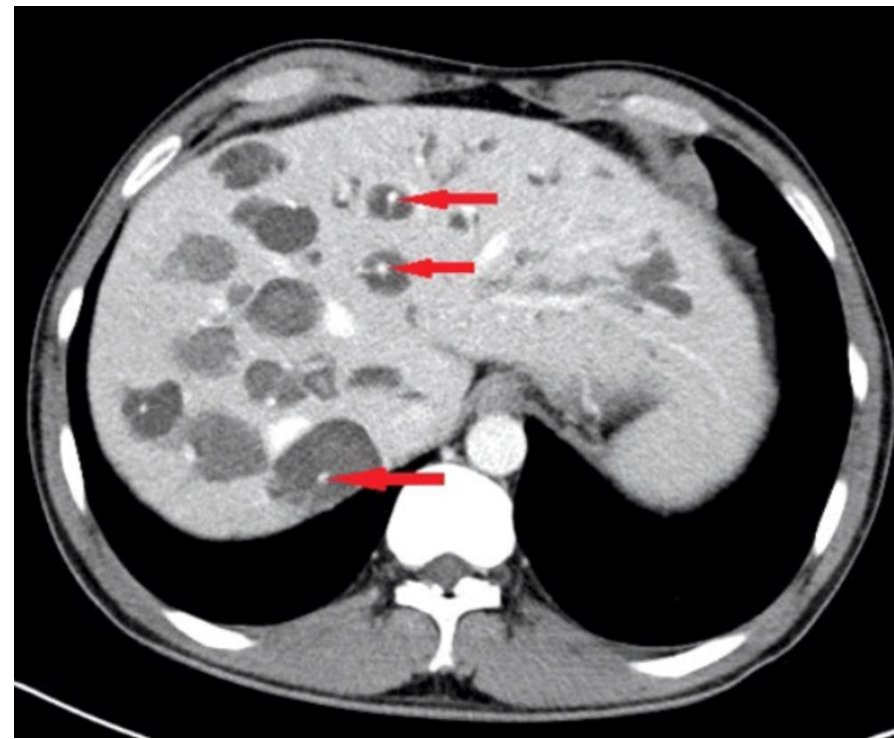
Choledochal cyst

- Congenital dilatation of the biliary tree, more common in females, has 5 types (1-5).
- **Symptoms:** jaundice, RUQ pain, RUQ mass, cholangitis.
- **Complications:** choledocholithiasis, cholangitis, portal hypertension, **cholangiocarcinoma**, rupture.
- **Diagnosis:** US or CT.
- **Treatment:**
 1. Type 1 & 4: hepatojejunostomy.
 2. Type 2: cyst excision.
 3. Type 3: cyst unroofing & sphincteroplasty.
 4. Type 5: hemihepatectomy.



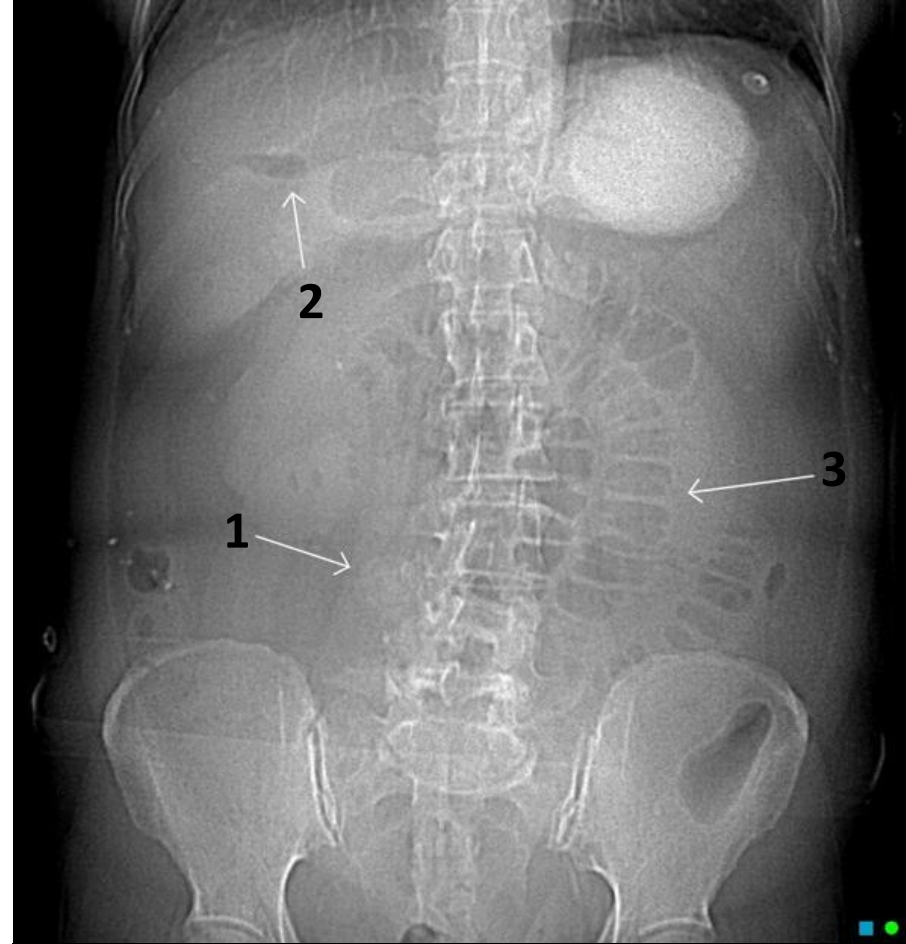
Caroli disease (type 5 Choledochal cyst)

- A congenital disorder comprising of multifocal cystic dilations of segmental **intrahepatic bile ducts**.
- Presentation is in the childhood or young adulthood.
- **Symptoms:** the simple type presents with RUQ pain, recurrent attacks of cholangitis, fever, jaundice.
- **Prognosis:** generally poor.
- **Treatment:** if the disease is localized, segmentectomy or lobectomy may be offered. In diffuse disease, management is generally conservative, liver transplantation may also be an option.



Gallstone ileus

- Occurs when a large gallbladder stone erodes into the duodenum via a fistula, eventually obstructing the ileal lumen usually some centimeters proximal to the ileocecal junction.
- **Symptoms:** signs of small bowel obstruction, RUQ pain.
- **Diagnosis:** AXR.
- **Treatment:** removal of the stone & cholecystectomy.



AXR shows:

1. Gallstone in the bowel.
2. Gas in the biliary tree & gallbladder.
3. Small bowel distension.

Pneumobilia

- Air in the biliary tree.
- **Causes:**
 1. Recent biliary instrumentation (e.g. ERCP or PTC).
 2. Incompetent sphincter of Oddi (sphincterotomy, following the passage of a gallstone).
 3. Biliary-enteric surgical anastomosis.
 4. Spontaneous biliary-enteric fistula (cholecystoduodenal accounts for about 70% of cases).
 5. Infection (rare. Ascending cholangitis, anaerobes).



Biliary tree tumours

1. Gallbladder carcinoma.

- A very aggressive (5% is the 5-year survival), rare tumour. Most commonly in the fundus.
- **Risk factors:** female, gallstones (90% of carcinomas are associated with gallstones), porcelain gallbladder, cholecystenteric fistula.
- The most common type is adenocarcinoma (90%).
- **Symptoms:** mostly asymptomatic. Might present with weight loss, anorexia, acute cholecystitis, jaundice, RUQ mass, **Courvoisier's sign**.
- **Diagnosis:** US, CT, ERCP.
- **Treatment:**
 - If confined to the mucosa: cholecystectomy.
 - If reached the muscular layer: radical cholecystectomy.

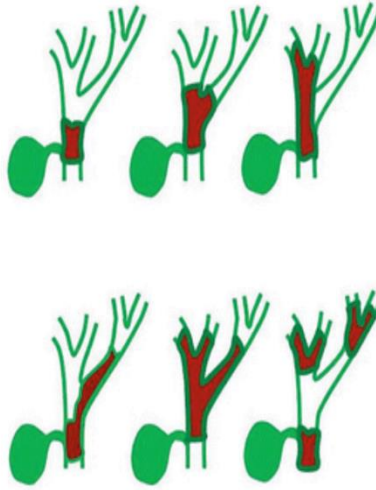


2.Cholangiocarcinoma.

- Malignancy of the ducts, 15-20% is the 5-year survival. Most commonly at the junction of the right & left hepatic ducts (Klatskin tumour).
- **Risk factors:** Choledochal cyst, primary sclerosing cholangitis, ulcerative colitis, radiation or toxin exposure.
- The most common type is adenocarcinoma.
- **Classification:** intrahepatic (20%), upper extrahepatic (40%), lower extrahepatic (40%).
- **Diagnosis:** US, CT, ERCP with biopsy.
- **Treatment:**
 - **Proximal:** resection with hepatojejunostomy.
 - **Distal:** Whipple procedure.
- **Prognostic factors:** location & extent, portal vein invasion, hepatic lobar atrophy.

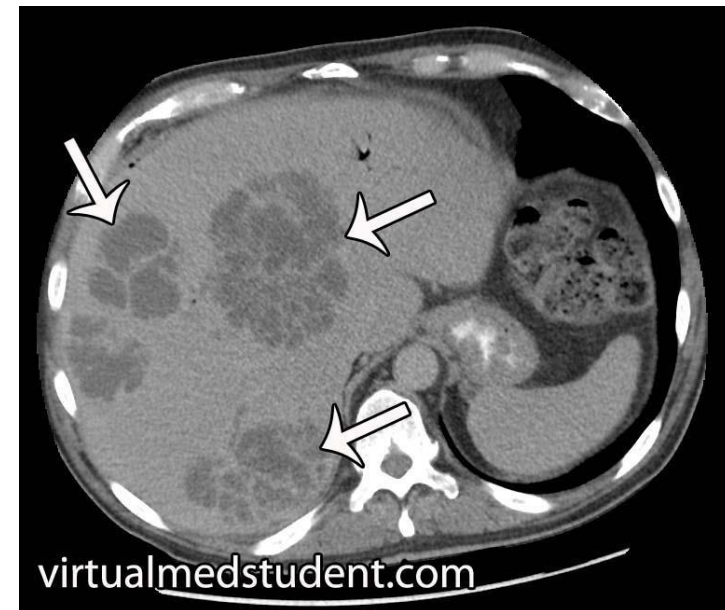


Type	Bismuth-Corlette Classification of Perihilar Tumors
I	Tumor involves common hepatic duct
II	Tumor involves bifurcation of the common hepatic duct
IIIa	Tumor involves the right hepatic duct
IIIb	Tumor involves the left hepatic duct
IV	Tumor involves both right and left hepatic ducts



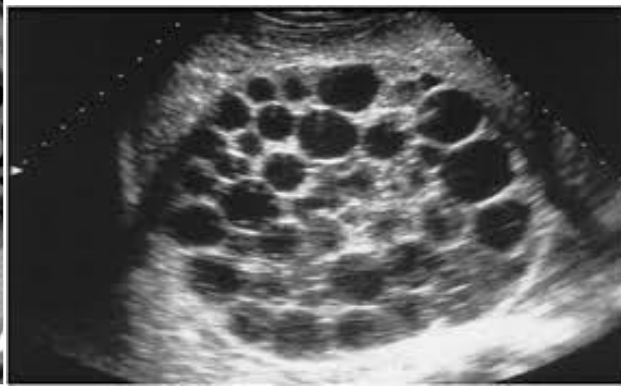
Liver abscess

- **Types:** pyogenic (bacterial, gram negative), parasitic (amebic, most common), fungal.
- Most common site is the right lobe.
- **Symptoms:** fever, chills, RUQ pain, jaundice, weight loss, **hepatomegaly (in amebic abscess)**.
- **Diagnosis:** high WBC, high LFT. **CT**.
- **Treatment:**
 - **Medical:** pyogenic (triple antibiotics with metronidazole), amebic (metronidazole).
 - **Surgical:** percutaneous drainage.
- **Indications for surgical drainage:**
 - **Pyogenic:** multiple lobulated abscess, multiple percutaneous attempts failed.
 - **Amebic:** refractory to metronidazole, bacterial co-infection, peritoneal rupture.

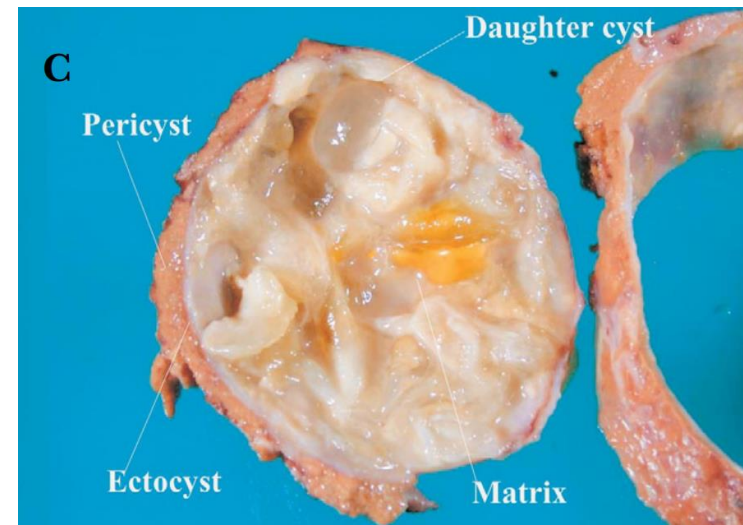


Hydatid disease

- It's a parasitic infestation by a dog tapeworm of the genus **Echinococcus**.
- Intermediate host (sheep), definitive host (dogs).
- **The cyst has 3 layers (from outside to inside):** outer adventitial (pseudocyst), outer laminated (ectocyst), inner germinal (endocyst).
- **Risk factors:** living in or visiting endemic area, exposure to the parasite through the ingestion of foods or water contaminated by the feces of dogs.
- **Symptoms:** RUQ pain, liver enlargement, jaundice, signs of anaphylactic reactions if the cyst ruptures.
- **Diagnosis:**
 - **Blood tests:** limited eosinophilia, high LFT.
 - **Serology:** Echinococcus antibodies.
 - **Imaging:** **US**, **CT** (100% sensitive).

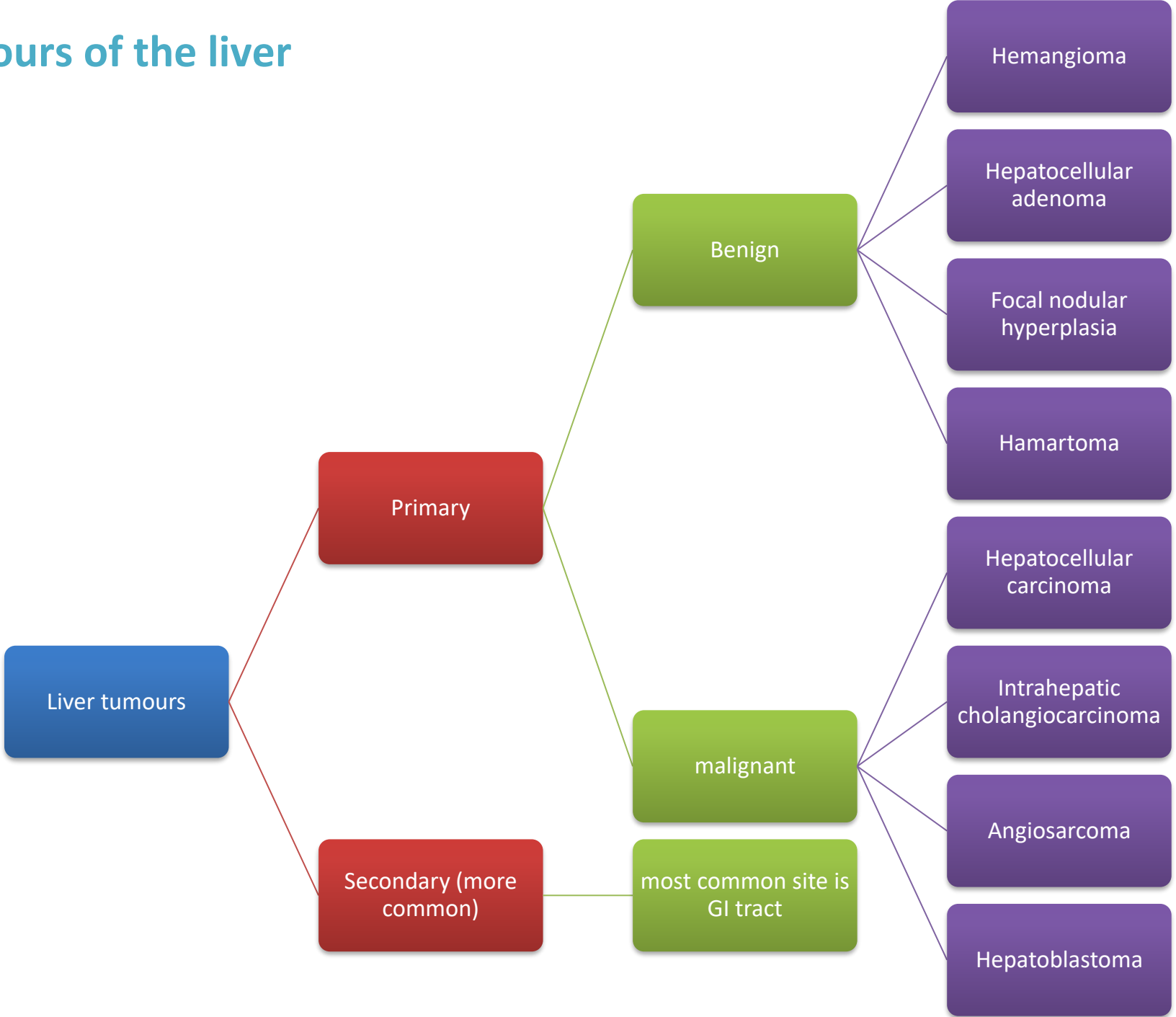


- **Physical examination:** (non-specific, depends on the site of the cyst. **Just read them & have an idea**)
 - **Vital signs:** fever could be a sign of secondary infection or allergic reaction. Hypotension is observed with anaphylaxis.
 - **Skin:** jaundice could be a sign of biliary obstruction (due to rupture of the cyst & an escape of a daughter cyst into the CBD causing obstruction, or external compression of the hepatic/CBD ducts). Spider angiomas are a sign of cirrhosis. Urticaria & erythema may be seen.
 - **Lungs:** decreased breath sounds could be a sign of airway obstruction.
 - **Abdomen:** the most common sign is abdominal tenderness. hepatosplenomegaly may be present. Tender hepatomegaly is a sign of secondary infection of the cyst, especially when coupled with fever & chills.
 - **Extremities:** bone involvement can result in tenderness over the affected area. Muscle involvement is usually characterized by a palpable mass. Peripheral nerve compression can occur.
- **Treatment:**
 - **Chemotherapy:** Albendazole.
 - **Percutaneous drainage.**
 - **Surgery:** the mainstay of treatment.



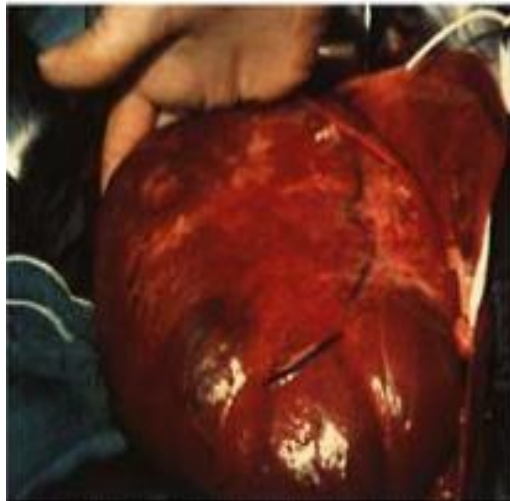
Gross appearance of a hydatid cyst.

Tumours of the liver



1. Hepatic hemangioma.

- The most common benign tumour. Not premalignant.
- **Variants:** capillary (more common, <2 cm, no need for surgery) & cavernous (giant).
- **Symptoms:** asymptomatic in 85%. Might present with RUQ pain, mass, bruits.
- **Complications:** CHF, coagulopathy, gastric outlet obstruction, **Kasabach-Meritt syndrome**, hemorrhage.
- **Diagnosis:** **US**, **MRI** (most sensitive & specific), **CT** with IV contrast, **tagged RBC scan**. Percutaneous biopsy is **contraindicated** due to risk of hemorrhage.
- **Treatment:** observation in 90%. Resection if (symptomatic, hemorrhage, can't be distinguished from hepatic malignancy).



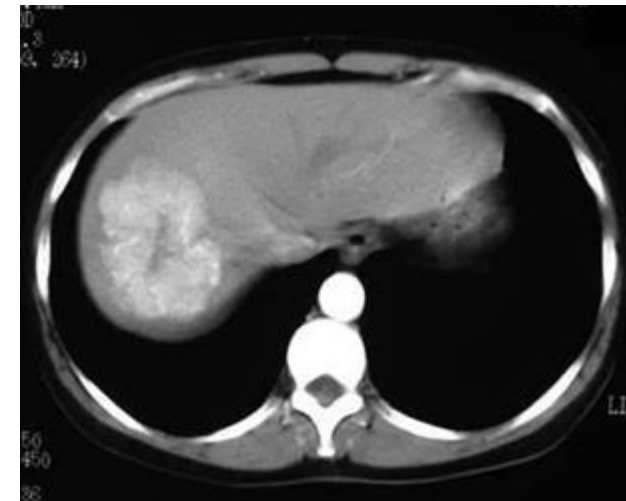
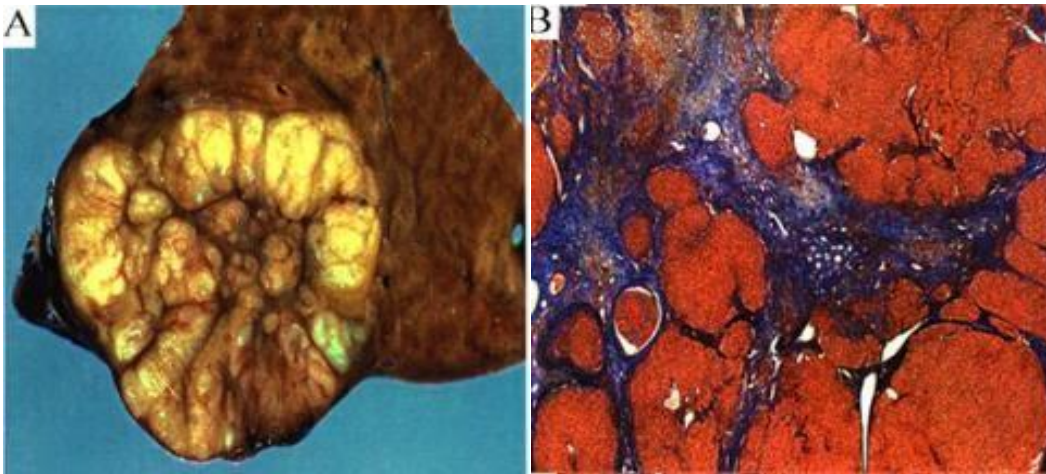
2. Hepatic adenoma.

- Premalignant
- **Risk factors:** female, **birth control pills**, anabolic steroids, glycogen storage disease.
- It's estrogen sensitive (pregnancy causes it to increase in size).
- **Symptoms:** RUQ pain, mass, fullness, bleeding.
- **Complications:** rupture, necrosis, **risk of HCC**.
- **Diagnosis:** **CT**, **US**, biopsy (but rule out hemangioma before the biopsy).
- **Treatment:**
 - if **<5 cm**: stop OCP, it may regress. If it didn't regress, then resection.
 - If **>5 cm** or **complicated (bleeding, painful, rupture, risk of cancer)**: resection.



3. Focal nodal hyperplasia.

- Normal functioning liver tissue in a disorganized pattern, most are solitary. Not premalignant.
- The second most common benign liver tumour.
- **Risk factors:** female, birth control pills.
- **Diagnosis:** nuclear technetium-99, US, CT, biopsy, angiogram (hypervascular mass with a central feeding vessel).
- **Treatment:**
 - If asymptomatic: follow up, stop OCP.
 - If symptomatic: resection or embolization.
- The most common indication for surgery is inability to exclude malignancy.

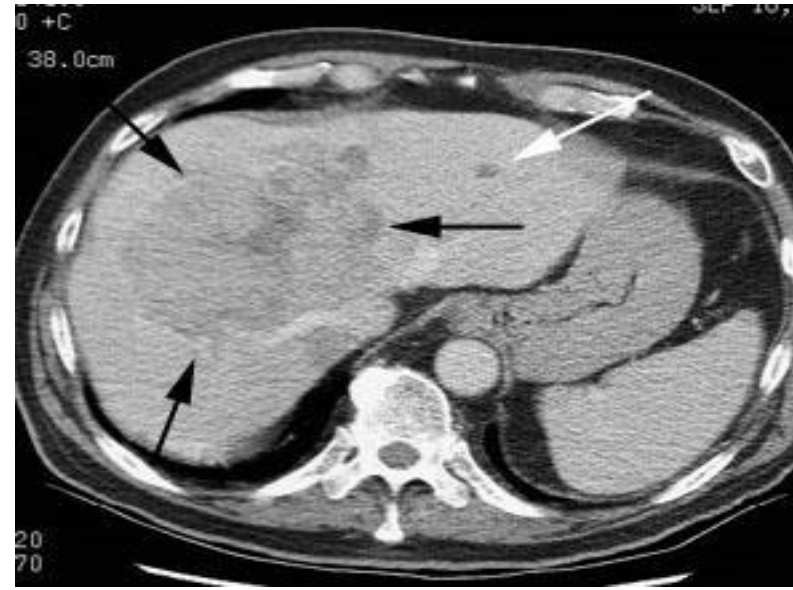


Focal Nodular Hyperplasia

Classic CT finding: liver mass with a central scar.

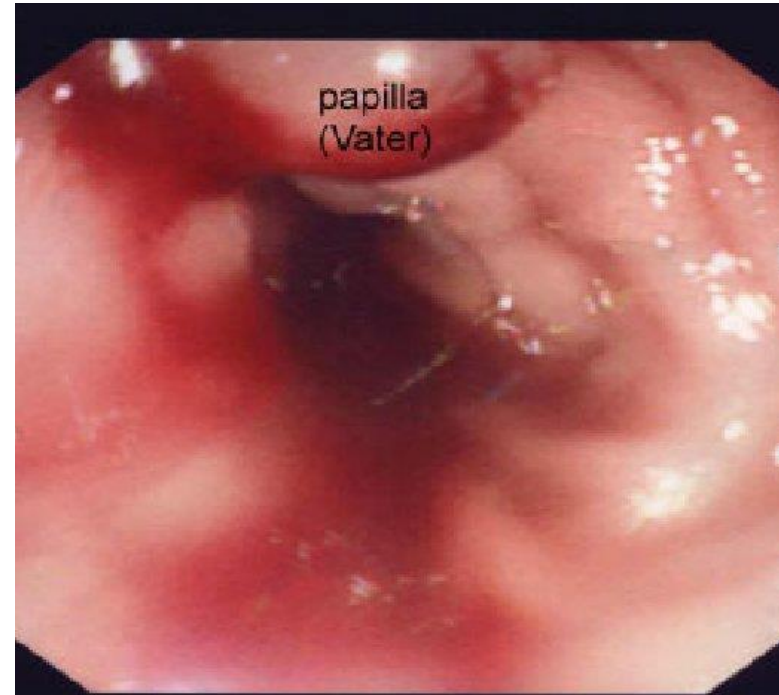
4. Hepatocellular carcinoma (hepatoma).

- The most common malignant **primary** liver tumour (80%).
- **Risk factors:** hepatitis B, cirrhosis, aflatoxin, α 1-antitrypsin deficiency.
- **Symptoms:** RUQ pain, **hepatomegaly**, weight loss, jaundice, signs of portal hypertension.
- **Diagnosis:** high α -feto protein (tumour marker). **US, CT, biopsy (the most common way to diagnose HCC).**
- **Treatment:** surgical resection. Liver transplant if:
 1. Cirrhosis, not a candidate for resection, no distant LN Metz, no vascular invasion.
 2. The tumour must be single & <5 cm or have 3 nodules with none larger >3 cm.
- The most common site of Metz: **lungs**.



Hemobilia

- Bleeding into the biliary tract.
- **Causes:** medical intervention, trauma, vascular disease, tumours.
- **Symptoms:** RUQ pain, obstructive jaundice, hematemesis & melena.
- **Diagnosis:** endoscopy, angiogram.
- **Treatment:** trans-arterial embolization.



Upper endoscopy: notice the blood at the ampulla of Vater.

Portal hypertension



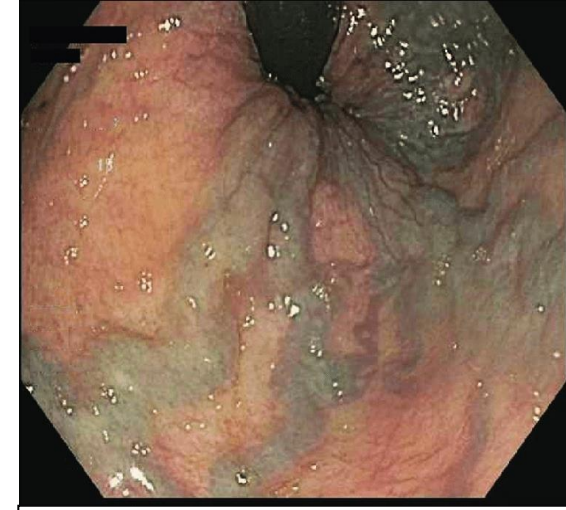
Caput Medusa

Between paraumbilical vein
& anterior abdominal veins.



Esophageal varices

between the left gastric vein
& the azygous vein through
the esophageal veins.

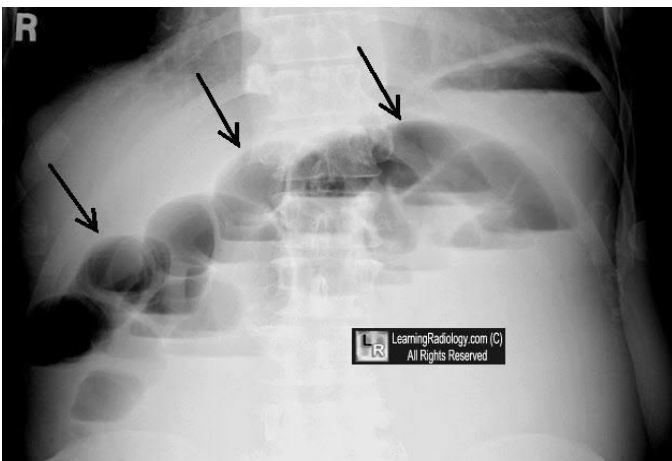


Rectal varices

Between the superior rectal
vein & the iliac vein through
the middle & lower rectal
veins.

Small bowel obstruction

- **Causes:** adhesions, hernia, tumours, volvulus, intussusception, etc.
- **Symptoms:** vomiting, constipation, abdominal pain, distension.
- **Signs of strangulation:** fever, tachycardia, shock.
- **Complications:** ischemia, perforation, sepsis, abscess.
- **Diagnosis:**
 - **Labs:** ask for CBC & electrolytes.
 - **Radiology:** AXR (multiple air-fluid levels & distended bowel).
- **Treatment:** NPO, NGT, IVF, maintain electrolyte balance. Specific treatment is directed towards the cause.



Erect AXR showing multiple air-fluid levels (stepladder appearance).

Due to **mechanical small bowel obstruction** (but could also be due to **paralytic ileus**, depending on the question).



Supine AXR showing distended **small** bowel loops (notice plicae circularis).

Zollinger-Ellison syndrome

- Endoscopic image of multiple small ulcers located in the distal duodenum in a patient with gastrinoma (ZES).

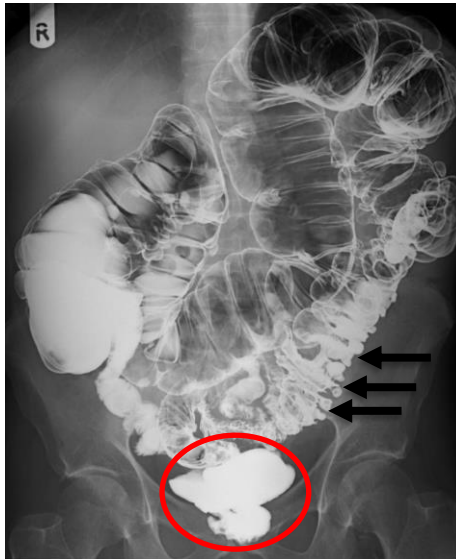


Fistulas

- **Classification:** external (to skin) vs internal (between 2 organs). Proximal vs distal.
- **Types:** enterocutaneous fistula, **colonic fistula**, enteropancreatic fistula, bladder fistula, **fistula-In-Ano**.

1. Colovesical fistula.

- The most common **colonic** fistula. Presents with recurrent UTI.
- **Causes:** the most common cause is diverticulitis. Other causes are colon cancer, Crohn's disease, radiotherapy, trauma.
- **Diagnosis:** barium enema or cystoscopy.
- **Treatment:** surgery (resection & anastomosis).



Barium enema

- Notice filling of the bladder, indicating the presence of a fistula.
- colonic diverticula (black arrows), the most probable cause of the fistula.

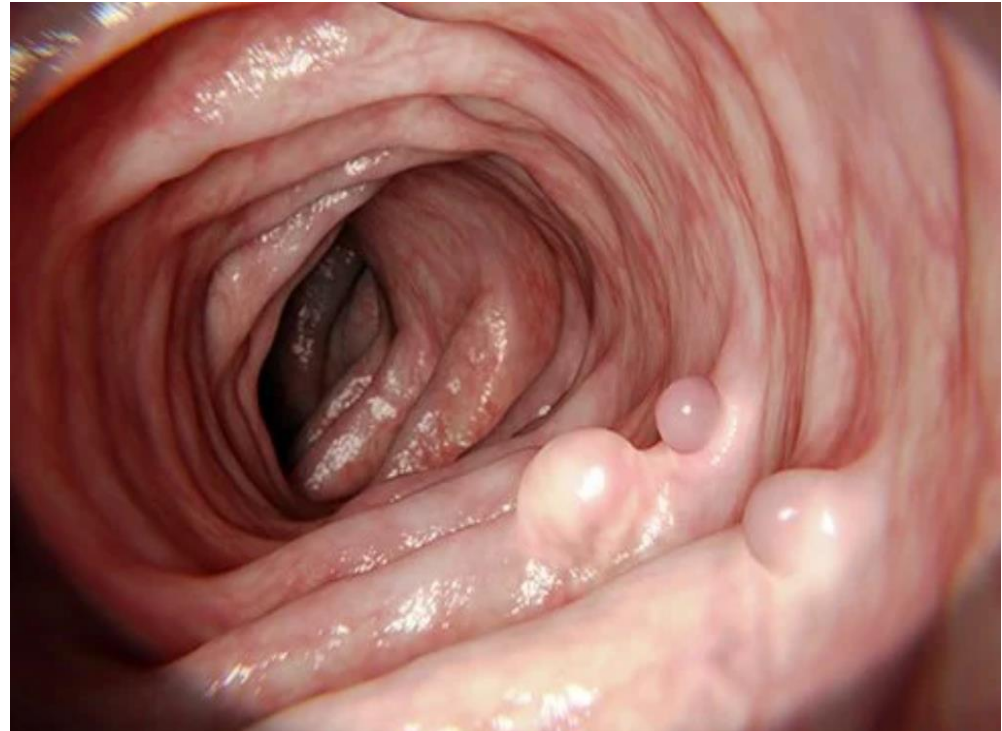
2. Fistula-In-Ano.

- Between the rectum & anal skin.
- **Causes:** anal crypt infection, perianal abscess.
- **Symptoms:** perianal drainage, itching, diaper rash.
- **Treatment:** fistulotomy.



Colonic polyps

- 4 types: inflammatory, metaplastic, hamartomatous, **neoplastic**.
- Most of colon cancer cases develop from polyps, so they must be removed.
- **Factors that determine the risk of malignancy:** degree of dysplasia, size, histological type (villous vs tubular), location, number of polyps.
- **Causes:** mostly sporadic. However, there are some familial syndromes:
 - **Familial adenomatous polyposis (FAP).**
 - **Peutz-Jeghers syndrome.**
 - Juvenile polyps.
 - Turcot syndrome.



1. Familial adenomatous polyposis

- An autosomal dominant inherited disorder. Mutation on the APC gene.
- Hundreds of polyps within the rectum & colon.
- **Extra-colonic manifestations:** upper GI adenoma (95%), Gardner syndrome, CHRPE.
- **Diagnosis:** colonoscopy, >100 polyps for diagnosis.
- **Complications:** if untreated, it's associated with 100% risk of colon cancer by the age 40-50.
- **Treatment:** proctocolectomy & ileostomy.



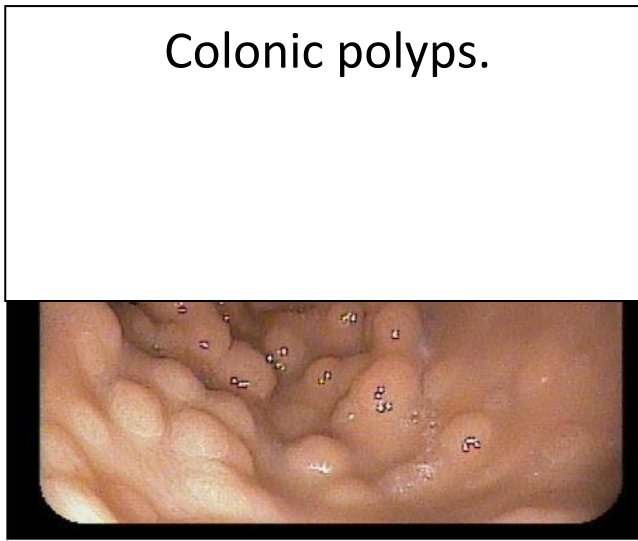
Gardner's Syndrome

- Autosomal dominant.
- Familial adenomatous polyposis syndrome with cutaneous manifestations:
 - Colonic polyps (hundreds with 100% risk of malignancy if untreated).
 - Osteomas.
 - Lipomas & epidermoid cysts.

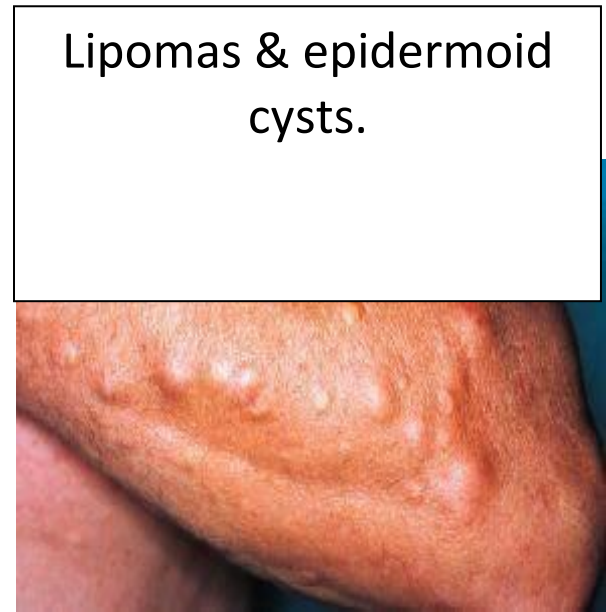
Osteomas.



Colonic polyps.



Lipomas & epidermoid cysts.



2. Peutz-Jeghers syndrome.

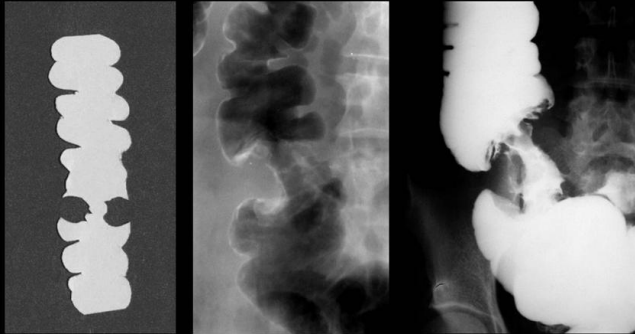
- An autosomal dominant inherited disorder.
- Multiple hamartomatous polyps + melanotic pigmentation on lips & buccal mucosa.
- Might cause intussusception or bowel obstruction.
- **Complications:** 50% risk of colon cancer by the age 60.



Colon cancer

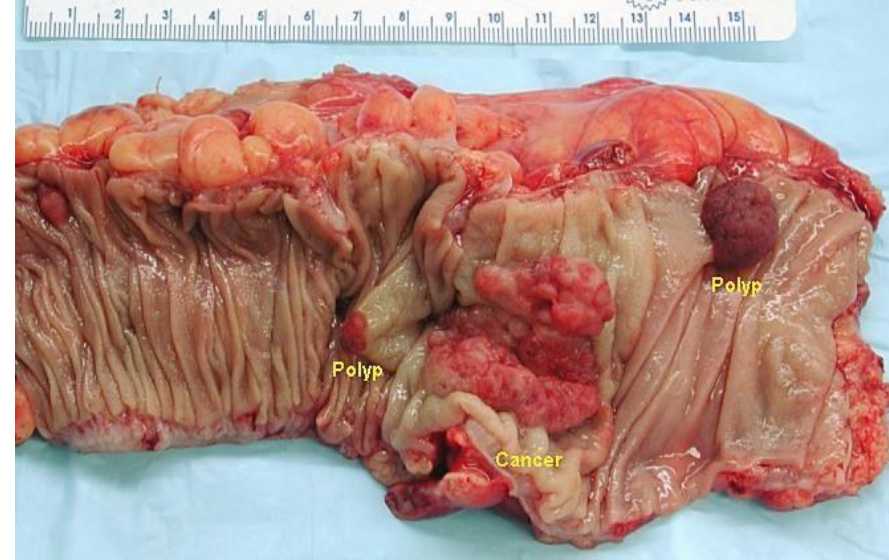
- Most commonly in the sigmoid. 45% survival.
- **Risk factors:** age >50, polyps, IBD, environmental (smoking, alcohol, low fiber, excess fat).
- **Symptoms:** weight loss, anoexia, **rectal bleeding with change in bowel habits & no anal symptoms**, abdominal mass, **IDA**.
- **Diagnosis:** colonoscopy (test of choice), barium enema, fecal occult blood (for screening), CEA is used to check recurrence of cancer.
- **Treatment:** surgical resection. Radiotherapy prior to surgery is helpful for **rectal lesions only**.
- **Determinants of prognosis:** stage & grade of the disease.

Apple-core Appearance of the Colon



MT, Niloofar
Cases from Prof. Saeed Rad, Tabriz, Iran

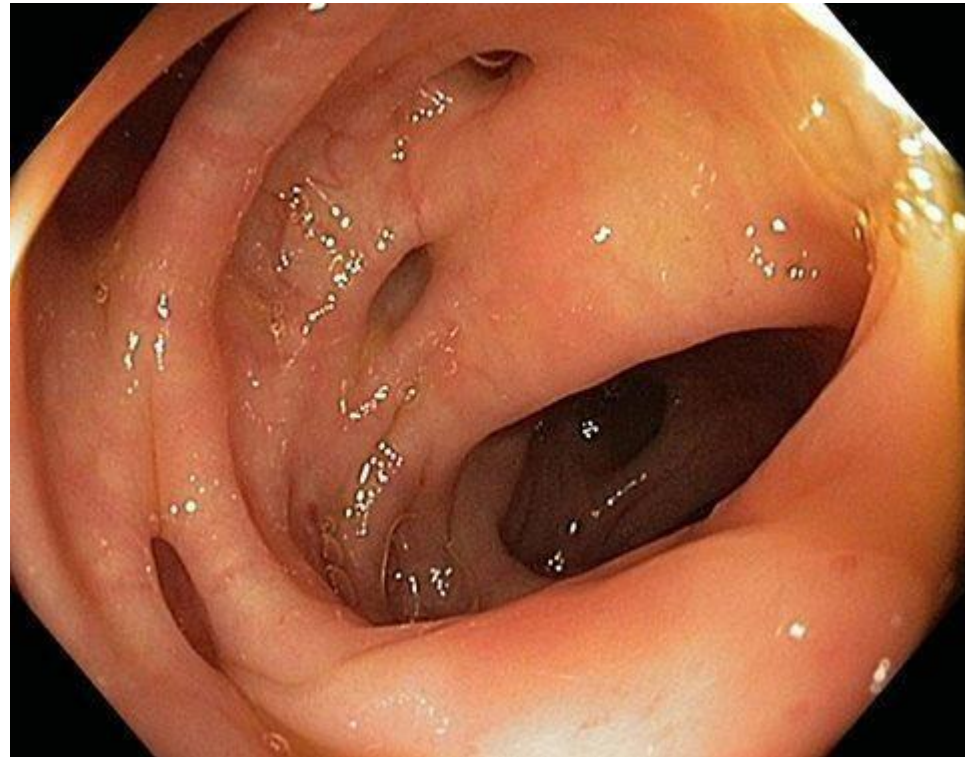
Barium enema: constriction of the lumen of the colon by a stenosing annular colorectal carcinoma.



- Normal looking colon on the left.
- Abnormal findings:
 1. 2 polyps on the right.
 2. 1 irregular mass (tumour).
 3. Thickening of the wall on the right.

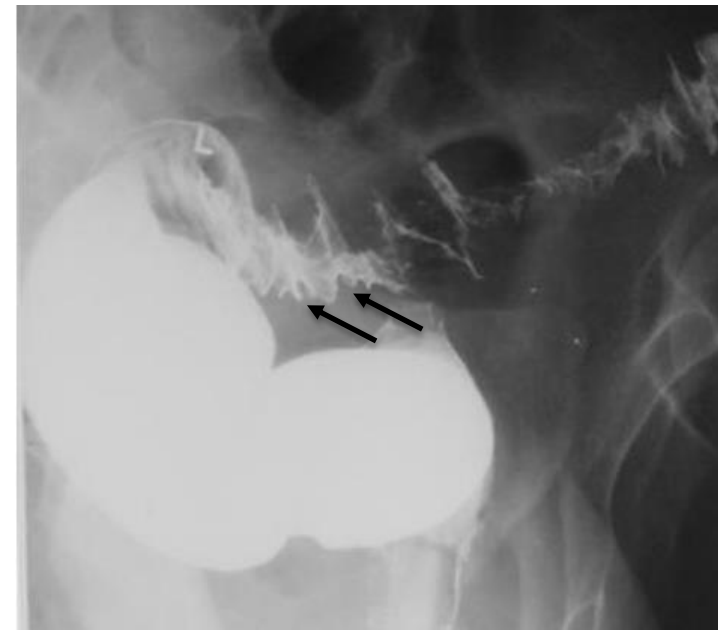
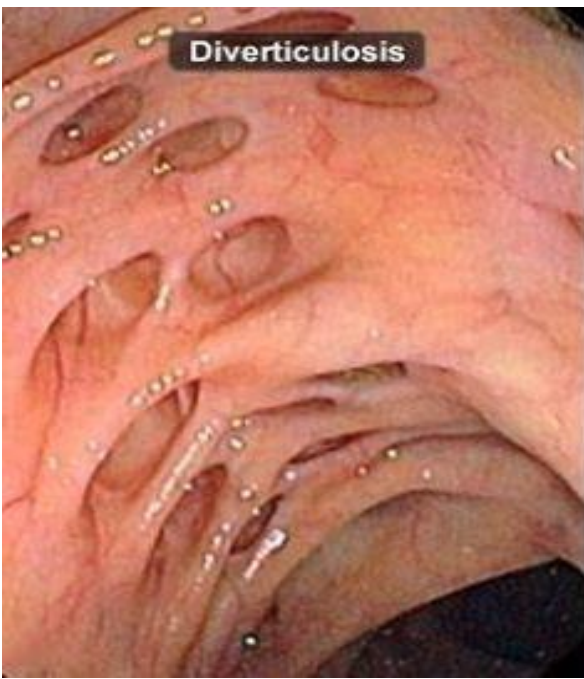
Diverticular diseases

- A common diseases affecting every third of the older population. Most commonly in the sigmoid (95%).
- Formed at a weak point in the bowel wall (site of perforators).
- The presence of the diverticula is called **diverticulosis**. If they become inflamed, the disease is called **diverticulitis**.
- **Risk factors:** old age, chronic constipation, low fiber, smoking, obesity.



1. Diverticulosis.

- **Symptoms:** mostly asymptomatic (80% of cases). Might present with bleeding (the most common cause of lower GI bleeding), LLQ pain.
- **Complications:** perforation, fistula, bleeding, diverticulitis.
- **Diagnosis:** colonoscopy (test of choice), barium enema. **Both are contraindicated if diverticulitis is suspected.**
- **Treatment:** if asymptomatic (dietary modification, e.g., high fiber diet). If bleeding (resuscitation with fluids).
- **Indications for surgery:** recurrent bleeding, need for long term anticoagulation, if excessive blood loss can't be tolerated.



Barium enema showing multiple diverticula (black arrows).

2. Diverticulitis.

- Occurs in 10-25% of patients with diverticulosis.
- **Symptoms:** LLQ pain, fever, diarrhea, nausea, vomiting.
- **Complications:** abscess, peritonitis, fistula (most commonly colovesical fistula).
- **Diagnosis:** CBC (high WBC), **CT**.
- **Treatment:**
 - **First, uncomplicated attack:** conservative management.
 - **If complicated or more than 2 attacks:** operative management.



Colonic volvulus

1. Sigmoid volvulus.

- Most common, ~75%.
- **Risk factors:** chronic constipation, high fiber diet, laxative abuse, elongated colon.
- **Symptoms:** pain, distension, obstipation, nausea, vomiting.
- **Complications:** **strangulation** (discolouration, bloody fluid in rectum, peritoneal signs, fever, hypotension, high WBC) & **necrosis** (on x-ray: free air, air in bowel wall).
- **Diagnosis:** **AXR** (coffee bean sign, towards the RUQ).
- **Treatment:**
 - If no strangulation: sigmoidoscopic reduction.
 - If strangulated or reduction failed: resection.



Coffee bean sign. Notice how the loop is pointing towards the RUQ.

2.Cecal volvulus.

- Second most common, ~25%.
- **Risk factors:** poor fixation of the right colon, abdominal surgery.
- **Symptoms:** RLQ pain, distension, obstipation, nausea, vomiting.
- **Complications:** strangulation & necrosis.
- **Diagnosis:** AXR (coffee bean sign, towards the LUQ).
- **Treatment:** right colectomy & anastomosis.



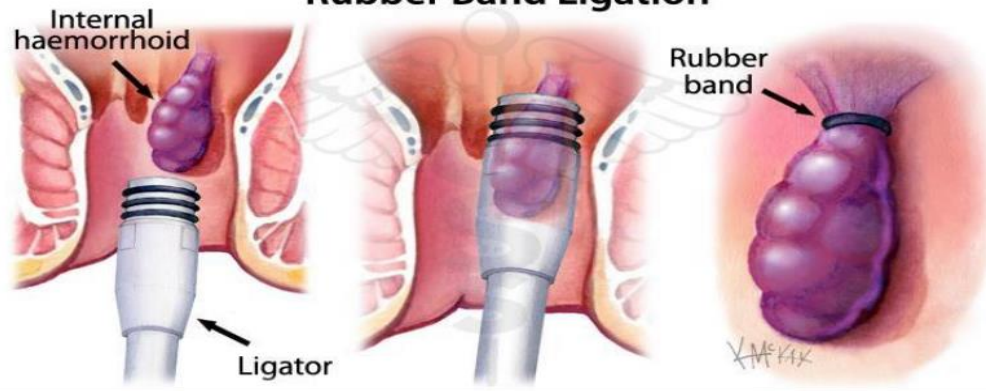
Coffee bean sign. Notice how the loop is pointing towards the LUQ.

Hemorrhoidal disease

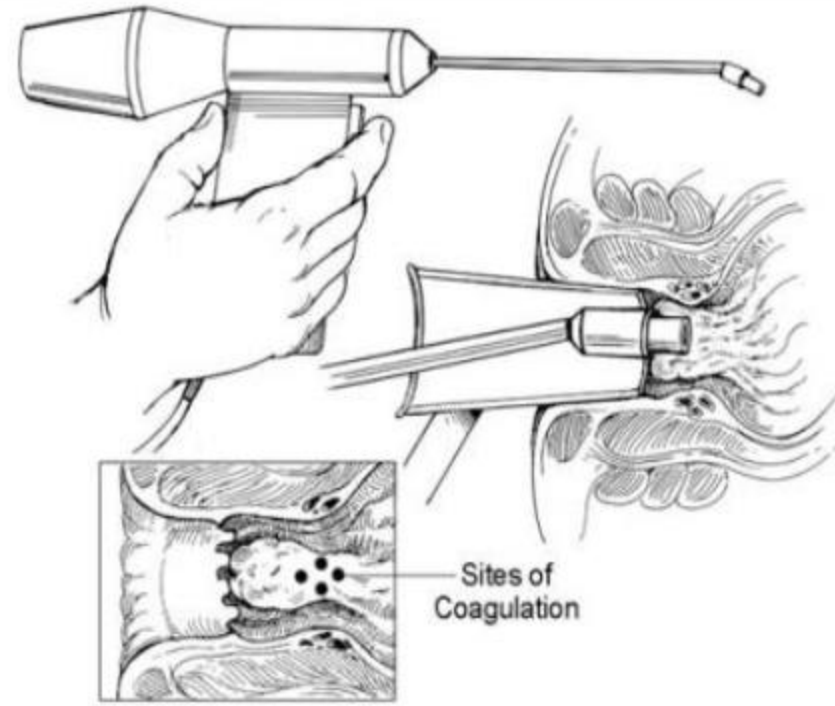
- Divided into **internal** (above the dentate line, covered by columnar epithelium) & **external** (below the dentate line, covered by squamous epithelium).
- **Risk factors:** age, increased abdominal pressure (constipation, pregnancy, ascites, etc).
- **Symptoms:** bleeding (usually fresh blood), anal mass, itching, prolapse, **pain (only if complicated)**.
- **Complications:** thrombosis, infection, ulceration.
- **Diagnosis:** inspection & PR.
- **Treatment:**
 - **Grade 1 & 2:** conservative (high fiber diet, laxatives, vasoconstrictors, Sitz baths). If failed, procedures such as: rubber band ligation, sclerotherapy, Doppler guided hemorrhoidal artery ligation, etc.
 - **Grade 3 & 4:** hemorrhoidectomy (contraindicated in Crohn's disease). Complications include: pelvic infection, incontinence, exsanguination.



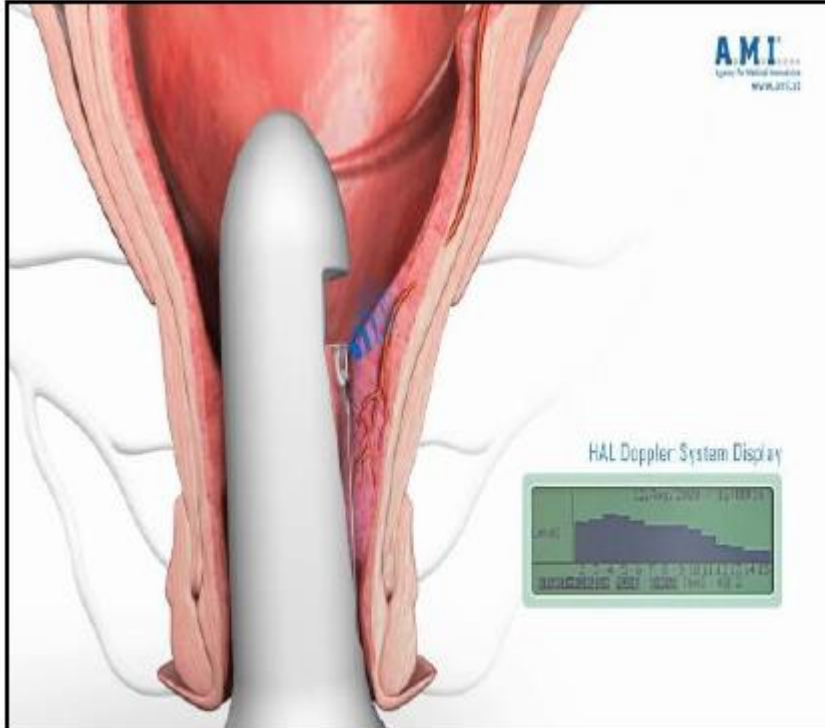
Rubber Band Ligation



Rubber band ligation.



Injection sclerotherapy.



Doppler guided hemorrhoidal artery ligation.

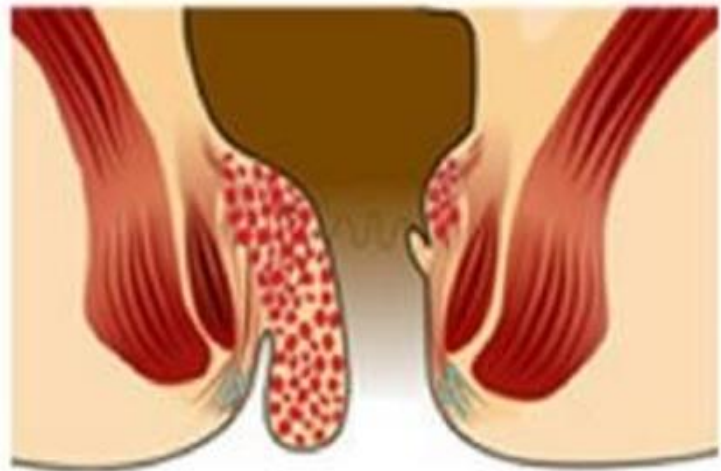
1st Degree: No Prolapse
Just prominent vessels



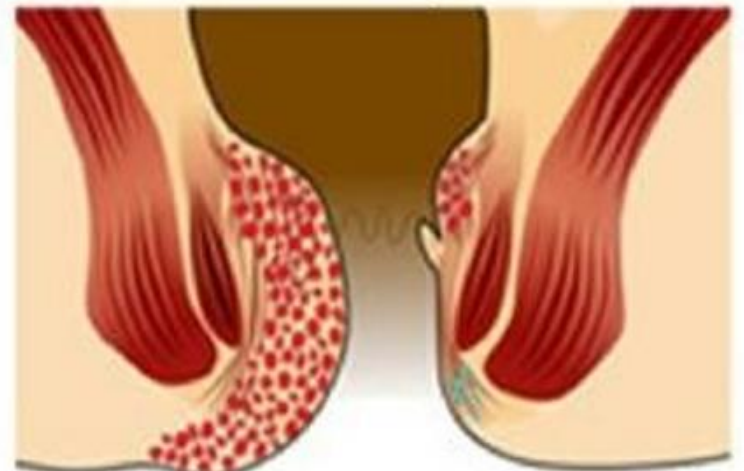
2nd Degree: Prolapse (come out) with strain
but spontaneously reduce (go back in)



3rd Degree: Prolapse with strain
and have to be pushed back in

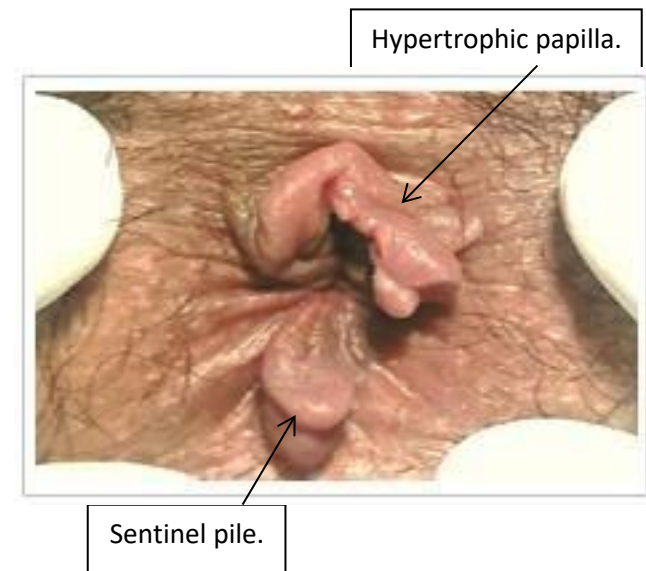


4th Degree: Prolapsed out and
cannot be reduced or pushed back in



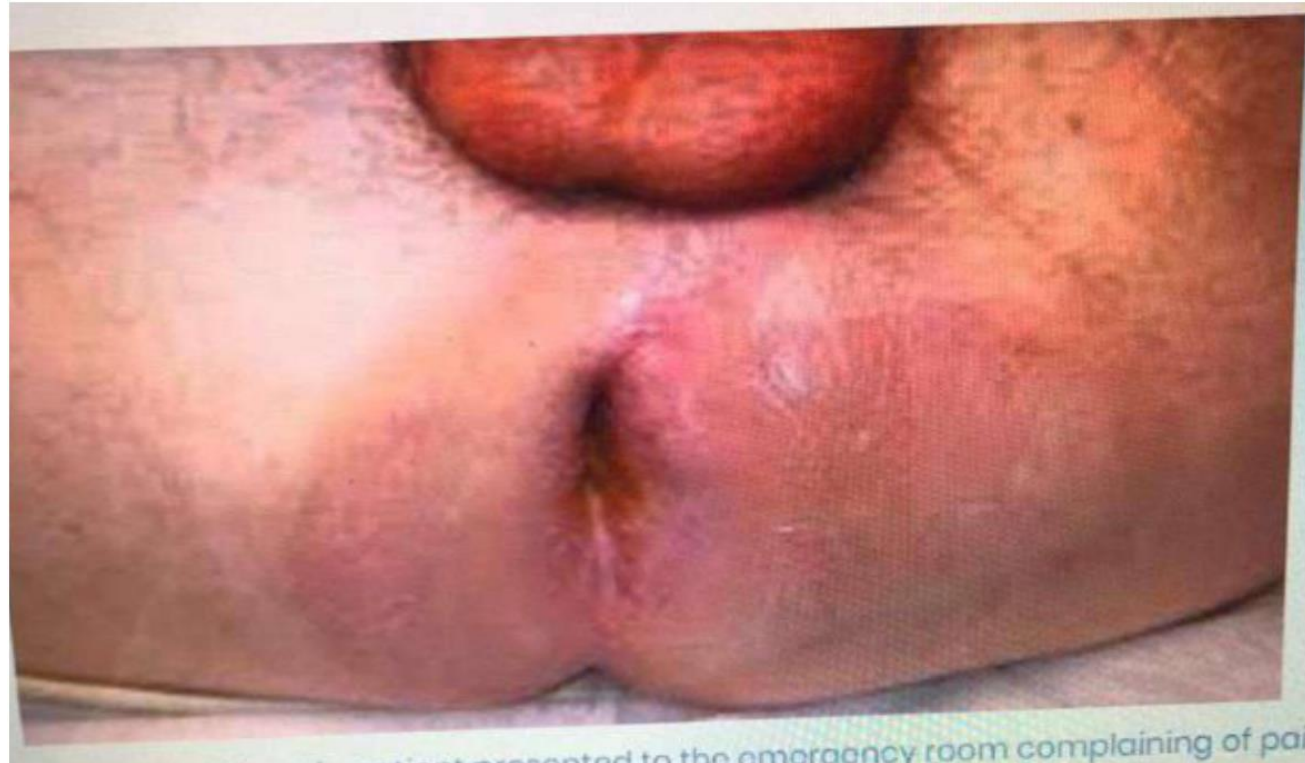
Anal fissure

- **Hypertonic internal sphincter.** Most common site is posteriorly.
- **Risk factors:** constipation, hyperactive sphincter, secondary to other diseases (Crohn's, HIV, postpartum).
- **Symptoms:** pain during & after defecation, bleeding, constipation, itching. Other signs include: **sentinel pile**, **hypertrophic papilla**, blood on toilet tissue.
- **Diagnosis:** the triad for chronic fissures: sentinel pile, hypertrophic papilla, hypertonic sphincter.
- **Treatment:**
 - **Acute fissures:** conservative (high fiber diet, laxatives, Sitz baths). If failed, then medical with glyceryl trinitrate or CCB. If failed, sphincterotomy.
 - **Chronic fissures:** conservative. If failed, lateral internal sphincterotomy (LIS).



Perianal abscess

- **Risk factors:** constipation, diarrhea, IBD, immunocompromise, trauma, surgery.
- **Symptoms:** pain, swelling, exudation of pus, bleeding, fever, chills.
- **Diagnosis:** examination under anesthesia.
- **Treatment:** surgical drainage. Complications include: fistula (50%).



Pilonidal sinus

- Infected tracts beneath the skin & occur at the end of the tailbone on the natal cleft above the buttocks.
- Can also occur between the fingers & on the belly button. They can have more than one channel.
- **Symptoms:** can start off as a small painless lump. However, once infected, it becomes inflamed & fills with pus & develops into a painful cyst.
- **Treatment:** not necessary if the cyst is asymptomatic. If it gets infected, then one of the following surgical approaches:
 - **Incision & drainage.**
 - **Wide excision** (less reinfection).
 - **Excision & primary closure** (more reinfection compared to wide excision).



Perianal warts

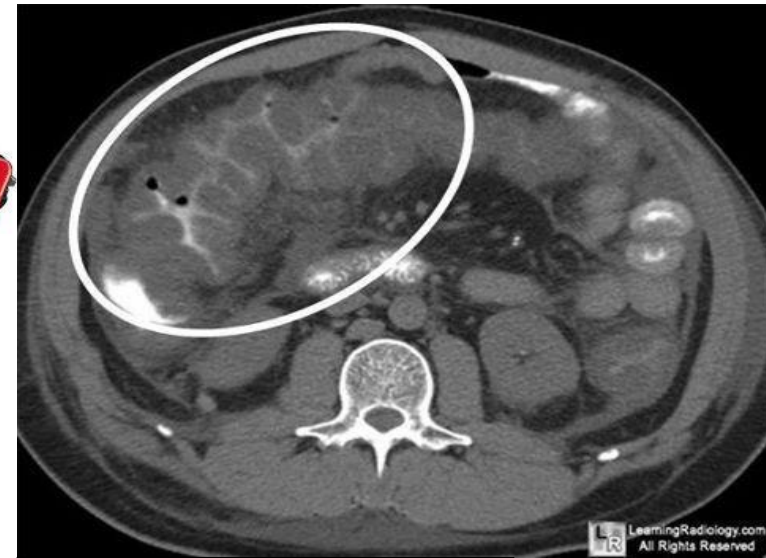
- Part of the genital warts (Condyloma Acuminatum).
- **Cause:** human papilloma virus (HPV).
- **Complications:** the major risk is squamous cell carcinoma.
- **Symptoms:** the warts themselves, itching, redness, discomfort.
- **Treatment:** if small (topical Podophyllin). If large (surgical resection or laser ablation).

Condylomata Acuminata



Pseudomembranous colitis

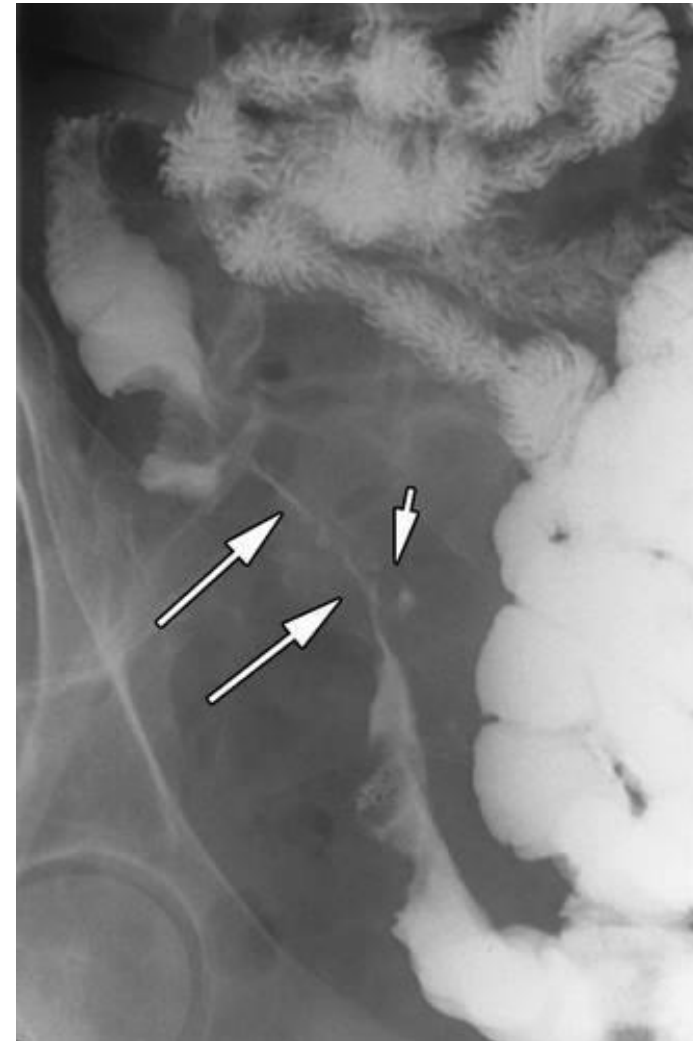
- **Cause:** Clostridium Difficile.
- **Risk factors:** the use of antibiotics.
- **Diagnosis:** toxin assay in stool. **CT** (accordion sign).
- **Treatment:** first line (oral vancomycin or fidaxomicin). Second line (metronidazole).



CT scan showing the **accordion sign** (that's due to

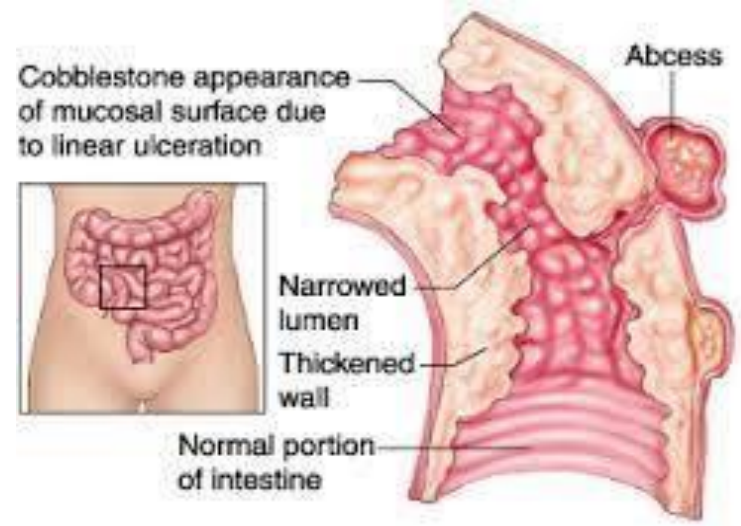
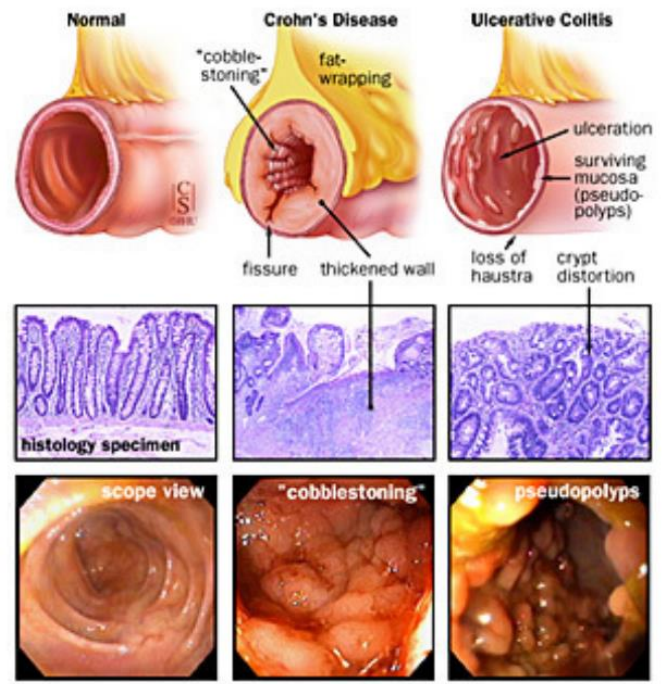
Crohn's disease (IBD)

- Autoimmune disease.
- Can occur anywhere in the GI tract, including the colon &, frequently, perianal. The disease is **patchy (skip lesions)**. The most common site is the terminal ileum, & often no involvement of the rectum (in UC, the rectum is always involved).
- it involves the full thickness of the bowel wall, with the serosa, mesentery, & regional LNs (while in UC, only the mucosa is involved).
- **Symptoms vary, including:** abdominal pain, weight loss, sometimes presenting with a picture of acute appendicitis (RIF pain, pyrexia, & vomiting). May also present as acute intestinal obstruction, abdominal mass, & with multiple perianal fissures & abscesses.
- **Extraintestinal manifestations:** arthritis, pyoderma gangrenosum, erythema nodosum.



Barium enema showing **string sign**.

- **Complications:** mainly strictures & fistulae.
- **Macroscopically:** the bowel wall is thick & red (while in UC, it's thin). The mucosa has a cobblestone appearance with deep fissures. The mesentery is shortened.
- **Microscopically:** non-caseating granulomas with narrow & deep ulcers.
- **Radiology:** barium enema (string sign, indicates narrowing of the lumen).
- Surgery plays a minor role in treatment.



Ulcerative colitis (IBD)

- A history of chronic abdominal pain with bloody diarrhea, age 30-40, after excluding the possibility of malignancy is highly suggestive of UC.
- Autoimmune disease, affects females>males.
- The rectum is always involved but the proximal extent is variable.
- High incidence among relatives of the patient.

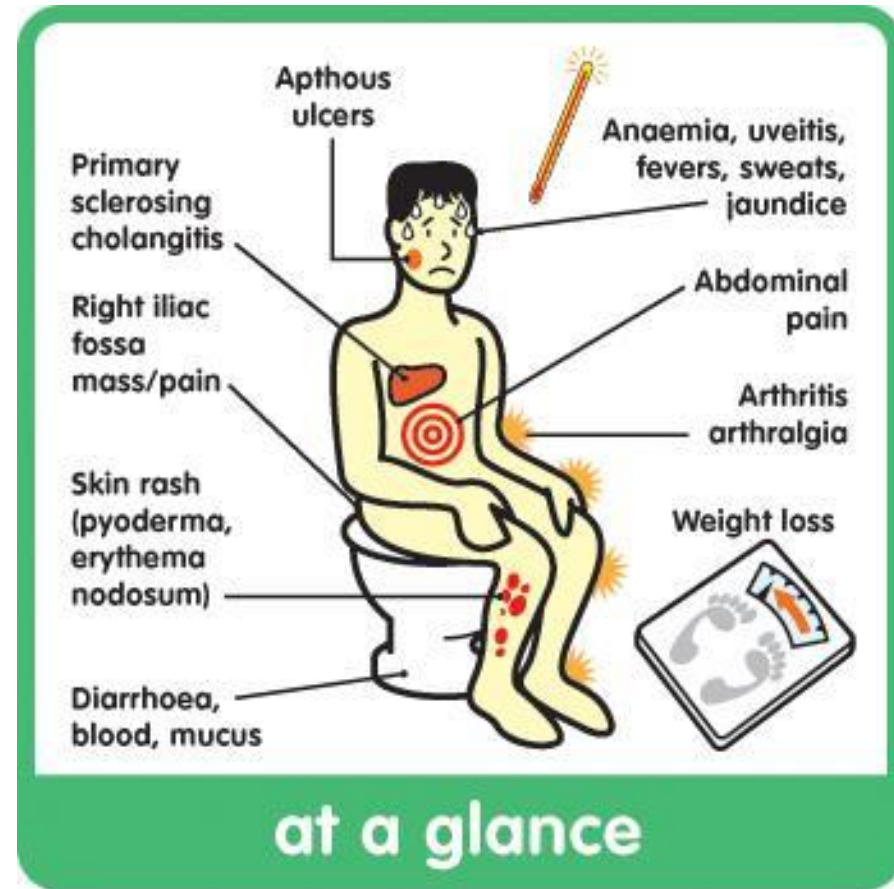
- Smoking is protective.

- **Clinical features:**

- Bloody diarrhea with pus & mucus.
- Weight loss, low grade fever & anorexia.
- Abdominal pain.

- **Extracolonic manifestations:**

- **Arthritis** (sacroiliitis & ankylosing spondylitis), **eyes** (iritis, keratitis), **renal** (calculi & pyelonephritis), **skin** (erythema nodosum & pyoderma gangrenosum), **blood** (anemia & higher risk of DVT), **hepatic disease & cholangitis** (PSC).



at a glance

Ulcerative colitis and Crohn's disease

● **Investigations:**

- **If perforated:** air under diaphragm on AXR.
- **In chronic UC:** barium enema will show loss of colonic haustration, rigidity, & shortening of the colon (lead pipe colon & **toxic megacolon** [UC is the most common cause of toxic megacolon]).

● **Treatment:**

- **Medical:** mainly steroids.
- **Surgery:** proctocolectomy with Brooke ileostomy is indicated when: medical treatment failed, toxic megacolon, perforation & subsequent peritonitis, too frequent relapses, duration of more than 10 years (>15 years --> 5% risk of CA).



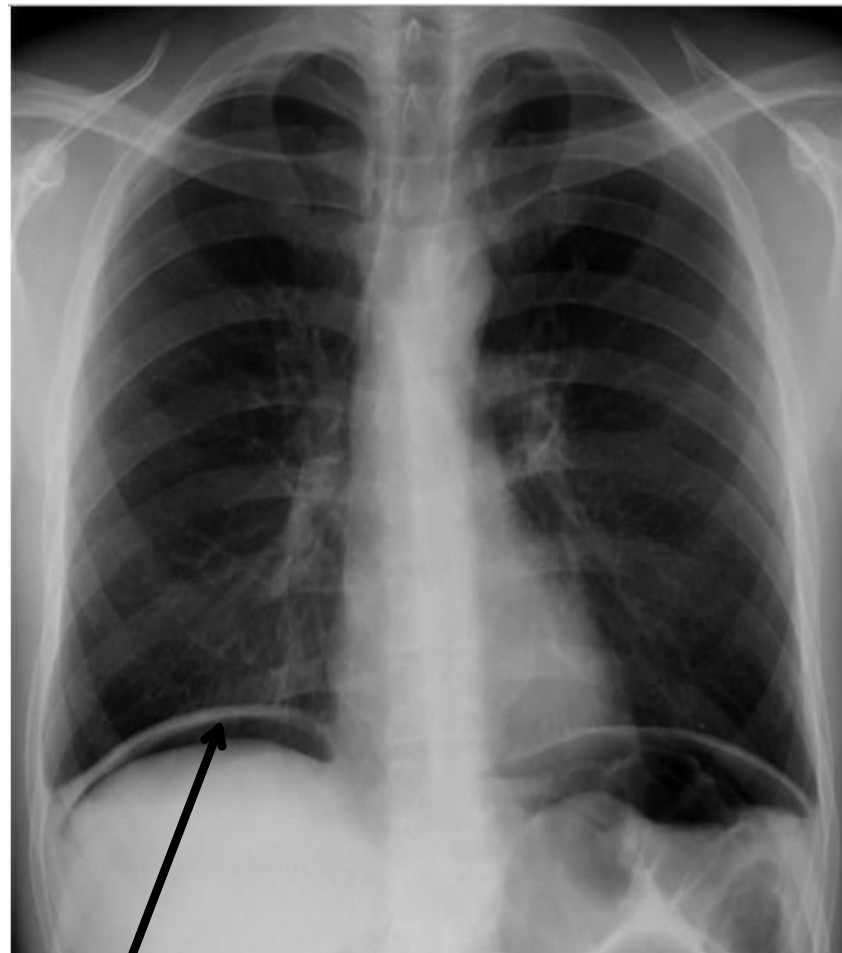
Toxic megacolon.



Lead pipe appearance.

➤ What is the finding in this Abdominal X-Ray? & mention 2 causes.

- Air under the right hemidiaphragm.
- **Causes:**
 1. Perforated viscous.
 2. Following a laparoscopic procedure.
 3. Following Tubal Insufflation Test.
 4. Infection with gas forming organisms.
 5. Most common cause is post operative.
 6. Chilaiditi's sign: due to interposition of the colon between the Diaphragm & the Liver. Such a gas shadow can be obtained even in a normal individual.



Management: Systemic antibiotics and surgical repair.